



Calculating

The Embodied Carbon

Measuring Today,
Building a Sustainable tomorrow



Mohamed Elgezawy
Associate Structural Engineer

The Climate Emergency is a

Structural Problem —



Structural engineers hold the key to dramatic emission reduction.



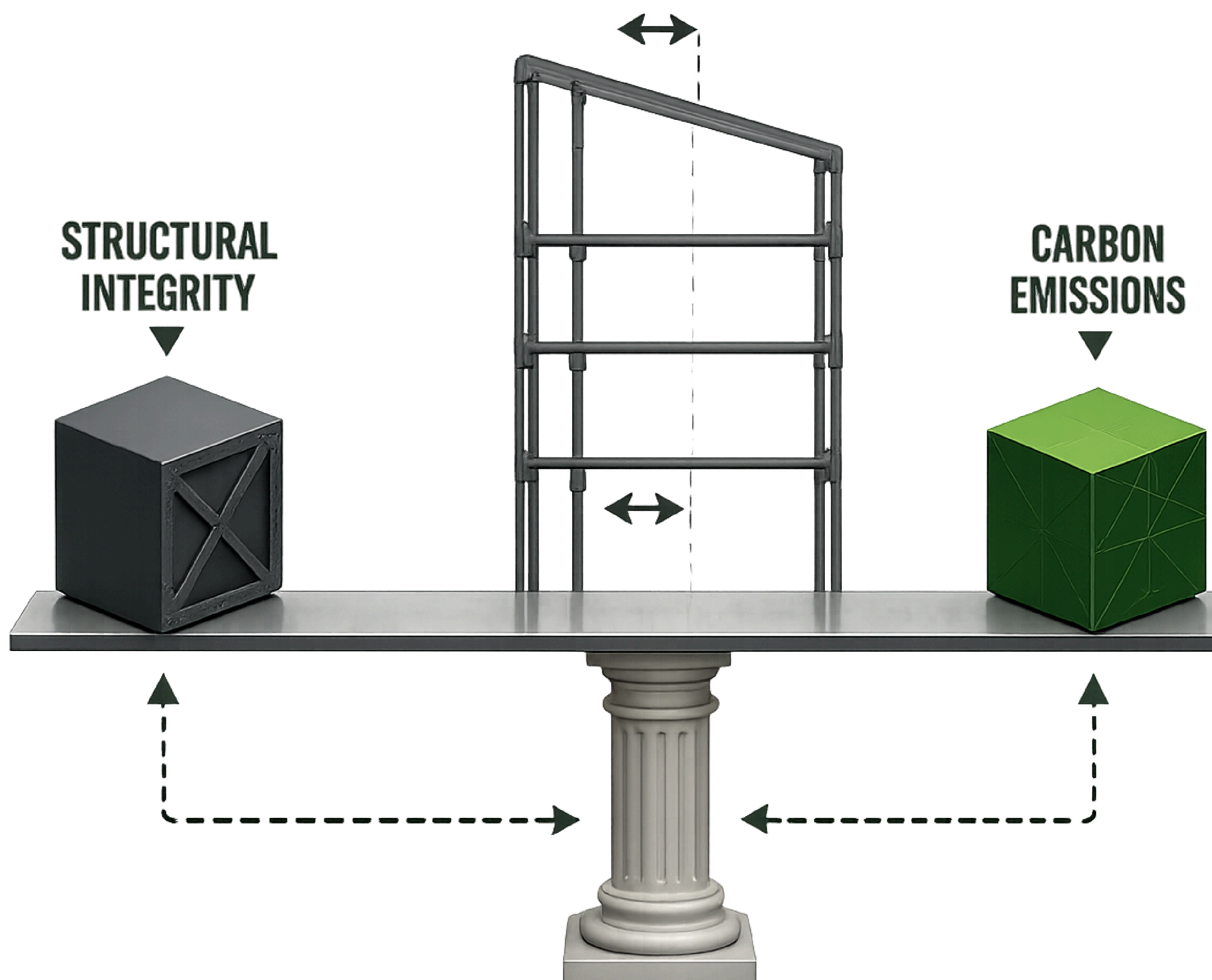
Firms must now include whole-life carbon modeling as part of their basic scope of work.



We must design for carbon as rigorously as we design for gravity.



Minimizing the embodied carbon of structures and elements is the primary mechanism for engineers to achieve **Global Net Zero** targets.



The Window of

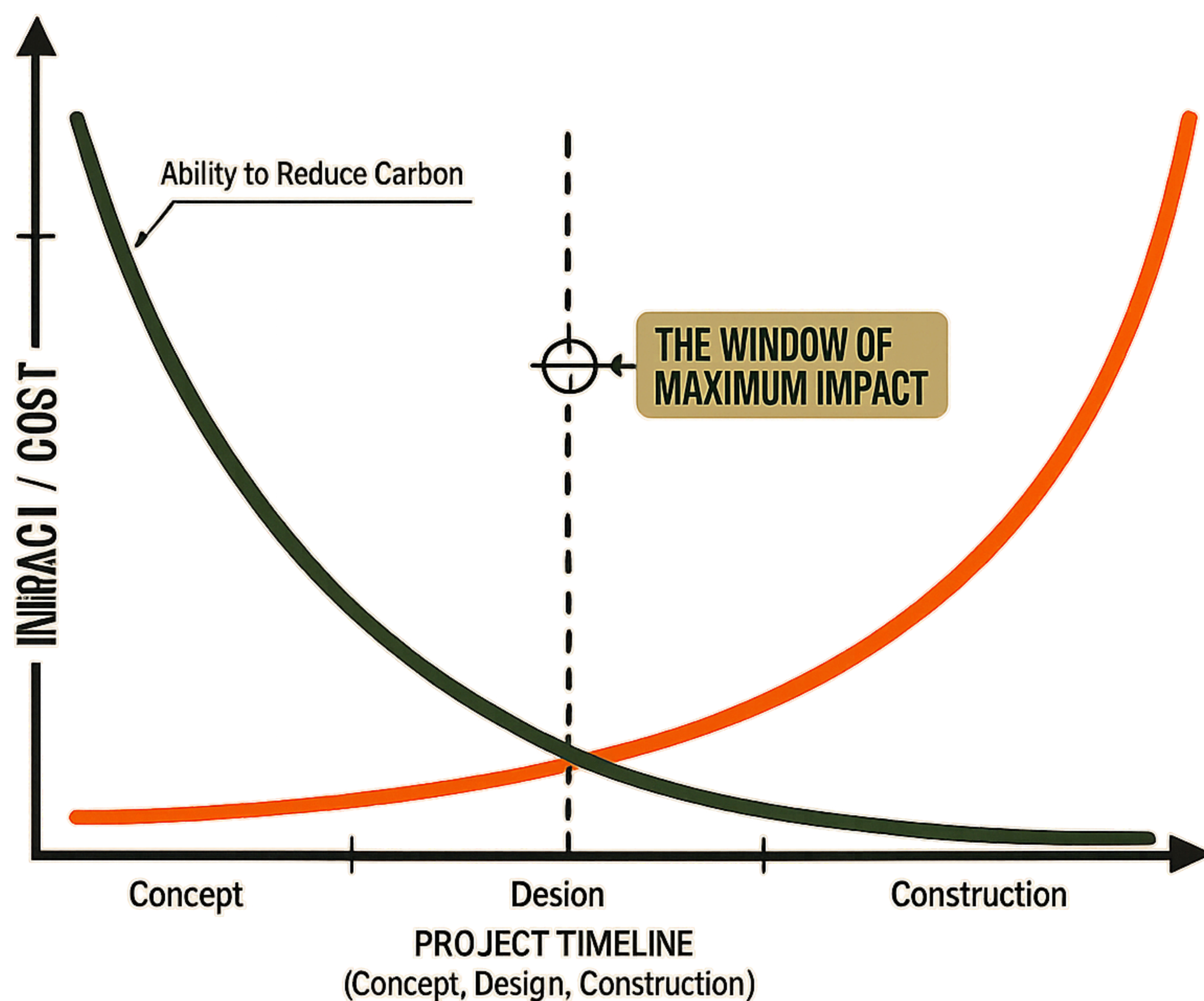
Maximum Impact

The most critical time to calculate embodied carbon is during the early concept stages.

Do not wait for perfect material quantities.

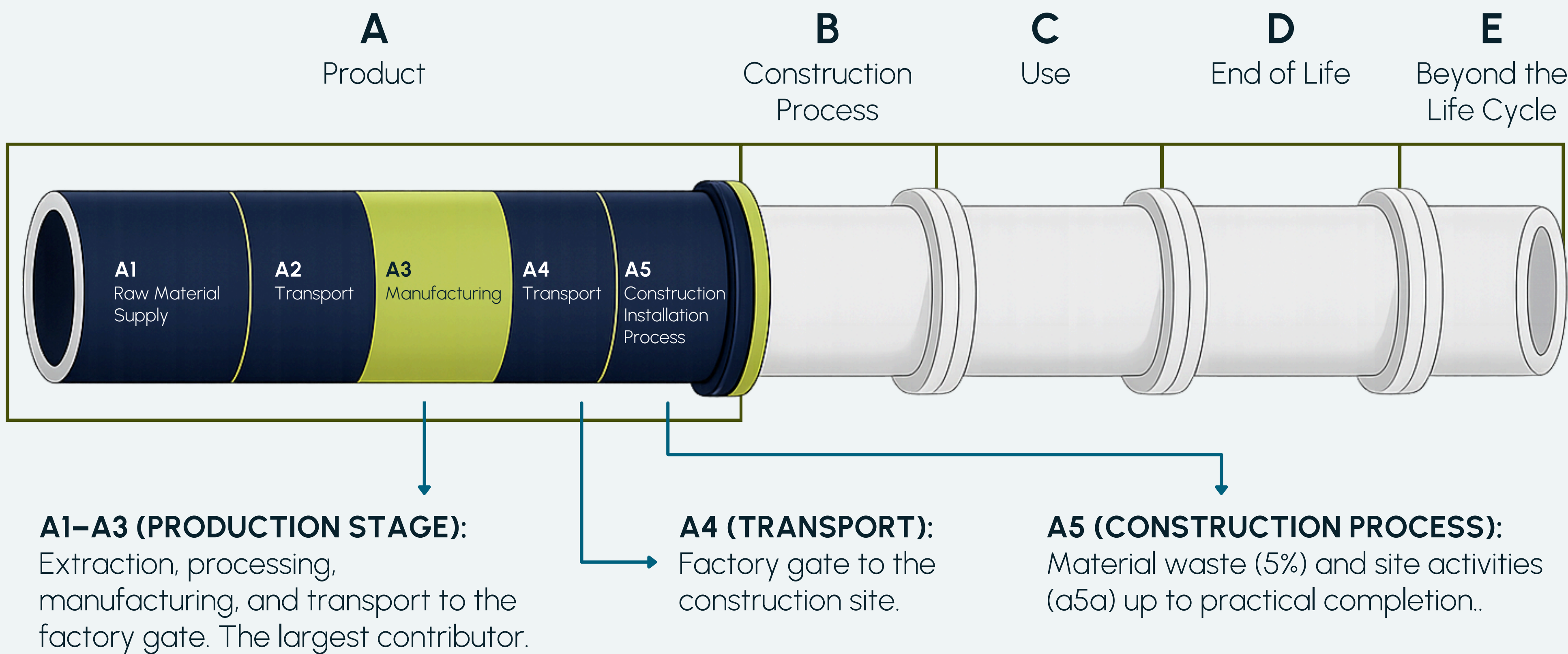
TAKEAWAY:

Estimate early using scheme design guides or experience. The goal is to influence material selection, specification, and structural efficiency before the cost of change becomes prohibitive.

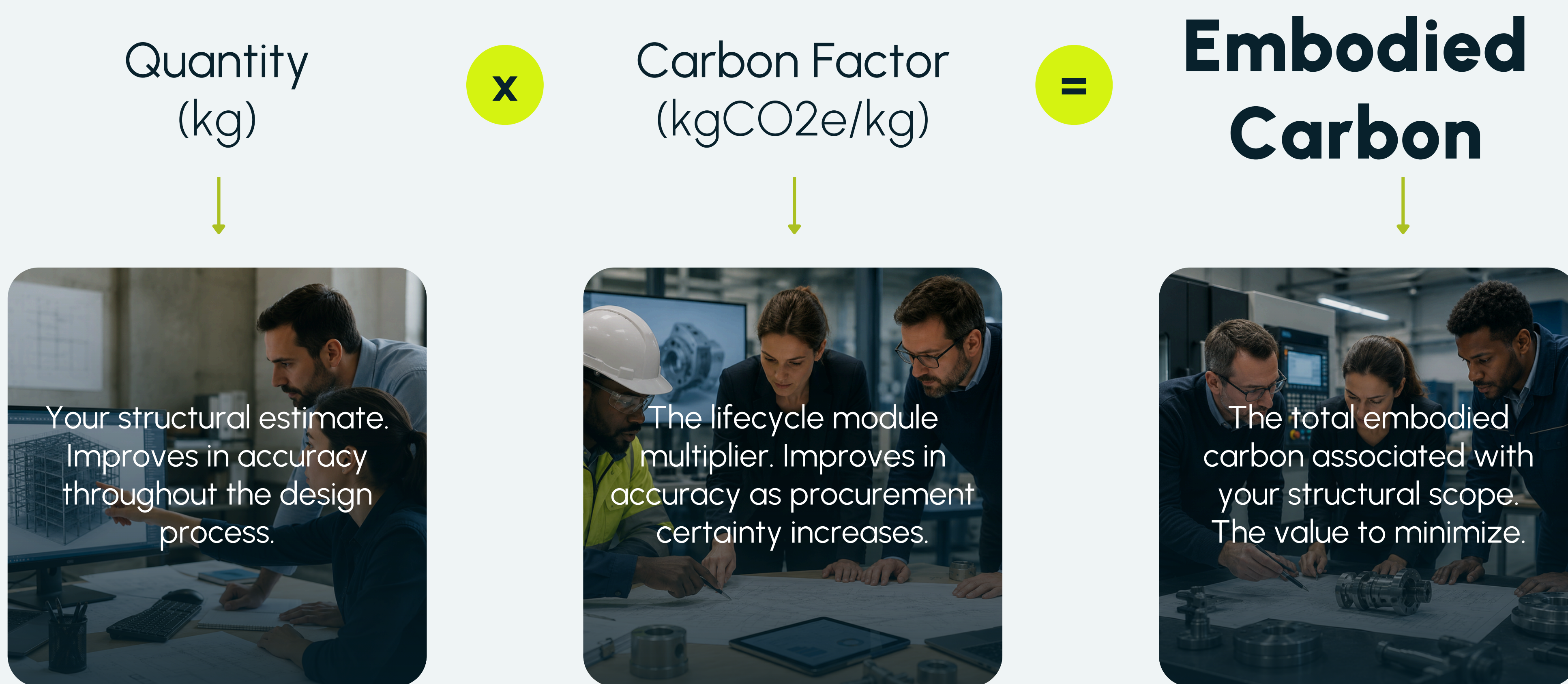


The Minimum Scope:

Cradle to Practical Completion



The Core Engine



Unpacking the Carbon Factors



Production (A1–A3)

The primary driver. Highly dependent on specification

Example:

UK rebar **averages 0.684 kgCO₂e/kg**, while imported steel without recycled content can exceed 2.0.

Source rule:

Always demand Environmental Product Declarations (EPDs).



Transport (A4)

Typically < 10% of total footprint.

Dictated by distance and mode (e.g., road vs. sea freight).



Construction (A5)

Split into two distinct loads:

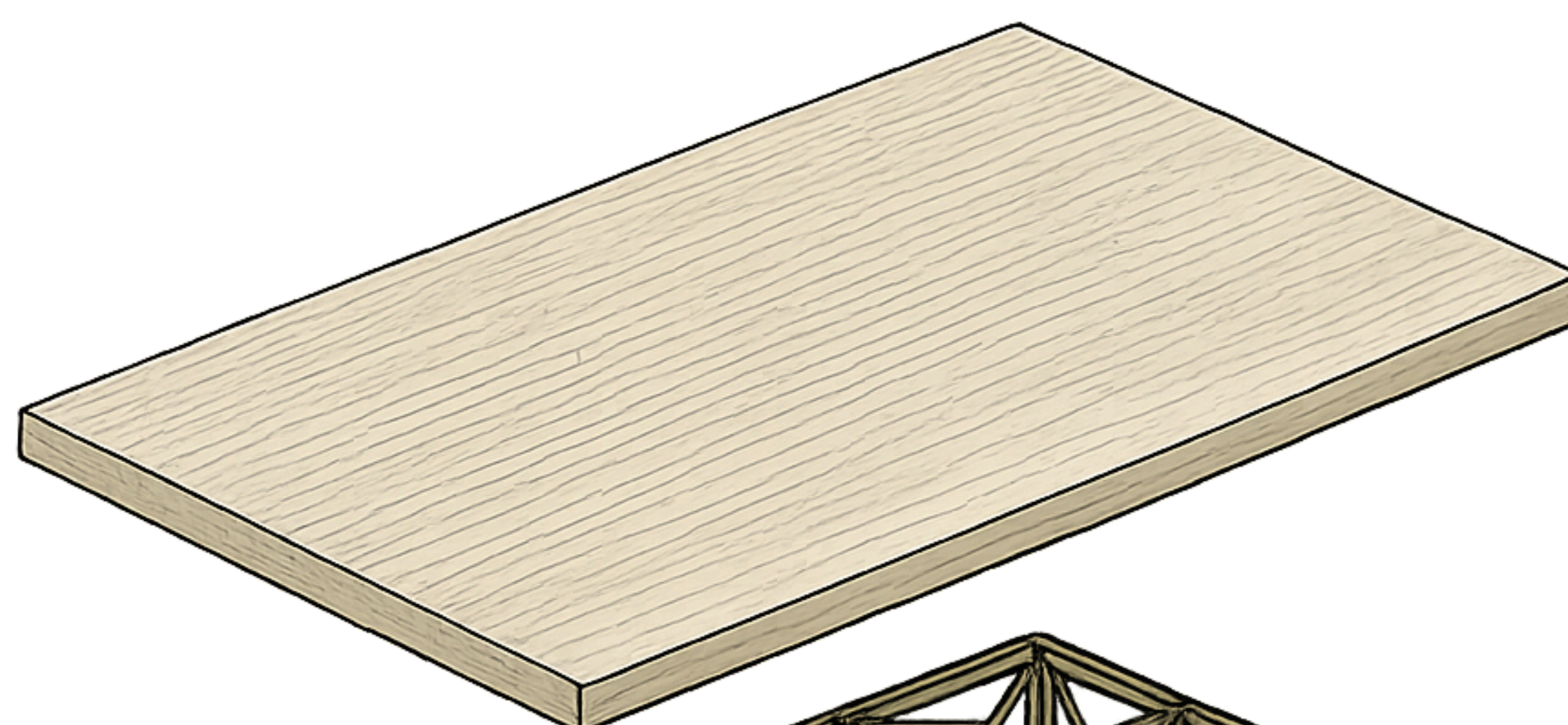
- **A5w** accounts for the total Lifecycle cost of material Wasted on site.
- **A5a** accounts for site energy use (default estimate: 700 kgCO₂e per £100K of structural cost).

The 792m² Pavilion

An efficient fusion of engineered timber, Steel and concrete to achieve low-carbon, high performance design.

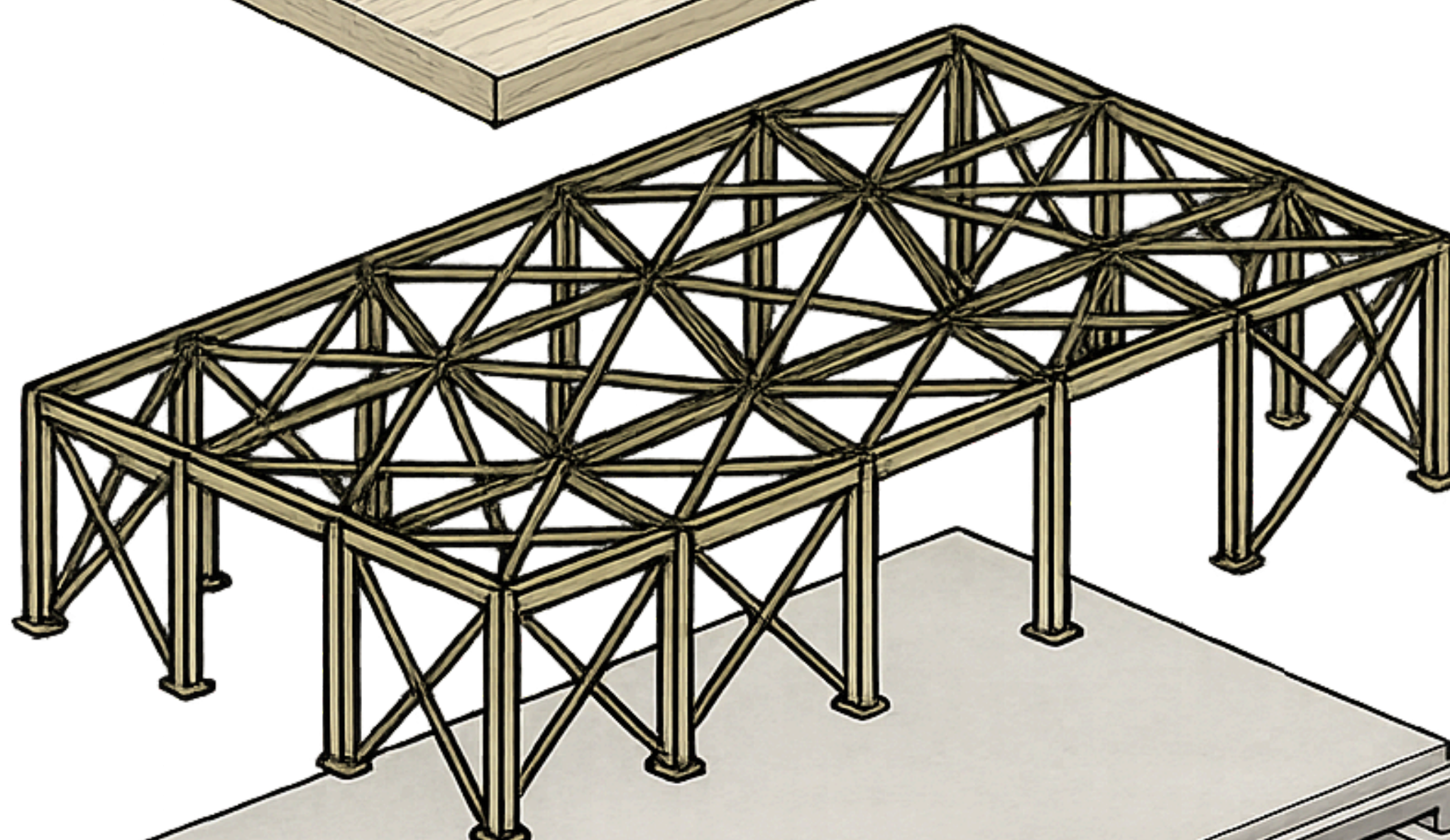
CLT Roof Slab (150mm Thick)

Cross-laminated timber slab
For low-carbon performance.



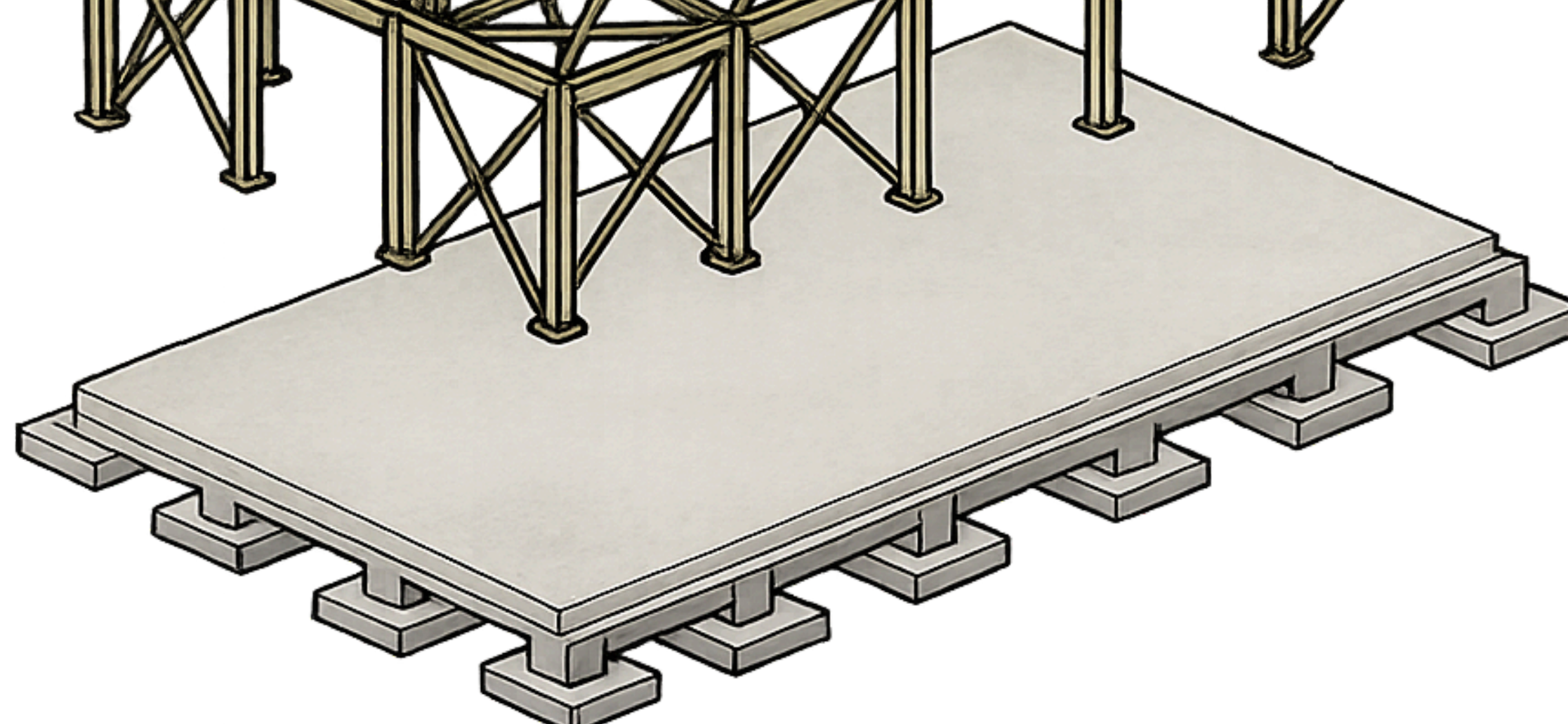
Single-story Braced Steel Frame (Assumed 30kg/M²)

Efficient braced steel system
For strength and stability.



Shallow Concrete Footings (24 pads) and 120mm Ground Bearing Slab

Simple, robust foundation
Solution for minimal impact.



Sustainable. Efficient. Build to Last.

A considered balance of material performance, structural efficiency, and embodied carbon.

Calculating the Load (A1-A5w)

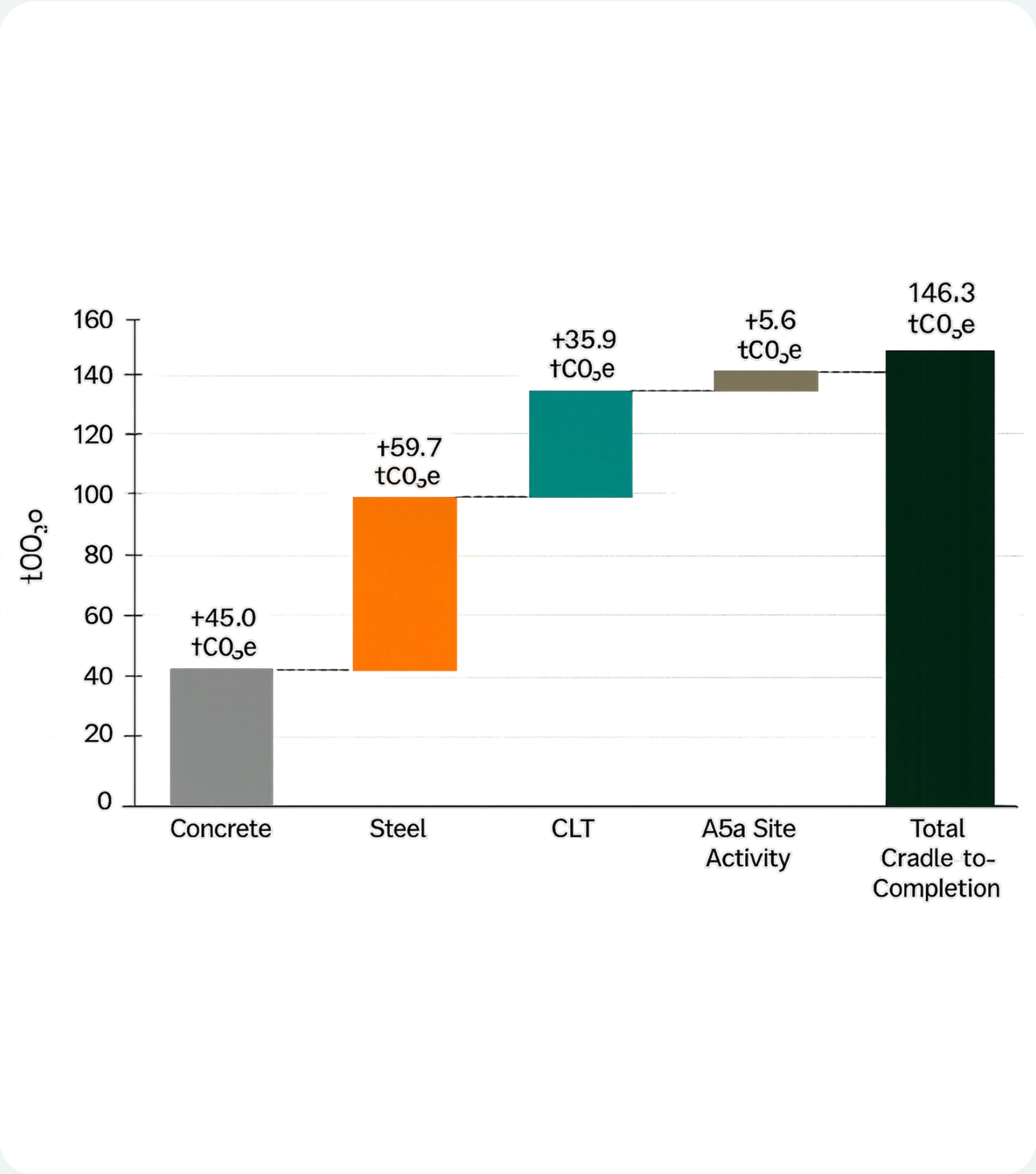
Material	Quantity	Primary Factor (A1 – A3) (kgCO ₂ e/kg)	Subtotal (tCO ₂ e)	Relative Contribution
Reinforced Concrete (Heavy Mass, Low Factor)	279.8 t	0.12 kgCO ₂ e/kg	45.0 tCO ₂ e	24%
Steel Frame (Light Mass, Highest Factor)	23.8 t	2.45 kgCO ₂ e/kg	59.7 tCO ₂ e	47%
CLT Roof Slab	59.4 t	0.437 kgCO ₂ e/kg	35.9 tCO ₂ e	29%

Total Cradle-to-Completion (A1-A5W):

146.3 tCO₂e (185 kgCO₂e/m²)

Note: Site activities (A5a) added 5.6 tCO₂e
Based on the £800K construction value.

The Final Carbon Footprint



KPI Readout

Total Cradle-to-Completion (A1-A5):
146.3 tCO₂e
(185 kgCO₂e/m²)

Calculation note: Site activities (A5a) added 5.6 tCO₂e based on the £300k construction value.

The Timber Advantage

Sequestered carbon (stored temporarily in the CLT roof) accounts for
-97.4 tCO₂e
(-123 kgCO₂e/m²)

Must be reported separately alongside the A1-A5 total, not subtracted from it.



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www.egis-group.com