BURO HAPPOLD

The ‘Conflict’ of Sustainability and Fire Safety in Facades

‘Green’ Fire Safety Issues Conference

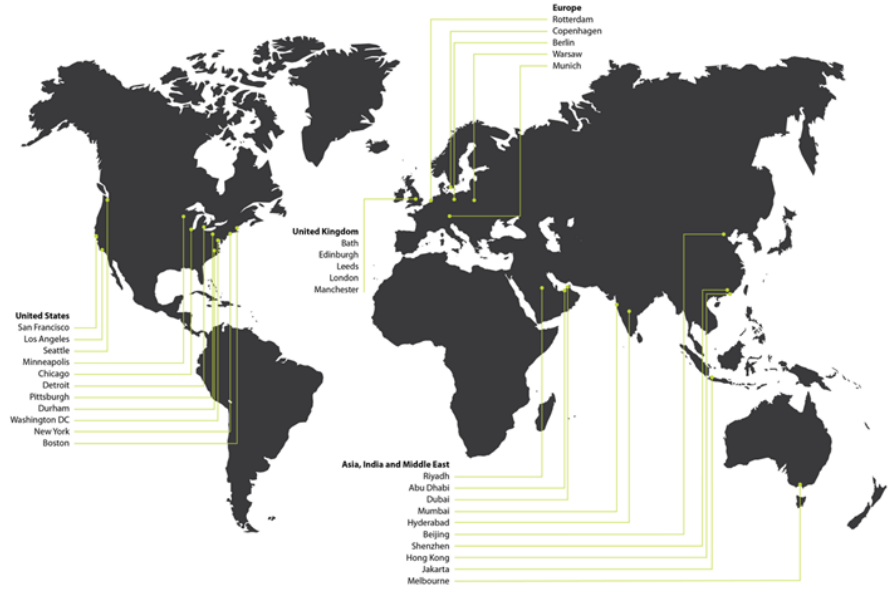
Simon Bate

Excel London

17th May 2023

Simon Bate
MEng

Façade Engineer



SECTORS

- Aviation
- Civic
- Commercial office
- Commercial residential
- Culture
- Education - schools & colleges
- Energy
- Healthcare
- Higher education
- Hospitality
- Rail
- Retail
- Scientific
- Sports & Entertainment
- Waste
- Water

SPECIALISMS

- Acoustics
- Air quality
- Asset management
- Bridges and civil structures
- Building services engineering
- Coastal and marine
- Computational analysis
- Drainage and storm water management
- Earthworks
- Economic development
- Economic Infrastructure
- Environmental consultancy
- Environmental impact assessments
- Facade engineering
- Fire engineering
- Flood risk
- Ground Engineering
- Highway engineering
- Inclusive design
- Integrated development planning
- IT communications & control
- Lighting
- Organisational development
- People movement
- Procurement
- Project management
- Regional planning
- Security
- Smart space
- Strategic infrastructure
- Structural engineering
- Sustainability
- Transport planning
- Utilities engineering
- Waste management
- Water management

BURO HAPPOLD

Motivation

- More than ever before, we are aware of the role of:
  - Fire safety in facades
  - Construction in relation to carbon emissions

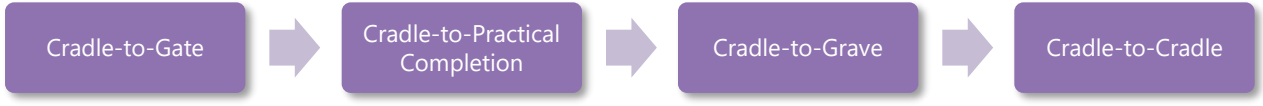
- World Green Building Council (WGBC): *'Buildings are currently responsible for 39% of global energy related carbon emissions: 28% from operational emissions, from energy needed to heat, cool and power them, and the remaining 11% from materials and construction'*

- Current perception of 'conflict' between fire safety and sustainability in facades

Contents

Embodied and Operational Carbon: What do we mean by 'Embodied Carbon' and 'Operational Carbon'?

- UKGBC, 2017: *'**Embodied carbon** is the total **greenhouse gas emissions** generated to produce a built asset. This includes emissions caused by **extraction, manufacture/ processing, transportation** and **assembly** of every product and element in an asset. In some cases, it may also include the **maintenance, replacement, deconstruction, disposal** and **end-of-life** aspects of the materials and systems that make up the asset.'*

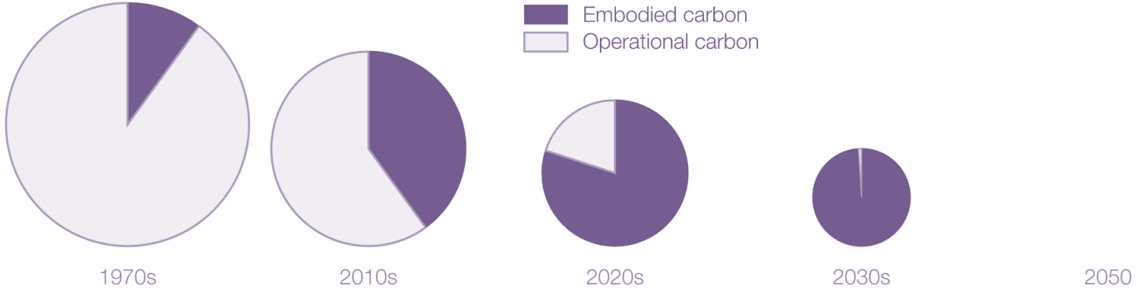


- **Operational carbon** refers to the total greenhouse gas emissions generated in the operation of a built asset. This may include heating, cooling, ventilation, lighting, water, and electricity.

Embodied and Operational Carbon: The Importance of Facades

- Facades account for **10-31%** of the total embodied carbon of a building (WBCSD, 2021)
- Ranking of embodied carbon by discipline:
  - New builds: 1. Structure, **2. Façade**, 3. MEP
  - Refurbishments: **1. Façade**, 2. MEP, 3. Structure (assuming retained primary structure)

- Operational carbon: insulation, control of thermal bridging, solar control, air-tightness



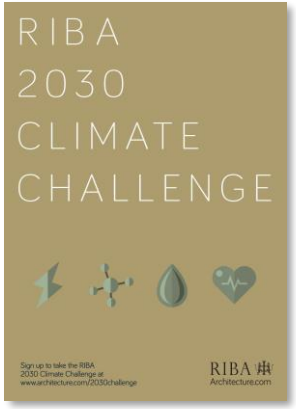
Embodied and Operational Carbon: Guidance and Targets

Long-term Buro Happold operational decarbonisation goal set, to achieve **NET ZERO** by 2045

For projects with collected data **71%** of project teams reported that the client's ambitions aligned with our principles and targets

Design all new build projects to be **NET ZERO CARBON** in operation by **2030**

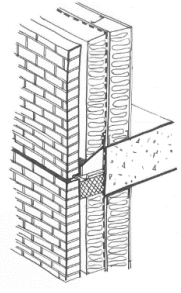
Reduce embodied carbon intensity of all new buildings, major retrofits and infrastructure projects **50%** By 2030 from 2020 baseline



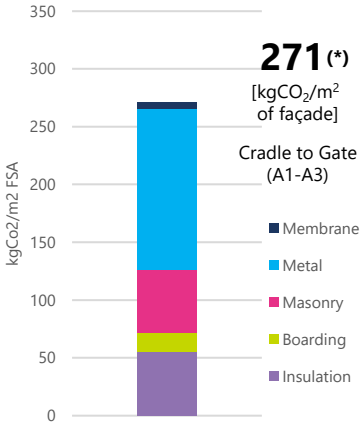
NEW BUILDINGS EMBODIED CARBON

Embodied Carbon of Façade Typologies

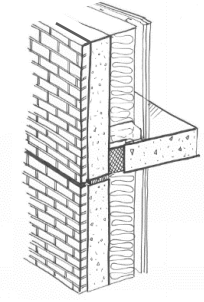
Brick Cavity Wall



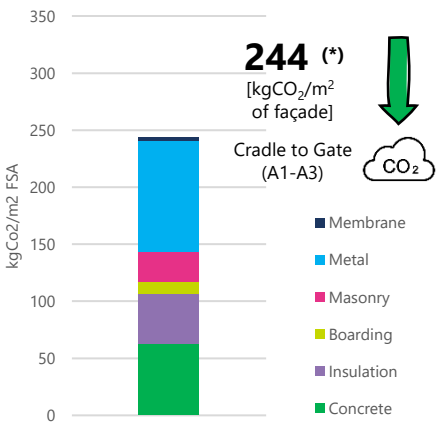
~344 kg/m² FSA
(3.4 kN/m²)



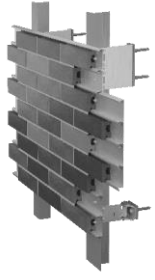
Brick Faced Precast



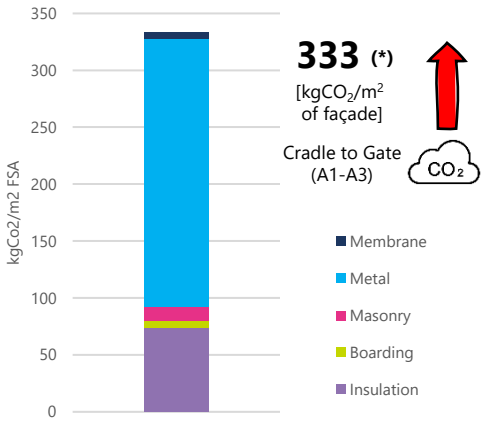
~605 kg/m² FSA
(5.9 kN/m²)



Brick Slip Rainscreen



~178 kg/m² FSA
(1.7 kN/m²)

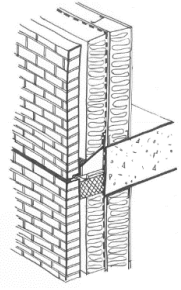


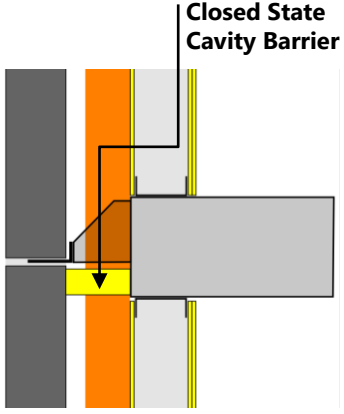
(*) Calculations assume the same thermal performance to meet LETI U-value targets for a 5.25m2 Facade Surface Area

BURO HAPPOLD

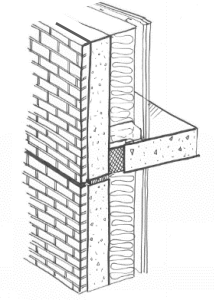
Embodied Carbon of Façade Typologies - Compartmentation

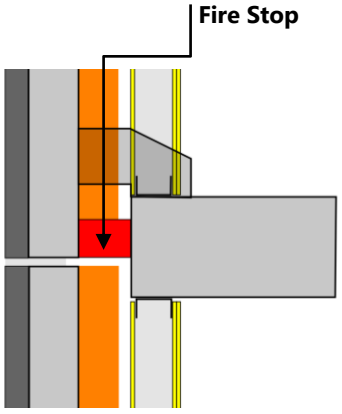
Brick Cavity Wall



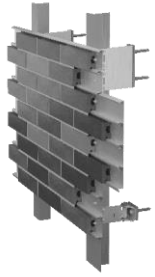


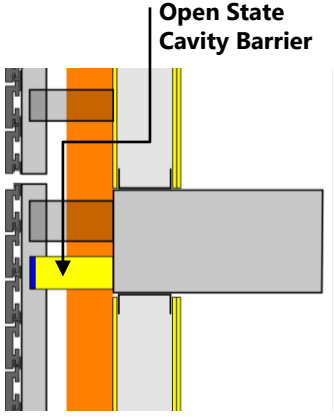
Brick Faced Precast





Brick Slip Rainscreen





Timber – Relevant and Non-Relevant Buildings

(2) Subject to paragraph (3), building work shall be carried out so that materials which become part of an external wall, or specified attachment, of a relevant building are of European Classification A2-s1, d0 or A1 (classified in accordance with the reaction to fire classification).

Materials and products

10.6 In a building with a storey 18m or more in height (see Diagram D6 in Appendix D) any insulation product, filler material (such as the core materials of metal composite panels, sandwich panels and window spandrel panels but not including gaskets, sealants and similar) etc. used in the construction of an external wall should be class A2-s3, d2 or better (see Appendix B). This restriction does not apply to masonry cavity wall construction which complies with Diagram 8.2 in Section 8. Where regulation 7(2) applies, that regulation prevails over all the provisions in this paragraph.

10.7 In buildings that include a 'residential' purpose (purpose groups 1 and 2) with a storey 11m or more in height (see Diagram D6 in Appendix D) any insulation product, filler material (such as the core materials of metal composite panels, sandwich panels and window spandrel panels but not including gaskets, sealants and similar) etc. used in the construction of an external wall should be class A2-s1, d0 or better (see Appendix B). This restriction does not apply to masonry cavity wall construction which complies with Diagram 8.2 in Section 8. Where regulation 7(2) applies, that regulation prevails over all the provisions in this paragraph.

Table 10.1 Reaction to fire performance of external surface of walls

Building type	Building height	Less than 1000mm from the relevant boundary	1000mm or more from the relevant boundary
'Relevant buildings' as defined in regulation 7(4) (see paragraph 10.14)		Class A2-s1, d0[1] or better	Class A2-s1, d0[1] or better
All 'residential' purpose groups (purpose groups 1 and 2)	More than 11m	Class A2-s1, d0[2] or better	Class A2-s1, d0[2] or better
	11m or less	Class B-s3, d2[2] or better	No provisions
Assembly and recreation	More than 18m	Class B-s3, d2[2] or better	From ground level to 18m: class C-s3, d2[2] or better
			From 18m in height and above: class B-s3, d2[2] or better
	18m or less	Class B-s3, d2[2] or better	Up to 10m above ground level: class C-s3, d2[2] or better
			Up to 10m above a roof or any part of the building to which the public have access: class C-s3, d2[2] or better[4]
			From 10m in height and above: no minimum performance
Any other building	More than 18m	Class B-s3, d2[2] or better	From ground level to 18m: class C-s3, d2[2] or better
			From 18m in height and above: class B-s3, d2[2] or better
	18m or less	Class B-s3, d2[2] or better	No provisions

NOTES:

In all cases all the following provisions apply.

- Regulation 7(1A) prohibits the use of relevant metal composite materials in the external walls, and specified attachments, of all buildings of any height (see paragraphs 10.11 and 10.12).
- The advice in paragraph 10.4 should always be followed.

In addition to the provisions within this table, buildings with a storey 18m or more above ground level should also meet the provisions of paragraph 10.6.

In addition to the provisions within this table, buildings with a storey 11m or more above ground level should also meet the provisions of paragraph 10.7.

1. The restrictions for these buildings apply to all the materials used in the external wall and specified attachments (see paragraphs 10.13 to 10.16 for further guidance).
2. Profiled or flat steel sheet at least 0.5mm thick with an organic coating of no more than 0.2mm thickness is also acceptable.
3. Timber cladding at least 9mm thick is also acceptable.
4. 10m is measured from the top surface of the roof.

Regulatory Compliance

- B4. (1): *The external walls of buildings shall adequately resist the spread of fire over the walls and from one building to another having regard to the height, use and position of the building.*

- Usage of combustible materials on projects need to be evaluated on factors such as the overall project context and occupant usage, in addition to the Government guidance, **and** considering the overarching regulatory requirements

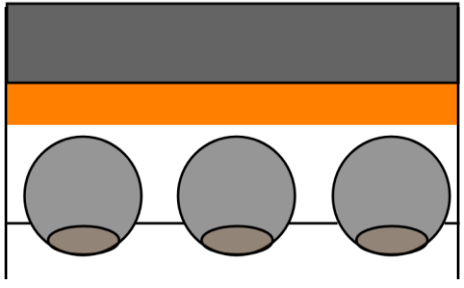
Source: London Fire Brigade, 2020

Green Walls

- Benefits in relation to biodiversity, air purification, noise, etc.
  - Embodied carbon?
- Suitable guidance?
  - Approved Document B (Dec. 2022)
  - Fire Performance of Green Roofs and Walls, DCLG (Aug. 2013)
- Design considerations:
  - Integration of Cavity Barriers in Profiled Systems
  - Environmental Conditions & Applicability of Testing
  - System Maintenance and Client Responsibility

Oasia Hotel, Singapore (Source: WLA, 2018)

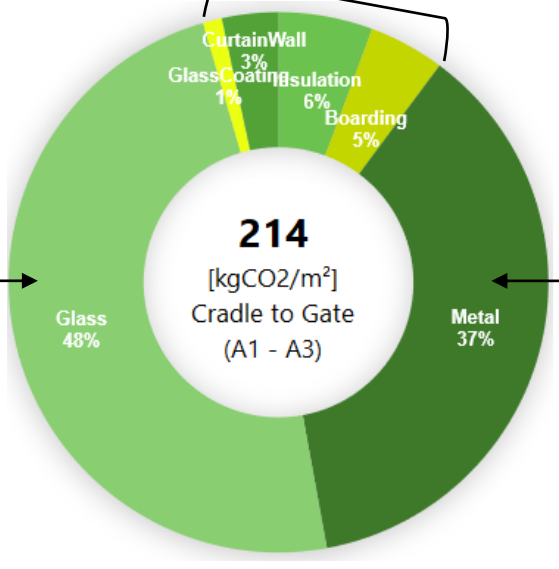
Example of 'Pocket' Green Wall System



Embodied Carbon: Glazing Systems

Low-carbon glass using recycled glass cullets

Account for a comparatively small percentage



What other materials can be used?

Embodied Carbon: Glazing Systems - Timber

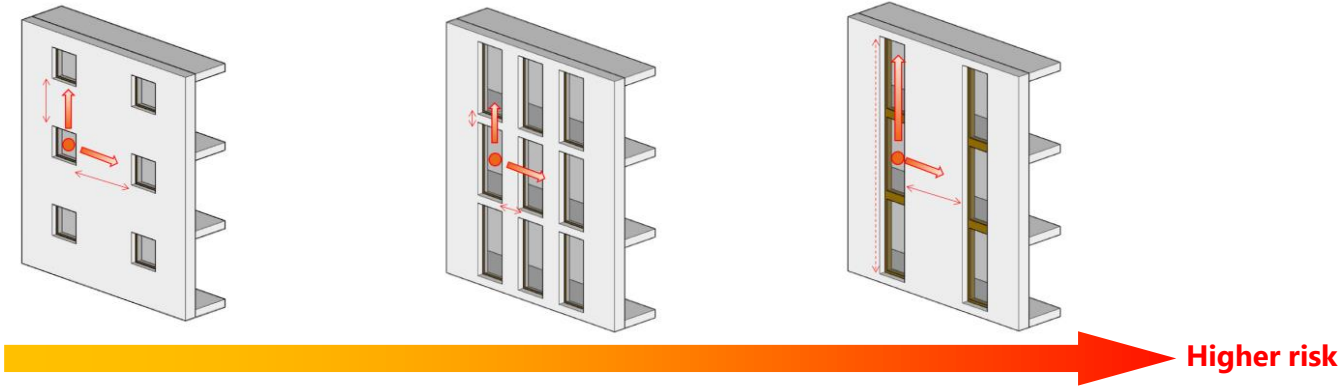
- Regulation 7(3) exempts:
  - (c) door frames and doors;
  - (j) window frames and glass;
- Requirement B(4)
- Project specific review: exposure, continuity, risk

Materials and products

10.6 In a building with a storey 18m or more in height (see Diagram D6 in Appendix D) any insulation product, filler material (such as the core materials of metal composite panels, sandwich panels and window spandrel panels but not including gaskets, sealants and similar) etc. used in the construction of an external wall should be class A2-s3, d2 or better (see Appendix B). This restriction does not apply to masonry cavity wall construction which complies with Diagram 8.2 in Section 8. Where regulation 7(2) applies, that regulation prevails over all the provisions in this paragraph.

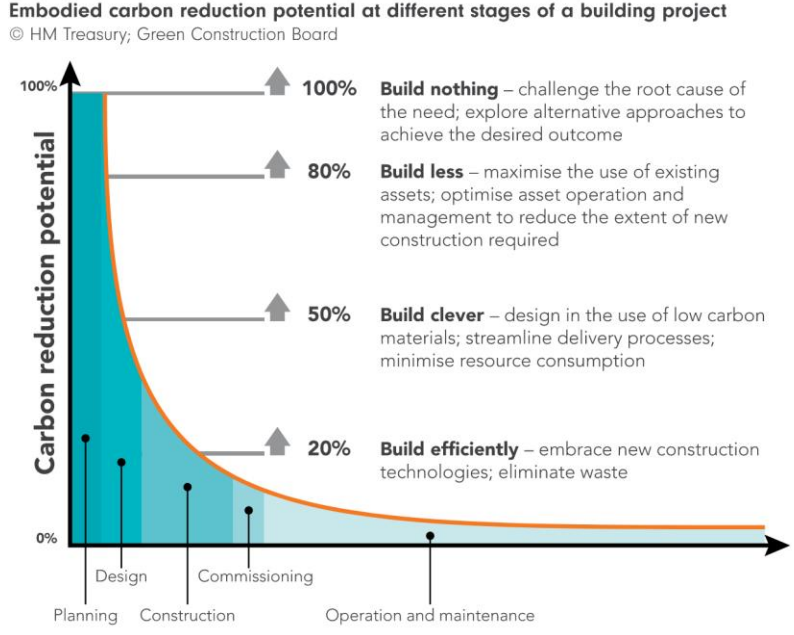
10.7 In buildings that include a 'residential' purpose (purpose groups 1 and 2) with a storey 11m or more in height (see Diagram D6 in Appendix D) any insulation product, filler material (such as the core materials of metal composite panels, sandwich panels and window spandrel panels but not including gaskets, sealants and similar) etc. used in the construction of an external wall should be class A2-s1, d0 or better (see Appendix B). This restriction does not apply to masonry cavity wall construction which complies with Diagram 8.2 in Section 8. Where regulation 7(2) applies, that regulation prevails over all the provisions in this paragraph.

The Building Regulations 2010, Approved Document B (2022)



How else can we reduce Embodied Carbon?

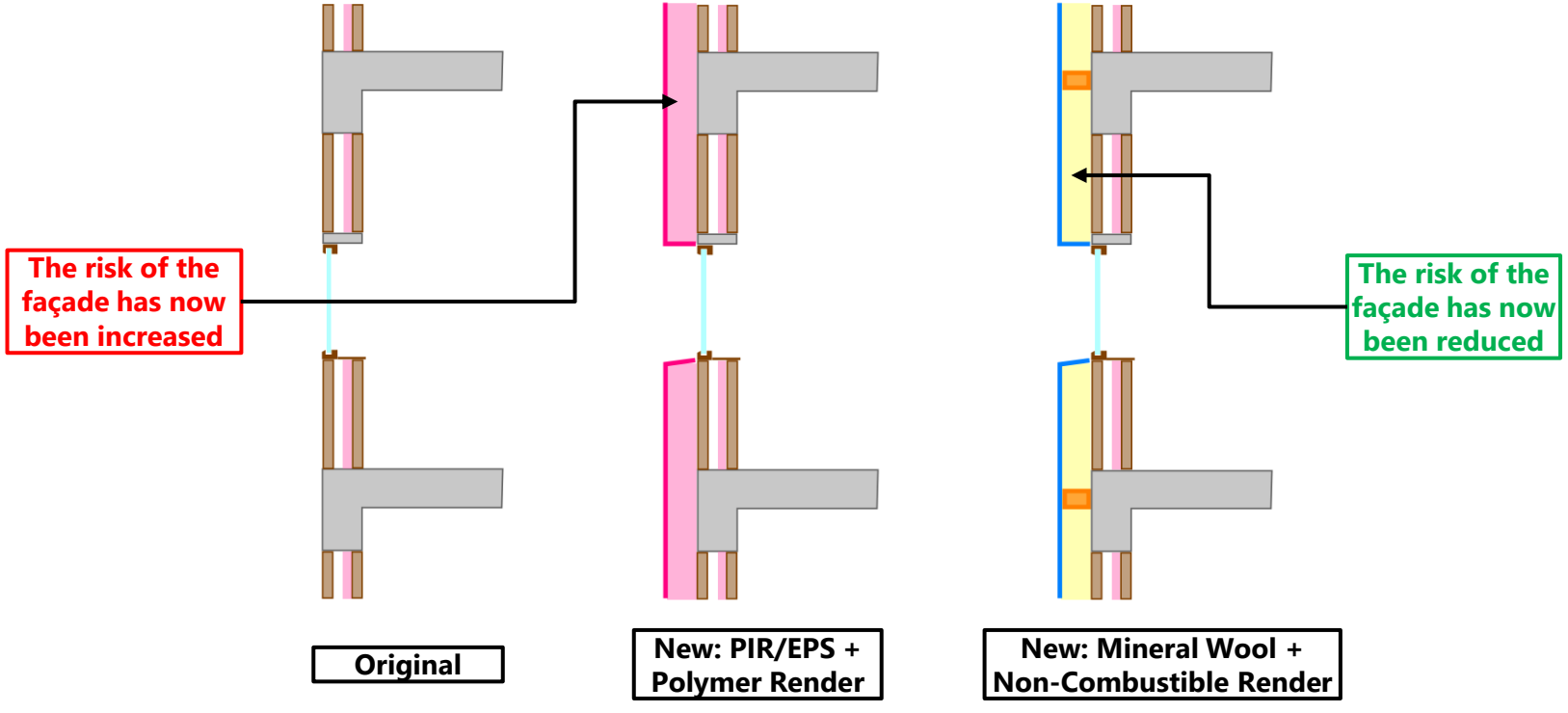
- Consider embodied carbon early on in the construction process
- Efficient designs
- Careful selection of materials and systems (low-carbon alternatives)
- Re-using and recycling materials
- Designing for disassembly
- Minimisation of waste and modularisation of components
- Discussing Client expectations



Source: Green Construction Board, adapted from UKGBC

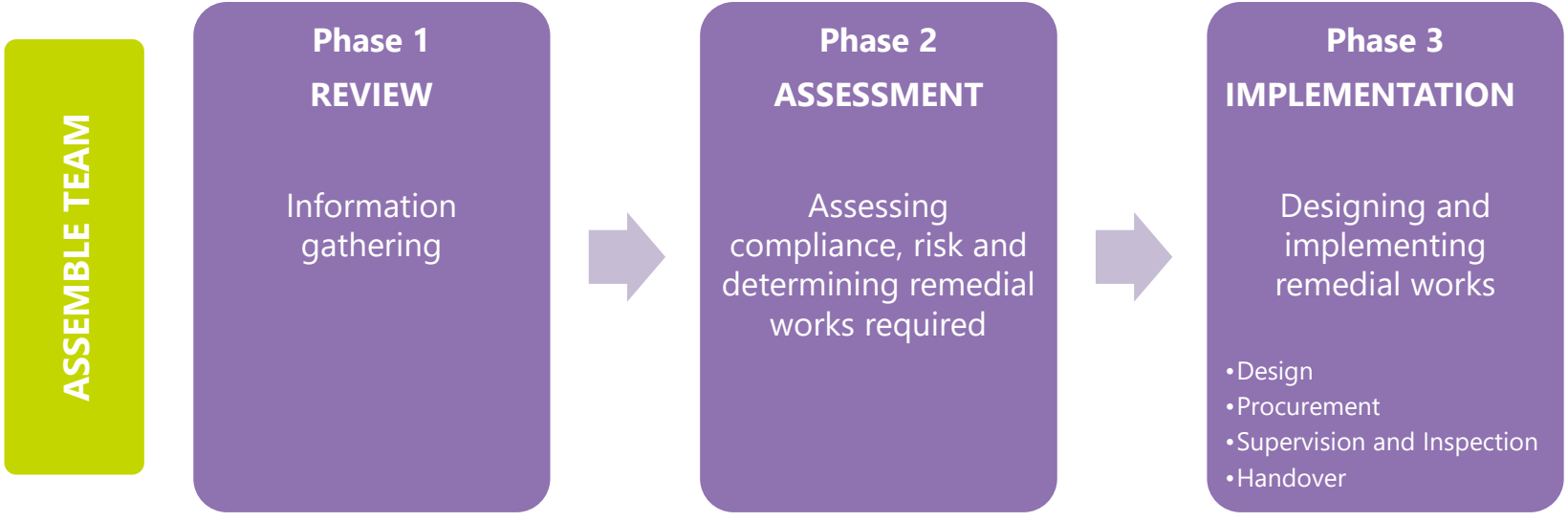
EXISTING BUILDINGS OPERATIONAL CARBON

Response to Operational Carbon Requirements

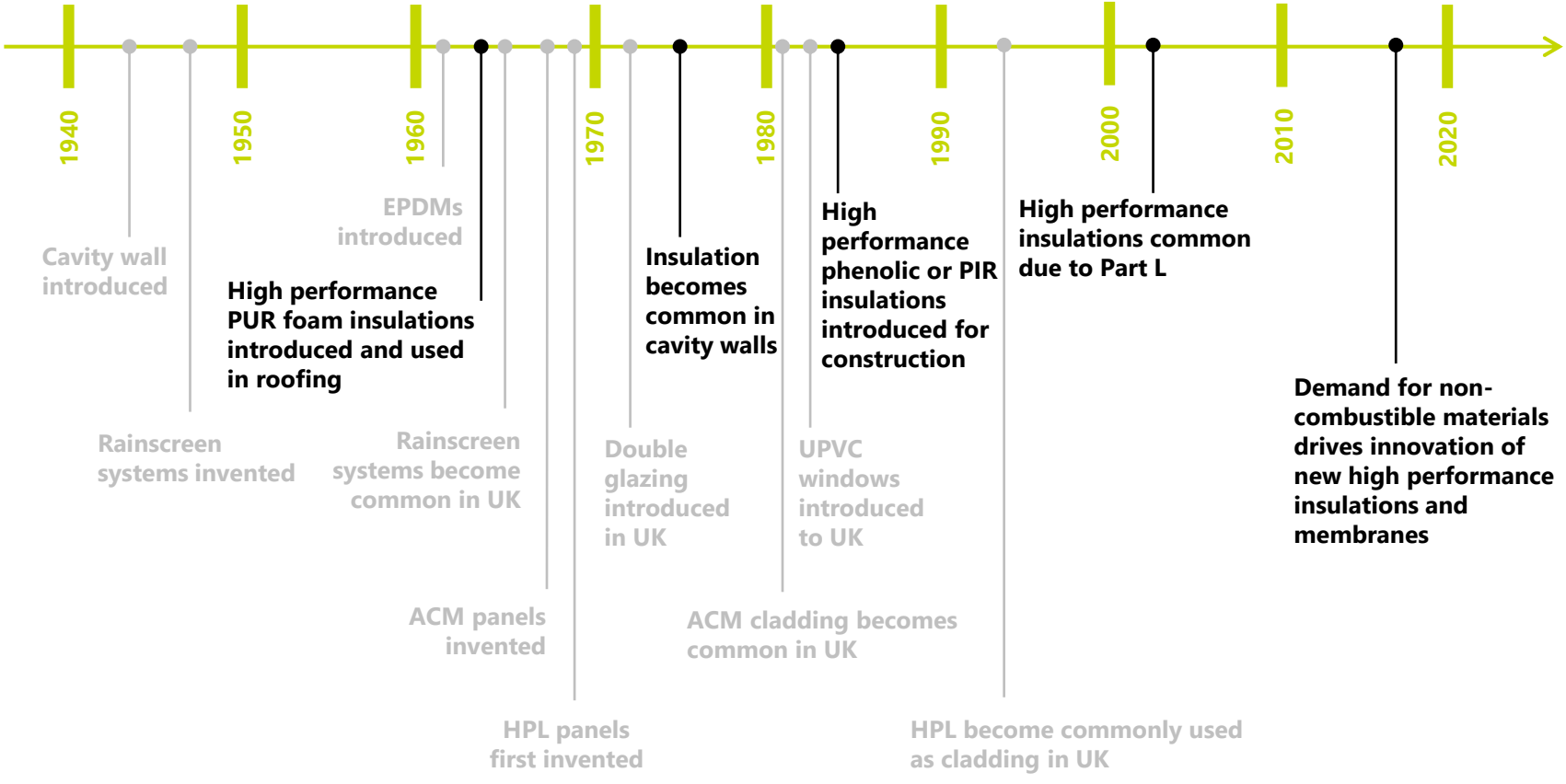


- Improving the existing fabric without compromising on fire safety

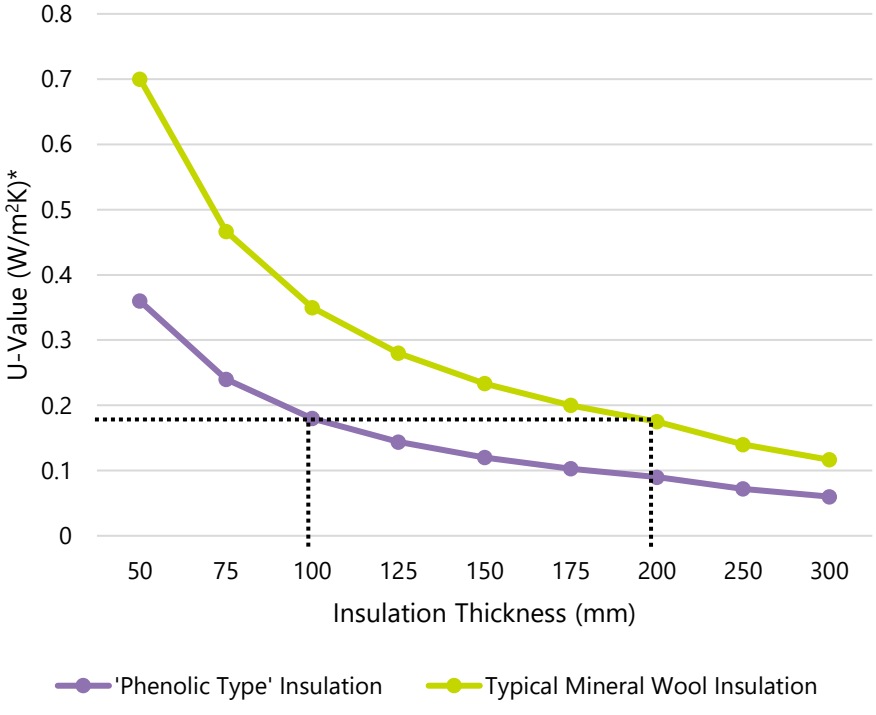
Approach to Remedial Works



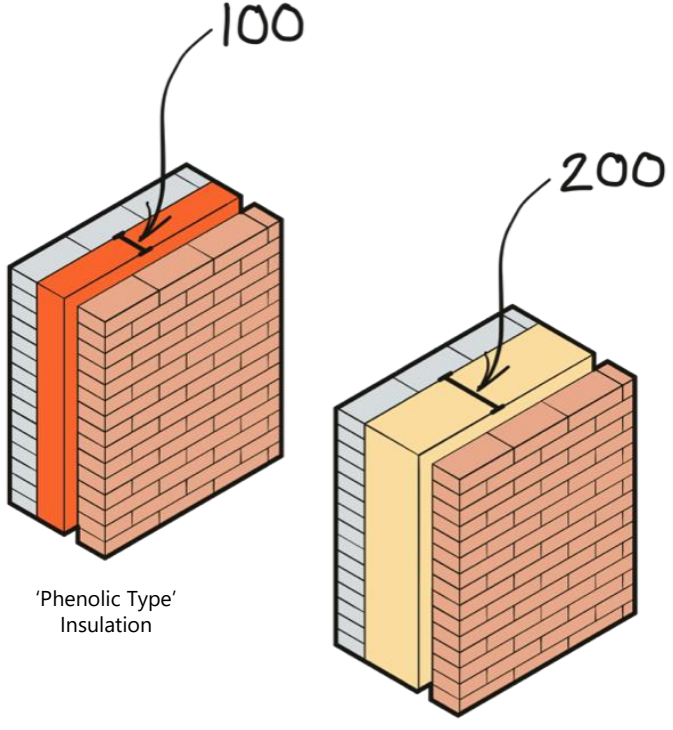
Insulation within the UK: A Timeline



Insulation Types and Thermal Performance



*U-Value assuming homogeneous insulation only

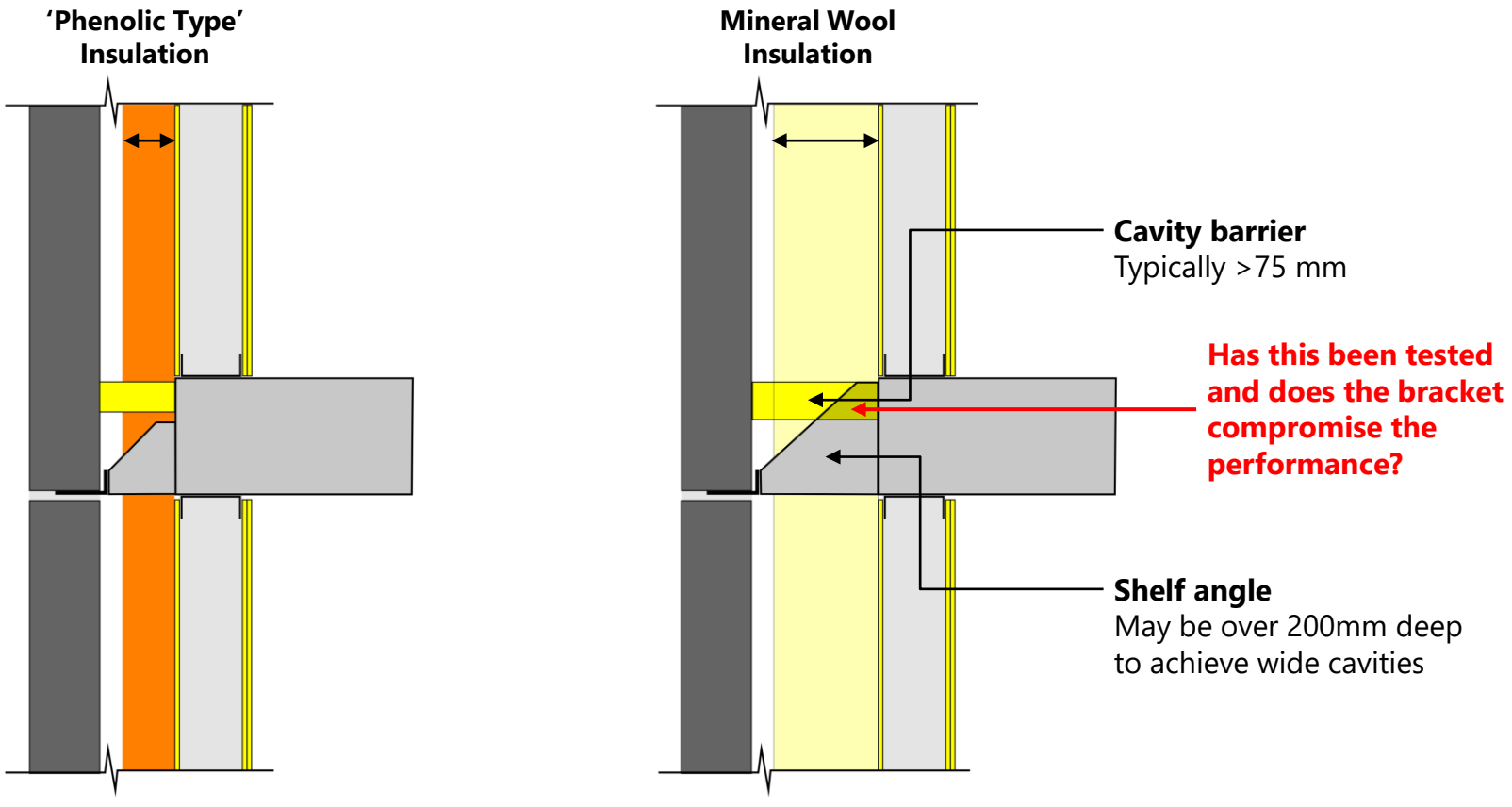


'Phenolic Type' Insulation

Mineral Wool Insulation

BURO HAPPOLD

What are the Implications?



What are the Implications?

Importance of Site Installation Quality

KEY TAKEAWAYS

Key Takeaways

- We need to reduce embodied carbon of new buildings, and operational carbon of existing buildings **without** compromising fire safety:
  - There are many methods of reducing embodied and operational carbon that do not impact the fire safety risk of a façade
  - We should not altogether abandon the use of low-carbon alternatives, even if they may have a higher combustibility - we need to understand better how these materials perform within systems and design with them conscious of minimising risk

- Monitoring of site installation is critical to ensure fire safety

BURO HAPPOLD

Thank you for listening!

Simon Bate
Simon.Bate@burohappold.com

www.burohappold.com