Architectural & Structural
Precast Association (ASPA)
The Old Rectory, Main Street
Glenfield, Leicester. LE3 8DG

UNDERSTANDING THE CRADLE-TO-GRAVE CARBON FOOTPRINT OF NON-LOADBEARING RECONSTRUCTED PORTLAND STONE CLADDING

INTRODUCTION

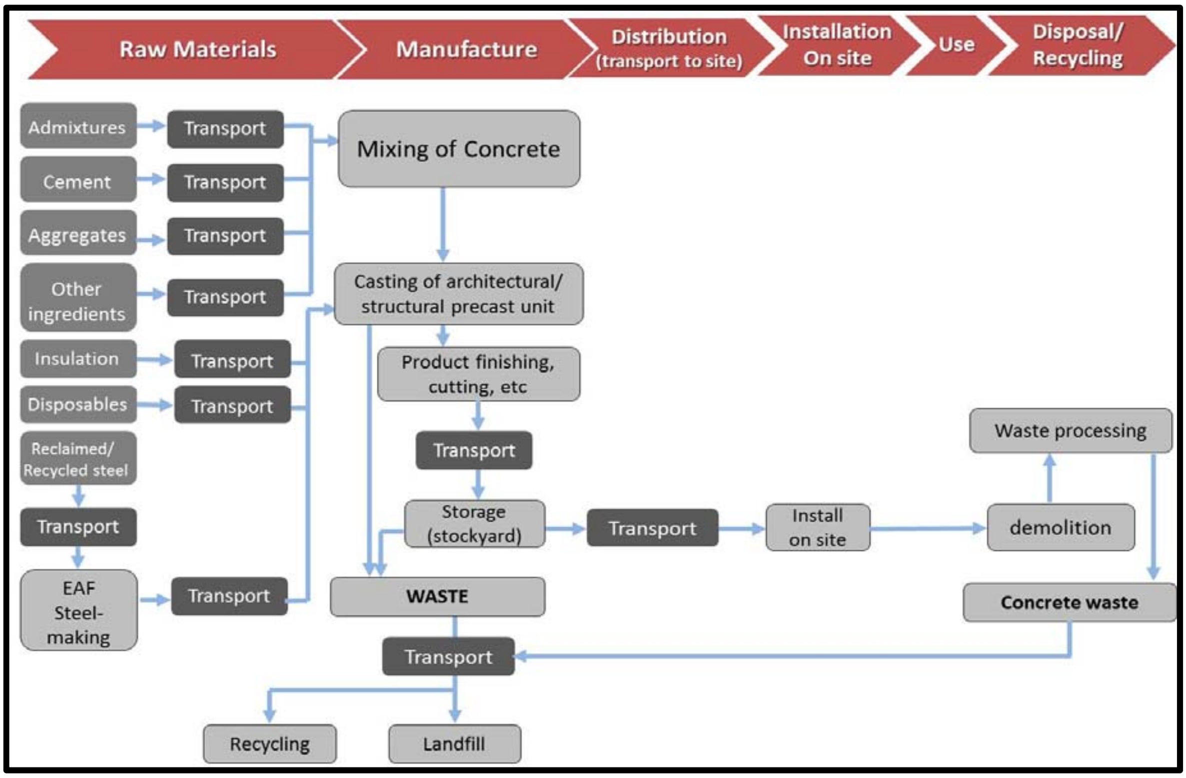
This factsheet offers an estimate of the **Cradle-to-Grave** Carbon Footprint of: Non-loadbearing reconstructed Portland stone cladding as manufactured by members of the Architectural & Structural Precast Association (ASPA). Data from a number of member companies was collected as part of British Precast's annual Sustainability Charter scheme and from the upstream of the supply chain. This data was used to calculate a carbon footprint which accounts for all the main carbon "hot spots" of the manufacture of:

- $1m^2$ of a reconstructed Portland Stone cladding wall (with insulation).

The Carbon Footprint for a single leaf unit was found to be around **132.75 kg CO_2e/ m^2**.

The methodology used was broadly based on the provisions of PAS 2050: 2011.

The Cradle-to-Grave carbon footprint accounts for life cycle stages A1, A2, A3, A4, A5, C1, C2, C3, and C4 as defined in EN 15804 and ISO 21930. Stages B1-B5 are expected to have minimal effect on the overall Lifecycle EPD (as explained below) nearing 'ZERO' at $1m^2$ of Declared Unit level. More information on the methodology is offered below:



Different "unit processes" associated with the Cradle-to-Grave service life of architectural/ structural precast units.

Architectural & Structural
Precast Association (ASPA)
The Old Rectory, Main Street,
Glenfield, LE3 8DG

GENERAL DESCRIPTION

Description of Declared Unit

- 1 m^2 of reconstructed Portland stone cladding unit, with insulation and plasterboard internal soffit

  Units are manufactured to Eurocodes requirements with an expected lifecycle equal to the life of the building in which it is installed (50 to 100 years).

Scope

The applicability of this factsheet is restricted to architectural precast concrete produced by members of ASPA.

Reference Year

Data was collected from 2013 production

Primary data used has been provided as part of the British Precast Sustainability Charter scheme.

Life Cycle stages included

Cradle-to-Grave
(A1, A2, A3, A4, A5, B1, B2, B3, B4, B5, C1, C2, C3, C4)

Footprinting methodology used

The methodology used was broadly based on the provisions of PAS 2050: 2011.

PRODUCT

Product description
Precast concrete is composed mainly of water, aggregate and cement. Admixtures and reinforcement may also be needed for different manufacturing or product physical or structural purposes. Architectural precast includes architectural cladding and sandwich panels with re-constructed stone, brick-facing or cast stone finishing. Production of specific types of architectural precast requires a wider range of materials than grey concrete (such as white cement, dolomite aggregates, or etching acid) and can be slightly more labour/energy intensive.

Precast concrete mix proportions:
Course aggregates: 39%, Fine aggregates: 37%, White cement: 18%, Water: 6%.

Technical Data

- Concrete is manufactured in accordance with BS 8500 and EN206.
- Precast cladding is manufactured in accordance with BS 8297/ BS 8298 and/ or EN 14992.

Ancillary materials
No “REACH” materials included.

Reference service life
Architectural cladding is designed to last throughout the duration of the building, with an estimated service life exceeding **100 years**.

U Value (for architectural cladding)
0.15 - 0.18 W/m^{2}K.

Declared Unit

1m^2 recon Portland stone cladding	value	unit
Precast concrete	0.35	t/m^2
Reinforcement steel	0.0175	t/m^2
Etching acid (HCl solution)	0.0002	t/m^2
100mm Kingspan insulation	1	m^2
Plasterboard/ battens	0.008	t/m^2

Architectural & Structural
Precast Association (ASPA)
The Old Rectory, Main Street,
Glenfield, LE3 8DG

METHODOLOGY & CALCULATION RULES

System boundary

Cradle-to-Grave stages (Modules A1- C4) include:

- Processes that provide materials and energy input for the system. Including extraction and production of raw materials (e.g. cement, aggregates), water, reinforcement, admixtures, fuels and energy used in manufacture and transport to precast factory.
- Manufacture: Including casting, curing, finishing and handling of precast units inside the precast factory. Any factory waste handling or processing.
- Transport to construction site.
- Installation at construction site.
- Use, maintenance of products
- End-of-Life: demolition and processing of product waste.

Comparability

- Basically, a comparison or an evaluation of carbon footprinting data is only applicable if all the data sets to be compared were created according to the same standard and the building context, respectively the product-specific characteristics of performance (e.g. service life), are taken into account.

Methodological Rules and Assumptions

- PAS 2050 requires that the owner of the Carbon Footprint has control over 10% of the overall emissions, with other emissions estimated from reliable secondary data sources.
- Secondary data was used to estimate the upstream impacts of cement, aggregates, reinforcement steel, thermal insulation and water. Impacts of ancillary materials and waste processing were also obtained from secondary sources.
- Some minor impacts (such as the impact of mastic sealant strips for architectural cladding) were cut off the assessment.
- Impacts from cleaning (water jetting) of cladding units and one-off polishing during service life (Module B5) were cut-off due to minimal contribution per Declared Unit.
- Section 5 of PAS 2050 notes that assessments "*shall include the GHG emissions and removals… occurring during the* 100 *years period following the formation of the product*". Therefore, any temporary emissions negated later by carbonation (even if occurring years after the end-of-life) are removed.
- Cut off impact are accounted for by multiplying the impacts calculated by 1.01 in line with the requirements of Clause 3.33 of PAS 2050.
- Apart from steel reinforcement, white cement and some fine aggregates, all raw materials used in the architectural concrete are believed to be manufactured and sourced from local producers.
- Most aggregate is assumed to have been sourced from a quarry 43.3 km away from the precast manufacturing site. For all other raw materials/ components a 100 km sourcing distance is assumed.
- White Cement and dolomite aggregates assumed to be imported from Europe.
- The concrete waste proportion used is 6.6% of total factory production. This was directly sourced from British Precast members' KPIs where 90% of all waste generated was assumed to be concrete waste.
- Data for Transport-to-Site distance and truckload capacities was collected directly from British Precast member companies.
- Assumptions for carbon emissions during Stages A5, B1 to B5, and C1 to C4 were sourced from secondary sources (a number of cement, plasterboard and concrete industry LCA studies).
- At the building/ structure Use Stage (Module B), it is assumed that no maintenance is needed for the concrete to continue to perform its function.
- At the End-of-Life Stage (Modules C1 to C4), it is assumed that all precast concrete products are demolished. All concrete will be recycled and sorted and around 90% will be reused in other applications (e.g. hardcore for new roads, piling matt within the same construction site). A very small amount will end up in landfill.

Architectural & Structural
Precast Association (ASPA)
The Old Rectory, Main Street,
Glenfield, LE3 8DG

CARBON FOOTPRINT/ LCA RESULTS (Cradle-to-Grave)

	A1-A3	A4	A5	B1-5	C1	C2	C3	C4
	Product stage	Transport	Installation	Use Stage	Demolition	Waste Transport	Waste Processing	Waste Disposal
1 m^2 of Reconstructed Portland stone cladding unit with insulation & plasterboard (kg CO_2/m^2)	128.47	3.16	0.221	0	0.49	0.08	0.23	0.1

CARBON FOOTPRINT/ LCA RESULTS (kg CO2/DU per year of service)

1 m^2 of Reconstructed Portland stone cladding unit with insulation & plasterboard (kg CO_2/m^2)	1.28	0.03	0	0	0.01	0	0	0

REFERENCES

- **BRE** (2013) BRE Environmental Profiles 2013: Product Category Rules for Type III environmental product declaration of construction products to EN 15804:2012 – Final Version.
- **BRE** (2007) Environmental Profiles of aggregates. Cited by Hammond & Jones (2011).
- **BSI** (2011) PAS 2050: Specification for the assessment of the life cycle greenhouse gas emissions of goods and services.
- **Defra** (2013) UK Government conversion factors for Company Reporting. Link: www.carbonfootprint.com/docs/dcfcarbonfactors_2013.xls
- **Hammond, G; Jones, C** (2011) *Embodied Carbon: The Inventory of Carbon and Energy (ICE)*. BSRIA, 201
- **Institut Bauen und Umwelt e.V.** (2013) UMWELT-PRODUKTDEKLARATION. Beton der Druckfestigkeitsklasse C45/55. InformationsZentrum Beton GmbH. Link: https://www.beton.org/fileadmin/beton-org/media/Wissen/Nachhaltigkeit/EPD_IZB_2013411_C45_55_D.pdf
- **MPA** (2012) *MPA Factsheet 18:* Embodied CO2e of UK cement, additions and cementitious materials. Mineral Products Association Ltd, 2012
- **MPA** (2011) Transport. Webpage at MPA Website Link (06.05.2014, at 16:07): http://www.mineralproducts.org/sustainability/transport.html
- **MPA** (2010) Reinforcement. Webpage at MPA Website. Link (06.05.2014, at 16:07): http://www.sustainableconcrete.org.uk/top_nav/what_is_concrete/reinforcement.aspx
- **UL** (2015) Product Category Rules (PCR) for Preparing an Environmental Product Declaration for Product Group – *Cladding System Products (draft)*. UL, 2015. Link (22.05.2015, at 16:04): http://industries.ul.com/wp-content/uploads/sites/2/2014/09/PCR_Cladding_v5.pdf