SISK
ESTD. 1859

How much does span really cost in carbon?

Span length is often driven by functionality, efficiency, or commercial considerations - but its carbon implications are rarely made fully visible at concept stage.

In our latest ISS research, we analysed the embodied carbon performance of multiple slab systems used in office buildings - testing how they behave across increasing grid sizes and comparing them under identical layout conditions.

The results are revealing.

View results →

1.

Carbon vs. Grid Size - The Span Penalty

As spans increase, embodied carbon does not rise linearly - it accelerates.

Some systems show sharp carbon escalation beyond certain thresholds, while others demonstrate more stable growth.

The key insight?

Longer spans quickly erode carbon efficiency. What appears to be a modest grid increase can trigger a disproportionate rise in material demand, and therefore carbon.

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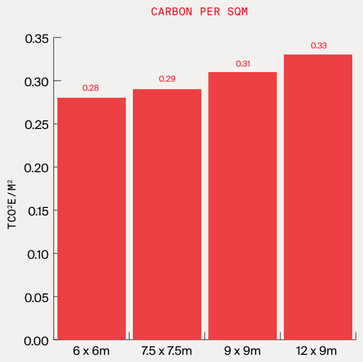
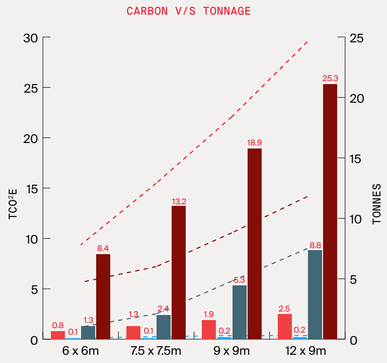
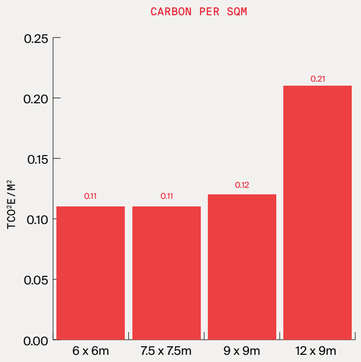
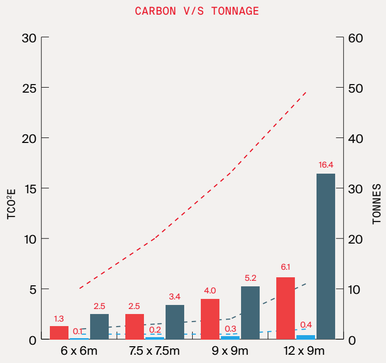
Composite Slab



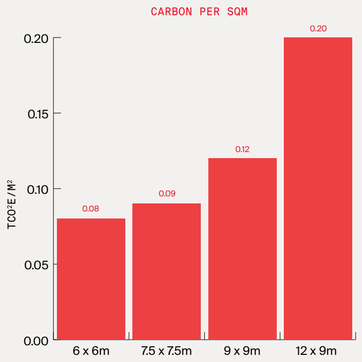


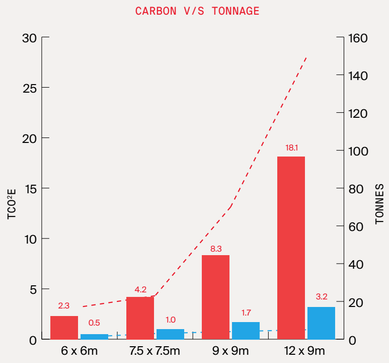
Hollow Core Slab



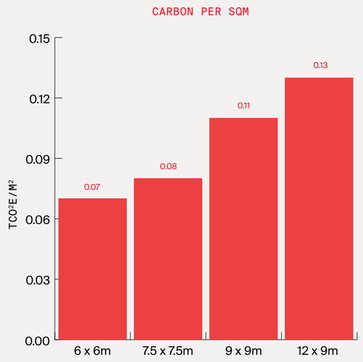


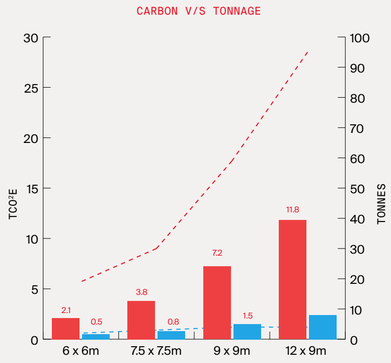
Flat Slab



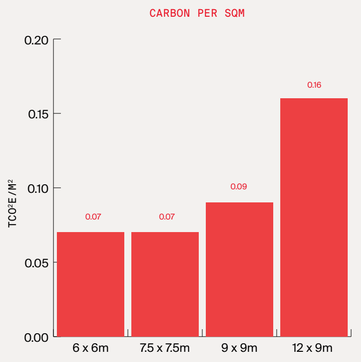


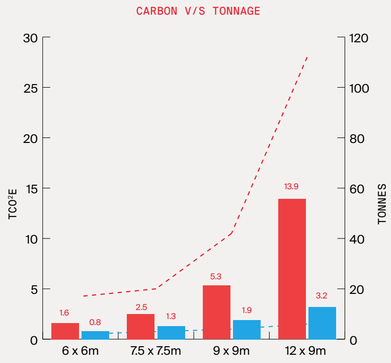
PT Slab



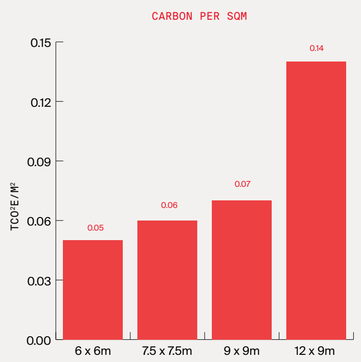


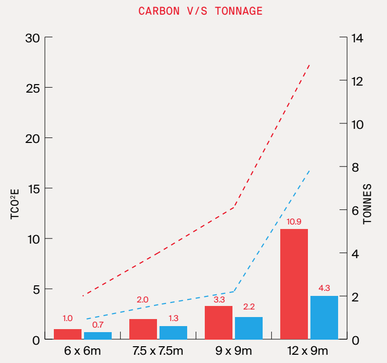
Waffle Slab





CLT Slab





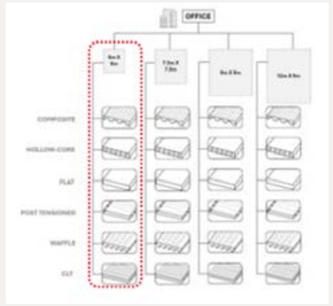
LEGEND

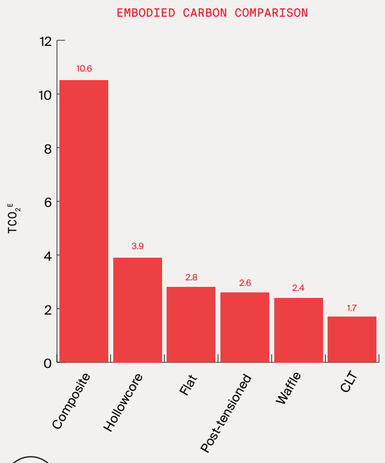
- Concrete embodied carbon
- Concrete tonnage
- Steel beam embodied carbon
- Steel beam tonnage
- Rebar / CLT embodied carbon
- Rebar / CLT tonnage
- Steel deck embodied carbon
- Steel deck tonnage

2. System vs. System – Same Grid, Different Outcomes

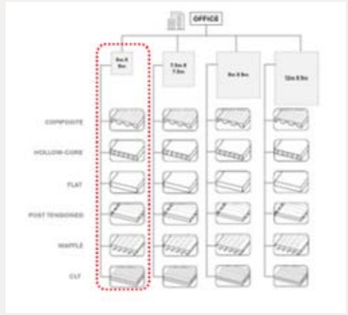
When comparing systems at identical grid sizes, the carbon spread between structural typologies becomes significant.

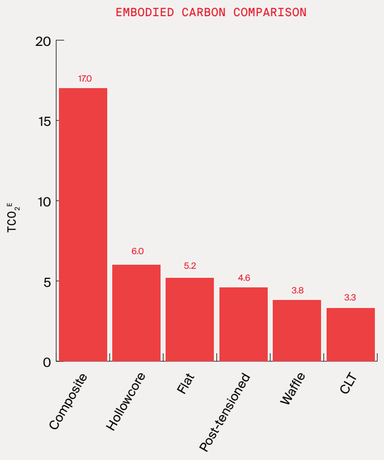
Carbon analyses of multiple slab types for a 6.0x6.0m grid



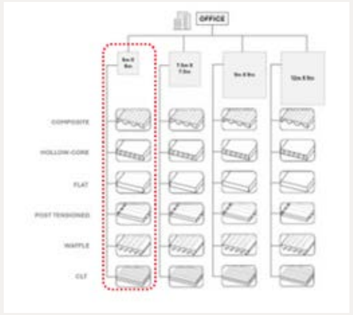


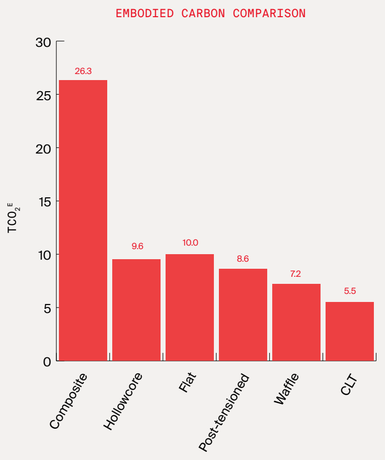
Carbon analyses of multiple slab types for a 7.5x7.5m grid



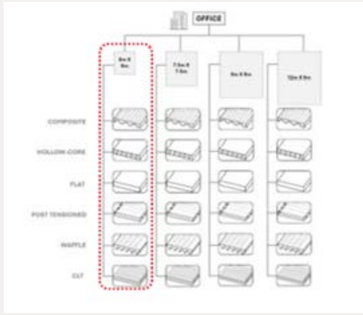


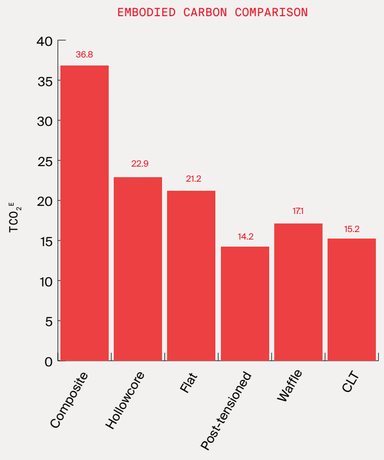
Carbon analyses of multiple slab types for a 9.0x9.0m grid





Carbon analyses of multiple slab types for a 12.0x9.0m grid





At the same span:

- Some systems consistently outperform others in $kgCO^2e/m^2$
- Material intensity- not just material type - drives performance
- Optimisation potential varies dramatically depending on the structural concept

There is no universally low-carbon slab, only context-specific efficiency.

What this means for design teams:

- Grid strategy is a carbon strategy
- Structural typology can shift embodied carbon by a meaningful margin
- Early-stage structural decisions carry long-term carbon consequences
- There is a definable “sweet spot” for each system, beyond which carbon performance deteriorates rapidly.

If we want to reduce embodied carbon in offices, structure cannot be a downstream decision.

Early structural decisions matter.

Grid strategy matters.

The cheapest carbon is the one you never design in.