Statement of Verification

BREG EN EPD No.: 000569 Issue 01

This is to verify that the

Environmental Product Declaration

provided by:

Philip Grahame International Ltd

is in accordance with the requirements of:

EN 15804:2012+A2:2019

and

BRE Global Scheme Document SD207

This declaration is for:

1 kg of horizontal/vertical pre-galvanized steel cable ladder

Company Address

Montrose Road
Dukes Park Industrial Estate
Chelmsford
Essex, CM2 6TE
United Kingdom

PHILIP GRAHAME
Member of NIEDAX GROUP

Signed for BRE Global Ltd	Emma Baker Operator	27 February 2024 Date of this Issue
27 February 2024 Date of First Issue		26 February 2029 Expiry Date

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Environmental Product Declaration

EPD Number: 000569

General Information

EPD Programme Operator	Applicable Product Category Rules
BRE Global Watford, Herts WD25 9NH United Kingdom	BRE 2021 Product Category Rules (PN 514 Rev 3.1) for Type III environmental product declaration of construction products to EN 15804:2012 + A2:2019.
Commissioner of LCA study	**LCA consultant/Tool**
Philip Grahame Ltd Montrose Road, Dukes Park Ind Est, Chelmsford, Essex, CM2 6TE	LCA Consultant: Chi Zhang LCA Tool: BRE LINA v2.0
Declared Unit	**Applicability/Coverage**
1 kg of horizontal/vertical pre-galvanized steel cable ladder for the support and accommodation of cables, electrical equipment, and communication systems of cables over 30 years.	Product Specific.
EPD Type	**Background database**
Cradle to Grave	Ecoinvent 3.8

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: Bala Subramanian
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 programs may not be comparable if not compliant with EN 15804:2012+A2:2019. 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+A2:2019 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

Montrose Road,
Dukes Park Ind Est,
Chelmsford,
Essex, CM2 6TE

Construction Product:

Product Description

In the electrical wiring of buildings, cable ladder systems, made up of 100% steel, are typically used to support steel-wire armoured electric cables for power distribution. These steel cable ladders are heavy-duty supports designed to carry large loads over large spans, making them ideal for use in commercial and industrial construction.

Cable ladder systems are designed for use as supports for cables and not as enclosures giving full mechanical protection. Usually, armoured cables are fastened to the ladder rungs by cable cleats. The alternating rung design on the Philip Grahame cable ladder allows installers to support both the ladder system itself and to fasten cables to the ladder in an upwards or downward orientation.

Philip Grahame manufactures rungs and sidewalls with different dimensions. The assembly of rungs and sidewalls takes place in the Philip Grahame factory before being sent to the customer unit. The rungs and sidewalls are made of 100% galvanized steel. Therefore, the LCA analysis is conducted for 1 kg of galvanized steel, using the total quantity of steel used for the production of L4 cable ladder medium dry - 100mm sidewall, L5 cable ladder heavy duty - 125mm sidewall, and L6 cable ladder extra heavy duty - 150mm sidewall. This enables the end-user to assess the impact of the type of cable ladder used at the construction site. Each version of cable ladder sidewall can be assembled in varied rung widths from 150mm to 900mm. The following table includes various widths/weight of rungs, sidewalls, and assembled cable ladders. End-users can use this table to calculate the bespoke impacts of the cable ladder.

Rungs and Sidewalls:

Sidewall weights and scrap by-product:

Product Code	Coil thickness (mm)	Coil Width (mm)	Blank Weight before punching (kg)	Surface area after punching (mm2)	Product weight (kg)
L4 SIDEWALL	1.6	163.0	6.14	451429.26	5.67
L5 SIDEWALL	2.0	210.7	9.92	594400.22	9.33
L6 SIDEWALL	2.0	235.7	11.10	669400.22	10.51
Note: The only scrap produced in the manufacture of cable ladder sidewall is the ‘slugs’ produced when punching the holes along the component and ‘L’ shaped slots required to form the pockets for the rungs.					

Rung weights and scrap by-products:

Rung width	Surface area(mm2)	Sheet size	Qty per sheet	Sheet weight (kg)	Rung weight (kg)
150	14538.3172	2040x1250x2.0	110	40.0350	0.22825158
300	28221.3172	1890x1250x2.0	55	37.0913	0.44307468
450	41904.3172	2040x1250x2.0	44	40.0350	0.65789778
600	55587.3172	2040x1250x2.0	33	40.0350	0.87272088
750	69270.3172	1740x1250x2.0	22	34.1475	1.08754398
900	82953.3172	2040x1250x2.0	22	40.0350	1.30236708
Note1: Surface area calculated via CAD as full product surface of the blank after production excluding holes					
Note 2: Scrap per rung includes skeleton, profiling, and rectangular slots within the rung.					

Assembled ladder length weights and scrap per length:

Product Code	Sidewall weight(kg)	Rung weight (kg)	Product weight (kg)
L4L/150/G	5.67	0.23	13.62
L4L/300/G	5.67	0.44	15.77
L4L/450/G	5.67	0.66	17.92
L4L/600/G	5.67	0.87	20.07
L4L/750/G	5.67	1.09	22.22
L4L/900/G	5.67	1.30	24.36
L5L/150/G	9.33	0.23	20.94
L5L/300/G	9.33	0.44	23.09
L5L/450/G	9.33	0.66	25.24

Product Code	Sidewall weight(kg)	Rung weight (kg)	Product weight (kg)
L5L/600/G	9.33	0.87	27.39
L5L/750/G	9.33	1.09	29.54
L5L/900/G	9.33	1.30	31.68
L6L/150/G	10.51	0.23	23.30
L6L/300/G	10.51	0.44	25.45
L6L/450/G	10.51	0.66	27.60
L6L/600/G	10.51	0.87	29.75
L6L/750/G	10.51	1.09	31.90
L6L/900/G	10.51	1.30	34.04

Technical Information

Property	Value, Unit
Philip Grahame Cable ladder is manufactured to the product standard BS EN 61537	Conforms
Standard Length (m)	3
Standard finish	Hot-Dip Pre-Galvanised to BS EN 10346
Special finish	Epoxy Powder Coated Black/White

Full technical submittal available on request
Note: The above technical properties apply to all products covered in this EPD

Main Product Contents

Material/Chemical Input	%
Pre-Galvanised sheet steel	100

Note: The above product contents apply to all products covered in this EPD.

Manufacturing Process

Philip Grahame cable ladder is manufactured from pre-galvanised steel to BS EN 10346. Pre-galvanized steel is produced by unwinding steel coil, passing it through a bath of molten zinc and then past air jets to remove excess zinc from the surface. The process is closely controlled to produce a thin, even and ripple free zinc coating with very few imperfections.

Philip Grahame purchases all steel for the manufacture of cable ladder from Tata Steel UK. Cable ladder is constructed by two sidewalls being joined together by rungs. The steel used to manufacture the sidewalls is purchased in coil form from Tata with the width of the coil cut precisely to the product width to reduce scrap. The rungs are punched from sheet steel.

Tata manufacture the wide coil in South Wales and then transport large wide coil by rail to their Steelpark Headquarters in the Midlands, here it is processed into the customers required widths.

Manufacture of sidewall flat blanks:

All manufacture is carried out at Philip Grahame's manufacturing facility in Chelmsford, Essex. The complete manufacturing facility is controlled by Philip Grahame's BS EN ISO 9001 Quality management system along with the BS EN ISO 14001 Environmental management System. To manufacture the flat blank for a cable ladder sidewall the coils are loaded onto a bespoke press line. The coil is unwound, flattened, and then passed through a power press where the holes are punched into the steel. The coil is then fed through a guillotine where it is cut to length and then conveyed to a stacking station where pallets of product are stacked. All cable ladder sidewalls are produced in 3 metre lengths from coils that are the precise width of the product. The slots and embosses are both created together in a single process by the progression press tool. The only scrap produced in the punching of the sidewall is the holes seen below, these 'slugs' are collected and recycled through Philip Grahame's steel waste recycling stream. During the punching process, the progression tool creates rung pockets in the sidewall. These allow the rungs to be located in a precise location along the ladder length. The precision of the rung pocket and rung form is key to the assembly and joining operation.

Manufacture of rungs:
The rung flat profile is punched from sheet steel on the automated turret punching machine. This machine can run fully autonomously in a 'lights out' production system, giving us 24 hours of a day in which to achieve an efficient running plan. Sixteen shelves across two towers enable the machine to be able to load 8 shelves of raw material and unload 8 shelves of punched product and scrap before needing to be emptied.

The ZRT machine is an electric punching machine, driven by servo motors and when not punching, is only using minimal power to keep the computer control components running.

Rungs are manufactured on this machine using pre-determined 'nests' which have been designed to maximise the number of rungs which can be produced from a single sheet of steel. Reducing both the scrap generated and running time of the machine.

A method in which Philip Grahame achieve this efficiency in the nest is the use of special punching tools. For rungs a custom profiled tool is used which requires one hit to create a tab on two rungs. This reduces the need for multiple tools and multiple hits to create the tab profile which leads to a reduction in scrap and energy use. Another method of reducing scrap is the use of 'ghost slitting', which means a normal tool hits a line of punching that joins two of the rungs together, similar to the special 'H' shaped tool. Effectively meaning that

Philip Grahame is punching two rungs instead of one, halving the number of slugs created, and also reducing the skeleton as much as possible to fit more rungs on one sheet of material.

Once the rung sheet punching is complete the are retained in a skeleton by micro joints. Then broken out of the skeleton into individual blanks as above. The scrap produced in the punching of the rung is the skeleton (remnant of the sheet) and punch 'slugs' which are all recycled through Philip Grahame's metal waste recycling stream. Bending operation – drawings to show bending operation required to form a complete rung and a drawing of a finished rung.

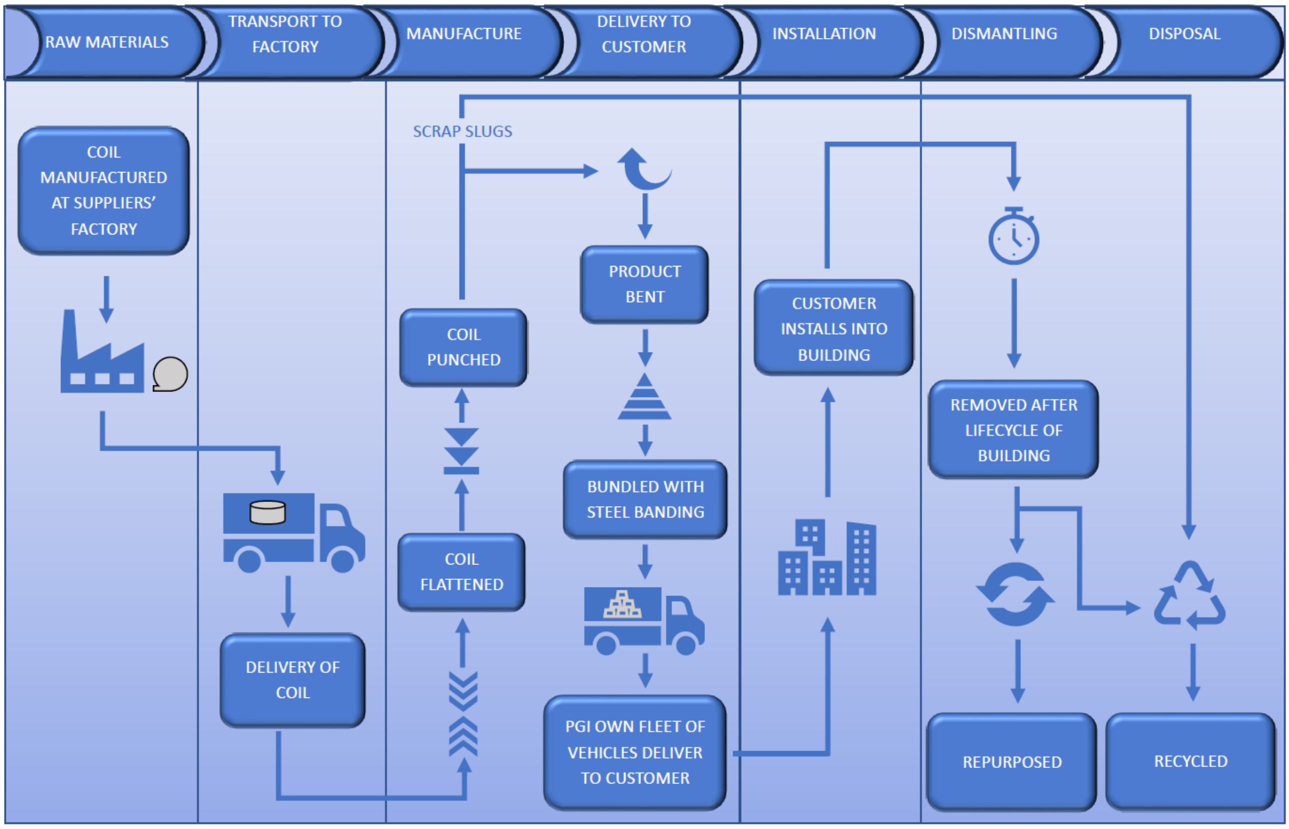
Ladder assembly:
Each ladder length consists of 10 rungs and 2 sidewalls. When all items are bent, ladders are assembled on a bespoke jig to ensure alignment before being joined by a clinching tool. Once joined, the product is complete for despatch to the customer.

The clinching joint is a cold joining process, requiring no heat to be applied such as in welding, and no extra material is needed such as in normal riveting. This means no scrap is created during the assembly of the cable ladder.

The clinching machines used to join the ladder length are a pneumo-hydraulic system, driven by air pressure instead of hydraulic pressure. Two joints are made in one operation of the joining tool. This reduces energy consumption in the ladder assembly by saving 85 percent of the energy that a single-acting hydraulic system might otherwise use.

Using the ladder jig, the ladder sidewalls, together with the rungs, are laid into place so that they are all in the correct location for joining. Air clamps hold the assembly in place during clinching. All of this ensures no movement and so removes any chance of a mis-clinch and wastage.

Process flow diagram



Construction Installation

For the installation of the product, only standard tools are required.

Use Information

Given the disparity in life expectancy between the LCA study period (60 years) and the cable ladder life service years (30 years), there will inevitably be a need for replacement halfway through the building's lifespan. When the cable ladder reaches the end of its service life or becomes unsuitable for its intended use, a complete replacement is required. Its modular design facilitates straightforward disassembly and replacement, ensuring minimal energy and ancillary consumption. Also, during the replacement, there is 0% reused with 95% being recycled which is based on commercial recycling rates.

End of Life

Cable ladder installations are essentially a kit of parts and could easily be dismantled and reused. This theoretically means that parts of Cable ladder installations could continually be reused and never sent to landfill or recycled. However, there is an issue with warranty, workmanship and product use that prevents this from happening. As there is no control of initial loading, installation practices and decommissioning there is no ability to understand if the SWL of the product has been compromised. For this reason, there is currently no reuse of this product being practiced.

Life Cycle Assessment Calculation Rules

Declared unit description

1 kg of horizontal/vertical pre-galvanised steel cable ladder for the support and accommodation of cables, electrical equipment, and communication systems of cables over 30 years.

System boundary

This is a cradle-to-grave LCA, reporting all the life cycle modules A1 to C4 and module D, in accordance with EN 15804:2012+A2:2019.

Data sources, quality, and allocation

Specific primary data derived from Philip Grahame's production process in the Chelmsford, Essex factory, have been modelled using the LINA A2 LCA and the ecoinvent 3.8 database. In accordance with the requirements of EN15804:2012 + A2:2019, the most current available data has been used. The manufacturer-specific data from Philip covers a period of one year (01/01/2021 – 31/12/2021). Secondary data has been obtained for all other upstream and downstream processes that are beyond the control of the manufacturer (i.e., raw material production) from the ecoinvent 3.8 database. All ecoinvent datasets are complete within the context used and conform to the system boundary and the criteria for the exclusion of inputs and outputs, according to the requirements specified in EN15804:2012+A2:2019.

Philip Grahame's cable ladder is not the only product manufactured at the Chelmsford, Essex factory other products are manufactured along with the cable ladder, so the allocation of energy, water, and waste is required, and this has been done by using the Mass allocation in the provisions of the BRE PCR PN514 and EN 15804:2012+A2:2019. Site wide values for energy, water and wastewater have been taken from bills. Figures for the raw materials, ancillary materials and packaging were from actual usages. This LCA covers the manufacturing of Philip Grahame's cable ladder for supporting and fastening ladder systems which cover 20.8% of the factory production.

Quality Level	Geographical representativeness	Technical representativeness	Time representativeness
Very Good	Data from area under study	Data from processes and products under study. Same state of technology applied as defined in goal and scope (i.e. identical technology).	There is less than 5 years between the ecoinvent LCI reference year, and the time period for which the LCA was undertaken.

Specific UK datasets have been selected from the ecoinvent LCI for this LCA. The quality level of geographical and technical representativeness is therefore Very Good. The quality level of time representativeness is Very Good as the background LCI datasets are based on ecoinvent v3.8 which was compiled in 2021. It's important to note that the LCA analysis utilizes electricity data from the GB National Grid, a detail that is integral to the system boundary of this assessment. This inclusion ensures that the environmental impacts associated with the use of electricity are accurately represented throughout the life cycle stages. As per the latest data, the emissions factor for electricity generated from the UK grid is 0.239 kgCO2e/kWh. The intended purpose of this LCA is for the data and results to be used in a published third-party verified EPD Therefore, there is less than 5 years between the ecoinvent LCI reference year and the time period for which the LCA was undertaken.

Cut-off criteria

All raw materials and energy input to the manufacturing process have been included, except for direct emissions to air, water, and soil, which are not measured. There are no ancillary or consumable materials used and so none have been included. Process energy, water use and discharge and process and general waste are included.

LCA Results

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CFC11 eq	mol H^+ eq	kg $(PO_4)^{3-}$ eq
Product stage	Raw material supply	A1	3.00e+0	2.99e+0	1.19e-2	2.84e-3	1.70e-7	3.93e-2	1.45e-3
	Transport	A2	3.08e-2	3.08e-2	2.62e-5	1.21e-5	7.12e-9	1.25e-4	1.98e-6
	Manufacturing	A3	7.53e-2	7.34e-2	1.67e-3	5.35e-5	1.04e-8	4.99e-4	7.14e-6
	Total (of product stage)	A1-3	3.11e+0	3.09e+0	1.35e-2	2.90e-3	1.87e-7	3.99e-2	1.46e-3
Construction process stage	Transport	A4	6.66e-3	6.65e-3	5.67e-6	2.61e-6	1.54e-9	2.70e-5	4.28e-7
	Construction	A5	9.33e-2	9.27e-2	4.06e-4	8.71e-5	5.61e-9	1.20e-3	4.38e-5
Use stage	Use	B1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Maintenance	B2	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Repair	B3	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Replacement	B4	3.21e+0	3.19e+0	1.40e-2	2.99e-3	1.94e-7	4.11e-2	1.51e-3
	Refurbishment	B5	3.21e+0	3.19e+0	1.40e-2	2.99e-3	1.94e-7	4.11e-2	1.51e-3
	Operational energy use	B6	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Operational water use	B7	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
End of life	Deconstruction, demolition	C1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Transport	C2	8.32e-3	8.31e-3	7.08e-6	3.26e-6	1.92e-9	3.37e-5	5.35e-7
	Waste processing	C3	5.47e-2	5.47e-2	1.93e-5	5.46e-6	1.17e-8	5.68e-4	1.69e-6
	Disposal	C4	2.64e-4	2.63e-4	2.61e-7	2.49e-7	1.07e-10	2.48e-6	2.41e-8
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.41e+0	-1.42e+0	3.23e-3	-8.94e-4	-6.44e-8	-5.44e-3	-6.25e-4

GWP-total = Global warming potential, total;
GWP-fossil = Global warming potential, fossil;
GWP-biogenic = Global warming potential, biogenic;
GWP-luluc = Global warming potential, land use and land use change;
ODP = Depletion potential of the stratospheric ozone layer;
AP = Acidification potential, accumulated exceedance; and
EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			EP-marine	EP-terrestrial	POCP	ADP-mineral&metals	ADP-fossil	WDP	PM
			kg N eq	mol N eq	kg NMVOC eq	kg Sb eq	MJ, net calorific value	m^3 world eq deprived	disease incidence
Product stage	Raw material supply	A1	4.04e-3	1.45e-1	1.34e-2	1.13e-4	3.33e+1	1.48e+0	4.84e-7
	Transport	A2	3.76e-5	4.11e-4	1.26e-4	1.07e-7	4.65e-1	2.09e-3	2.66e-9
	Manufacturing	A3	2.03e-4	2.16e-3	5.86e-4	1.23e-7	1.48e+0	8.96e-3	1.09e-8
	Total (of product stage)	A1-3	4.28e-3	1.47e-1	1.41e-2	1.13e-4	3.52e+1	1.49e+0	4.97e-7
Construction process stage	Transport	A4	8.13e-6	8.88e-5	2.72e-5	2.31e-8	1.01e-1	4.52e-4	5.74e-10
		A5	1.29e-4	4.42e-3	4.23e-4	3.40e-6	1.06e+0	4.48e-2	1.49e-8
Use stage	Use	B1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Maintenance	B2	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Repair	B3	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Replacement	B4	4.42e-3	1.52e-1	1.46e-2	1.17e-4	3.64e+1	1.54e+0	5.13e-7
	Refurbishment	B5	4.42e-3	1.52e-1	1.46e-2	1.17e-4	3.64e+1	1.54e+0	5.13e-7
	Operational energy use	B6	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Operational water use	B7	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
End of life	Deconstruction, demolition	C1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Transport	C2	1.02e-5	1.11e-4	3.40e-5	2.89e-8	1.26e-1	5.65e-4	7.17e-10
	Waste processing	C3	2.52e-4	2.76e-3	7.58e-4	2.81e-8	7.50e-1	1.73e-3	1.52e-8
	Disposal	C4	8.61e-7	9.42e-6	2.74e-6	6.01e-10	7.35e-3	3.37e-4	4.99e-11
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.30e-3	-1.37e-2	-6.72e-3	-1.93e-6	-1.37e+1	-3.39e-1	-1.08e-7

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
EP-terrestrial = Eutrophication potential, accumulated exceedance;
POCP = Formation potential of tropospheric ozone;
ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;
ADP-fossil = Depletion potential of the stratospheric ozone layer;
WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and
PM = Particulate matter.

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts							
			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U^{235} eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	1.75e-1	1.19e+2	2.16e-8	1.16e-7	1.08e+1
	Transport	A2	2.39e-3	3.63e-1	1.18e-11	3.81e-10	3.20e-1
	Manufacturing	A3	3.63e-2	8.07e-1	2.13e-11	4.92e-10	4.27e-1
	Total (of product stage)	A1-3	2.14e-1	1.21e+2	2.16e-8	1.17e-7	1.15e+1
Construction process stage	Transport	A4	5.17e-4	7.84e-2	2.54e-12	8.22e-11	6.91e-2
	Construction	A5	6.41e-3	3.62e+0	6.49e-10	3.52e-9	3.45e-1
Use stage	Use	B1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Maintenance	B2	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Repair	B3	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Replacement	B4	2.21e-1	1.24e+2	2.23e-8	1.21e-7	1.19e+1
	Refurbishment	B5	2.21e-1	1.24e+2	2.23e-8	1.21e-7	1.19e+1
	Operational energy use	B6	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Operational water use	B7	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
End of life	Deconstruction, demolition	C1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Transport	C2	6.46e-4	9.81e-2	3.18e-12	1.03e-10	8.63e-2
	Waste processing	C3	3.38e-3	4.39e-1	1.70e-11	3.18e-10	9.55e-2
	Disposal	C4	3.27e-5	4.64e-3	1.18e-13	3.05e-12	1.54e-2
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-3.49e-2	-3.96e+1	-8.29e-9	-2.94e-8	-3.80e+0

IRP = Potential human exposure efficiency relative to U235;
ETP-fw = Potential comparative toxic unit for ecosystems;
HTP-c = Potential comparative toxic unit for humans;
HTP-nc = Potential comparative toxic unit for humans; and
SQP = Potential soil quality index.

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use, primary energy								
			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	2.93e+0	0.00e+0	2.93e+0	3.29e+1	0.00e+0	3.29e+1
	Transport	A2	6.56e-3	0.00e+0	6.56e-3	4.57e-1	0.00e+0	4.57e-1
	Manufacturing	A3	1.53e-1	2.64e-2	1.79e-1	1.46e+0	8.78e-3	1.46e+0
	Total (of product stage)	A1-3	3.09e+0	2.64e-2	3.12e+0	3.48e+1	8.78e-3	3.48e+1
Construction process stage	Transport	A4	1.42e-3	0.00e+0	1.42e-3	9.87e-2	0.00e+0	9.87e-2
	Construction	A5	9.28e-2	7.91e-4	9.35e-2	1.04e+0	2.64e-4	1.04e+0
Use stage	Use	B1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Maintenance	B2	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Repair	B3	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Replacement	B4	3.19e+0	2.72e-2	3.21e+0	3.60e+1	9.05e-3	3.60e+1
	Refurbishment	B5	3.19e+0	2.72e-2	3.21e+0	3.60e+1	9.05e-3	3.60e+1
	Operational energy use	B6	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Operational water use	B7	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
End of life	Deconstruction, demolition	C1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Transport	C2	1.77e-3	0.00e+0	1.77e-3	1.23e-1	0.00e+0	1.23e-1
	Waste processing	C3	4.20e-3	0.00e+0	4.20e-3	7.36e-1	0.00e+0	7.36e-1
	Disposal	C4	6.27e-5	0.00e+0	6.27e-5	7.22e-3	0.00e+0	7.22e-3
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-4.35e-1	0.00e+0	-4.35e-1	-1.36e+1	0.00e+0	-1.36e+1

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

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

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+0	0.00e+0	0.00e+0	3.66e-2
	Transport	A2	0.00e+0	0.00e+0	0.00e+0	5.19e-5
	Manufacturing	A3	2.63e-4	0.00e+0	0.00e+0	2.26e-4
	Total (of product stage)	A1-3	2.63e-4	0.00e+0	0.00e+0	3.69e-2
Construction process stage	Transport	A4	9.87e-2	0.00e+0	0.00e+0	1.12e-5
	Construction	A5	7.88e-6	0.00e+0	0.00e+0	1.11e-3
Use stage	Use	B1	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Maintenance	B2	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Repair	B3	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Replacement	B4	2.71e-4	0.00e+0	0.00e+0	3.80e-2
	Refurbishment	B5	2.71e-4	0.00e+0	0.00e+0	3.80e-2
	Operational energy use	B6	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Operational water use	B7	0.00e+0	0.00e+0	0.00e+0	0.00e+0
End of life	Deconstruction, demolition	C1	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Transport	C2	0.00e+0	0.00e+0	0.00e+0	1.40e-5
	Waste processing	C3	2.88e-4	0.00e+0	0.00e+0	4.28e-5
	Disposal	C4	1.52e-6	0.00e+0	0.00e+0	7.88e-6
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00e+0	0.00e+0	0.00e+0	-8.12e-3

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)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	1.06e+0	5.33e+0	7.61e-5
	Transport	A2	5.13e-4	9.11e-3	3.15e-6
	Manufacturing	A3	2.69e-3	3.46e-2	1.20e-5
	Total (of product stage)	A1-3	1.07e+0	5.37e+0	9.13e-5
Construction process stage	Transport	A4	1.11e-4	1.97e-3	6.80e-7
	Construction	A5	3.20e-2	1.61e-1	2.74e-6
Use stage	Use	B1	0.00e+0	0.00e+0	0.00e+0
	Maintenance	B2	0.00e+0	0.00e+0	0.00e+0
	Repair	B3	0.00e+0	0.00e+0	0.00e+0
	Replacement	B4	1.10e+0	5.53e+0	9.47e-5
	Refurbishment	B5	1.10e+0	5.53e+0	9.47e-5
	Operational energy use	B6	0.00e+0	0.00e+0	0.00e+0
	Operational water use	B7	0.00e+0	0.00e+0	0.00e+0
End of life	Deconstruction, demolition	C1	0.00e+0	0.00e+0	0.00e+0
	Transport	C2	1.39e-4	2.46e-3	8.50e-7
	Waste processing	C3	9.88e-4	6.92e-3	5.18e-6
	Disposal	C4	7.65e-6	1.08e-4	4.82e-8
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-2.63e-1	-2.25e+0	-2.21e-5

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

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing output flows – at end of life									
			CRU	MFR	MER	EE	Biogenic carbon (product)	Biogenic carbon (packaging)
			kg	kg	kg	MJ per energy carrier	kg C	kg C
Product stage	Raw material supply	A1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Transport	A2	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Manufacturing	A3	0.00e+0	2.11e-1	3.10e-11	0.00e+0	0.00e+0	4.18e-4
	Total (of product stage)	A1-3	0.00e+0	2.11e-1	3.10e-11	0.00e+0	0.00e+0	4.18e-4
Construction process stage	Transport	A4	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Construction	A5	0.00e+0	6.32e-3	9.31e-13	0.00e+0	0.00e+0	1.26e-5
Use stage	Use	B1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Maintenance	B2	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Repair	B3	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Replacement	B4	0.00e+0	2.17e-1	3.20e-11	0.00e+0	0.00e+0	4.31e-4
	Refurbishment	B5	0.00e+0	2.17e-1	3.20e-11	0.00e+0	0.00e+0	4.31e-4
	Operational energy use	B6	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Operational water use	B7	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
End of life	Deconstruction, demolition	C1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Transport	C2	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Waste processing	C3	0.00e+0	9.50e-1	0.00e+0	0.00e+0	0.00e+0	0.00e+0
	Disposal	C4	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0
Potential benefits and loads beyond	Reuse, recovery, recycling	D	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0

CRU = Components for reuse;
MFR = Materials for recycling

MER = Materials for energy recovery;
EE = Exported Energy

Scenarios and additional technical information

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
A4 – Transport to the building site	Throughout 2021 Philip Grahame delivered 13384 customer orders by their own fleet of vehicles. The total distance travelled by all vehicles was 546391km. So 40km is the average distance.		
	Diesel/ 16-32 t lorry	t/km	0.3
	Distance:	km	40
	Capacity utilization (incl. empty returns)	%	26
	Weight of transported products	kg / unit	1.0
A5 – Installation in the building	Installation waste is minimal as Philip Grahame have no minimum order quantities and offer a return scheme based on resaleable condition for stock items. Site installations may require cutting and a small amount of site fabrication work to ensure the installation fits the building requirements. Based on this, estimate a maximum of 3% wastage.		
	Installation waste percentage	3%	
Installation waste	Product waste: Steel waste to recycling	kg	0.03
B1 – Use	The steel cable ladder is utilized in electrical infrastructure for supporting armoured cables, and facilitating power distribution in buildings.		
B2 – Maintenance	Regular inspections ensure the ladder remains free from corrosion and physical damage, requiring minimal maintenance due to its durable steel construction.		
B3 – Repair	In case of damage, sections of the ladder can be repaired or replaced as needed, with the steel material allowing for welding or bolting of new sections.		
B4 – Replacement	Given the disparity in life expectancy between the building (60 years) and the cable ladder (30 years), there will inevitably be a need for replacement halfway through the building's lifespan. When the cable ladder reaches the end of its service life or becomes unsuitable for its intended use, a complete replacement is required. Its modular design facilitates straightforward disassembly and replacement, ensuring minimal energy and ancillary consumption.		
	Number of described replacement cycles per study period:	1	
B5 – Refurbishment	While the cable ladder is designed for a 30-year service life, opportunities for refurbishment may arise to address wear and tear or to update parts of the system. However, due to the significant difference in the lifespan of the ladder compared to the building, refurbishment options are limited and focused on short-term solutions. Ultimately, a full replacement will be necessary to align with the building's longer service life, ensuring the continued safety and efficiency of the cable management system.		
	Number of described refurbishments per study period:	1	
B6 – Operational	This module does not directly apply to the passive nature of the steel cable ladder, as it does not consume energy during operation.		
B7 – Operational water use	Similar to energy use, the steel cable ladder does not consume water during its operational phase, making this module not applicable.		

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
Reference service life	The 30 years' service life is derived from the life span of commercial buildings. After 30 years of electrical installation, there may be outdated infrastructure and advances in communications and building use necessitating building refurbishments and rebuilds.		
C1 - Deconstruction	In most cases, the cable ladder will remain in place until the demolition of the building, as it can be conveniently uninstalled when it reaches the end of its lifecycle. The demolition strategy for both the building and the cable ladder will vary significantly from one location to another, influenced by a variety of factors including the method of construction, the local geography. Nonetheless, it is reasonable to infer that the energy required to dismantle the cable ladder, in comparison to the total energy expended on demolition, will be minimal. Consequently, no significant environmental impacts are assigned to module C1. It is assumed 100% of the product is recovered from the deconstruction unit.		
C2 – End of Life transport	50km by road has been modelled for module C2 as a typical distance from the demolition site to factory. However, end-users of the EPD can use this information to calculate the impacts of a bespoke transport distance for module C2 if required.	Litres per km	0.227
	Distance: Deconstruction unit to pre-processing unit	km	50
C3 – Waste Processing	The cable ladder produced by Philip Grahame is made entirely of 100% pre-galvanised steel. At the end of its life cycle, 95% of the steel will be recycled and 5% send to landfilling (BRE PCR EN 15804 + A2 Rev 3.1) Recycling processing has not been included in Module C3 because it is assumed to be very small and effectively negligible.		
	Steel waste to recycling	kg	0.95
C4 - Disposal	5% of steel waste can't be recovered during recycling so they will be ended in landfilling.		
	Steel waste to landfill	kg	0.05
Module D	"Benefits and loads beyond the system boundary (Module D) accounts for the environmental benefits and loads resulting from the steel that is used as a raw material in steel making process via EAF or BOF and that is collected for recycling at end of life. These benefits and loads are calculated by excluding the pre-existing recycled steel that is used in the primary process. 1 kg of product at the end of life, becomes 0.95 kg of scrap steel and as a small percentage will have lost due to wear, this 95% of the product will be recycled. In order to calculate the benefits of the product at Module D, the pre-existing recycled content will be excluded, and the benefits will be calculated for virgin steel. According to the ecoinvent 3.8 database, hot-dipped galvanized steel sheet already includes 19% recycled material. Therefore, only 81% of the virgin material can be considered as Benefits and Loads Beyond the System Boundary. Consequently, 77% (81% * 95%) of the steel per unit will be recycled.		

Interpretation

Individual product calculations

The LCA results listed in the table above are for Philip Grahame processing of 1 kg of horizontal/vertical pre-galvanized steel cable ladder. The end-user of this EPD can therefore use these results to calculate impact profile for each Philip Grahame's products listed in the tables below. The LCA results for each EN 15804 indicator will need to be multiplied by the weight of the respective product:

Product Code	Sidewall weight(kg)	Rung weight (kg)	Product weight (kg)
L4L/150/G	5.67	0.23	13.62
L4L/300/G	5.67	0.44	15.77
L4L/450/G	5.67	0.66	17.92
L4L/600/G	5.67	0.87	20.07
L4L/750/G	5.67	1.09	22.22
L4L/900/G	5.67	1.30	24.36
L5L/150/G	9.33	0.23	20.94
L5L/300/G	9.33	0.44	23.09
L5L/450/G	9.33	0.66	25.24
L5L/600/G	9.33	0.87	27.39
L5L/750/G	9.33	1.09	29.54
L5L/900/G	9.33	1.30	31.68
L6L/150/G	10.51	0.23	23.30
L6L/300/G	10.51	0.44	25.45
L6L/450/G	10.51	0.66	27.60
L6L/600/G	10.51	0.87	29.75
L6L/750/G	10.51	1.09	31.90
L6L/900/G	10.51	1.30	34.04

Example Calculation:

If the customer wants to use the L4L/150/G product, by multiplying the weight 13.62kg, by the impacts e.g. GWP Total = 3.11e+0 x 13.62 = 42.36 kg CO2 equivalent for L4L/150/G product. Please see the table below for the results of the L4L/150/G product.

Parameters describing environmental impacts			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CFC11 eq	mol H^+ eq	kg $(PO_4)^{3-}$ eq
Product stage	Raw material supply	A1	4.09E+01	4.07E+01	1.62E-01	3.87E-02	2.32E-06	5.35E-01	1.97E-02
	Transport	A2	4.19E-01	4.19E-01	3.57E-04	1.65E-04	9.70E-08	1.70E-03	2.70E-05
	Manufacturing	A3	1.03E+00	1.00E+00	2.27E-02	7.29E-04	1.42E-07	6.80E-03	9.72E-05
	Total (of product stage)	A1-3	4.24E+01	4.21E+01	1.84E-01	3.95E-02	2.55E-06	5.43E-01	1.99E-02

References

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