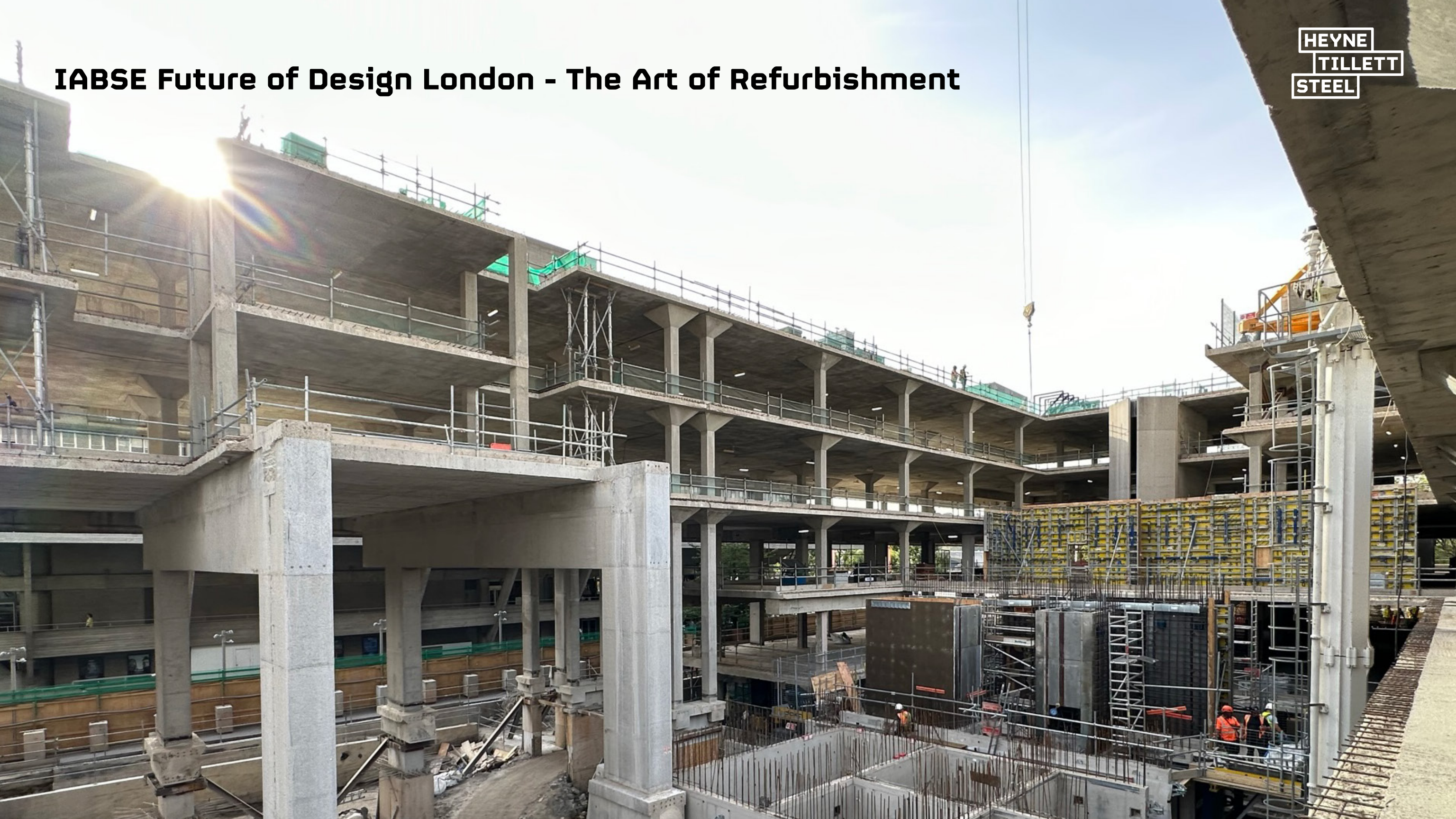


# IABSE Future of Design London - The Art of Refurbishment

HEYNE  
TILLET  
STEEL





# Practice Overview

Delivering intelligent low carbon solutions on complex, urban sites.



**AJ** RETROFIT  
AWARDS

Winner of the AJ Retrofit of the Year 2022



# Practice in Numbers



**3000**

projects across  
all major building  
types, materials and  
modern methods of  
construction

**172**  
employees



**16**  
years

HTS was founded in 2007 and is now one of the leading structural and civil engineering practices in London. In 2021 we became an employee-owned trust and opened our Manchester office.



**100**  
awards

## Engineering - the second coming

As an industry, and as individuals, we have a massive influence and a huge responsibility to society to lower carbon. We all need to act responsibly.

But who is the judge of what is sustainable?

Or what is retainable?

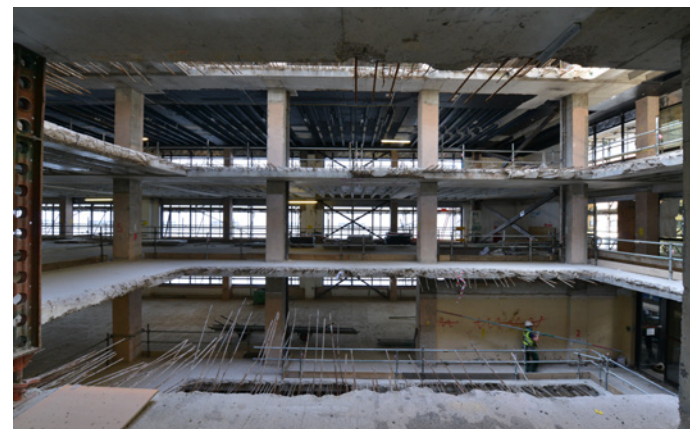
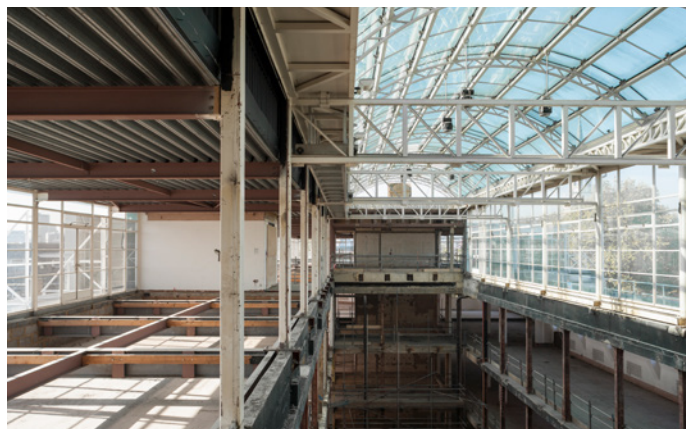
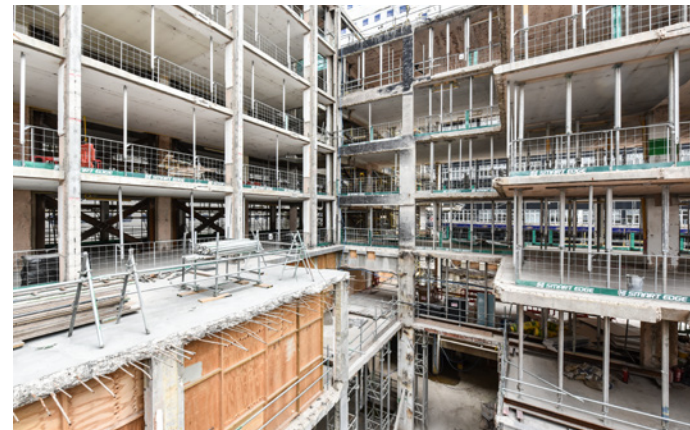
Ultimately, it's down to the planning authorities.

Opinions and judgements on a building's future are formed based on research, facts and the information presented by consultants. How do we ensure that this is transparent, consistent, experienced and fair?

...Being led by science

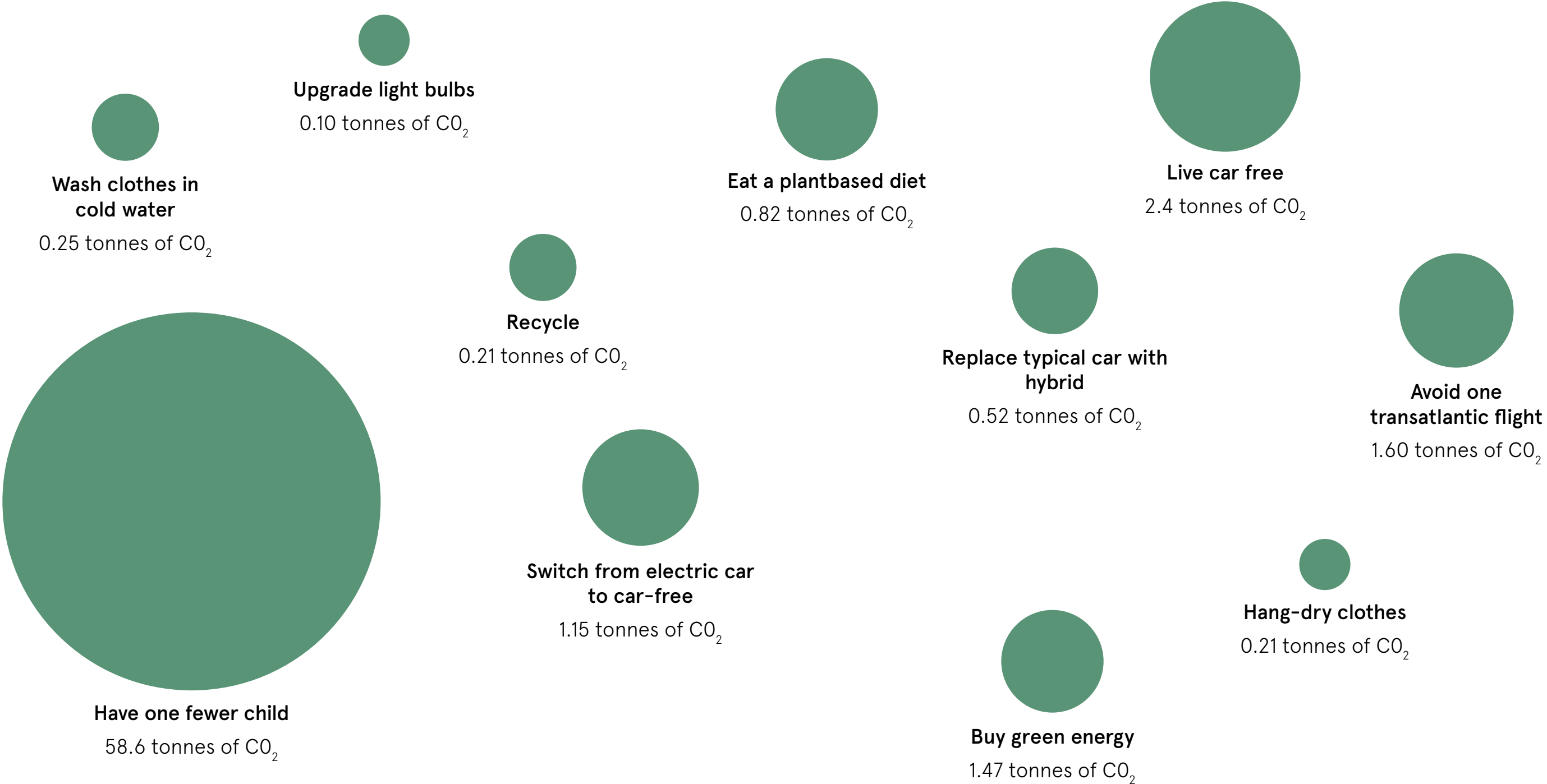


# 30 Years of adapting structures



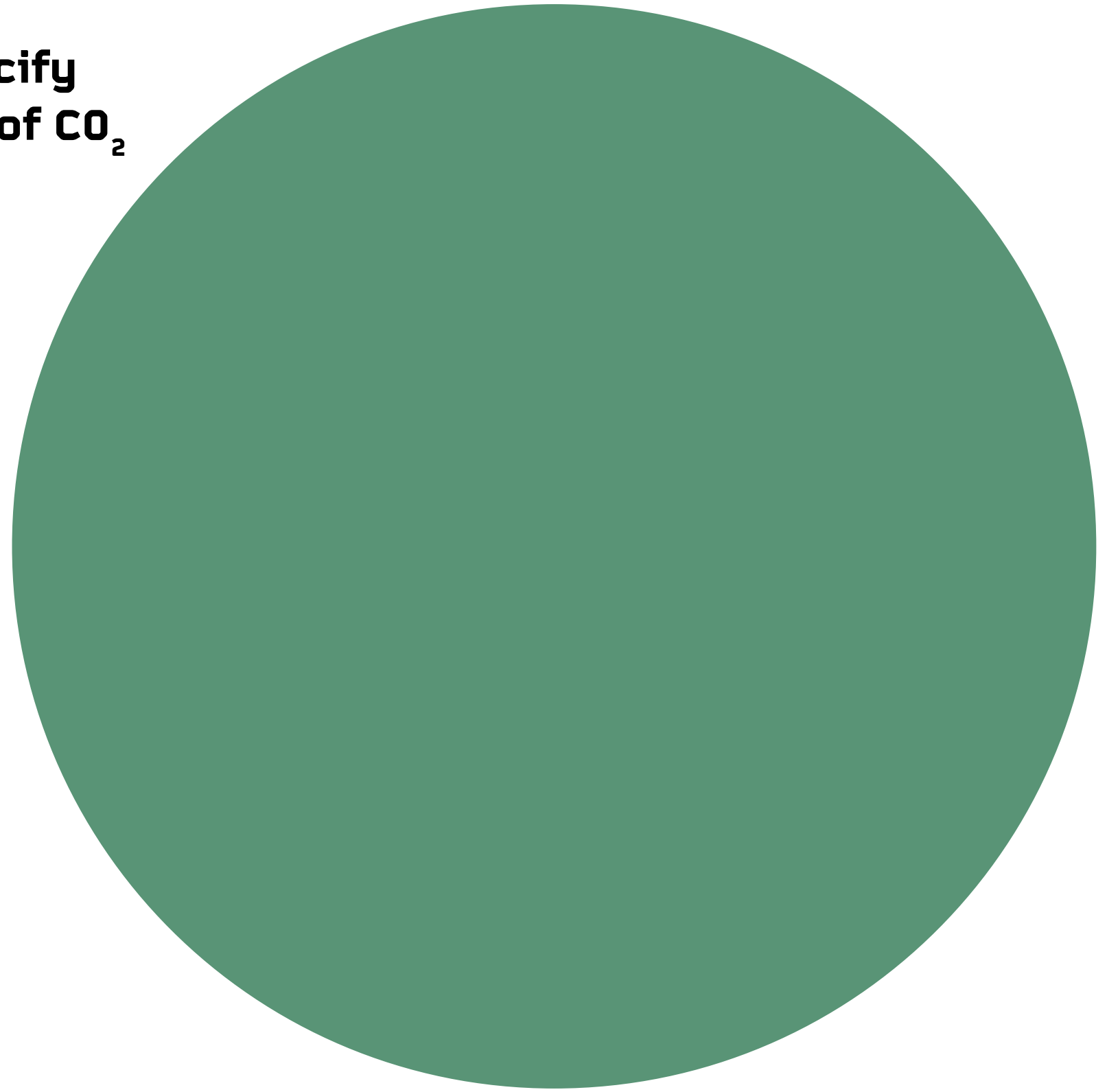
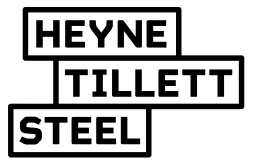


# Lifestyle Choices on Carbon Emissions Per Year





**Structural Engineers Each Specify  
on Average Over 1000 Tonnes of CO<sub>2</sub>  
Per Year**





# Engineers Declare: HTS Approach

- + Design to retain existing structure make the most of what you have.
- + Design to minimise material used – always maximise utilisation.
- + Use low embodied carbon material.
- + Designs to achieve the targets set out in the 'RIBA 2030 Climate Challenge'.
- + Measure embodied carbon of our designs at all stages using our Embodied carbon tool to be assessed for all.
- + Optioneer to find the most sustainable solution assessing carbon as you go.
- + Design with future adaptations and flexibility in mind – again this must be communicated to clients clearly.
- + Sustainable benefits to be communicated clearly to clients









“Emissions are a symptom of rampant resource consumption. If we do not get resource consumption under control, we will not get emissions under control. That is absolutely clear.”

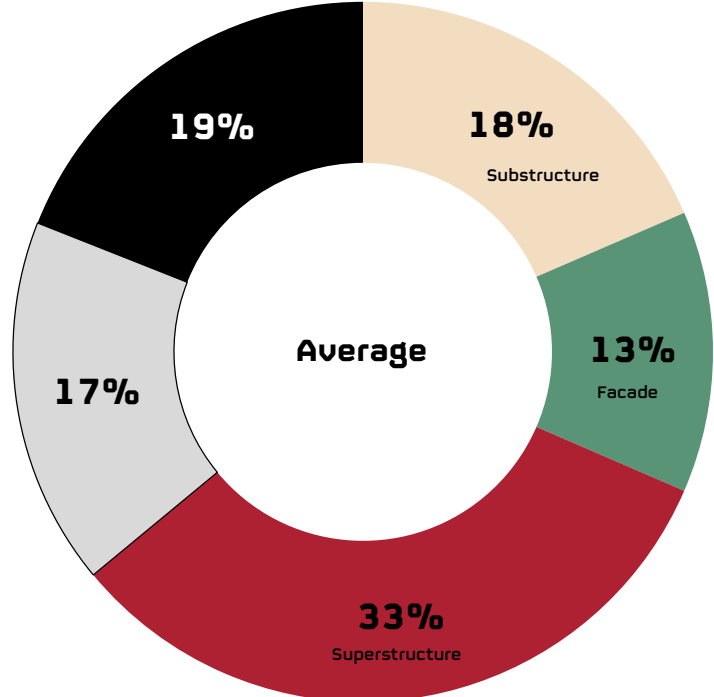
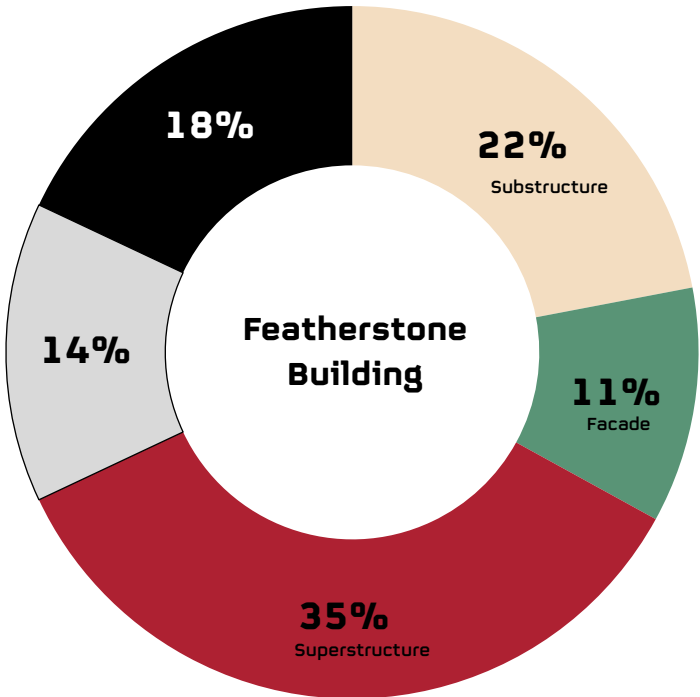
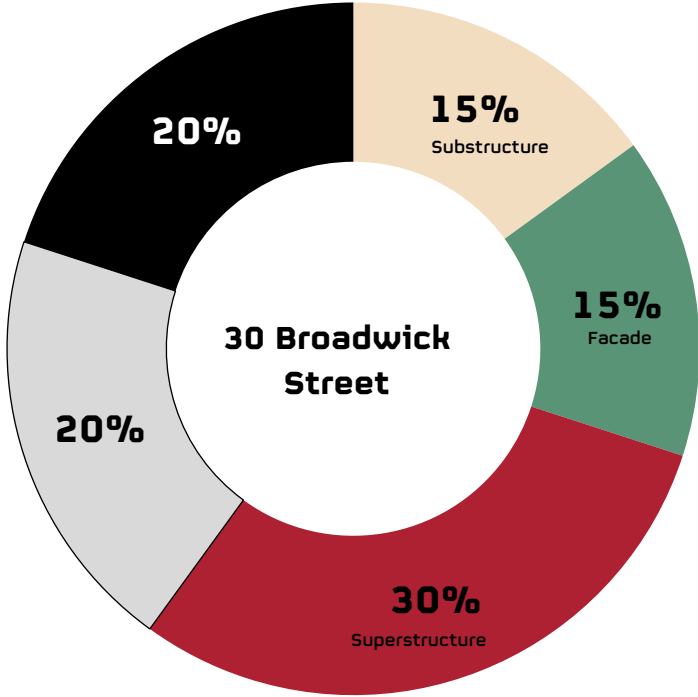
Professor Sir Ian Boyd, Chief Scientific Adviser at the Department of Environment, Dec. 2017

Re use is nothing new.

We must consume less.

**The climate emergency is NOW.**

# The Built Environment is Responsible for 42% of Emissions - What Percentage (A1 - A5) at Practical Completion is Structure?

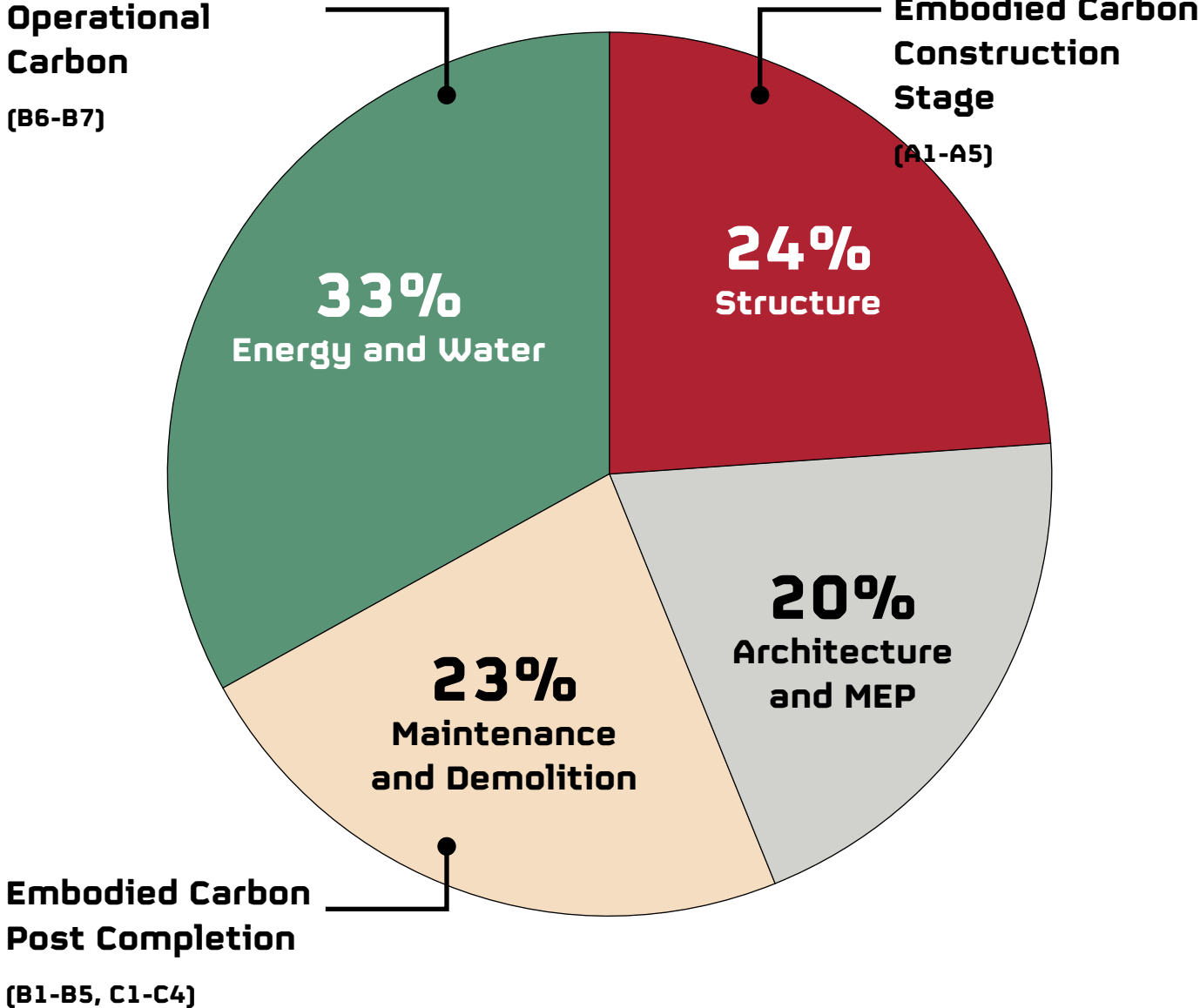


50-70% of overall embodied carbon is structure



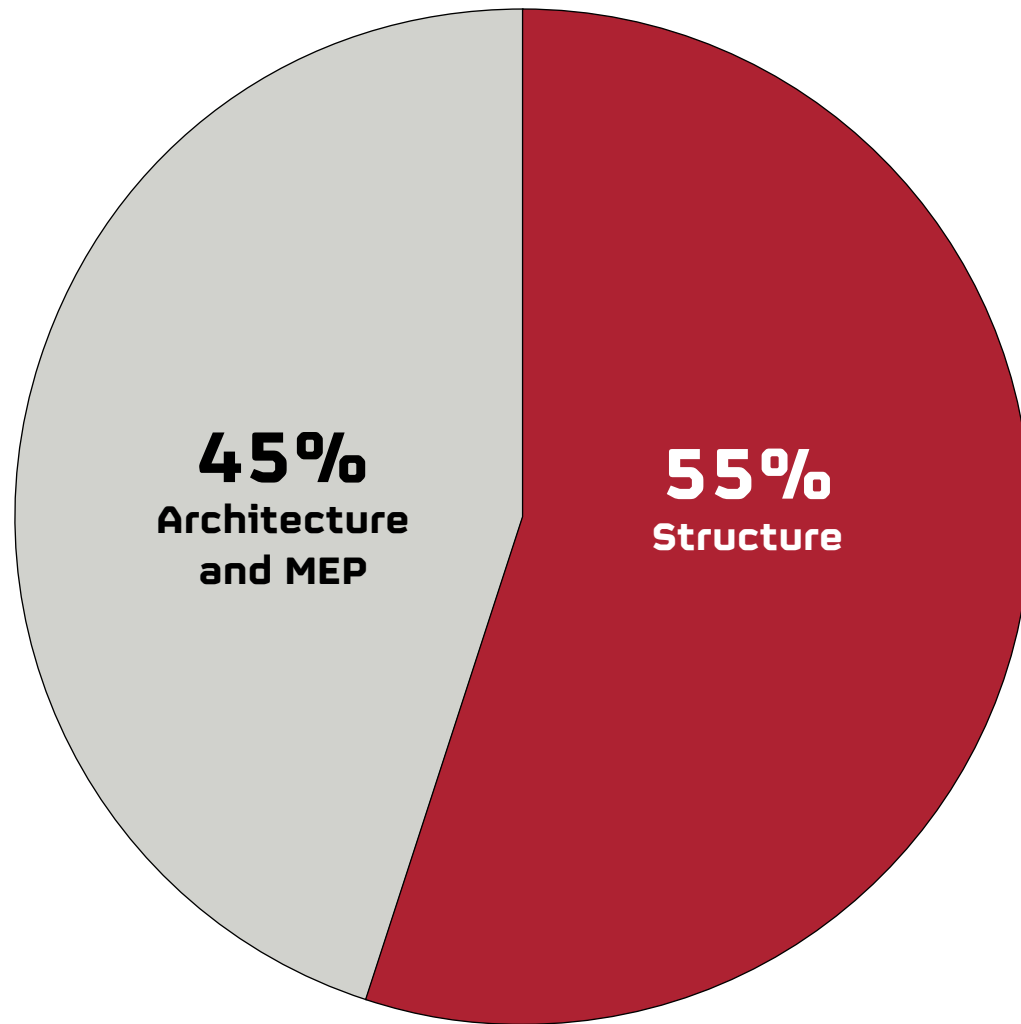
# Where is the Lifetime Carbon in an Office Building?

## Whole Life Embodied Carbon

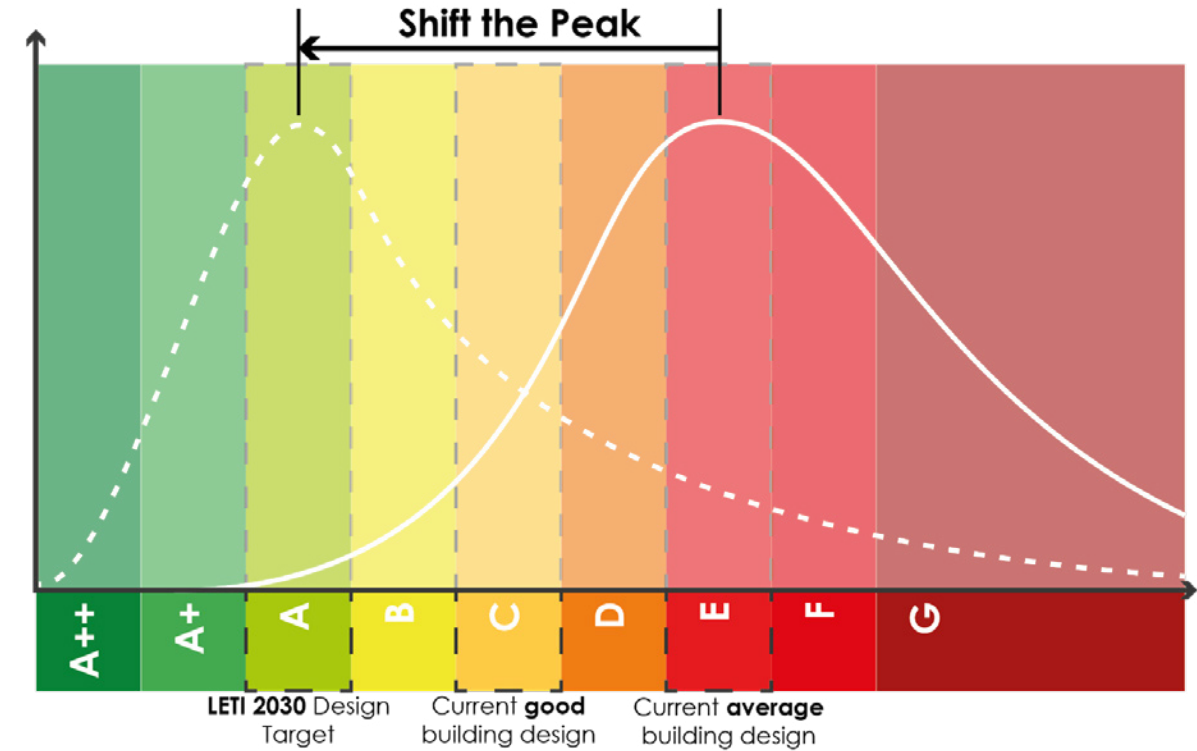




# What Should We Be Aiming For?



A1 - A5 (construction)



	Whole building A1 - A5	Structure only (~55%) A1 - A5
Current average office building	950 kg CO <sub>2</sub> e/m <sup>2</sup> (E)	523 kg CO <sub>2</sub> e/m <sup>2</sup>
Current good office building	600 kg CO <sub>2</sub> e/m <sup>2</sup> (C)	330 kg CO <sub>2</sub> e/m <sup>2</sup>
2030 target	350 kg CO <sub>2</sub> e/m <sup>2</sup> (A)	193 kg CO <sub>2</sub> e/m <sup>2</sup>



# Re-use is nothing new

## 200 Oxford Street



## 499 Oxford Street





76 Upper  
Ground  
68% retained





The Hickman  
51% retained





Woolgate  
Exchange  
95% retained





Technique  
69% retained





HEYNE  
TILLET  
STEEL

60 London Wall  
50% retained





160 Old Street  
75% retained





The Standard  
94% retained





Gilbert & One  
Lackington  
90% retained







**Berkley Estate  
69% retained**

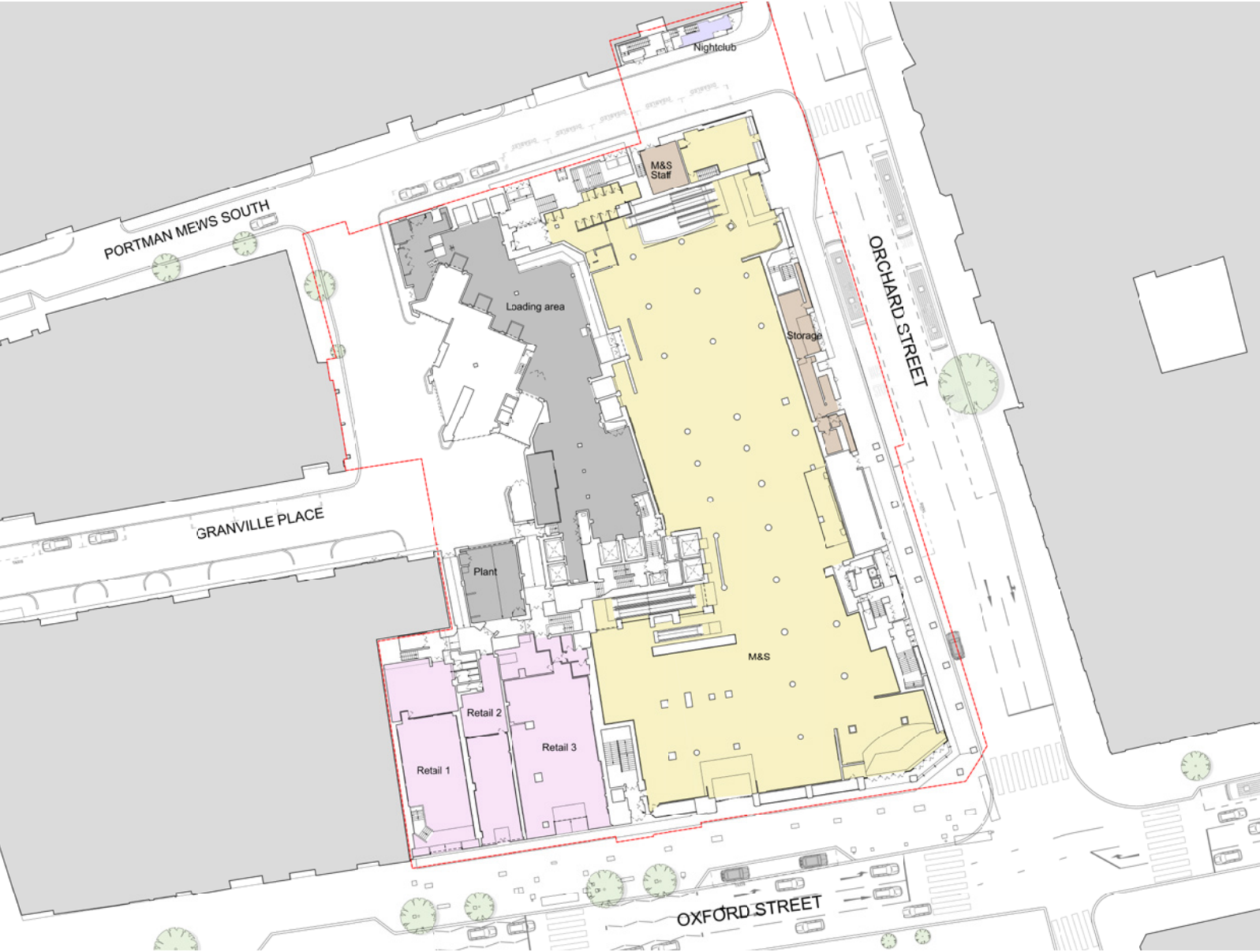


20 St James's  
Street  
75% retained





**Don't muddy the water or generalise responses**  
**Each building and structure has unique opportunities**

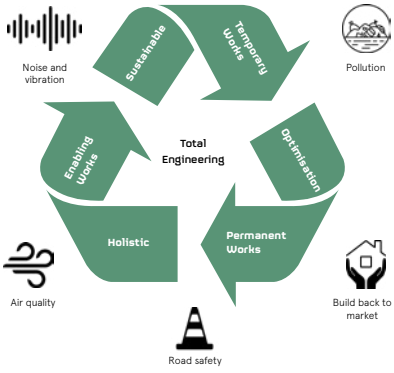
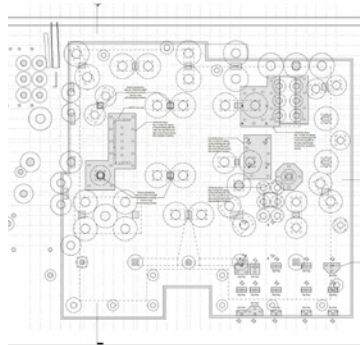


M&S

**Each building considered on a case by case basis**



# Reset the design collaboration process...



Process:  
continuing  
throughout in  
real time



Research

Testing

Finding the opportunities,  
working with the grain

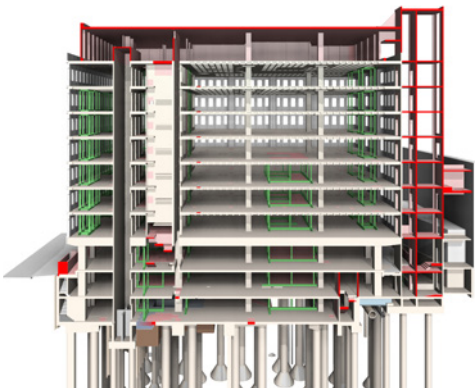
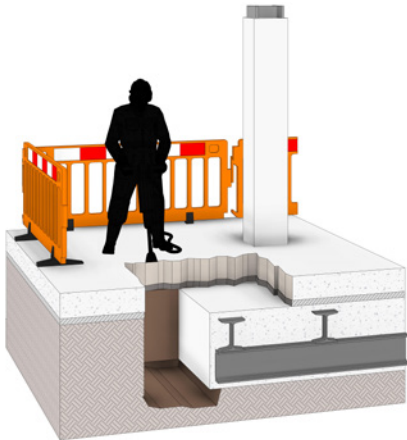
Total engineering +  
contractor input

Investigations

Modelling the bones  
and structure

Option testing  
cost, programme, carbon

Client and design team  
make an informed decision



...Understand the asset before you define the proposal



## A Change of order is required

The Old Way: “Sketch a vision and make it work”

Sketch / Draw → Investigate → Test → Justify →

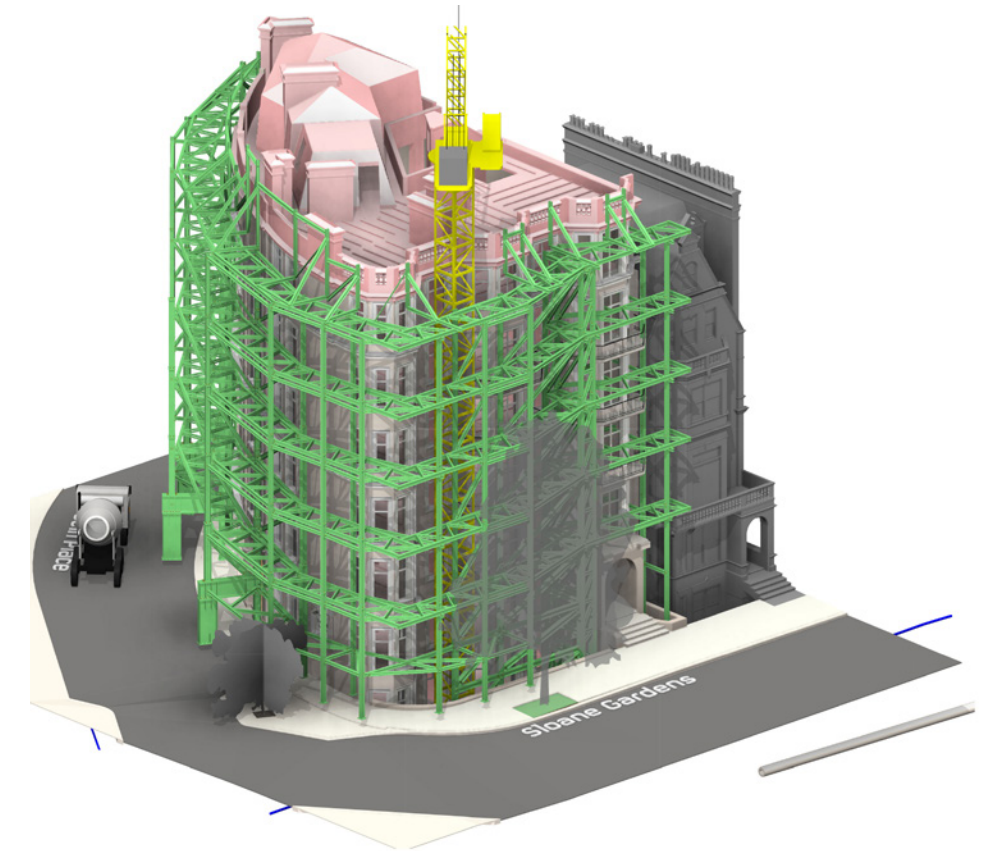
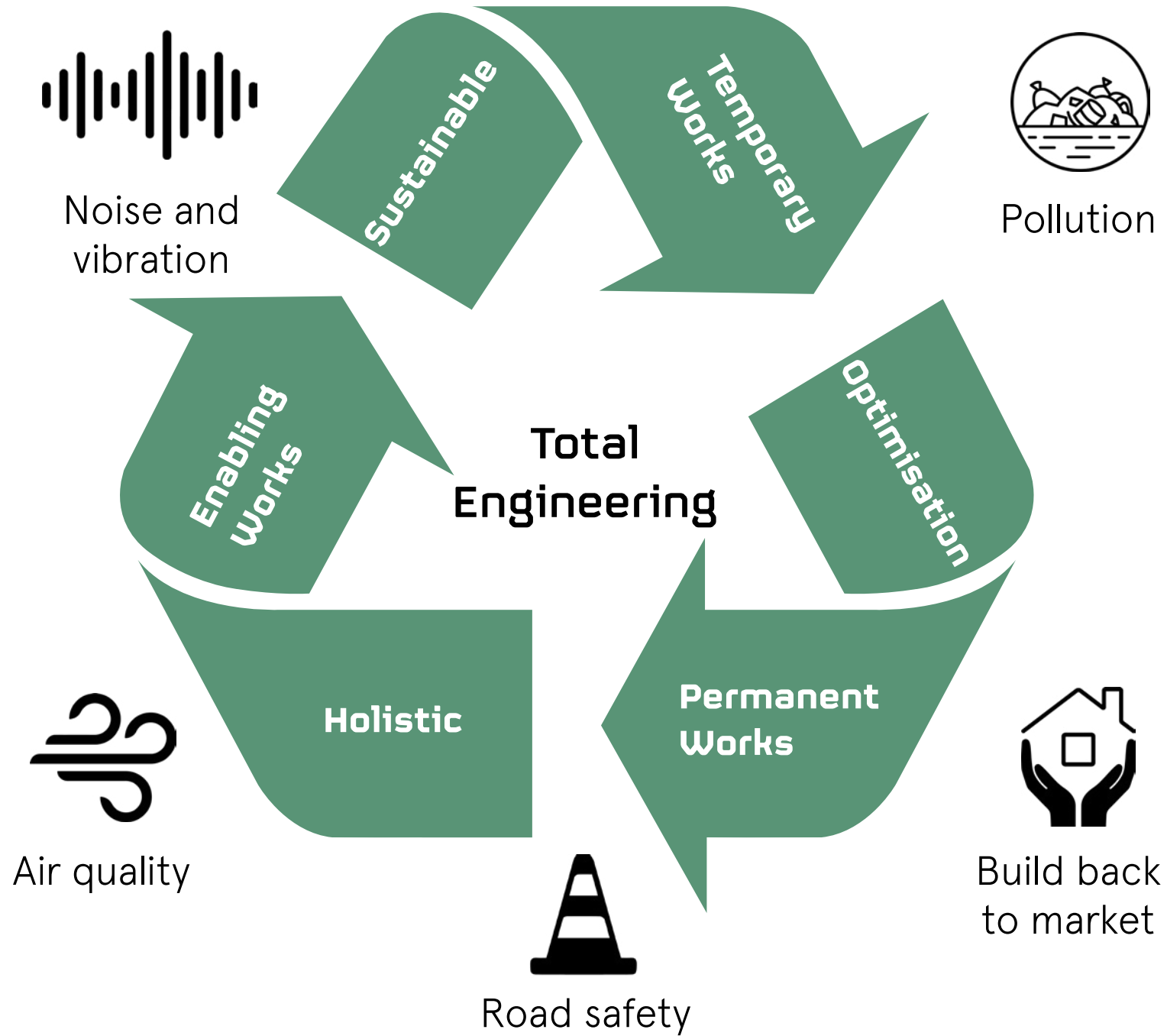
The New Way: “We research, interrogate and collaborate to identify opportunity and potential”

Research → Model → Test → Explore →

**...pick the right team**



# Total engineering



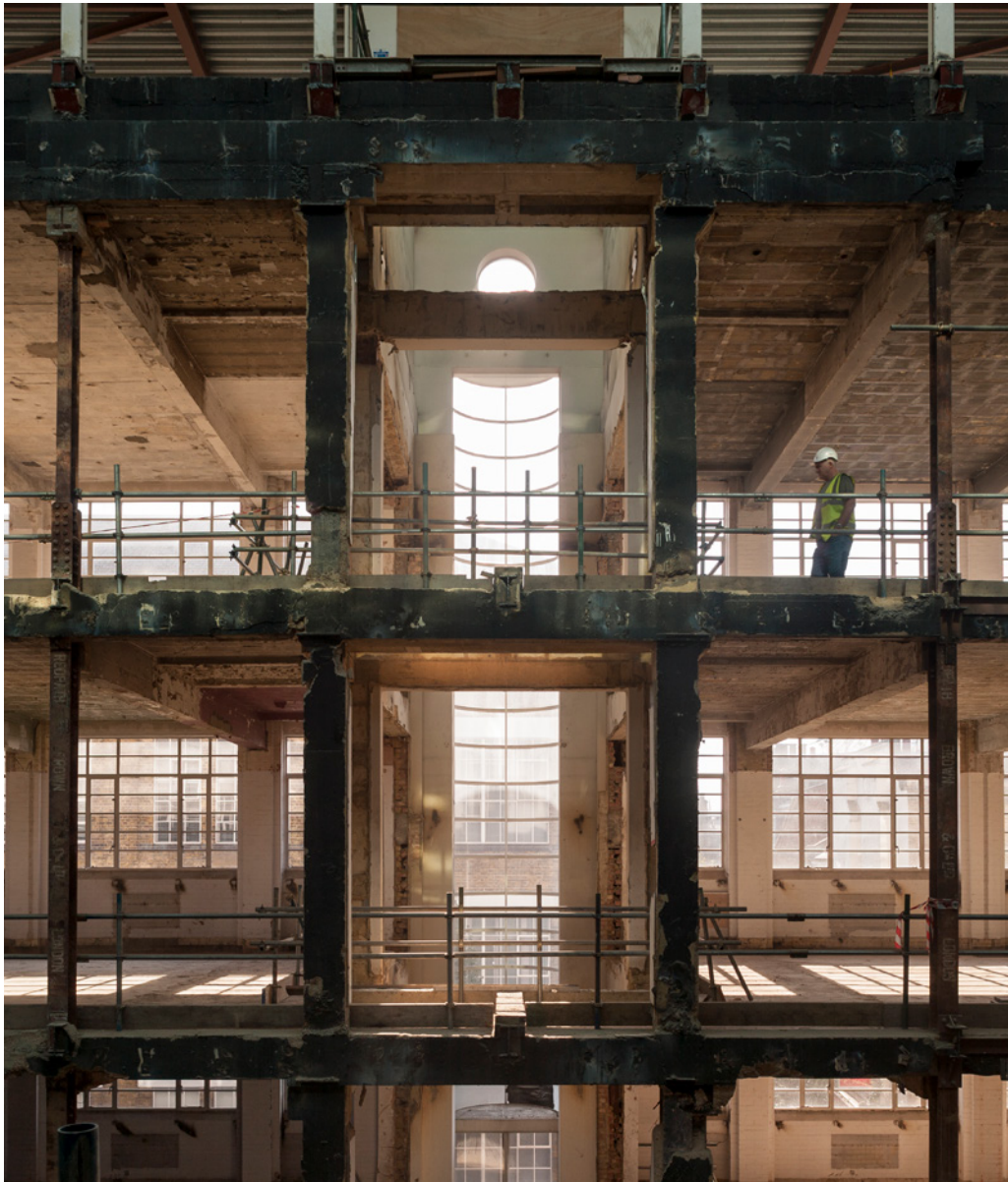
**Is façade retention sustainable ?**



# What refurbishment looked like in the 1990's - 2000's

Principally pre & Inter-war steel frame on spread foundations

Buckley Building



Lime Street



499 Oxford Street

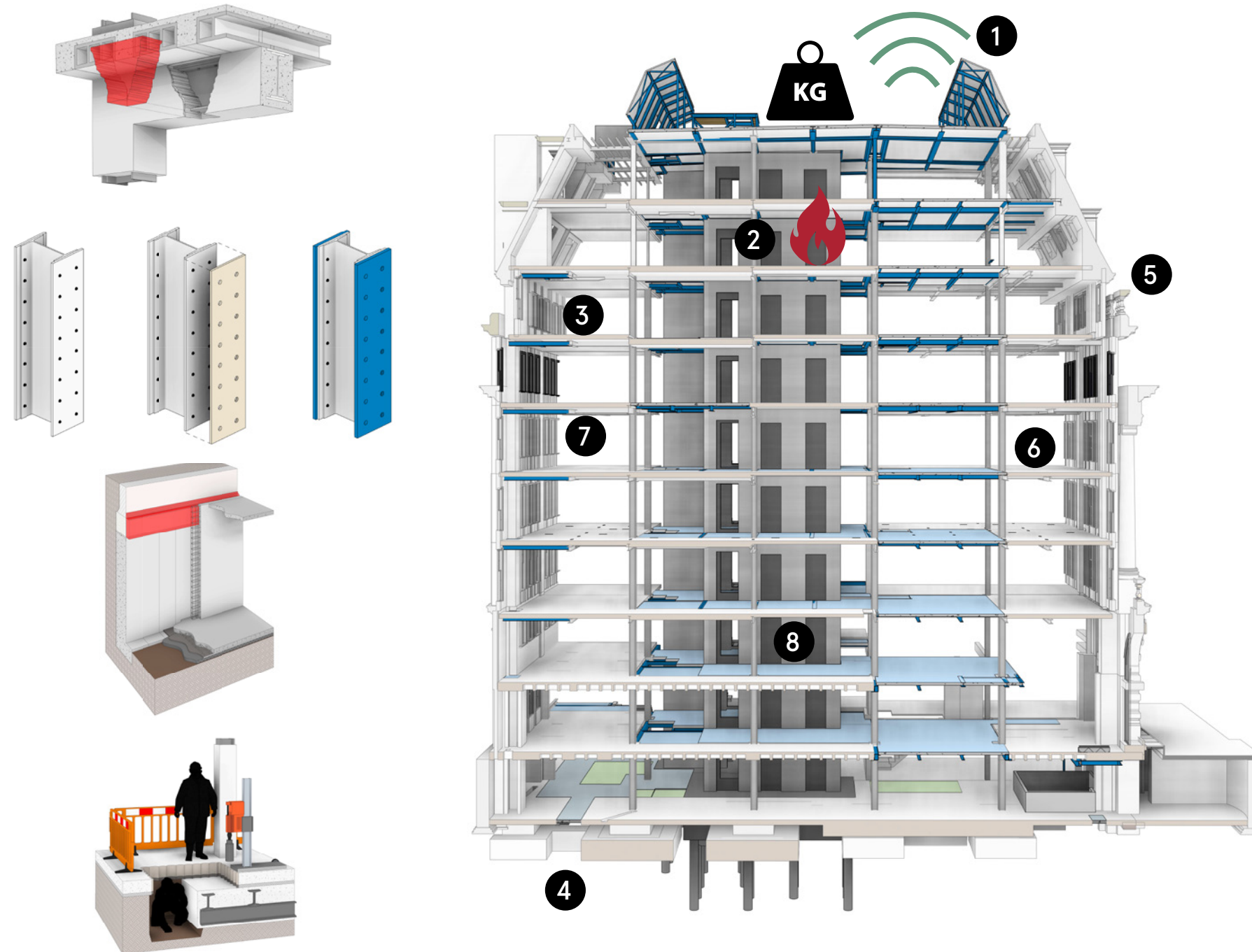


200 Oxford Street





# Pre-war steel frames - St James



- 1 Some Capacity for additional load – Can be strengthened relatively easily
- 2 Fire protection generally applied and generally needs replacing
- 3 Column and frame strengthening relatively easy
- 4 Foundation strengthening relatively straightforward
- 5 Steel frame corrosion a significant and on-going maintenance issue
- 6 Stability easier to adapt and reframe
- 7 Openings through down stand beams possible to improve services coordination and floor to ceiling heights
- 8 Opportunity for steel re-use



# What refurbishment looked like in the 2010's - 2022

Concrete frames and composite steel on piles and raft foundations

The Standard Hotel



Commodity Quay



160 Old Street



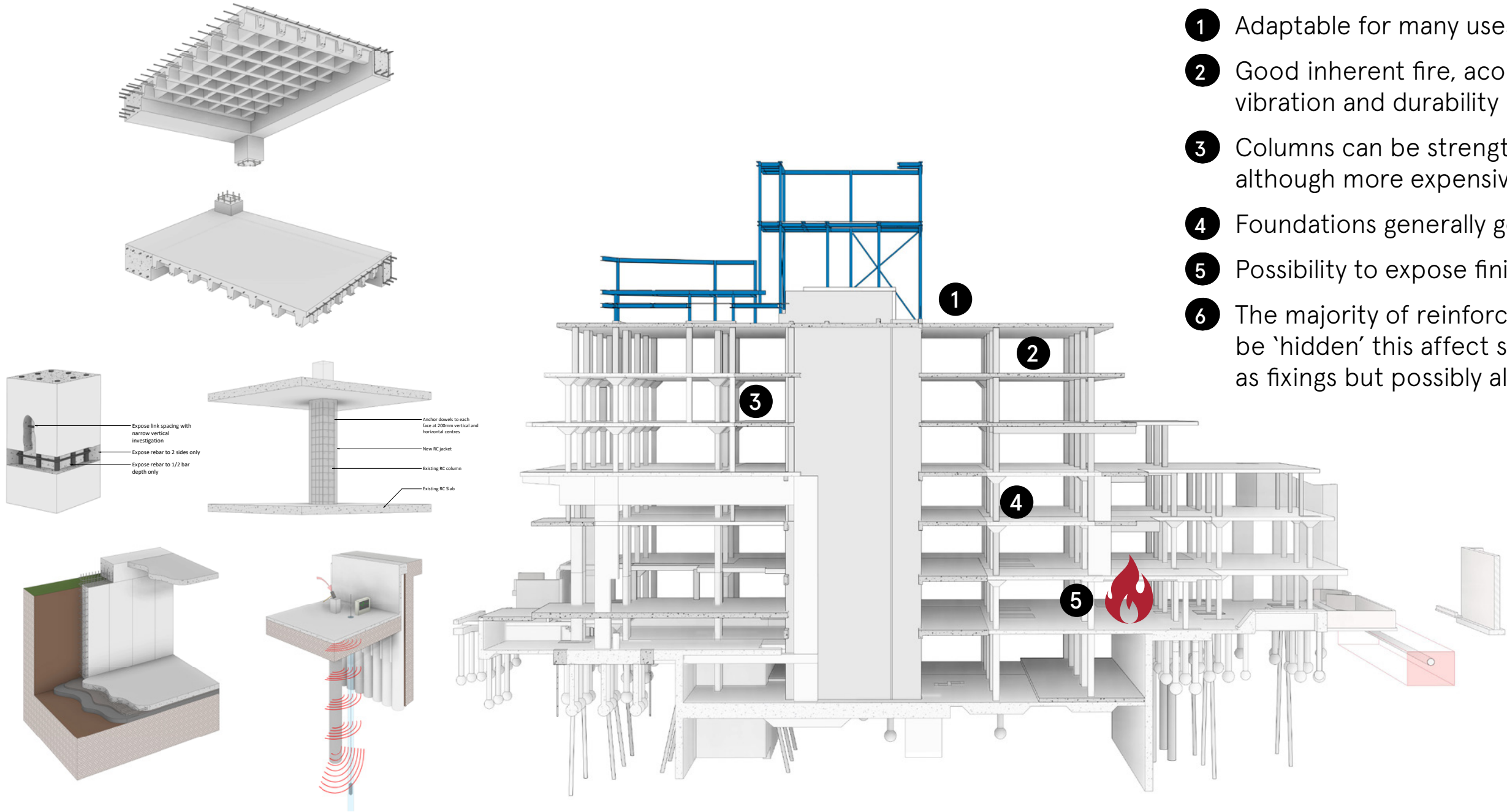
60 London Wall



... Each era is having its day, requiring different approaches



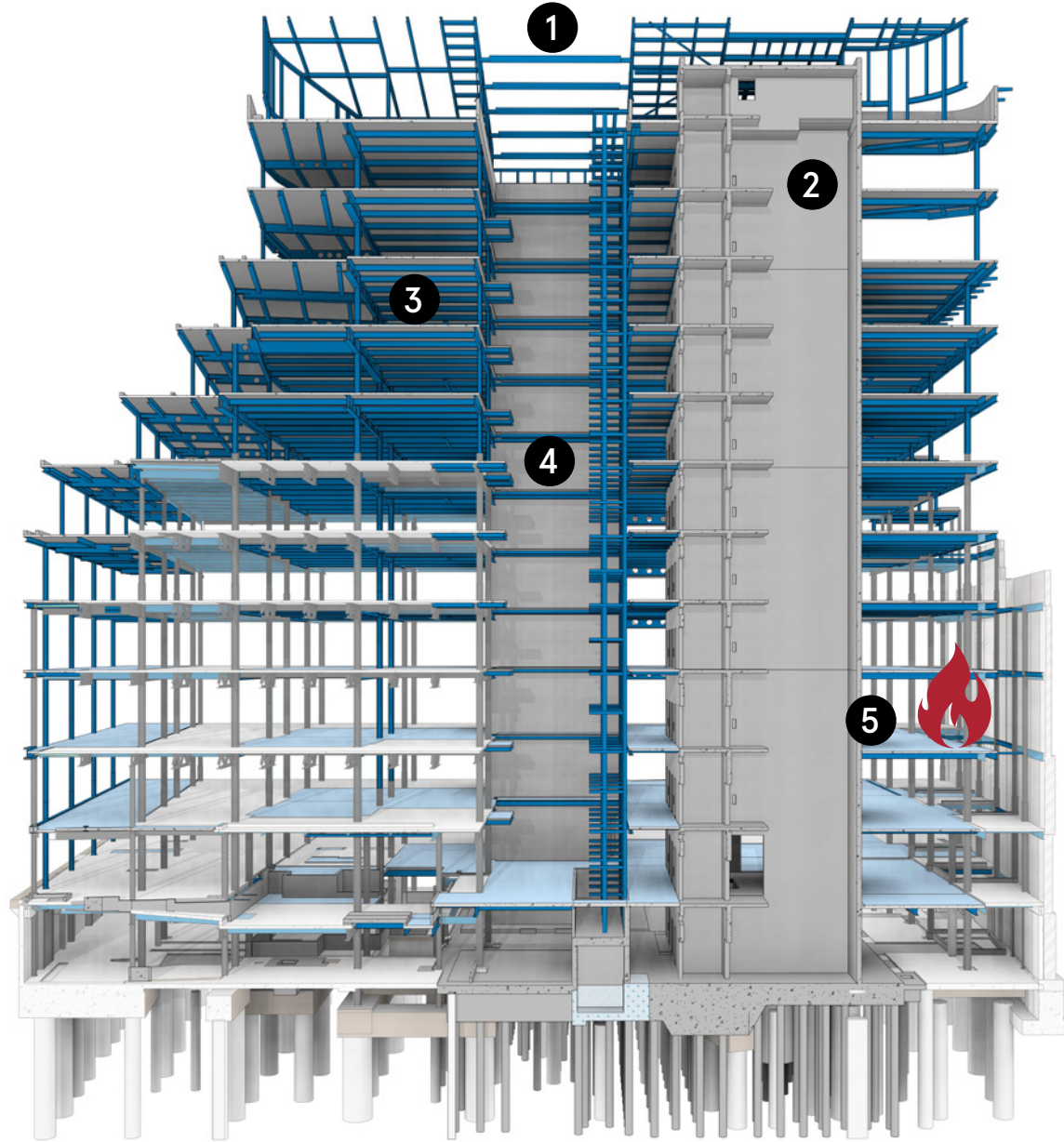
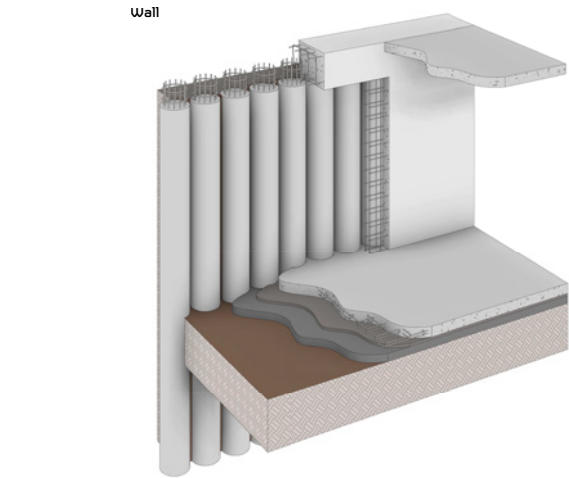
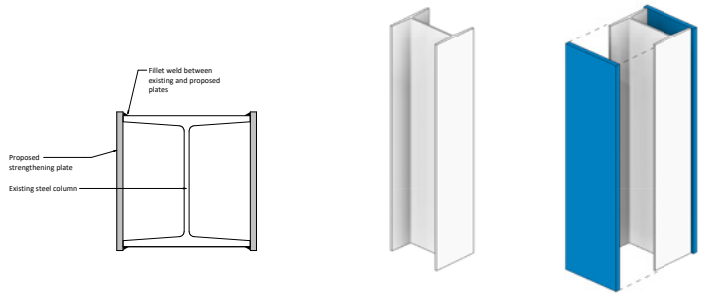
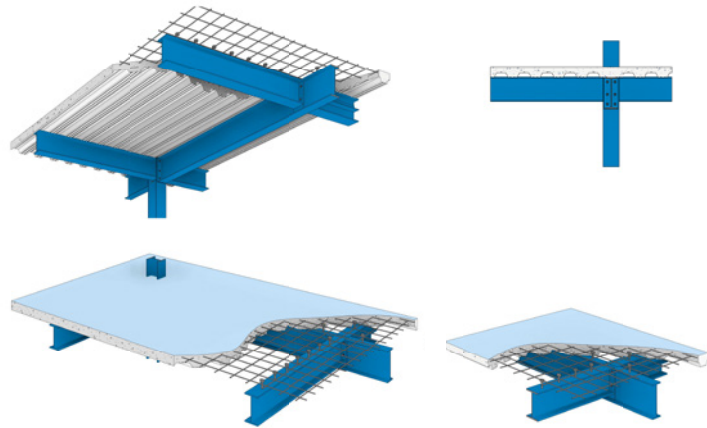
# Post War RC Frames - 76 Upper Ground



- 1 Adaptable for many uses
- 2 Good inherent fire, acoustic, vibration and durability
- 3 Columns can be strengthened if required although more expensive than steel
- 4 Foundations generally good spare capacity
- 5 Possibility to expose finishes
- 6 The majority of reinforcement will forever be 'hidden' this affect site actions such as fixings but possibly also warranties.



# Post War Composite Steel and Metal Deck - 60 London Wall



- 1 Long spans can limit adaptability
- 2 Applied fire proofing vulnerable to damage / falling outside warranty
- 3 Often over-designed so frame has spare capacity. Opportunity to strengthen
- 4 Framing is clean so soft spots / vertical distribution relatively easy to frame out
- 5 Fire protection of slabs / metal-deck typically integral – challenging to retrospectively improve



# Long life, loose fit - design for adaptability - but not at a disproportionate carbon cost

**Life Science:**

Imposed load = 4 +1 kN/m<sup>2</sup>  
 Vibration = R=0.5 (VC-A), R=0.2 (VC-C) over part of the floor  
 Acoustics = Medium  
 Achievable with localised structural adaptations

**Office:**

Imposed load = 2.5 kN/m<sup>2</sup>  
 Vibration = 4 Hz, R = 8  
 Acoustics = Medium  
 Achieved

**Residential:**

Imposed load = 1.5 kN/m<sup>2</sup>  
 Vibration = 2-4Hz (1.4 at night)  
 Acoustics = Stringent  
 Can be achieved in finishes and space plan

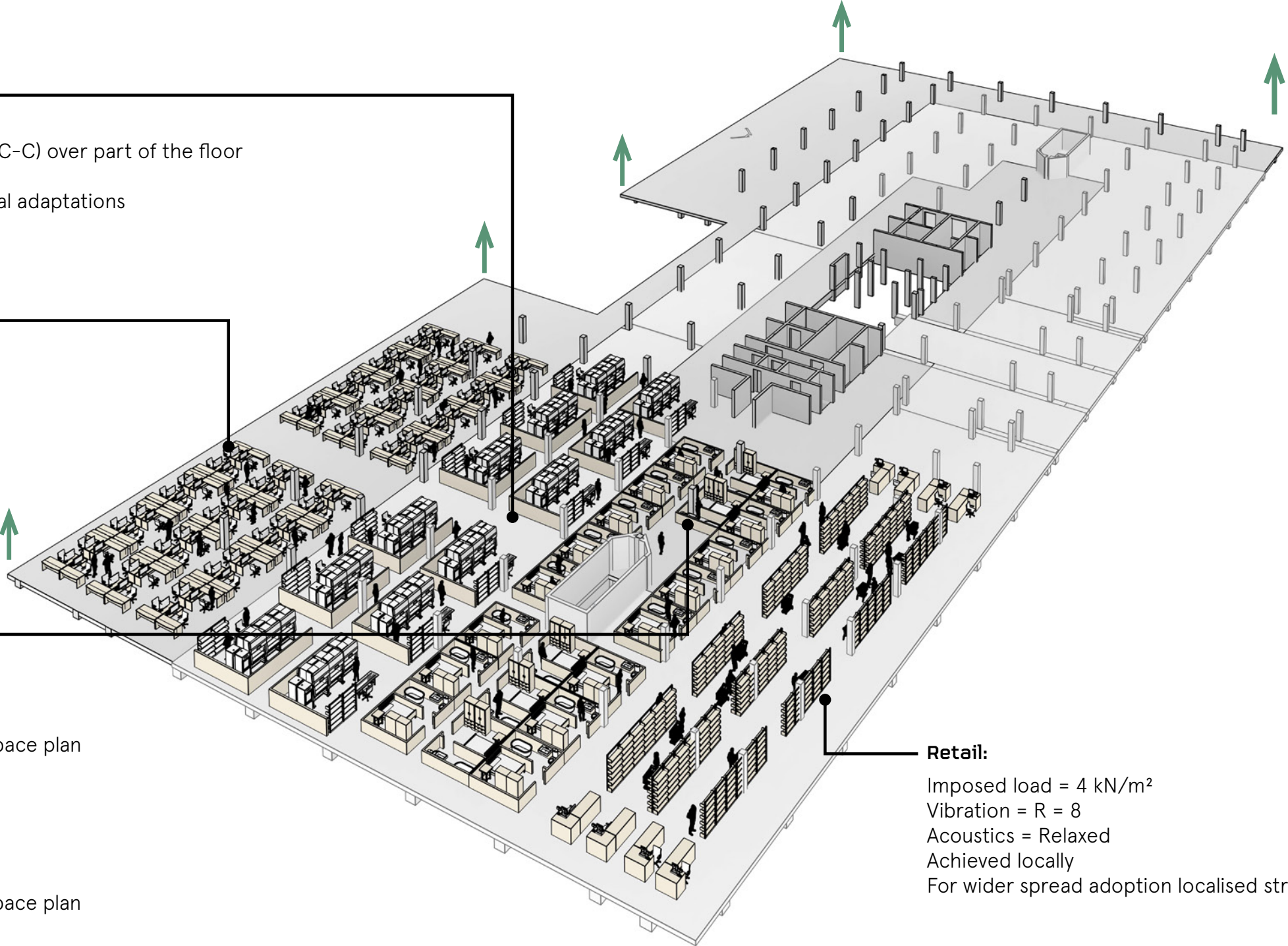
**Hotel:**

Imposed load = 2 kN/m<sup>2</sup>  
 Vibration = 2-4Hz (1.4 at night)  
 Acoustics = Stringent  
 Can be achieved in finishes and space plan

**Retail:**

Imposed load = 4 kN/m<sup>2</sup>  
 Vibration = R = 8  
 Acoustics = Relaxed  
 Achieved locally  
 For wider spread adoption localised strengthening required

Future additional floors  
 achieved with localised  
 structural strengthening





# Long Life - Loose fit Adaptable Structures with Soft Cores - Case Studies

What We Have Learnt - A Different Approach To The Role Of The Building Core - Considerations learnt from reworking existing buildings

77 Coleman



60 London Wall



Cityside



160 Old Street



Commodity Quay



Old Bailey



77 Shaftsbury



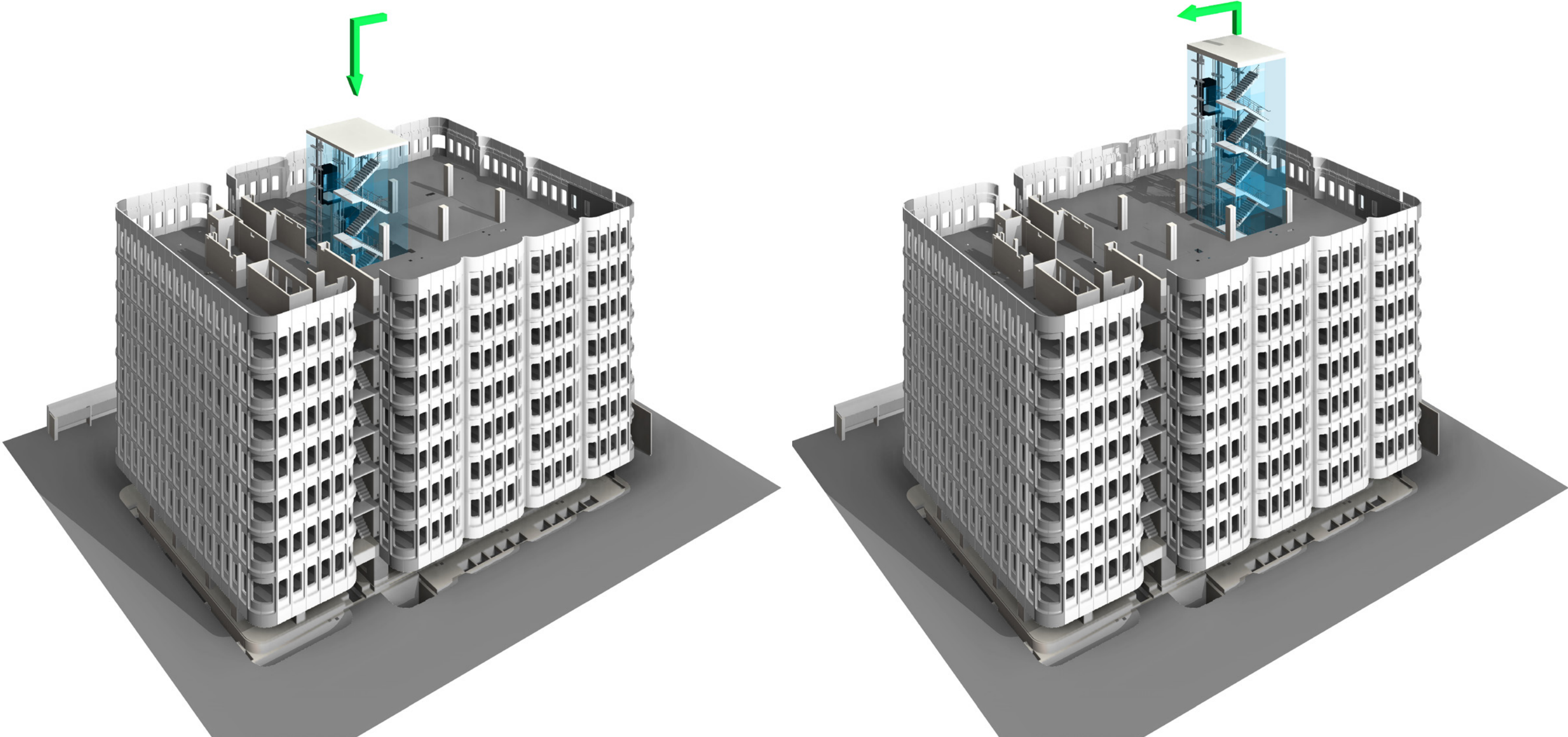
20 St. James's Street





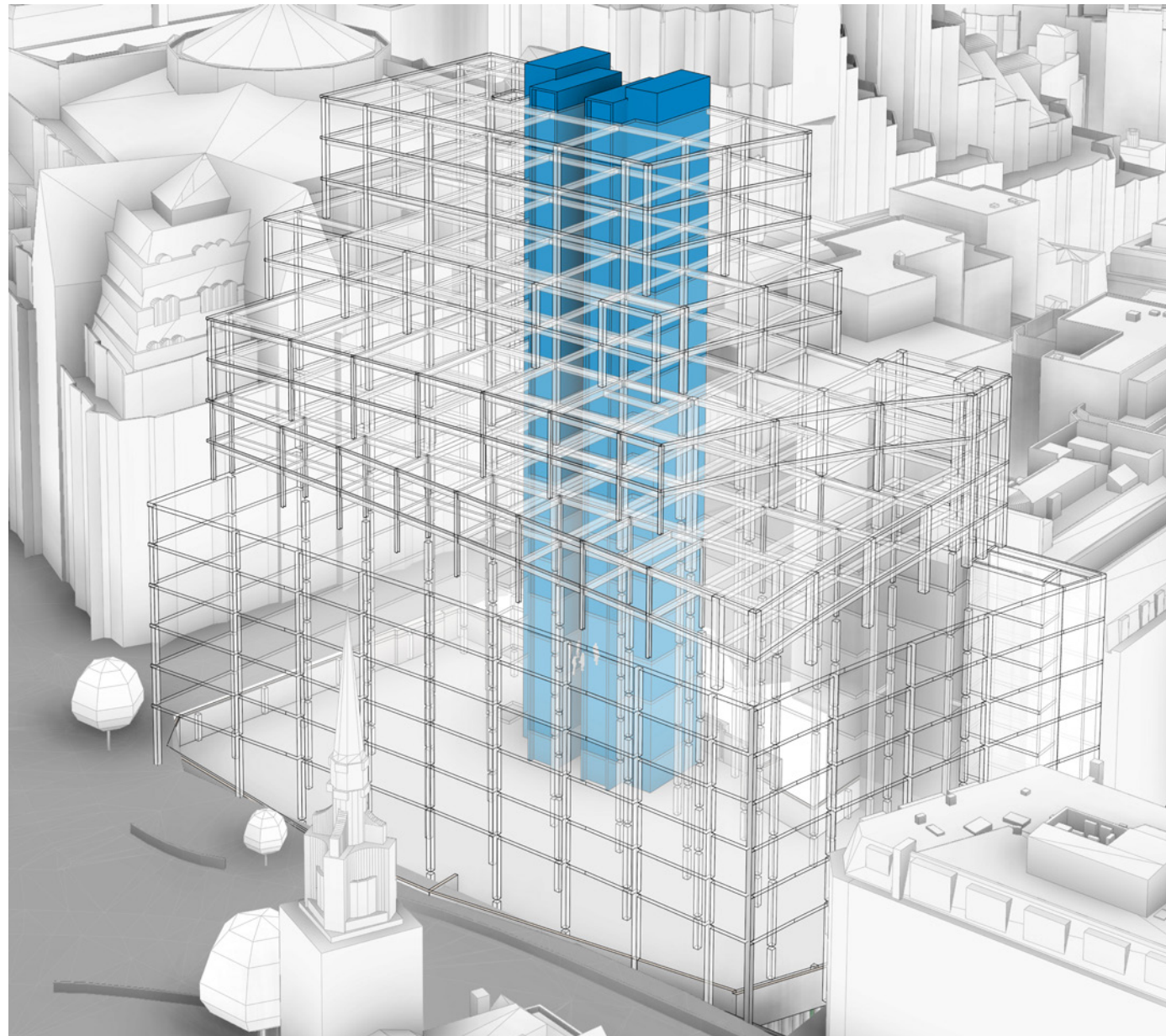
# Long Life - Loose fit Adaptable Structures with Soft Cores

Stability built into the façade to avoid structural re-coreing

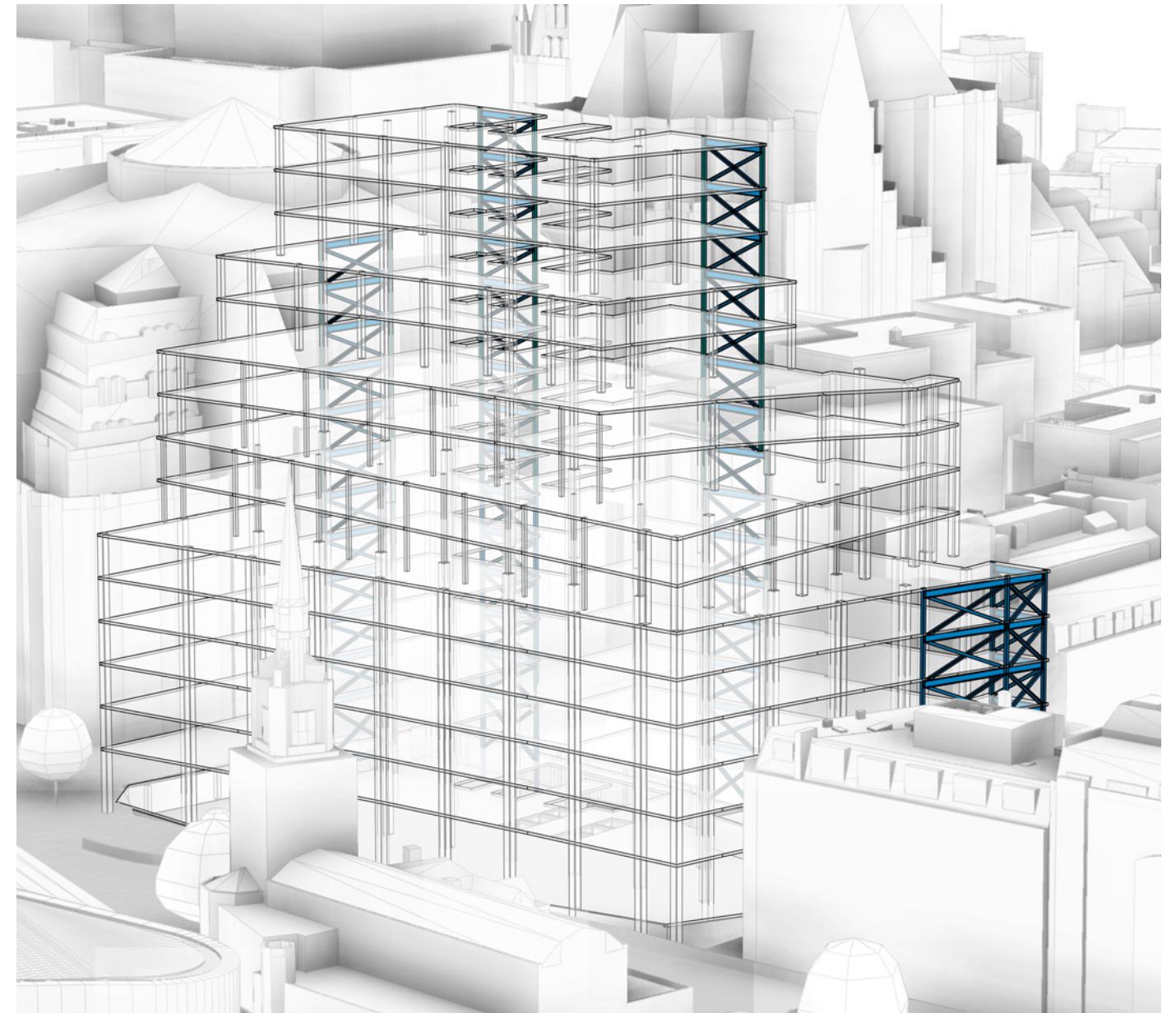




# Soft Core - True Sustainability, Long Life, Loose Fit - Core Adaptability



**Traditional RC Stability Core**



**Soft Core Approach - Maximise future flexibility**



# Core Adaptability - The Principle

**Short Pedal Crank**

**+ Hard Work**



**Long Pedal Crank**

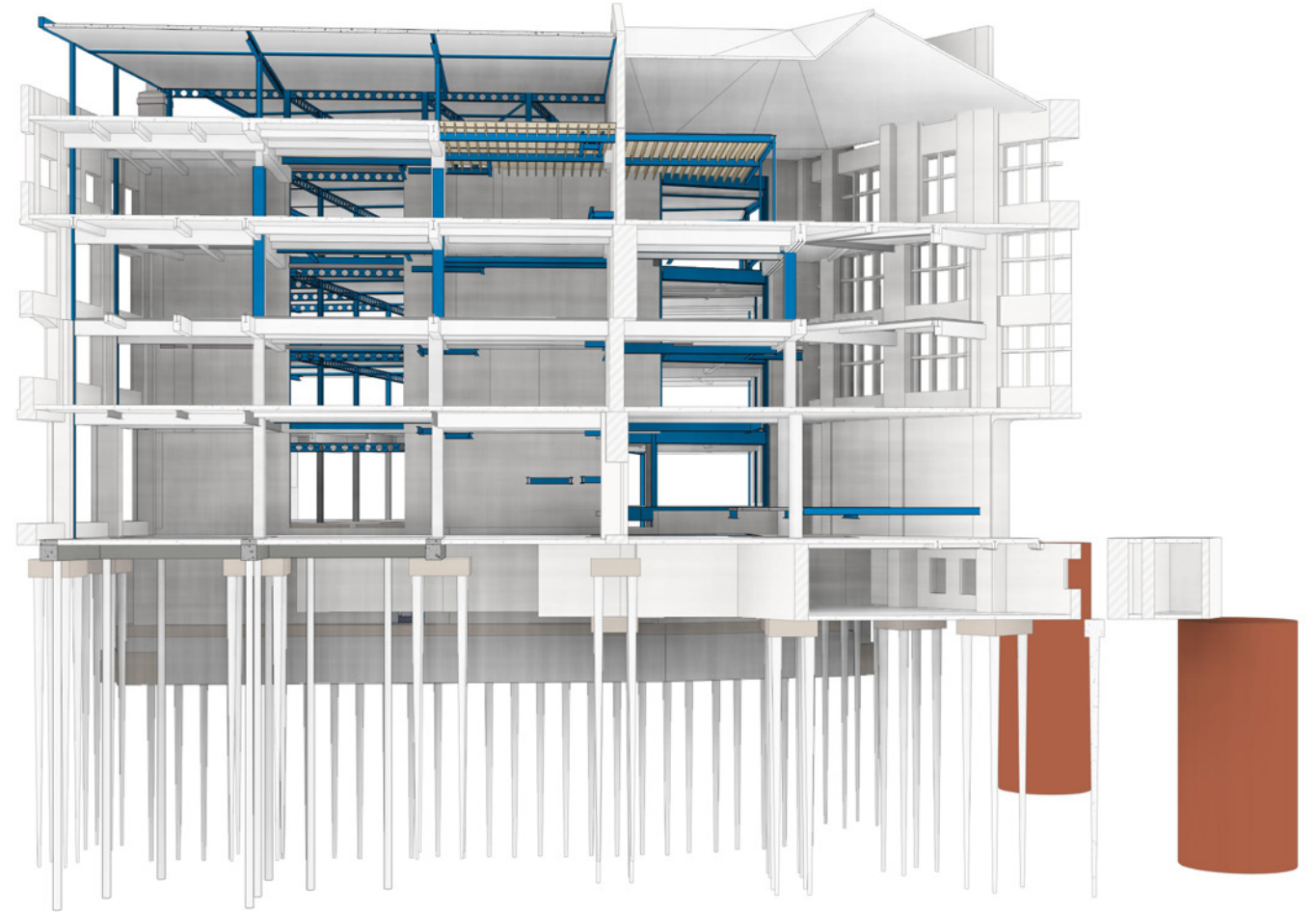
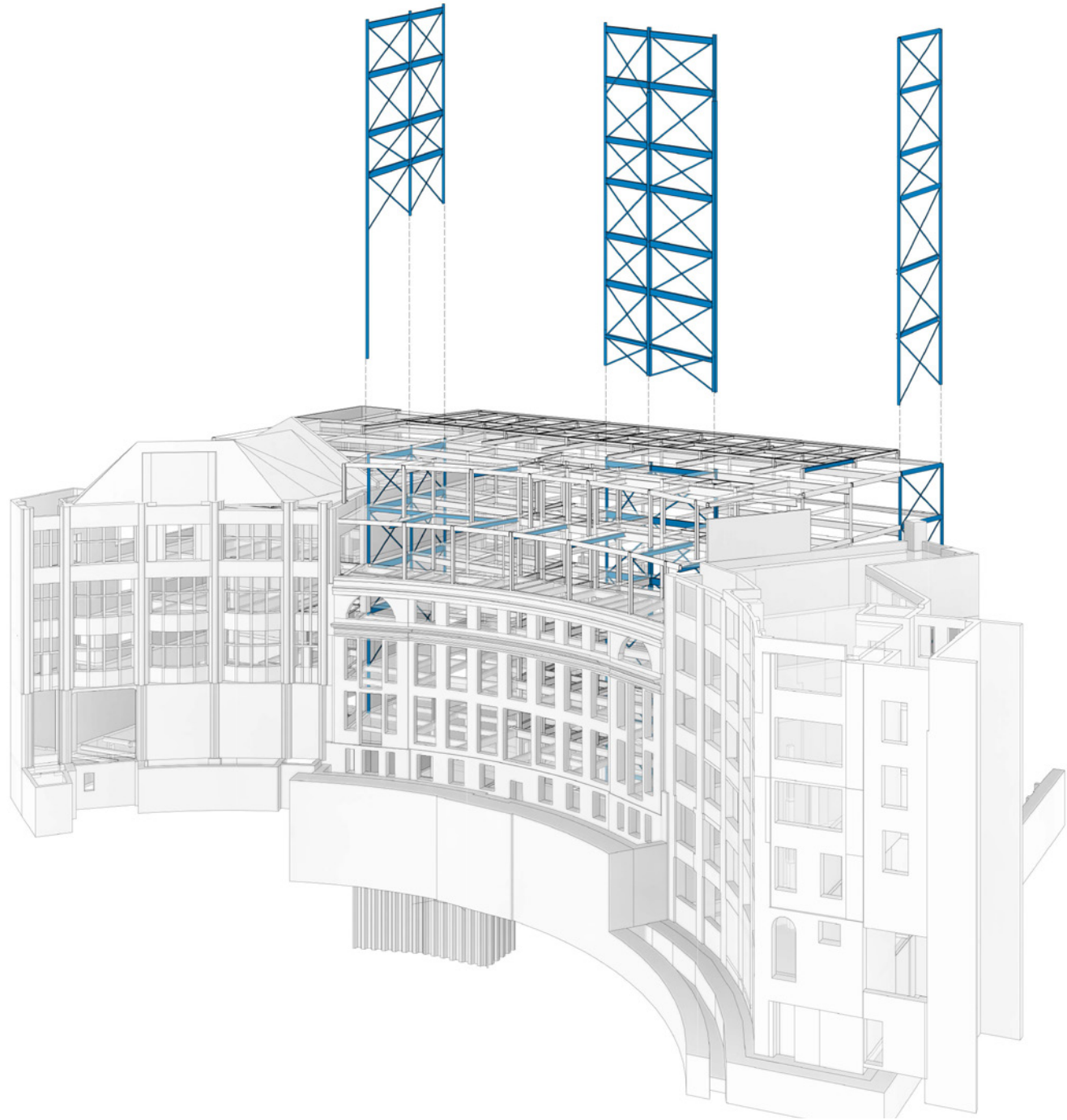
**+ Easy Work**

**+ Less Carbon**





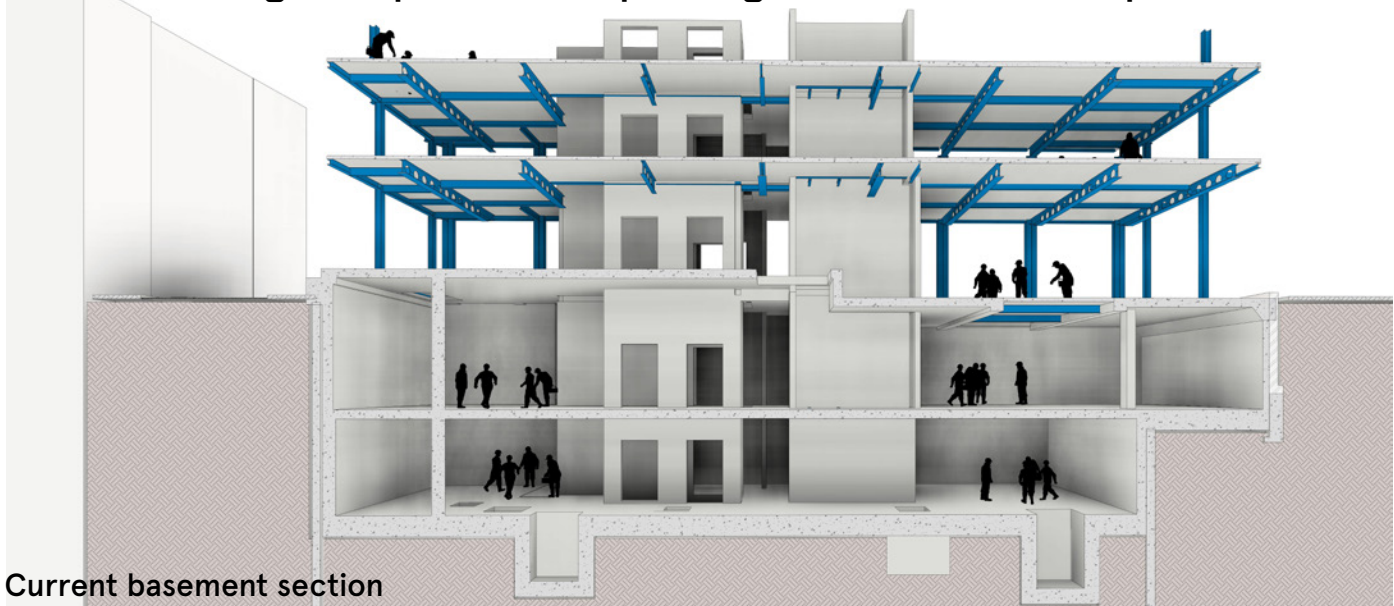
# Soft Core - Chenies Street



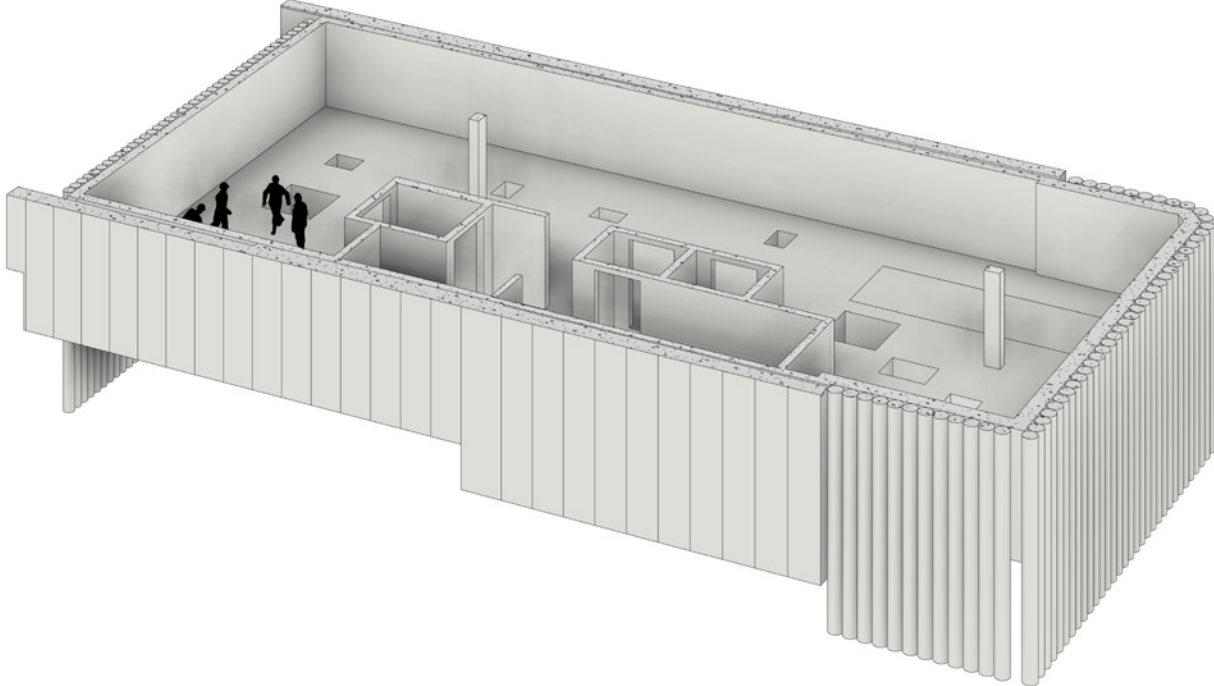


# Challenging Conventional Approaches to Construction

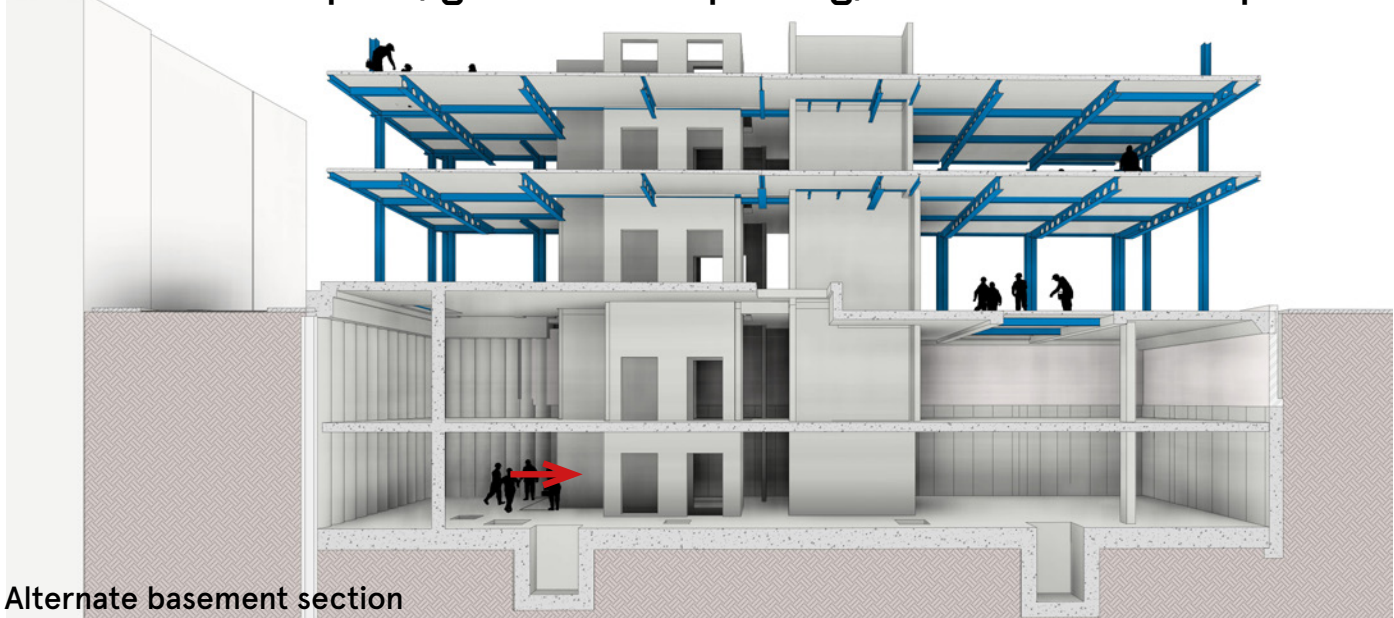
Current contiguous piles, underpinning, liner wall and step



Current basement section

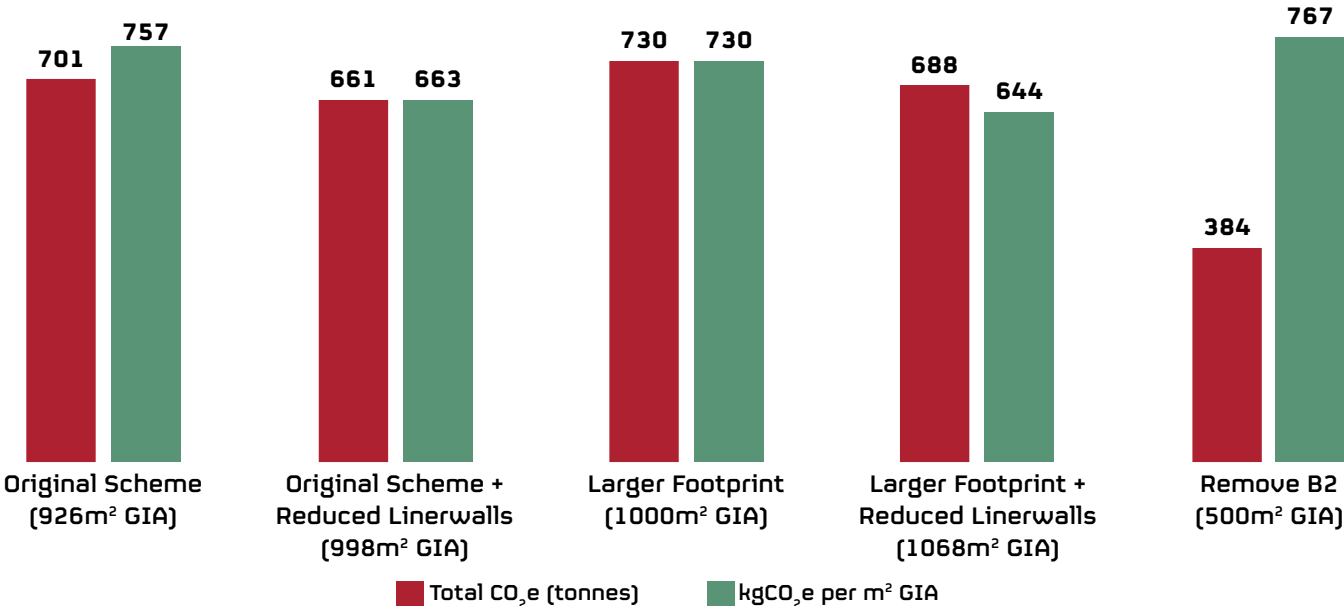


Possible secant piles, greater underpinning, no liner wall or step



Alternate basement section

Original Basement Scheme and Alternatives - Total Embodied Carbon and Embodied Carbon per m<sup>2</sup> GIA





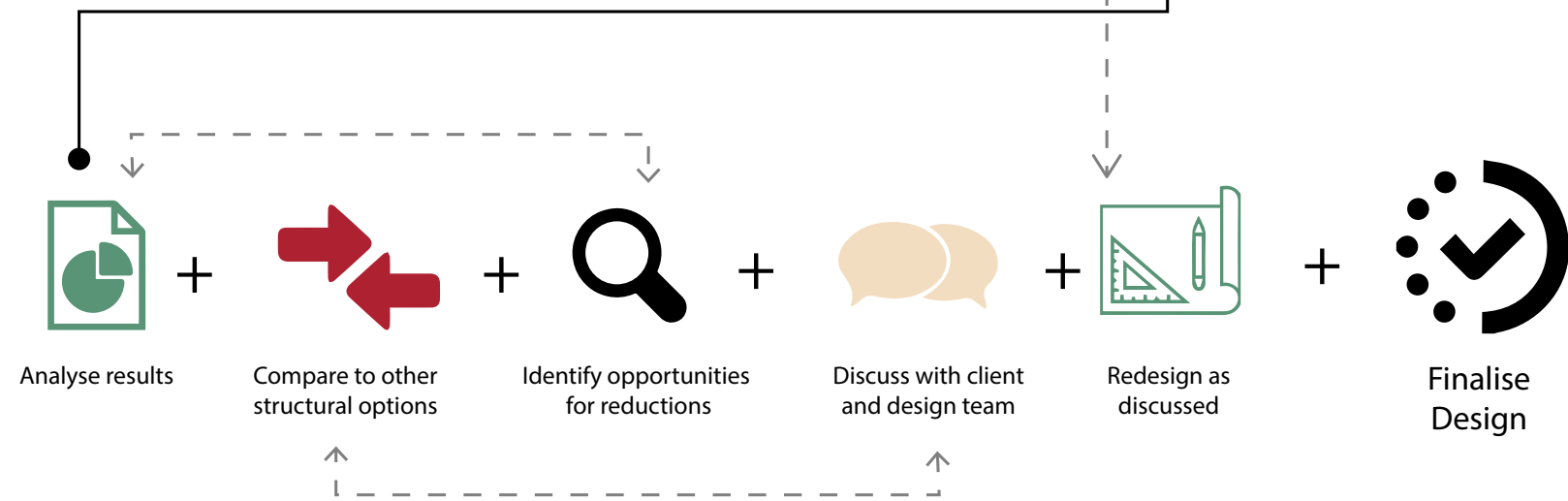
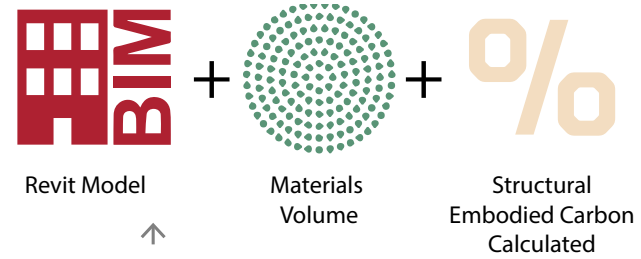
# HTS+ Carbon Counter Tool

## Carbon counting tool process:

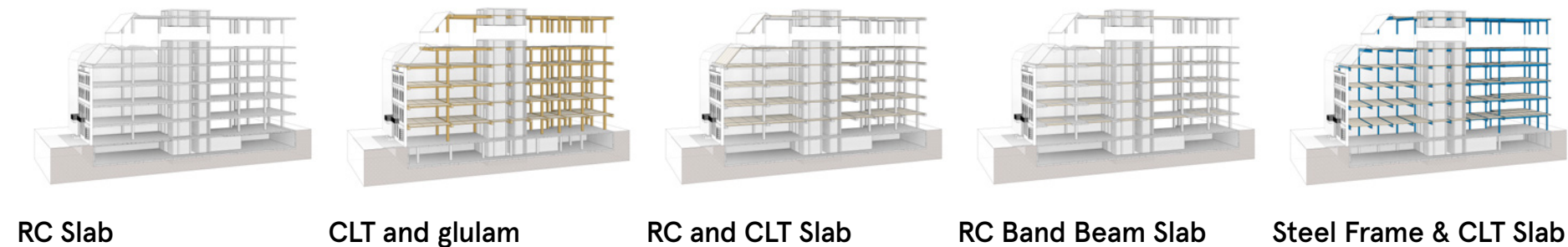
### Materials Information



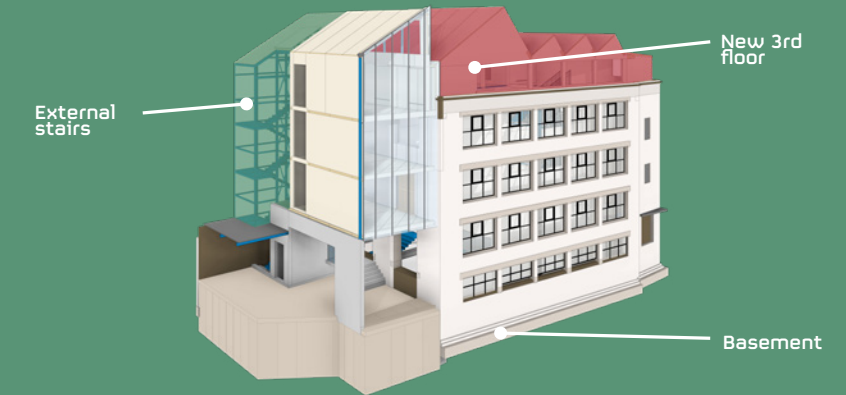
### Carbon Counter



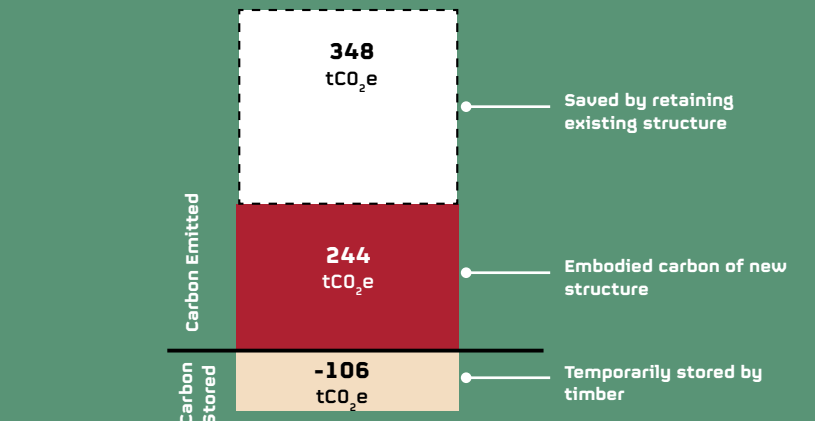
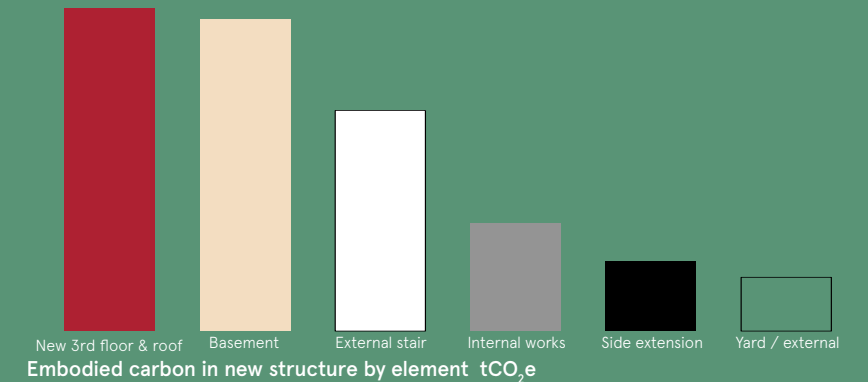
## Optioneering:



## Clear Reporting:



Revit model showing heavy hitters embodied carbon by element



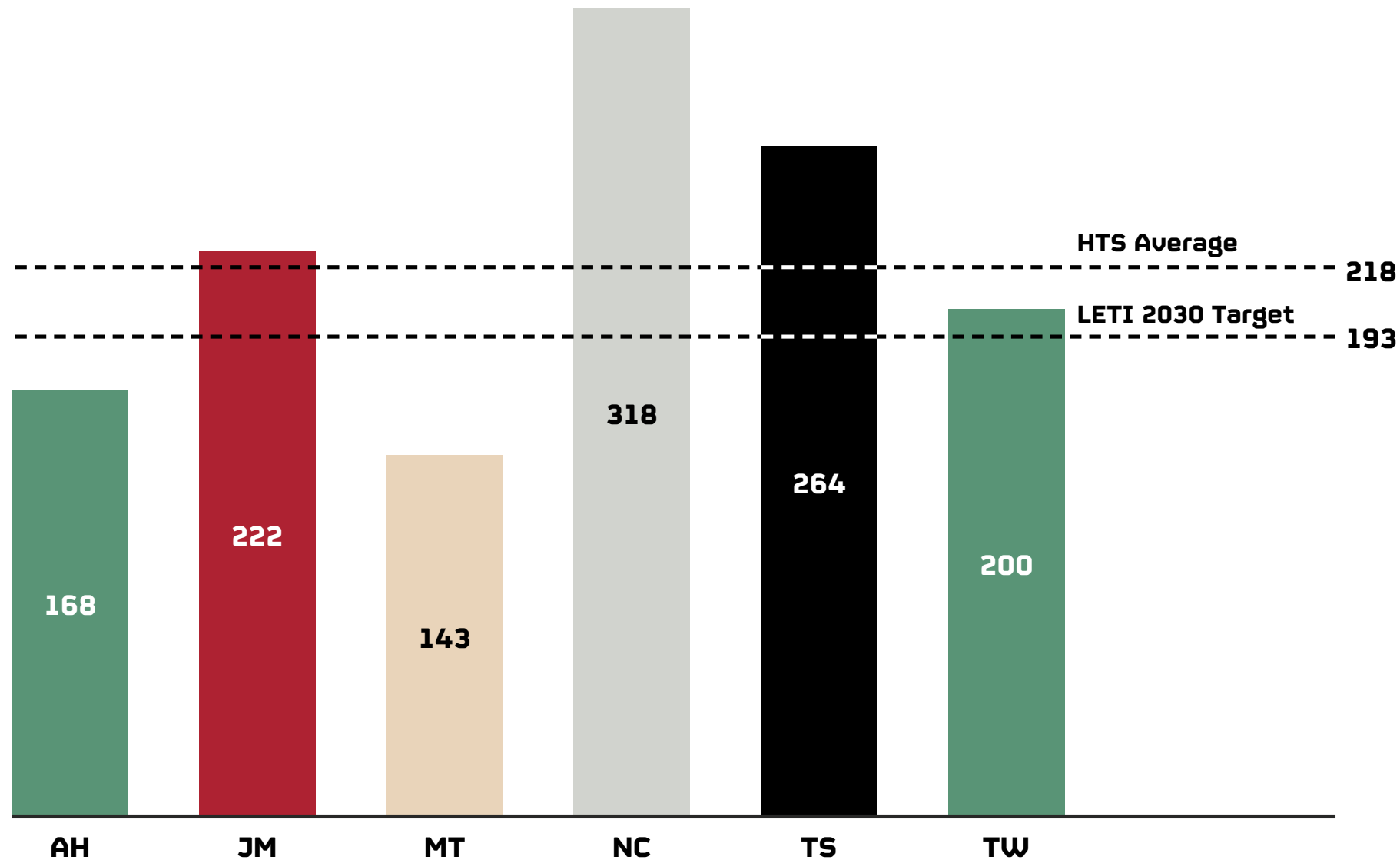
Embodied carbon: Stored and Emitted



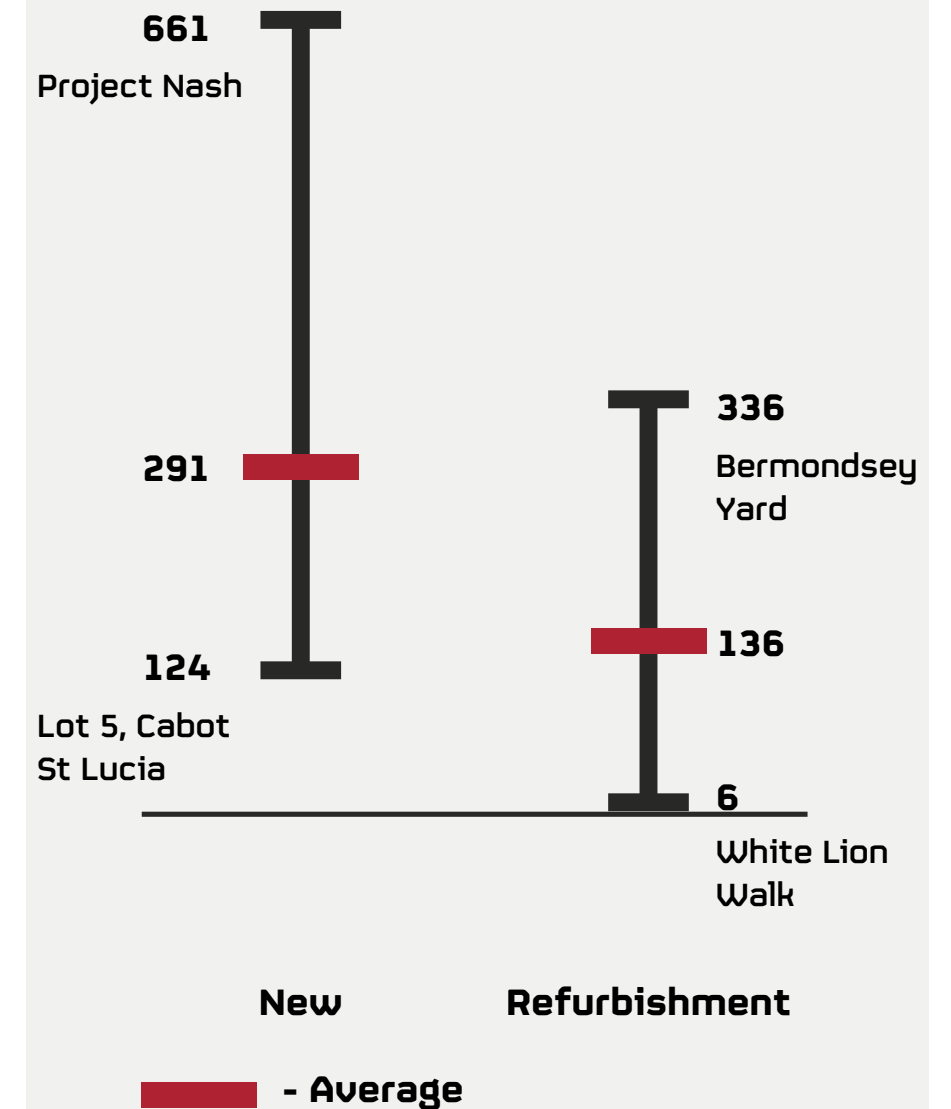
# Average kgCO<sub>2</sub>e/m<sup>2</sup> by HTS Team

HTS have been undertaking A1- A5 carbon calculations on all jobs since 2016, and we have completed 450 carbon calculations across all types of projects

## HTS Projects Average kgCO<sub>2</sub>e/m<sup>2</sup> by Director Team:



## HTS Projects Range of kg CO<sub>2</sub>e/m<sup>2</sup>:

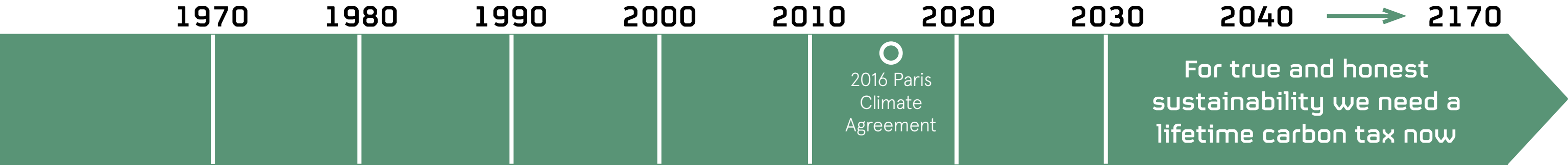




# We Must Change The Parameters - Buildings Are Forever

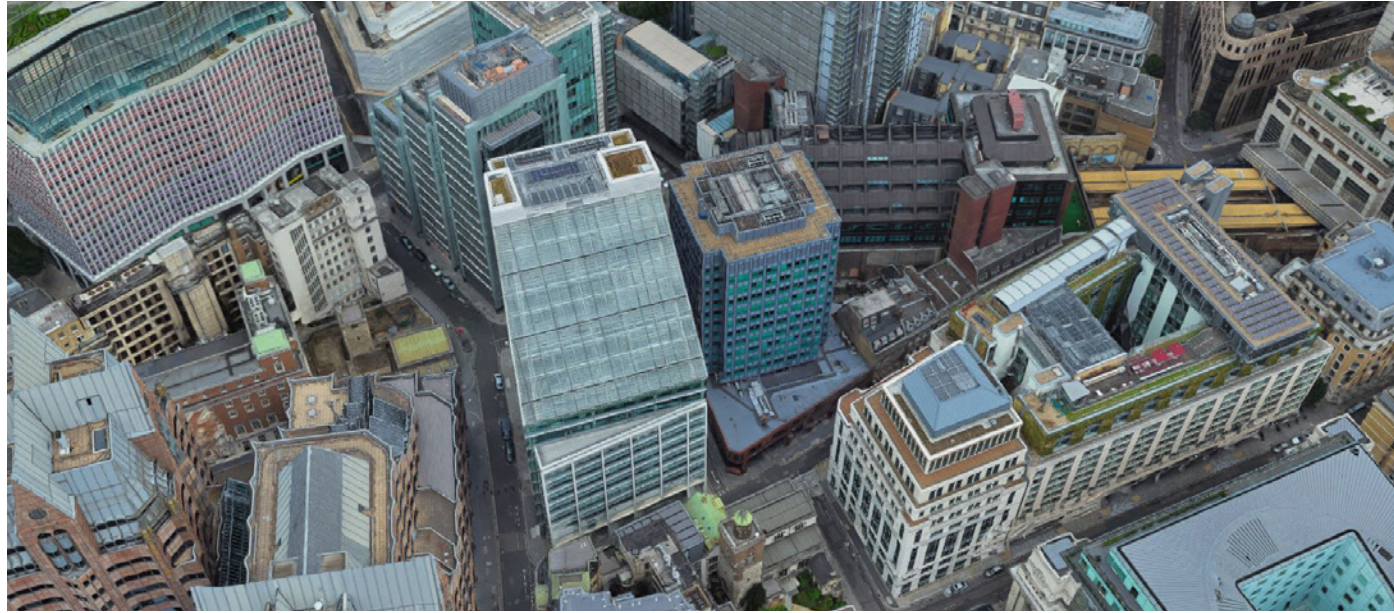
## Live Long and Prosper - 200 Year Design Life

- + Currently, commercial buildings are designed for a 60 year life span – although a large proportion of UK building stock is Victorian
- + A new building designed for a **200-year** life span will last until 2223
- + Life time achievement awards. Be all it can be, design for the unknown



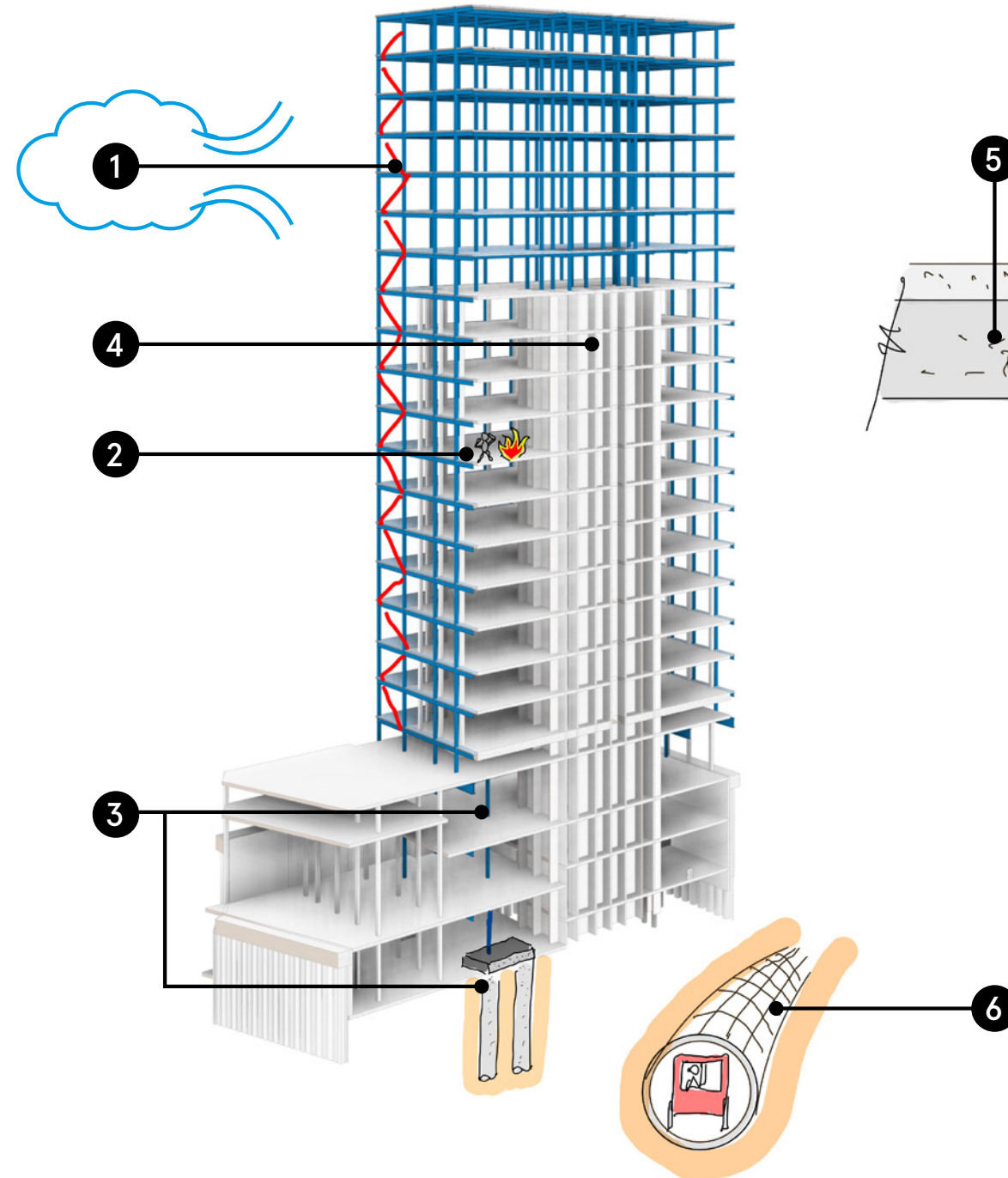
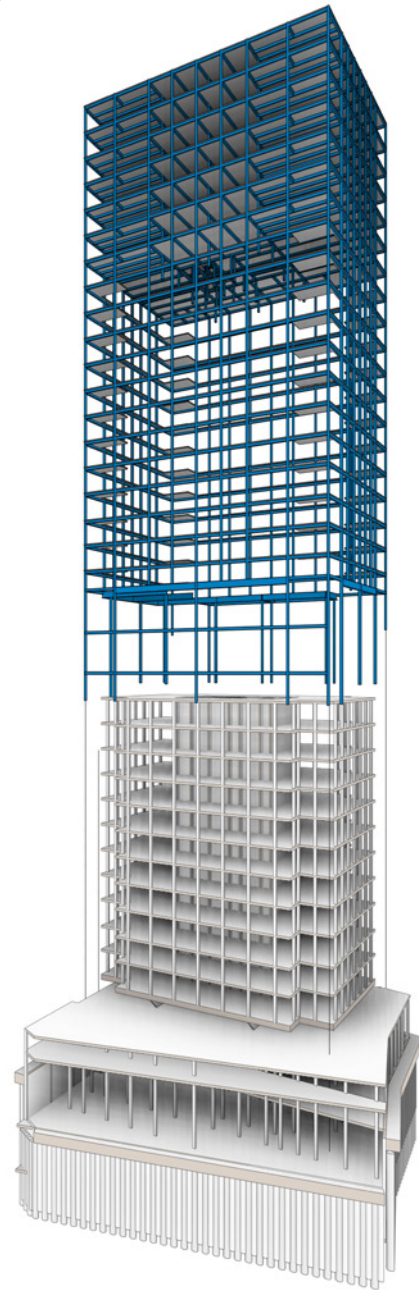


# Fenchurch Street - Building on stilts - How to turn a 12 storey building into a 32 storey building



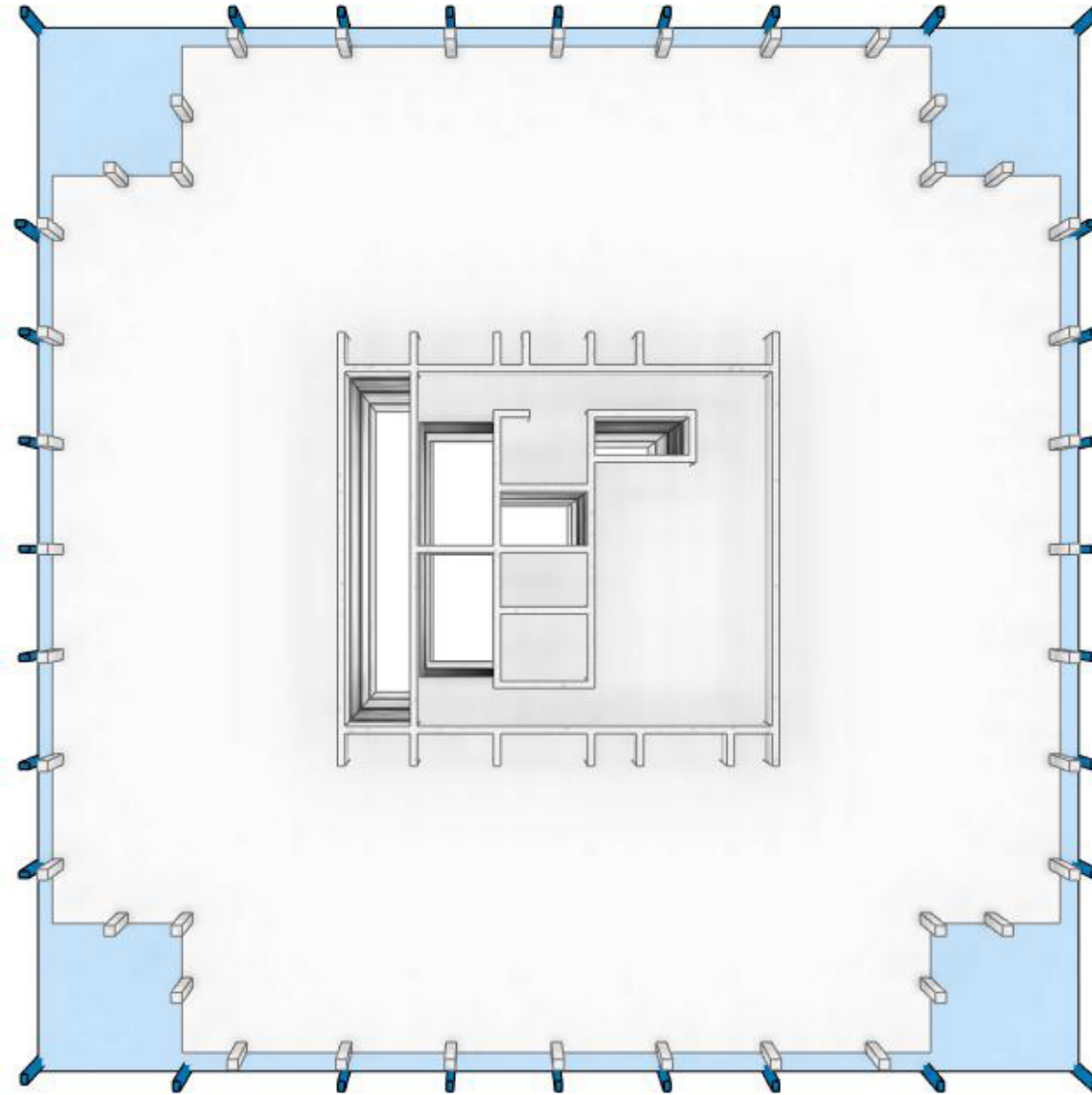


# Fenchurch Street - Building on stilts - How to turn a 12 storey building into a 32 storey building





# Building on stilts - How to turn a 12 storey building into a 32 storey building



**...There are no limits to how far you can adapt a retained structure**



# Key Takeaways

1

## Research, Consider + Retain

Be led by the science and understand the asset before you define the proposal. Retain as much existing structure as possible.

2

## Design Responsibly

Minimise materials with simple geometry, sensible grids. Challenge conventions.

3

## Specify Low Carbon

Specify reused, low carbon, natural or renewable materials.

4

## Build For The Future

Design for long life, loose fit, adaptability and deconstruction.

5

## Gear Up / Train Up

This is a specialist feild requiring unique knowledge, skills and 200 years of historic construction knowledge

6

## Take Responsibility

Make change happen. Petition for a carbon tax to measure the true life time carbon of buildings.