# Statement of Verification

BREG EN EPD No.: 000592 Issue 01

This is to verify that the

**Environmental Product Declaration**

provided by:

CCL Stressing 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 Post-tensioning Unbonded Strand System

## Company Address

CCL Stressing International
Unit 8,
Millennium Drive,
Leeds,
LS11 5BP

| | | |
|---|---|---|
| Signed for BRE Global Ltd | Emma Baker<br>Operator | 27 June 2024<br>Date of this Issue |
| 27 June 2024<br>Date of First Issue | | 26 June 2029<br>Expiry Date |



# Environmental Product Declaration

## EPD Number: 000592

## General Information

| EPD Programme Operator | Applicable Product Category Rules |
|---|---|
| BRE Global<br>Watford, Herts<br>WD25 9XX<br>United Kingdom | BRE Environmental Profiles Product Category Rules for Type III environmental product declaration of construction products to EN 15804+A2 PN 514 Rev 3.1 |
| **Commissioner of LCA study** | **LCA consultant/Tool** |
| CCL Stressing International<br>Unit 8,<br>Millennium Drive,<br>Leeds,<br>LS11 5BP | LCA Consultant: Bala Subramanian<br>LCA Tool: BRE LINA A2 |
| **Declared/Functional Unit** | **Applicability/Coverage** |
| 1 kg of Post-tensioning Unbonded Strand System | Other (please specify). Product Specific |
| **EPD Type** | **Background database** |
| Cradle to Gate with Module C and D | 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<br>☐Internal ☒ External |
| (Where appropriate [b])Third party verifier:<br>Pat Hermon |
| a: Product category rules<br>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+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(s)

CCL USA,
8296 Sherwick Ct,
Jessup,
MD USA

# Construction Product:

## Product Description

Post-tensioning Unbonded Single Strand Tendons are manufactured at CCL's PTI-certified manufacturing facility. The unbonded (greased and sheathed) strands are manufactured from uncoated (bare) 7-wire prestressing steel strands which are then coated with grease and encased in plastic sheathing through extrusion process meeting PTI M10.2 to form unbonded strands.

The unbonded strands are then cut to length and attached with post-tensioning anchors typically on each end, then labelled and shipped to site.

The Post-tensioning Unbonded Single Strand Tendon is used in elevated slabs, ground slabs, and bridge deck construction. They are used in buildings, containment, and civil structures, as well as remedial applications. They cover 13 mm (0.5 in) and 15 mm (0.6 in) nominal diameter strands, as well as other strand sizes.

## Technical Information

| Property |
|---|
| Uncoated (bare) 7-wire prestressing steel shall conform to A416/A416M (or equivalent for non-US usage). Plastic, colour pigment and grease specifications conform to PTI M10.2 "Specification for Unbonded Single Strand Tendons" and ACI 423.7 "Specification for Unbonded Single-Strand Tendon Materials" (or equivalent for non-US usage). The plastic sheathing thickness shall be 0.50 mil to 0.05 mi (1.25mm). |

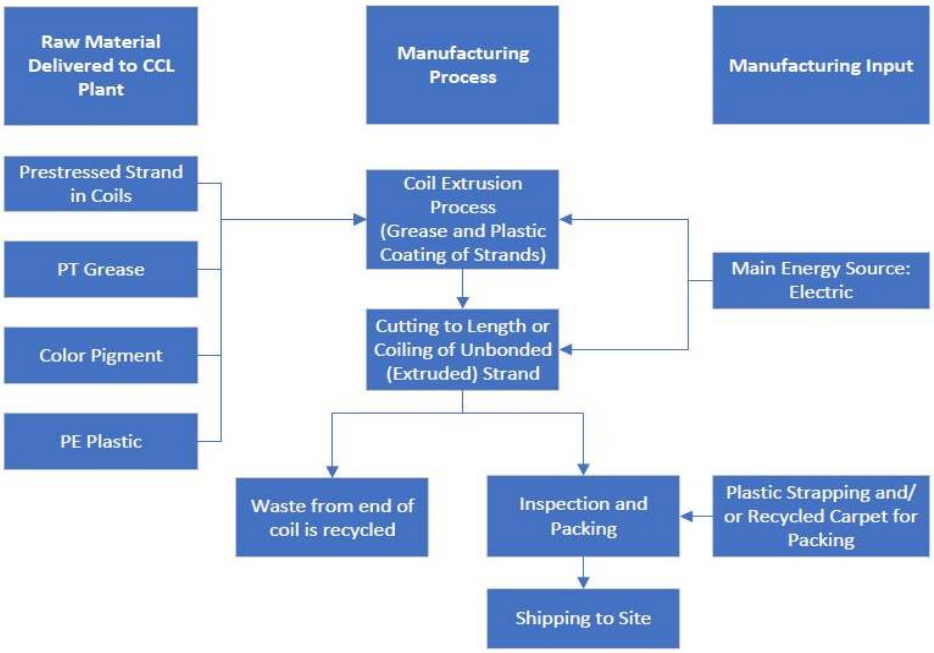
## Main Product Contents

| Material Input | % |
|---|---|
| Steel with the recycled content of 50.2% | 85-90 |
| Polyethylene | 5-10 |
| Grease | 0-5 |

## Manufacturing Process

Post-Tensioning unbonded single strand tendons consist of prestressing steel strand covered with PT coating and encased in continuous plastic sheathing with anchorages at each end as required. The unbonded single strands are manufactured from uncoated (bare) 7-wire steel strands purchased by CCL. The strands are then grease coated and encased in plastic sheathing at CCL's plant through an extrusion process. They are cut to specified lengths, fitted with post-tensioning anchors at each end, packed in a bundle and labelled and then shipped to site. Depending on their final use, the post-tensioning anchors on either end may be attached on site or at the plant. The extrusion process and fabrication of tendons are done at CCL's PTI certified plant (The PTI certificates are renewed yearly and can be found on CCL website)

## Process flow diagram




## End of Life

The end-of-life stage starts when the construction product is replaced, dismantled, or deconstructed from the building or construction work and does not provide any further function. Deconstruction will happen for the entire building by using power tools, so while comparing the energy used to deconstruct the building and the quantity used to remove the post-tensioning unbonded single strand tendons, which is very small, it is negligible. The recovered steel is transported for recycling, while a small portion is assumed to be unrecoverable and remains in the rubble, which is sent to landfills (BRE PCR 3.1).

# Life Cycle Assessment Calculation Rules

## Declared / Functional unit description.

1 kg of Post-tensioning Unbonded Strand System

## System boundary

This is a cradle-to-gate with modules C and D LCA, reporting all production life cycle stages of modules A1 to A3 and end of life stages C1-C4, and D in accordance with EN 15804:2012+A2:2019 and BRE 2021 Product Category Rules (PN 514 Rev 3.1).

## Data sources, quality and allocation

The datasets are derived from Ecoinvent v3.8, and the LCA tool used was BRE LINA A2. The quantity used in the data collection for this EPD is therefore a total production data of Post-tensioning Unbonded Strand System produced during the data collection period (01/01/22-31/12/22) manufactured at CCL USA.

CCL receives the steel from the third-party supplier, which has the post-consumer recycled content of 50.2%, therefore the Ecoinvent dataset was adjusted to match the supplier specs for recycled content (post-consumer). CCL manufactures other products along with the Post-tensioning Unbonded Strand System therefore allocation of fuel consumption, water consumption & discharge, and waste emissions was required, and this has been done according to the provisions of the BRE PCR PN514 and EN 15804.The original data collection form has

been used while doing an LCA analysis, there was no uplift in the given data. Electricity consumption was determined by measuring the consumption on the manufacturing site for all production lines and weighted proportionally by production of the PT Strands. The consumption of water is calculated based on the factual consumption. The manufacturer has confirmed that there are no packaging materials used during the data collection period.

| ISO14044 guidance. **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). | n/a |
| Very Good | n/a | n/a | There is approximately 1-2 years between the Ecoinvent LCI reference year, and the time period for which the LCA was undertaken. |

The original data collection form has been used while doing an LCA analysis, there was a no uplift in the given data. Specific European datasets have been selected from the ecoinvent LCI for this LCA. Manufacturer uses the national grid electricity and natural gas for production, so therefore the most recent US consumption mix has been used for the LCA modelling (Ecoinvent 3.8). The GWP carbon footprint for using 1 kWh of electricity, US kWh is 0.1417 in kgCO2e/kWh and the GWP of 1kWh of Natural gas, at industrial furnace is 0.2564 kgCO2e/kWh. The quality level of time representativeness is also Very Good as the background LCI datasets are based on ecoinvent v3.8 which was compiled in 2021. 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 inputs or outputs have been included and all raw materials, packaging and transport, energy, water use and wastes, are included, except for direct emissions to air, water and soil, which are not measured. Upstream extraction and/or processing of inputs are included within the use of the background datasets within LINA.

## 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 | 9.79E-01 | 9.80E-01 | -1.69E-03 | 5.31E-04 | 7.50E-08 | 4.02E-03 | 3.19E-04 |
| | Transport | A2 | 1.14E-01 | 1.14E-01 | 4.01E-05 | 6.47E-05 | 2.45E-08 | 2.14E-03 | 5.49E-06 |
| | Manufacturing | A3 | 3.04E-02 | 3.02E-02 | 1.42E-04 | 1.06E-05 | 2.36E-09 | 8.10E-05 | 1.73E-05 |
| | Total | A1-3 | 1.12E+00 | 1.12E+00 | -1.51E-03 | 6.07E-04 | 1.02E-07 | 6.24E-03 | 3.42E-04 |
| Construction process stage | Transport | A4 | MND | MND | MND | MND | MND | MND | MND |
| | Construction | A5 | MND | MND | MND | MND | MND | MND | MND |
| Use stage | Use | B1 | MND | MND | MND | MND | MND | MND | MND |
| | Maintenance | B2 | MND | MND | MND | MND | MND | MND | MND |
| | Repair | B3 | MND | MND | MND | MND | MND | MND | MND |
| | Replacement | B4 | MND | MND | MND | MND | MND | MND | MND |
| | Refurbishment | B5 | MND | MND | MND | MND | MND | MND | MND |
| | Operational energy use | B6 | MND | MND | MND | MND | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND | MND | MND | MND | MND |
| **88% Recycled & 12% Landfill** | | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 8.32E-03 | 8.31E-03 | 7.08E-06 | 3.26E-06 | 1.92E-09 | 3.37E-05 | 5.35E-07 |
| | Waste processing | C3 | 4.87E-02 | 4.86E-02 | 1.72E-05 | 4.85E-06 | 1.04E-08 | 5.05E-04 | 1.51E-06 |
| | Disposal | C4 | 8.87E-03 | 8.86E-03 | 8.77E-06 | 1.49E-06 | 4.47E-10 | 1.25E-05 | 2.67E-07 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -7.09E-01 | -7.11E-01 | 2.23E-03 | -2.01E-04 | -2.84E-08 | -2.58E-03 | -2.81E-04 |

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 | 8.97E-04 | 9.41E-03 | 5.75E-03 | 3.76E-06 | 1.56E+01 | 1.65E-01 | 7.01E-08 |
| | Transport | A2 | 5.38E-04 | 5.96E-03 | 1.58E-03 | 2.73E-07 | 1.59E+00 | 5.54E-03 | 6.61E-09 |
| | Manufacturing | A3 | 1.80E-05 | 1.39E-04 | 4.31E-05 | 4.10E-08 | 5.04E-01 | 6.12E-03 | 4.68E-10 |
| | Total | A1-3 | 1.45E-03 | 1.55E-02 | 7.37E-03 | 4.07E-06 | 1.77E+01 | 1.77E-01 | 7.72E-08 |
| Construction process stage | Transport | A4 | MND | MND | MND | MND | MND | MND | MND |
| | Construction | A5 | MND | MND | MND | MND | MND | MND | MND |
| Use stage | Use | B1 | MND | MND | MND | MND | MND | MND | MND |
| | Maintenance | B2 | MND | MND | MND | MND | MND | MND | MND |
| | Repair | B3 | MND | MND | MND | MND | MND | MND | MND |
| | Replacement | B4 | MND | MND | MND | MND | MND | MND | MND |
| | Refurbishment | B5 | MND | MND | MND | MND | MND | MND | MND |
| | Operational energy use | B6 | MND | MND | MND | MND | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND | MND | MND | MND | MND |
| **88% Recycled & 12% Landfill** | | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 1.02E-05 | 1.11E-04 | 3.40E-05 | 2.89E-08 | 1.26E-01 | 5.65E-04 | 7.17E-10 |
| | Waste processing | C3 | 2.24E-04 | 2.45E-03 | 6.74E-04 | 2.50E-08 | 6.67E-01 | 1.54E-03 | 1.35E-08 |
| | Disposal | C4 | 1.52E-04 | 4.59E-05 | 1.50E-05 | 4.51E-09 | 3.43E-02 | 1.53E-03 | 2.42E-10 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -6.12E-04 | -6.50E-03 | -3.57E-03 | -5.36E-07 | -7.19E+00 | -5.10E-02 | -4.76E-08 |

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 | 3.79E-02 | 2.68E+01 | 4.19E-09 | 1.87E-08 | 2.73E+00 |
| | Transport | A2 | 7.70E-03 | 1.11E+00 | 5.66E-11 | 9.83E-10 | 6.76E-01 |
| | Manufacturing | A3 | 8.26E-03 | 3.78E-01 | 9.96E-12 | 1.71E-10 | 6.36E-02 |
| | Total | A1-3 | 5.39E-02 | 2.83E+01 | 4.25E-09 | 1.99E-08 | 3.47E+00 |
| Construction process stage | Transport | A4 | MND | MND | MND | MND | MND |
| | Construction | A5 | MND | MND | MND | MND | MND |
| Use stage | Use | B1 | MND | MND | MND | MND | MND |
| | Maintenance | B2 | MND | MND | MND | MND | MND |
| | Repair | B3 | MND | MND | MND | MND | MND |
| | Replacement | B4 | MND | MND | MND | MND | MND |
| | Refurbishment | B5 | MND | MND | MND | MND | MND |
| | Operational energy use | B6 | MND | MND | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND | MND | MND |
| **88% Recycled & 12% Landfill** | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 6.46E-04 | 9.81E-02 | 3.18E-12 | 1.03E-10 | 8.63E-02 |
| | Waste processing | C3 | 3.01E-03 | 3.90E-01 | 1.51E-11 | 2.83E-10 | 8.50E-02 |
| | Disposal | C4 | 1.63E-04 | 4.86E-02 | 1.01E-12 | 2.33E-11 | 7.89E-02 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -1.27E-02 | -2.13E+01 | -3.80E-09 | -1.46E-08 | -1.40E+00 |

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 | 1.43E-01 | 0.00E+00 | 1.43E-01 | 1.05E+01 | 4.70E+00 | 1.52E+01 |
| | Transport | A2 | 1.69E-02 | 0.00E+00 | 1.69E-02 | 1.56E+00 | 0.00E+00 | 1.56E+00 |
| | Manufacturing | A3 | 1.01E-03 | 0.00E+00 | 1.01E-03 | 1.27E-01 | 1.00E-04 | 1.27E-01 |
| | Total | A1-3 | 1.61E-01 | 0.00E+00 | 1.61E-01 | 1.22E+01 | 4.70E+00 | 1.69E+01 |
| Construction process stage | Transport | A4 | MND | MND | MND | MND | MND | MND |
| | Construction | A5 | MND | MND | MND | MND | MND | MND |
| Use stage | Use | B1 | MND | MND | MND | MND | MND | MND |
| | Maintenance | B2 | MND | MND | MND | MND | MND | MND |
| | Repair | B3 | MND | MND | MND | MND | MND | MND |
| | Replacement | B4 | MND | MND | MND | MND | MND | MND |
| | Refurbishment | B5 | MND | MND | MND | MND | MND | MND |
| | Operational energy use | B6 | MND | MND | MND | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND | MND | MND | MND |
| **88% Recycled & 12% Landfill** | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 1.77E-03 | 0.00E+00 | 1.77E-03 | 1.23E-01 | 0.00E+00 | 1.23E-01 |
| | Waste processing | C3 | 3.74E-03 | 0.00E+00 | 3.74E-03 | 6.54E-01 | 0.00E+00 | 6.54E-01 |
| | Disposal | C4 | 4.22E-04 | 0.00E+00 | 4.22E-04 | -2.13E+00 | 2.16E+00 | 2.40E-02 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -2.49E-01 | 0.00E+00 | -2.49E-01 | -7.06E+00 | 0.00E+00 | -7.06E+00 |

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 | 3.96E-04 | 0.00E+00 | 0.00E+00 | 3.95E-03 |
| | Transport | A2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.37E-04 |
| | Manufacturing | A3 | 7.48E-05 | 0.00E+00 | 0.00E+00 | 1.57E-04 |
| | Total (Consumption grid) | A1-3 | 4.70E-04 | 0.00E+00 | 0.00E+00 | 4.24E-03 |
| Construction process stage | Transport | A4 | MND | MND | MND | MND |
| | Construction | A5 | MND | MND | MND | MND |
| Use stage | Use | B1 | MND | MND | MND | MND |
| | Maintenance | B2 | MND | MND | MND | MND |
| | Repair | B3 | MND | MND | MND | MND |
| | Replacement | B4 | MND | MND | MND | MND |
| | Refurbishment | B5 | MND | MND | MND | MND |
| | Operational energy use | B6 | MND | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND | MND |
| **88% Recycled & 12% Landfill** | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.40E-05 |
| | Waste processing | C3 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 3.81E-05 |
| | Disposal | C4 | 1.33E-06 | 0.00E+00 | 0.00E+00 | 3.60E-05 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 0.00E+00 | 0.00E+00 | 0.00E+00 | -1.24E-03 |

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 | 6.98E-02 | 1.49E+00 | 2.87E-05 |
| | Transport | A2 | 1.93E-03 | 2.46E-02 | 1.09E-05 |
| | Manufacturing | A3 | 1.27E-04 | 1.50E-03 | 9.71E-08 |
| | Total (Consumption grid) | A1-3 | 7.18E-02 | 1.51E+00 | 3.97E-05 |
| Construction process stage | Transport | A4 | MND | MND | MND |
| | Construction | A5 | MND | MND | MND |
| Use stage | Use | B1 | MND | MND | MND |
| | Maintenance | B2 | MND | MND | MND |
| | Repair | B3 | MND | MND | MND |
| | Replacement | B4 | MND | MND | MND |
| | Refurbishment | B5 | MND | MND | MND |
| | Operational energy use | B6 | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND |
| **88% Recycled & 12% Landfill** | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 1.39E-04 | 2.46E-03 | 8.50E-07 |
| | Waste processing | C3 | 8.79E-04 | 6.15E-03 | 4.61E-06 |
| | Disposal | C4 | 4.44E-05 | 7.08E-02 | 1.47E-07 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -1.40E-01 | -1.31E+00 | -1.24E-05 |

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+00 | 7.97E-06 | 2.46E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | A2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Manufacturing | A3 | 0.00E+00 | 1.48E-03 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Total (Consumption grid) | A1-3 | 0.00E+00 | 1.49E-03 | 2.46E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Construction process stage | Transport | A4 | MND | MND | MND | MND | MND | MND |
| | Construction | A5 | MND | MND | MND | MND | MND | MND |
| Use stage | Use | B1 | MND | MND | MND | MND | MND | MND |
| | Maintenance | B2 | MND | MND | MND | MND | MND | MND |
| | Repair | B3 | MND | MND | MND | MND | MND | MND |
| | Replacement | B4 | MND | MND | MND | MND | MND | MND |
| | Refurbishment | B5 | MND | MND | MND | MND | MND | MND |
| | Operational energy use | B6 | MND | MND | MND | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND | MND | MND | MND |
| **88% Recycled & 12% Landfill** | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Waste processing | C3 | 0.00E+00 | 8.45E-01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Disposal | C4 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

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 |
| C1 – Deconstruction | The end-of-life stage starts when the construction product is replaced, dismantled, or deconstructed from the building or construction work and does not provide any further function. Deconstruction will happen for the entire building by using power tools, so while comparing the energy used to deconstruct the building and the quantity used to remove the PT strand tendons, which is very small, it is negligible. The recovered steel is transported for recycling, while a small portion is assumed to be unrecoverable and remains in the rubble, which is sent to landfills. | | |
| C2- Transportation | 50km by road has been modelled for module C2 as a typical distance from the demolition site to the disposal unit. However, end-users of the EPD can use this information to calculate the impacts of a bespoke transport distance for module C2 if required. | | |
| | Fuel type / Vehicle type | Road transport | 16–32-ton lorry |
| | Deconstruction site to the disposal unit | km | 50 |
| C3 – Preprocessing | PT strand tendons are made up of 89% of steel and remaining 11% of PE and Grease and it is assumed to remain uncollected or to go to disposal e.g., landfill. Regarding the steel, in 0.89kg of the steel 95% will be recycled and 5% will be considered as a natural loss during the recycling process and it will be sent to landfill (according to BRE PCR 3.1). The energy used for the processing the recovered steel is not included in module C3, it is assumed to be very small and effectively negligible. | | |
| | Recovered PT strand tendons to recycling | Kg | 0.845 |
| C4 – Disposal | Some of the plastic, grease, and steel are unrecovered, and they will end up in landfills. | | |
| | Unrecovered Plastic and grease waste to Landfill | Kg | 0.11 |
| | Unrecovered Steel waste during the recycling to landfill | Kg | 0.044 |
| Module D | “Benefits and loads beyond the system boundary” (module D) accounts for the environmental benefits and loads resulting from Iron and steel that is used as raw material in the 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.<br><br>In the pre-processing stage, 0.845 kg of recovered steel is recycled, initially which is a mix of scrap steel (50.2%) and virgin steel (49.8%). In order to calculate the benefits of the product at Module D, the pre-existing content of scrap steel in the recovered steel waste should be excluded from 0.845 kg, i.e., 0.424 kg of pre-existing content should be avoided and only 0.421 kg of virgin steel should be considered in Module D.<br><br>In line with this, 0.421 kg of virgin steel recovered from the demolition sites can be used to offset the impacts of 0.421 kg of virgin steel material in A1, and it is assumed that there is a 100% recycling yield from the recycling process. | | |

## Interpretation of results:

Post-Tensioning unbonded single strand tendons are composed of 85-90% steel, with the remaining 10% consisting of polyethylene and grease. Consequently, the bulk of the environmental impacts and primary energy demand are attributed to the upstream manufacturing process of the PT strand tendons. This is covered by information modules A1-A3 of EN15804:2012+A2:2019.

# References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ASTM A416/A416M-18 - Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete

PTI M10.2-17 Specification for Unbonded Single Strand Tendons

ACI SPEC-423.7-14 Specification for Unbonded Single-Strand Tendon Materials

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