UNIVERSITY OF CAMBRIDGE

EPSRC
Engineering and Physical Sciences Research Council

The impact of the client brief on material efficiency in construction

The New Civil Engineering Building

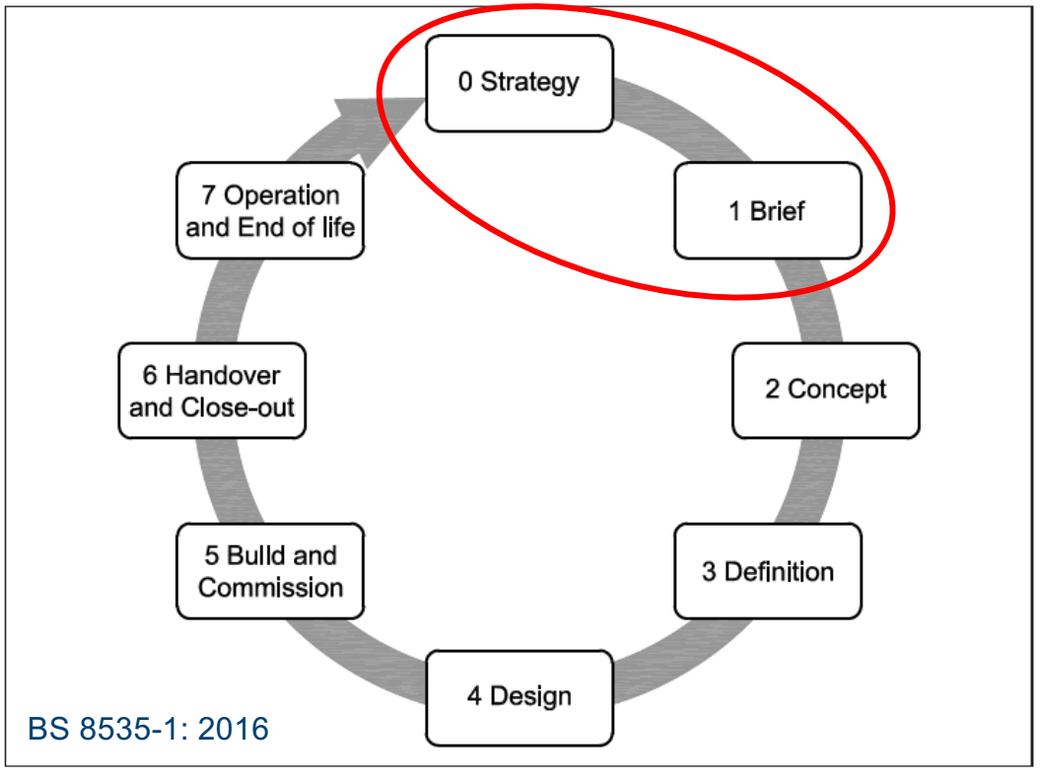
Iain Cameron

Supervisor: Professor Julian Allwood

FIBE CDT

THE USE | LESS GROUP
LIVING WELL WHILE USING LESS

What is the client brief?



As a document

"Needs, aims, resources of client.. Content of project" [2]

As a process

Facilitates 'Formal' and 'informal' collaboration [3]

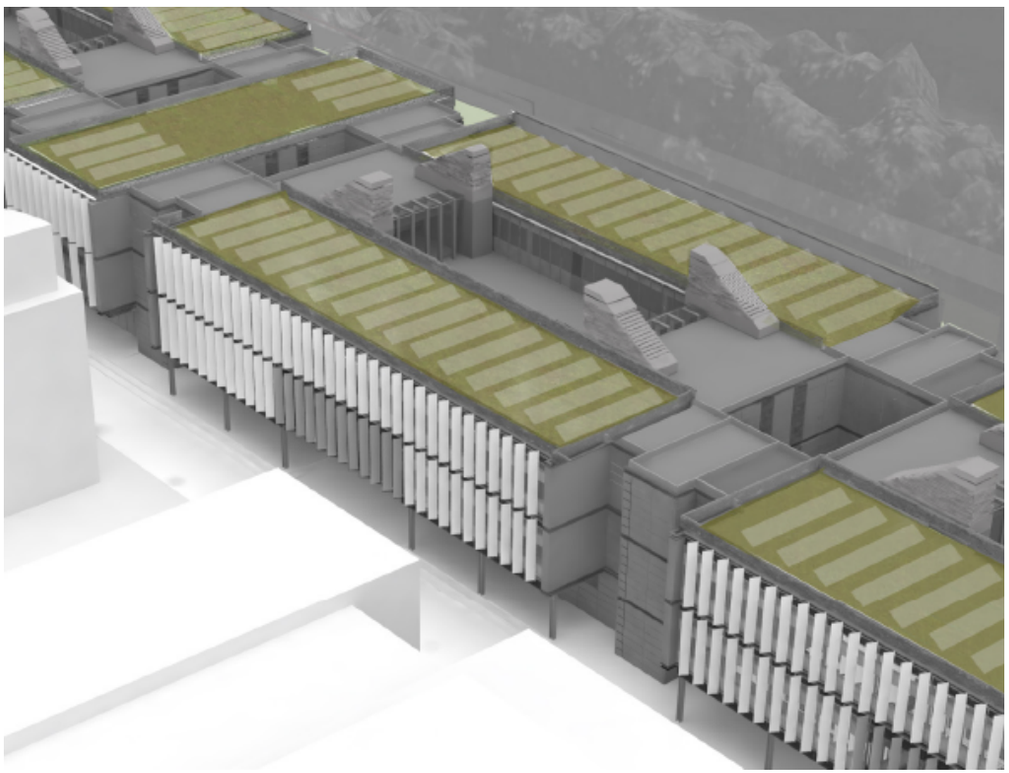
A major factor in project success [4]

[2] BSI, (2005), [3] de Blois, (2011), [4] Kometa et al (1994)

Mres Thesis - Research Aims

- Understand the impact of briefing on material efficiency performance
- Assess the formal and informal influence of the briefing documents during design and contractual document development
- Visualise changes in the structural frame cost/carbon during the design development, and relate this to requirements development.

Research Programme



Detailed case study of a New Civil Engineering Building

- Data collection
  - Briefing documents, contractual documents, project reporting
- Benchmarking of structural design cost-energy using PANDA software
- Semi structured project actor interviews

Case Study – New Civil Engineering Building

Cambridge Move West
Phase 1

4380m^2 facility
Completion - 2019

Energy Aims

Low Energy
Pleasant for Occupants
Zero Bling
Well Measured

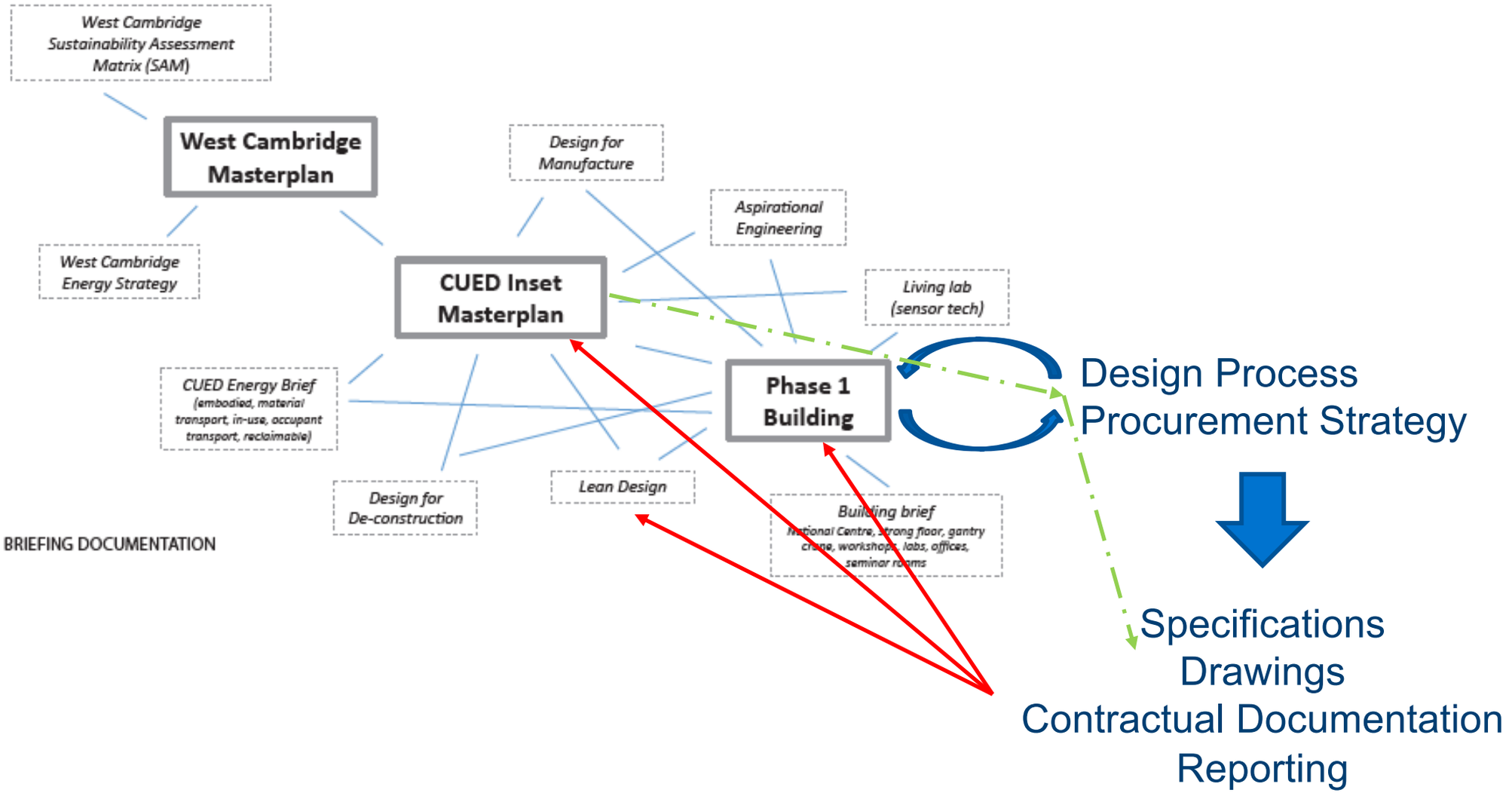
NCE Brief Material Efficiency Aspirations

Highlighted potential strategies in brief

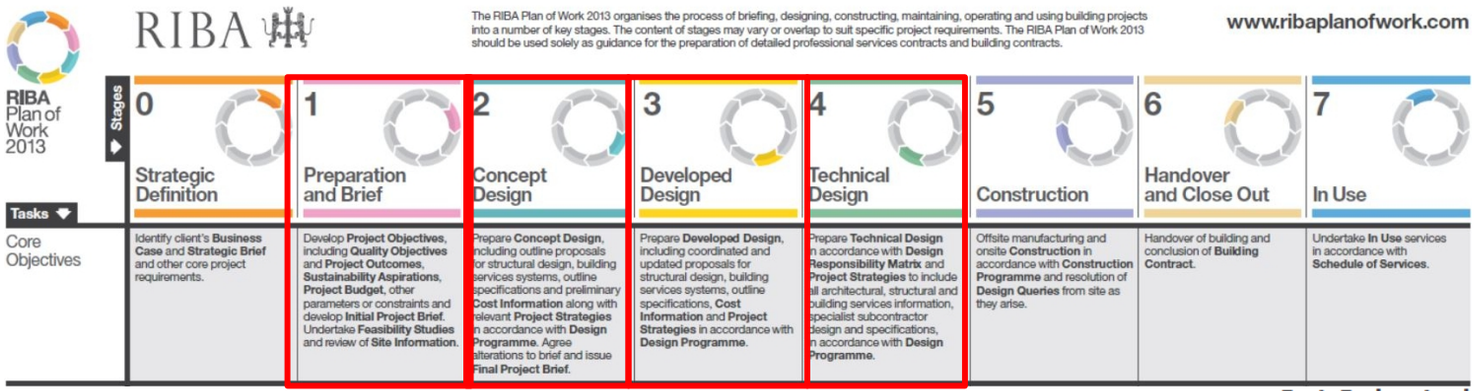
- '*Require all design consultants to rigorously record…'*
- *'Make comparisons of these quantities with benchmark data…'*
- *'Track the changes to the material quantity estimates…'*
- *'Procure an embodied energy analysis in accordance with the latest industry recognised methodology..'*

Which strategies incorporated? if not, why?

Briefing Document Impact



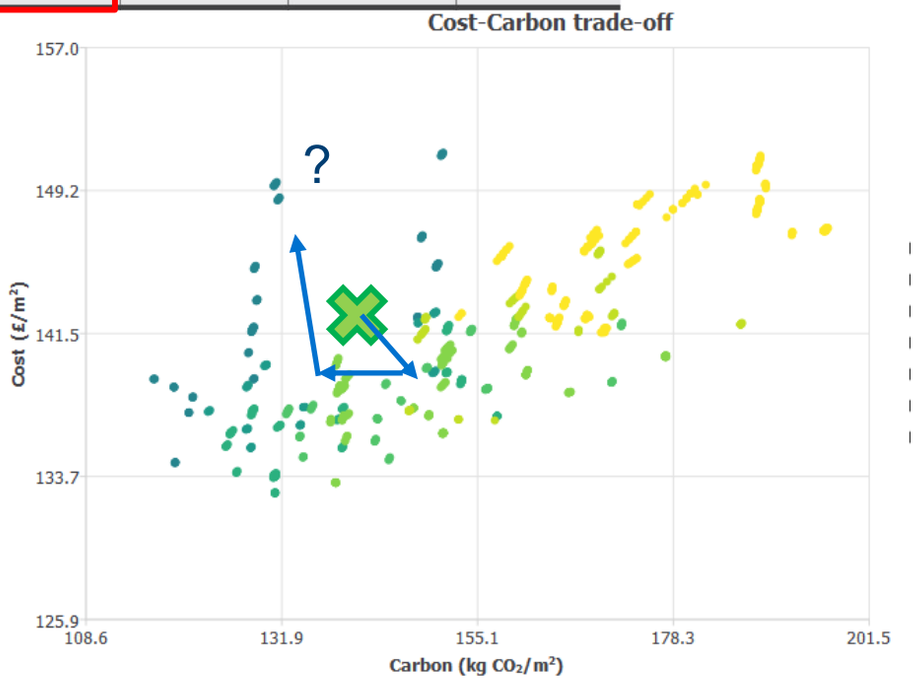
Structural design material efficiency - Benchmarking



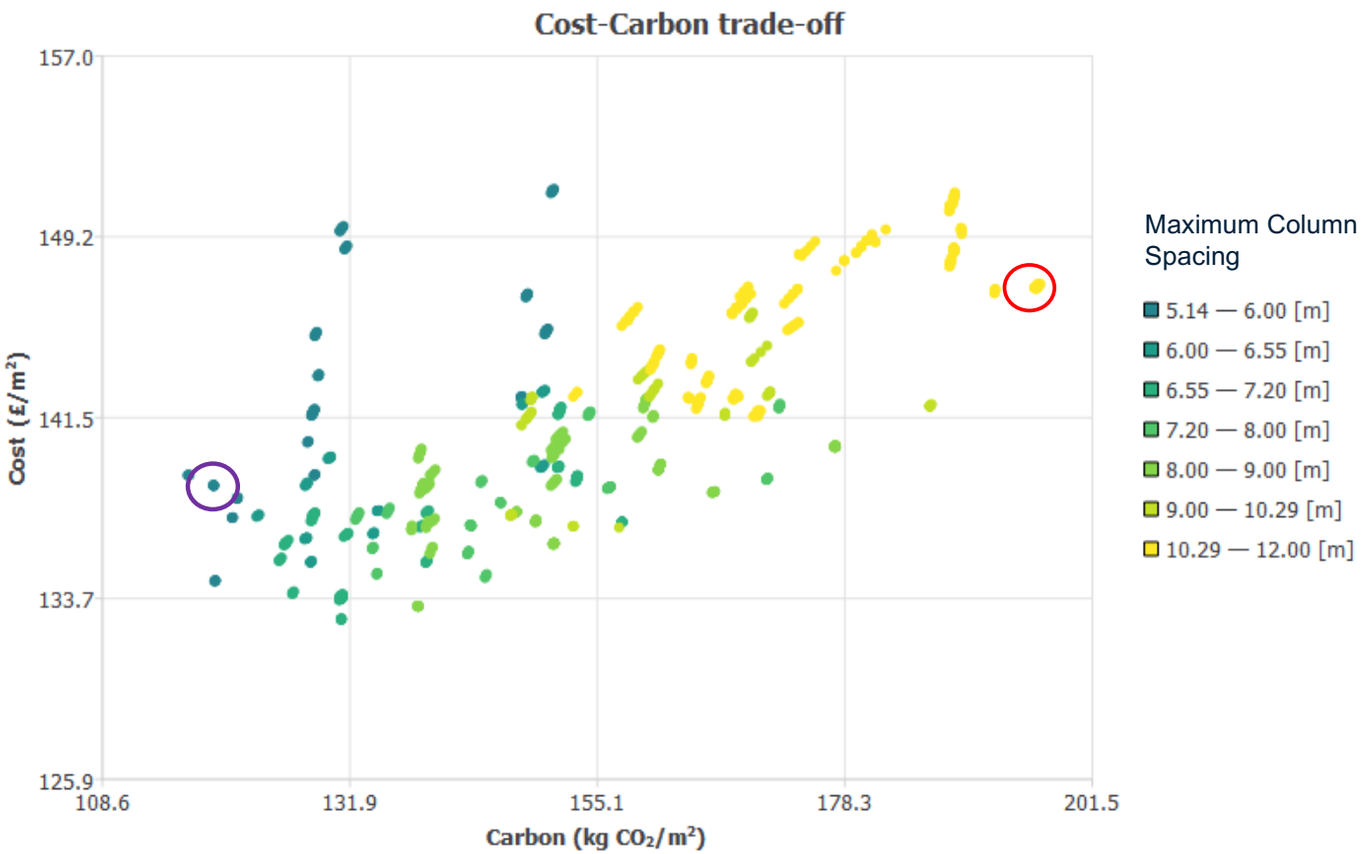
Competing Requirements

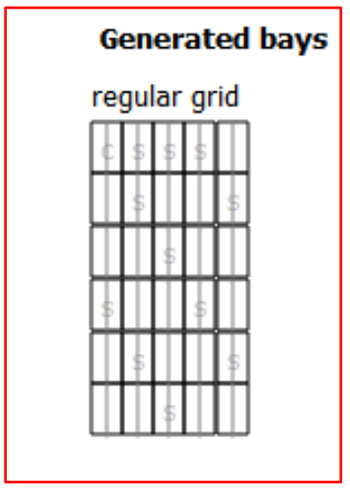
Impact of value engineering

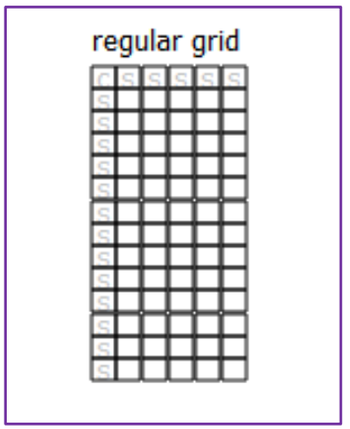
Energy Cost Metric impact



Methods: Cost-Carbon design space mapping

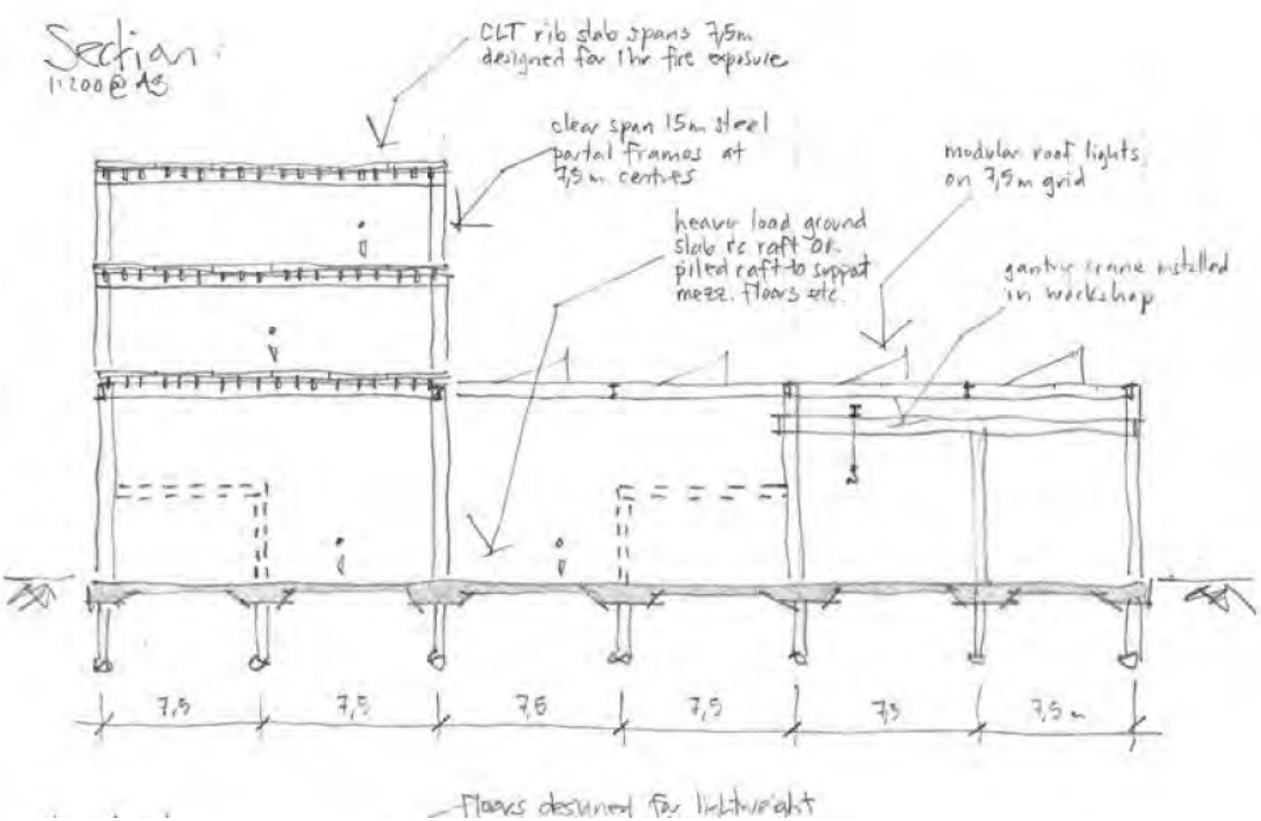


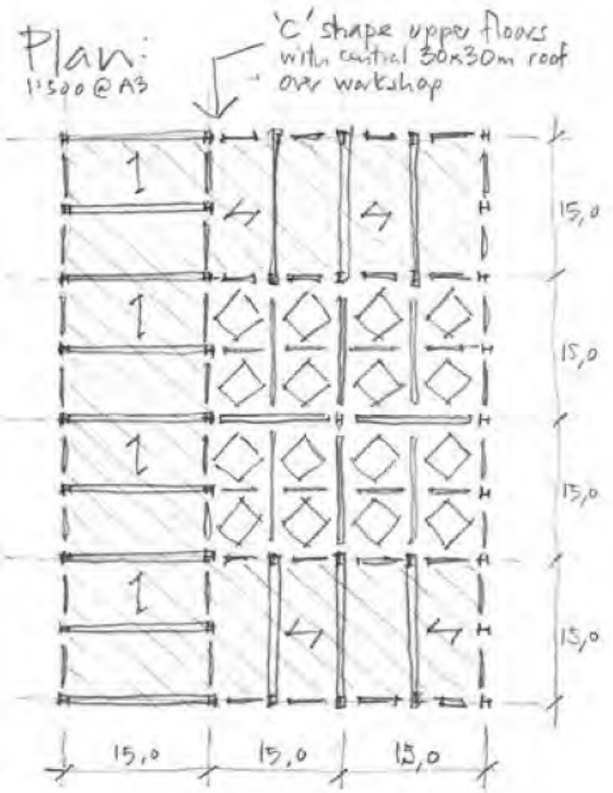




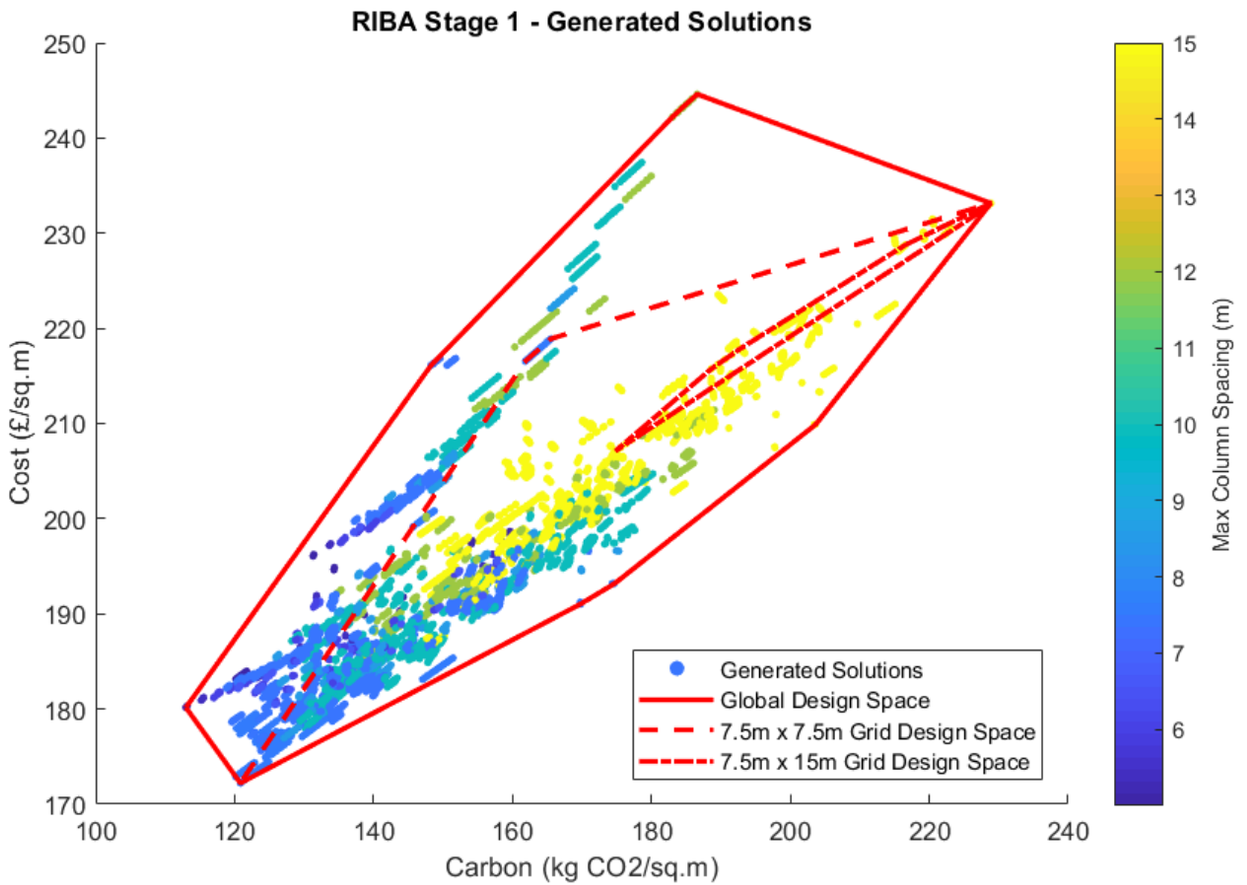
PANDA v1.0, cfd30@cam.ac.uk

RIBA Stage 1 – Concept Design

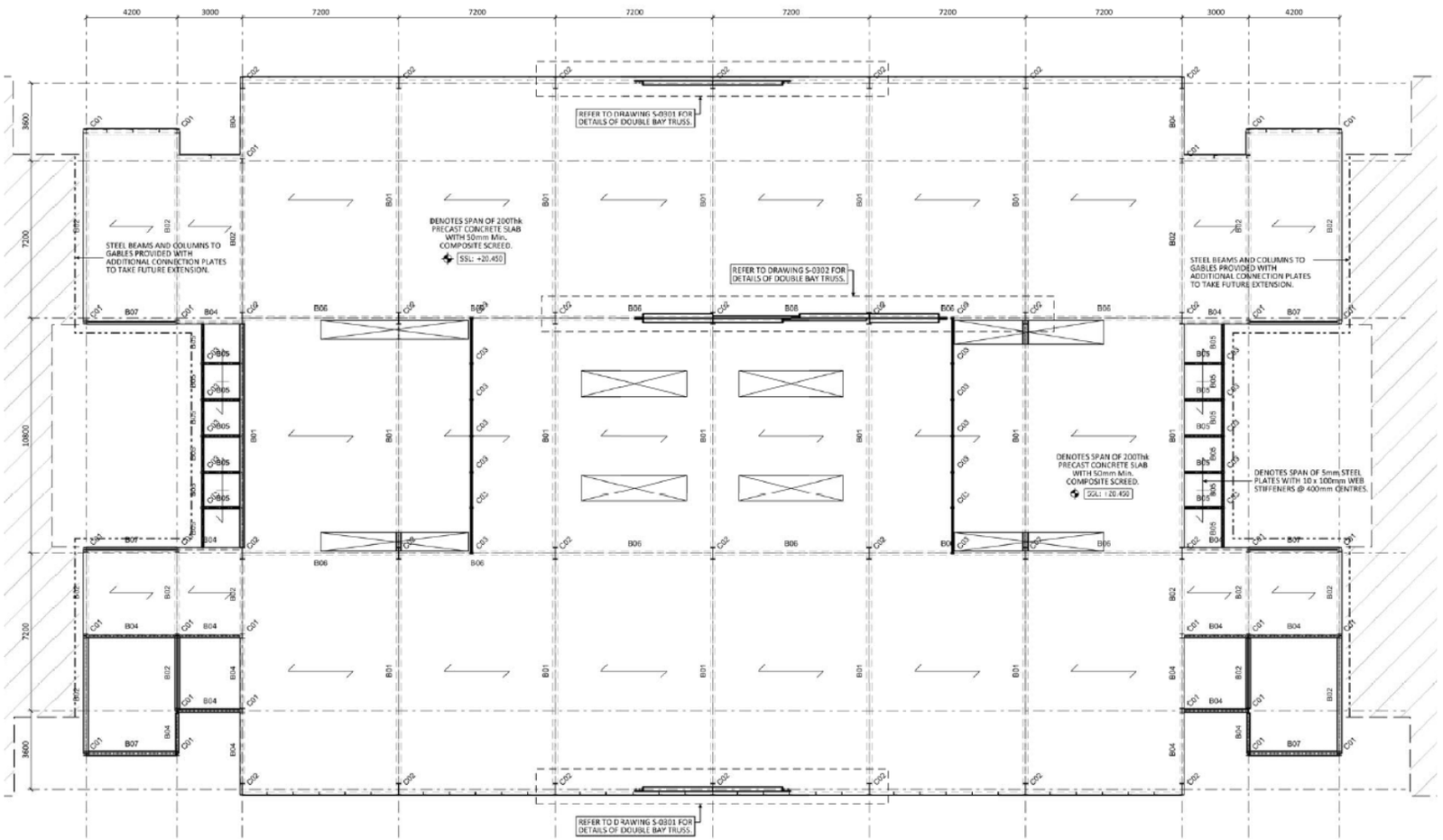




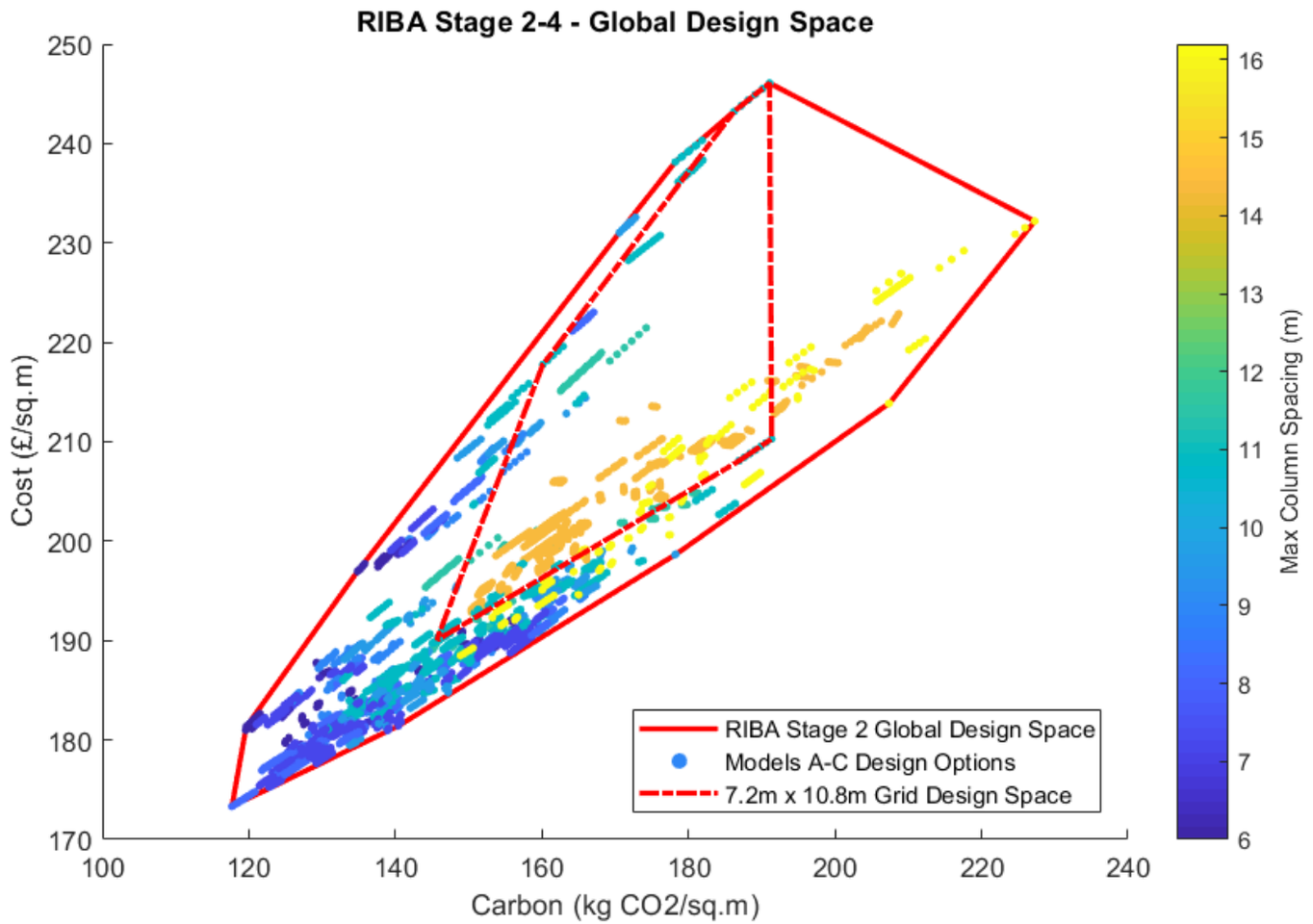
RIBA Stage 1 – Generated Design Space



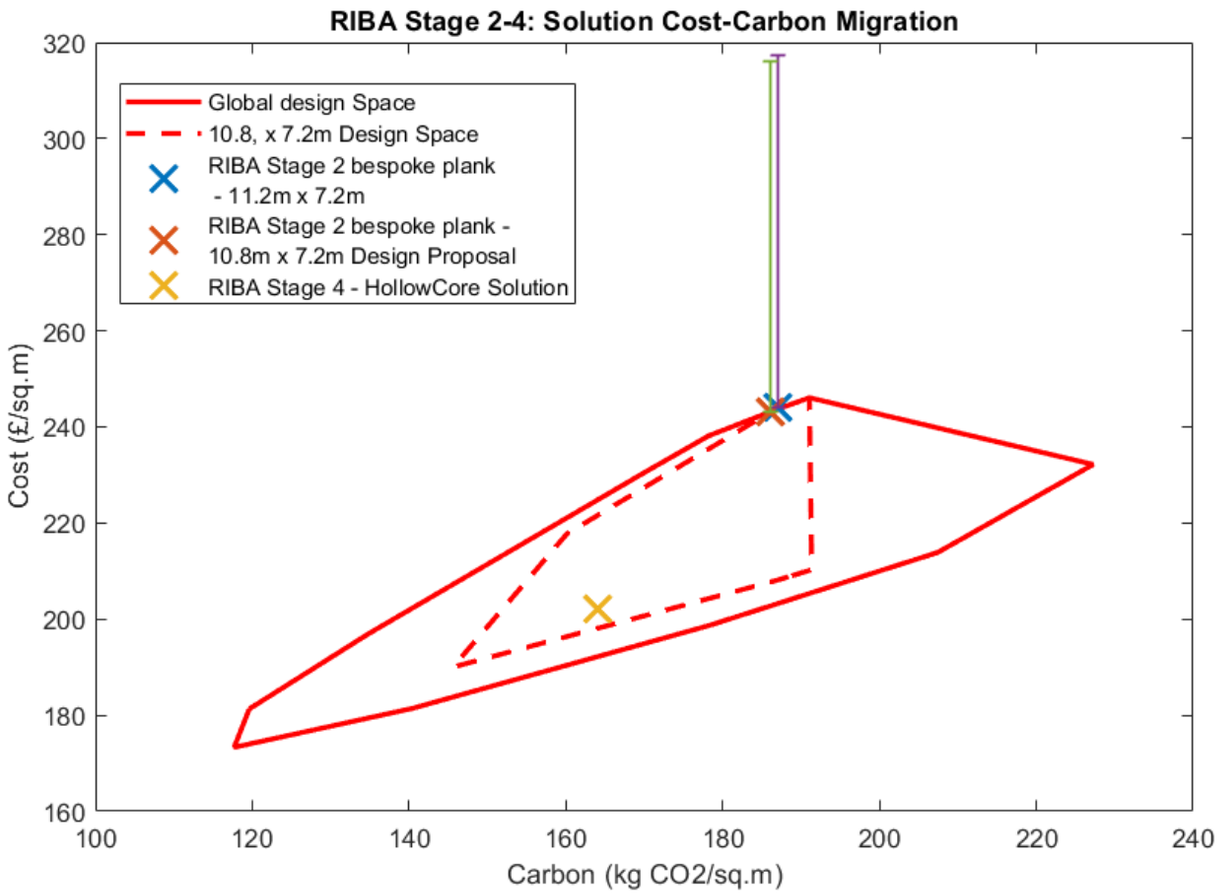
RIBA Stage 2 - 4 Developed Design



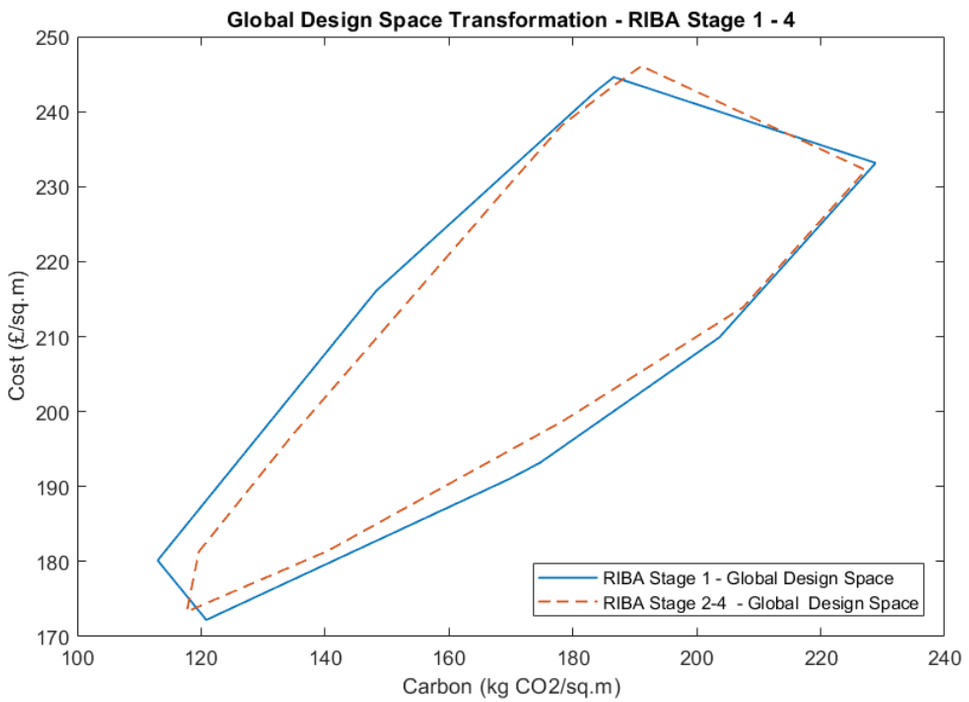
RIBA Stage 2 – 4 Generated Design Space

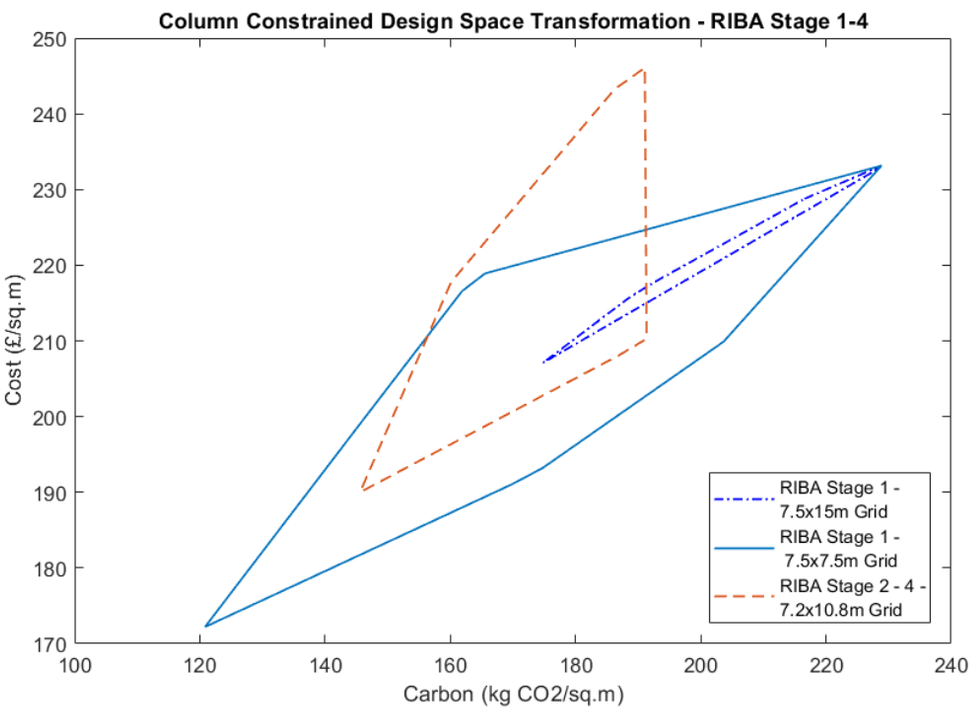


Design for Deconstruction – Slab design

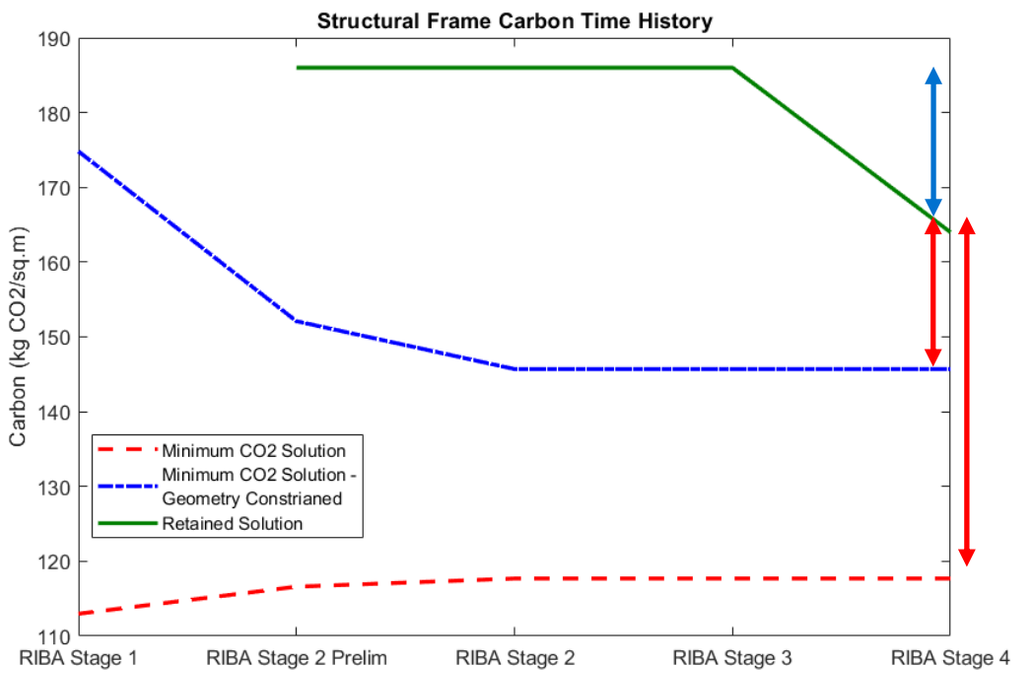


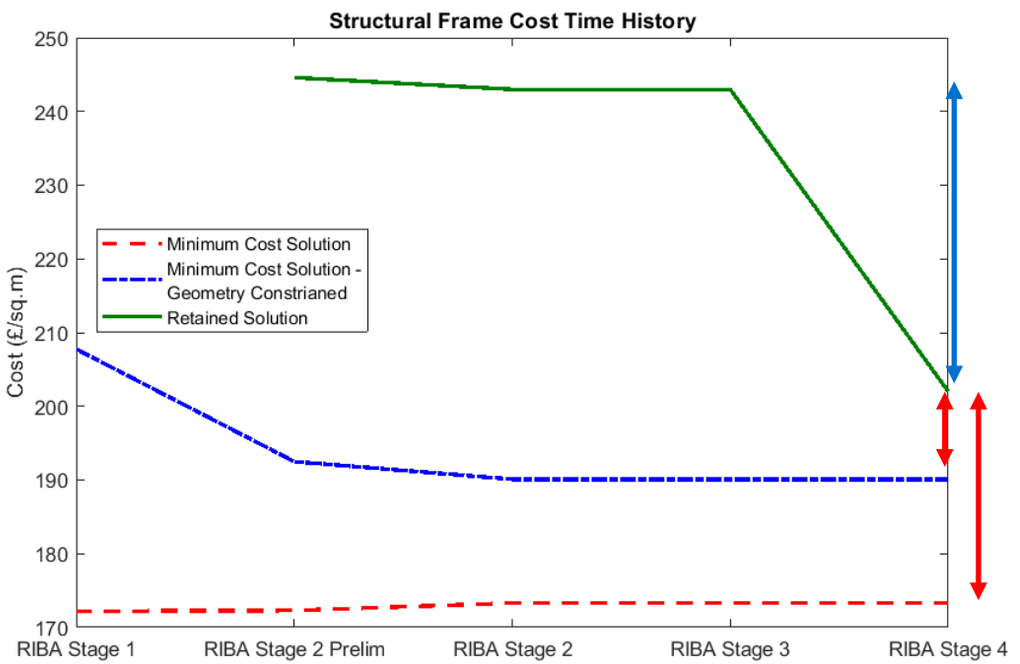
Design Space Migration – RIBA Stages



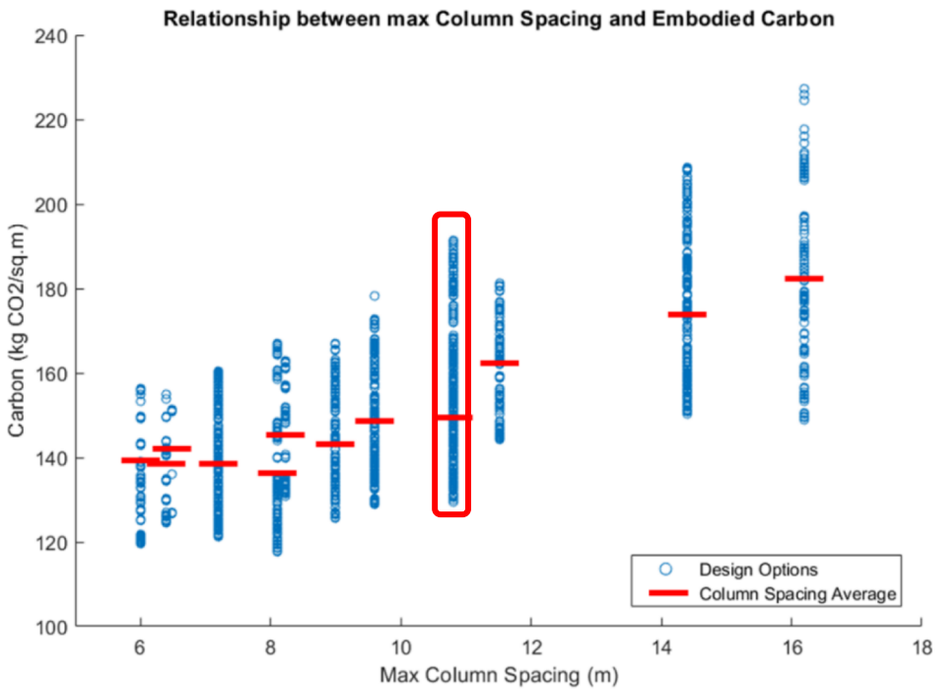


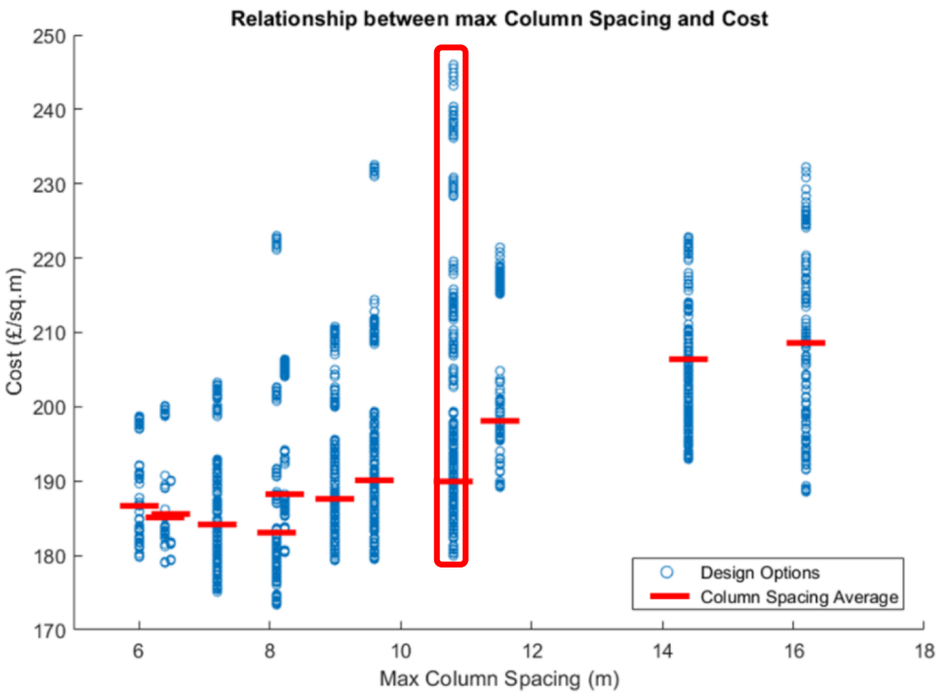
Solution Migration and Optimisation Potential





Impact of Structural Grid decisions on Design Space





Pilot Study Outcomes

Span/Cost Relationships

Shape of the design space influenced by geometry

- Limits to optimisation – Impact allocation of design resources?

Performance gap – What influences the level of service of a space?

PhD Work: What drives an acceptable grid?

‘You can’t put a desk in a column’

‘A 10m span wouldn’t interest a commercial client’

BRIGHT AND AIRY, HIGHLY FLEXIBLE FLOOR PLATES

How far can you go?

The demand for long single spans to provide column-free space is spreading beyond the financial services and leisure sectors as clients seek greater flexibility in their assets

PhD Work: What is flexibility?

Literature Review Open Questions:

What is the understanding of flexibility, and its impact on building design?

What are the measurable costs (£ and CO_2) of flexible strategies?

What are the measurable financial benefits of flexible strategies?

Which strategies are most common in the UK office building stock?

How do interpretations of flexibility impact design?

Industry survey – Perceptions from industry practitioners

What does flexibility mean to built environment professionals?

What does flexibility look like in a structure?

How does flexibility affect a building's

- Cost
- Embodied Carbon
- Value

Currently accepting responses

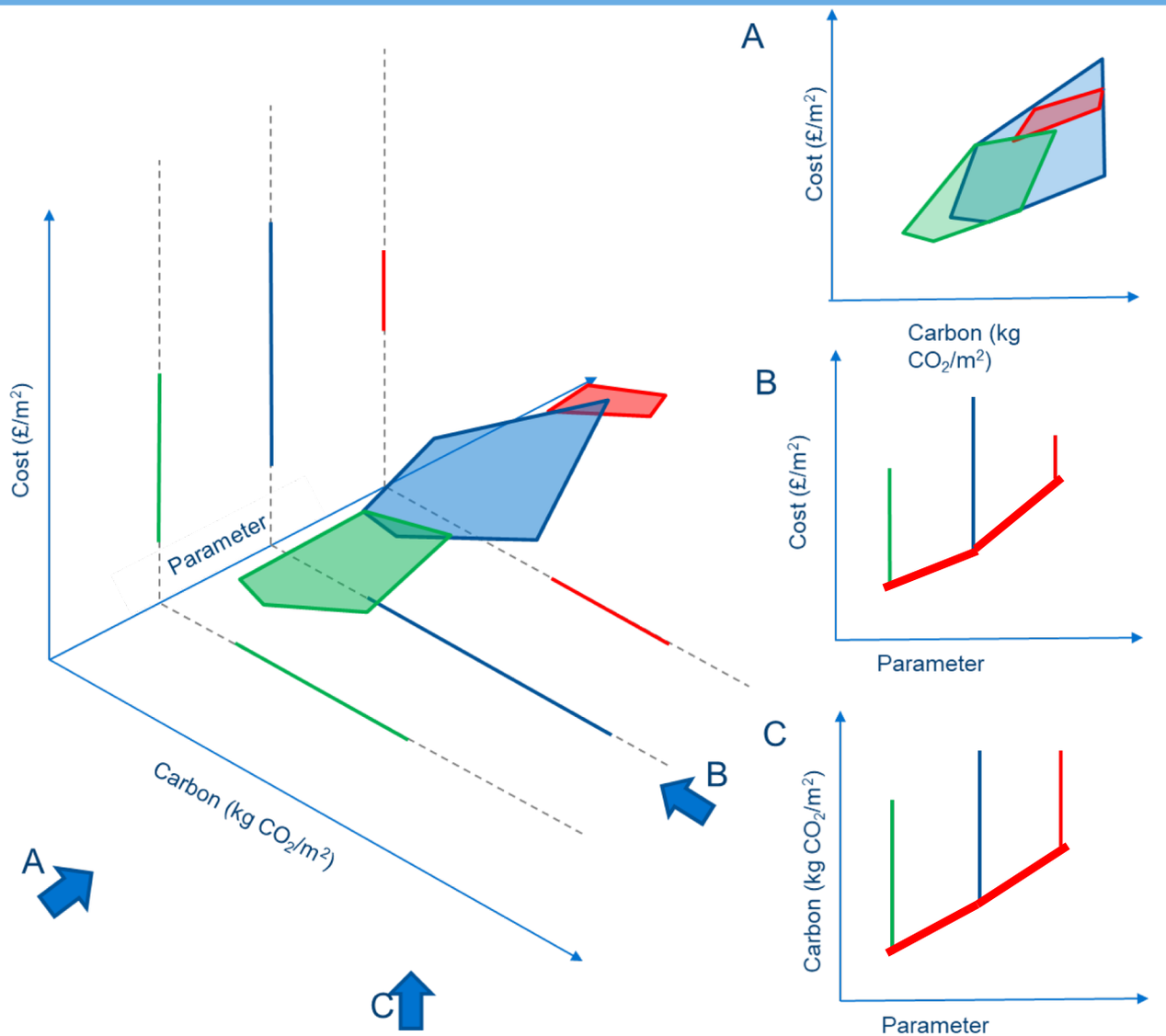
Environmental and Financial Costs of Flexibility

Method

Parametric study of flexible attributes in PANDA

- Floor load
- Floor-Floor Height
- Column Geometry
- Column Redundancy
- Structural Element Fire Rating

What is the cost/carbon sensitivity of altering these parameters?



Thank you

Questions?

References

- [1] J. M. Allwood, M. F. Ashby, T. G. Gutowski, and E. Worrell, “Material efficiency: A white paper,” *Resour. Conserv. Recycl.*, vol. 55, no. 3, pp. 362–381, 2011.
- [2] BSi, “BS7832:1995 Performance standards in building - checklist for briefing - contents of brief for building design,” BSi, BS 7832:1995, 1995.
- [3] B. De, B. Herazo-Cueto, I. Latunova, and G. Lizarralde, “Relationships between construction clients and participants of the building industry: Structures and mechanisms of coordination and communication,” *Archit. Eng. Des. Manag.*, vol. 7, no. 1, pp. 3–22, 2011.
- [4] S. T. Kometa, P. O. Olomolaiye, and F. C. Harris, “Attributes of UK construction clients influencing project consultants’ performance,” *Constr. Manag. Econ.*, vol. 12, no. 5, pp. 433–443, 1994.