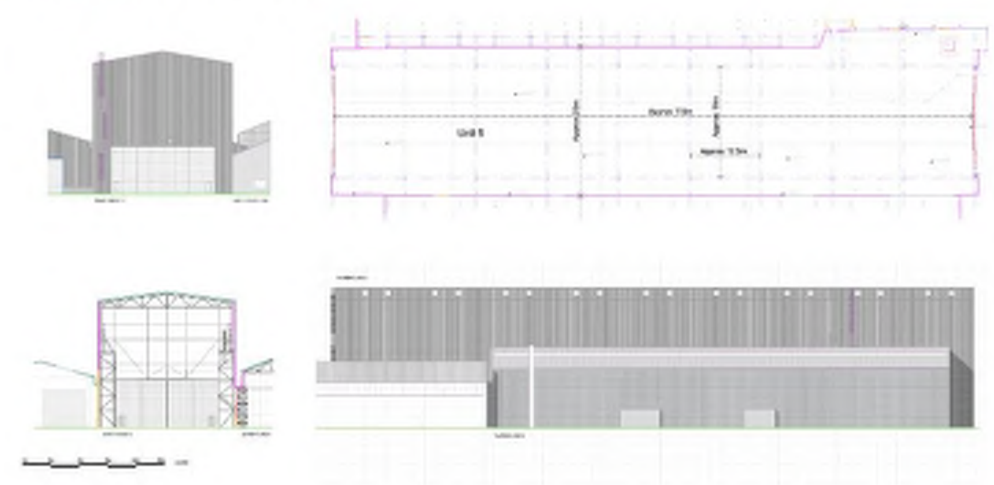
EARLY ENGAGEMENT - DEMOLITION CONTRACTOR

1. SURVEY
2. MATERIAL INVENTORY
3. CARBON BANK
4. CARBON OPPORTUNITIES
5. METHODOLOGY
6. LOGISTICS
7. PROGRAMME
8. COST
9. ONE KEY METRIC

Deconstruction and Surveys



DONOR ASSET: THE DRUMSHEDS

NetPositive SOLUTIONS

Drumshed 5 drawings (nts)

Drumshed 5

Profiled metal sheet cladding (m2) walls	Sides = 4,620m2 + 620 (both ends) minus openings (127) = **5,113 m2**
Profiled metal sheet cladding (m2) roof	**2,765 m2**
Steel access doors (m2)	Both ends = **506 m2** (assumes 45% of end area (25 x 22.5 m)
Primary steel columns	**Vertical 40 x 12.5 metres** = 500 m length (260 x 260mm, 18 mm flange) = ~ 6 m3 **Upper Horizontal 220 m** length (400*260mm, 18 mm flange) = 0.42 m3 **Lower horizontal 220 m** length (260*150mm, 18 mm flange) = 0.15 m3
Bricks (m2 or estimated no. bricks)	**330 m2** (assume single skin)
Individual reusable components	List here
Comments on condition/ deconstruction: Primary steelwork bolted and over painted. Generally in good condition for reuse.	

https://www.steelbeamsuppliers.co.uk/products/universal-columns/

https://britishsteel.co.uk/media/40517/british-steel-universal-beams-uc-datasheet.pdf

Material/ product	BAU	Good result	Best result
Steel cladding	Recycle metal	Reuse cut down segments	Reuse multiple segments/ whole building
Steel roofing	Recycle metal	Reuse cut down segments	Reuse multiple segments/ whole building
Steel access doors	Recycle metal	Reuse cut down segments	Reuse multiple segments/ whole building
Steel columns			
Brickwork	Crush to fill grade	Feed into Type 1 mix/ reuse offsite	Reuse bricks on site
Concrete	Crush to fill grade	Type 1 recycled aggregates for onsite roadbuilding	Recycled aggregates for onsite concrete
Other material streams…	… low grade recycling	… higher value/ closed loop recycling	… closed loop recycling/ reuse & repurpose
External access ladders	Recycle metal	Reuse segments	Reuse whole units
….			

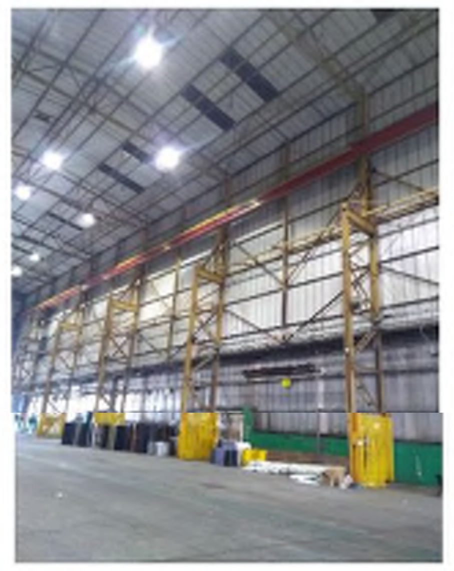
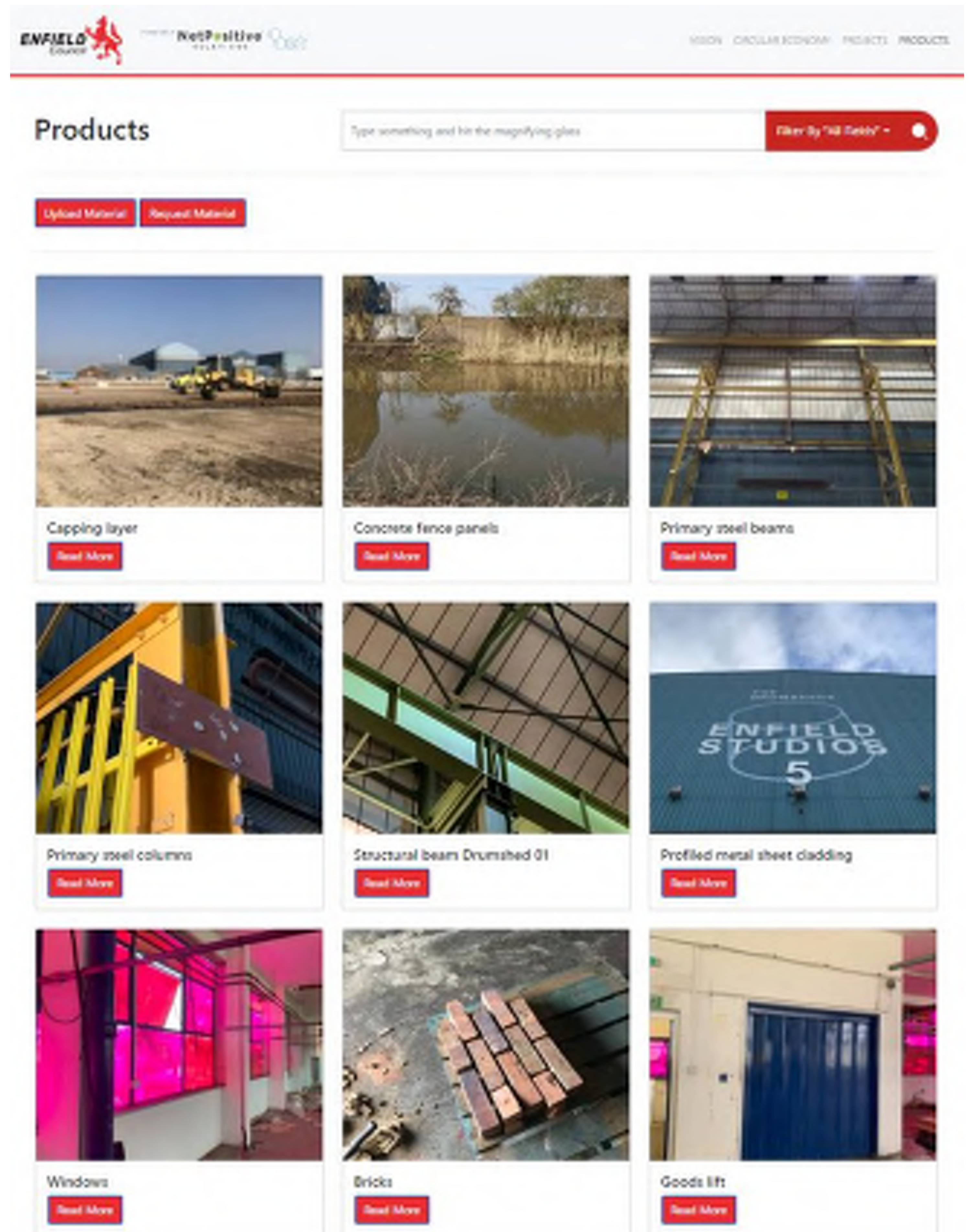


Photo:

Description: Coming from F Block demolition - the material will be crushed to Type 1 following the quality protocol for recycled aggregates from inert waste



1. Understand our assets

- Early development / demolition audit
- Needs to be a strategic document – so we can react to it early in the process.

2. Understand the reuse market

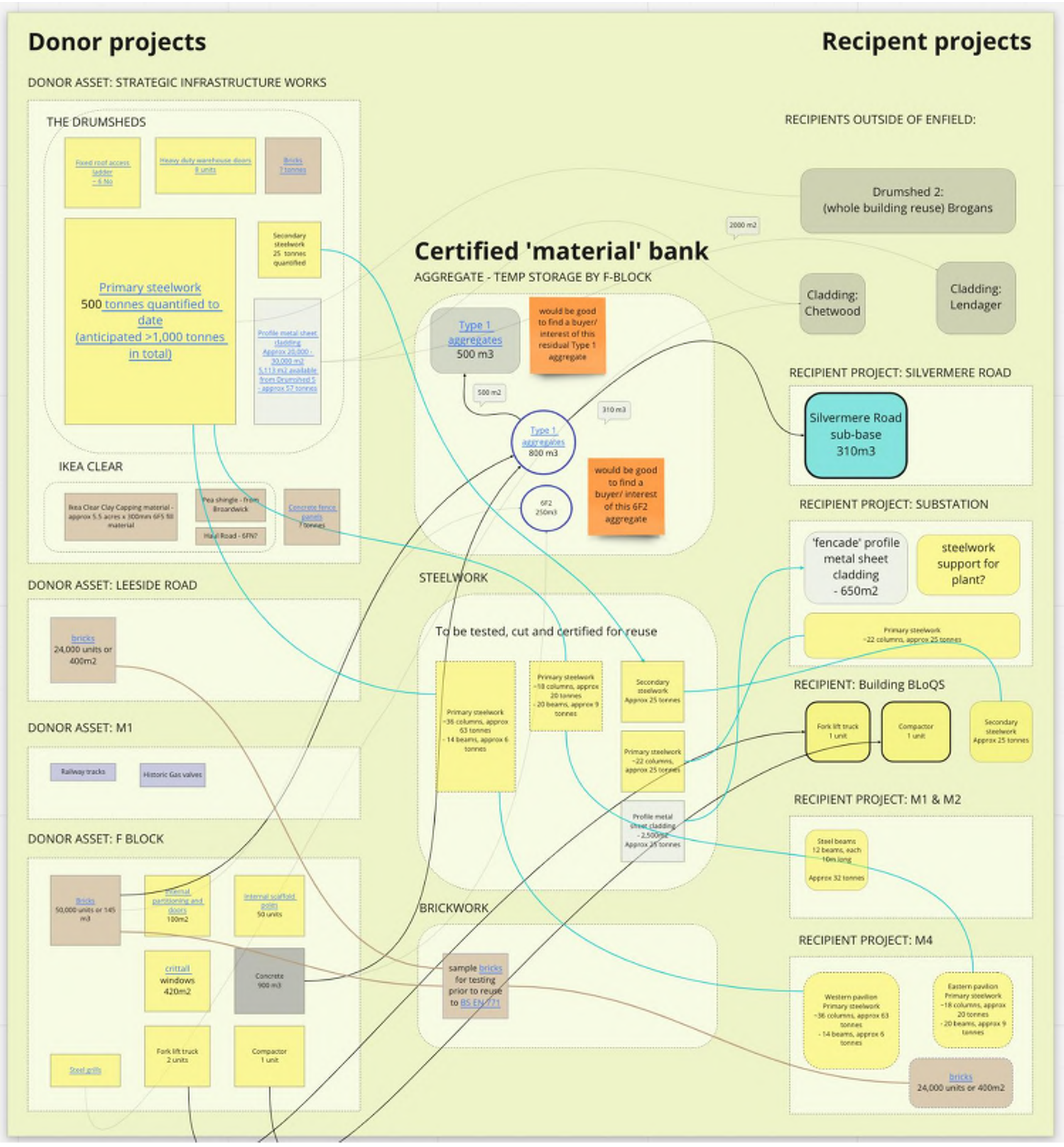
- What re-use happens as 'business as usual' for assets
- Understand barriers (eg. certification, timing, storage)
- Focusing on assets ready for the next step

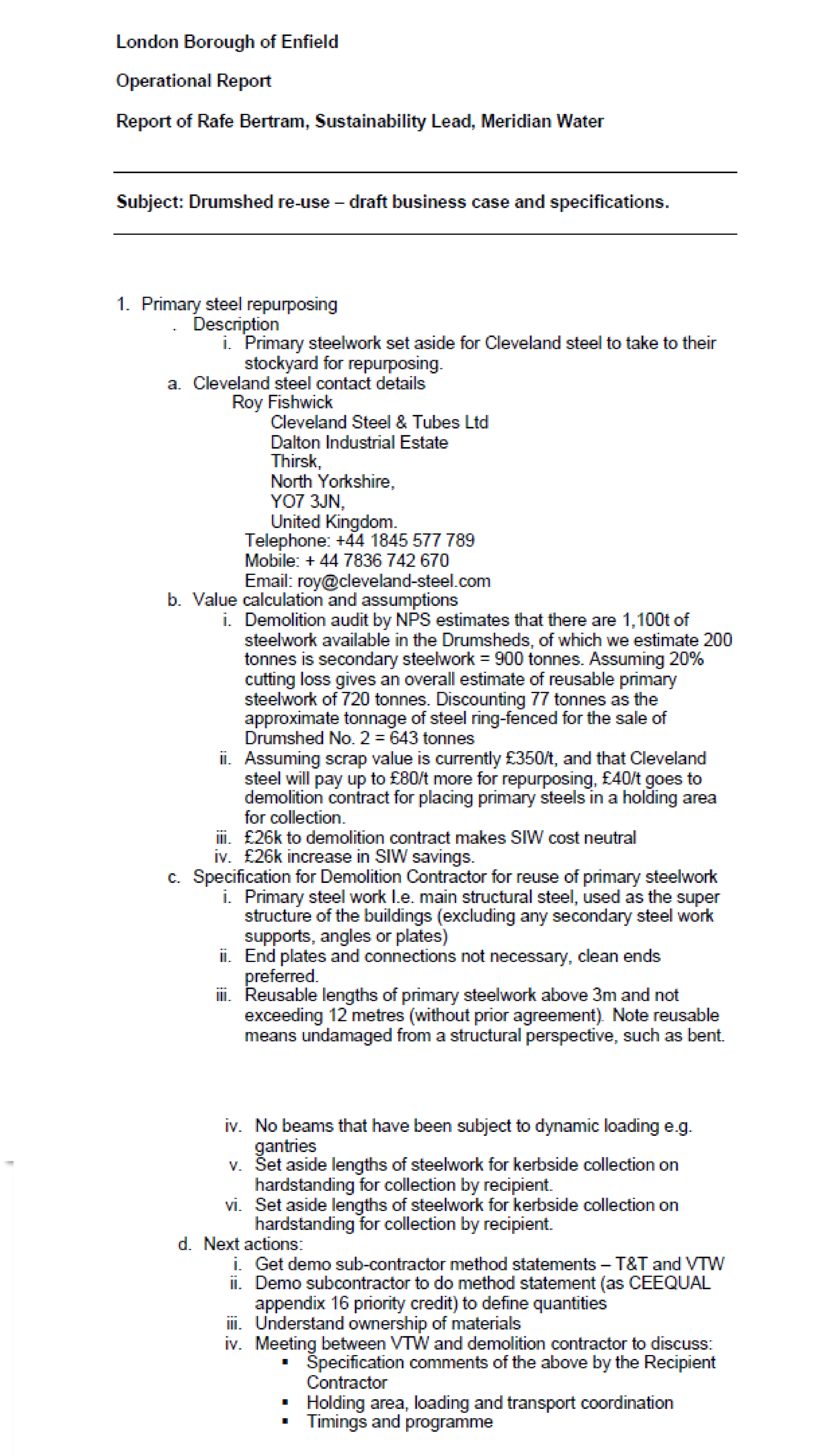
3. Making the information widely available

- Using the Enfield Excess Material Exchange
- Information uploaded and distributed before deconstruction starts

Deconstruction and Surveys

ENFIELD Council | NetPositive SOLUTIONS | stace | UK GBC | CIRCULAR STEEL





London Borough of Enfield

Operational Report

Report of Rafe Bertram, Sustainability Lead, Meridian Water

Subject: Drumshed re-use – draft business case and specifications.

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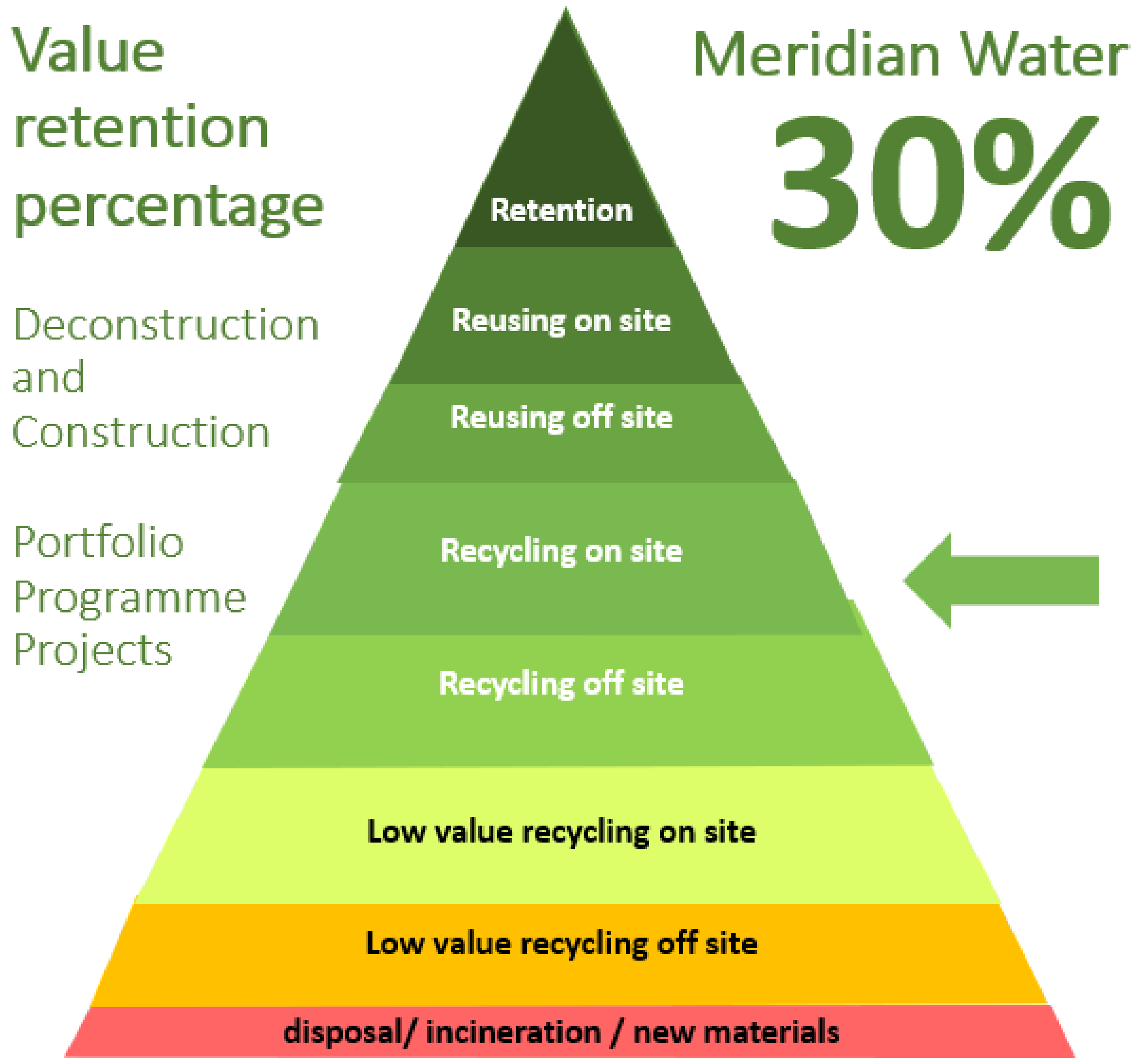
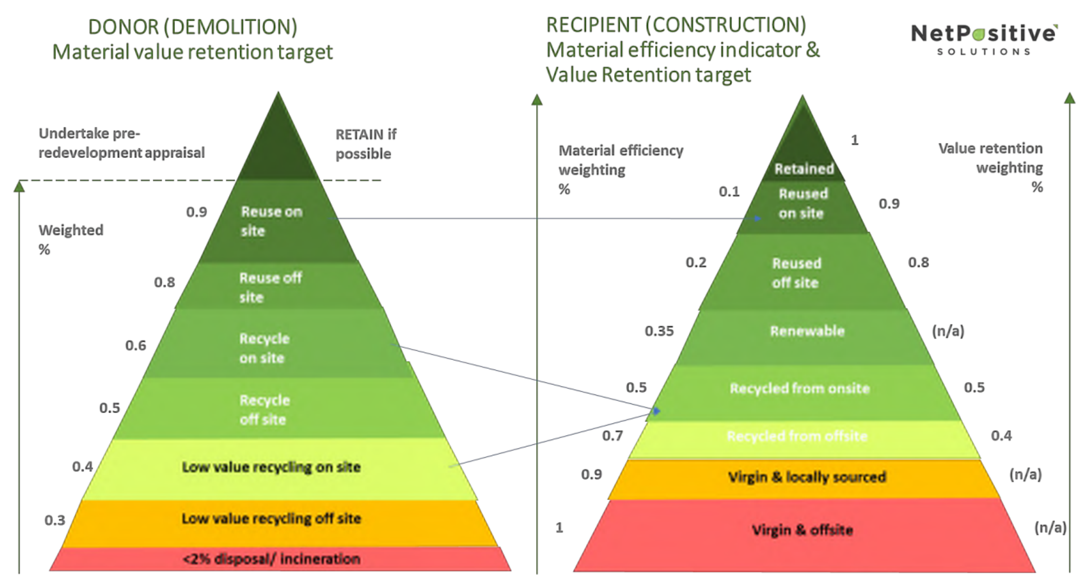
1. Primary steel repurposing
   - . Description
     - i. Primary steelwork set aside for Cleveland steel to take to their stockyard for repurposing.
   - a. Cleveland steel contact details
     - Roy Fishwick
       - Cleveland Steel & Tubes Ltd
       - Dalton Industrial Estate
       - Thirsk,
       - North Yorkshire,
       - YO7 3JN,
       - United Kingdom.
     - Telephone: +44 1845 577 789
     - Mobile: + 44 7836 742 670
     - Email: roy@cleveland-steel.com
   - b. Value calculation and assumptions
     - i. Demolition audit by NPS estimates that there are 1,100t of steelwork available in the Drumsheds, of which we estimate 200 tonnes is secondary steelwork = 900 tonnes. Assuming 20% cutting loss gives an overall estimate of reusable primary steelwork of 720 tonnes. Discounting 77 tonnes as the approximate tonnage of steel ring-fenced for the sale of Drumshed No. 2 = 643 tonnes
     - ii. Assuming scrap value is currently £350/t, and that Cleveland steel will pay up to £80/t more for repurposing, £40/t goes to demolition contract for placing primary steels in a holding area for collection.
     - iii. £26k to demolition contract makes SIW cost neutral
     - iv. £26k increase in SIW savings.
   - c. Specification for Demolition Contractor for reuse of primary steelwork
     - i. Primary steel work I.e. main structural steel, used as the super structure of the buildings (excluding any secondary steel work supports, angles or plates)
     - ii. End plates and connections not necessary, clean ends preferred.
     - iii. Reusable lengths of primary steelwork above 3m and not exceeding 12 metres (without prior agreement). Note reusable means undamaged from a structural perspective, such as bent.
     - iv. No beams that have been subject to dynamic loading e.g. gantries
     - v. Set aside lengths of steelwork for kerbside collection on hardstanding for collection by recipient.
     - vi. Set aside lengths of steelwork for kerbside collection on hardstanding for collection by recipient.
   - d. Next actions:
     - i. Get demo sub-contractor method statements – T&T and VTW
     - ii. Demo subcontractor to do method statement (as CEEQUAL appendix 16 priority credit) to define quantities
     - iii. Understand ownership of materials
     - iv. Meeting between VTW and demolition contractor to discuss:
       - Specification comments of the above by the Recipient Contractor
       - Holding area, loading and transport coordination
       - Timings and programme





4. Increase value of assets

- Mapping links between Donor and Recipient projects
- Who wants or needs the assets from deconstruction

5. Agree business case and deconstruction specification

- Agreement between donor and recipient projects
- Deconstruction Specification

6. Measure success

- Value retention percentage
- For Deconstruction and construction
- For Projects and Programmes

The carbon impact of de-fabrication

elliottwood | CST CLEVELAND STEEL & TUBES LTD | UK GBC | CIRCULAR STEEL

Process of de-fabrication / remanufacturing

Typical processes required to prepare a second-hand steel section for fabrication and reuse.

Remove existing coatings

- Hand blasting with glass grit 0.75 kgCO$_2$e / m^2

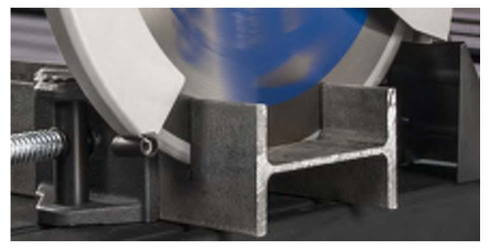
OR

- Machine blasting with steel shot 0.27 kgCO$_2$e / m^2

↓

Remove end plates & attachments (if required)

- Saw cutting 0.07–0.3 kgCO$_2$e/cut



OR

- Gas cutting 0.035-0.05 kgCO$_2$e/cut

↓

Remove shear studs

- Gas cut 0.0005 kgCO$_2$e / stud

AND

- Grind 0.02 kgCO$_2$e / stud

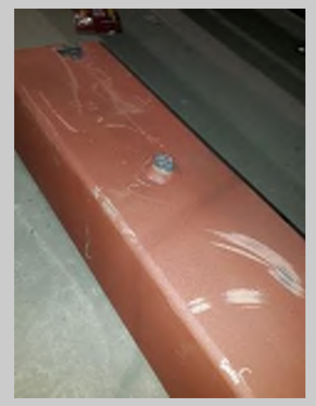
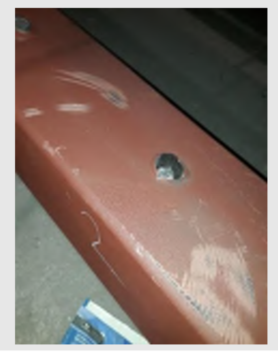
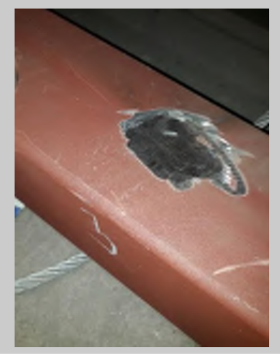
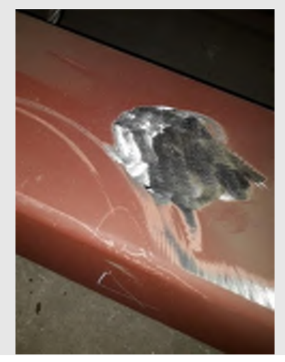
Our testing & analysis has shown that to de-fabricate a typical beam by cleaning it, removing an end plate from each end and removing shear studs at 300 centres results in embodied carbon emissions of approximately 30kgCO$_2$e/tonne

A1-A3 Embodied Carbon

1,740 kgCO$_2$e/tonne	New steel	Note: this value reflects the average mix of recycled and new steel in the UK market
330* kgCO$_2$e/tonne	Recycled steel	*XCarb from ArcelorMittal Note: recycled 'green'/electric arc furnace steel is only available in limited quantities so use of this is no net benefit to the planet because demand exceeds supply
30 kgCO$_2$e/tonne	Reused steel	

Note: None of these figures include emissions due to fabrication. New steel used for new connections and fabrication processes should be allowed for.

Shear stud removal – alternative methods

Method of removal	Photo after removal	Time per stud	Photo after resprayed	Carbon per stud kgCO$_2$e / stud
Gas cut above weld [note: can't cut lower as it deflects into the beam & scars it]		2 seconds		0.0005
Cutting disc used to remove stud		20 seconds		0.002
Gas cut above weld & ground after		3 minutes		0.021
Cutting disc used to remove stud & ground after		4 minutes		0.026

Carbon impact

Three different beam sizes were used to assess the energy used to remove 2 No. end plates and shear studs at 300mm centres. The results are shown below.

		kgCO$_2$e					
Steel section (all 6m long)	Weight of section (tonnes)	Hand blasting	Gas cutting 2 cuts per section	Stud removal (gas) 18 studs per 6m	Stud removal: grind flush	Total kgCO$_2$e/6m section	Total kgCO$_2$e /tonne
152*152 UC 37	0.22	6.1	0.07	0.01	0.38	6.57	30
203*133 UB 25	0.15	4.1	0.07	0.01	0.38	4.61	31
762*267 UB 173	1.04	28.6	0.10	0.01	0.38	29.05	28

UKGBC Excel Calculator Tool

We have used this test data to create an Excel calculator to estimate de-fabrication carbon.

Section size

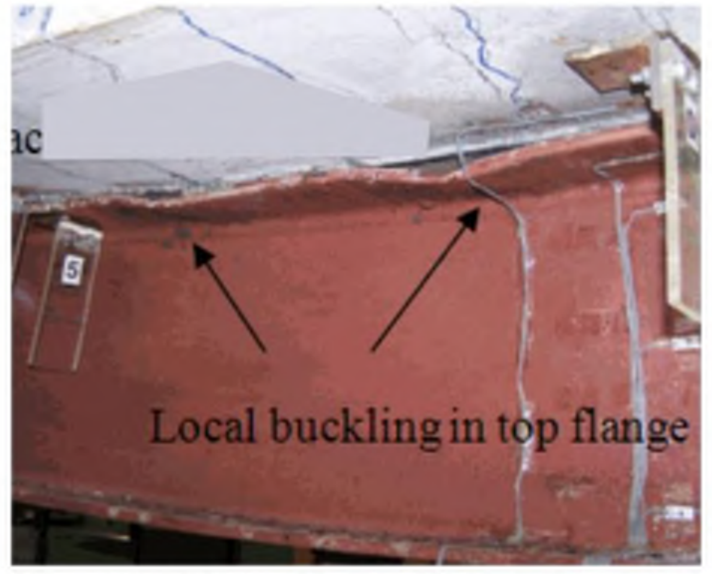
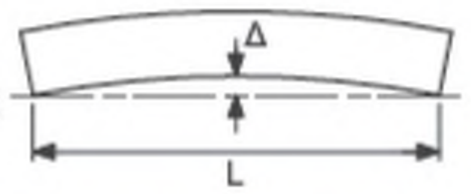
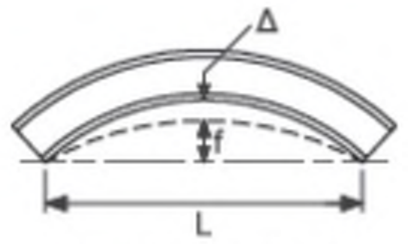
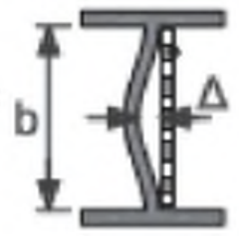
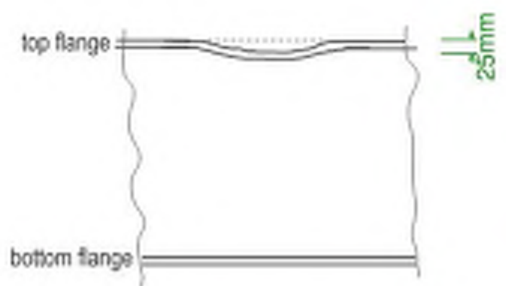
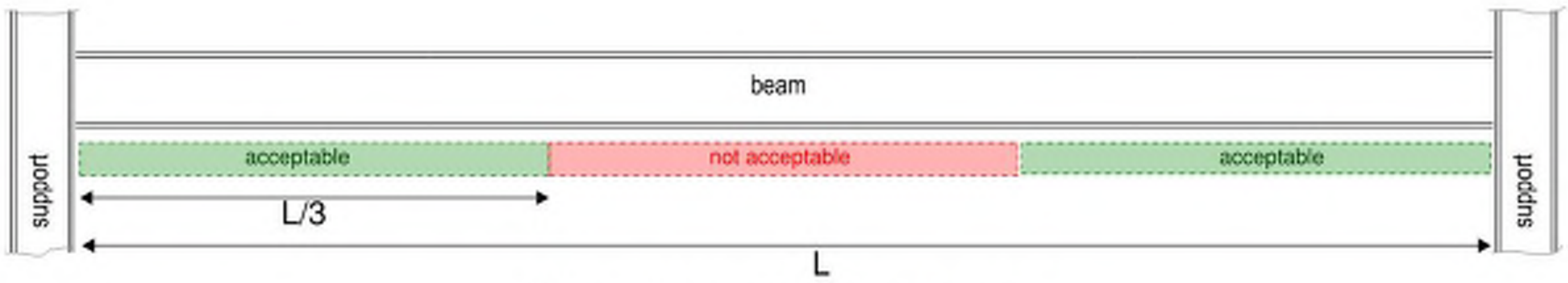
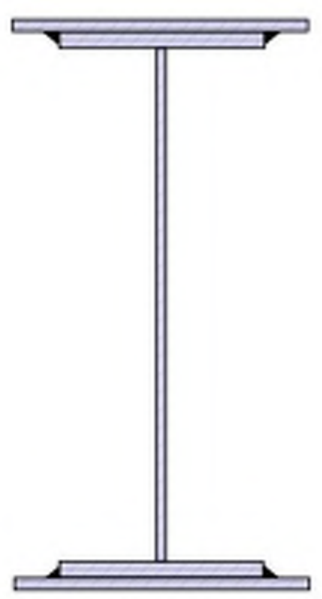
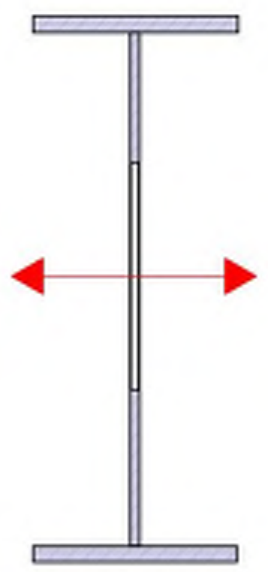
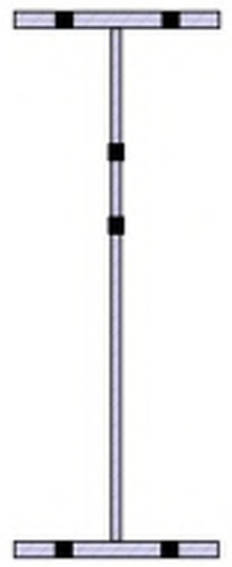
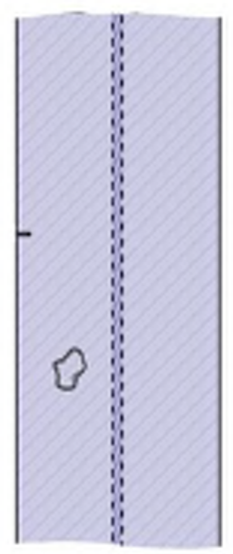
Height	width	weight	length		m2/linear metre
203	133	25	6		0.938

number of studs	18	
metres of welds (attachments)	1	20 mins per metre for 10mm plate plus weld
grind flush y/n	y	
number of cuts	2	

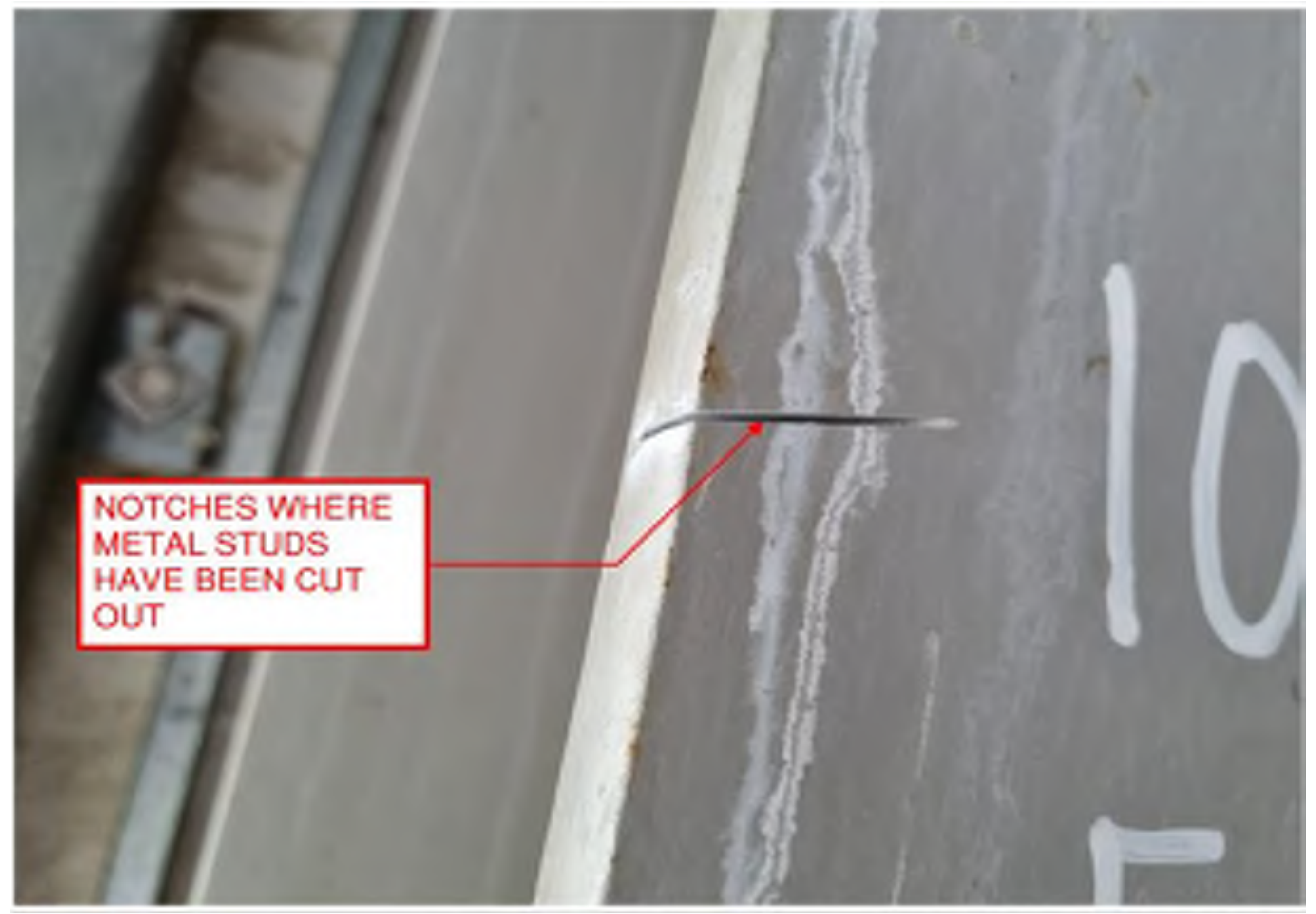
		kgCO2e						
Steel section	Weight of section (tonnes)	Hand blasting	Cutting	Stud removal (gas)	Stud removal: grind flush	weld/attachment removal (gas)	weld/attachment grind flush	Total kg CO2e / length
Gas cutting	0.15	6.38	0.05	0.01	0.38	0.01	0.13	6.84
Saw cutting	0.15	6.38	0.14	0.01	0.38	0.01	0.13	6.93

Reclaimed Steel – Acceptance Criteria

Guidance for site assessment acceptance criteria:

GENERAL	All concrete and metal deck to be fully removed. Shear studs to be removed off site (Top section of the stud can be removed on site, if required to assist with transportation).
REJECT	 **Excessive corrosion**  **Fire exposure**  **Plastic/Excessive deformation**  **Cracked steelwork**
ACCEPTABLE IMPERFECTIONS ANYWHERE ALONG THE BEAM	Straightness on both axes:  $\Delta = \pm L/750$ Curve or camber:  $\Delta = \pm L/500$ or 6mm whichever is greater Web distc  $\Delta = b/200$ Flange distortion:  $\Delta = b/150$
ACCEPTABLE "DINGS"	Dings up to 25mm at end thirds of the beam span - maximum 1 ding per beam (Dings greater than 25mm or at middle third of the beam, are not not acceptable)  example of acceptable ding  different beam areas along the span
ACCEPTABLE DAMAGE	Damaged coating or finishes:  Twisted or damaged shear studs: 
ACCEPTABLE FEATURES (SUBJECT TO CASE BY CASE ASSESSMENT BY ENGINEER) **SEE SITE EXAMPLES OPPOSITE**	 **Plated standard sections** (I.E NOT FABRICATED PLATE GIRDERS)  **Web Penetrations**  **Localised plate stiffeners**  **Bolt holes**  **Localised defects** which may be easily repairable or cut from beam length

Recent Examples:



REUSABLE STEEL – ENVIRONMENTAL PRODUCT DECLARATION

REUSABLE STEEL ENVIRONMENTAL PRODUCT DECLARATION

IN ACCORDANCE WITH ISO 14025 AND EN 15804:2012+A2:2019

Programme
The International EPD® System
www.environdec.com

Programme Operator
EPD International AB

1 → 2 → 3 → 4 → 5

1. **Pre-demolition**
Reusable steel identification

2. **Demolition/ Deconstruction**
Careful removal of potentially reusable steel sections

3. **EMR Reusable Steel Facility**
Initial assessment, testing and characterisation

4. **Reusable Steel Manufacturing**
Removal of extraneous materials, size reduction and shot-blasting

5. **Product**
Sales and distribution of reusable steel sections

EPD®

ENVIRONMENTAL PRODUCT DECLARATION

	Product Stage			Construction Process Stage		Use Stage							End of Life Stage				Benefits and Loads
	Raw Material Supply	Transport	Manufacturing	Transport	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction/demolition	Transport	Waste Processing	Disposal	Future reuse. recycling or energy recovery potentials
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules Declared	X	X	X	NR	NR	NR	NR	NR	NR	NR	NR	NR	X	X	X	X	X
Geography	GB	GB	GB	GLO	GLO	GLO	GLO	GLO	GLO	GLO	GLO	GLO	GLO	GLO	GLO	GLO	GLO
Specific Data Used	90%					–	–	–	–	–	–	–	–	–	–	–	–
Variation – Products	NR					–	–	–	–	–	–	–	–	–	–	–	–
Variation – Sites	NR					–	–	–	–	–	–	–	–	–	–	–	–

A1 → A2 → A3

A1 Raw Material
Raw materials for resuable steels consist of steel sections extracted from demolition/deconstruction projects and fabricated sections which were never installed.

A2 Upstream Transportation
Transport is relevant for delivery of the extracted steel to EMR Reusable Steel facility.

A3 Manufacturing
The manufacturing phase includes de-fabrication to remove extraneous materials and cutting to enable reuse.

C1 → C2 → C3

C1 Deconstruction / Demolition
As a recycling business, C1 equals to A1 for EMR, which is already taken into account. To avoid double counting, this is taken as 0.

C2 Transport to Disposal Site
This stage is related to the transportation of product when they come to the end of their life cycle. Transportation of used steel is already accounted for in A2 for reusable steel.

C3 Waste Processing
Waste processing refers to the processing steps for the deconstructed steel for its final end-of-life phase. C3 is already accounted for in A3 for reusable steel

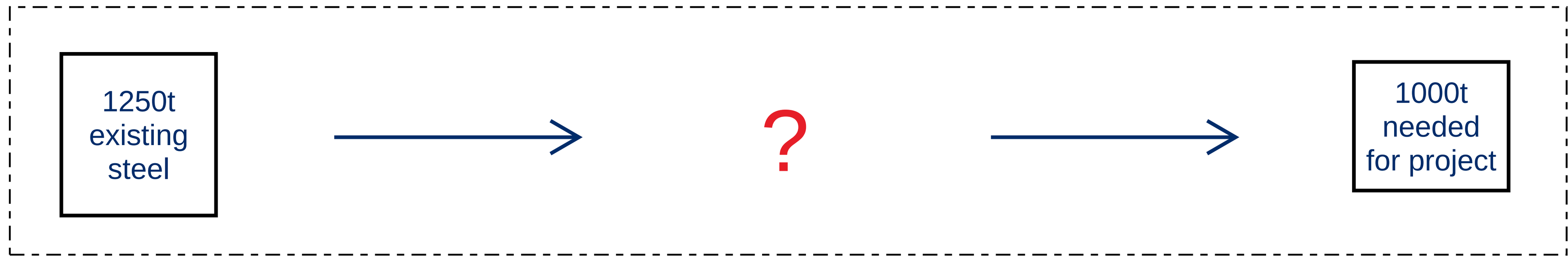
C4 → D

C4 Disposal
Disposal is the final stage of product life and it is assumed that 96% of the steel is recycled or reused while the remainder is subjected to disposal.

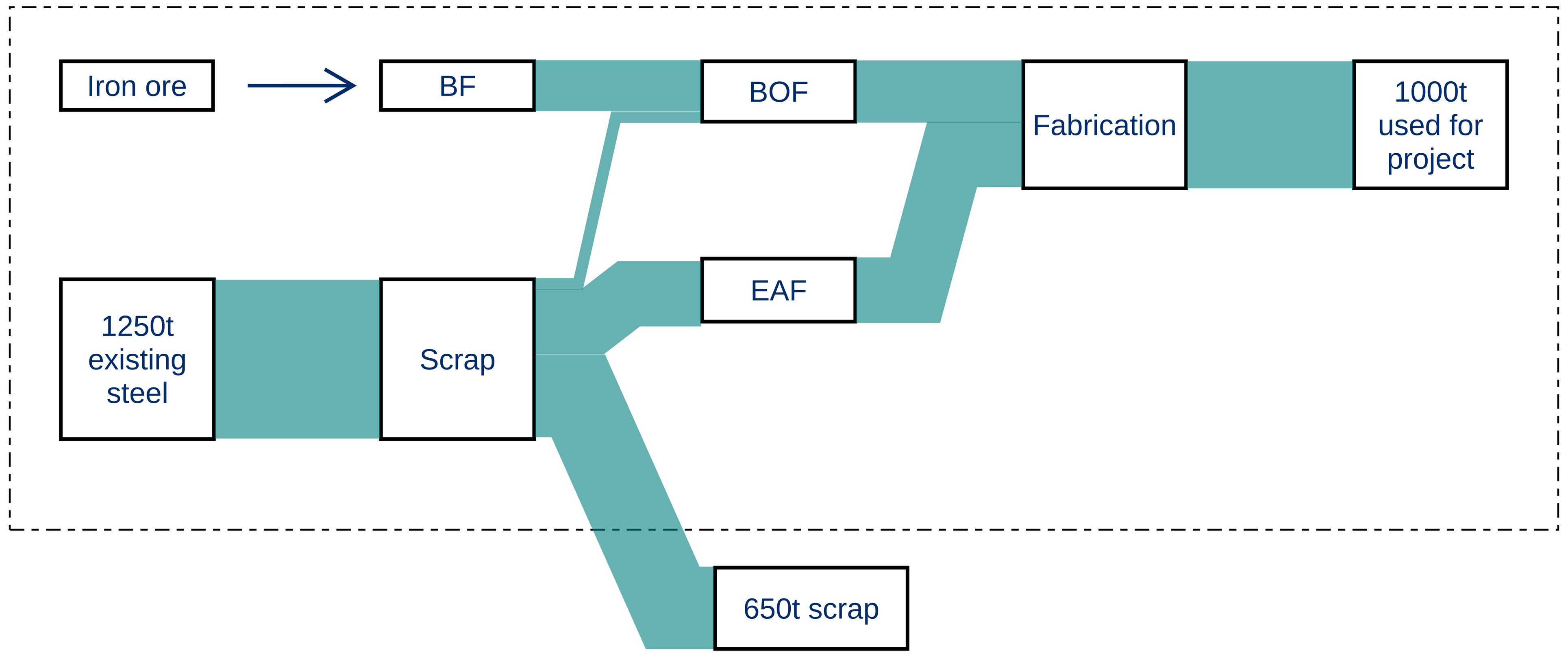
D Benefits & Loads
At this stage, benefits and loads from the reusable steel are calculated.

Making the best use of existing resources

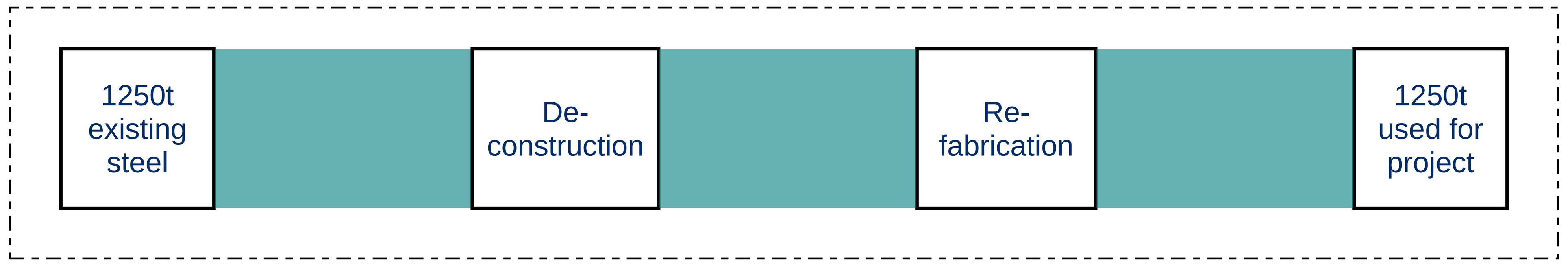
Project:



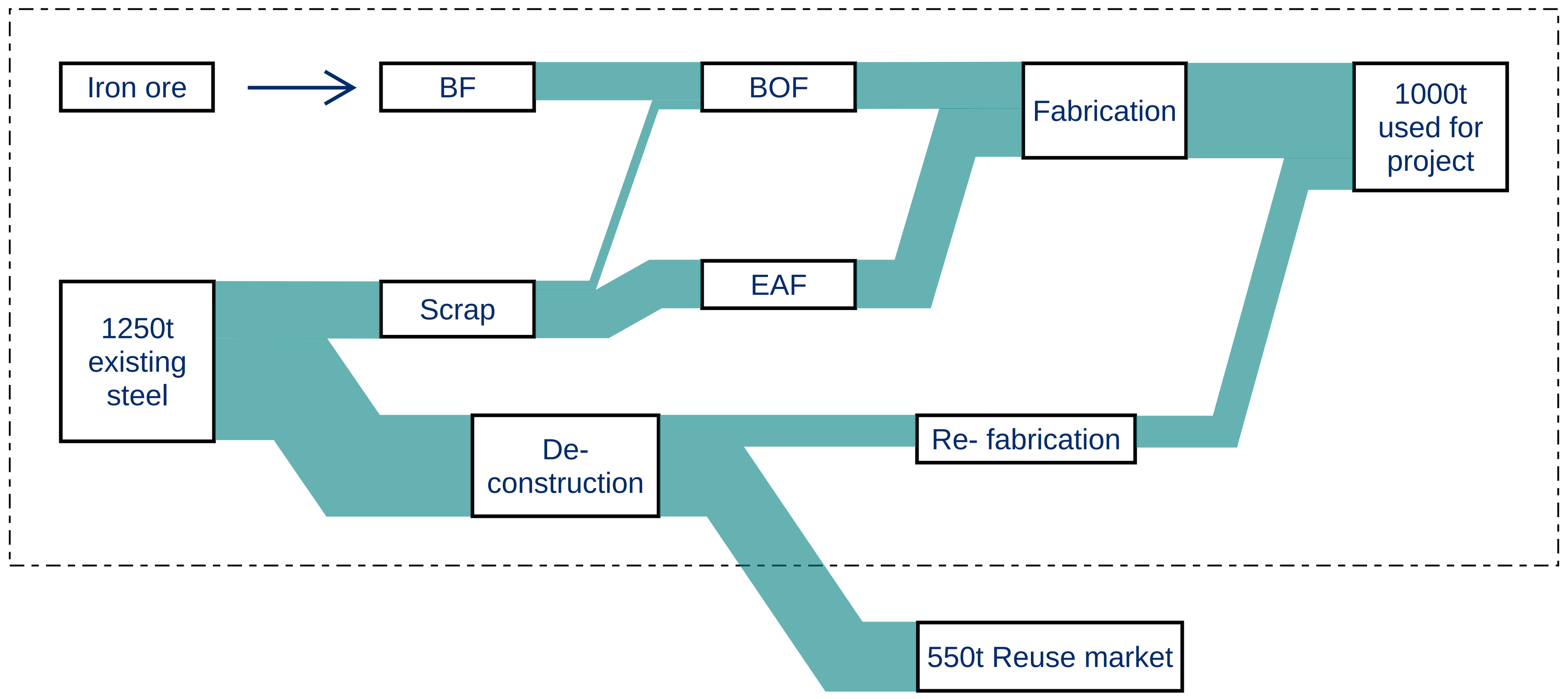
Option 1:
Scrap it



Option 2:
Reuse it



Option 3:
Make best use of it



In this example a new project requires 1000t of steel. An existing 'donor building' is available that can provide 1250t of steel sections.

In Option 1 we consider the 'business as usual' case where the existing building steel is scrapped. The new steel frame is assumed to use 60% scrap in its production.

Option 2 reclaims the steel from the donor building for use in the project. It is not possible to match the steel sections to the minimum weight required, so there is some inefficiency involved. Re-fabrication and transport is still required.

Option 3 reclaims 65% of the steel from the donor building but only uses existing sections where these are well matched to the new needs, and so does not increase the steel weight. In this example 25% of the steel in the new building consists of reclaimed sections.

Greenhouse gas emissions

Looking only inside project boundaries

Option 1 1670 tCO_2e [(1)]

Option 2 435 tCO_2e [(2)]

Option 3 1340 tCO_2e

Looking at the big picture

Option 1makes 650t of scrap steel available to reduce demand for primary steel for other projects. This scrap is worth at least 1.5tCO_2e/t of saved greenhouse gas emissions [(3)].

Option 3 releases steel suitable for reuse. This steel is worth 2.0tCO_2e/t of saved greenhouse gas emissions.

Option 1 1670 - 1.5 x 650 = 695 tCO_2e

Option 2 435 tCO_2e

Option 3 1340 - 2.0 x 550 = 240 tCO_2e

Recovering 65% of the steel for reuse and using 25% in the project is, in this example, better than trying to reuse it all on one project.

Look at the big picture - are we making best use of the resources in our control or influence?

What other uses could these resources be put to?

Can existing materials be retained *in situ* - avoiding transport and re-work?

If not, is there a market for these resources and how can our projects help develop this market?

(1) Based on a range of EPD for rolled sections adjusted for the assumed scrap content and allowance of 300kgCO_2e/t for fabrication, transport and erection (2) Based on 50 kgCO_2e/t for reclaimed sections and allowance of 300kgCO_2e/t for re-fabrication, transport and erection. (3) https://worldsteel.org/wp-content/uploads/Fact-sheet-Scrap-use-in-the-steel-industry.pdf

Brent Cross Town Primary Substation

Argent's History of Re-use

Argent has a strong history of re-use. The classic image of Kings Cross below encapsulates this approach with the Granary Building, Grain Store, Coal Drops Yard and Gasholders all partially or entirely re-purposed buildings.

Undoubtedly this had an environmental benefit, but it has also delivered social (identity / heritage) and value performance that is unlikely to have been possible with new-build.

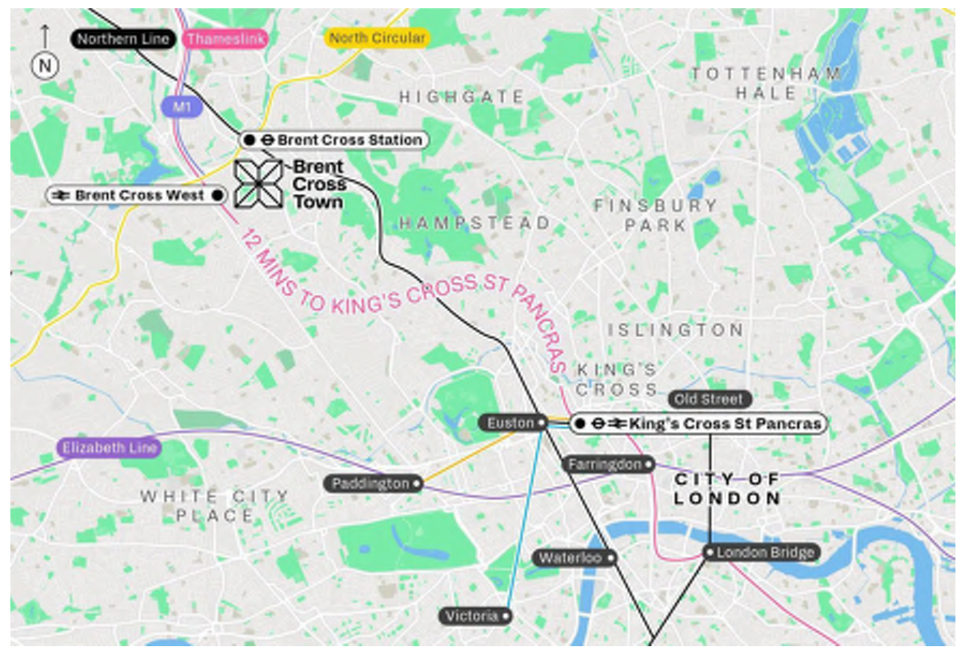
A Net Zero Carbon Town

Brent Cross Town is committed to being Net Zero Carbon by 2030 at the latest.

The minimisation of operational carbon emissions is well established through measures such as intelligent building design, power purchasing agreements for renewable electricity, and electrification of the town's heating and cooling.

Embodied carbon emissions now tend to account for >50% of a building's lifecycle emissions. Mainstream awareness of this is increasing rapidly and innovative approaches to reducing embodied carbon are now critical in order to capture the interest of top-tier occupiers, funders and partners.

Buildings constructed without a forward-thinking approach to lifecycle carbon risk rapid depreciation in value and potentially becoming stranded assets.



BXT Primary Substation Project

Brent Cross Town requires a new 80MVA substation to deliver (100% renewable) electrical power to the new town.

The site identified did not have any existing elements that could be reused in a structure but, there was a strong desire to do something which would brighten up this rather grey (but prominent) intersection of highway and railway infrastructure.

The winning scheme (from IF_DO architects and north London artist Lakwena) is a 21m high, 115m circumference oval wrap around the main transformer pens / switchroom. We knew that in order to justify this new structure in the context of our net zero carbon town we would have to look at innovative ways to reduce embodied carbon.

Design and Delivery

Arup were appointed as Lead Designer and across all engineering disciplines from Stage 1 of the project (refer to Arup Board for detail).

Although our usual procurement route is to then move to a Main Contractor to undertake Stage 4 through a PCSA we decided that for this project we would instead engage Bourne Special Projects (BSP) directly to undertake the Stage 4 design of the steelwork alongside our architect.

This enabled us to work directly with BSP (who would then fabricate and install the Wrap) to develop the design and work through any elements of risk.

BSP were then taken on as a domestic sub-contractor to Galldris who were the Main Contractor for the wider substation delivery.

Risk

Initially the specification of the reused steel raised several potential risks. For BXT the key concerns were around:

1. Availability of stock (what happens if the reused sections were no longer available after the design progressed).
2. Material performance warranty.

Both of these risk items were minimised through early engagement of the supply chain.

Stock was reserved through Cleveland Steel and Tubes (CST) during Stage 3, early orders placed through BSP in Stage 4.

Selecting BSP as preferred sub-contractor from the end of Stage 3 allowed them to undertake sufficient due diligence on the material and specify the requirements for testing in order to satisfy themselves as to its suitability.

Commercial

In 2021 our initial analysis indicated that:

- Cost per tonne for reused / repurposed material is generally 50% less than prime.
- Even after considering the additional testing / surface preparation / transport etc the all-in cost of reused steel was still ~25% less than prime.

The final contract was being negotiated during February / March 2022. During this period sharp increases in commodities prices threatened the overall viability of the project.

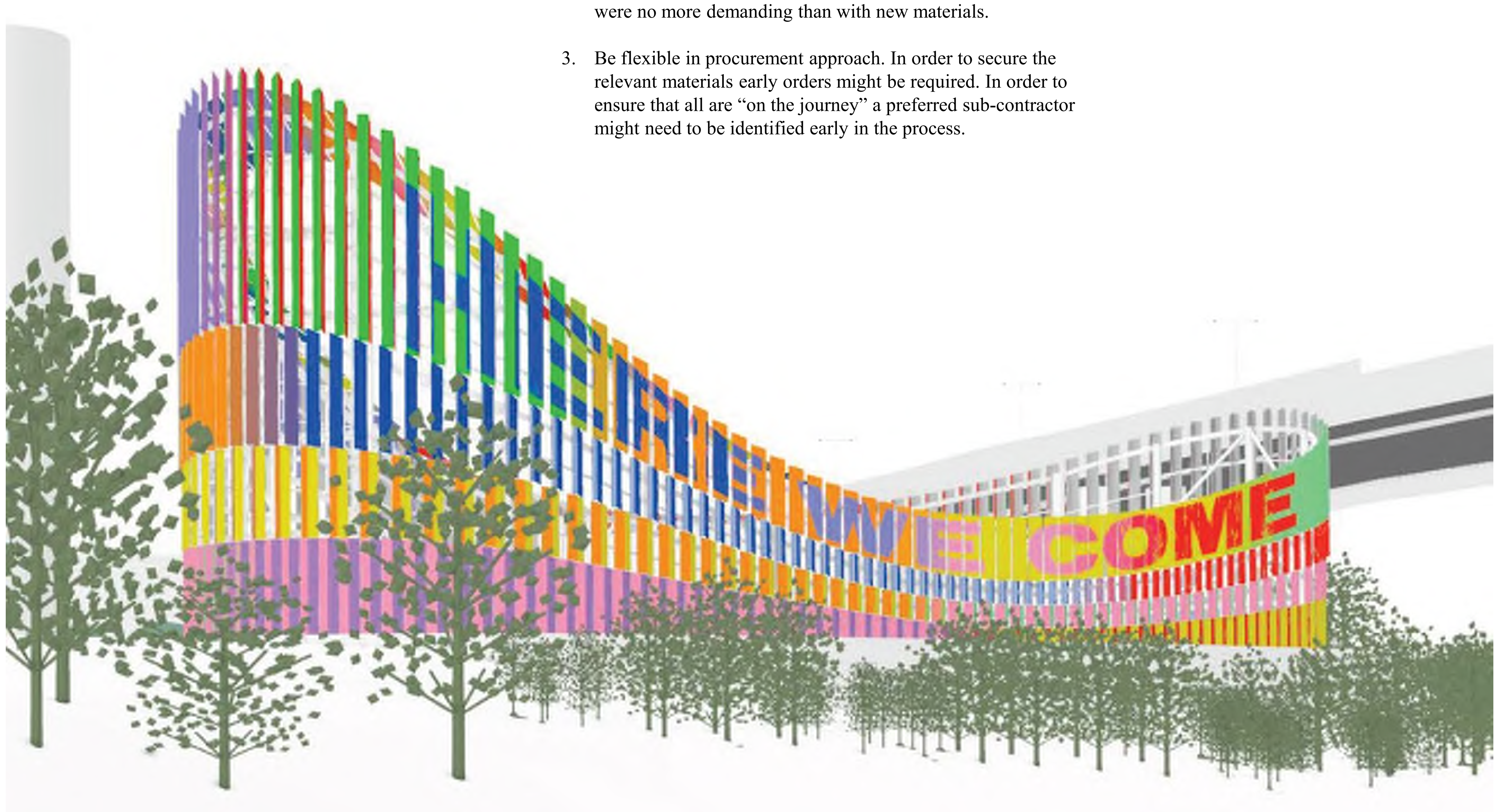
However, the price of the reused steel remained consistent throughout this period – further improving its commercial performance and helping the overall project to proceed.

Key Client Lessons Learnt

1. Do an early assessment of where it might be possible to reuse material. The design obviously needs to evolve with this in mind but so does the project team.

2. Engage directly with forward thinking suppliers and sub-contractors. Due to the knowledge, experience and practical approach of the parties involved the conversations around risk were no more demanding than with new materials.

3. Be flexible in procurement approach. In order to secure the relevant materials early orders might be required. In order to ensure that all are "on the journey" a preferred sub-contractor might need to be identified early in the process.



Brent Cross Town Primary Substation Design

The Winning Scheme

A huge piece of public artwork. An immense colourful signpost to the Brent Cross development which can be seen both from the north circular and from the railway line. It was vital to demonstrate a responsible use of our precious resources. The structure presented an excellent opportunity to innovate and reuse some existing steelwork.

The Challenge

To achieve this challenge, we knew we needed to collaborate as a project team. Arup's 30-year relationship with Argent opens the door to honest conversations and promotes opportunities to innovate. With support from the Steel Construction Institute and Cleveland Steel we established a source for reused steel, settling on some ex-oil industry steelwork. Cleveland Steel have catalogued the steelwork they own helping the design process.

We eventually decided upon using the reused steel tubes for the long columns together with conventional steelwork for the façade support, where tubes would have been less efficient and clunky for connections. What helped to decide was that reused steel saved approximately 75TCO2. Moreover, the whole project team have learned how to do incorporate reused steel into a project.

Lesson Learned

The Circular Buildings Toolkit developed by Ellen MacArthur Foundation and Arup is free to use for all. It provides an excellent framework for incorporating circular economy principals into real estate. The tool is free to use via the link below. What other circular innovations could we have achieved had we used the toolkit?

The Efficiency of Recycling Scrap

Recycling of scrap steel makes a major, and increasing, contribution to reducing global warming and is key to addressing the global climate emergency. This is because recycling scrap reduces the demand for primary 'pig iron' production, which currently involves high emissions from blast furnaces. Scrap steel from all sources is currently extensively and efficiently recycled.

It is typically processed through electric arc furnaces, and is also added to the basic oxygen steelmaking furnaces that are fed mainly with primary 'pig iron' from a blast furnaces. Either of these two routes can and are used to produce the full range of structural steel products and reinforcement.

"Inefficient use of scrap steel resources in a project reduces scrap availability generally in the industry and this can lead to an increase in global primary steel production, so care is needed to avoid any unintended adverse impact on global warming potential."

– Research via 'Invest in Arup 23997'

Embodied Carbon & Circular Economy

Major shift in focus towards embodied carbon to sweep through markets in coming decades.

Key strategies to reduce embodied carbon	Key strategies to reduce embodied carbon
Build nothing	Extension and repositioning of existing assets, deconstruct and reconstruct existing fabric
Build for long-term use	Façade and structure designed for multiple typologies Passive services provision for multiple typologies anticipate user-adaptation and change
Build efficiently	Choose sufficient grids, adopt off-site and digital fabrication
Build with the right materials	Where exposed, choose naturally durable materials, everywhere else, choose bio-based materials, avoid hybrids

Circular Buildings Toolkit

Each Strategy includes a set of specific Action Cards across all design stages that guide users on how the circularity concept described within the strategy can be translated to practice. The platform features a library of case studies where users can find existing examples across the globe where the circular design principles embedded in this framework have been implemented.

Each Tool Card features a description of the tool/guideline, the individual KPIs addressed by the tool, and a link to the external official website for further information.

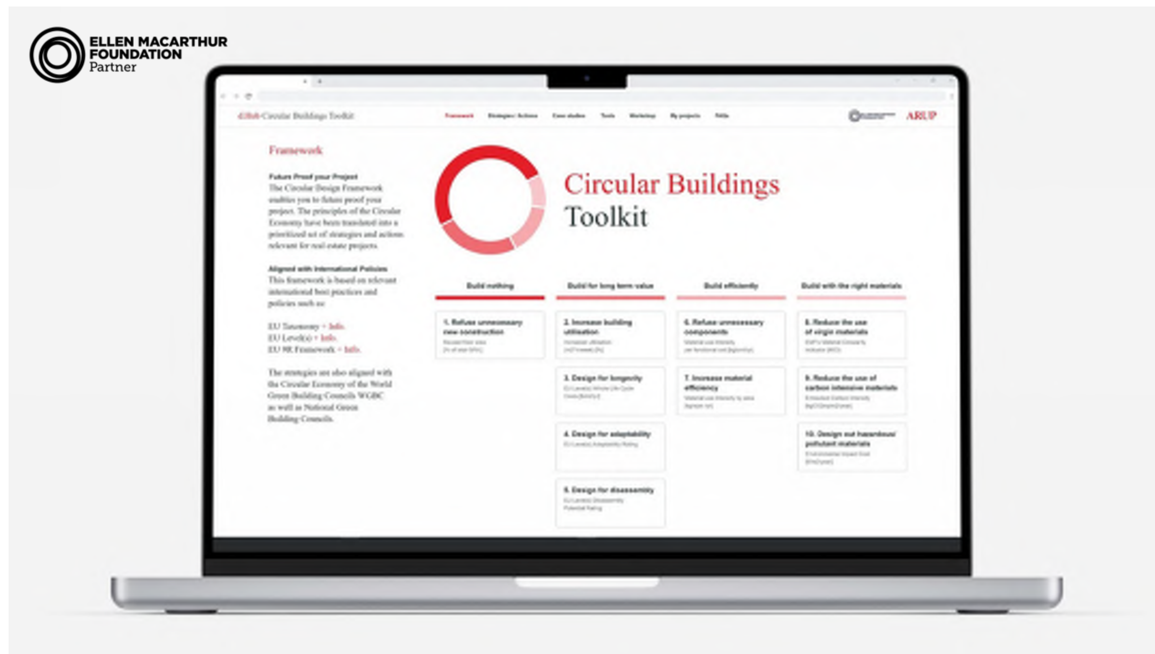
The Workshop section provides materials and guidance on how project teams can use the framework in a structured, interactive session, where they can effectively identify the strategies and actions that they wish to implement in the project.

Users can create an account add their own projects. Once registered, users can revisit their project any time, modify the inputs and track performance directly on the platform.

Circular Buildings Toolkit – Strategy cards

Users will have access to a set of strategy cards, each one containing the following information:

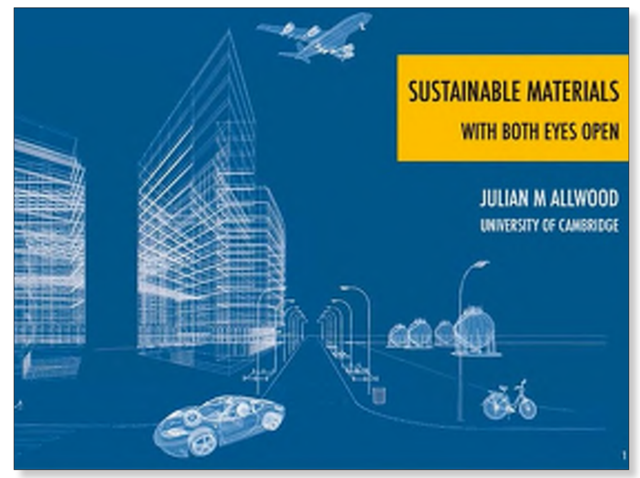
- Description
- Relevant indicator KPI
- Benefits
- Challenges
- Impact level
- Key design phase
- Designer impact

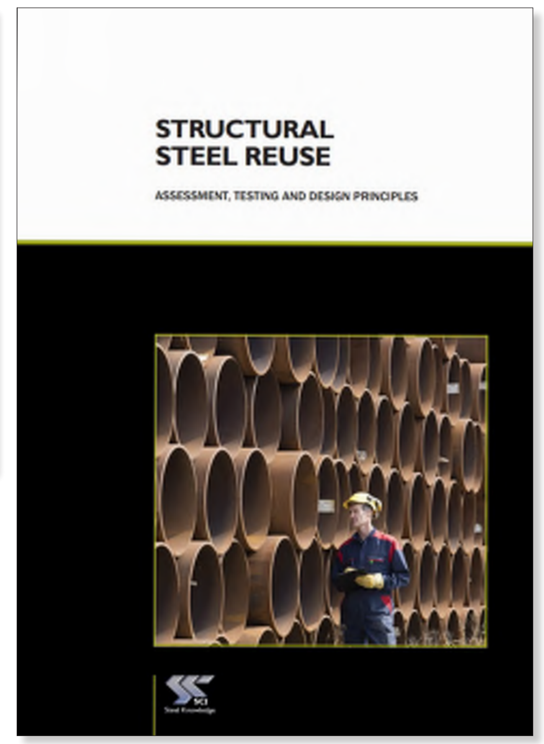


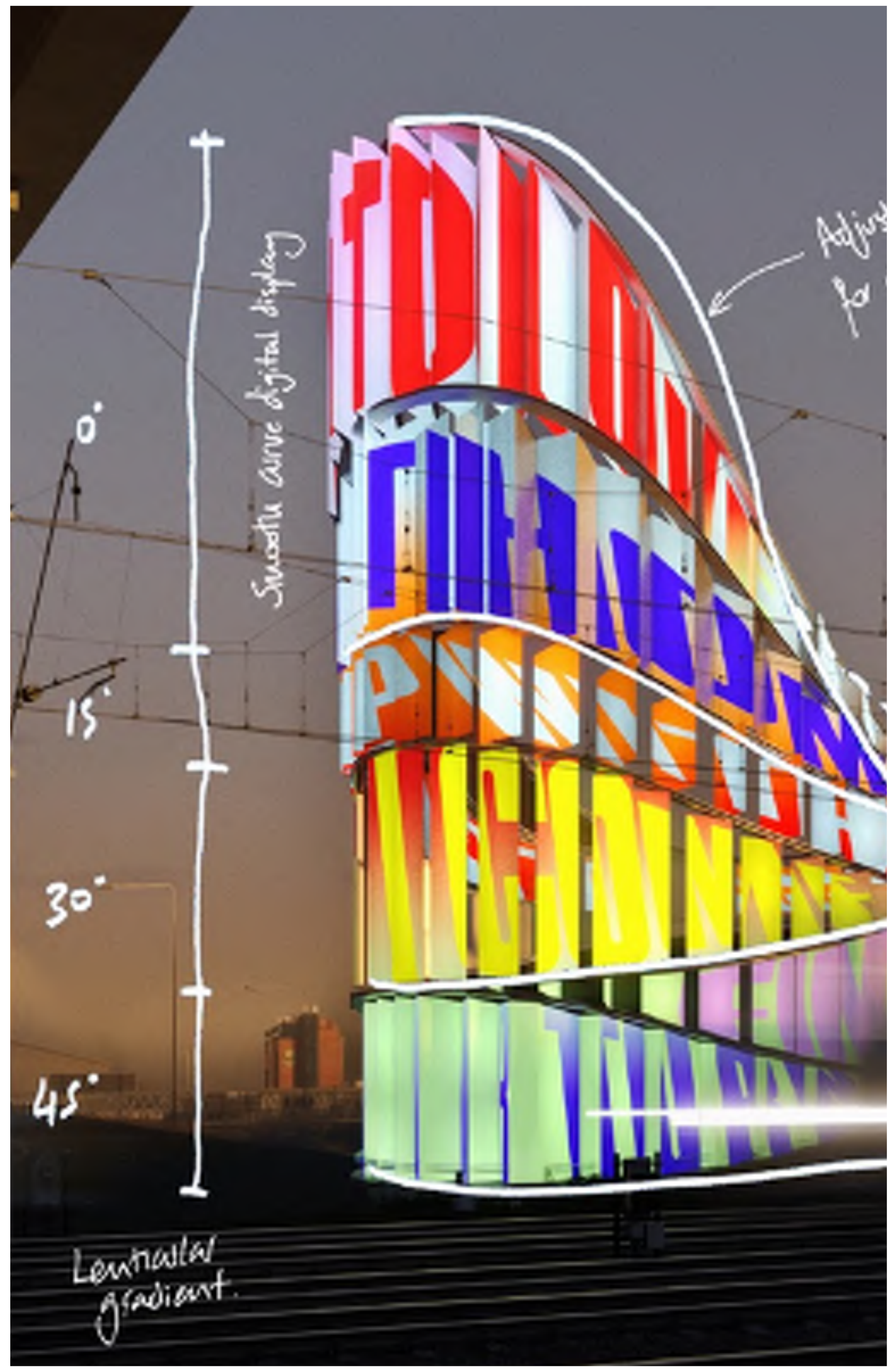
https://ce-toolkit.dhub.arup.com/

Exact matches

Product	Diameter (OD - mm)	Wall thk (mm)	Quantity	
27mmx4mm	27mm	4.0mm	12 to 50 metres available	Enquire
27mmx6.3mm	27mm	6.3mm	12 to 50 metres available	Enquire
32mmx4.5mm	32mm	4.5mm	12 to 50 metres available	Enquire
34mmx5mm	34mm	5.0mm	Less than 12 metres available	Enquire
36mmx2mm	36mm	2.0mm	More than 1000 metres available	Enquire
44mmx5mm	44mm	5.0mm	More than 1000 metres available	Enquire
48mmx3mm	48mm	3.0mm	More than 1000 metres available	Enquire
57mmx3.2mm	57mm	3.2mm	Less than 12 metres available	Enquire







One Broadgate Deconstruction & Urban Mining

cantillon · morrisroe group · UK GBC · CIRCULAR STEEL

- Partners -

- The Project -

- Plan/Consider/Decide -

- Is It Viable? -

- Set The Standard -

- Set The Standard -

STEP 1
NO TRANSFER BEAMS OR SECONDARY TRIMMING STEELS TO BE ACCEPTED

↓

STEP 2
ENSURE ALL CONCRETE AND METAL DECKING HAS BEEN REMOVED FROM THE TOP FLANGE. ALL SECONDARY BEAMS TO BE TRIMMED BACK TO CONNECTION.

↓

STEP 3
STEEL LAID DOWN HAS NOT BEEN BUCKLED OR SUFFERED EXCESSIVE DAMAGE OR YIELDING THROUGH DEMOLITION PROCESS

↓

STEP 4
NUMBER OF DINGS GREATER THAN 20mm DEEP IN MIDDLE THIRD OF BEAM NOT GREATER THAN 2 IN NUMBER

(Steps 1–4:) TO BE CHECKED BY AKTII & CANTILLON ON SITE

AKTII TO ADVISE ON ACCEPTABILITY OF SECTIONS

WHERE CONSIDERED ACCEPTABLE PROCEED TO STEP 5. NOT CONSIDERED ACCEPTABLE MEMBERS WILL BE REJECTED FOR THE PURPOSE OF PROCUREMENT UNDER THIS CONTRACT

↓

STEP 5
LOAD STEELWORK ONTO BACK OF TRANSPORT WITH STEEL SECTIONS ON TOES OF FLANGES AND WITH SHEAR STUDS FACING SAME DIRECION TO PREVENT INTERLOCKING OF BEAMS

(Step 5:) CHECKED BY CANTILLON

- Consider Impact -

- Logistics -

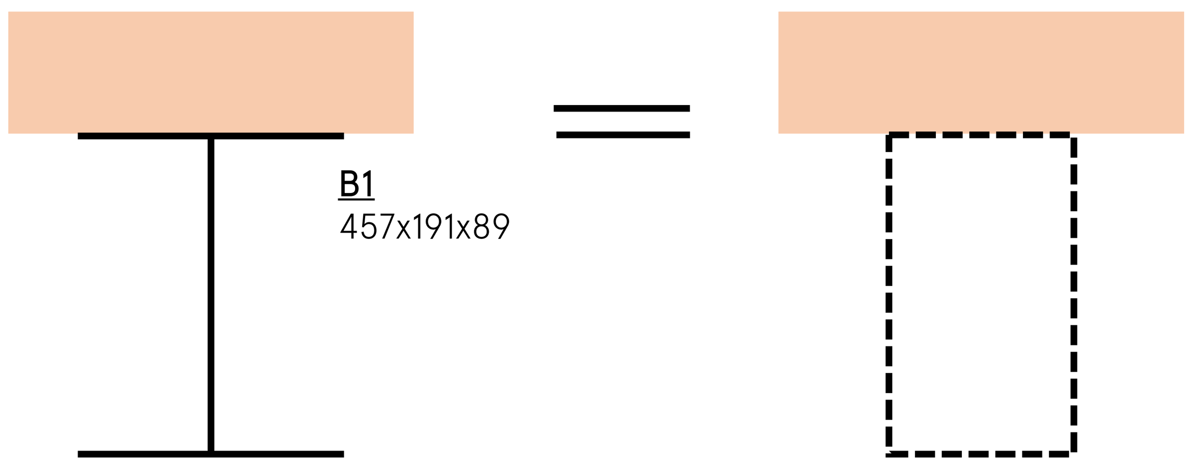
Design for Steel Reuse - Engineer's Perspective

Design for Re-Use: Summary

- For buckling resistance for reclaimed steel a modification factor of $\gamma_{M1,mod} = 1.15\gamma_{M1}$, this is to allow for the increased uncertainty with reused/reclaimed steel.
- Depending on the age of the building typically start with the assumption the grade of steel is S275.
- Avoid specifying unusual sections such as very large sections which will be harder to find.
- If bolt holes reduces the section by more than 15% the new cross-section properties should be considered.
- Recommended that for reclaimed steel with existing holes, new connections within 100mm should be avoided.
- Existing connections can be reused but careful inspection and testing (eg of the wleds) would be required.
- Extra testing care and consideration needs to be given to any reused steel used prior to 1970, eg sub-grade of steel is assumed to be JR without testing for steel post this date but additional testing would be required prior to this date.
- No reliance should be placed on original fire protection.

Designing for Re-Use: Take Aways

- **Flexibility for change:** Specify beam properties and model volumes rather than exact beam until later in design.. Stage 4/5.



B1
457x191x89

B1
d = 400-475mm
b = N/A
fy*Wpl,yy = 530kNm fully restrained
fy*Wel,zz = 60kNm fully restrained
Iyy = 40,000 cm4
Izz = 1,000cm4

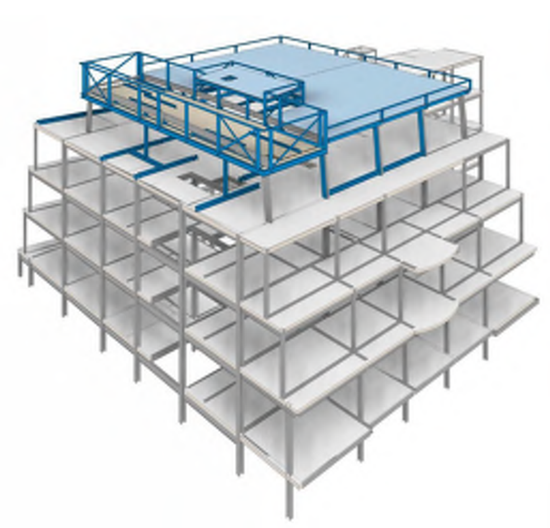
- **Educate the client and get them on board early:** reuse requires a different process, which is perceived as riskier. Perfect steel may not be available at the right time but something similar might be. Agree extent of holes, welded plates etc. from previous use that can be accepted.
- **Educate contractors of the process:** provide information of the procedure, what's involved at each stage to be able to give more programme and cost certainty.

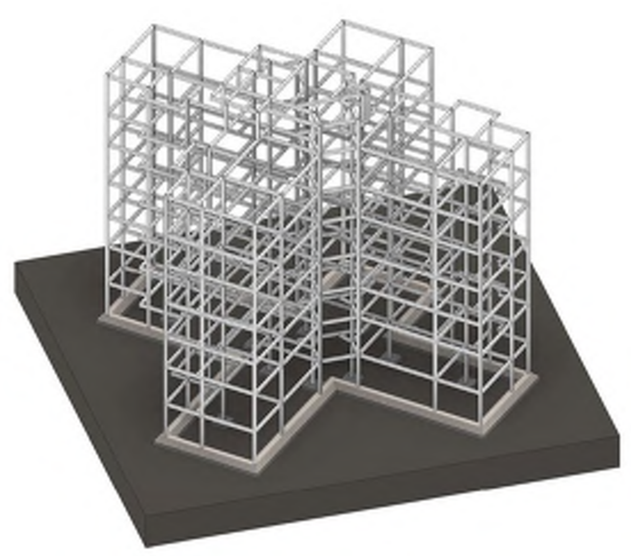
Challenges to the Design

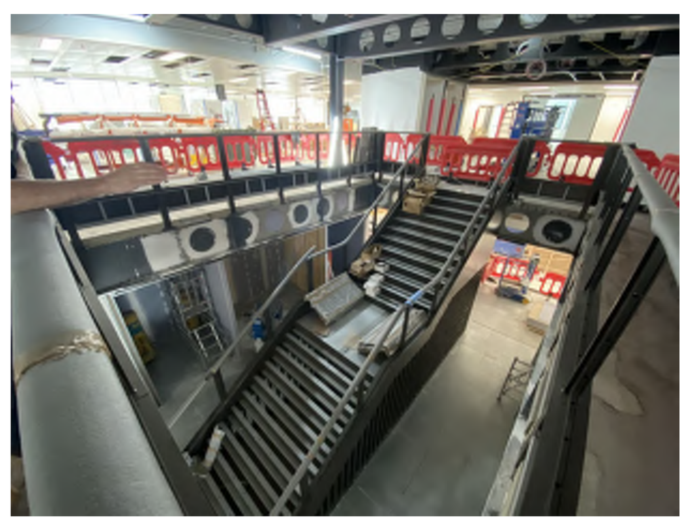
Challenges to the Design		How they were solved on Holbein
Finding the right reclaimed steel and stock limitations.	Bigger, unusual sizes more difficult to come by. Limited stock list currently.	Smaller, more common sizes targeted.
The right timing and programme influences.	Programme didn't allow for steelwork to be tested and refabricated from the original site. Also missed out on more stock becoming available by weeks.	Understanding programme implications if steel from original site is to be reused.
Getting the builders and subcontractors on board.	Contractors could have provided inflated costs as it is currently the 'unknown' and were nervous about implications.	Engages with stocklist early to provide advice to main contractor.
Testing and warranties.	Nervousness around testing protocol and ability to provide CE markings limits fabricators willing to use reused steelwork.	Use fabricators familiar with the process. Educate client and fabricators.
What is the final product going to look like.	Steelwork may have holes and marks from previous use, client education required.	Show examples of condition of steelwork to client if steel is to be visual.
Demolition.	Demolition takes longer, cost implications, some structures better suited to others.	Undertake an early demolition audit to establish if reuse of steelwork is viable.

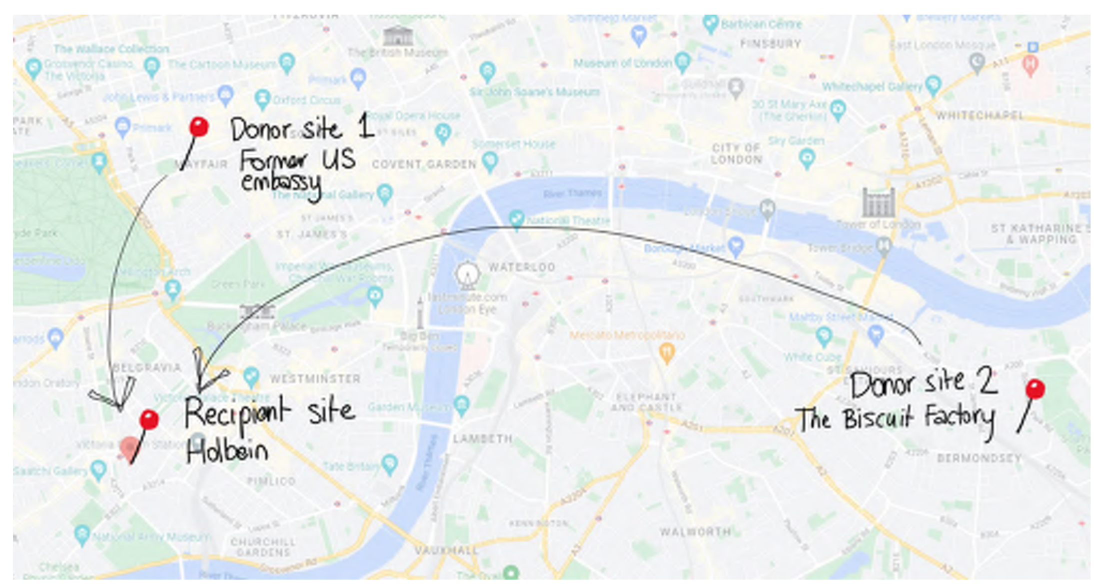
Photos from Holbein Gardens

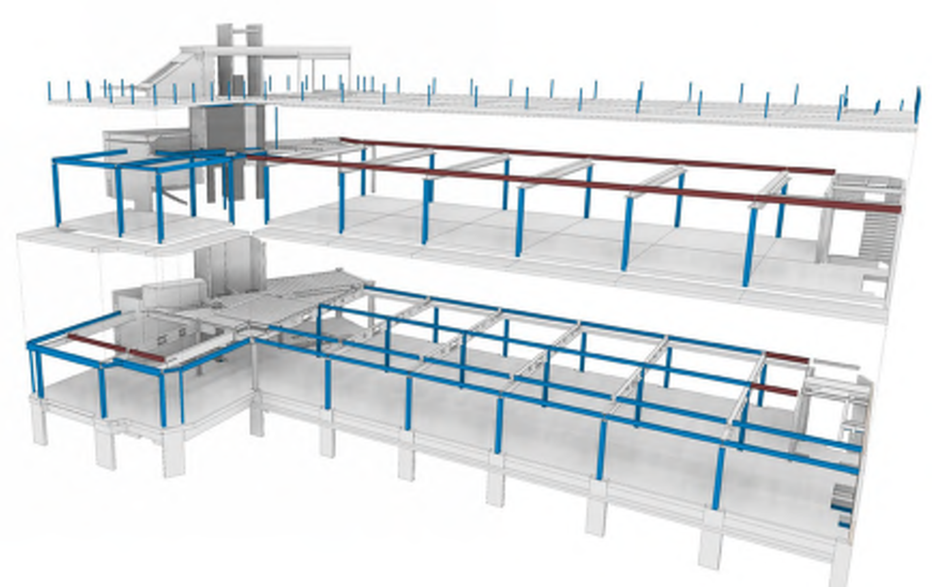
In the pipeline











Holbein Extent of Reused Steel

Design for Steel Reuse - Holbein Gardens Case Study

HEYNE TILLETT STEEL | UK GBC | CIRCULAR STEEL

New Steelwork

(Incorporated in design RIBA Stage 1/2)

Limestone
Iron Ore
Coal

Iron Making

Scrap metal

Steel making- steel made into semi-finished products (blooms, billets, slabs)

Plates and sections formed at rolling mills. Products provided with CE Marking

Traditional Steel
2.1 to 2.7 kg CO2e/kg

Current Site

(Incorporated in design RIBA Stage 2 & 3)

Steel for potential reuse at Holbien was identified by HTS.

Measured survey provided approximate lengths, HTS measured steel sizes and undertook visual inspection of steelwork.

Demolition undertaken in a controlled manner for steel reuse.

Transported to Cleveland Steel testing facilities.

Steel sorted, inspected tested and cleaned. Record of declaration created to allow for distribution into supply chain.

Steelwork stored for future builds by client.

Or

Sold

Not possible to reuse on project due to programme constraints

Reused Steel
0.3 kg CO2e/kg

Fabricated by Cleveland Steel, finishes applied and CE mark provided.

Transported to site

Steel Erected

Other Sites Owned by Client

(Incorporated in design RIBA Stage 3 & 4)

Steel for potential reuse at Holbien identified at the 'Biscuit Factory' in Bermondsey. HTS measured steel sizes and undertook visual inspection of steelwork.

Structure deconstructed, bolted connections.

Transported to Cleveland Steel testing facilities

Steel sorted, inspected tested and cleaned. Record of declaration created to allow for re-use of steel.

Reused Steel
0.3 kg CO2e/kg

Stocklists

(Incorporated in design RIBA Stage 4 & 5)

Cleveland Steel stock holders provided information to HTS regarding current steel stock.

Steel identified for reuse by Cleveland steel including US Embassy Temporary Works

Demolition undertaken in a controlled manner for steel reuse.

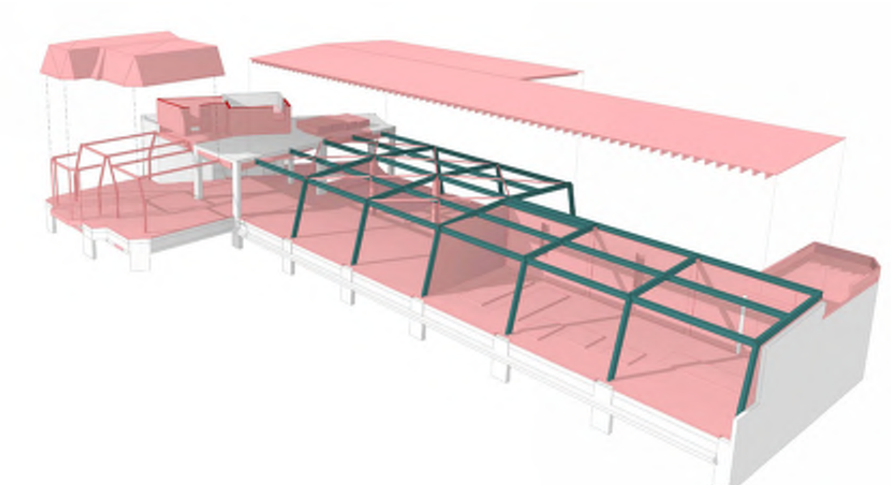
Transported to Cleveland Steel testing facilities

Steel sorted, inspected tested and cleaned. Record of declaration to allow for distribution into supply chain.

Steelwork held in storage, and logged on stock list to sell on open market for re-use.

Reused Steel
0.3 kg CO2e/kg


Stock steelwork


Existing Steel on 7 Holbein Place

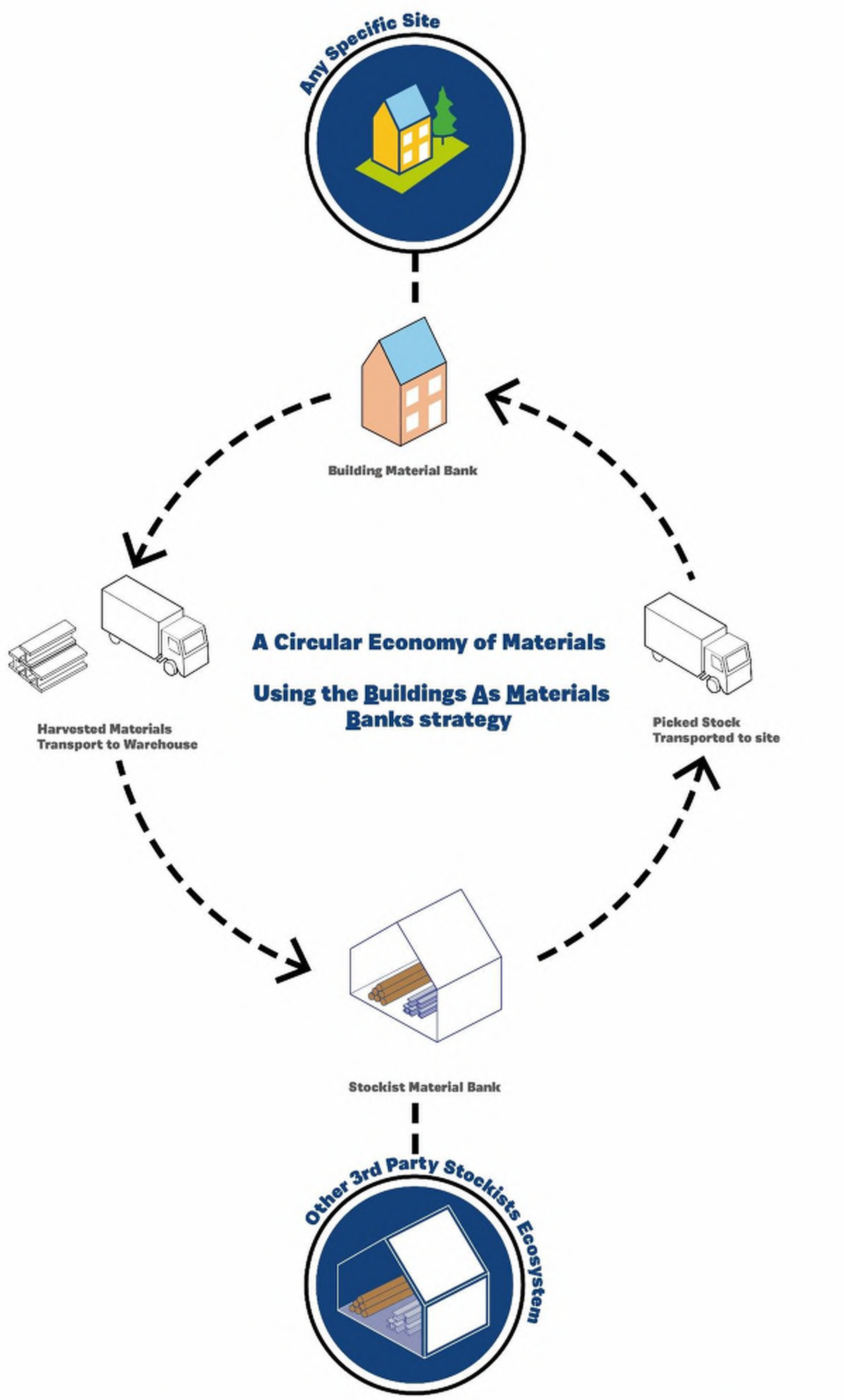

Steel from Biscuit Factory


Steel from 30 Grosvenor Square Temporary Works

Specification + Design for Steel Reuse

Orms HETA UK GBC CIRCULAR STEEL

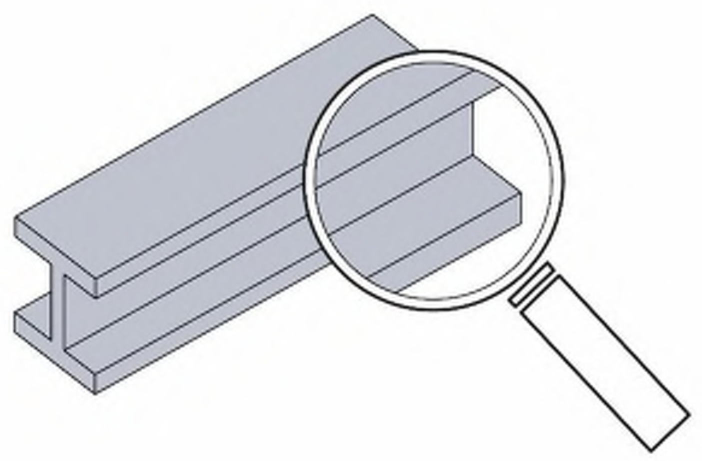
WHAT? THE ULTIMATE WIDER GOAL IS TO CREATE AN ECOSYSTEM OF MATERIAL RE-USE:



A STANDARD PRACTICE CIRCULAR ROUTE FOR MATERIAL RE-USE, INCLUDING STEEL, WITHIN THE CONSTRUCTION PROCESS

HOW?

ESTABLISH MATERIAL CONDITION



Establish critical performance suitability - will it function first, then grade for the aesthetic condition

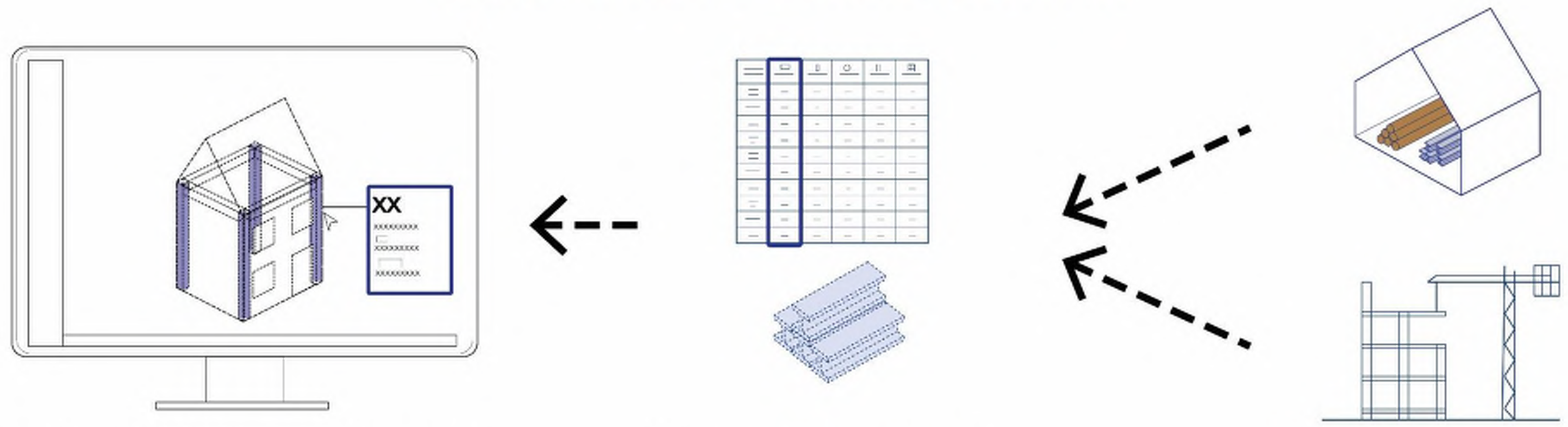
Grade for final finish according to a system that is logical and understandable for later designers to make informed choices for best placement and use / any actual need for refurbishment

Until any wider system is in place for a database of materials with their condition and provenance that can be relied upon to judge/order material stock, this must either be done:

a) on a case by case basis by accredited professional means as materials become available (from any site deconstruction source or in-situ retention)

b) from accredited recycling sources.

MAKE INFORMED DESIGN DECISIONS



Digitally Encoded materials linked to BIM design software's

This allows design to occur what you have, and to make considered best use of what material to use where based on it's conditions in a live manner, allowing everything from loose-fit to bespoke reconditioned and in-situ to be tuned to need in BIM CAD; which also remains as close to 'business as usual' as possible in terms of design process.

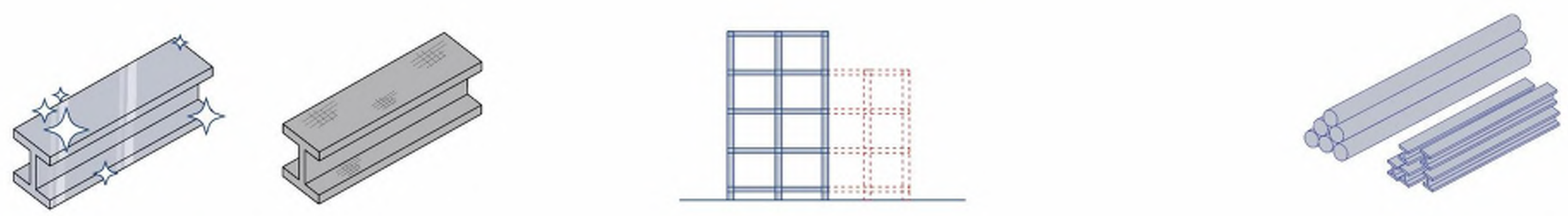
Digitally Encoded materials - Materials Passport

A database of materials and their conditions is kept as a live document - to be linked to BIM schedules and specifications, covering current condition and history as far as is known including refurbishment and treatments carried out.

Considered Demolition Harvesting & Storage

Material must be 'harvested' from existing building with considered demolition practice - contractors must be knowledgeable and trained to allow this to occur. Materials need to be processed, marked as needed and put into a storage facility ready for digital cataloguing

PERFORMANCE - APPEARANCE: HOW MUCH OF ANY SPECIFICATION NEED ONLY BE ABOUT PERFORMANCE?



Does it need to be in pristine condition for its use?

Consider Where it can be used:
- Will it be visible?
- Is it in a 'back of house' area

What importance is it's final finish?

Can existing steelwork be incorporated into the design as is?

Can a building audit occur to survey the existing and then be considered at the design phase?

Can you 'design in' the differences / condition into the scheme?

Can you work to what is available?

Does it matter if all the elements match?

Assuming connections can be made - do we care if some columns are circular steel sections and others are universal columns, if both have the same ultimate performance specification?

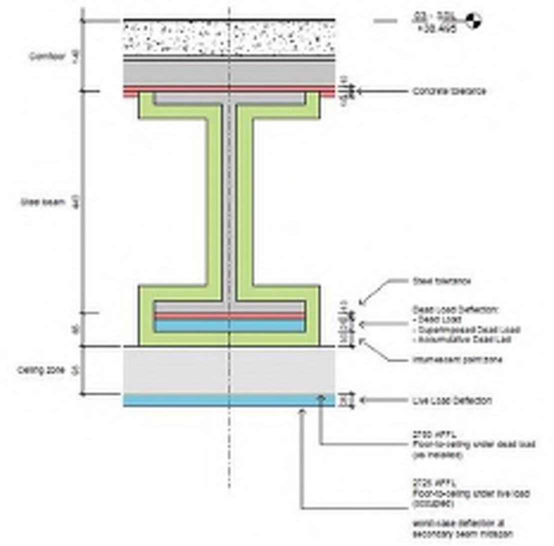
Specification + Design for Steel Reuse

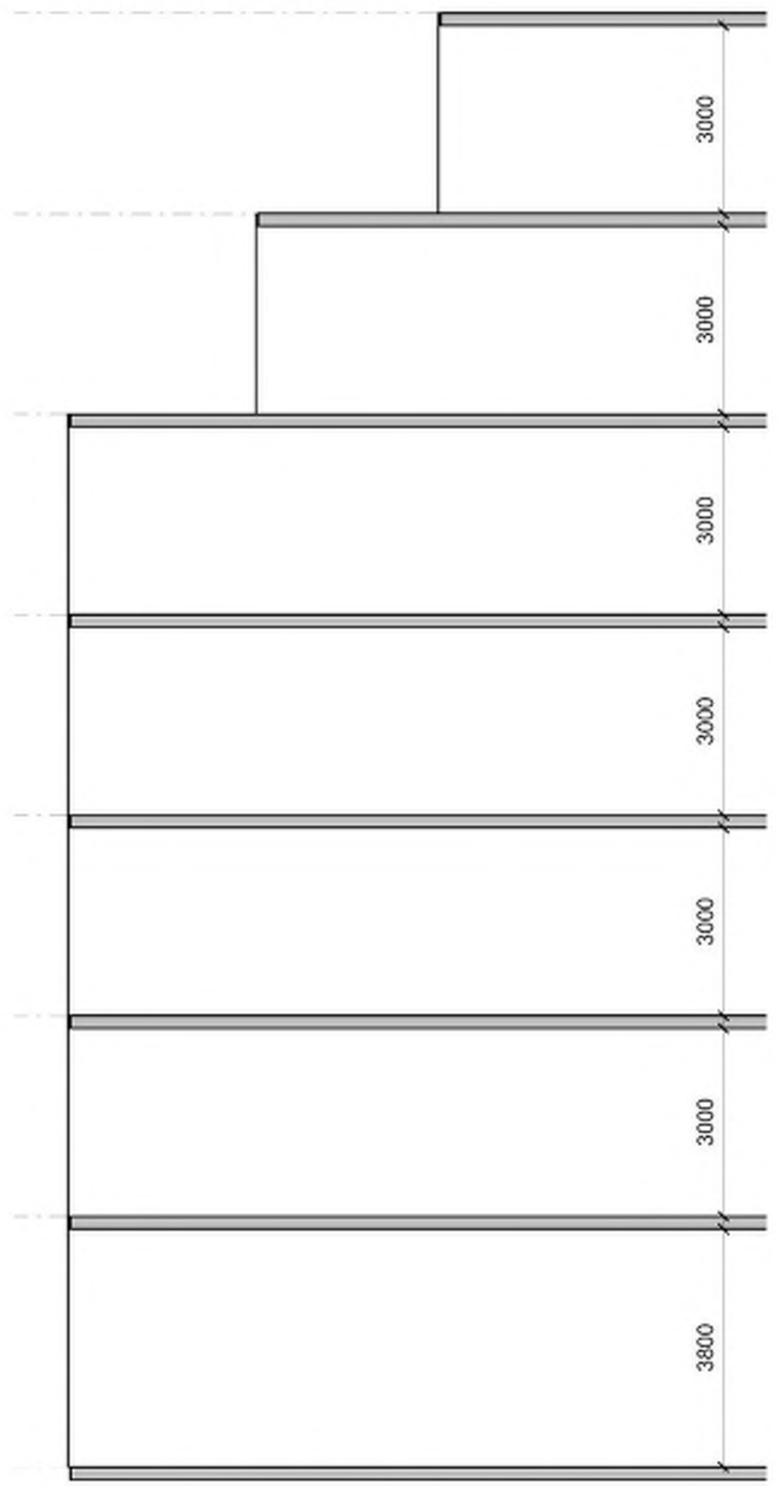
Orms HETA UK GBC CIRCULAR STEEL

Successful reuse is a matter of tolerance...

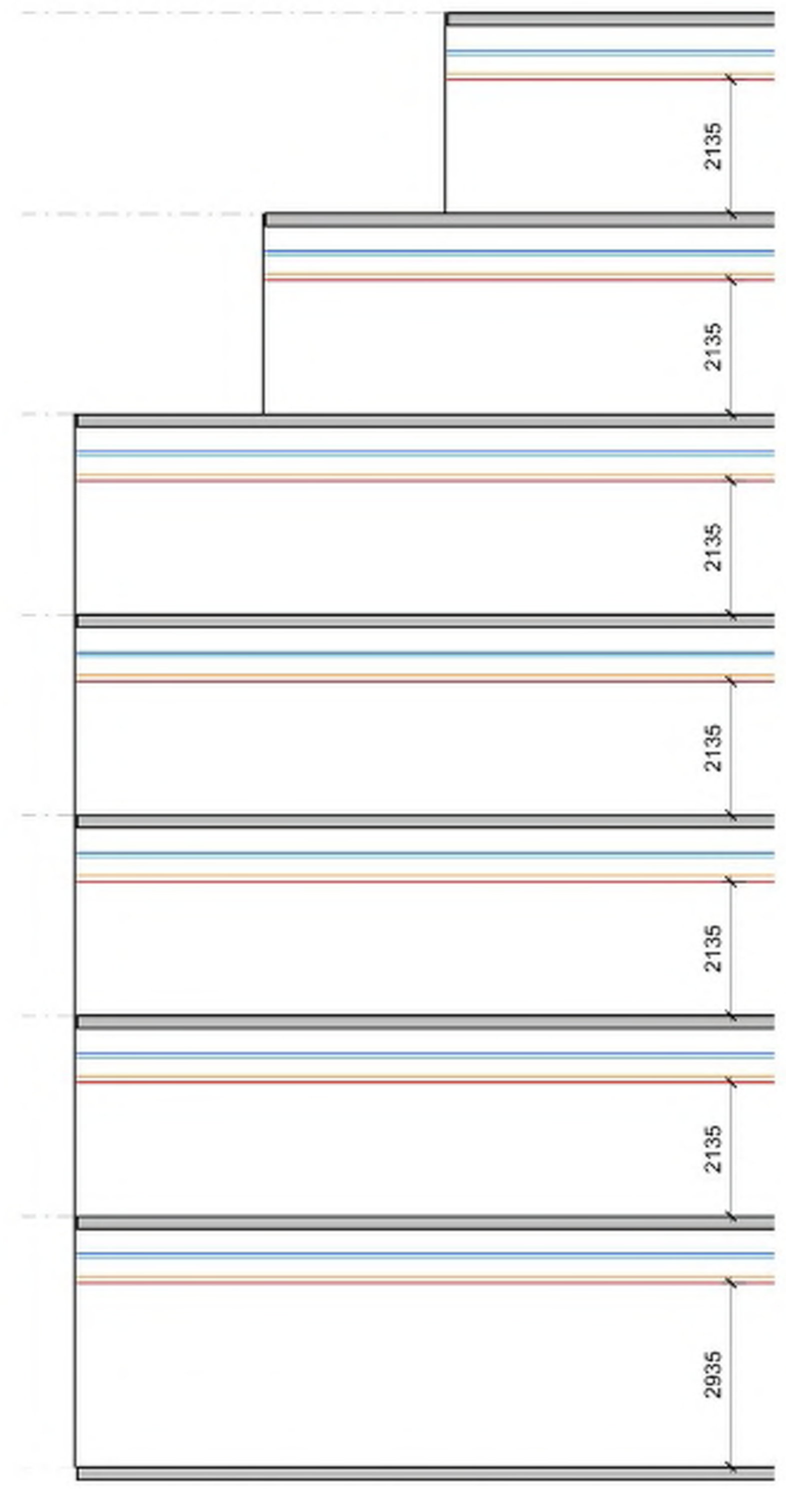
Project tolerances

Every project starts with a vision of simplicity - large volumes of space and no clutter.
But buildings are highly complex machines. In an ideal world, each discipline would have it's own zone of space to work within. But by the time we do this, we have no space left. As architects, our role is to make the engineering acrobatics look effortless. We lead the coordination process, negotiating tolerances and anticipating construction issues to reach a compromise that meets everyone's requirements and expectations.
Currently we are experiencing a shift towards the distribution of air (one of the biggest consumers of space in a building) within the floor void. This transforms the ceiling plane into the clean surface we aspire to, and forces us to question if a suspended ceiling is really required.
Even if the client does select a suspended ceiling, our current specifications utilise the slab as the suspension points - not the beams. So why can't the beams be different depths, widths, or types? And when it comes to columns, there is no architectural reason why they can't differ - especially if choose to celebrate differences and call them architectural features.
At the end of the day, it's just a case of understanding and accommodating the tolerances - something that we are already very adept at doing...

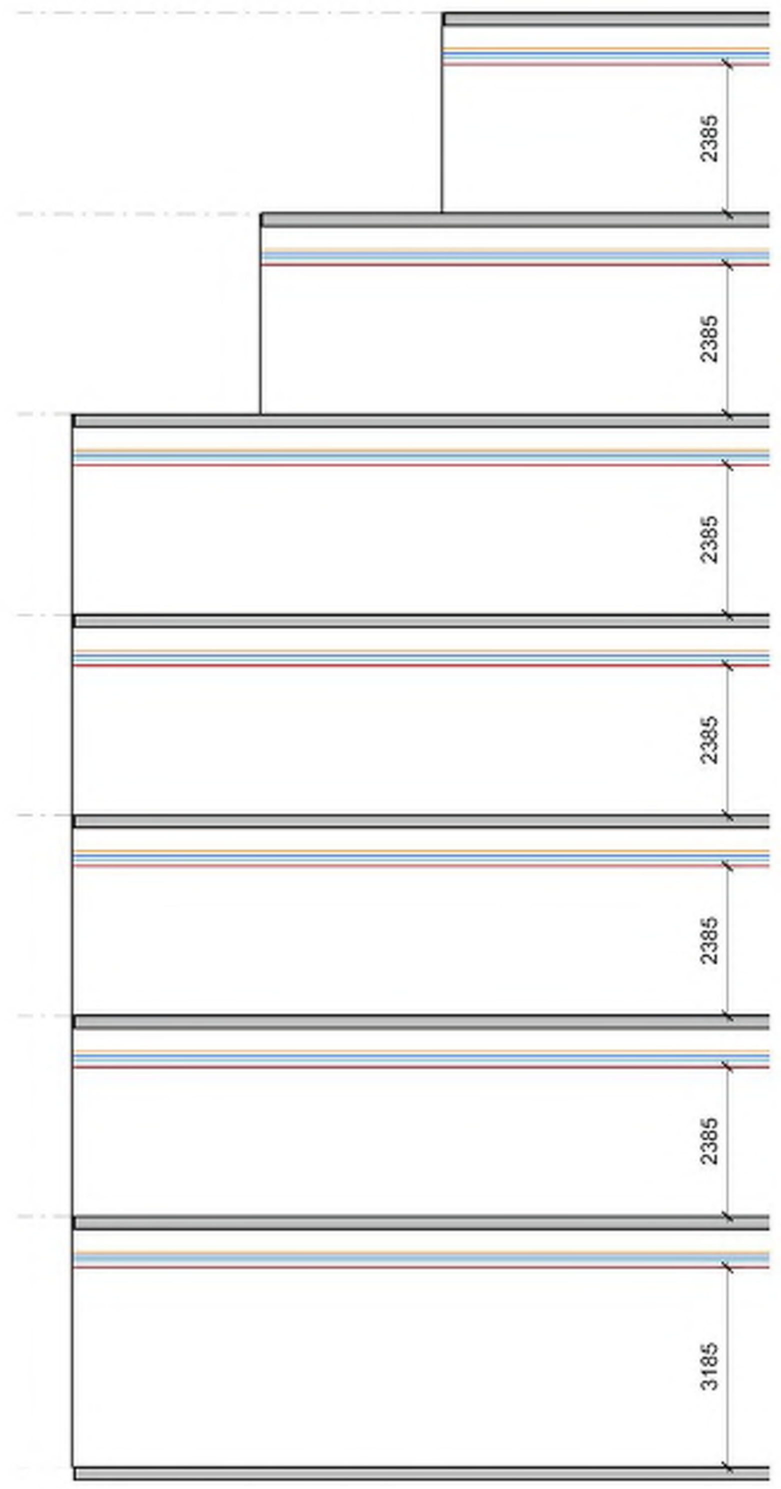




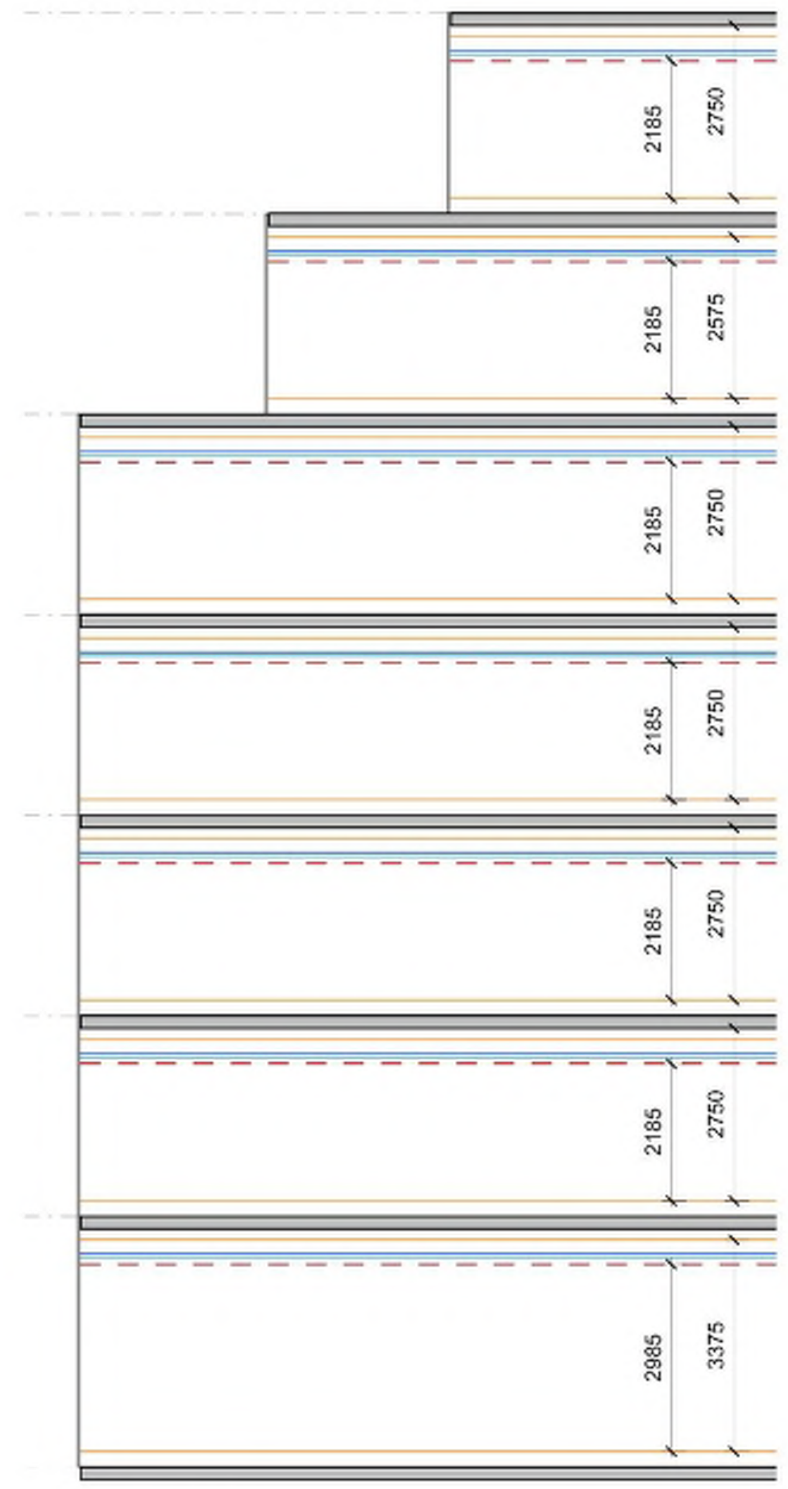
The Client's Dream



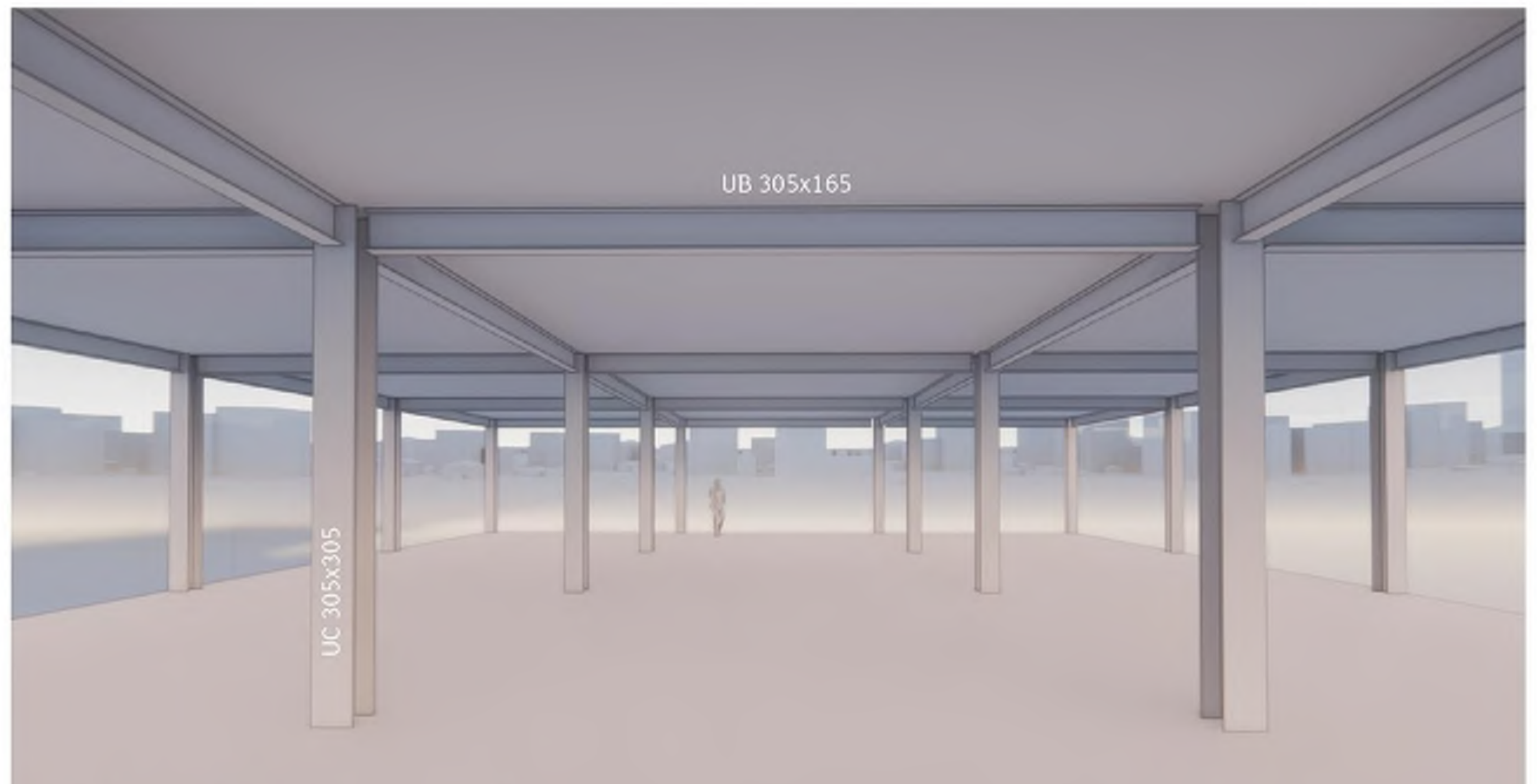
The Engineer's Dream



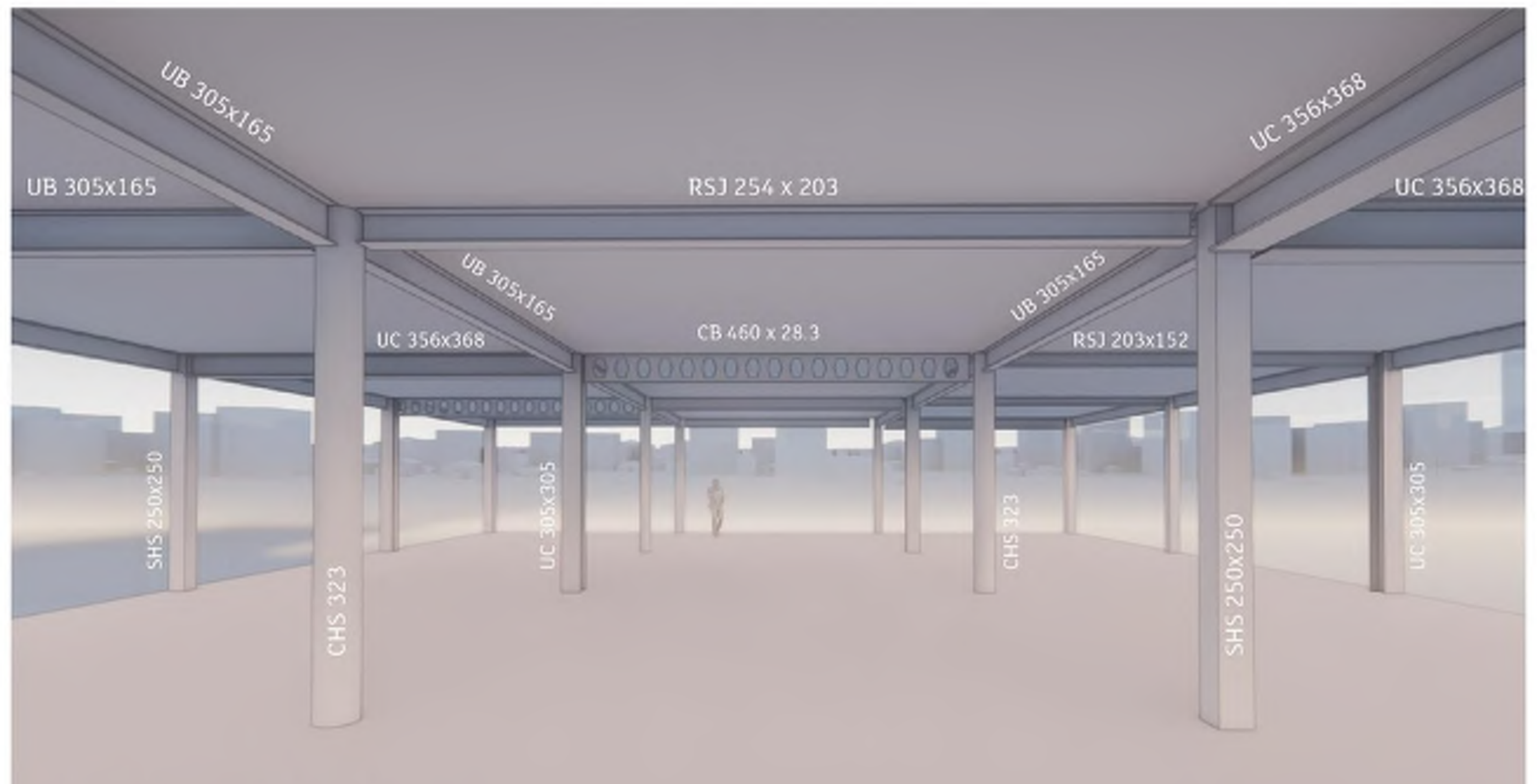
The Compromise



A Vision...



The Present



The Future

The Problem?

ECTC Steel Re-Use

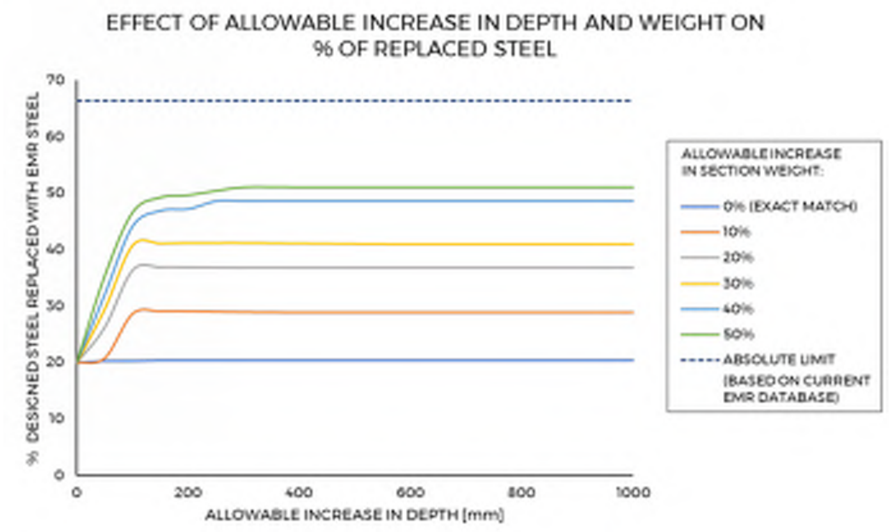
DELANCEY MULTIPLEX WSP UK GBC CIRCULAR STEEL

Working in collaboration with EMR and Multiplex, WSP are looking to use **reclaimed steel sections** for the Elephant & Castle Town Centre development, building E2, E3 and E4 building, (approx. 371t of designed steel).

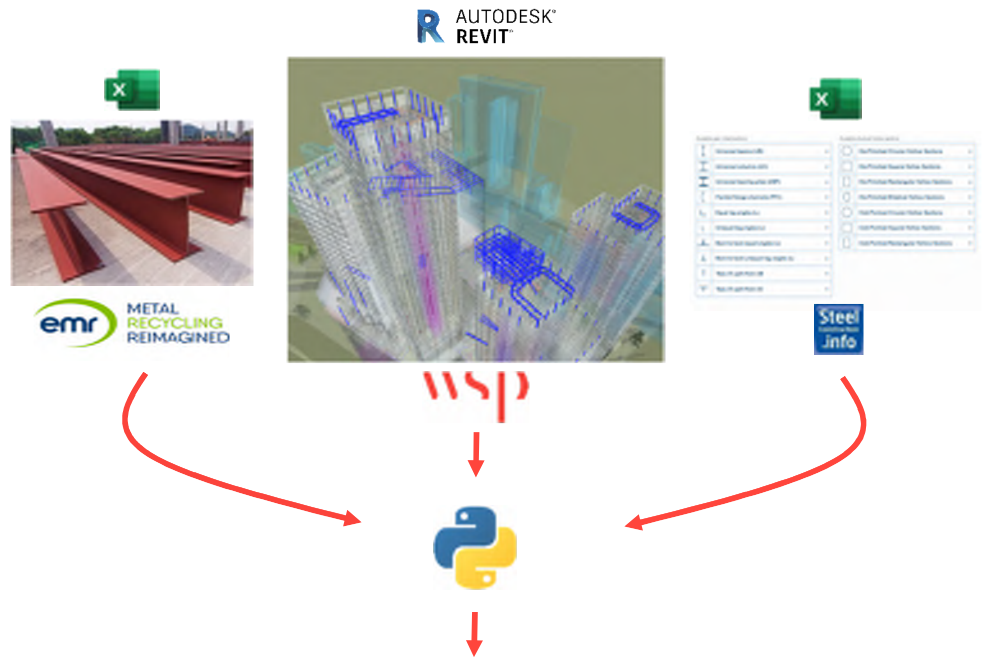
EMR have provided a database of steel sections **available** for re-use.

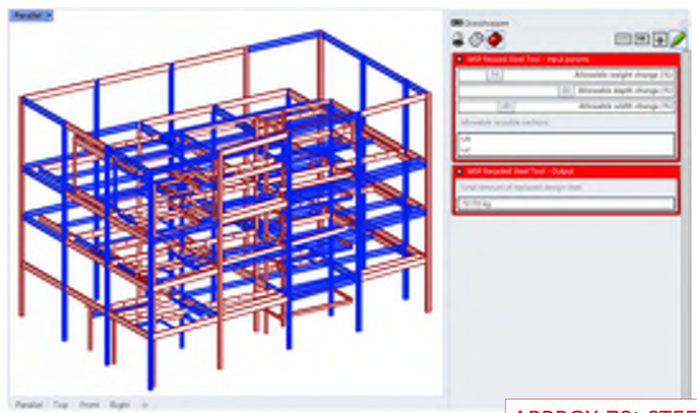
To facilitate the **'matching' process**, we are developing a **digital tool** which uses an optimisation algorithm to replace designed sections with suitable reclaimed sections based on **set parameters** (capacity, depth, weight), **maximising** the amount of reused steel.

Assuming steel re-use stock **availability**, the tool could potentially be used across a number of our projects to **reduce upfront carbon** and the requirement for new resources.



Embodied carbon of reused steel certified by the Carbon trust for EMR is circa 50-60kg/CO2e/t, compared to circa 600 for electric arc & 2000 for blast furnace.





APPROX 70t STEEL REUSED

Future Development:

- Create an option for sections to be 'spliced'
- Integrate tool with Revit model
- Create user friendly interface to maximise usage and engagement with design teams

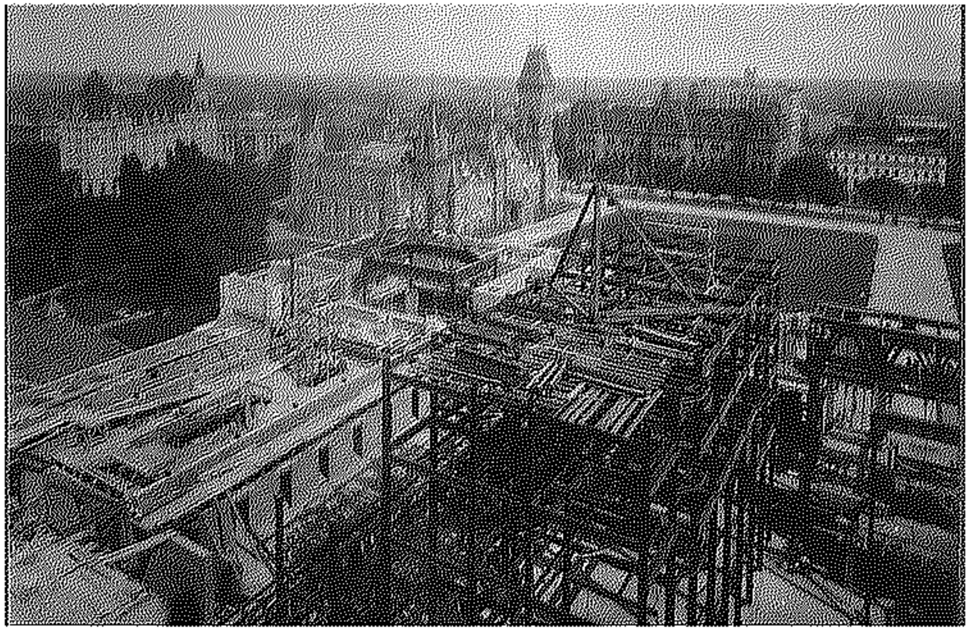
Centre Block, Canadian Parliament Building.

The Centre Block Rehabilitation of the Canadian Parliament Building has identified over 4500 structural steel elements that needed to be removed as part of the extensive renovation works.

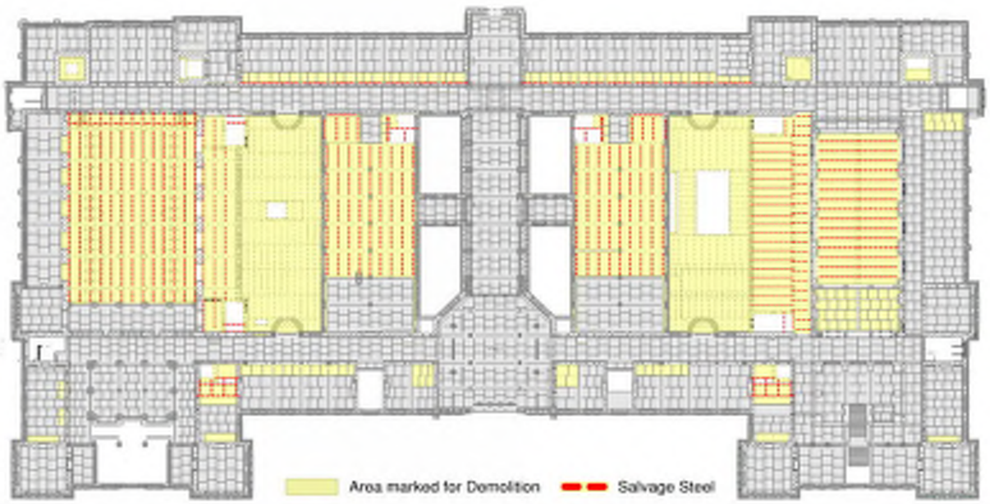
Despite steelwork being made in 1920, WSP specified appropriate testing for strength, plastic deformation and weldability which identified the steel as being suitable for reuse in new build areas of the project.

The current design has identified 1700 elements for reuse within the project, roughly 25% of the new build, with a projected saving of 750tCO2e.

In addition, the remaining elements will be triaged for potential reuse in another redevelopment project within the Parliamentary Precinct, an opportunity to save up to another 800tCO2e.



Centre Block during original construction



Centre Block. Example plan for level 2