THE ENGINEERS REUSE COLLECTIVE

Talking Reuse: From Targets to Reality

THE ENGINEERS REUSE COLLECTIVE

Welcome

David Leversha - WSP

THE ENGINEERS REUSE COLLECTIVE

Introduction

Andy Yates - tERC

THE ENGINEERS REUSE COLLECTIVE

Slido: Please submit any questions via Slido: #2421538

THE ENGINEERS REUSE COLLECTIVE

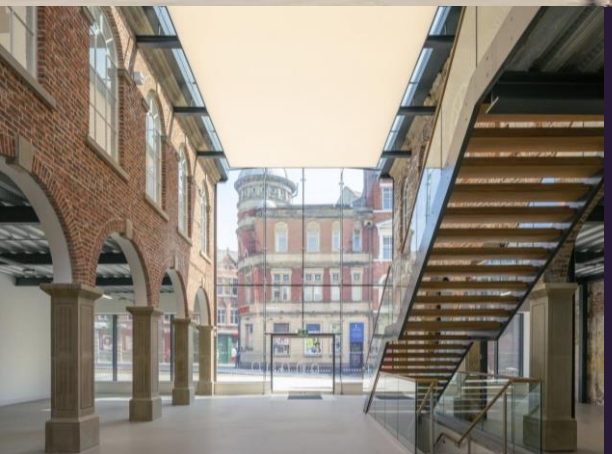
The Engineers Reuse Collective is a not-for-profit group of practising engineers championing, accelerating and delivering reuse in the built environment to support the transition of the UK's built environment to Net Zero Carbon.

Our mission is to dramatically increase reuse within the built environment, with minimal reprocessing, to support the transition to circular economy principles and to urgently reduce the carbon intensity of the built environment.

THE ENGINEERS REUSE COLLECTIVE

“A collective of minds focused on positive action and empowerment”


98
100
GELDER'S
GELDER'S
GELDER'S
CARPETS



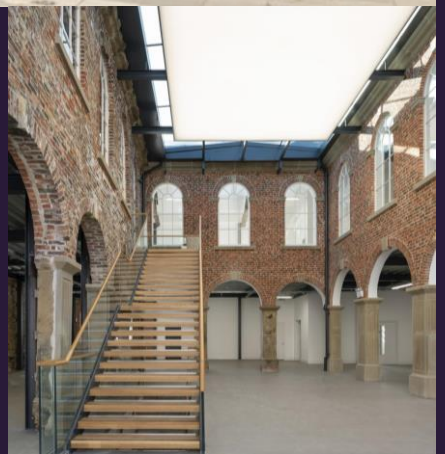


Image credits: © Gavin Stewart

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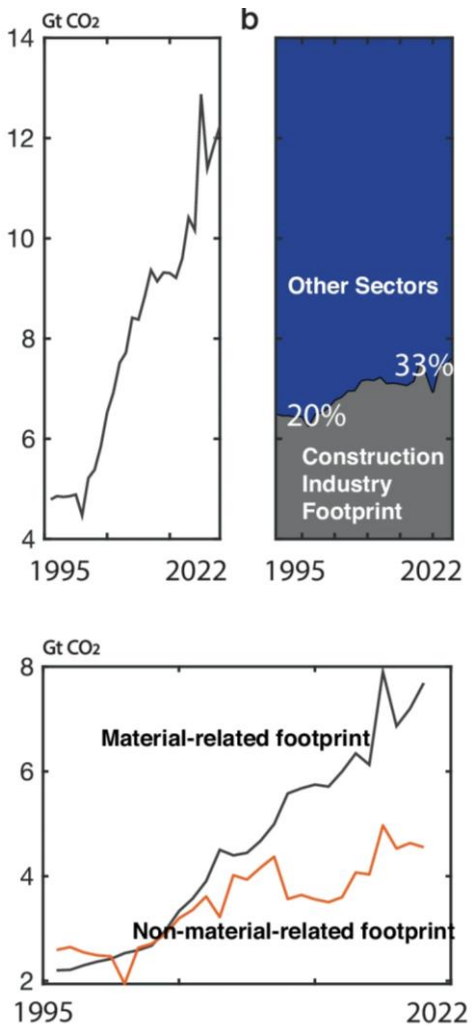
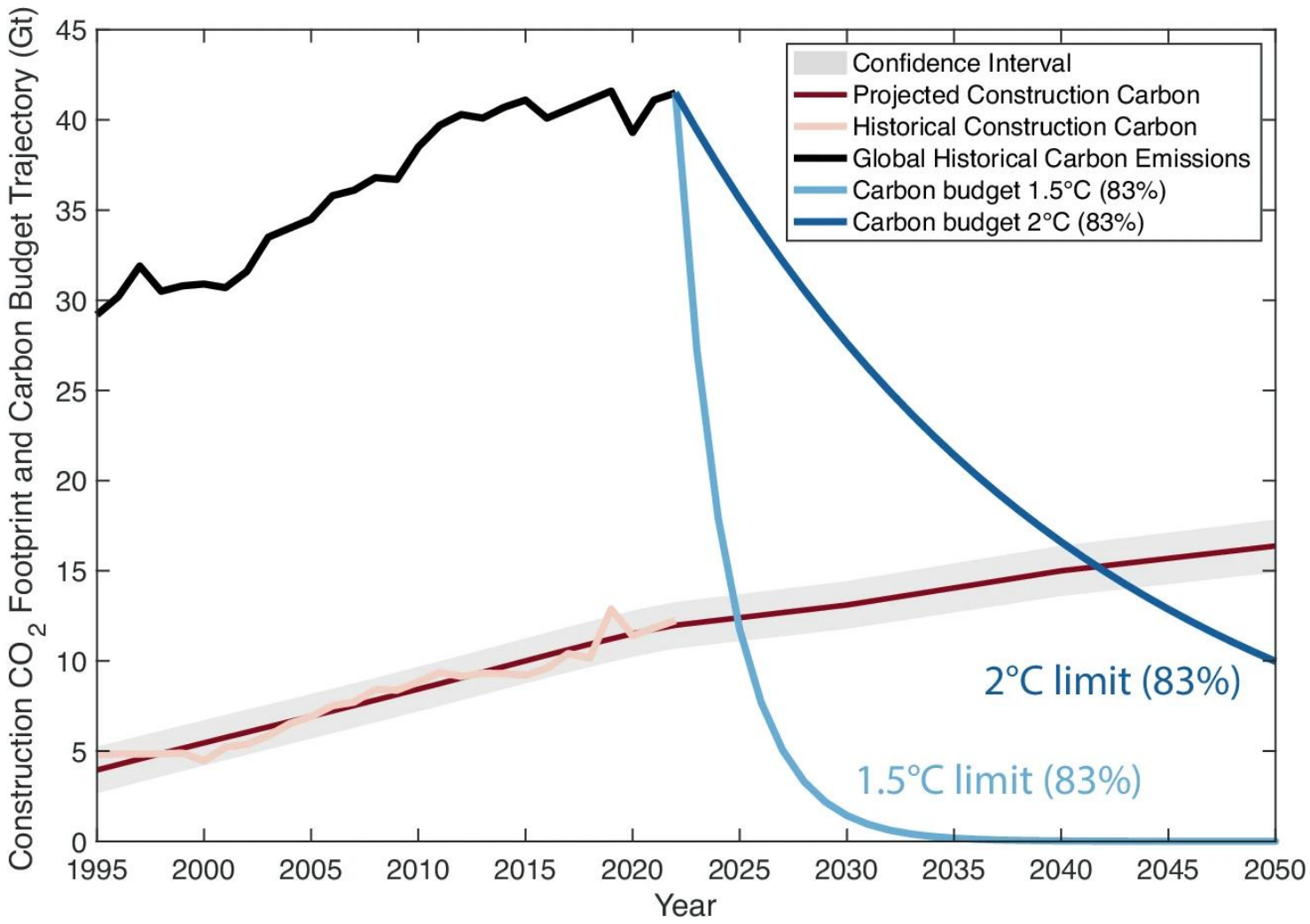
Carbon footprint of the construction industry





Source: Li, C *et al*. (2025), *Carbon footprint of the construction sector is projected to double by 2050 globally*, Communications: Earth & Environment, **6**, 831. https://doi.org/10.1038/s43247-025-02840-x

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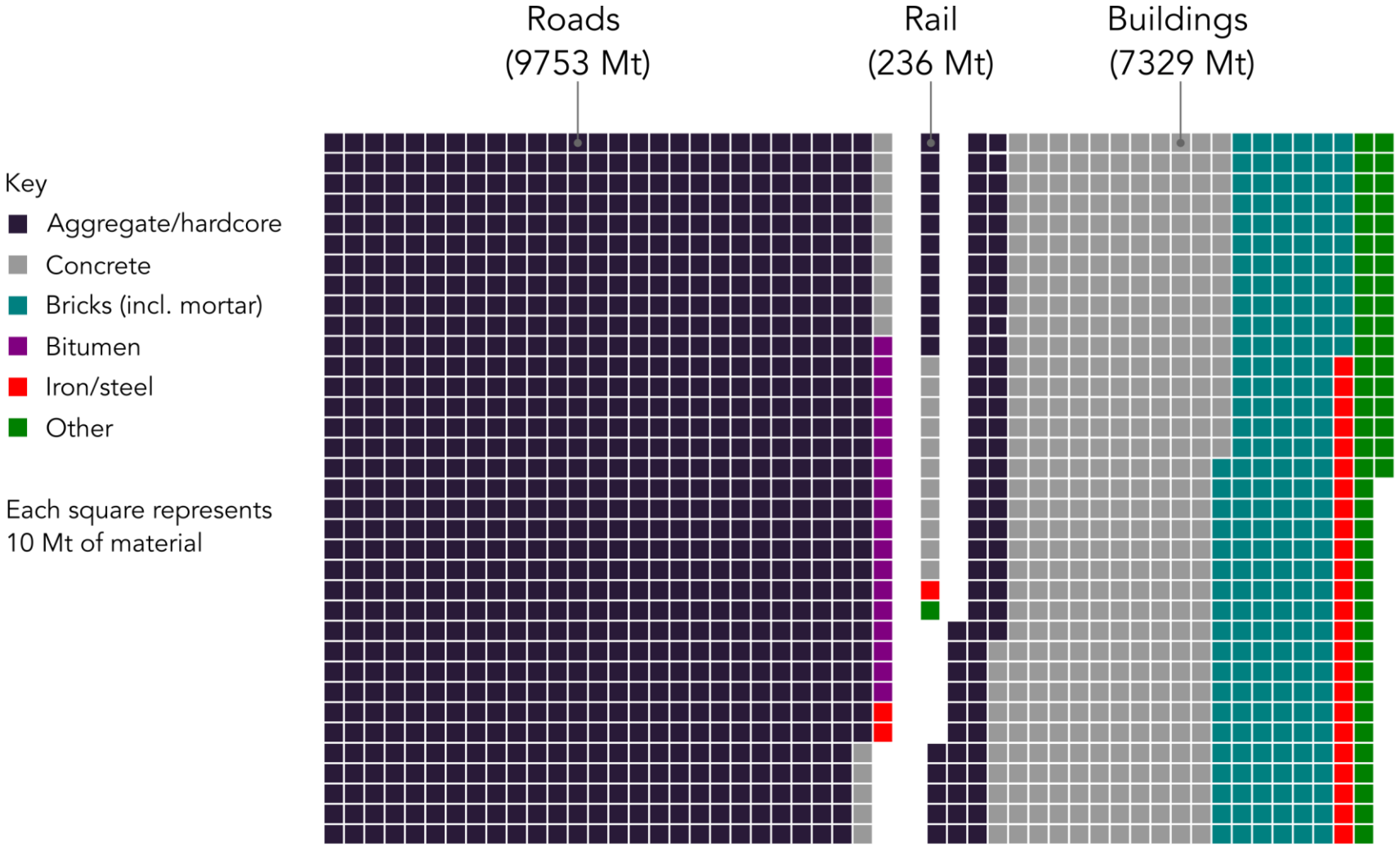
UK Material stocks



Source: Wiedenhofer, D *et al*. (2024), *Mapping material stocks of buildings and mobility infrastructure in the United Kingdom and the Republic of Ireland*, Resources, Conservation & Recycling, vol 206, 107630. https://doi.org/10.1016/j.resconrec.2024.107630

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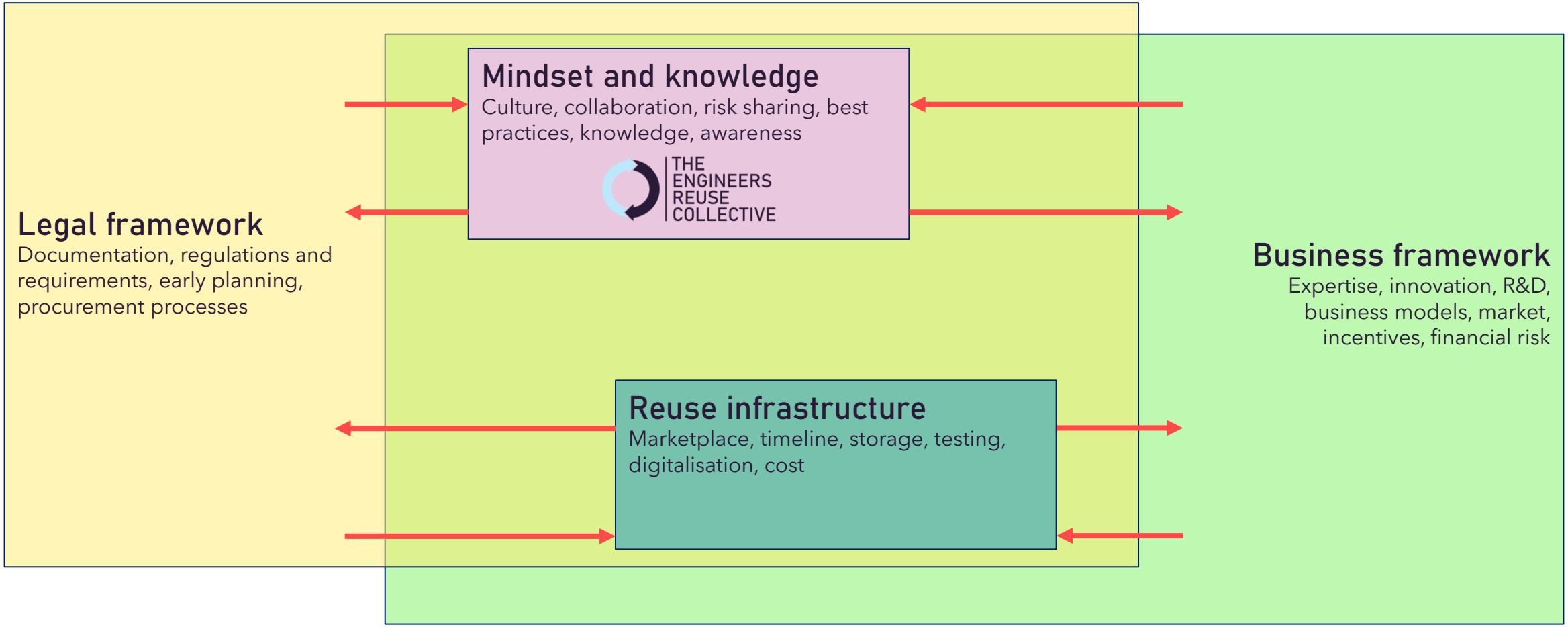
Barriers and success factors to reuse



Source: Knoth, K *et al*. (2022), *Barriers, success factors, and perspectives for the reuse of construction products in Norway*, Journal of Cleaner Production, vol 337, 130494. https://doi.org/10.1016/j.jclepro.2022.130494

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Hierarchy of Net Zero Design

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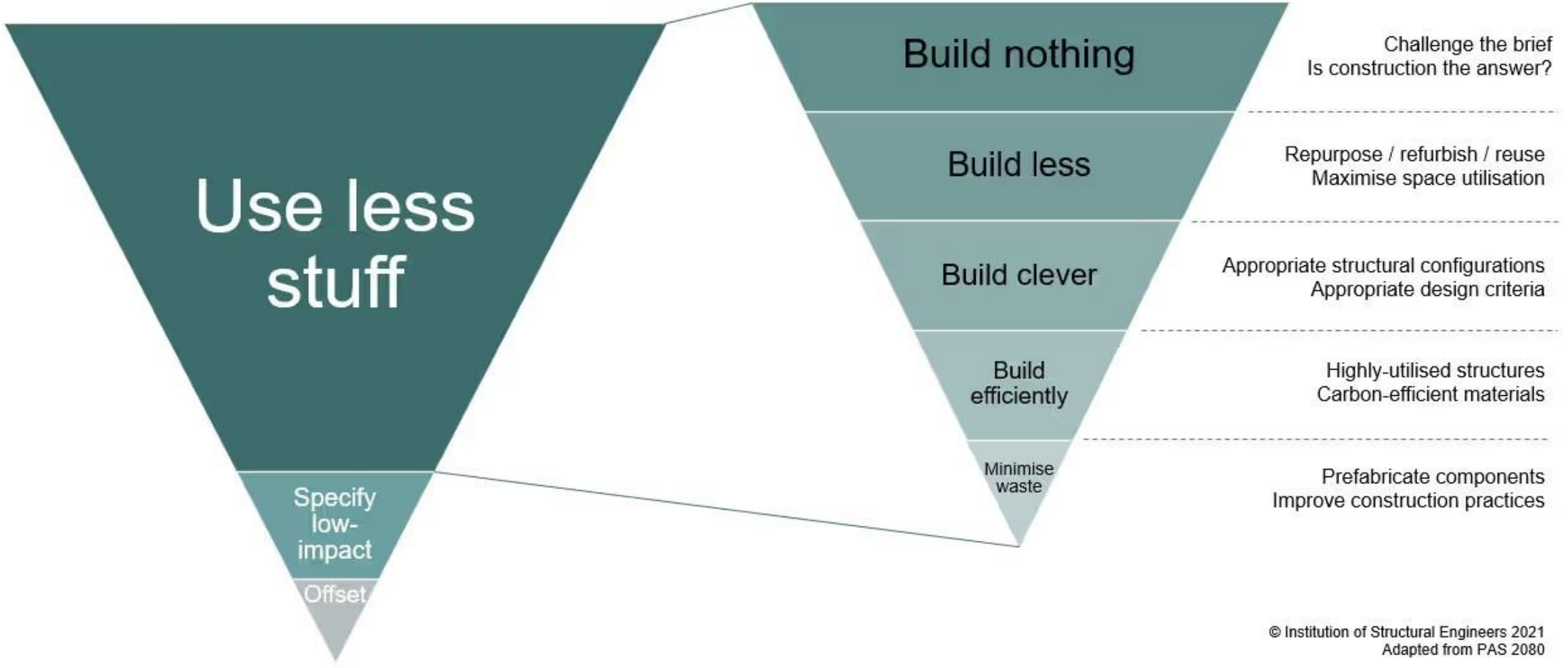

Adapted from PAS 2080

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The Reuse Hierarchy

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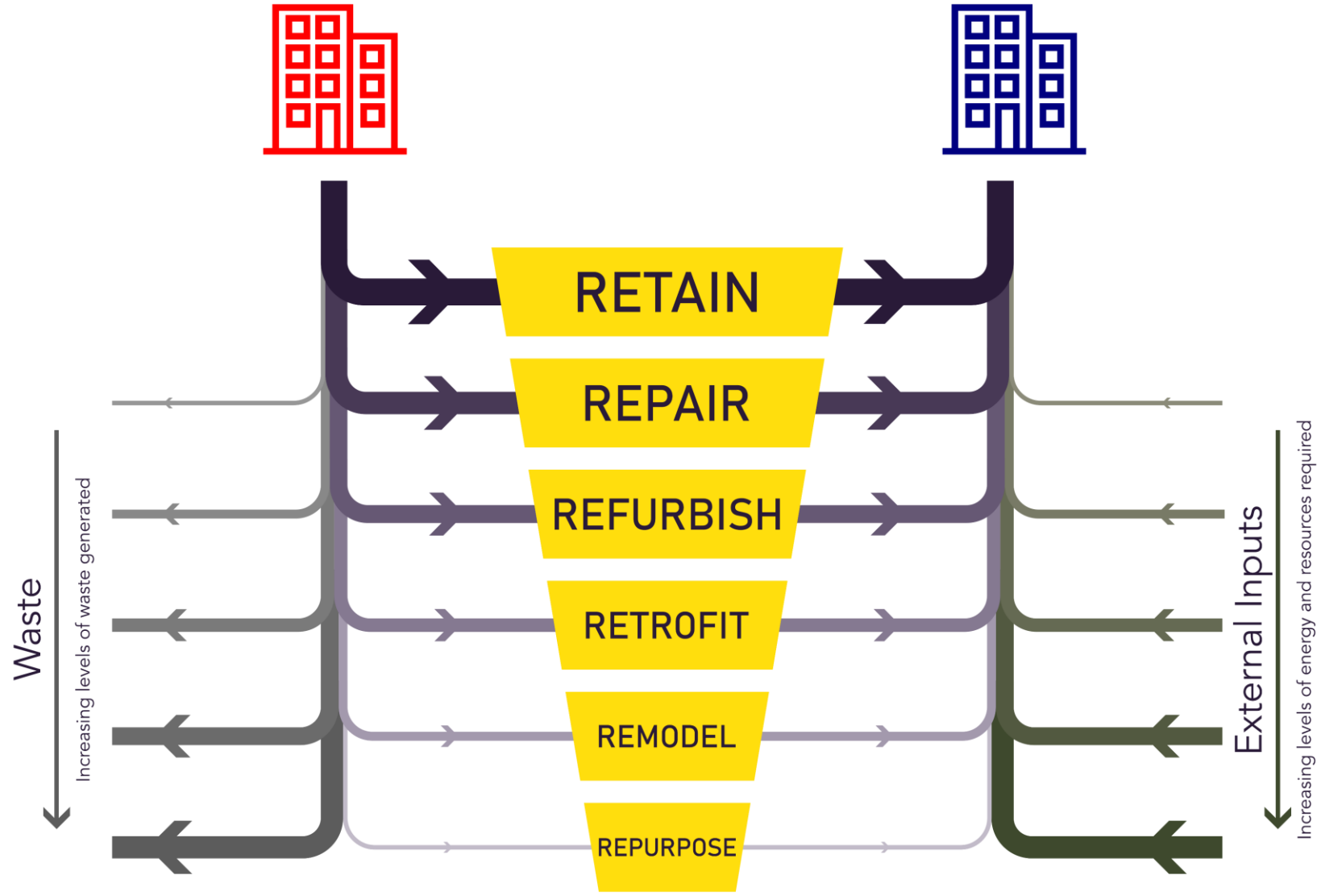


ALLCLEAR
DEMOLITION

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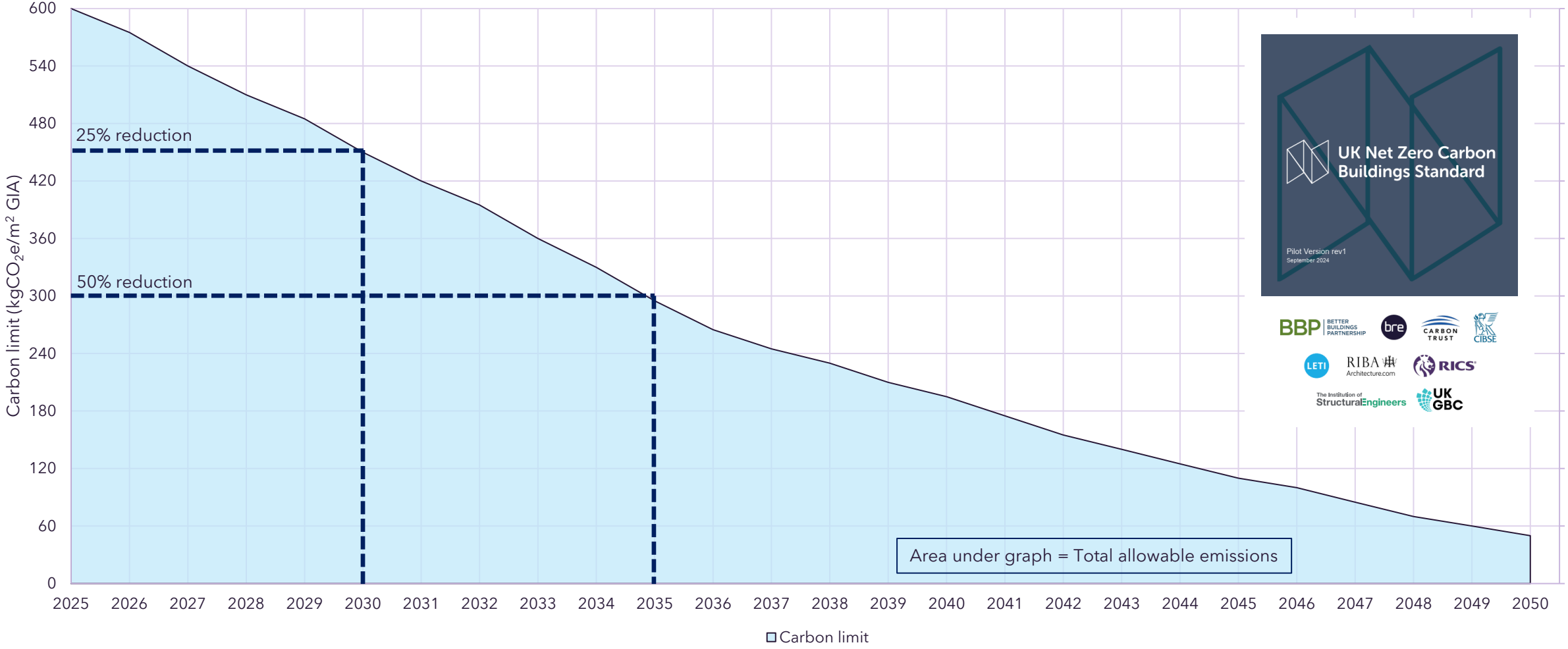
UK Net Zero Carbon Buildings Standard: Upfront carbon limits for office retrofit works



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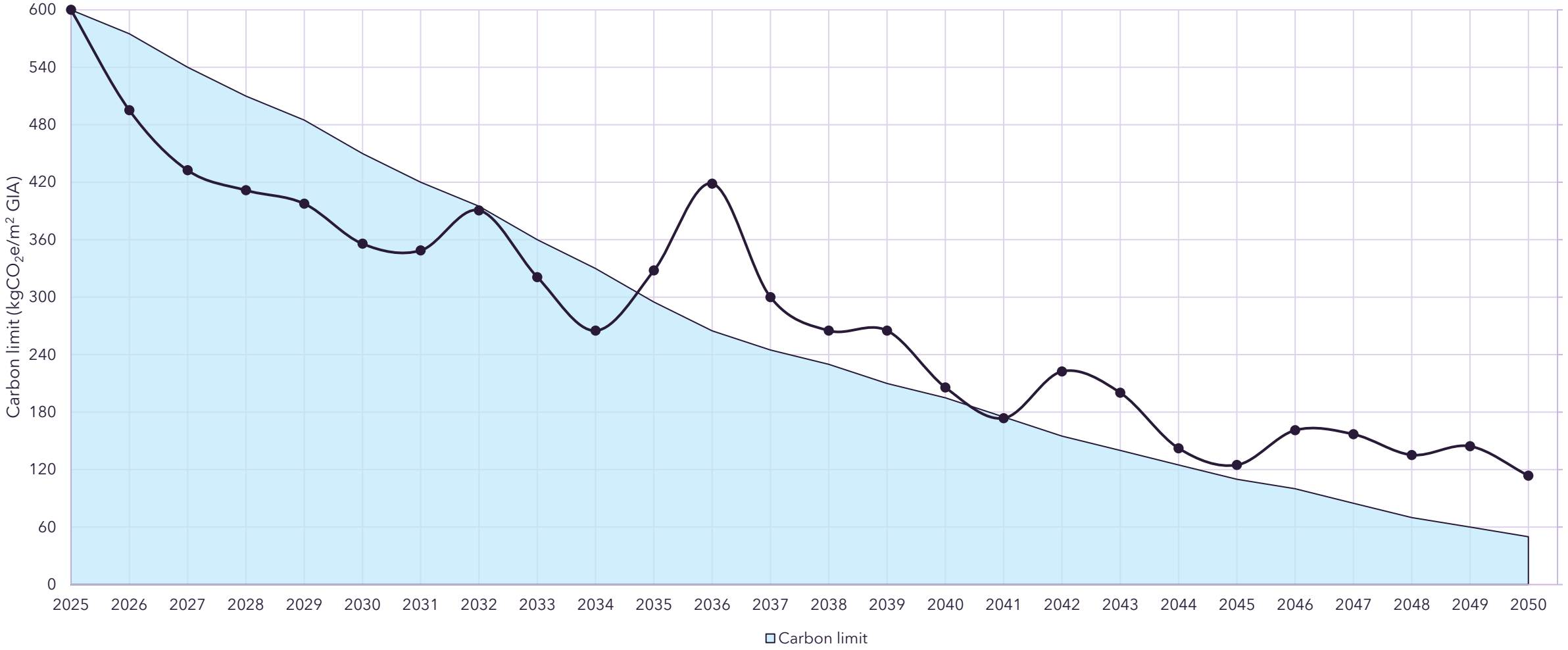
UK Net Zero Carbon Buildings Standard: Upfront carbon limits for office retrofit works



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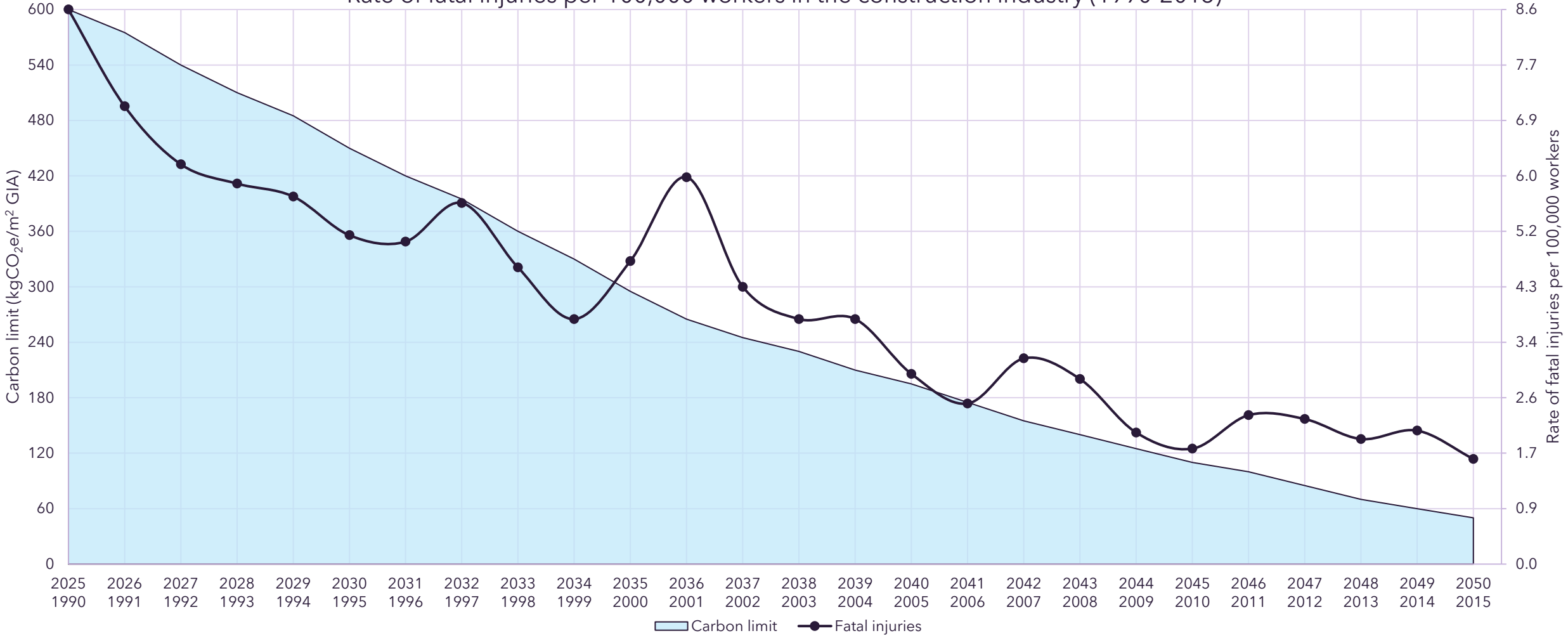
UK Net Zero Carbon Buildings Standard: Upfront carbon limits for office retrofit works /
Rate of fatal injuries per 100,000 workers in the construction industry (1990-2015)



Source: Health and Safety Executive (2024), *Work-related injuries reported under RIDDOR from 1974.* https://www.hse.gov.uk/Statistics/history/index.htm [accessed November 2024]

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How can we justify continuing to use new materials?

How can we reuse what we already have?

How can we apply our creativity and design skills to reuse more?

How can we think differently?

WORK TOGETHER

CHANGE MINDSETS

WASTE LESS

REUSE MORE

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Enabling reuse through a circular economy

Charles Gillott – WSP

DRIVERS OF A CIRCULAR ECONOMY

ENABLING REUSE THROUGH A CIRCULAR ECONOMY

Charles Gillott

Direct targets

Combined/local planning policy:

- *“95% reuse/recycling/recovery of construction and demolition waste”.*
- *“95% beneficial use of excavation waste”.*
- *“65% recycling of municipal waste by 2030”.*

Developer frameworks:

- *“98% recycled content in steel reinforcement”.*
- *“20% recycled content in structural steel”.*
- *“50% recycled content in blockwork”.*

Indirect targets

Industry standards:

- *“490 kgCO2e/m2 upfront carbon in new build flats commencing in 2027”.*
- *“510 kgCO2e/m2 upfront carbon in retrofitted offices commencing in 2028”.*

Combined/local planning policy:

- *“<950 kgCO2e/m2 upfront carbon in new build offices”.*
- *“<1200 kgCO2e/m2 whole life carbon in new build residential”.*

Developer frameworks:

- *“450 kgCO2e/m2 upfront carbon in new build residential”.*
- *“570 kgCO2e/m2 upfront carbon in new build hotels”.*

CIRCULAR ECONOMY DEFINITIONS

ENABLING REUSE THROUGH A CIRCULAR ECONOMY

Charles Gillott

Origins of the circular economy

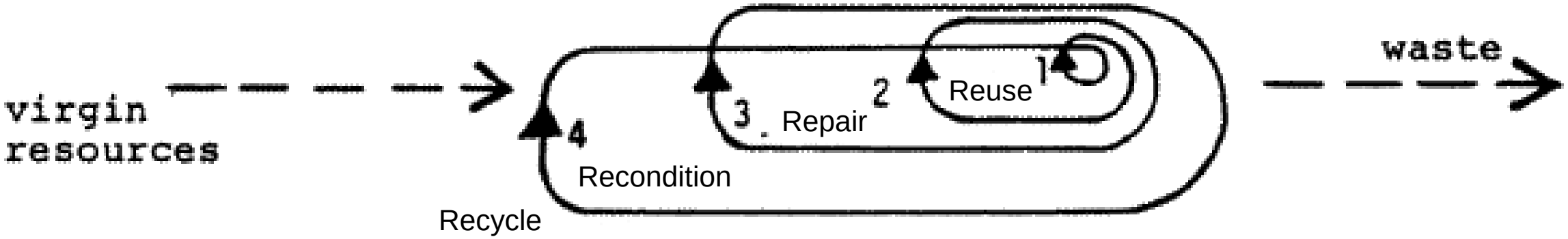
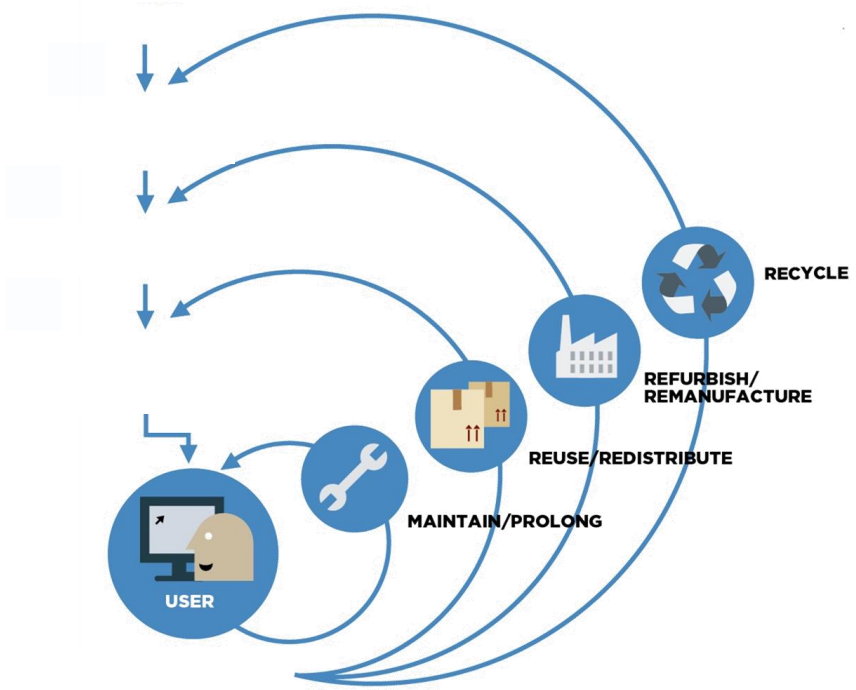


FIGURE C: THE SELF-REPLENISHING SYSTEM (PRODUCT-LIFE EXTENSION)

Stahel (1982)

Modern circular economy definitions



Ellen MacArthur Foundation (2019)

CIRCULAR ECONOMY IN CONSTRUCTION

ENABLING REUSE THROUGH A CIRCULAR ECONOMY

Charles Gillott

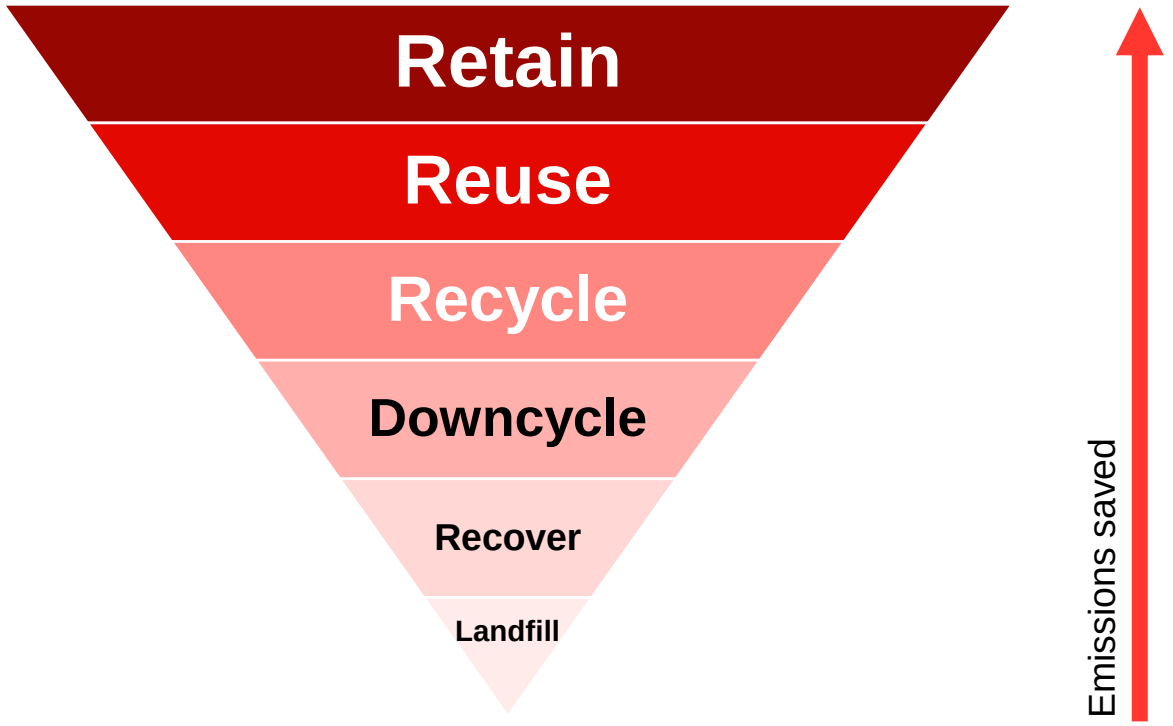
Narrow, slow & close

Narrow
Resource in-flows
e.g. retention, reuse, recycling

Close
Resource out-flows
e.g. reuse, recycling, downcycling

Slow
Resource through-flows
e.g. retention, reuse

Circular economy/low carbon hierarchy

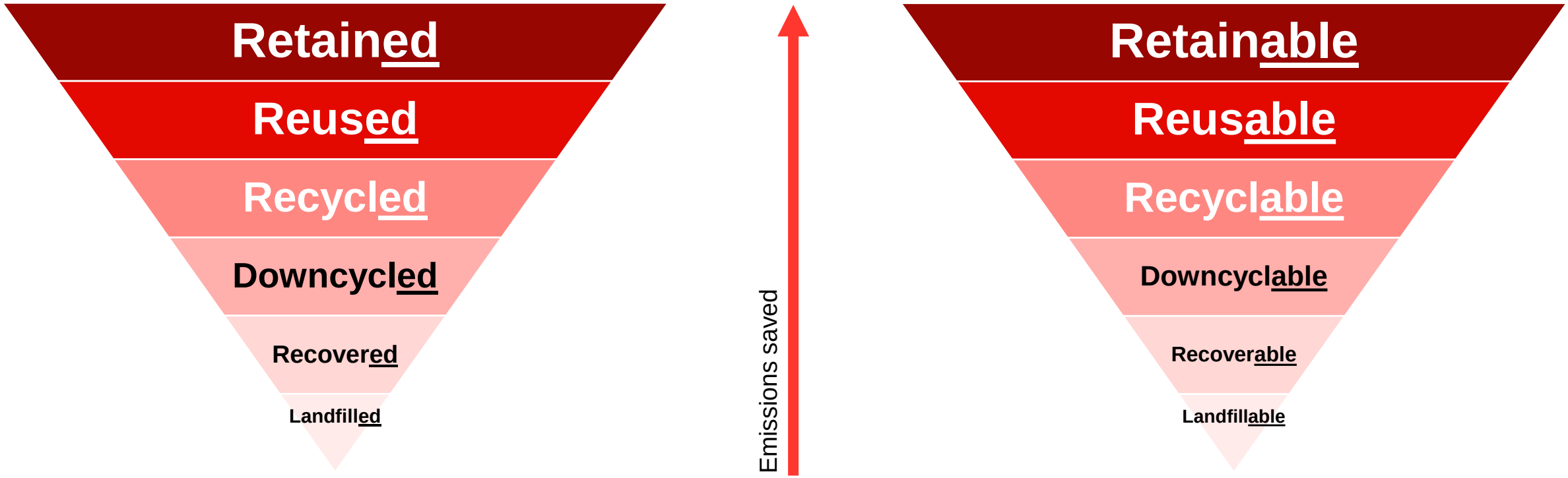


Upstream vs. downstream circularity

Upstream circularity

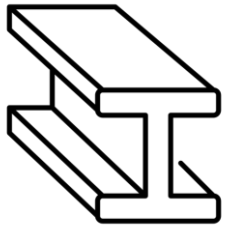
Downstream circularity

Up/downstream circular economy hierarchies

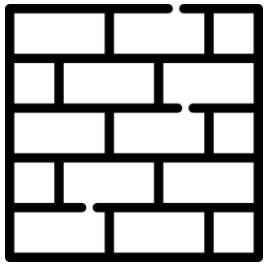


Buildings as complex systems

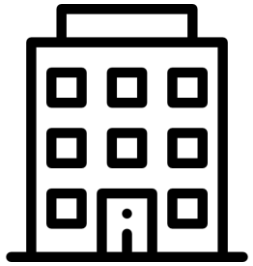
Materials



Elements

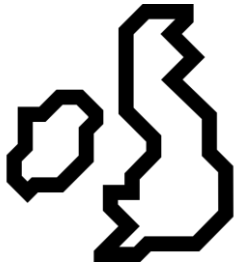


Components



Buildings

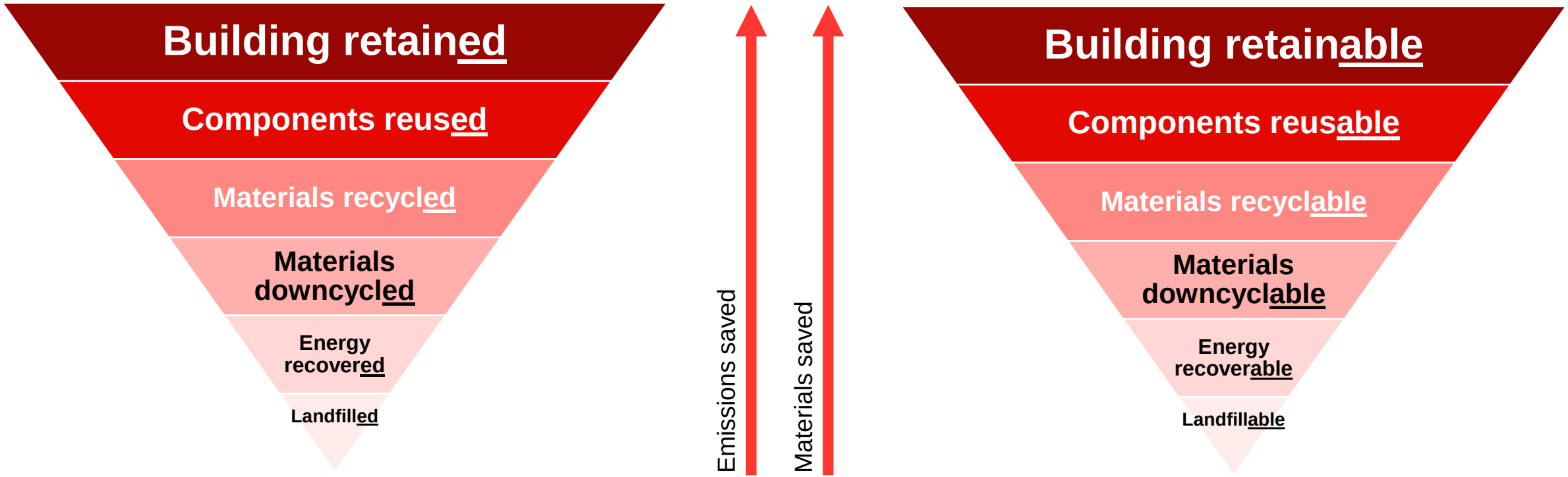
Cities/Regions



Nations

Built environment

Combined circular economy hierarchies

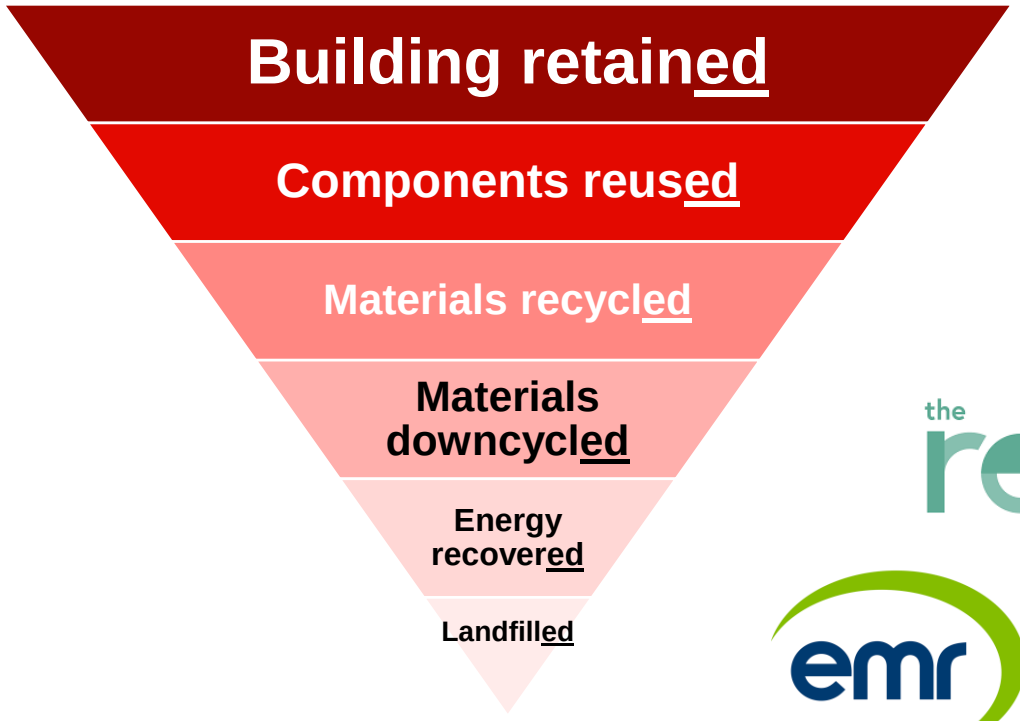


ENABLING UPSTREAM CIRCULARITY

ENABLING REUSE THROUGH A CIRCULAR ECONOMY

Charles Gillott

Enabling upstream circularity



Romulus

macomda

madaster

Circuland

Lancaster University

the rebuild site

URBAN MINERS

reusefully

emr

TIMBER DEVELOPMENT UK

the pallet loop®

CST
CLEVELAND STEEL & TUBES LTD

Enabling reuse: URBAN MINERS

Sourcing and Supply:

- Collection of salvaged materials from demolition and strip-out contractors (typically free).
- Inspection, storage, testing and reconditioning (where necessary).
- Rehoming of items via sales and brokerage channels.

Reclamation Logistics and Coordination:

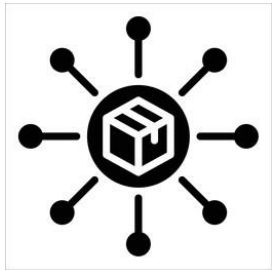
- Single point of contact for all reuse and high-value recycling activities on demo/construction projects.
- Planning of site procedures and sequencing for soft strip, disassembly, packaging, and recovery.
- Coordination of retrieval, loading, and delivery of reclaimed materials on and off site.
- Support for sourcing and stock-matching, from our own stock as well as our wider networks
- Tracking inbound and outbound consignments, adjusting to programme changes in real time.

Enabling reuse: URBAN MINERS

Lorries and equipment for collections and deliveries

Willingness to get stuck in

Warehouse for storage, inspection, reconditioning



Network of partners (storage, logistics, testing, reconditioning, etc)

Logistics knowhow

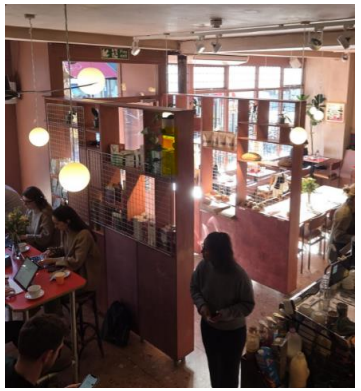
Sales, brokerage & marketing channels

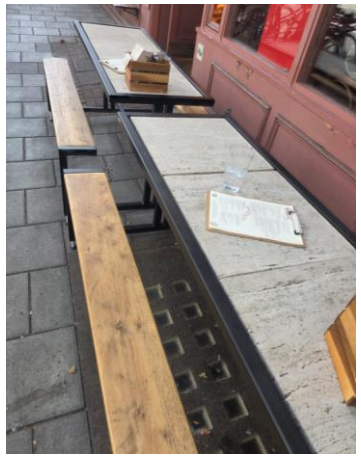
Passporting, tracking, and inventory skills & procedures

Insurances (eg public liability, product liability, professional indemnity)

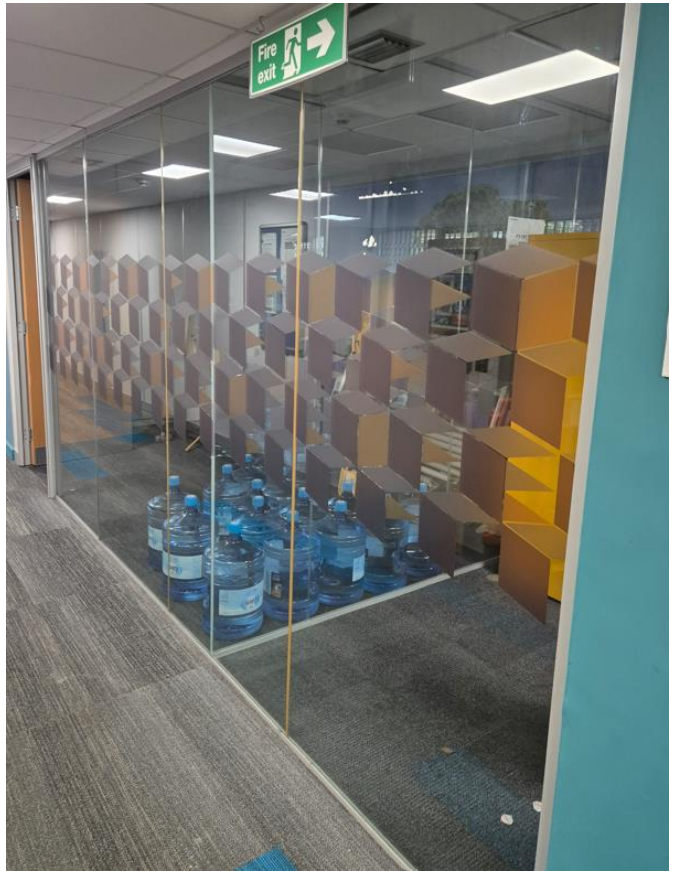
Reuse of ‘bespoke’ items:



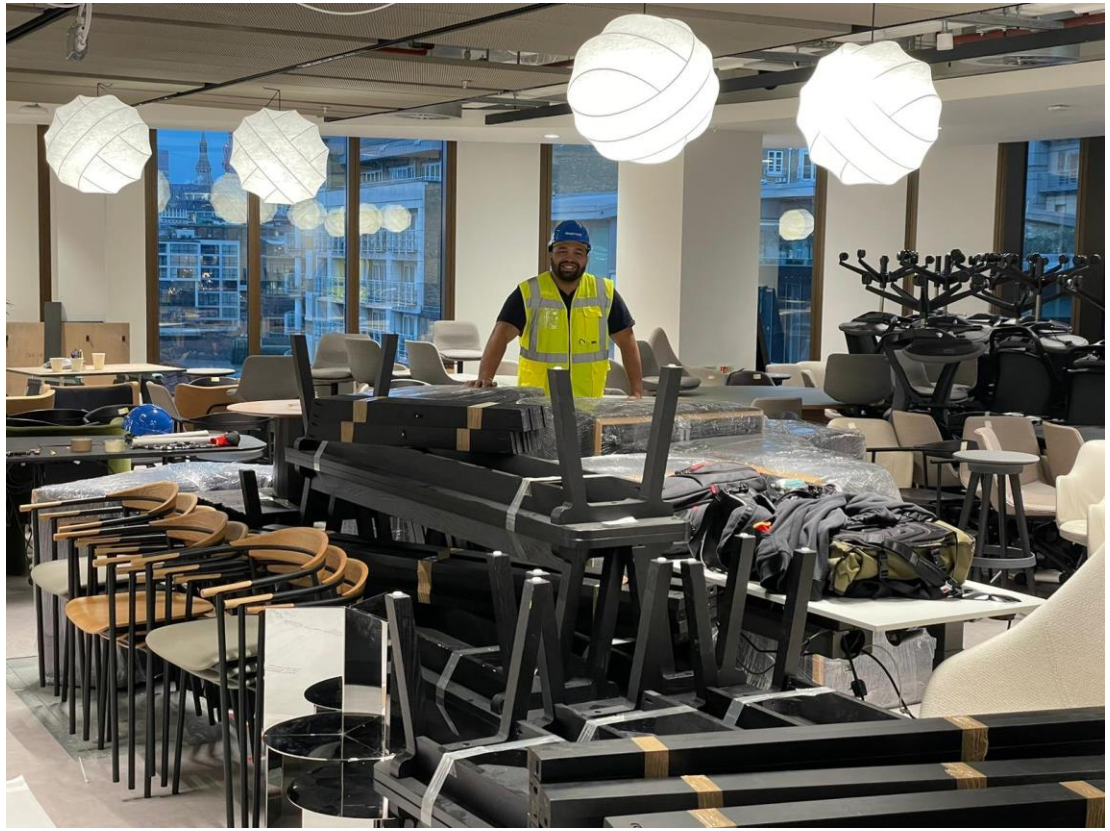




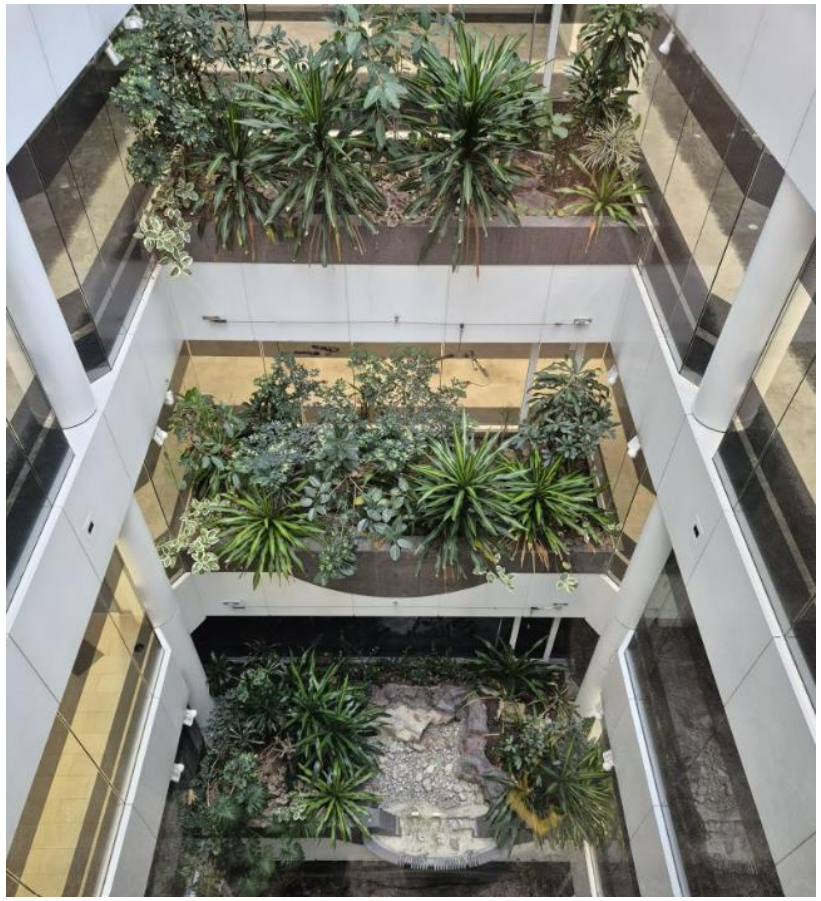
Reuse of glass partitions: URBAN MINERS



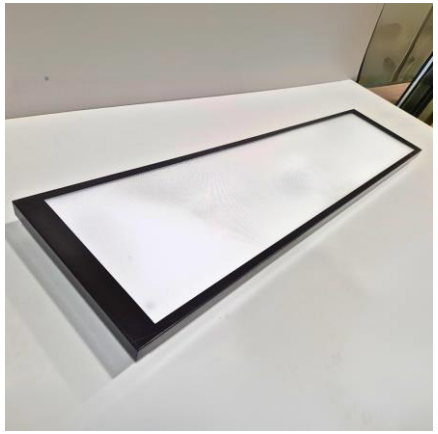
Reuse of furniture: URBAN MINERS

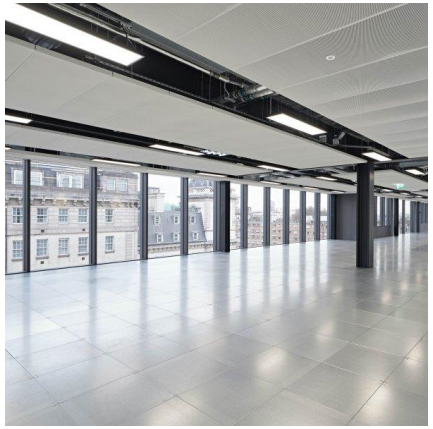


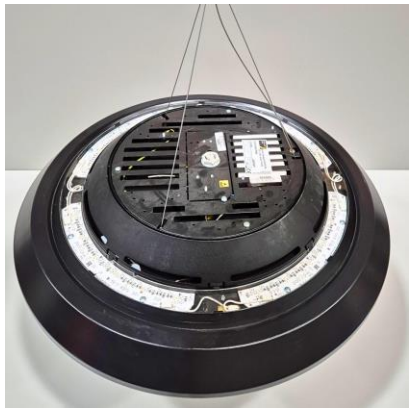
Reuse of plants and trees: URBAN MINERS



Reuse of lighting: URBAN MINERS







End-to-end collaboration: URBAN MINERS

reusefully — Data, audits, inventories, reporting, tracking & tracing

URBAN MINERS — Logistics, storage, reconditioning, resale/brokerage

BLACKSTONE STRIP OUT — Circular strip-out / demolition contractor

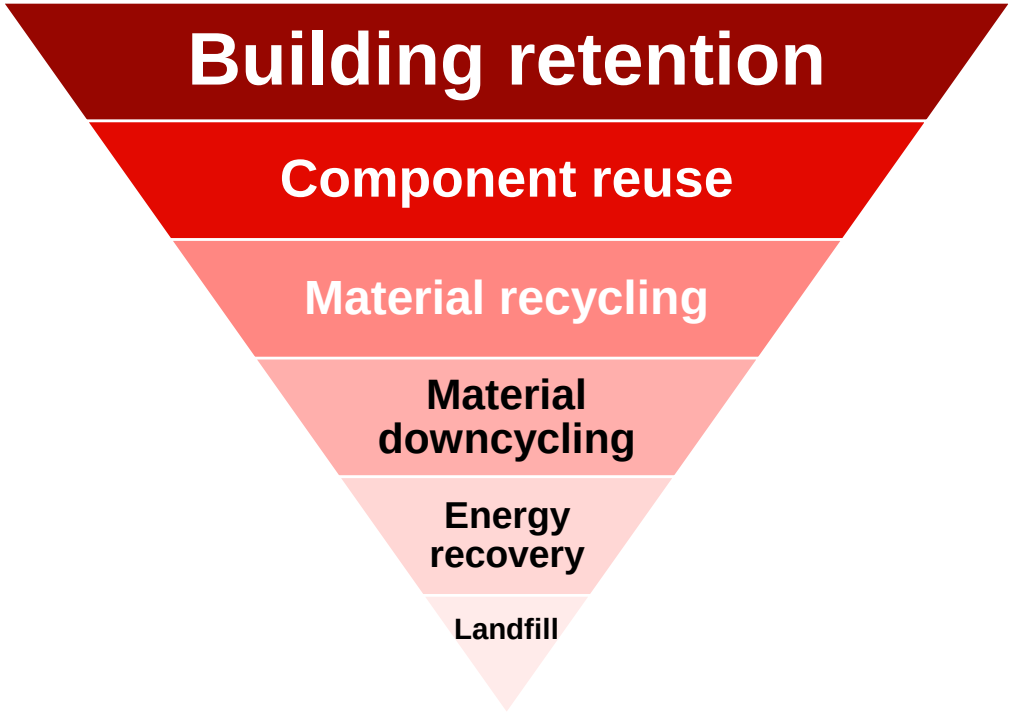
LUMYBEL — Circular fit-out contractor

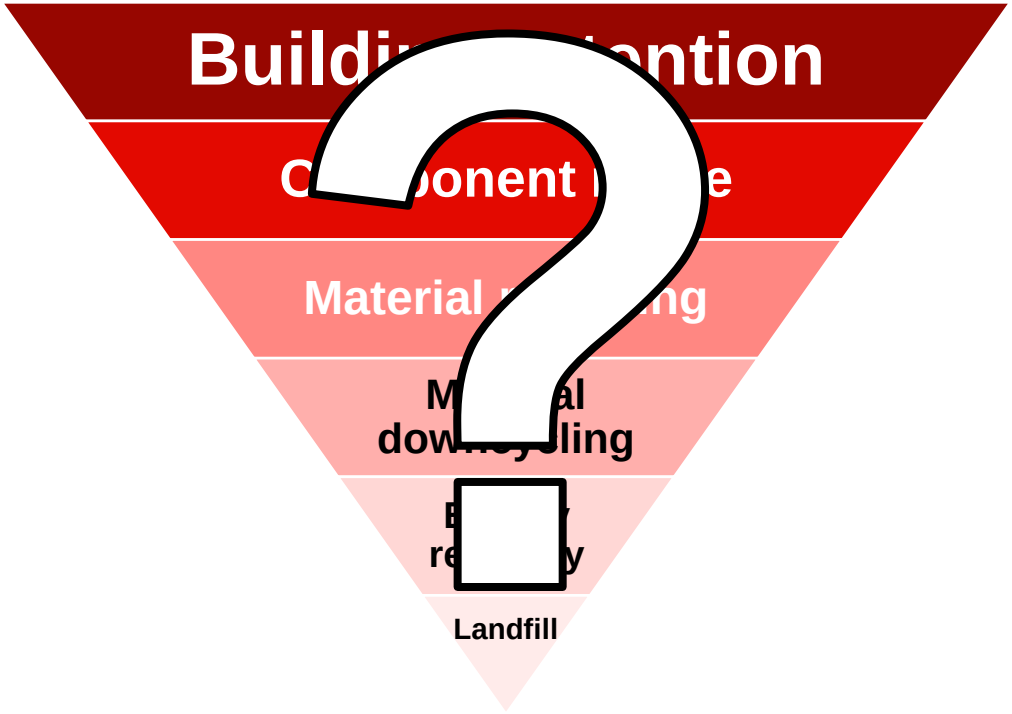
ENABLING DOWNSTREAM CIRCULARITY

ENABLING REUSE THROUGH A CIRCULAR ECONOMY

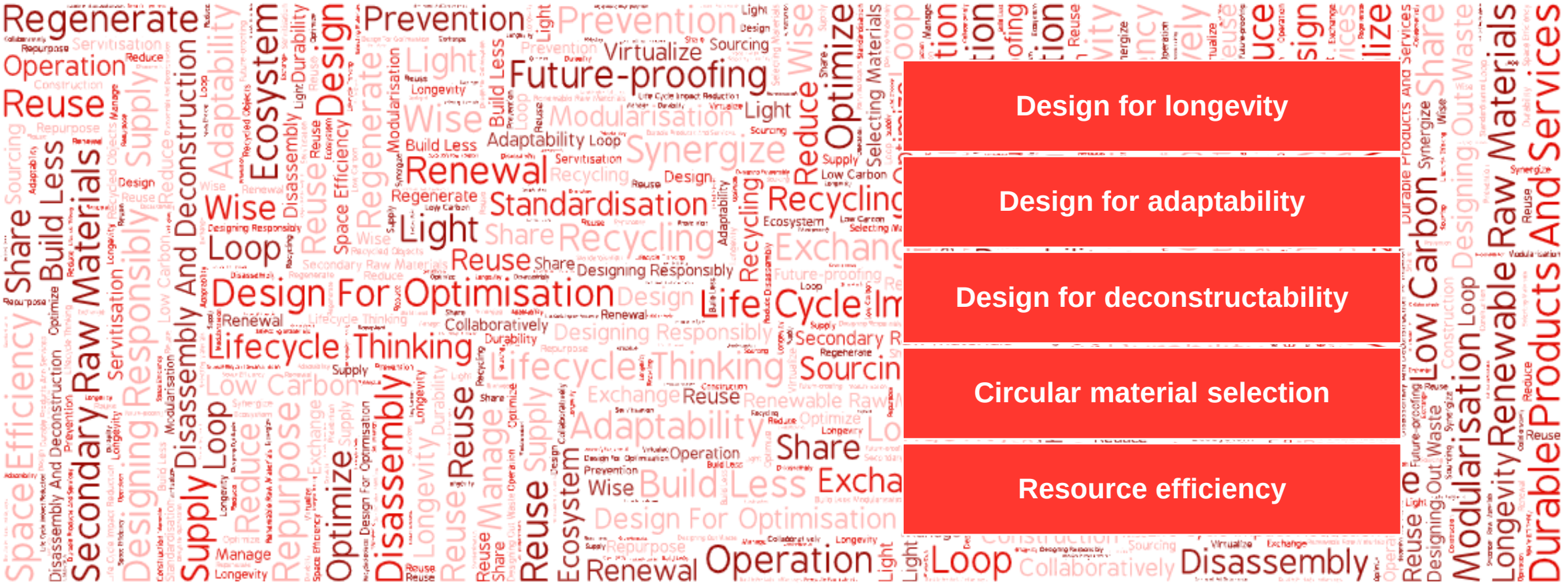
Charles Gillott

Combined circular economy hierarchies





Downstream circular economy strategies



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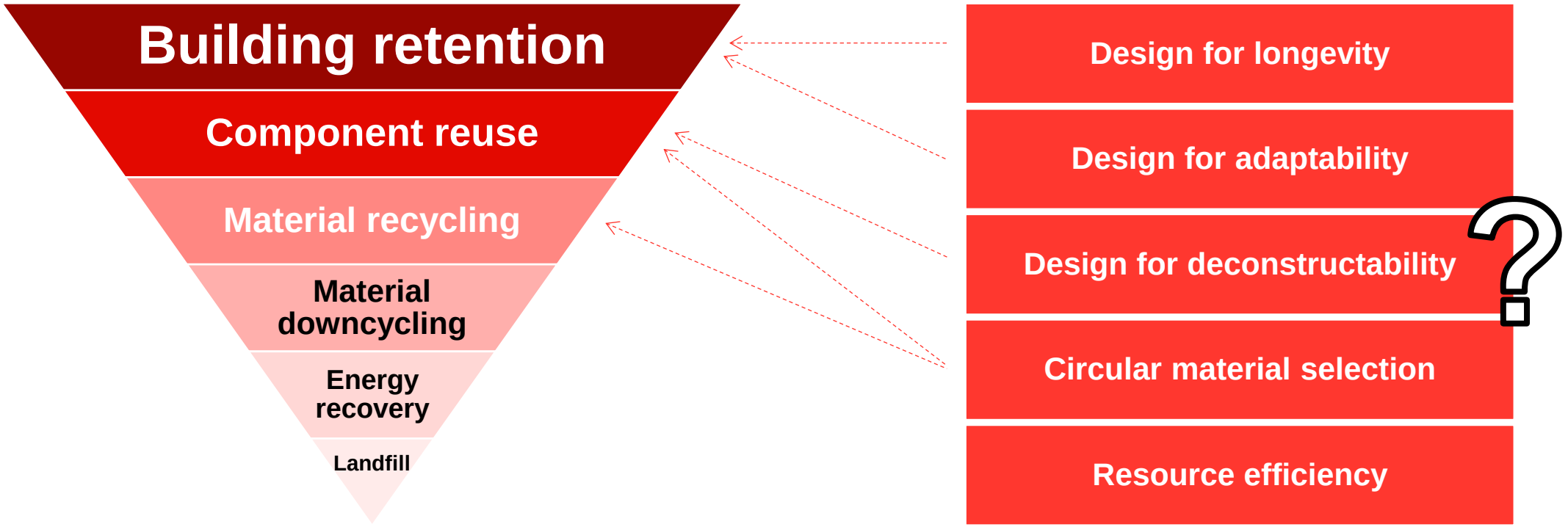

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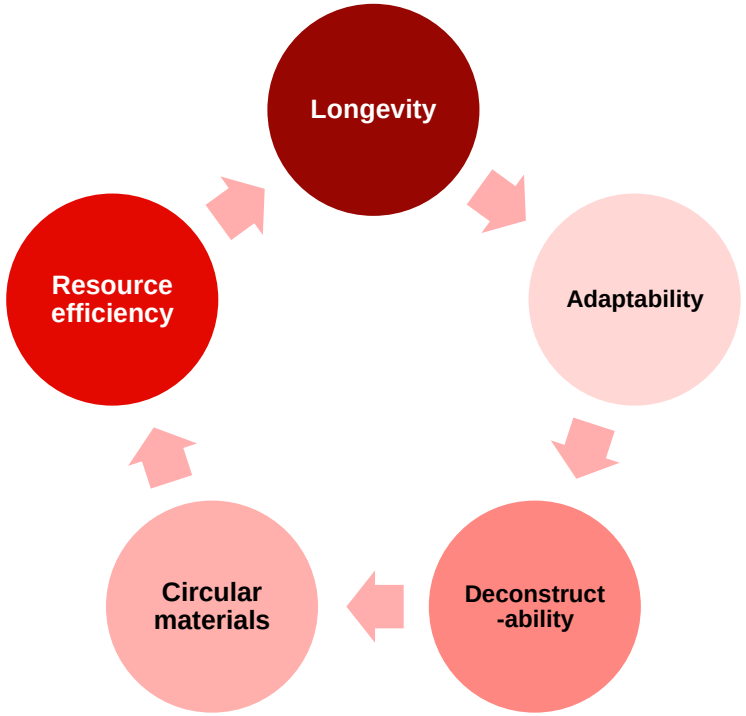
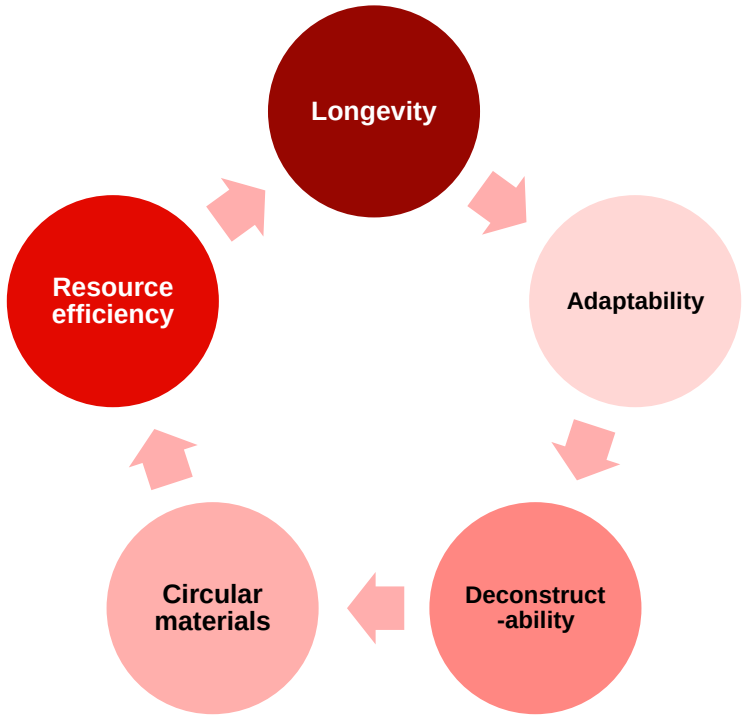
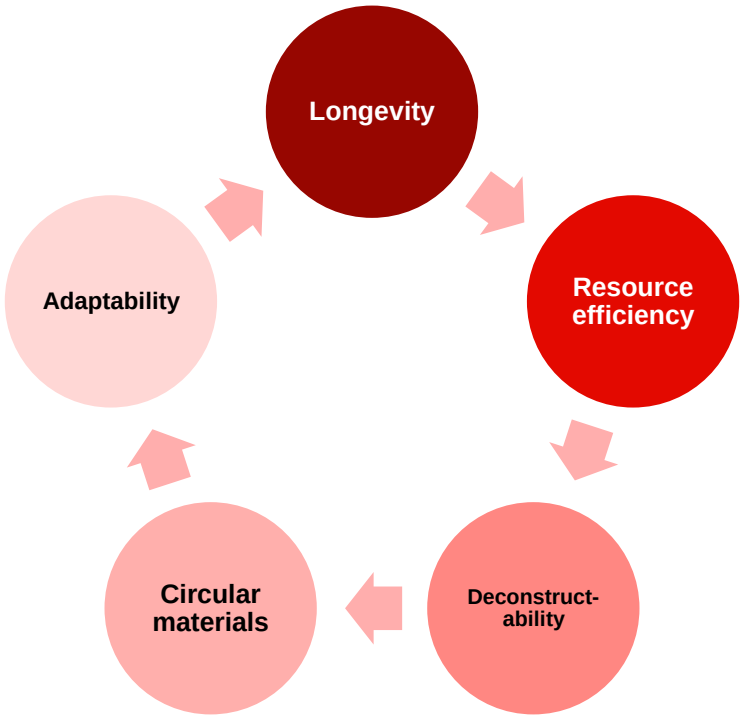


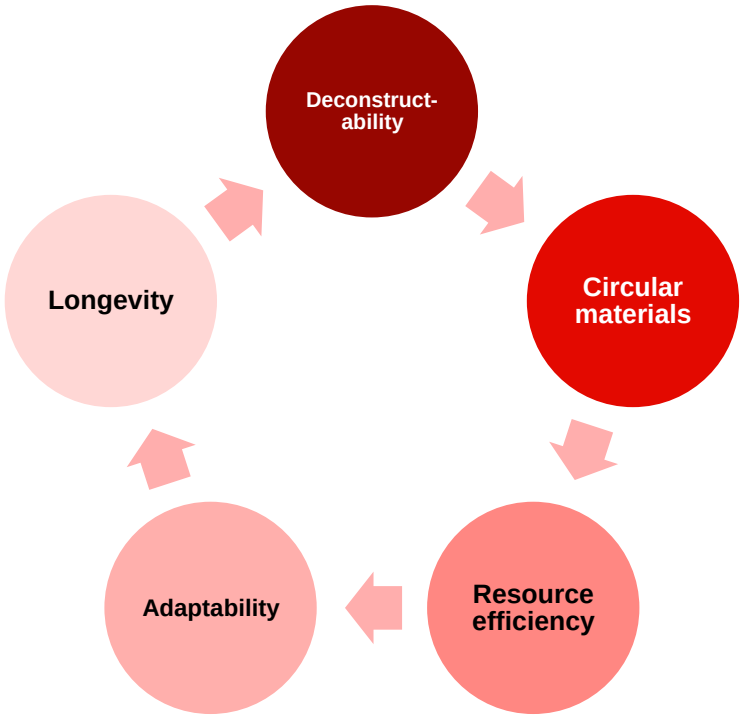
Downstream circular economy strategies



General (e.g. residential)

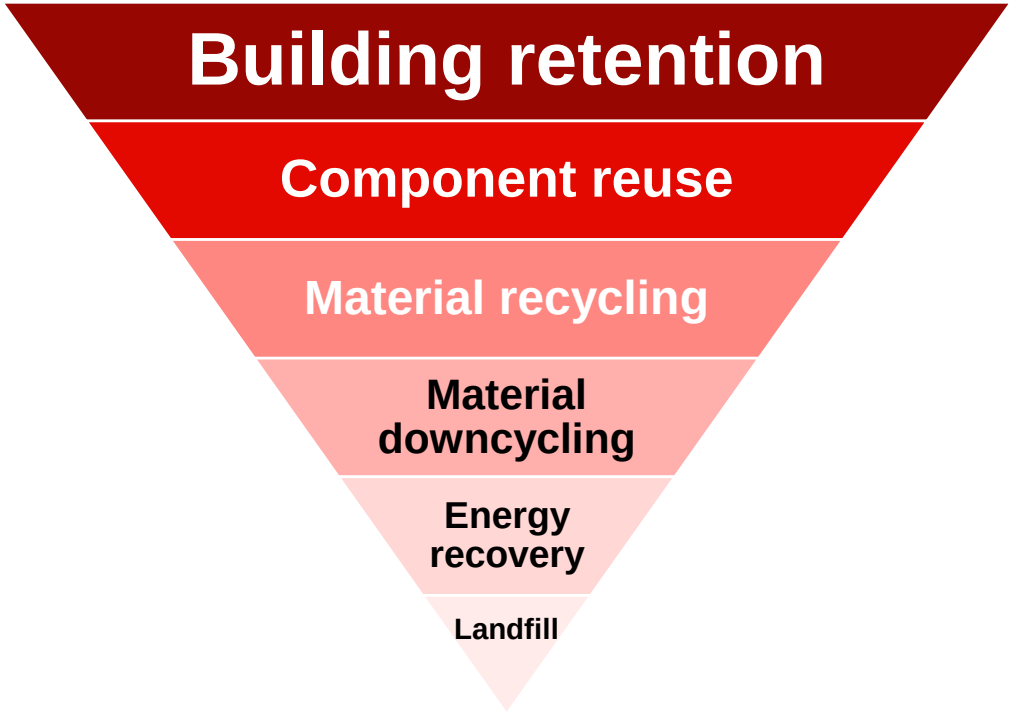


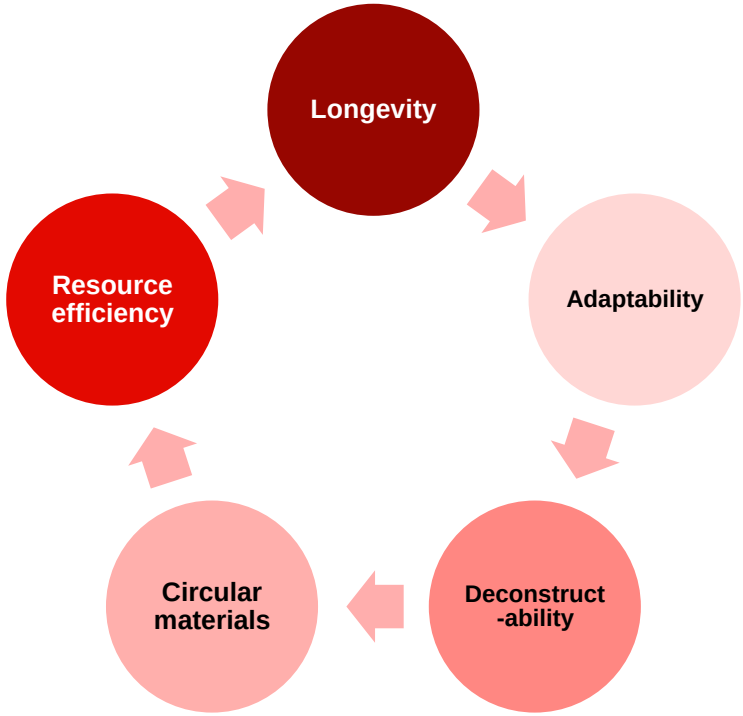
Bespoke use (e.g. car park)



Temporary structure (e.g. classrooms)

Up/downstream circular economy strategies





ENABLING REUSE THROUGH A CIRCULAR ECONOMY

THE ENGINEERS REUSE COLLECTIVE - FROM TARGETS TO REALITY

Charles Gillott

THE ENGINEERS REUSE COLLECTIVE

Leeds Office Stair

Mike Farrell – Arup
Chandan Joshi – Arup

ARUP

Leeds Office Stair

The Engineers Reuse Collective

Chandan Joshi & Mike Farrell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5 NABERS ENERGY DESIGN FOR PERFORMANCE

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CIBSE Certification Ltd.

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NABERS UNITED KINGDOM

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OUTSTANDING

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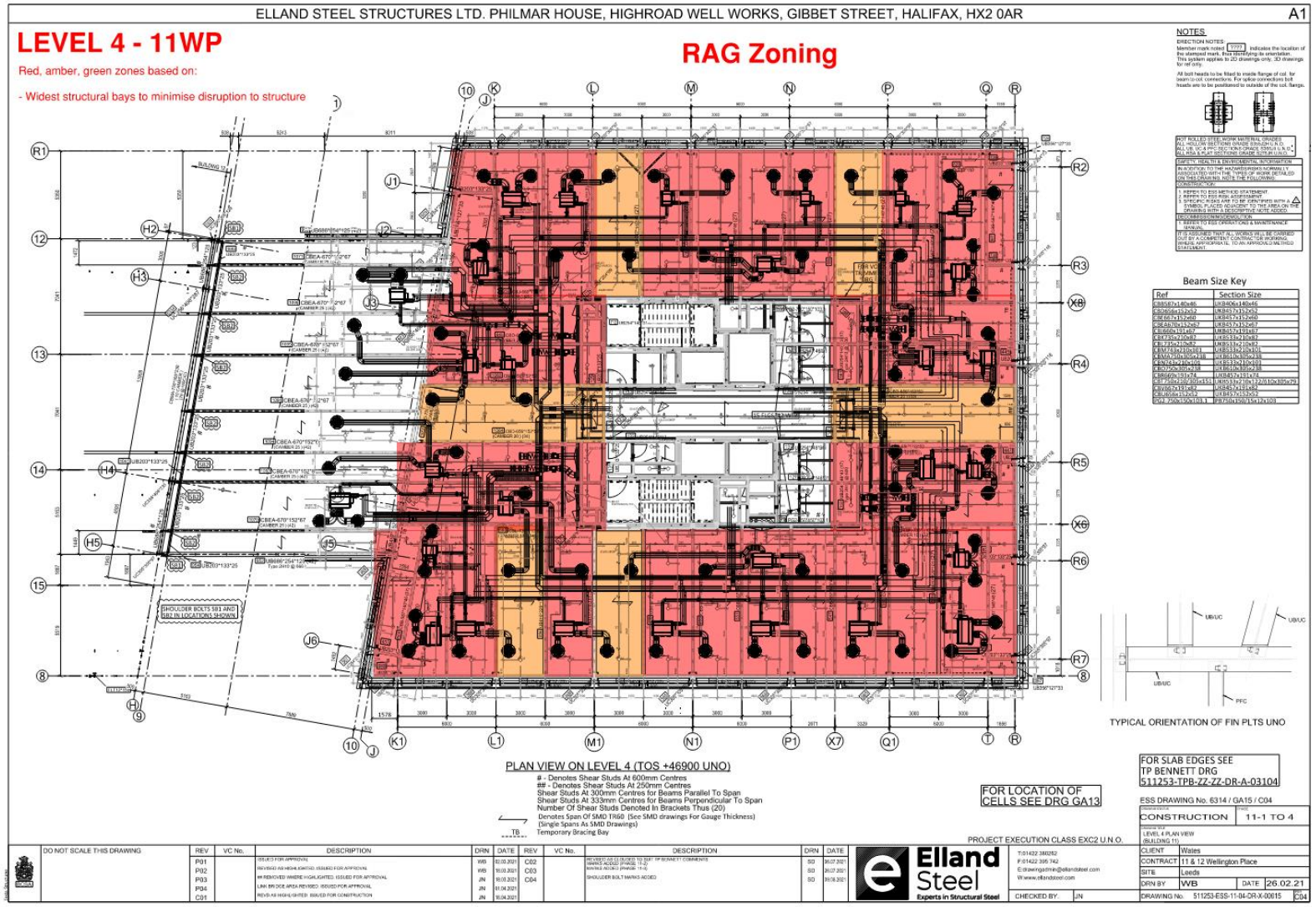
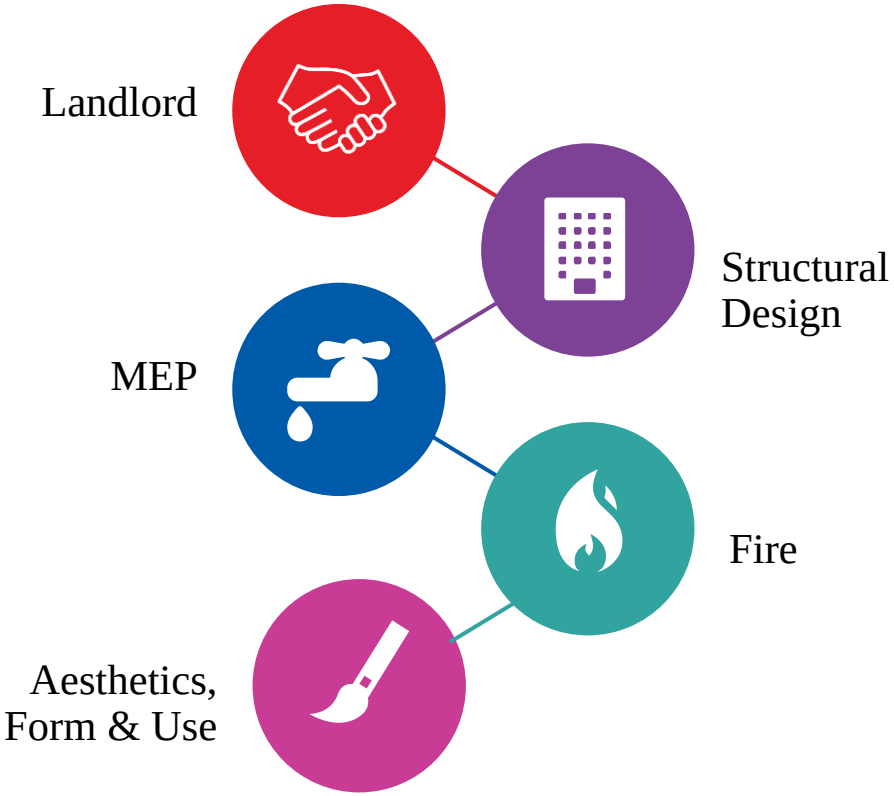

ELLAND STEEL STRUCTURES LTD. PHILMAR HOUSE, HIGHROAD WELL WORKS, GIBBET STREET, HALIFAX, HX2 0AR
A1
LEVEL 4 - 11WP
RAG Zoning
Red, amber, green zones based on:
- Widest structural bays to minimise disruption to structure
NOTES
Beam Size Key
TYPICAL ORIENTATION OF FIN PLTS UNO
PLAN VIEW ON LEVEL 4 (TOS +46900 UNO)
- Denotes Shear Studs At 600mm Centres
- Denotes Shear Studs At 250mm Centres
Shear Studs At 300mm Centres for Beams Parallel To Span
Shear Studs At 333mm Centres for Beams Perpendicular To Span
Number Of Shear Studs Denoted In Brackets Thus (20)
Denotes Span Of SMD T160 (See SMD drawings For Gauge Thickness)
(Single Spans As SMD Drawings)
Temporary Bracing Bay
FOR LOCATION OF CELLS SEE DRG GA13
FOR SLAB EDGES SEE TP BENNETT DRG 511253-TPB-ZZ-ZZ-DR-A-03104
PROJECT EXECUTION CLASS EXC2 U.N.O.
ESS DRAWING No. 6314 / GA15 / C04
CONSTRUCTION
11-1 TO 4
LEVEL 4 PLAN VIEW (BUILDING 11)
CLIENT Wales
CONTRACT 11 & 12 Wellington Place
SITE Leeds
DRN BY WB
DATE 26.02.21
DRAWING No. 511253-ESS-11-04-DR-X-00615
C04
Elland Steel
Experts in Structural Steel
DO NOT SCALE THIS DRAWING


Landlord
Structural Design
MEP
Fire
Aesthetics, Form & Use

ARUP

ARUP

ARUP


What if the planks break?
What if there aren't enough planks?
What if they don't have longevity?
What if they look messy?

ARUP

ARUP

bradford.ac.uk/sustainable-environments/industry-themes/steel-concrete/

UNIVERSITY of BRADFORD

Steel-Concrete Composite Strucutres and Circular Economy | Water engineering and natural environment | Concrete and geotechnical engineering

Acoustic engineering and management

University of Bradford / Centre for Sustainable Environments / Research themes / Steel-Concrete Composite Strucutres and Circular Economy

Steel-concrete composite structures and circular economy

Bradford hosts a leading research group in steel-concrete composite structures , including composite beams and concrete-filled steel tubes. Our current [illegible] are focussed on structures and are demountable to promote reuse at the end of life and circular economy. Several large-scale tests have [illegible] to finite element simulations.

Cite this article
Hopkinson P, Chen HM, Zhou K, Wang Y and Lam D (2019) Recovery and reuse of structural products from end-of-life buildings. *Proceedings of the Institution of Civil Engineers – Engineering Sustainability* **172(3)**: 119–128, https://doi.org/10.1680/jensu.18.00007

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Keywords: brickwork & masonry/ buildings, structures & design/concrete structures

Engineering Sustainability

ice Publishing

Recovery and reuse of structural products from end-of-life buildings

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Buildings and construction have been identified as having the greatest potential for circular economy value creation. One source of value creation is to recover and reuse building products from end-of-service-life buildings, rather than destructive demolition and downcycling. While there is a trade in non-structural and heritage product recovery and reuse, the largest volume, mass and value of most buildings comprise structural elements – concrete, brick and masonry, and steel – which present many challenges. A comprehensive literature review confirms limited attention to innovation and [illegible] address these challenges and therefore the potential reuse of the stocks [illegible] d associated environmental benefits. Potential techniques being tested [illegible] rch Council circular economy research programme are referenced as a [illegible] uilding system redesign.

[illegible] increasing [illegible] oducts and [illegible] alue in a [illegible] aining the [illegible] economic [illegible] ng use in [illegible] feedstock [illegible] rts have [illegible] highest [illegible] ion and [illegible] usiness [illegible] deliver [illegible] vity to

the stocks of such buildings at the end of their service lives and (*b*) whether the products can be remanufactured and reused in future buildings. If this is possible, then the final question is (*c*) how to translate the potential of mining such buildings to create a new circular building construction system that coordinates and integrates key players and activities, including building and product design, dismantling and separation, high-value remanufacture and marketplace exchange. The questions form the first part of a new Engineering and Physical Sciences Research Council (EPSRC) project, Regenerative Buildings and Products for a Circular Economy (Rebuild) (EPSRC EP/P008917/1), which is investigating novel techniques for the recovery of the most common building products from load-bearing structures: structural concrete components from reinforced-concrete (RC) structures, steel from steel–concrete composite structures and bricks from masonry walls bonded by cement-based mortar. A fuller description of the project and some early findings are presented towards the end of the paper.

UNIVERSITY of BRADFORD

Dennis Lam

Emeritus Professor

Faculty of Eng & Digital Technologies

d.lam1@bradford.ac.uk

Research

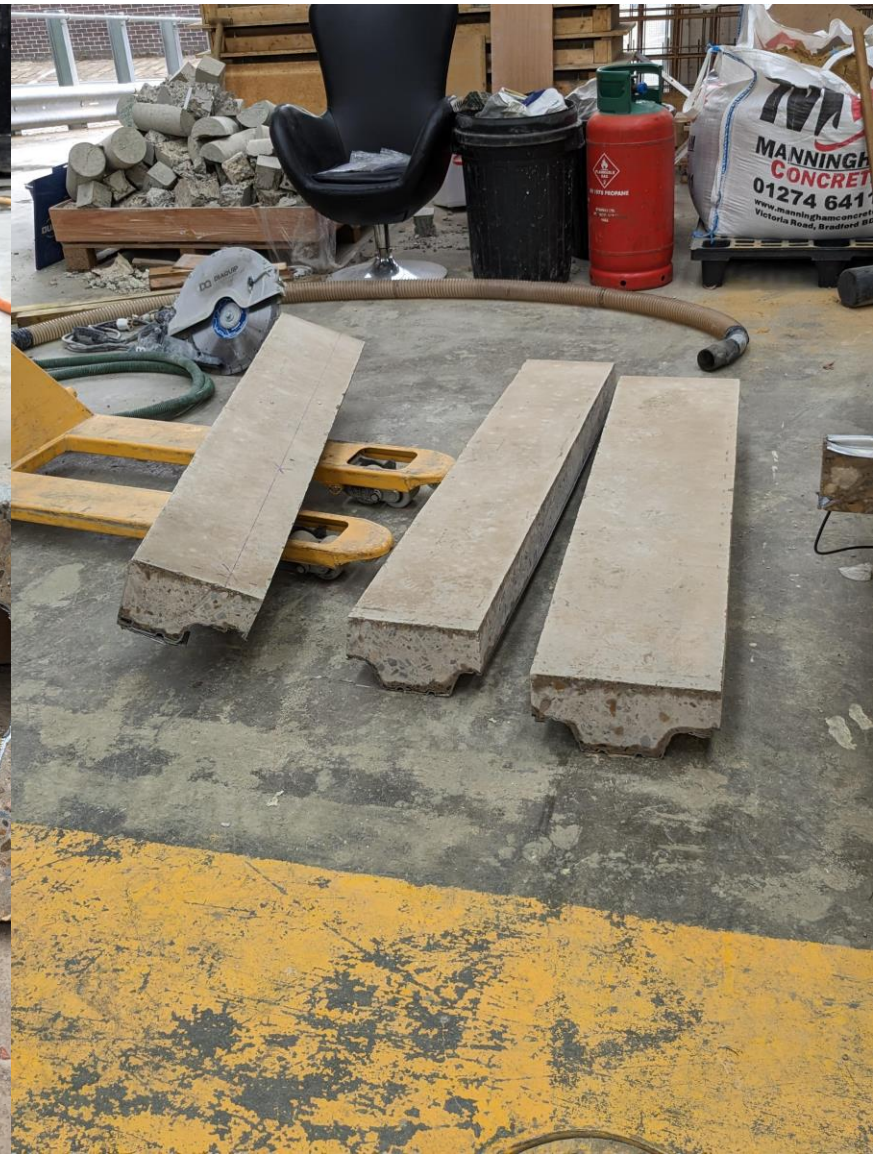
His main research interests are in the area of steel structures, steel-concrete composite structures, including the use of stainless steel, precast concrete and fibre reinforced polymers.

Research projects

- Development of Improved Shear Connection Rules in Composite Beams (RFCS)
- Slim-Floor Beams - Preparation of Application rules in view of improved safety, functionality and LCA (RFCS)
- Reuse and Demountability using Steel Structures and the Circular Economy (RFCS)
- Structural and Fire Resistance of a Reusable Steel/Concrete Composite Floor System (EPSRC)
- REBUILD - Regenerative Buildings and products for a circular economy (EPSRC)

ARUP

ARUP



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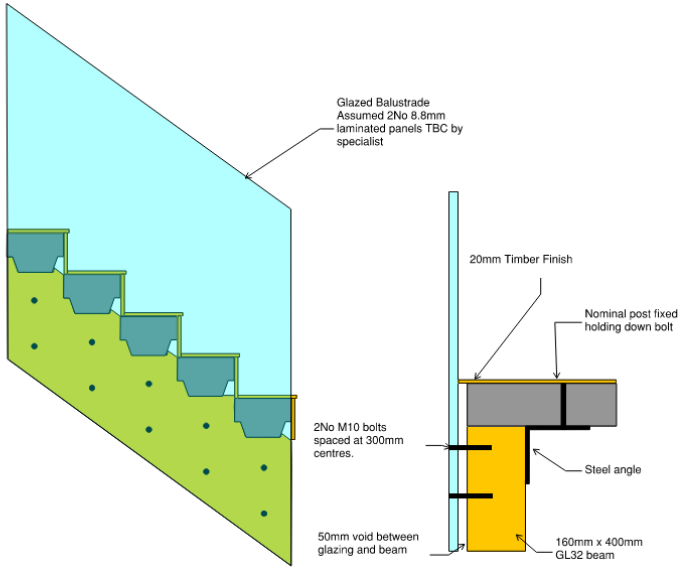
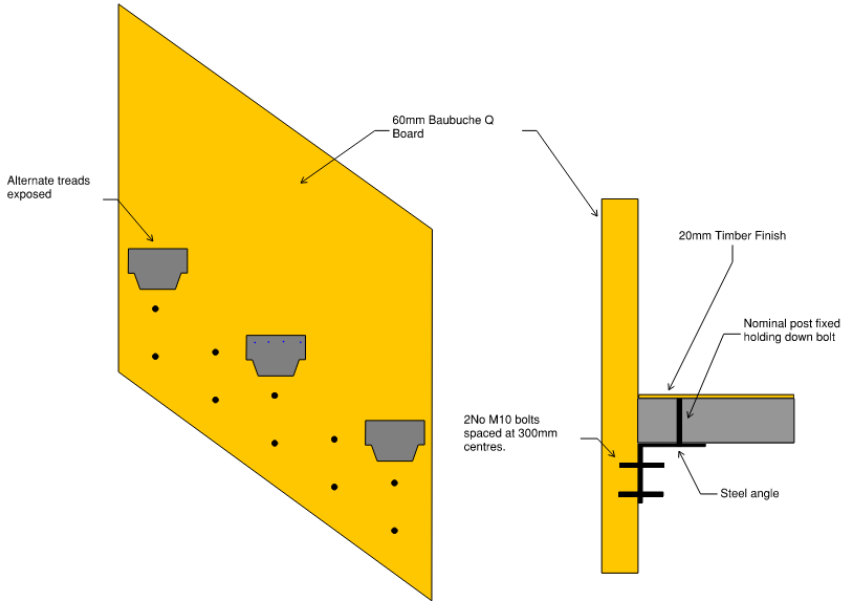
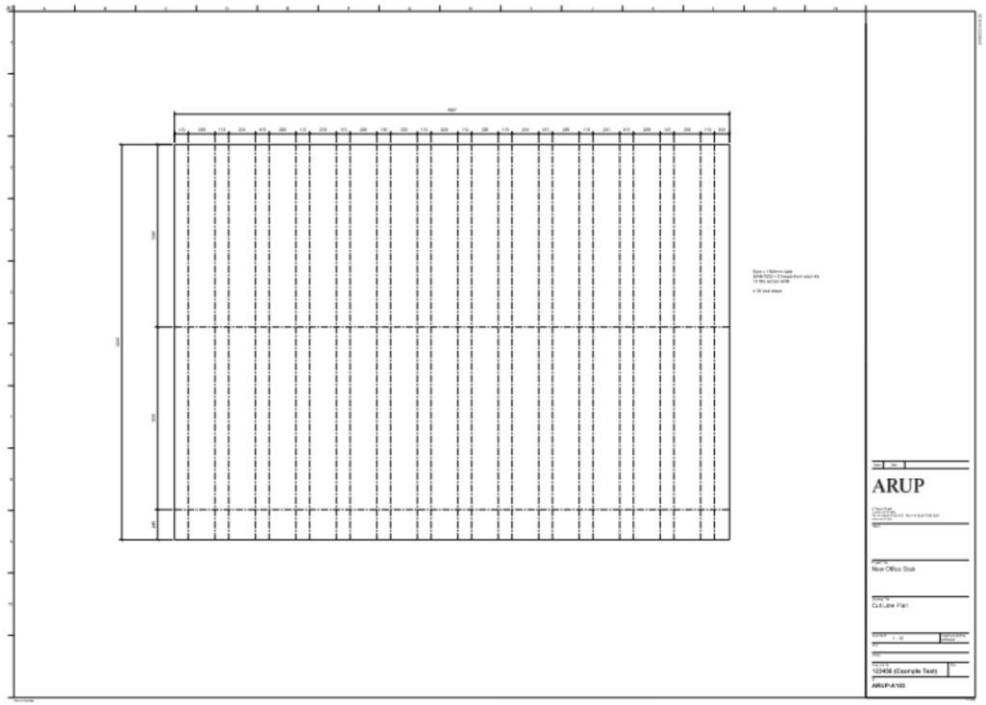
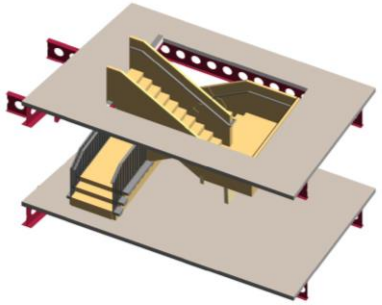
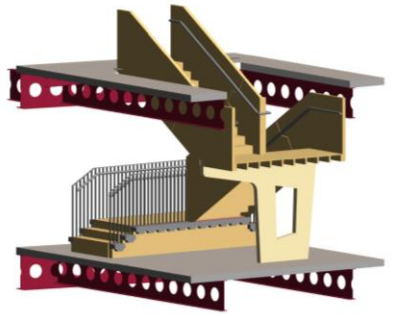




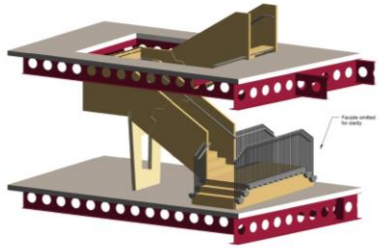




3D View 1



3D View 2

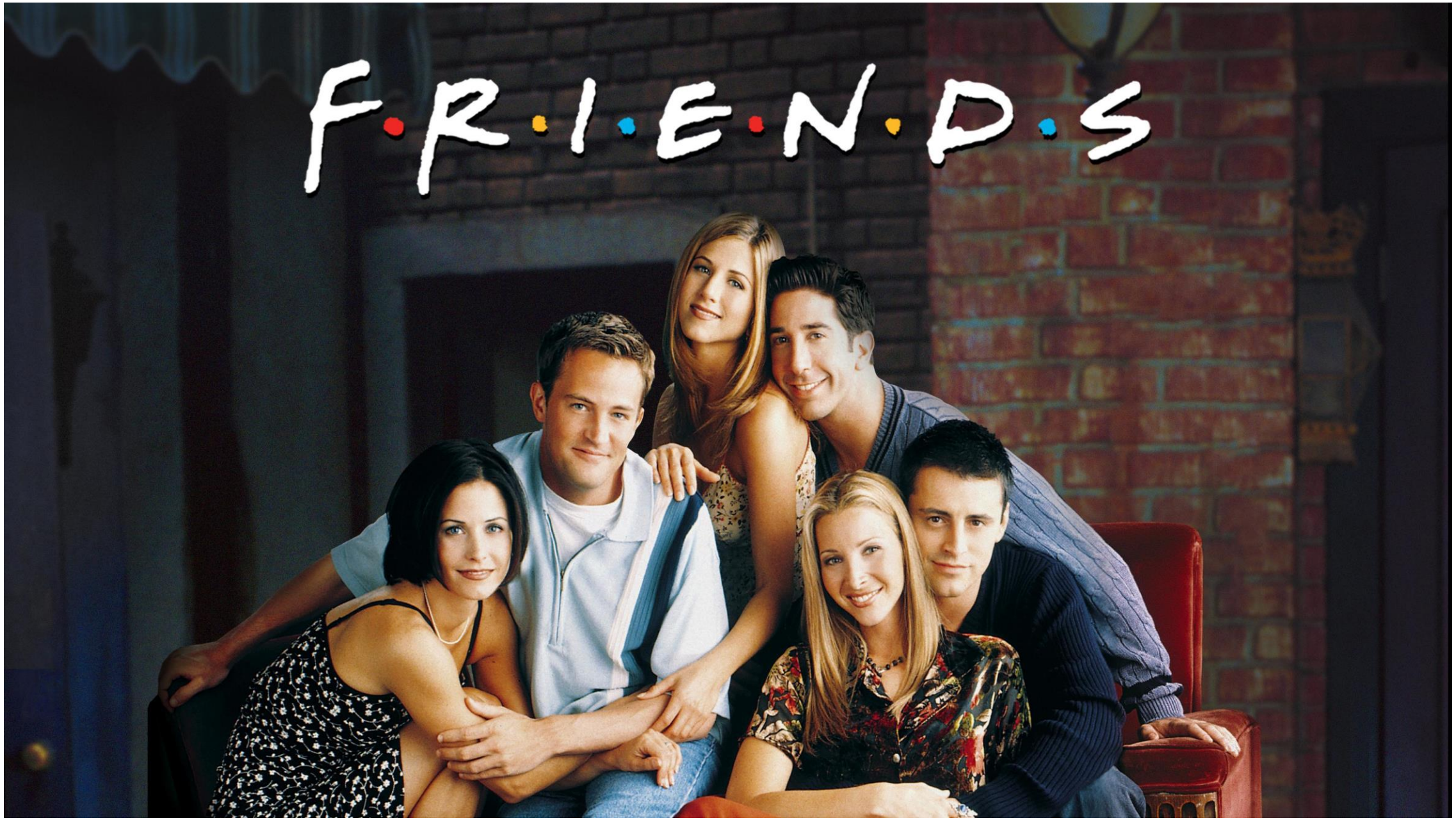


3D View 3

3D View 4

3D View 5

ARUP



ARUP

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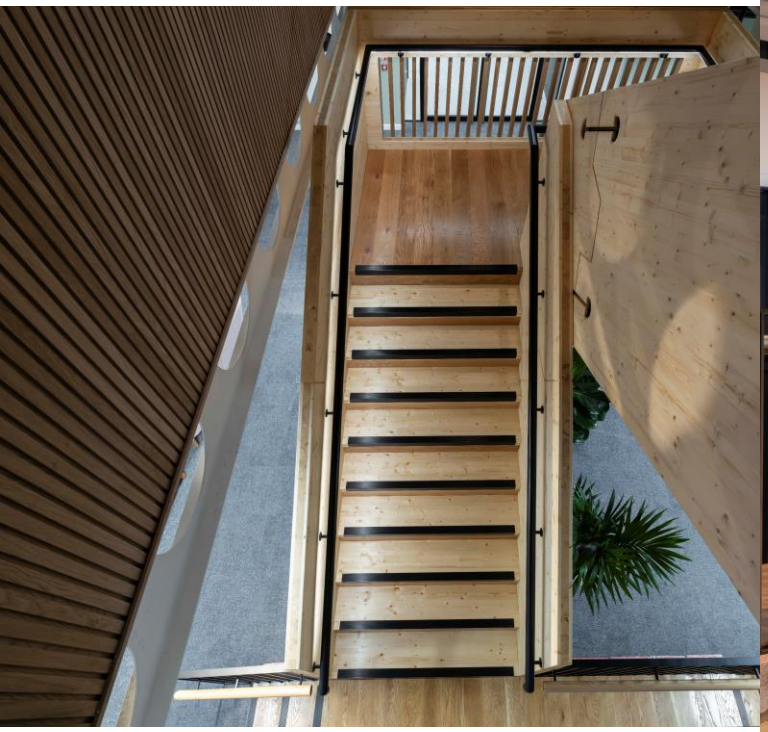

Talking Reuse: From Targets to Reality

THE ENGINEERS REUSE COLLECTIVE

Nuance of Refurbishment

Ben Tapley – Whitby Wood

whitby wood

Talking Reuse – Nuance of Refurbishment

AGENDA

CASE STUDY INTRODUCTION

INVESTIGATIONS

CO-ORDINATION

STRENGTHENING & STABILITY

RESOURCING

SUMMARY

IMAGE Whitby Wood

whitby wood

CASE STUDY INTRODUCTION

CASE STUDY INTRODUCTION

78-84 COLMORE ROW BIRMINGHAM

whitby wood

IMAGE GPAD

CASE STUDY INTRODUCTION

78-84 COLMORE ROW BIRMINGHAM

whitby wood

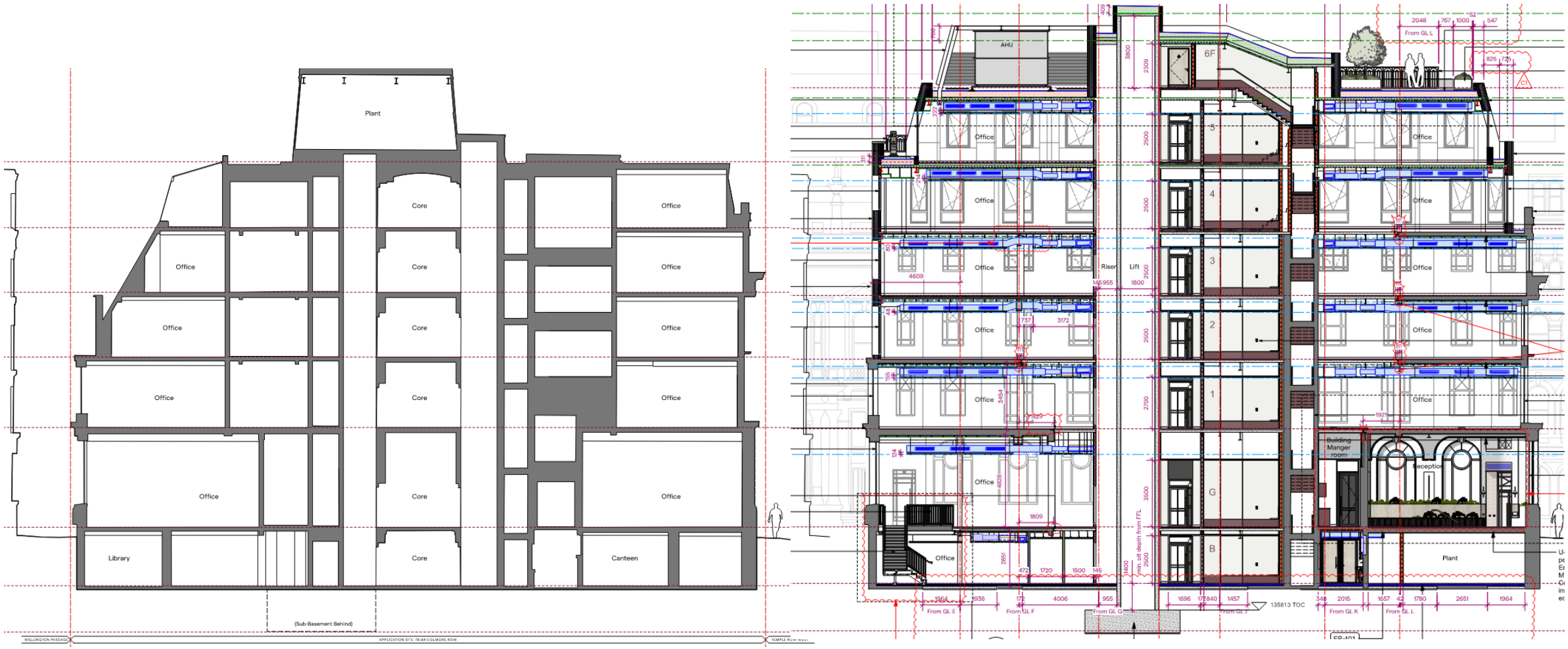

IMAGE GPAD

CASE STUDY INTRODUCTION

78-84 COLMORE ROW BIRMINGHAM

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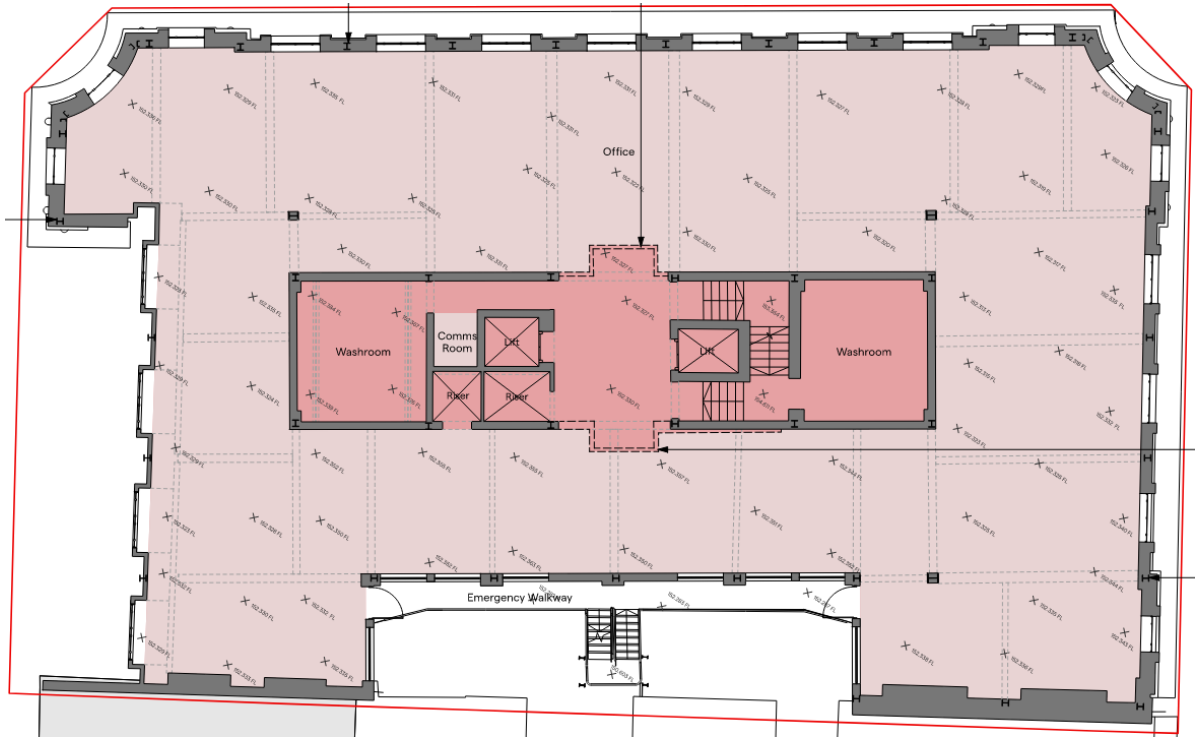


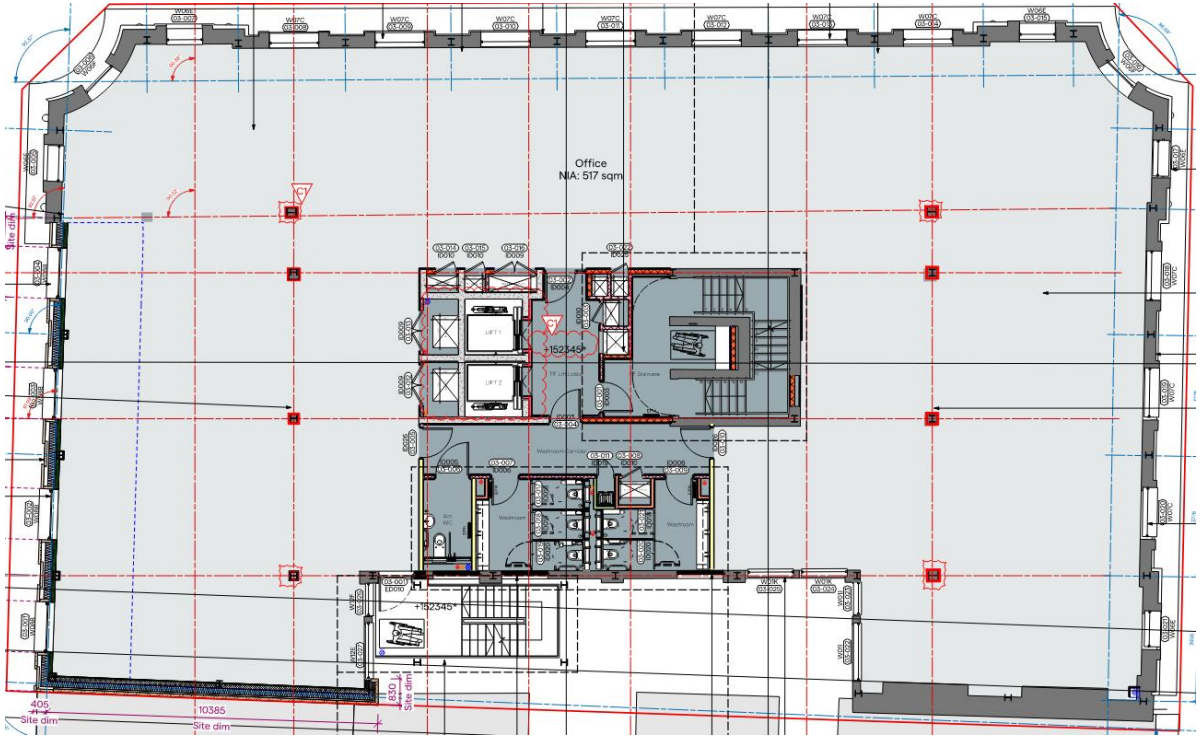


IMAGE GPAD

CASE STUDY INTRODUCTION

78-84 COLMORE ROW BIRMINGHAM

whitby wood

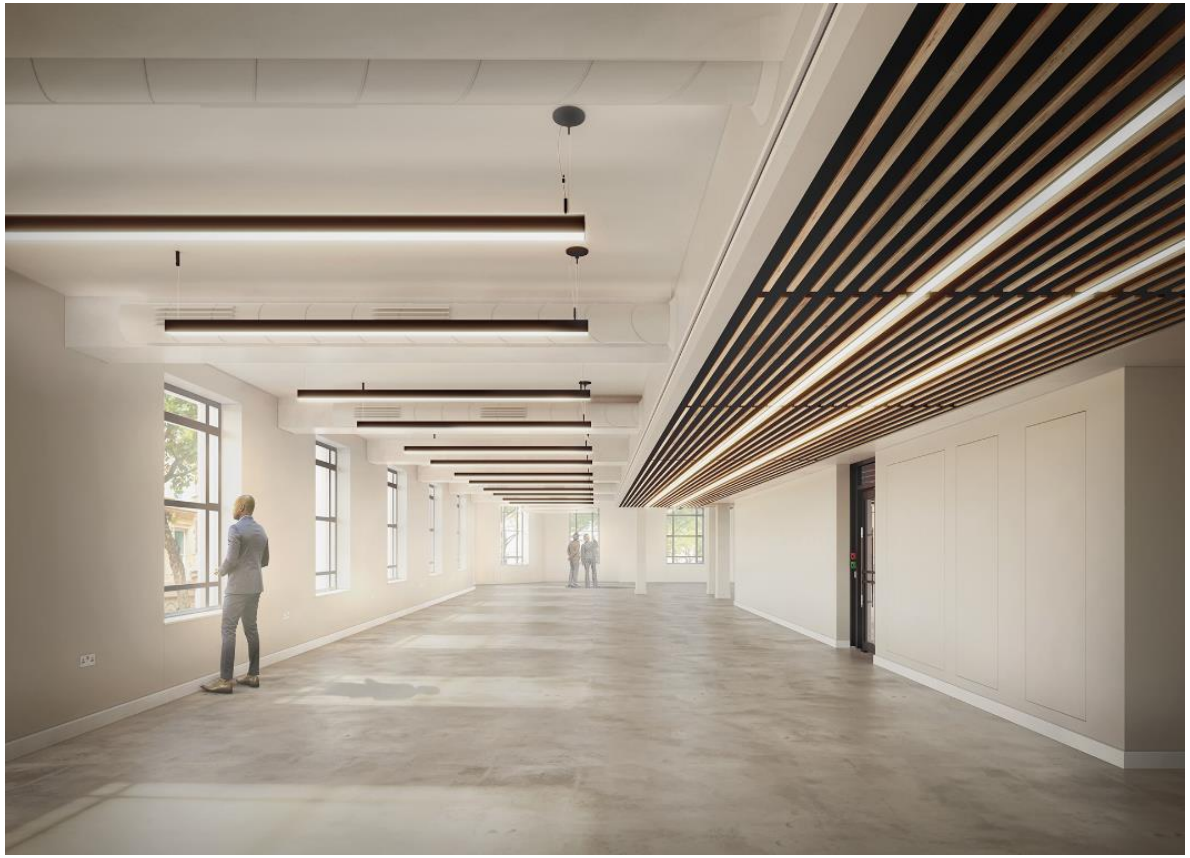


IMAGE GPAD

CASE STUDY INTRODUCTION

78-84 COLMORE ROW BIRMINGHAM

whitby wood

IMAGE GPAD

CASE STUDY INTRODUCTION

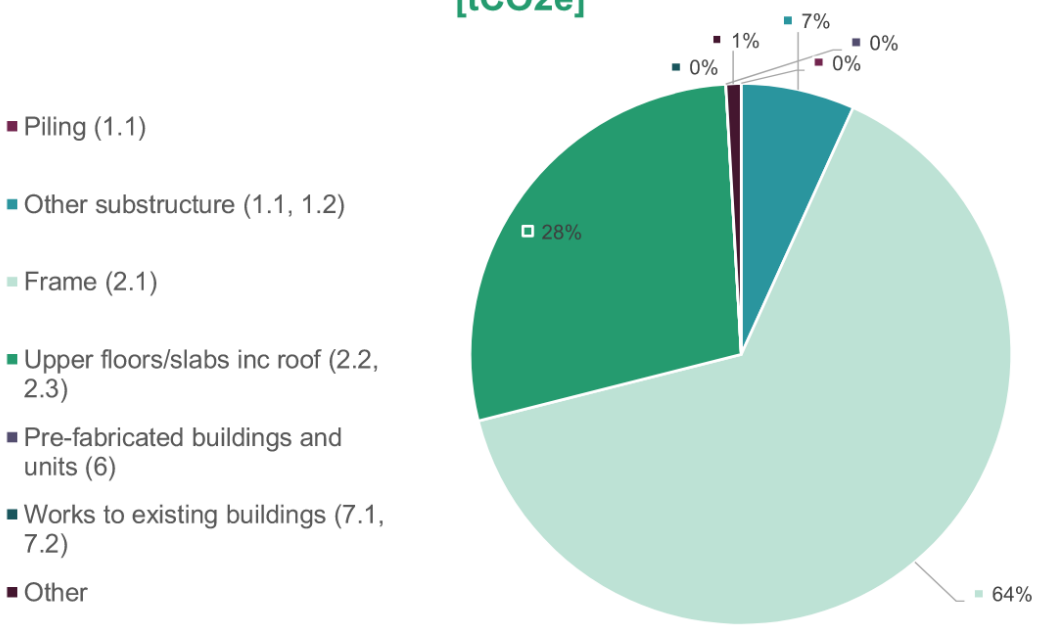
78-84 COLMORE ROW BIRMINGHAM

CO_2e

Substructure & Superstructure

A0 - A5:	**483 tCO_2e**	**116 $kgCO_2e/m^2$**
Biogenic Carbon:	0 tCO_2e	0 $kgCO_2e/m^2$
A-C (Including decarbonisation):	**502 tCO_2e**	**121 $kgCO_2e/m^2$**
A-C (Excluding decarbonisation):	520 tCO_2e	125 $kgCO_2e/m^2$
Module D (Including decarbonisation):	-69 tCO_2e	-17 $kgCO_2e/m^2$
Module D (Excluding decarbonisation):	-137 tCO_2e	-33 $kgCO_2e/m^2$

Scheme 1 - Element emission breakdown [tCO2e]



Includes Lifecycle Modules A1-A4, A5.2 TW (if Significant Temporary Works are present), and A5.3

This project scheme has a SCORS rating of A

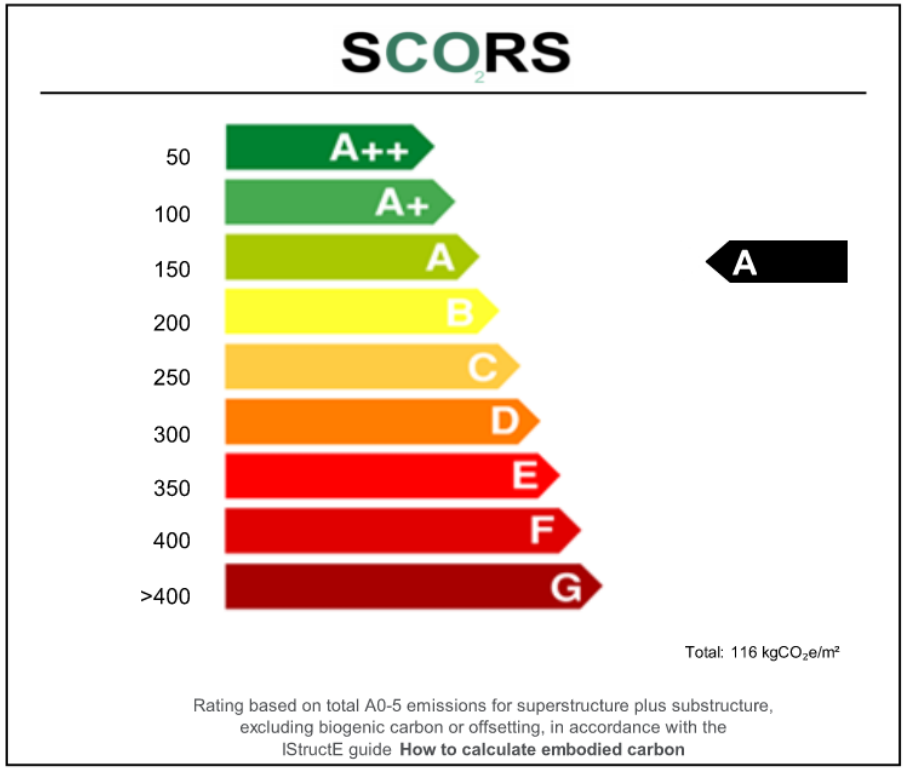


IMAGE Whitby Wood

CASE STUDY INTRODUCTION

78-84 COLMORE ROW BIRMINGHAM

IMAGE Whitby Wood

whitby wood

INVESTIGATIONS

INVESTIGATIONS

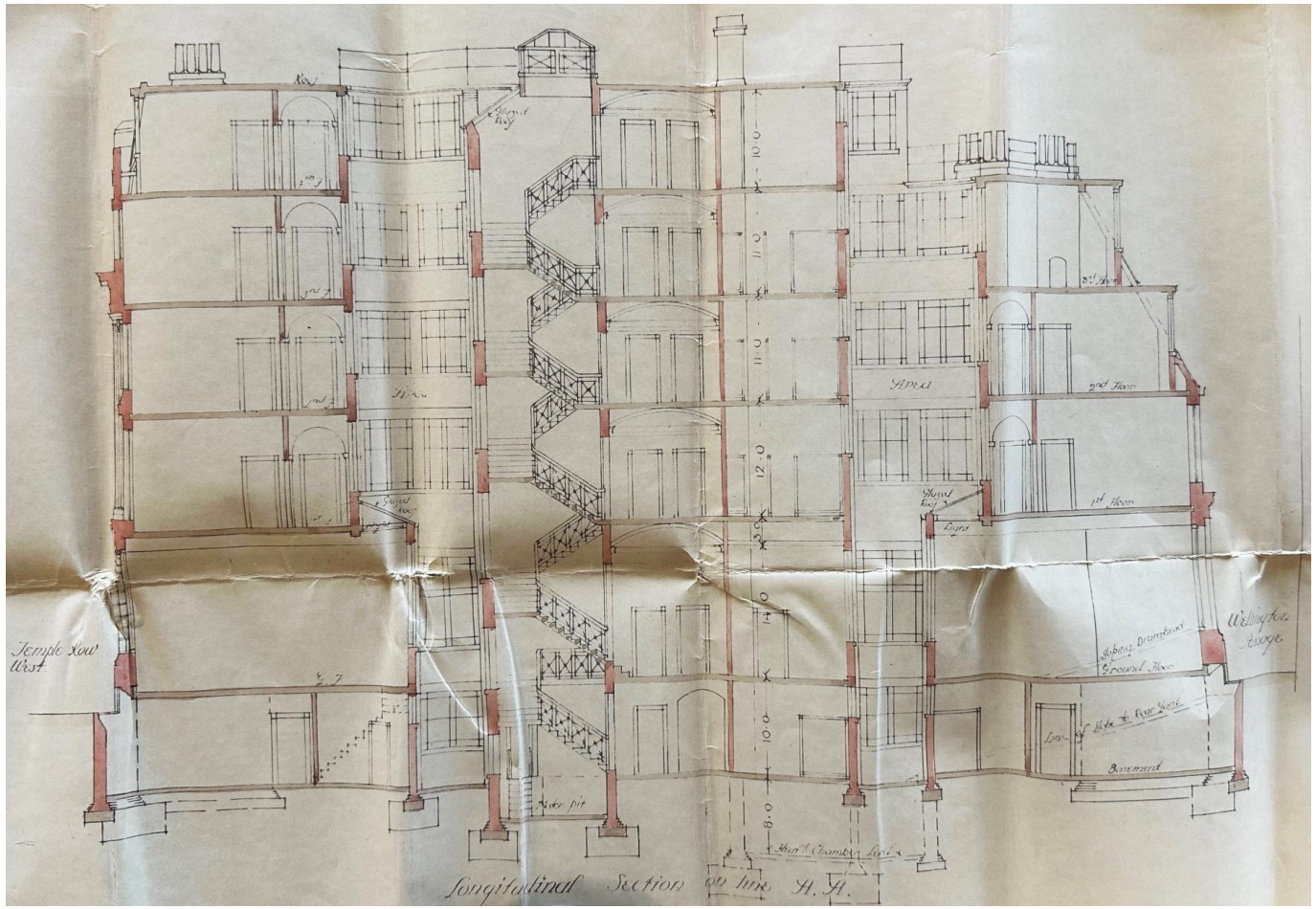
WHERE TO START?

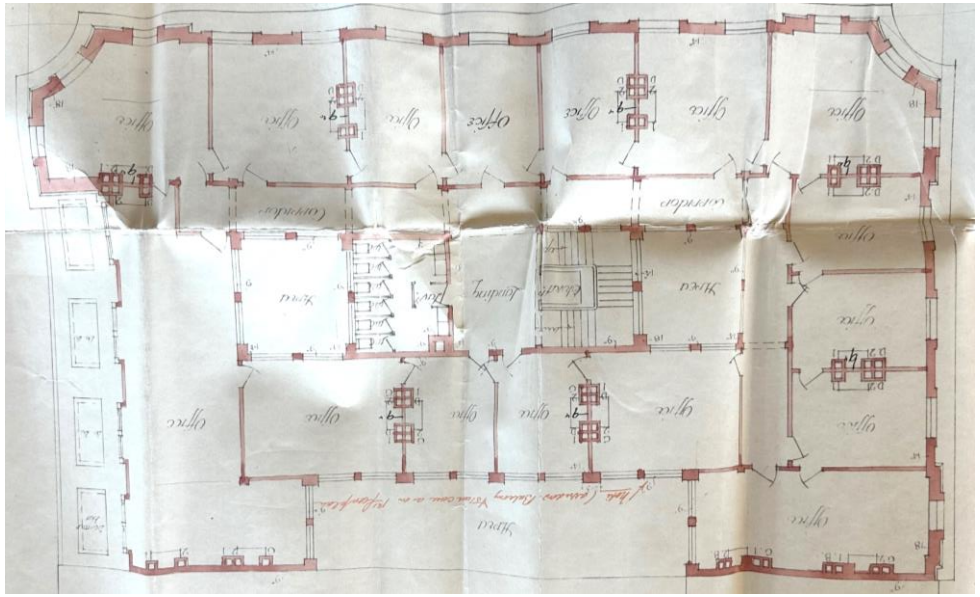
IMAGE Whitby Wood

whitby wood

INVESTIGATIONS

PLANNING PORTALS OR LIBRARIES





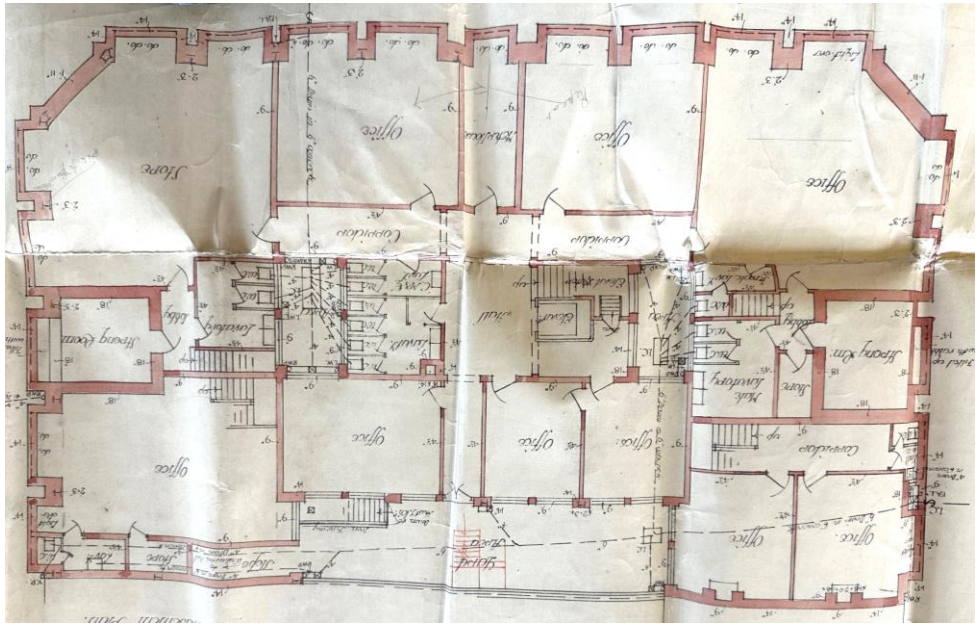


IMAGE Whitby Wood

INVESTIGATIONS

SCOPE THOROUGHLY

Full condition report or just informing design?

What are the existing loadings & load paths?

What members are going to be impacted by the proposed changes?

What members are you fixing to?

What tie details exist?

How much variation are you expecting in the building?

IMAGE Whitby Wood

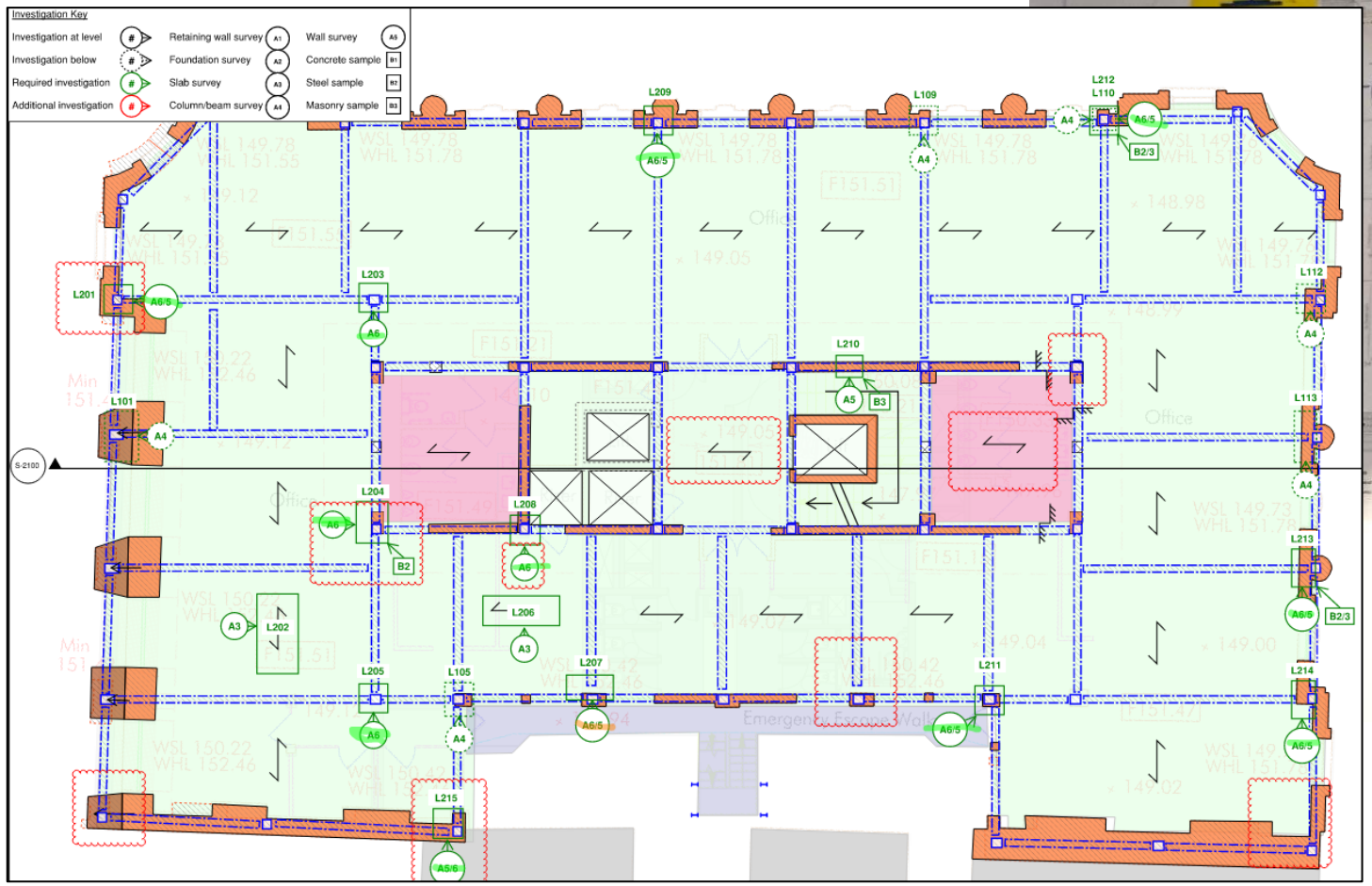
INVESTIGATIONS

WHEN TO SURVEY

IMAGE Whitby Wood

INVESTIGATIONS

COMMUNICATE ACCURATELY



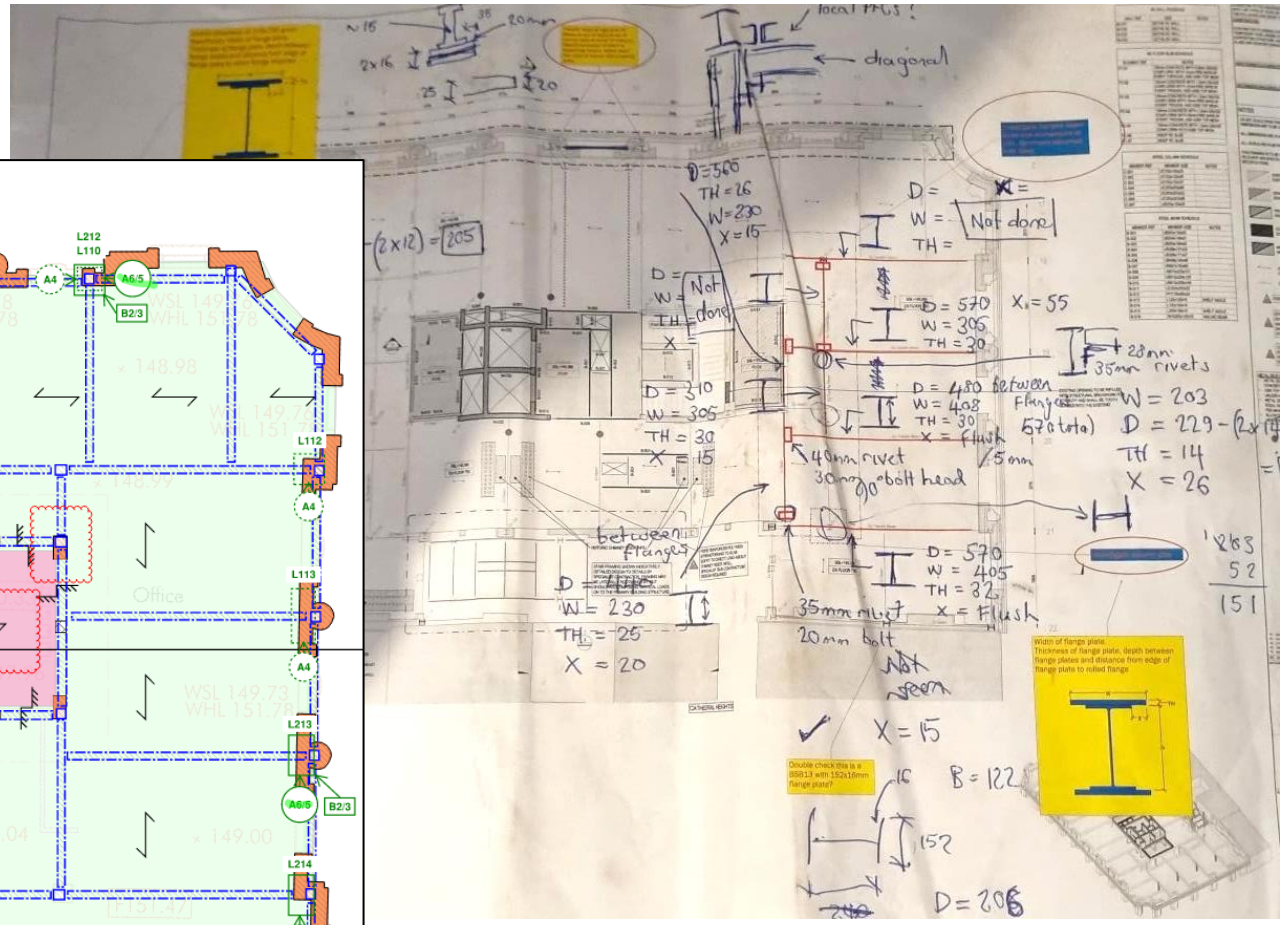
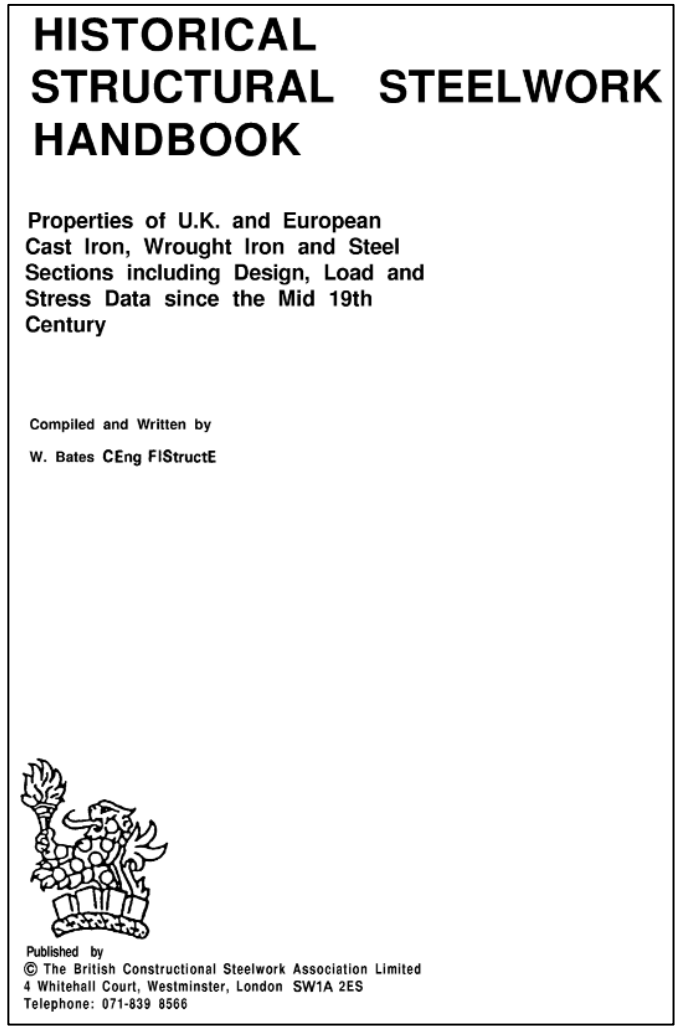


IMAGE Whitby Wood

INVESTIGATIONS

REFERENCE HISTORIC SECTIONS



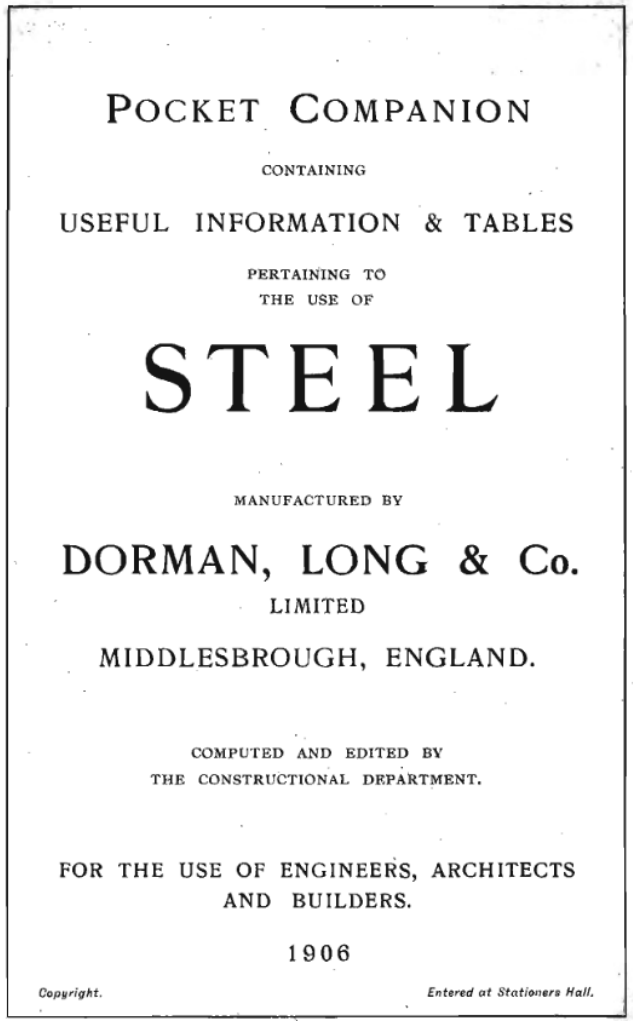
HISTORICAL STRUCTURAL STEELWORK HANDBOOK

Properties of U.K. and European Cast Iron, Wrought Iron and Steel Sections including Design, Load and Stress Data since the Mid 19th Century

Compiled and Written by

W. Bates CEng FIStructE

Published by
© The British Constructional Steelwork Association Limited
4 Whitehall Court, Westminster, London SW1A 2ES
Telephone: 071-839 8566



POCKET COMPANION

CONTAINING

USEFUL INFORMATION & TABLES

PERTAINING TO
THE USE OF

STEEL

MANUFACTURED BY

DORMAN, LONG & Co.
LIMITED

MIDDLESBROUGH, ENGLAND.

COMPUTED AND EDITED BY
THE CONSTRUCTIONAL DEPARTMENT.

FOR THE USE OF ENGINEERS, ARCHITECTS AND BUILDERS.

1906

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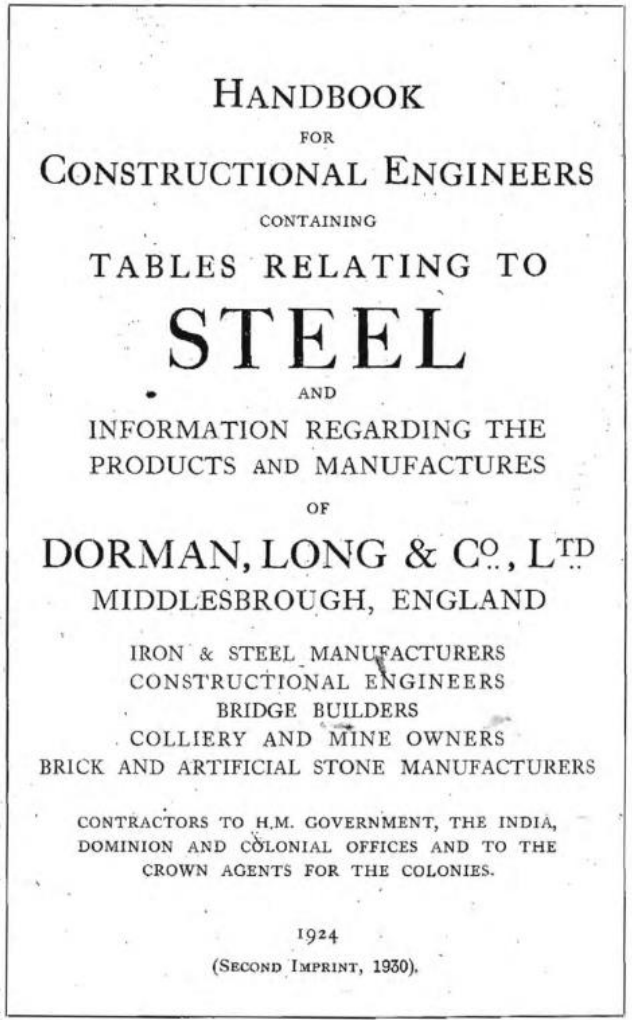

HANDBOOK
FOR
CONSTRUCTIONAL ENGINEERS

CONTAINING

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STEEL

AND

INFORMATION REGARDING THE PRODUCTS AND MANUFACTURES

OF

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MIDDLESBROUGH, ENGLAND

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BRIDGE BUILDERS
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BRICK AND ARTIFICIAL STONE MANUFACTURERS

CONTRACTORS TO H.M. GOVERNMENT, THE INDIA, DOMINION AND COLONIAL OFFICES AND TO THE CROWN AGENTS FOR THE COLONIES.

1924
(SECOND IMPRINT, 1930).

IMAGE Whitby Wood

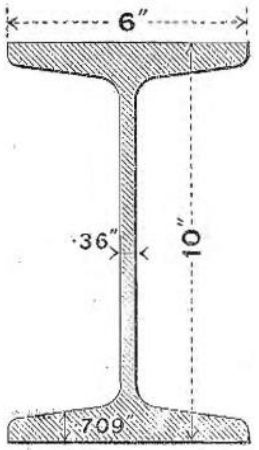
INVESTIGATIONS

REFERENCE HISTORIC SECTIONS

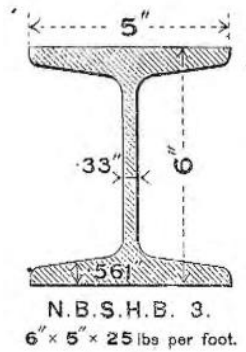
TABLE NO. 3.7 PROPERTIES OF BEAMS TO BRITISH STANDARD 4. 1903

IMPERIAL UNITS See separate page for notes

Ref No.	Size D x B	Approximate Mass/ft	Metric Equivalent D x B	Metric Equivalent Mass/m	Thickness Web	Thickness Flange	Area	Mom. of Inert. X - X	Mom. of Inert. Y - Y	Rad. of Gyr. X - X	Rad. of Gyr. Y - Y	Sec. Mod. X - X	Sec. Mod. Y - Y
	ins	lbs	mm	kg	ins	ins	ins2	ins4	ins4	ins	ins	ins3	ins3
BSB 1	3 x1.50	4.0	76x 38	6	0.16	0.25	1.18	1.66	0.12	1.19	0.33	1.11	0.17
BSB 2	3 x3	8.5	76x 76	13	0.20	0.33	2.50	3.79	1.26	1.23	0.71	2.53	0.84
BSB 3	4 x1.75	5.0	102x 44	7	0.17	0.24	1.47	3.67	0.19	1.58	0.36	1.84	0.22
BSB 4	4 x3	9.5	102x 76	14	0.22	0.34	2.80	7.53	1.28	1.64	0.68	3.76	0.85
BSB 5	4.75x1.75	6.5	121x 44	10	0.18	0.33	1.91	6.77	0.26	1.88	0.37	2.85	0.30
BSB 6	5 x3	11.0	127x 76	16	0.22	0.38	3.24	13.6	1.46	2.05	0.67	5.45	0.97
BSB 7	5 x4.50	18.0	127x114	27	0.29	0.45	5.29	22.7	5.66	2.07	1.03	9.08	2.51
BSB 8	6 x3	12.0	152x 76	18	0.26	0.35	3.53	20.2	1.34	2.40	0.62	6.74	0.89
BSB 9	6 x4.50	20.0	152x114	30	0.37	0.43	5.88	34.7	5.41	2.43	0.96	11.6	2.40
BSB 10	6 x5	25.0	152x127	37	0.41	0.52	7.35	43.6	9.11	2.44	1.11	14.5	3.64
BSB 11	7 x4	16.0	178x102	24	0.25	0.39	4.71	39.2	3.41	2.89	0.85	11.2	1.71
BSB 12	8 x4	18.0	203x102	27	0.28	0.40	5.30	55.7	3.57	3.24	0.82	13.9	1.79
BSB 13	8 x5	28.0	203x127	42	0.35	0.58	8.24	89.4	10.3	3.29	1.12	22.3	4.10
BSB 14	8 x6	35.0	203x152	52	0.44	0.60	10.29	110.6	17.9	3.28	1.32	27.6	5.98
BSB 15	9 x4	21.0	229x102	31	0.30	0.46	6.18	81.1	4.20	3.62	0.82	18.0	2.10
BSB 16	9 x7	58.0	229x178	86	0.55	0.92	17.06	229.7	46.3	3.67	1.65	51.05	13.20
BSB 17	10 x5	30.0	254x127	45	0.36	0.55	8.82	145.7	9.78	4.06	1.05	29.14	3.91
BSB 18	10 x6	42.0	254x152	63	0.40	0.74	12.36	211.6	22.9	4.14	1.36	42.32	7.64
BSB 19	10 x8	70.0	254x203	104	0.60	0.97	20.58	345.0	71.6	4.09	1.87	69.01	17.9
BSB 20	12 x5	32.0	305x127	48	0.35	0.55	9.41	220.1	9.74	4.84	1.02	36.69	3.90
BSB 21	12 x6	44.0	305x152	66	0.40	0.72	12.95	315.4	22.3	4.94	1.31	52.57	7.42
BSB 22	12 x6	54.0	305x152	80	0.50	0.88	15.88	375.6	28.3	4.86	1.33	62.60	9.43
BSB 23	14 x6	46.0	356x152	69	0.40	0.70	13.53	440.6	21.6	5.71	1.26	62.95	7.20
BSB 24	14 x6	57.0	356x152	85	0.50	0.87	16.77	533.1	27.9	5.64	1.29	76.16	9.31
BSB 25	15 x5	42.0	381x127	63	0.42	0.65	12.35	428.2	11.9	5.89	0.98	57.09	4.78
BSB 26	15 x6	59.0	381x152	88	0.50	0.88	17.35	629.1	28.2	6.02	1.28	83.88	9.40
BSB 27	16 x6	62.0	406x152	92	0.55	0.85	18.23	726.0	27.1	6.31	1.22	90.74	9.02
BSB 28	18 x7	75.0	457x178	112	0.55	0.93	22.07	1150.0	46.6	7.22	1.45	127.7	13.30
BSB 29	20 x7.50	89.0	508x191	132	0.60	1.01	26.16	1671.0	62.6	7.99	1.55	167.1	16.70
BSB 30	24 x7.50	100.0	610x191	149	0.60	1.07	29.39	2655.0	66.9	9.50	1.51	221.2	17.80



N.B.S.H.B. 6.
10" × 6" × 40 lbs per foot.



N.B.S.H.B. 3.
6" × 5" × 25 lbs per foot.

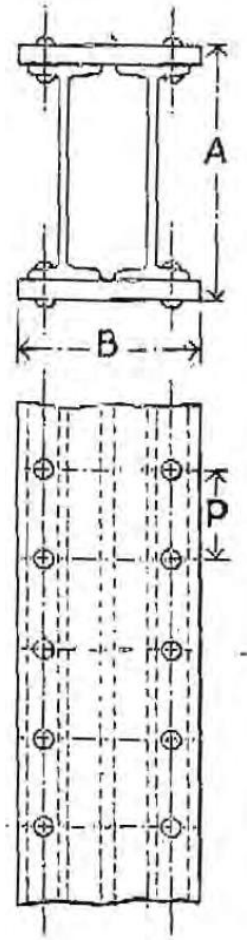


IMAGE Whitby Wood

whitby wood

CO-ORDINATION

CO-ORDINATION

SURVEYS

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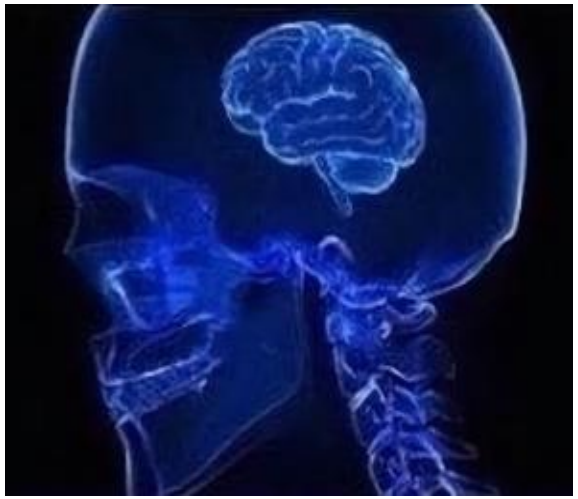
Pre-strip-out 2D surveys	Post-strip-out 2D surveys	Cloud point surveys with Revit model	Cloud point surveys with model and 360º photos on online portal
			

IMAGE Meming Wiki

CO-ORDINATION

GRID LINES VS SITE DIMENSIONS

IMAGE KYTC

CO-ORDINATION

THERMAL BOUNDARIES

IMAGE Emperor Paint

CO-ORDINATION

CONSTRAINTS

IMAGE Whitby Wood

CO-ORDINATION

~~CONSTRAINTS~~ DIRECTION

IMAGE Whitby Wood

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STRENGTHENING & STABILITY

STRENGTHENING

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KEY CONSIDERATIONS

Do not underestimate the time required

- Historical steel structures may be highly utilised
- Historical built-up sections limit ability to use software

Providing an alternative load path is sometimes the best solution

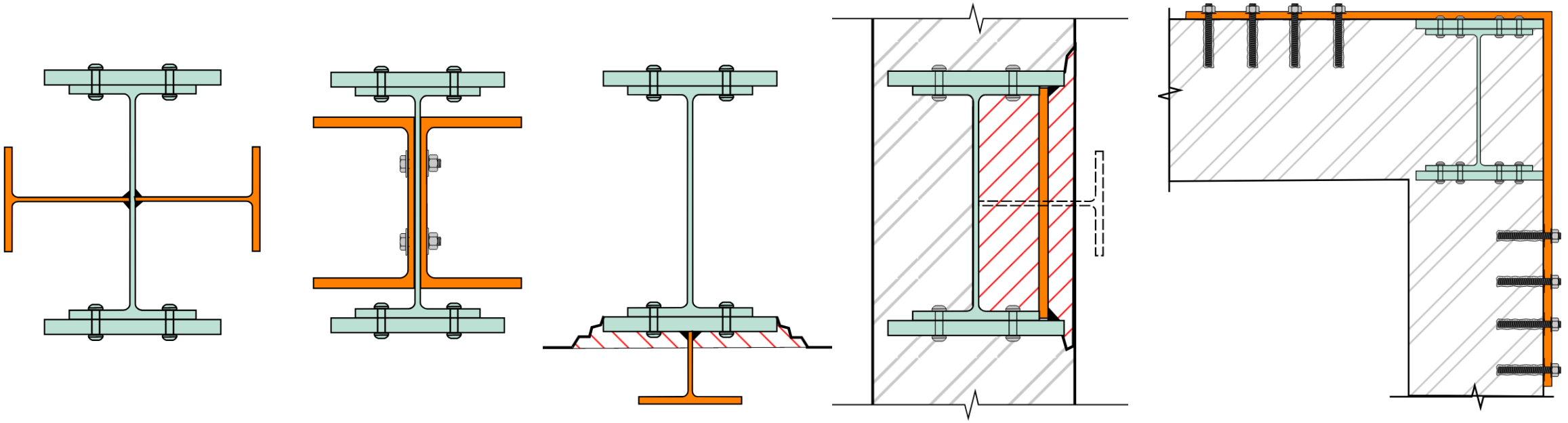


IMAGE Whitby Wood

STRENGTHENING

TYPICAL MEMBERS

Historical steel beams

- Bending … Easy … Parallel axis theorem, I_y W_{ely}, model as an equivalent plated member
- Shear … Tricky … Existing shear stress in beam … Suggest building a deconstruction analysis model … Strengthening required at peak deconstruction, propping may help.

Historical steel columns

- Difficult … Software limitations … Detailed design process … Group members to limit calculations, carefully review critical design conditions.

Foundations

- Typically, 10% load increase is acceptable due to ground consolidation.
- Think about constructability … Avoid load increase for those impossible to strengthen.

STABILITY

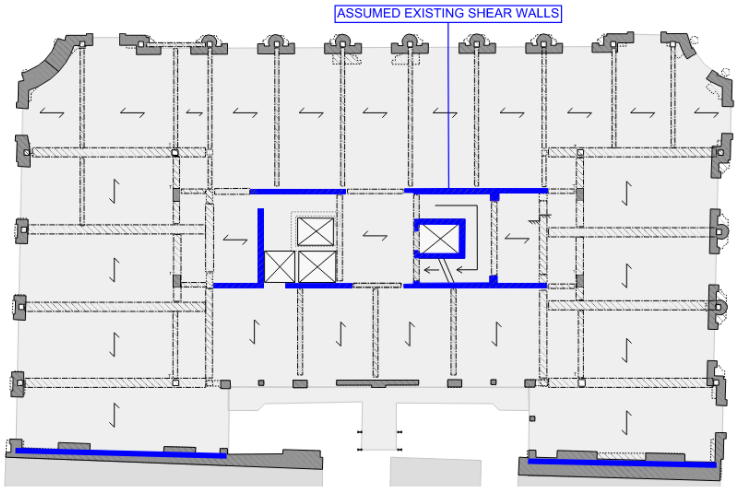
KEY CONSIDERATIONS

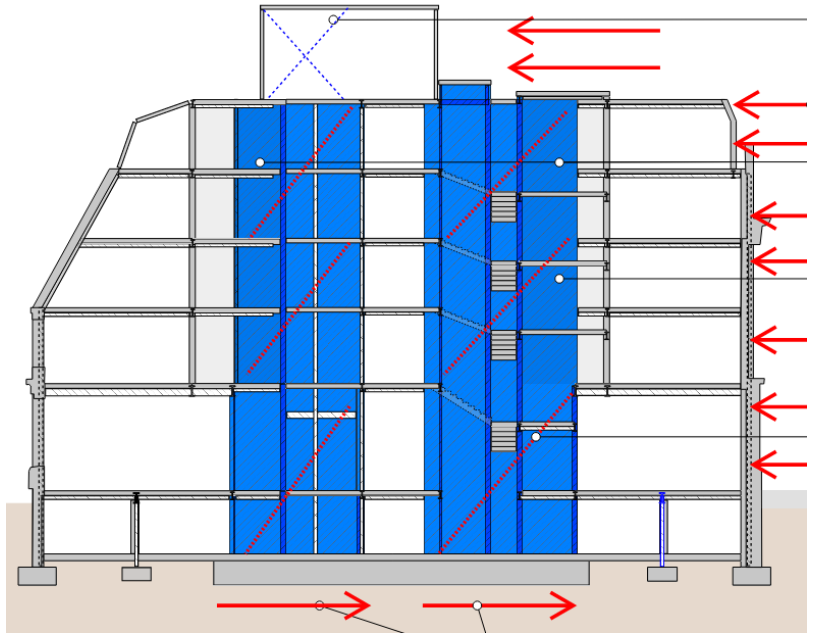
A small increase in building height has a disproportionate effect on stability forces

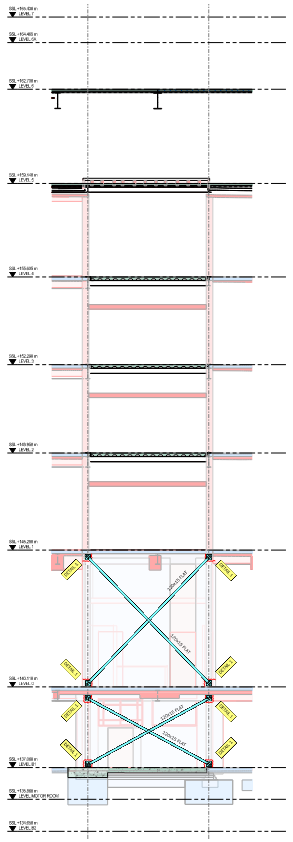
New stability systems may not have the benefit of stabilising gravity forces

Quantifying existing stability systems can be difficult

It may be beneficial to separate SLS and ULS design







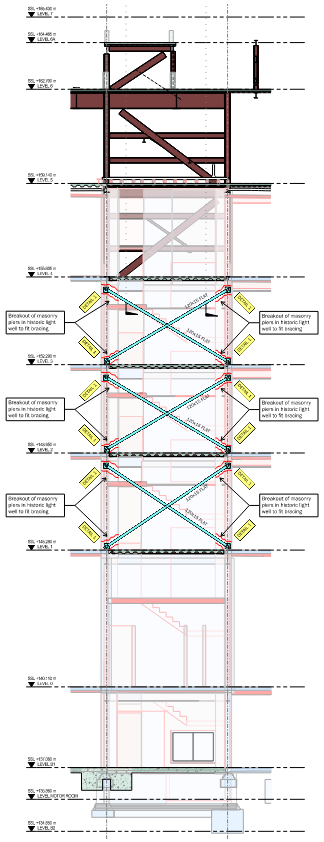


IMAGE Whitby Wood

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RESOURCING

RESOURCING

NOT THE SAME AS NEW BUILD

IMAGE Knowledge at Wharton

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SUMMARY

SUMMARY

Reuse = good (even outside London).

Seek historical records and investigate what you need to investigate, with clear instructions, referencing historic sections, ASAP.

Use cloud point surveys, allow for development of design and co-ordination post-strip-out and set out to existing, not grid lines.

Let the building direct its development with early engineer involvement. Control the impact of thermal boundaries.

Do not underestimate the time and cost of verifying and strengthening existing structure. Factor into resourcing.

Expect the unexpected

THANK YOU

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THE ENGINEERS REUSE COLLECTIVE

Q+A

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Thank you

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WASTE LESS

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