smithandwallwork engineers

Annual materials and carbon report 2025

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Introduction

Smith and Wallwork is a civil and structural engineering design company based in Cambridge. We carry out the structural design of buildings and the civil engineering aspects associated with those buildings. Our projects range from small private houses through to large building projects. Our largest completed construction project to date, by value, is £40m.

Founded in 2012, we started recording the quantities of structural materials used in our projects from day one. This is our sixth annual report on the materials and carbon used in our projects – more specifically, on the structural materials installed on sites in 2025 and the CO2 emissions associated with the production, fabrication, transport and installation on site of those materials (i.e. stages A1-A5). The methodology used to apportion materials to a date range and the figures used to calculate carbon are explained in this report.

2025 Materials and Carbon

In 2025, Smith and Wallwork had 10No. live construction projects. These projects total 61,937m^2 GIA (of which 13,452m^2 is assumed to have been completed during the period). Of the 10No. projects, 3No. were refurbishment projects involving structural alterations to existing buildings and 7No. were new build and. 6No. of the 10No. building projects were brownfield developments.

10,106 t *(the total tonnage of structural material used on our sites in 2025)*

3,377 tCO2e *(the total emission associated with these structural materials, stages A1-A5)*

Some key statistics from the structural materials used in are provided below. These figures include sub- and super-structure data. Carbon data are for life cycle stages A1-A5:

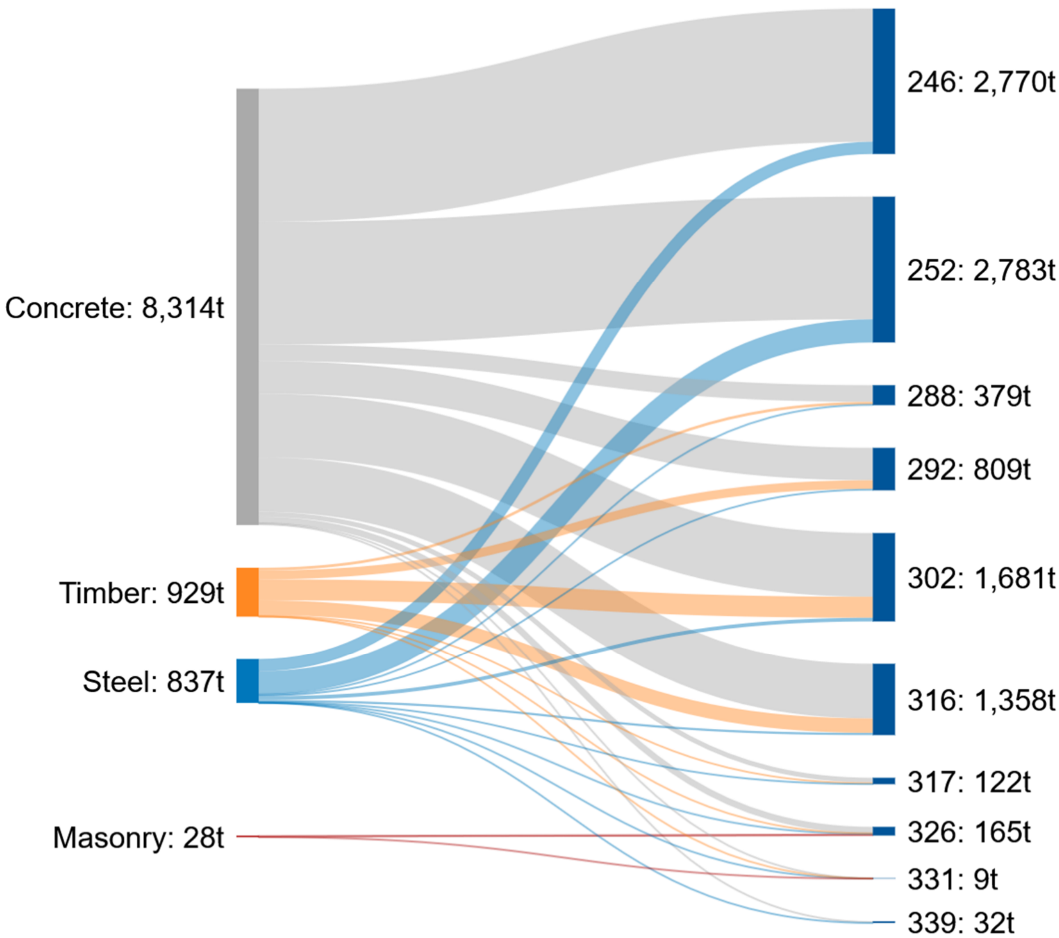
	2025	2024	2023	2022	2021	2020	
Concrete	8,314	2,897	3,362	9,781	13,368	8,250	t
Steel (incl. rebar)	836	128	125	741	899	460	t
Timber	928	735	887	1,142	1,130	914	t
Masonry	28	55	9	93	104	31	t
Erected GIA	13,452	6,510	6,058	12,606	15,061	N/A	m2
Average building mass	751	617	607	911	1,029	1,249	kg/m2
Max building mass	1,428	1,003	1,051	1,610	1,610	2,195	kg/m2
Min building mass	34	34	145	309	309	472	kg/m2
Average CO2	251	160	164	231	249	287	kgCO2e/m2
Max CO2	428	246	258	347	347	514	kgCO2e/m2
Min CO2	6	17	30	54	54	161	kgCO2e/m2

2025 represents a sudden rise in total erected tonnage of material over previous years - this increase is explained by an increase in the number of projects on-site in 2025 (10No. in 2025 vs 6No. in 2024, with many of the latter being refurb). The increase in tonnage and embodied carbon per m2 GIA reflects that the majority of the additional projects are new builds, in addition to the new methodology recommended by the IStructE for calculation of embodied carbon factors in *How to calculate embodied carbon*, 3rd ed. The impact of this new methodology on embodied carbon calculations is explored further later in this document.

Meanwhile, the maintenance of reduced project mass per m2 GIA compared to 2022 – the last year with comparable erected tonnage – is likely due to the increased prevalence of projects involving refurbishment in Smith and Wallwork's portfolio.

Sankey Diagram of 2025 Materials Use

The diagram below is to scale and represents the flow of structural materials to our sites in 2025. The units used are tonnes of structural material. The steel tonnage includes both structural steel and rebar.



Methodology and Data

This section describes the extent of structural materials recording, the assumptions made as to when materials are installed on site and the dataset used in calculating CO2 emissions associated with structural materials.

Structural Materials Recorded

Smith and Wallwork records structural materials for sub-structure and super-structure as set out below. For the annual figures reported, these are either derived from RIBA stage 4 information or, where a building has been completed, a mix of Smith and Wallwork figures in combination with as-built figures given by the various sub-contractors.

	Recorded	Not recorded
Concrete	• Insitu structural concrete • Precast structural concrete	• Blinding concrete • Screeds
Steel	• Primary structural steelwork • Structural steel decking • Reinforcing bar in concrete • Steel sheet piling	• Secondary steelwork • Cold-formed steelwork • Steel cladding
Timber	• Primary timbers and decking/sheeting • Glulam • CLT	• Secondary timber and decking/sheeting
Masonry	• Structural load bearing masonry only	• Masonry cladding • Internal non-loadbearing masonry partitions

It should be noted that RIBA stage 4 information for projects for which works have commenced within the annual reporting year may include some estimates for structural materials such as rebar quantities, concrete and sheet pile quantities etc.

The increasing prevalence of projects involving refurbishment of existing structures in the company's portfolio has led to internal discussions on how material quantities for these projects should be considered, specifically with respect to inclusion of materials used to carry out spot repairs to existing elements and the fact that such repairs are not typically incorporated into the BIM models from which our annual quantities are drawn. In future, our approach will be to liaise with contractors regarding quantities they have ordered in to facilitate repairs to ensure these materials are captured.

Installation of Structural Materials

Each project at Smith and Wallwork is recorded with a commencement date and a completion date. These dates are used to apportion the installation of structural materials on site.

Smith and Wallwork has chosen to apportion the installation of structural materials on a project over the entire construction period. Furthermore, structural materials are assumed to be installed at a consistent rate throughout the construction period. Strictly speaking this assumption is incorrect as typically on a building project, most of the construction materials will have been installed within the first half of the overall construction period.

This simplification in reporting the installation of materials on construction sites provides a smoothing-out of the reported material use on Smith and Wallwork construction sites. Over the years, some projects will be under-reported and some over-reported. However, the total quantities reported over the lifespan of a given project will be accurate.

CO2 Emissions of Structural Materials

Background Information

The lifecycle stages in BS EN 15978 and BS EN 15804 are used to define the amount of carbon released at the different stages of a material or products life.

- A1-A3: Product stage
- A4-A5: Construction process
- B1-B6: Use stage
- C1-C4: End of life stage
- D: Beyond end of life

An example from LETI's *Embodied Carbon Primer* suggests that stages A1-A3 and B1-B6 together account for more than 90% of the life cycle of a building's carbon emissions with a balanced distribution of emissions between the two. The diagram below is taken from *How to calculate embodied carbon*, 2nd ed.

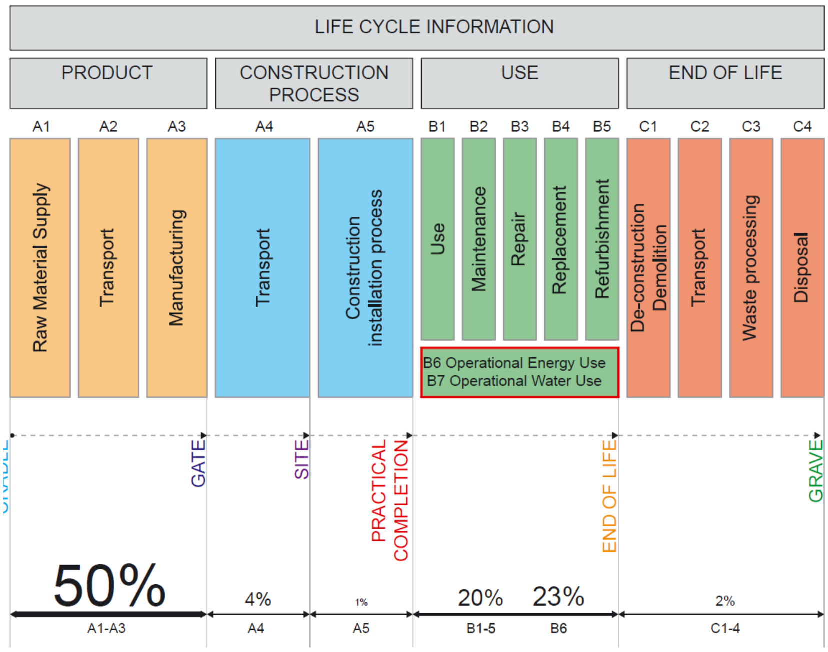


Figure: Lifecycle stages (ref.: The Structural Engineer July 2020)

It should be noted that the calculation of the CO2 emissions associated with structural materials is a new area of research and implementation. The available pool of datasheets is relatively small and as such it can be difficult to justify data. As the dataset of materials and products gets larger, the reliability of data is likely to increase. In this respect, care should be taken when comparing historic carbon data as each year our carbon data is reviewed and updated.

Also of note is the origin of structural materials used on site. A change in location of manufacture can significantly alter the CO2 figures.

Whilst the foundations and structure are likely to form the largest component of CO2 emissions in stage A it is worth noting that different structural solutions can have impacts of finishes applied as well as operational energy (and hence CO2 emissions).

Smith and Wallwork Dataset

Several assumptions have been made in order to establish a set of embodied carbon data for structural engineering materials and products. A summary of the various figures and factors used, sourced from The Institution of Structural Engineers' guide *How to calculate embodied carbon*, 3rd ed., 2025:

(kgCO2e/kg)	A1-A3	A4	A5.3	A1-A5
Steel sections UK	1.640	0.021	0.017	1.678
Steel section Global	1.660	0.262	0.019	1.941
Steel profile decking	2.830	0.021	0.029	2.880
Rebar	1.245	0.096	0.071	1.412
Rebar UK	0.720	0.021	0.039	0.780
Rebar Global	1.770	0.262	0.108	2.042
CLT UK	0.217	0.262	0.010	0.489
CLT Global	0.437	0.173	0.012	0.622
Glulam UK	0.280	0.262	0.011	0.553
Glulam Global	0.512	0.173	0.014	0.699
Concrete (insitu unreinforced)	0.113	0.009	0.006	0.128
Concrete (insitu 50kg/m3 rebar)	0.125	0.009	0.007	0.141
Concrete (insitu 100kg/m3 rebar)	0.137	0.009	0.008	0.154
Concrete (insitu 150kg/m3 rebar)	0.148	0.011	0.008	0.167
Concrete (precast unreinforced)	0.173	0.021	0.002	0.196
Concrete (precast 50kg/m3 rebar)	0.184	0.021	0.002	0.207
Concrete (precast 100kg/m3 rebar)	0.195	0.021	0.002	0.218
Concrete (precast 150kg/m3 rebar)	0.205	0.021	0.002	0.228
Blockwork	0.280	0.021	0.016	0.317
Brickwork	0.213	0.021	0.016	0.250

This represents a change from our reports issued from 2022-2024, which were collated with reference to the 2nd ed. of this guide. Other changes to our carbon calculations have been noted below.

For Smith and Wallwork standard embodied calculations the following data has been used:

- An average value for UK and European steel sections is taken for A1-A3.
- An average value for UK and global rebar is taken for A1-A3.
- An average UK concrete mix of C30/37 with 35% cement replacement material is taken for insitu concrete for A1-A3.
- An average UK mix of C40/50 is taken for precast concrete for A1-A3.

Transport carbon factors (A4) for movement of materials and products between factory and site are based on local, national and European scenarios. The methodology outlined by *How to calculate embodied carbon* 3rd ed. has introduced additional transport distances for return journeys and the A4 factors have therefore typically increased since our last report:

A4 factor	Outbound (km)	Return (km)		
Local manufacture	50	21.5	0.009	kgCO2e/kg
National manufacture	120	34.4	0.021	kgCO2e/kg
Europe manufacture	1500 (+100)	645	0.262	kgCO2e/kg

The new edition of *How to calculate embodied carbon* has introduced significant changes to the A5 factor calculation. Where previously the factor was calculated on the basis of 2No. factors – A5a corresponding to site activity and calculated on the basis of project construction value and A5w corresponding to waste – the factors is now calculated on the basis of 4No. factors:

A5.1 – Pre-construction demolition

A5.2 – Construction activities

A5.3 – Waste and waste management

A5.4 – Workers' transport

A5.1, A5.2 and A5.4 effectively correspond to the A5a factor presented in *How to calculate embodied carbon* 2nd ed. However, *How to calculate embodied carbon* 3rd ed. suggests that the A5.1 and A5.2 factors should be calculated on the basis of project GIA rather than project construction value, while the A5.4 factor should be provided by the contractor(s). The A5.3 factor is calculated in an identical way to the old A5w factor.

For the purposes of our calculations, factors A5.1 and A5.2 are taken as 17.5kgCO2e/m2GIA and 20kgCO2e/m2GIA, respectively, as per IStructE guidance. These figures are based on an assumption that 50% of the RICS values of 35kgCO2e/m2 GIA and 40kgCO2/m2GIA, suggested for demolition and construction activities respectively, can be attributed to the structural frame.

Waste and waste management factors (A5.3) are based on simplified data from the RICS and local disposal of waste. Waste percentages range from 1% to 5% for structural materials and products but can be as high as 20% for some construction products. Timber manufacturing waste is assumed to be subject to a mixture of reuse, recycling, incineration and dumping to landfill at end-of-life, with the proportion of material subject to these end-of-life conditions varying with the nature of the product.

The component of A5.3 = WF*(A1+A2+A3+A4+C2+C3+C4).

A5.3 factor		
Steel frame	0.010	
Steel rebar	0.053	
Concrete insitu	0.053	
Concrete precast	0.010	
Timber frame CLT	0.020	
Timber frame glulam	0.020	
Blockwork	0.053	
Brickwork	0.064	
Prefab components	0.010	
C2 waste from site	0.009	kgCO2e/kg
C3-4 waste disposal (timber)	1.670	kgCO2e/kg
C3-4 waste disposal	0.013	kgCO2e/kg

Standard practice suggests 20% error bars are appropriate for the reporting of carbon factors and actual material quantities installed on site.

Note on changes from HTCEC 2nd ed. to 3rd ed.

The changes to the A5 factor presented above mean that A1-A5 embodied carbon values can no longer be calculated purely based on material quantities. Embodied carbon figures presented for projects in this report are therefore not directly comparable with previous reports. It is important to understand the impact this change has on project reporting. Breakdowns of 2No. all-up embodied carbon calculations, employing the methods and figures from *How to calculate embodied carbon* 2nd ed. and 3rd e.d, respectively, are presented below for Smith & Wallwork project 278, completed in 2024:

Quantities		
Concrete	4354t	
Steel	138t	
Timber	1249t	
GIA	8600m2	
	tCO_2e	
Embodied Carbon Factor	HTCEC 2nd ed., 2022	HTCEC 3rd ed., 2025
A1-A3	949.8	937.5
A4	234.9	386.0
A5a	183.1	-
A5.1 + A5.2	-	322.5
A5w/A5.3	67.5	95.8
TOTAL A1-A4	**1184.7**	**1323.5**
TOTAL A1-A4 + A5w/A5.3	**1252.2**	**1419.3**
TOTAL A1-A5	**1435.3**	**1741.8**

It can therefore be seen that the changes in specific ranges of embodied carbon factors are as follows:

ECF Range	Change, 2nd ed. to 3rd ed. (tCO2e)
A1-A3	-12.3
A1-A4	138.8
A1-A4 + A5w/A5.3	167.1
A1-A5	306.5

This comparison suggests that, for the same structure, the methodology and figures presented in *How to calculate embodied carbon* 3rd ed. result in significantly higher estimates of embodied carbon than the 2nd ed, and that this increase stems mainly from increases in A4 factors and from the change from the A5a calculation based on construction value to the A5.1+A5.2 calculation based on GIA. Note that the 21% increase observed for the embodied carbon calculation for project 278 corresponds well to the 18% increase in embodied carbon per m2 GIA from 2024 to 2025, i.e. to the transition from the 2nd ed. to 3rd ed. methodology.

Historic Data

Smith and Wallwork has been collecting data on materials use since its inception in 2012. The chart below shows the structural material used on construction sites from 2014 onwards.

The information shown on materials and carbon per engineer is derived from the total annual mass divided by the total number of technical staff (full time equivalent). In 2025, the number of full time technical staff continued to increase from 16 to 18.