ENVIRONMENTAL PRODUCT DECLARATION

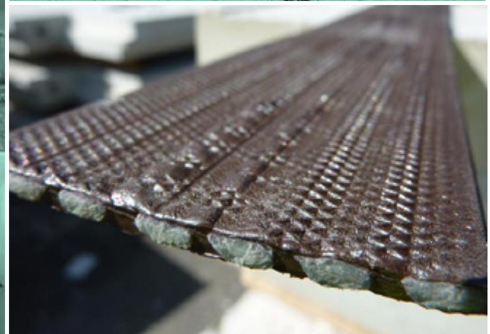
IN ACCORDANCE WITH EN 15804+A2 & ISO 14025 / ISO 21930

GEOSTRAP® REINFORCEMENT

TERRE ARMEE
SUSTAINABLE TECHNOLOGY

REINFORCED EARTH
SUSTAINABLE TECHNOLOGY

TIERRA ARMADA
SUSTAINABLE TECHNOLOGY



Environmental Product Declaration created with One Click LCA

GENERAL INFORMATION

MANUFACTURER INFORMATION

Manufacturer	Reinforced Earth India Private Limited
Address	"Arjikuja" Plot No. 255, 250, 251 & 252, GIDC Industrial Estate, Hansalpur, Viramgam, District: Ahmedabad, INDIA
Contact details	info@terre-armee.com
Website	https://www.terre-armee.com/

PRODUCT IDENTIFICATION

Product name	GeoStrap® Reinforcement
Additional label(s)	GeoStrap® 5 / GeoStrap® 7 / GeoStrap® 9
Place(s) of production	India

The Building Information Foundation RTS sr

EPDs within the same product category but from different programmes may not be comparable.

EPD INFORMATION

The EPD owner has the sole ownership, liability, and responsibility for the EPD. Construction products EPDs may not be comparable if they do not comply with EN 15804 and if they are not compared in a building context.

EPD program operator	The Building Information Foundation RTS sr
EPD standards	This EPD is in accordance with EN 15804+A2 and ISO 14025 standards.
Product category rules	The CEN standard EN 15804 serves as the core PCR. In addition, the RTS PCR (English version 26.8.2020) is used.
EPD author	Romaric QUENTIN
EPD verification	Independent verification of this EPD and data, according to ISO 14025: ☐ Internal certification ☑ External verification
Verification date	16.9.2021
EPD verifier	Anni Oviir, Rangi Maja OÜ, www.lcasupport.com
EPD number	RTS_155_21
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PRODUCT INFORMATION

PRODUCT DESCRIPTION

GeoStrap® reinforcements consist in a strip composed of discrete channels filled with closely packed high tenacity Polyethylene terephthalate yarns (PET). PET yarns are encased in a linear low density polyethylene sheath (LLDPE) and manufactured through a co-extrusion process.

GeoStrap® are CE certified for reinforcement applications and approved by the BBA (British Board of Agreement) and NTPEP (National Transportation Product Evaluation Program - USA).

Raw material choices have been carried out based on the recommendation for Geotextiles given in the international technical report ISO/TS 13434 and ISO/TR 20432 as well as a large series of study performed by Terre Armée over the past decades. All the raw materials used for GeoStrap® strip manufacturing are qualified and approved by Terre Armée technical department.

PRODUCT APPLICATION

GeoStrap® reinforcements are suitable for a large range of soil reinforcement applications, usually with concrete, steel or other material facing panels, such as Reinforced Earth® MSE (Mechanically Stabilized Earth) structures, steep slopes, reinforced embankments and more globally all kind of soil/structure interface systems involving such reinforcements for structures for an extended array of market segments: roads and motorways, environment, railways, hydraulic works, mining, industry, energy, commercial, housing or military.

Wide ranges of physical, chemical and biological conditions found in reinforced soil structures can be addressed by the GeoStrap® reinforcements. Contact us for more details.

TECHNICAL SPECIFICATIONS

GeoStrap® reinforcements consist in a strip composed of discrete channels filled with closely packed high tenacity Polyethylene terephthalate yarns (PET). PET yarns are encased in a linear low density polyethylene sheath (LLDPE) and manufactured through a co-extrusion process. Some additives are also used but only represent less than 1% in mass when all added with an impact on the indactors even lower.

PRODUCT STANDARDS

Non-exhaustive list of standards for reference (without limitations)

International technical reports ISO/TS 13434 and ISO/TR 20432 / EN 13249 / EN 13250 / EN 13251 / EN 13253 / EN 13254 / EN 13255 / EN 13257 / EN 13265

PHYSICAL PROPERTIES OF THE PRODUCT

Technical Characteristics of GeoStrap® reinforcement are listed and detailed in the technical data sheet available through Terre Armée support teams.

GeoStrap® strips exist in three different widths and are named accordingly:

- 90 mm for GeoStrap® 9
- 70 mm for GeoStrap® 7
- 50 mm for GeoStrap® 5

For each width, different grades are available.
Without width consideration grades are going from 20 kN to 190 kN (this range is not to be considered as fixed). Refer to the annex 3.

ADDITIONAL TECHNICAL INFORMATION

Further information can be found at https://www.terre-armee.com/.

PRODUCT RAW MATERIAL COMPOSITION

Product and Packaging Material	Weight, kg	Post-consumer %	Renewable %	Country Region of origin
High tenacity Polyethylene terephthalate (PET)	0.5 - 0.7	0	0	Asia
Linear Low Density Polyethylene (LLDPE)	0.3 - 0.5	0	0	Asia
Masterbatch	0.006 - 0.01	0	0	Asia

PRODUCT RAW MATERIAL MAIN COMPOSITION

Raw material category	Amount, mass- %	Material origin
Metals	0	-
Minerals	0	-
Fossil materials	100	Asia
Bio-based materials	0	-

SUBSTANCES, REACH - VERY HIGH CONCERN

The product does not contain any REACH SVHC substances in amounts greater than 0,1 % (1000 ppm).

PRODUCT LIFE-CYCLE

MANUFACTURING AND PACKAGING (A1-A3)

The manufacturing process is a co-extrusion process of LLDPE to coat channels of PET yarns in order to obtain the composite GeoStrap®.
The product is then cut at the right length allowing to roll it into individual and standard length coils.
Those coils are tightened and wrapped with BOPP tape and binding PET strap before placing them on wood pallet for shipment.

TRANSPORT AND INSTALLATION (A4-A5)

Transportation impacts occurred from final products delivery to construction site (A4) cover fuel direct exhaust emissions, environmental impacts of fuel production, as well as related infrastructure emissions.

Freight mode and distances for transportation from the production site to the construction site has been approached by an averaged transport scenario based on a barycentric method applied to sales on a representative year.

Regarding the installation process, a productivity ratio has been used to allocate the excavation/compaction works (diesel machine operation in hours and translated in liters) needed to install the whole system (panels, reinforcements and backfill). It is based on an average reinforcements density and onsite building productivity ratio for a typical reinforced soil structure. Note that this system involves concrete panels (most common application).

A 5% waste generation of GeoStrap® reinforcements has been considered during the installation phase.

PRODUCT USE AND MAINTENANCE (B1-B7)

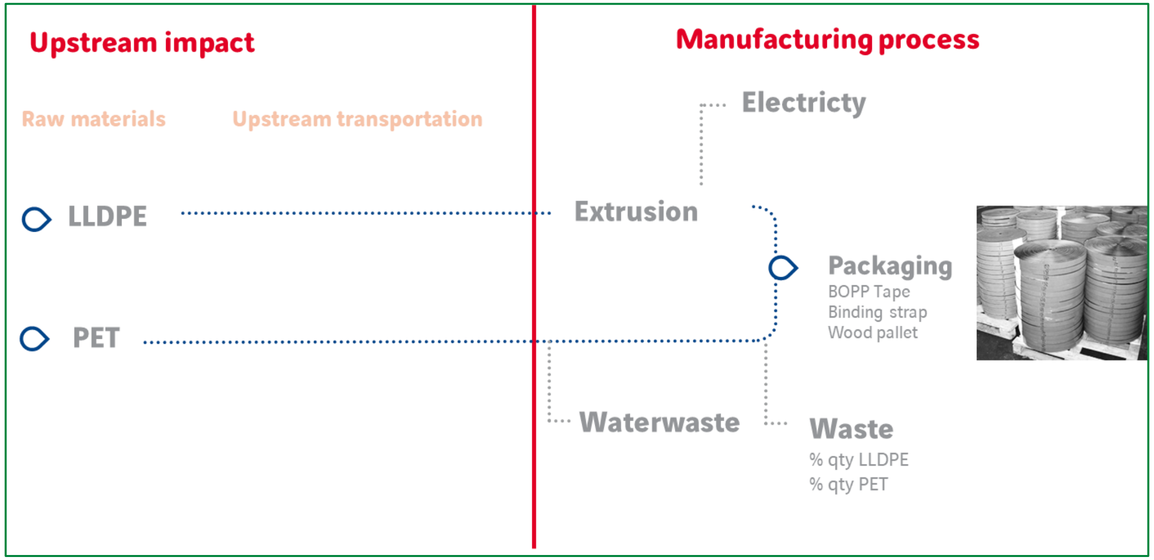
This EPD does not cover the use phase. Air, soil and water impacts during the use phase have not been studied.

PRODUCT END OF LIFE (C1-C4, D)

For the end of life, a demolition ratio has been used to allocate the required operation of diesel machines (expressed in hours and translated in liters of diesel) for dismantling the reinforced soil structure system (panels, reinforcements and backfill). As for the installation phase, this ratio has been calculated taking into account an average reinforcements density and onsite demolition productivity ratio for a typical reinforced soil structure.

After circa 100 years of service life, retrieved PET and LLDPE are considered treated through waste disposal in a municipal solid waste incinerator (MSWI) (based on current practice and experience).

MANUFACTURING PROCESS



LIFE-CYCLE ASSESSMENT

LIFE-CYCLE ASSESSMENT INFORMATION

Period for data	2020

DECLARED AND FUNCTIONAL UNIT

Declared unit	1 kg averaged GeoStrap
Mass per declared unit	1

Note: linear mass of the average product is 0.180 kg/m (see details in Annex 3).

BIOGENIC CARBON CONTENT

Product's biogenic carbon content at the factory gate

Biogenic carbon content in product, kg C	
Biogenic carbon content in packaging, kg C	0.008

SYSTEM BOUNDARY

This EPD covers the *cradle to gate with options* scope with following modules; A1 (Raw material supply), A2 (Transport) and A3 (Manufacturing), A4 (Transport), A5 (Installation into the structure) as well as C1 (Deconstruction), C2 (Transport at end-of-life), C3 (Waste processing) and C4 (Disposal). In addition, module D - benefits and loads beyond the system boundary is included.

Product stage			Assembly stage		Use stage							End of life stage				Beyond the system boundaries		
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
x	x	x	x	x	MND	MND	MND	MND	MND	MND	MND	x	x	x	x	x	x	x
Raw materials	Transport	Manufacturing	Transport	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstr./demol.	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling

Modules not declared = MND. Modules not relevant = MNR.

CUT-OFF CRITERIA

The study does not exclude any modules or processes which are stated mandatory in the EN 15804:2012+A2:2019 and the applied PCR. The study does not exclude any hazardous materials or substances.

The study includes all major raw material and energy consumption. All inputs and outputs of the unit processes, for which data is available for, are included in the calculation. There is no neglected unit process more than 1% of total mass or energy flows. The module specific total neglected input and output flows also do not exceed 5% of energy usage or mass.

The study does not exclude any modules or processes which are stated mandatory in the EN 15804:2012+A2:2019 and RTS PCR.

Excluded modules are use stage modules (B1-B7), which are not mandatory according to the RTS PCR. The study does not exclude any hazardous materials or substances. The study includes all major raw material and energy consumption. All inputs and outputs of the unit processes which data are available for are included in the calculation. There is no neglected unit process more than 1% of total mass and energy flows. The total neglected input and output flows do also not exceed 5% of energy usage or mass. The life cycle analysis includes all industrial processes from raw material acquisition to production, distribution and end-of-life stages. The production of capital equipment, construction activities, and infrastructure, maintenance and operation of capital equipment, personnel-related activities, energy and water use related to company management and sales activities are excluded.

ALLOCATION, ESTIMATES AND ASSUMPTIONS

Allocation is required if some material, energy, and waste data cannot be measured separately for the product under investigation.

In this study, as per EN 15804, allocation is conducted in the following order;

1. Allocation should be avoided.
2. Allocation should be based on physical properties (e.g. mass, volume) when the difference in revenue is small.

3. Allocation should be based on economic values.

Allocation is based on annual production rate and made with high accuracy and precision. The values for 1 kg of the produced product which is used within this study are calculated by considering the total product weight per annual production. According to the ratio of the annual production of the declared product to the total annual production at the factory, the annual total energy consumption, packaging materials and the generated wastes per the declared product are allocated.

Note that the product output (meaning that the product is installed, all the losses/waste along the way being deduced) is fixed to 1 kg and the corresponding amount of product is used in the calculations.

In the production covered by this EPD, several grades of products are included; since the production processes of these products are similar, allocations is taken as directly proportional to the linear weight of the product according to the table in annex 3.

This LCA study is conducted in accordance with all methodological considerations, such as performance, system boundaries, data quality, allocation procedures, and decision rules to evaluate inputs and outputs. All estimations and assumptions are given below.

- Module A1: For raw materials, when several suppliers are involved, a barycentric approach is performed on transportation distances and modes (i.e. the averages take into account weights according to the percentage of supply between the different suppliers).

- Module A2: Additional transport is considered for the wood pallet used with a conservative default value of 300km by truck.

- Module A3:
All ancillary and packaging materials volumes per 1kg of produced product are coming from average consumption on a representative annual production. Transportation scenario are conservative values.
Electricity consumption for 1kg of produced product is obtained by dividing the reported annual electricity consumption by the annual weight of product produced. Note that the electricity datapoint is taken to fit with the actual location of the plant.
Same principle is applied for wastewater and percentage of waste

for raw materials (averages done over a representative year of production).

- Module A4: Transportation doesn't cause losses as products are packaged properly. Also, volume capacity utilisation factor is assumed to be 1 for the nested packaged products. Additionally, an average transportation scenario is based on a barycentric approach (i.e. averages distances observed along a representative year).

- Module A5: A productivity ratio has been used to allocate the excavation/compaction works (diesel machine operation in hours and translated in liters) needed to install the whole system (panels, reinforcements and backfill). It is based on an average reinforcements density and onsite building productivity ratio for a typical reinforced soil structure. Note that this system involves concrete panels (most common application).
Other devices and elements for the system to be able to work are included in this section (backfill + panel).
Additionally, 5% of waste on GeoStrap® is considered during the implementation onsite.
Since the treatment of the wood pallet depends on the worksites, it is considered untreated for conservatism with associated direct biogenic carbon emissions.

- Module C1: A demolition ratio is used to allocate the required operation of diesel machines (expressed in hours and translated in liters of diesel) for dismantling the reinforced soil structure system (panels, reinforcements and backfill). As for the installation phase, this ratio has been calculated taking into account an average reinforcements density and onsite demolition productivity ratio for a typical reinforced soil structure.

- Module C2: Transportation distance to the closest disposal area is estimated as 50 km and the transportation method is assumed as lorry which is the most common.

- Module C3, C4, D: The end-of-life product is assumed to be 100% treated through waste disposal in a municipal solid waste incinerator (MSWI) without any recovery or recycling as per a conservative scenario. Hence, there is no benefit from the reusing, recycling or recovery.

Note for all transportation by truck:
Vehicle capacity utilization volume factor is assumed to be 1 which means full load. In reality it may vary but as the role of transportation emission in total results is small and so the variety in load assumed to be negligible. Empty returns are not taken into account as it is assumed that return trip is used by transportation companies to serve the needs of other clients.

Allocation used in Ecoinvent 3.6 environmental data sources follows the methodology 'allocation, cut-off by classification'. This methodology is in line with the requirements of the EN 15804 - standard.

ENVIRONMENTAL IMPACT DATA

Note: additional environmental impact data may be presented in annexes.

CORE ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP – total	kg CO2e	2,93E0	1,56E-1	2,07E-1	3,3E0	3,62E-1	5,99E1	MND	MND	MND	MND	MND	MND	MND	1,65E0	4,55E-3	2,98E-1	2,39E0	0E0
GWP – fossil	kg CO2e	2,93E0	1,56E-1	2,37E-1	3,32E0	3,65E-1	5,95E1	MND	MND	MND	MND	MND	MND	MND	1,65E0	4,54E-3	2,44E-1	2,39E0	0E0
GWP – biogenic	kg CO2e	3,25E-3	4,27E-5	-3,01E-2	-2,68E-2	7,37E-5	4,27E-1	MND	MND	MND	MND	MND	MND	MND	4,55E-4	3,3E-6	5,38E-2	4,12E-5	0E0
GWP – LULUC	kg CO2e	1,45E-3	6,59E-5	5,29E-5	1,56E-3	1,68E-4	4,42E-2	MND	MND	MND	MND	MND	MND	MND	1,38E-4	1,37E-6	2,54E-4	5,05E-6	0E0
Ozone depletion pot.	kg CFC11e	1,21E-7	3,35E-8	4,6E-9	1,59E-7	7,77E-8	5,6E-6	MND	MND	MND	MND	MND	MND	MND	3,54E-7	1,07E-9	2,86E-8	2,54E-9	0E0
Acidification potential	mol H+e	1,25E-2	1,34E-3	9,95E-4	1,48E-2	4E-3	3,29E-1	MND	MND	MND	MND	MND	MND	MND	7,31E-3	1,91E-5	1,18E-3	4E-4	0E0
EP-freshwater[2)]	kg Pe	7,3E-5	1,39E-6	1,19E-5	8,63E-5	3,08E-6	1,55E-3	MND	MND	MND	MND	MND	MND	MND	6,62E-6	3,7E-8	6,53E-6	2,68E-7	0E0
EP-marine	kg Ne	2,17E-3	3,47E-4	1,89E-4	2,7E-3	9,44E-4	9,54E-2	MND	MND	MND	MND	MND	MND	MND	2,68E-3	5,75E-6	3,78E-4	2,02E-4	0E0
EP-terrestrial	mol Ne	2,37E-2	3,85E-3	2,08E-3	2,96E-2	1,05E-2	1,1E0	MND	MND	MND	MND	MND	MND	MND	2,95E-2	6,35E-5	3,52E-3	2,08E-3	0E0
POCP ("smog")	kg NMVOCe	9E-3	1,08E-3	6,28E-4	1,07E-2	2,92E-3	3,03E-1	MND	MND	MND	MND	MND	MND	MND	8,46E-3	2,04E-5	1,15E-3	5,01E-4	0E0
ADP-minerals & metals	kg Sbe	4,49E-5	3,64E-6	1,18E-6	4,97E-5	7,88E-6	1,81E-3	MND	MND	MND	MND	MND	MND	MND	2,5E-6	7,75E-8	4,72E-6	3,86E-7	0E0
ADP-fossil resources	MJ	7,13E1	2,25E0	3,76E0	7,73E1	5,2E0	6,14E2	MND	MND	MND	MND	MND	MND	MND	2,25E1	7,07E-2	3,81E0	2,69E-1	0E0
Water use[1)]	m3e depr.	1,7E0	8,1E-3	4,71E-2	1,75E0	1,8E-2	4,63E2	MND	MND	MND	MND	MND	MND	MND	4,2E-2	2,63E-4	7,85E-2	9,67E-5	0E0

1) GWP = Global Warming Potential; EP = Eutrophication potential; POCP = Photochemical ozone formation; ADP = Abiotic depletion potential. 2) EN 15804+A2 disclaimer for Abiotic depletion and Water use and optional indicators except Particulate matter and Ionizing radiation, human health. The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator. 3) Required characterisation method and data are in kg P-eq. Multiply by 3,07 to get PO4e.

ADDITIONAL (OPTIONAL) ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Particulate matter	Incidence	1,11E-7	9,67E-9	5,05E-9	1,26E-7	1,99E-8	5,02E-6	MND	MND	MND	MND	MND	MND	MND	1,29E-7	4,11E-10	2,27E-8	2,02E-9	0E0
Ionizing radiation[3)]	kBq U235e	5,31E-2	9,4E-3	3,2E-3	6,57E-2	2,18E-2	2,45E0	MND	MND	MND	MND	MND	MND	MND	9,66E-2	3,09E-4	9,69E-3	3,68E-4	0E0
Ecotoxicity (freshwater)	CTUe	4,16E1	1,84E0	4,66E0	4,81E1	4,16E0	1,06E3	MND	MND	MND	MND	MND	MND	MND	1,32E1	5,4E-2	5,26E0	6,48E-1	0E0
Human toxicity, cancer	CTUh	1,29E-9	5,77E-11	6,9E-11	1,41E-9	1,44E-10	3,32E-8	MND	MND	MND	MND	MND	MND	MND	1,13E-9	1,38E-12	4,26E-10	9,08E-11	0E0
Human tox. non-cancer	CTUh	2,77E-8	1,86E-9	2,48E-9	3,2E-8	4,03E-9	9,31E-7	MND	MND	MND	MND	MND	MND	MND	1,2E-8	6,4E-11	5,5E-9	5,37E-9	0E0
SQP	-	2,74E0	1,6E0	3,05E-1	4,64E0	3,33E0	8,16E2	MND	MND	MND	MND	MND	MND	MND	5,78E-1	1,07E-1	2,47E0	6,42E-2	0E0

4) SQP = Land use related impacts/soil quality.5) EN 15804+A2 disclaimer for Ionizing radiation, human health. This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

USE OF NATURAL RESOURCES

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Renew. PER as energy	MJ	1,46E0	2,38E-2	1,89E-1	1,68E0	5,31E-2	3,49E1	MND	MND	MND	MND	MND	MND	MND	1,22E-1	8,9E-4	1,64E-1	4,96E-3	0E0
Renew. PER as material	MJ	0E0	0E0	2,82E-1	2,82E-1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	0E0	0E0
Total use of renew. PER	MJ	1,46E0	2,38E-2	4,71E-1	1,96E0	5,31E-2	3,49E1	MND	MND	MND	MND	MND	MND	MND	1,22E-1	8,9E-4	1,64E-1	4,96E-3	0E0
Non-re. PER as energy	MJ	3,33E1	2,25E0	2,59E0	3,81E1	5,2E0	6,12E2	MND	MND	MND	MND	MND	MND	MND	2,25E1	7,07E-2	3,81E0	2,69E-1	0E0
Non-re. PER as material	MJ	3,81E1	0E0	1,17E0	3,92E1	0E0	1,65E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	0E0	0E0
Total use of non-re. PER	MJ	7,13E1	2,25E0	3,76E0	7,73E1	5,2E0	6,14E2	MND	MND	MND	MND	MND	MND	MND	2,25E1	7,07E-2	3,81E0	2,69E-1	0E0
Secondary materials	kg	8,65E-3	0E0	2,2E-4	8,87E-3	0E0	4,02E-4	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	0E0	0E0
Renew. secondary fuels	MJ	0E0	0E0	0E0	0E0	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	0E0	0E0
Non-ren. secondary fuels	MJ	0E0	0E0	0E0	0E0	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	0E0	0E0
Use of net fresh water	m3	1,17E-2	3,64E-4	1,37E-3	1,34E-2	8,06E-4	1,11E1	MND	MND	MND	MND	MND	MND	MND	1,99E-3	1,47E-5	9,22E-4	5,5E-4	0E0

6) PER = Primary energy resources

END OF LIFE – WASTE

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Hazardous waste	Kg	1,23E-1	2,9E-3	1,38E-2	1,4E-1	6,68E-3	2,77E0	MND	MND	MND	MND	MND	MND	MND	2,43E-2	6,87E-5	0E0	1,56E-2	0E0
Non-hazardous waste	Kg	3,02E0	1,46E-1	4,83E-1	3,65E0	3,1E-1	8,07E1	MND	MND	MND	MND	MND	MND	MND	2,59E-1	7,6E-3	0E0	9,84E-1	0E0
Radioactive waste	Kg	4,99E-5	1,5E-5	2,84E-6	6,77E-5	3,49E-5	2,86E-3	MND	MND	MND	MND	MND	MND	MND	1,58E-4	4,85E-7	0E0	4,93E-7	0E0

END OF LIFE – OUTPUT FLOWS

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Components for re-use	Kg	0E0	0E0	0E0	0E0	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	0E0	0E0
Materials for recycling	Kg	0E0	0E0	0E0	0E0	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	0E0	0E0
Materials for energy rec	Kg	0E0	0E0	0E0	0E0	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	0E0	0E0
Exported energy	MJ	0E0	0E0	0E0	0E0	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	0E0	0E0

KEY INFORMATION TABLE (RTS) – KEY INFORMATION PER KG OF PRODUCT

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP – total	kg CO2e	2,93E0	1,56E-1	2,07E-1	3,3E0	3,66E-1	5,99E1	MND	MND	MND	MND	MND	MND	MND	1,65E0	4,55E-3	2,98E-1	2,39E0	0E0
ADP-minerals & metals	kg Sbe	4,49E-5	3,64E-6	1,18E-6	4,97E-5	7,88E-6	1,81E-3	MND	MND	MND	MND	MND	MND	MND	2,5E-6	7,75E-8	4,72E-6	3,86E-7	0E0
ADP-fossil	MJ	7,13E1	2,25E0	3,76E0	7,73E1	5,2E0	6,14E2	MND	MND	MND	MND	MND	MND	MND	2,25E1	7,07E-2	3,81E0	2,69E-1	0E0
Water use	m3e depr.	1,7E0	8,1E-3	4,71E-2	1,75E0	1,8E-2	4,63E2	MND	MND	MND	MND	MND	MND	MND	4,2E-2	2,63E-4	7,85E-2	9,67E-5	0E0
Secondary materials	kg	8,65E-3	0E0	2,2E-4	8,87E-3	0E0	4,02E-4	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	0E0	0E0
Biog. C in product	kg C	N/A	N/A	0E0	0E0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Biog. C in packaging	kg C	N/A	N/A	8E-3	8E-3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

7) Biog. C in product = Biogenic carbon content in product

SCENARIO DOCUMENTATION

Manufacturing energy scenario documentation

Scenario parameter	Value
Electricity data source and quality	Electricity, high voltage, production mix (Reference product: electricity, high voltage) Datapoint region: India - Indian Southern Grid Ecoinvent3.6
Electricity CO2e / kWh	1.16
District heating data source and quality	-
District heating CO2e / kWh	-

Transport scenario documentation (A4)

Scenario parameter	Value
Specific transport CO2e emissions, kg CO2e / tkm	0.03035
Average transport distance, km	11500
Capacity utilization (including empty return) %	100
Bulk density of transported products, kg/m^3	1073
Volume capacity utilization factor	1

Note: A4 average transport CO2e emissions has been computed from emissions factors freight modes and distances used in the average scenario: 10000 km with container ship (0.0094 kg CO2e / tonkm) and 1500 km with lorry 32tons (0.17 kg CO2e / tonkm)
→ (10000*0.0094+1500*0.17)/11500 = 0.03035

End of life scenario documentation

Scenario parameter	Value
Collection process – kg collected separately	1
Collection process – kg collected with mixed waste	0
Recovery process – kg for re-use	0
Recovery process – kg for recycling	0
Recovery process – kg for energy recovery	0
Disposal (total) – kg for final deposition	1
Scenario assumptions e.g. transportation	50 km lorry (see § Allocation, estimates and assumptions)

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RTS PCR (English version 26.8.2020)

GeoStrap® Reinforcement LCA background report 31.08.2021

ABOUT THE MANUFACTURER

Reinforced Earth India Private Limited is a subsidiary of Terre Armée. At the origin of mechanically stabilized earth structures, Terre Armée has an active presence on the five continents. Worldwide leader in soil reinforcements, we are proud to build on the legacy of Henri Vidal's Reinforced Earth® invention and call ourselves The Original. Today, Terre Armée concentrates an unequalled combination of expertise and accumulated experience in the fields of soil-structure interaction and engineered backfills. Our expansive portfolio of techniques applies to a wide range of structures for an extended array of market segments: roads and motorways, environment, railways, hydraulic works, mining, industry, energy, commercial, housing or military.

EPD AUTHOR AND CONTRIBUTORS

Manufacturer	Reinforced Earth India Private Limited
EPD author	Romaric QUENTIN
EPD verifier	Anni Oviir, Rangi Maja OÜ, www.lcasupport.com
EPD program operator	The Building Information Foundation RTS sr
Background data	This EPD is based on Ecoinvent 3.6 (cut-off) and One Click LCA databases.
LCA software	The LCA and EPD have been created using One Click LCA Pre-Verified EPD Generator for Plastic-based Products and Systems

VERIFICATION STATEMENT

VERIFICATION PROCESS FOR THIS EPD

This EPD has been verified in accordance with ISO 14025 by an independent, third-party verifier by reviewing results, documents and compliancy with EN 15804, ISO 14025 and ISO 14040/14044, following the process and checklists of the program operator for:

- This Environmental Product Declaration
- The Life-Cycle Assessment used in this EPD
- The background report (project report) for this EPD

Why does verification transparency matter? Read more online.

VERIFICATION OVERVIEW

Following independent third party has verified this specific EPD:

EPD verification information	Answer
Independent EPD verifier	Anni Oviir, Rangi Maja OÜ
EPD verification started on	15.09.2021
EPD verification completed on	16.09.2021
Approver of the EPD verifier	The Building Information Foundation RTS sr

Author & tool verification	Answer
EPD author	Romaric QUENTIN
EPD author training completion	12.5.2021
EPD Generator module	Plastic-based products and systems
Independent software verifier	Silvia Vilčeková, Silcert sro
Software verification date	7.5.2021

THIRD-PARTY VERIFICATION STATEMENT

I hereby confirm that, following detailed examination, I have not established any relevant deviations by the studied Environmental Product Declaration (EPD), its LCA and project report, in terms of

- the data collected and used in the LCA calculations,
- the way the LCA-based calculations have been carried out,
- the presentation of environmental data in the EPD, and
- other additional environmental information, as present

with respect to the procedural and methodological requirements in ISO 14025:2010 and EN 15804:2012+A2:2019.

I confirm that the company-specific data has been examined as regards plausibility and consistency; the declaration owner is responsible for its factual integrity and legal compliance.

I confirm that I have sufficient knowledge and experience of construction products, this specific product category, the construction industry, relevant standards, and the geographical area of the EPD to carry out this verification.

I confirm my independence in my role as verifier; I have not been involved in the execution of the LCA or in the development of the declaration and have no conflicts of interest regarding this verification.

Anni Oviir, Rangi Maja OÜ

ANNEX 1 : ENVIRONMENTAL IMPACTS – EN 15804+A1, CML / ISO 21930

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Global Warming Pot.	kg CO2e	2,75E0	1,55E-1	2,31E-1	3,13E0	3,62E-1	5,84E1	MND	MND	MND	MND	MND	MND	MND	1,64E0	4,5E-3	2,6E-1	2,39E0	0E0
Ozone depletion Pot.	kg CFC11e	1,1E-7	2,66E-8	4,33E-9	1,4E-7	6,17E-8	4,65E-6	MND	MND	MND	MND	MND	MND	MND	2,8E-7	8,49E-10	2,32E-8	2,2E-9	0E0
Acidification	kg SO2e	1,06E-2	1,04E-3	8,39E-4	1,25E-2	3,17E-3	1,79E-1	MND	MND	MND	MND	MND	MND	MND	2,42E-3	9,25E-6	9,09E-4	2,77E-4	0E0
Eutrophication	kg PO4 3e	2,79E-3	1,61E-4	3,77E-4	3,32E-3	4,18E-4	6,14E-2	MND	MND	MND	MND	MND	MND	MND	4,26E-4	1,87E-6	1,17E-3	2,19E-4	0E0
POCP (“smog”)	kg C2H4e	6,42E-4	3,41E-5	3,72E-5	7,14E-4	9,89E-5	1,38E-2	MND	MND	MND	MND	MND	MND	MND	2,89E-4	5,86E-7	7,79E-5	4,71E-6	0E0
ADP-elements	kg Sbe	4,49E-5	3,64E-6	1,18E-6	4,97E-5	7,88E-6	1,81E-3	MND	MND	MND	MND	MND	MND	MND	2,5E-6	7,75E-8	4,72E-6	3,86E-7	0E0
ADP-fossil	MJ	7,13E1	2,25E0	3,76E0	7,73E1	5,2E0	6,14E2	MND	MND	MND	MND	MND	MND	MND	2,25E1	7,07E-2	3,81E0	2,69E-1	0E0

ANNEX 2 : ENVIRONMENTAL IMPACTS – TRACI 2.1. / ISO 21930

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Global Warming Pot.	kg CO2e	2,77E0	1,54E-1	2,31E-1	3,15E0	3,62E-1	5,81E1	MND	MND	MND	MND	MND	MND	MND	1,64E0	4,5E-3	2,64E-1	2,39E0	0E0
Ozone Depletion	kg CFC11e	1,36E-7	3,54E-8	6,31E-9	1,78E-7	8,22E-8	6,17E-6	MND	MND	MND	MND	MND	MND	MND	3,73E-7	1,13E-9	3,09E-8	2,68E-9	0E0
Acidification	kg SO2e	1,06E-2	1,15E-3	8,6E-4	1,26E-2	3,39E-3	2,87E-1	MND	MND	MND	MND	MND	MND	MND	6,51E-3	1,66E-5	1,06E-3	3,72E-4	0E0
Eutrophication	kg Ne	1,03E-3	9,51E-5	1,24E-4	1,25E-3	2,36E-4	2,98E-2	MND	MND	MND	MND	MND	MND	MND	8,29E-4	2,34E-6	1,93E-4	1,14E-4	0E0
POCP (“smog”)	kg O3e	1,34E-1	2,2E-2	1,15E-2	1,67E-1	6E-2	6,02E0	MND	MND	MND	MND	MND	MND	MND	1,71E-1	3,65E-4	2E-2	1,2E-2	0E0
ADP-fossil	MJ	9,58E0	3,19E-1	3,17E-1	1,02E1	7,39E-1	6,17E1	MND	MND	MND	MND	MND	MND	MND	3,33E0	1,01E-2	4,73E-1	3,83E-2	0E0

ANNEX 3 : GWP TOTAL AND ACIDIFICATION RESULTS PER LINEAR METER FOR THE DIFFERENT GRADES AND WIDTHS (CML / ISO 21930)

Reinforcement type (width)	Grade (kN)	Linear mass (kg/m)	Global Warming Pot. (A1-A3) (kg CO2e)	Global Warming Pot. (A1-A5 + C1-D) (kg CO2e)	Acidification (A1-A3) (kg SO2e)	Acidification (A1-A5 + C1-D) (kg SO2e)
GeoStrap 9	30	7.40E-02	2.32E-01	4.90E+00	9.23E-04	1.47E-02
	40	9.40E-02	2.94E-01	6.22E+00	1.17E-03	1.86E-02
	50	1.10E-01	3.44E-01	7.28E+00	1.37E-03	2.18E-02
	60	1.31E-01	4.10E-01	8.67E+00	1.63E-03	2.60E-02
	70	1.46E-01	4.57E-01	9.66E+00	1.82E-03	2.89E-02
	75	1.56E-01	4.88E-01	1.03E+01	1.95E-03	3.09E-02
	80	1.66E-01	5.20E-01	1.10E+01	2.07E-03	3.29E-02
	90	1.86E-01	5.82E-01	1.23E+01	2.32E-03	3.69E-02
	100	2.06E-01	6.45E-01	1.36E+01	2.57E-03	4.08E-02
	110	2.25E-01	7.04E-01	1.49E+01	2.81E-03	4.46E-02
	120	2.40E-01	7.51E-01	1.59E+01	2.99E-03	4.76E-02
	130	2.59E-01	8.11E-01	1.71E+01	3.23E-03	5.14E-02
	140	2.78E-01	8.70E-01	1.84E+01	3.47E-03	5.51E-02
	150	2.97E-01	9.30E-01	1.97E+01	3.71E-03	5.89E-02
	160	3.16E-01	9.89E-01	2.09E+01	3.94E-03	6.27E-02
	170	3.31E-01	1.04E+00	2.19E+01	4.13E-03	6.56E-02
	180	3.50E-01	1.10E+00	2.32E+01	4.37E-03	6.94E-02
	190	3.69E-01	1.15E+00	2.44E+01	4.60E-03	7.32E-02
GeoStrap 7	30	7.40E-02	2.32E-01	4.90E+00	9.23E-04	1.47E-02
	40	9.30E-02	2.91E-01	6.16E+00	1.16E-03	1.84E-02

	50	1.10E-01	3.44E-01	7.28E+00	1.37E-03	2.18E-02
	60	1.27E-01	3.98E-01	8.41E+00	1.58E-03	2.52E-02
	70	1.48E-01	4.63E-01	9.80E+00	1.85E-03	2.93E-02
	75	1.59E-01	4.98E-01	1.05E+01	1.98E-03	3.15E-02
	80	1.69E-01	5.29E-01	1.12E+01	2.11E-03	3.35E-02
	90	1.85E-01	5.79E-01	1.22E+01	2.31E-03	3.67E-02
	100	2.06E-01	6.45E-01	1.36E+01	2.57E-03	4.08E-02
	110	2.22E-01	6.95E-01	1.47E+01	2.77E-03	4.40E-02
	120	2.42E-01	7.57E-01	1.60E+01	3.02E-03	4.80E-02
	130	2.62E-01	8.20E-01	1.73E+01	3.27E-03	5.19E-02
	140	2.78E-01	8.70E-01	1.84E+01	3.47E-03	5.51E-02
	150	2.97E-01	9.30E-01	1.97E+01	3.71E-03	5.89E-02
GeoStrap 5	20	5.70E-02	1.78E-01	3.77E+00	7.11E-04	1.13E-02
	25	6.50E-02	2.03E-01	4.30E+00	8.11E-04	1.29E-02
	30	7.30E-02	2.28E-01	4.83E+00	9.11E-04	1.45E-02
	38	8.20E-02	2.57E-01	5.43E+00	1.02E-03	1.63E-02
	40	9.00E-02	2.82E-01	5.96E+00	1.12E-03	1.78E-02
	50	1.09E-01	3.41E-01	7.21E+00	1.36E-03	2.16E-02
	60	1.29E-01	4.04E-01	8.54E+00	1.61E-03	2.56E-02
	65	1.39E-01	4.35E-01	9.20E+00	1.73E-03	2.76E-02
	70	1.48E-01	4.63E-01	9.80E+00	1.85E-03	2.93E-02
	75	1.58E-01	4.95E-01	1.05E+01	1.97E-03	3.13E-02
	80	1.67E-01	5.23E-01	1.11E+01	2.08E-03	3.31E-02
	90	1.86E-01	5.82E-01	1.23E+01	2.32E-03	3.69E-02
	100	2.04E-01	6.39E-01	1.35E+01	2.55E-03	4.04E-02

Calculation method:

GWP_{linear_meter} (kgCO²e/lm) = GWP_{mass} (kgCO2e/kg) * linear_mass (kg/lm)

AP_{linear_meter} (kgSO²e/lm) = AP_{mass} (kgSO2e/kg) * linear_mass (kg/lm)