Architectural & Structural
Precast Association (ASPA)
The Old Rectory, Main Street
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UNDERSTANDING THE CRADLE-TO-GRAVE CARBON FOOTPRINT OF STRUCTURAL PRECAST CONCRETE PRODUCTS

INTRODUCTION

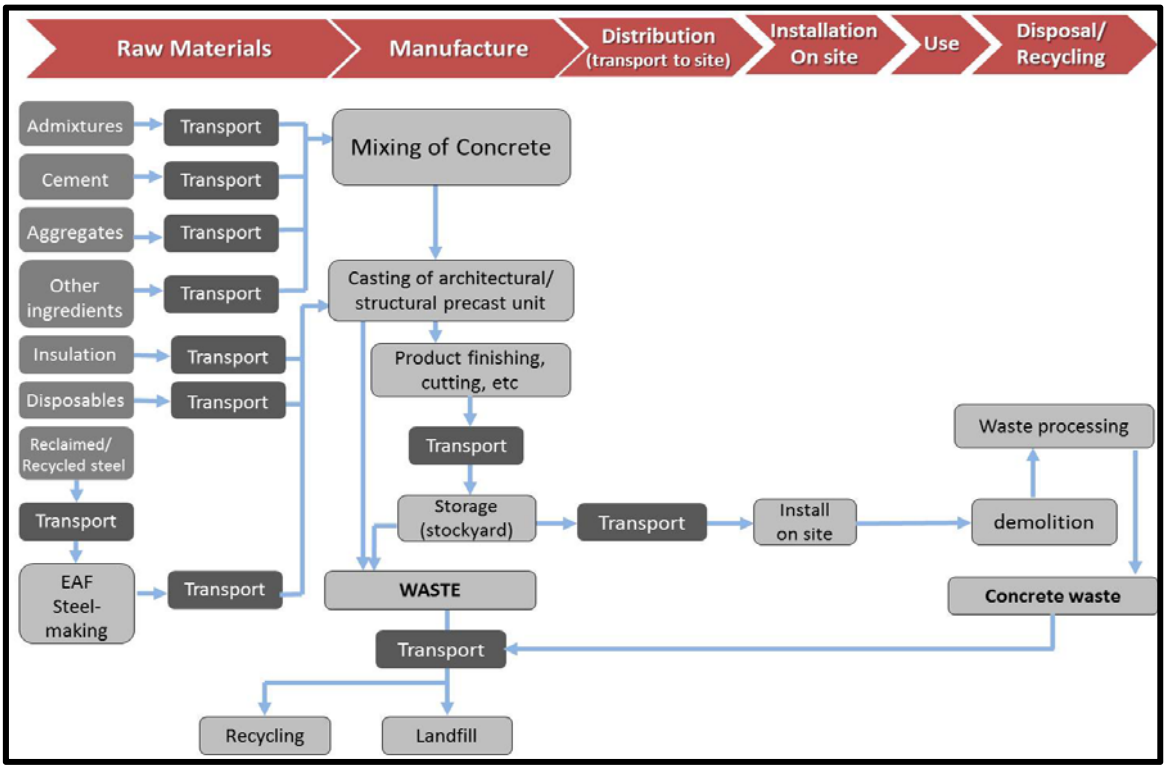
This factsheet offers an estimate of the **Cradle-to-Grave** carbon footprint of concrete used in the manufacture of structural precast products by members of the Architectural and Structural Precast Association (ASPA). Data from a number of member companies, collected as part of British Precast's annual Sustainability Charter scheme, and from the upstream of the supply chain, was used to calculate a carbon footprint which accounts for all the main emission "hot spots" of the manufacture of:

- 1 metric tonne of factory made generic structural precast concrete (with reinforcement).

The Cradle-to-Grave carbon footprint of structural reinforced precast concrete was found to be **173.8 kg CO_2e/t**.

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, B1-B5, C1, C2, C3 and C4 as defined in EN 15804 and pr-ISO 21930. Stages B1-B5 are expected to have no effect on the overall lifecycle EPD (as explained below).

More information on the methodology is offered below:



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

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GENERAL DESCRIPTION

Description of Declared Unit

- 1 tonne of reinforced C40/C50 structural precast unit.

  Units are manufactured to Eurocodes requirements with an expected lifecycle equal to the life of the building/ infrastructure in which the structural precast units are used (≥ 100 years).

Scope

The applicability of this factsheet is restricted to precast concrete made by member companies 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)

Foot printing 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. Structural products covered include: sea defences, bridge beams, road barriers, cover slabs, custom made culverts, car park decks, cross walls, staircases, lift shafts and railway sleepers, bespoke structural components, etc.

Precast concrete mix proportions:
Course aggregates: 43%, Fine aggregates: 34.6%, Cement: 16.4%, Water: 6%.

Note: Proportions amended slightly to reflect a realistic structural precast factory mix.

Technical Data

- Concrete is manufactured in accordance with BS 8500 (and EN 206).
- Structural concrete components are designed in accordance with Eurocodes (BS EN 1992) and other specifications.

Ancillary materials
No "REACH" materials included.

Reference service life
Structural precast are designed to last throughout the duration of the building/ structure. Precast concrete products have an estimated service life that can reach over **100 years** *(120 years for infrastructures)*.

Declared Unit

1 tonne structural precast	value	unit
Precast concrete	0.9643	t/t
Reinforcement steel	0.0357	t/t

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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 factories.
- Manufacturing: 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 foot printing 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.
- Primary data was used to estimate the amounts and proportions of coarse aggregates, fine aggregates, cement, water and factory energy used. The averaged mix proportions were amended to reflect a 390 kg/m^3 cement content, which is the amount recommended by ASPA members for most structural precast concrete mixes.
- Secondary data was used to estimate the upstream impacts of cement, aggregates, reinforcement steel and water. Impacts of ancillary materials and waste processing were also obtained from secondary sources.
- Some minor impacts (such as the impact of capital equipment or some factory consumables) were cut off the assessment.
- 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. Calculations were based on carbonation occurring at stages B1, C3 and C4.
- 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, all raw materials used in the production of structural and architectural concrete are believed to be manufactured and sourced from local producers.
- All 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.
- Transport loading for all raw materials was mostly sourced using a combination of DEFRA and DfT conversion factors.
- The concrete waste proportion used is 3% 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.
- For the structural concrete footprint, 3.57% reinforcement content was assumed.
- 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 concrete and reinforcement 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 another application (e.g. hardcore for new roads, piling matt within the same construction site). A very small amount will end up in landfill.

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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
Structural reinforced precast concrete (kg CO_2/ tonne).	162.8	8.11	0.57	0	1.27	0.2	0.58	0.25

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

Structural reinforced precast concrete (kg CO_2/ tonne/ year).	1.63	0.08	0.01	0	0.01	0	0.01	0

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