

Co-op Live, Manchester

Detailed Design LCA Options Assessment- Stage 4

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Glossary

Term	Definition
LCA	Life Cycle Assessment
BRE	Building Research Establishment
BREEAM	Building Research Establishment Environmental Assessment Method
GWP	Global Warming Potential
AP	Acidification Potential
EP	Eutrophication Potential
ODP	Ozone Depletion Potential
POCP	Photochemical Ozone Creation Potential
NHWD	Non-Hazardous Waste Potential
GIFA	Gross Internal Floor Area

1 Executive Summary

During construction phase, it is recommended when considering the roof build-up that the contractor's and design teams implement the existing design - the outer layer consists of a roofing membrane, rigid thermal insulation, vapour control membrane over a composite in-situ concrete deck. The inner layer is plasterboard surrounded by medium density mineral fibre insulation with a perforated liner system. Incorporating this design will reduce the embodied carbon and other environmental impacts of the building when compared to the alternative design options proposed.

1.1 Methodology

The LCA study provides quantified environmental information to assess the environmental performance of a building over its life (60 years). The impact category outlines This assessment was carried out using an IMPACT (Integrated Material Profile And Costing Tool) compliant software programme; One Click LCA (LCA for BREEAM UK)

In line with BREEAM methodology stages B6, B7 (Operational energy and water) and D (Beyond the system boundary) have been excluded from the assessment.

The impact categories studied are as per the BREEAM NC 2018 requirements:

- Global Warming Potential (GWP): GWP is a measure of how much heat is trapped by a greenhouse gas in the atmosphere. It is calculated in carbon dioxide equivalent. The unit used is kgCO₂e.

1.2 LCA Results

The proposed Stage 4 design has been used as a baseline for the LCA, covering the superstructure but excluding the MEP systems and their replacement along with external areas and site elements. The embodied carbon footprint of Co-op Live over the lifespan of the building (60 years) is 613 kgCO₂e /m² (BREEAM Superstructure Scope, Baseline).

1.3 Superstructure

Three Stage 4 design options for the roof build up have been investigated in this report with an emphasis on quantifying the global warming potential for each option. A summary of the options selected for comparison can be found in the table below.

Table 1 - Superstructure option appraisal during Technical Design

Option	1 - Baseline	2	3
Description	Current design – fully on-site build up	Fully prefabricated cassettes	Hybrid – top part insitu and bottom part prefabricated cassettes
Chosen / Rejected	Chosen	Rejected	Rejected
Total embodied carbon (GWP) (tCO ₂ e)	9,101 tCO ₂ e	9,643 tCO ₂ e	10,192 tCO ₂ e

2 Introduction

The purpose of this Life Cycle Assessment (LCA) study is to measure the environmental impacts of construction materials on the OVG Manchester project. The LCA aims to quantify the life cycle environmental impacts of construction materials of the office building using robust life cycle environmental assessment tools and environmental data. This then allows design decisions to be made to reduce the impacts.

Construction materials can contribute significantly to a building's lifecycle environmental impact. Research has shown that the manufacture of construction materials is the second most significant stage of Green House Gas (GHG) emissions from the entire life cycle of a building, following the operational stage. However as national grid continues to de-carbonise, the embodied carbon of construction materials has an increasing proportion of the of the building's lifecycle environmental impact. The embodied carbon of the building therefore also needs to play a significant role in the design decisions of the development.

A Life Cycle Assessment is a standardised methodology for assessing the environmental impacts of a product or system, which considers its entire life cycle, from raw materials extraction, through product manufacturing, to the use of the product and the end-of-life treatment and disposal.

The LCA study assesses the environmental impacts generated by a product or service during its entire lifetime from the extraction of the raw materials to the use stage and to the end of life and disposal or recycle of any materials, accounting for various significantly different design options over their life cycle. The purpose of this analysis is to understand the life cycle carbon impact of the proposed development and propose recommendations regarding the construction materials in order to reduce the embodied carbon footprint of the development.

In order to account for all associated emissions during the building's whole life cycle, a **Cradle-to-Grave** approach was adopted in this LCA analysis (**Error! Reference source not found.**2.1). This includes Global Warming Potential (GWP) emissions from extraction, factory processing, site delivery, site construction, assembly, maintenance, refurbishment, demolition, waste treatment and disposal. GWP expressed as a carbon dioxide equivalent (CO₂eq) over 100 years is all the greenhouse gases that cause damage to the atmosphere (including carbon dioxide, methane, nitrous oxide etc). This boundary is recommended by the 2012 report of the Royal Institution of Chartered Surveyors (RICS) and BS EN 15978:2011-*Sustainability of construction works, Assessment of environmental performance of buildings*.

This LCA study complies with the BREEAM New Construction 2018 requirements and thus can be used for the pursuit of the design options appraisal credits during the Technical Design Stage for the superstructure. The results of this study can be used by the design team to inform the design and identify opportunities to reduce the proposed buildings' environmental impacts.

In the case of this study the examined product is the building referred as Co-op Live, previously known as Project Bradford and OVG Arena.

The building's Gross Internal Floor Area (GIFA) is 61,082 m². The architectural design is undertaken by Populous, the structural engineering by Buro Happold and the principal contractor on the project is BAM Construction Ltd, who have been brought on board at Stage 4b to develop the detailed design prior to construction.

The LCA study included all the appropriate building elements based on the BREEAM NC 2018 requirements and the building's life expectancy was set to 60 years. The study's scope includes all building components from Table 9.1 Superstructure in the manual: structural frame, external walls, internal walls, external windows, stairs/ramps, roofs and floors. All floor finishes were excluded.

All calculations were performed using One Click LCA tool, which is an IMPACT (Integrated Material Profile And Costing Tool) compliant software programme. The software has been approved by BRE for the options appraisal credits in Mat 01 for BREEAM NC 2018. The assessment was carried out using the OneClick LCA tool. All information needed for this study were directly provided by the design team.

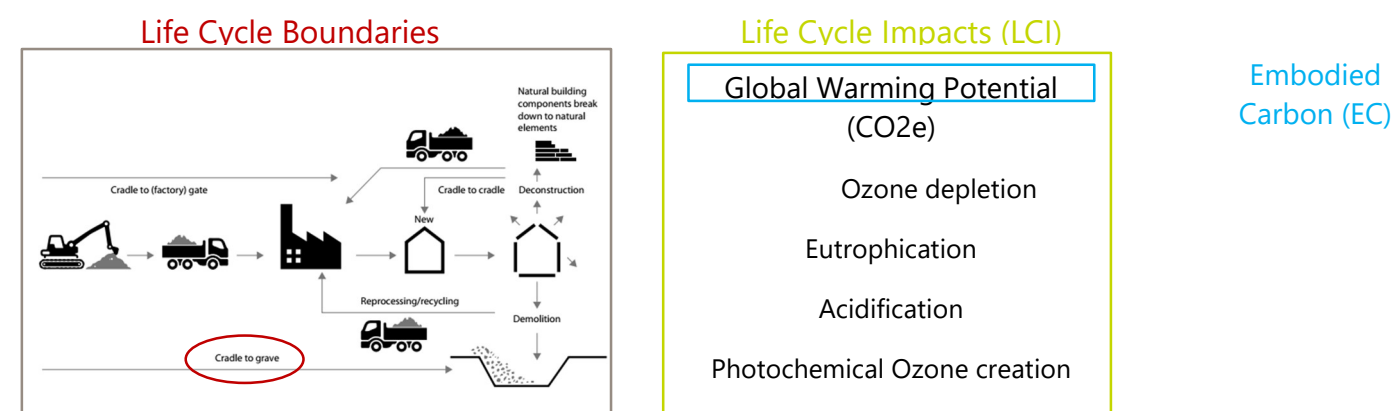


Figure 1 - Life cycle boundaries and impacts, climate change impact considered as embodied carbon.

3 Methodology

3.1 Life Cycle Assessment (LCA) Calculation process

The LCA study provides quantified environmental information to assess the environmental performance of a building over its life. The impact categories studied are as per the BREEAM NC 2018 requirements:

- Global Warming Potential (GWP):** GWP is a measure of how much heat is trapped by a greenhouse gas in the atmosphere. It is calculated in carbon dioxide equivalents. The unit used is kgCO₂e.

In this study, the environmental impacts relate to the proposed development and is based on a 60-year reporting period. Emissions are attributed to four main categories as specified in BS EN 15978:2011, ‘Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method’. The categories are:

Construction process stages (A1 - A5)

These stages consist of:

- a. *Product Manufacture (A1 - A3)*
Carbon emissions generated from extracting the raw materials from the ground, their transport to a point of manufacture and then the primary energy used (and the associated carbon impacts that arise) from transforming the raw materials into construction products.
- b. *Construction (A4 - A5)*
Carbon emissions generated from transporting the construction products to site, and their subsequent processing and assembly into the building.

In Use stages (B1 - B7)

This covers a wide range of sources from the carbon emissions associated with the operation of the building (heating, domestic hot water, cooling, ventilation, lighting, auxiliary energy used for pumps, control and automation), maintenance, repair and replacement over a 60 year assessment period.

B6 & B7 excluded from this Life Cycle Analysis - Operational energy is included as part of the Part L analysis and CIBSE TM54 modelling

End of Life stages (C1 – C4)

The eventual deconstruction and disposal of the existing building at the end of its life takes account of the on-site activities of the deconstruction contractors.

Benefits and loads beyond the system boundary (D)

Module D covers any benefits or burdens accruing from the repurposing of elements discarded from the built asset, or any energy recovered from them beyond the project’s life cycle. (excluded from this Life Cycle Analysis)

This assessment tackles the stages within the scope of the BREEAM Mat 01 credits.

Table 2 - BS EN 15978:2011 Product stages A to C described, as within BREEAM Mat 01 scope.

Product Stage (A1-A3)			Construction Stage (A4-A5)		Use (B1-B7)					End of Life (C1-C4)			
A1: Raw Materials Extraction	A2: Transport	A3: Manufacturing	A4: Transport	A5: Construction & Installation	B1: Use	B2: Maintenance	B3: Repair	B4: Replacement	B5 Refurbishment	C1: De-construction/Demolition	C2: Transport	C3: Waste Processing	C4: Disposal
					B6 & B7: Operational energy and water B6 & B7 excluded from this Life Cycle Analysis Operational energy is also included as part of the Part L analysis								

All data used in OneClick LCA are sourced from various national databases, Environmental Product Declarations (EPDs) and generic materials datasets developed by OneClick LCA. All data used in this analysis conform to the BREEAM certification.

As per BS EN 15978:2011, the following parameters have been considered as part of the analysis;

- Service life (years): how often a material is replaced- this coupled the period of study (set at 60 years for BREEAM Mat 01 analysis) adjusts LCA calculation with service life frequency,
- Site wastage %: how much wastage is produced when installing. Default values have been set by One Click LCA in the database. For example, a 4% wastage is assumed for in-situ concrete, 8% for rockwool insulation and 12.5% for gypsum boards.
- Adjustment factor %: to account for instances where adjustments are required e.g. overlapping roof slates (typical factors have already been set by One Click LCA in the database, i.e. 4% for concrete).
- Transport distance: default transport distances have been used in absence of specific data (these are set in One Click LCA software). The BRE database accounts for transport distances to the factory gate and from the factory gate to the site.
- Construction and installation

3.2 IMPACT (Integrated Material Profile and Costing Tool)

IMPACT is a BRE specification and database for software developers to incorporate into their tools to enable consistent Life Cycle Assessment (LCA) and Life Cycle Costing (LCC). The library in IMPACT compliant tools works by allowing the user to attribute environmental and cost information to scheduled items in the models. The tool multiplies the inserted quantities by the environmental impact and /or cost “rates” to produce an overall impact and cost for the whole (or selected part) of the building.

IMPACT compliant tools allow users to accurately model the life cycle performance of primary structures and substructures, which are not covered by the Green Guide to Specification.

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3.3 Scope

The following table indicates sub-elements that were included or excluded from the scope of the building LCA. Inclusion is necessary to ensure an appropriate level of comparability between assessments. All other sub-elements shall be ignored for the overall building impact reporting for the purposes of the BREEAM LCA (this is in line with the BREEAM NC 2018 scheme).

Table 3 - Elements within and out of scope as per BREEAM 2018 Mat 01 issue.

Element	Sub-element	In scope	Out of scope
Superstructure	Frame	Steel/ concrete frames, concrete casing, metal deck	
	Upper floors	Floors	Balconies and drainage
	Roof	Roof structure, coverings	Roof features and drainage
	Stairs	Stair and ramp structure	Stair or ramp finishes, balustrades and handrails
	External wall	External enclosing above and below ground floor, solar or rain screening	External soffit Subsidiary walls, balustrades, proprietary balconies Facade access or cleaning system
	Windows and external doors	External windows	External doors
	Internal walls and partitions		Walls and partitions, internal doors, balustrades and handrails, moveable room dividers, cubicles
Substructure	Foundations	Concrete foundations and rebar	Ground floor, basement excavation, basement retaining walls
External works			Site clearance, preparatory groundworks Seeding, turfing, planting Fencing, walls, screens, retaining walls, barriers Site or street furniture Ancillary buildings and structures External services and drainage Roads, paths and paving's Specialist surfacing
Internal finishes			Finishes to walls floors, ceiling
Fittings, furnishing and equipment			General fittings and furnishing Equipment
Minor fixings			Brackets, sealants, ironmongery

Adhesives		Excluded if adhesive is applied to less than 20% of the product's surface
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3.4 Study Assumptions and Limitations

3.4.1 Material quantities and generic types

- Material quantities were provided at Stage 4 by BAM Construction Ltd, Buro Happold Structures team and Populous: Architectural Design.

3.4.2 Assumptions and Limitations

- Building life expectancy - The life expectancy of the building has a large impact on the results of the LCA. Buildings with large life spans will have proportionally lower impacts in the construction stages and higher impacts due to operation. Although statistics on building life span are difficult to obtain, the literature that is available leads to the conclusion that redevelopment potential is the largest influence on a building’s service life, rather than the structural integrity. For this study the chosen life span is 60 years as per BRE’s ‘Guidance note GN08: Scope of IMPACT Compliant Tools and Data Submission Requirements’.
- Quantities that make up less than 1% of overall volume were excluded from the assessment. This rule was not applied to Steel due to its carbon intensive nature.
- extracted at this stage are only indicative and subject to change as design evolves- these should not be used in any cost plan.
- Where no exact match of a material was found in the LCA database, a closest match was chosen.
- Secondary steel structure and miscellaneous steel (connections, stability bracing, steel stairs and ladders, steel balustrades) have not been incorporated at this stage.
- Please note that One Click LCA tool does not consider the use stage [B1-B7] except for [B4-B5] Replacement.

4 LCA Results – Embodied Carbon of the Baseline Design

4.1 Embodied Carbon of the Baseline Design

The Stage 4 design has been used as a baseline for the LCA. The Embodied Carbon (GWP) of the proposed Stage 4 baseline (Option 1) design has been calculated through the LCA process. The results can be seen in Table 4-1 and have been broken down by life cycle stage. This includes the activities prior to occupation of the development (modules A1-A5), during its occupation (modules B2-B5) and at the end of its life (modules C1-C4).

Table 4 - Embodied carbon emissions of the Stage 4 design over Life Cycle (60 years) per life cycle stage.

Stage	RICS	Building life cycle stages	tCO ₂ e-building
Materials and Construction Stage	A1-A3	Product Stage - Extraction, Transport, Manufacturing and Fabrication	41662
	A4	Transport to project site	842
	A5	Construction installation process	0
Use Stage	B1	Use	0
	B2-B5	Maintenance, Repair, Replacement, Refurbishment	819
	B6	Operational energy use	N/A
	B7	Operational water use	N/A
End-of-life Stage	C1-C4	De-construction, demolition, Transport, Waste processing, Disposal	1381
Benefits and loads beyond the system boundary	D	Reuse/Recovery/Recycling Potential	N/A
Total			44704

The vast majority of the embodied carbon emissions is attributed to the product stage (modules A1-A3,). Modules A1-A3 focus on the extraction, processing and manufacturing of the materials and therefore the initial selection of the materials is a key factor for reducing the CO₂e emissions of the development.

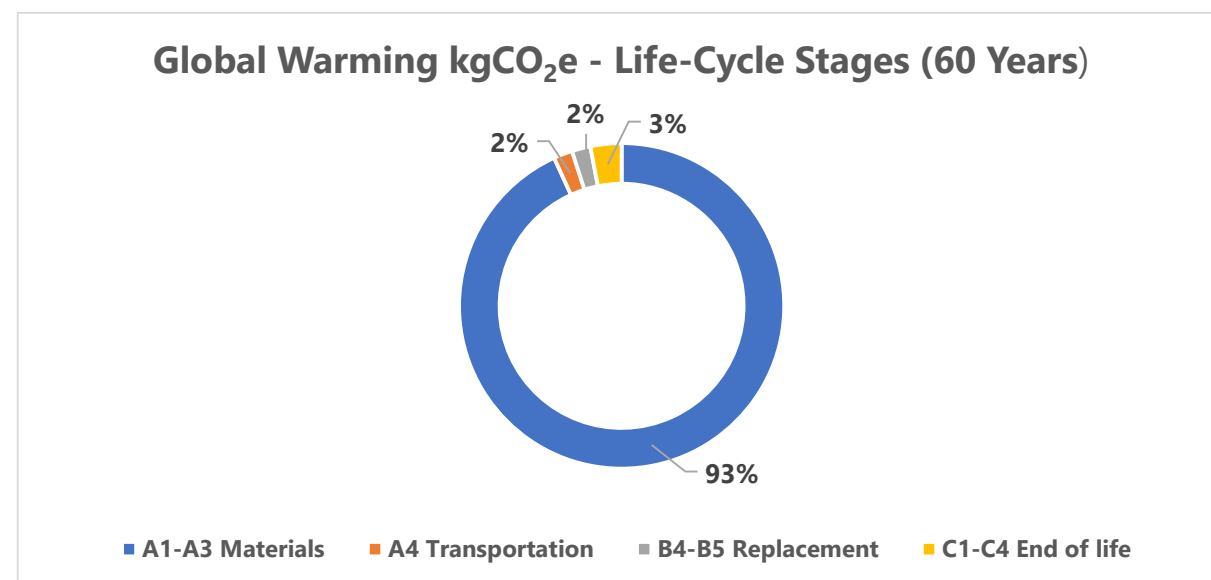


Figure 2 - Baseline Whole Life Carbon emissions over Life Cycle (60 years) per life cycle stage.

Due to project being in its technical design stage and the difficulty of determining the locations, distances and means of transport for each construction material and equipment, OneClick baselines have been used for module A4 (Transport of equipment and materials). This is in accordance with RICS Stage 2 assumptions. Consequently, the 842 tCO₂e emissions which derive from stage A4 is an indicative figure which can be reconsidered at later stages.

Finally, modules B1-B5 cover any emissions relating to the embodied carbon impacts associated with maintenance, repair and replacement of building components over its assumed lifespan (60 years). These stages include the production, transportation to the site and installation of the replacement items and cover any losses during these processes, as well as the carbon associated with component removal and end-of-life treatment.

4.2 High Impact Elements

A number of construction elements have the highest impact on the overall GWP and therefore are responsible for the highest CO₂e emissions of the whole development.

The results demonstrate the material emission shares, with the highest impacts highlighted.

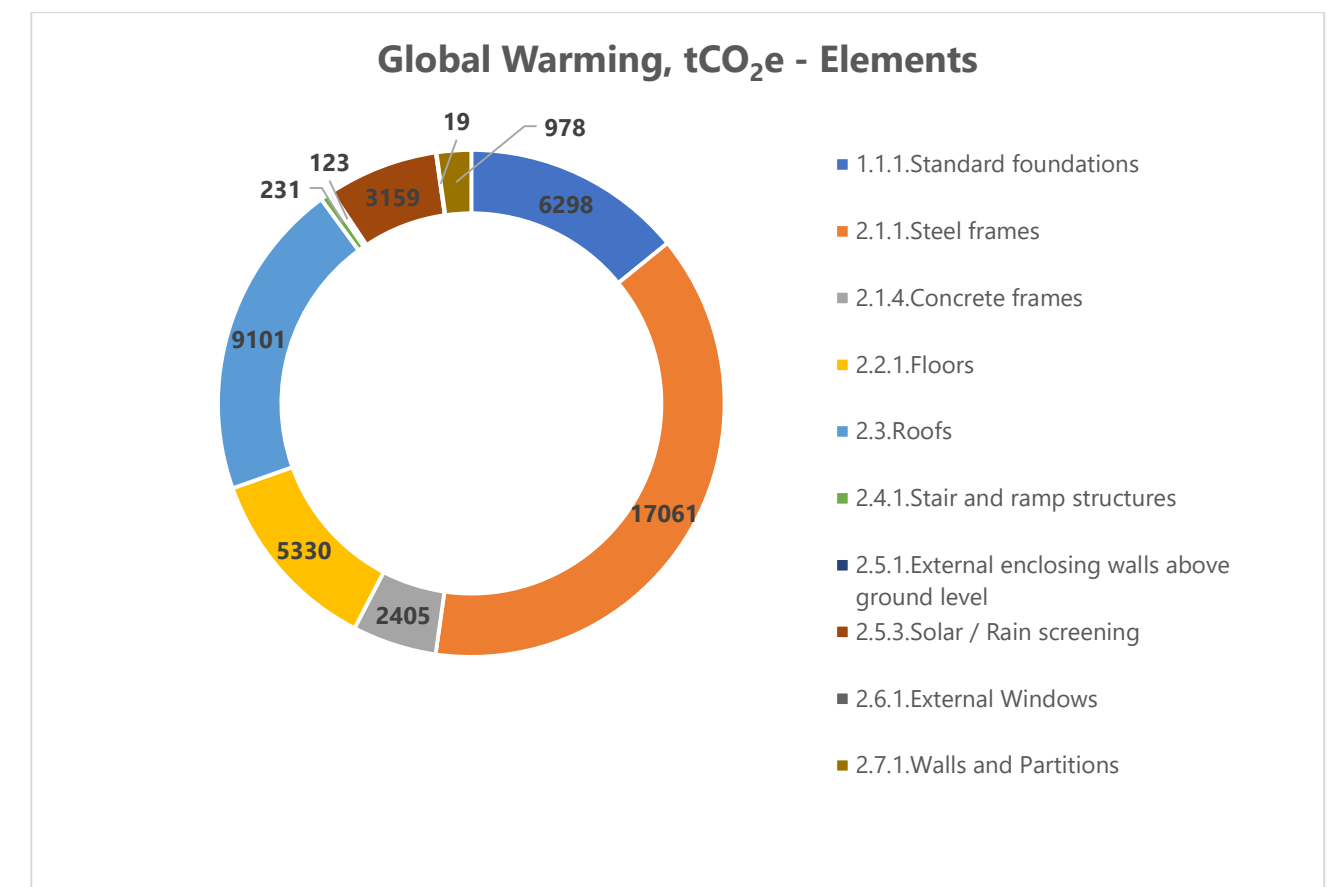


Figure 3 - Construction elements with the highest embodied carbon over the Life Cycle of the building.

The steel frame, roof build up and external enclosing walls have the highest contributions in terms of embodied carbon. Any meaningful reduction in the associated embodied carbon of these elements can be assumed to have a considerable impact on the total embodied carbon for the development.

5 Superstructure

The building’s various superstructure options were assessed separately to provide more detailed and informative results and to comply with the BREEAM 2018 NC Mat 01 requirements. Information has been received from the design team and is based on the information available at this project stage in terms of quantities.

5.1 Options assessed

At Stage 4 three different superstructure options were assessed for the roof build up as outlined below:

- 1. **Option 1** is the baseline design where the outer layer consists of a roofing membrane, rigid thermal insulation, vapour control membrane over a composite in-situ concrete deck. The inner layer is plasterboard surrounded by medium density mineral fibre insulation with a perforated liner system.
- 2. **Option 2** looks to explore a similar design with the main alterations being the use of prefabricated roof cassettes attached to an additional steel frame.
- 3. **Option 3** – this option is a hybrid of the previous two where the inner roof build up is prefabricated and the outer roof build up is constructed in-situ.

The design drawings for all three options are included in Appendix 1.

Table 6 summarises the various superstructure design options assessed and the changes in the main building elements with the LCA scope.

Table 5 - Superstructure options summary

Roof build up - Option 1	Roof build up - Option 2	Roof build up - Option 3
1.5mm Sarnifill membrane	1.5mm galvanised steel liner tray	1.8mm Sarnafil membrane
200mm mineral wool insulation	350mm mineral wool insulation	210mm Sarnafil urethane insulation
Sarnifill membrane	1.5mm Thermo-Purlins	Sarnavap VCL
Composite deck + insitu concrete	22mm Samsox board	110mm concrete slab 40%GGBS
100mm Rockwool insulation panels	Rainwater barrier	22mm Sasmox board
15mm fibre cement boards	1.2mm Sarnifill membrane	100mm mineral wool insulation
100mm Rockwool insulation panels	200mm mineral wool insulation	150mm mineral wool insulation
	1mm steel liner tray	1.5mm Thermo-Purlins
	150mm mineral wool insulation	200mm mineral wool insulation
	100mm mineral wool insulation	1.5mm galvanised steel liner tray

5.2 Results

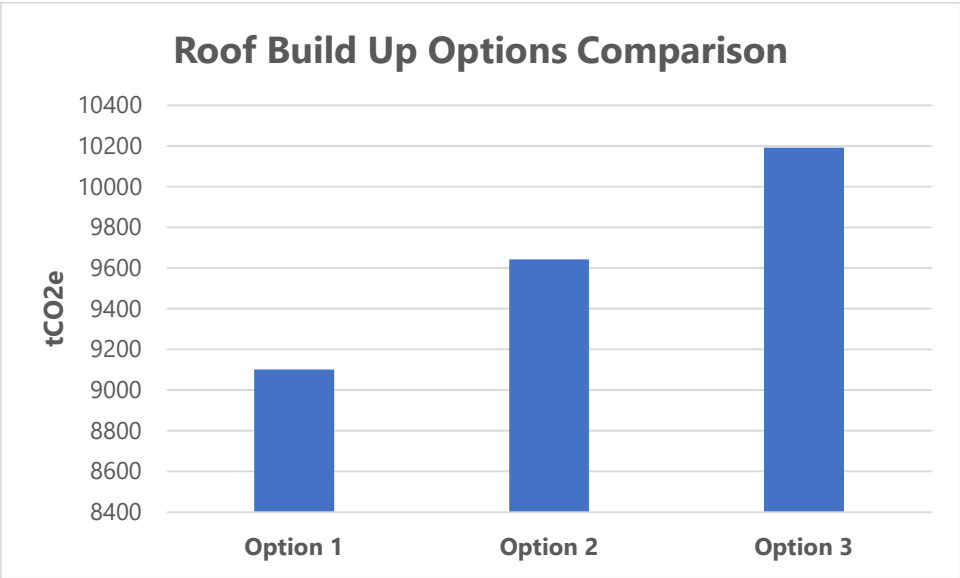


Figure 4 - Comparative superstructure design options

Key points

- Figure 4 compares the three proposed design options for the roof build-up and shows that the original design; Option 1 has the lowest embodied carbon measuring **9,101 tCO2e**.
- Option 2 and option 3 increase the embodied carbon associated with the roof build up measuring **9,643 tCO2e** and **10,192 tCO2e** respectively.

6 BREEAM 2018 Mat 01 Summary

6.1 Mat 01 Credit Breakdown

Up to Seven credits and three exemplary credits, can be achieved under the Mat 01 BREEAM 2018. The aim of these credits is to reduce the burden on the environment from construction products by recognising and encouraging measures to optimise construction product consumption efficiency and the selection of products with a low environmental impact (including embodied carbon), over the life cycle of the building. The credits breakdown is as follows:

Table 6 - Mat 01 Credit breakdown and targeted credits

Mat 01 Credit Breakdown		Credit Requirement	Targeted / Awarded
Superstructure LCA	Up to 6 credits	Stage 2 - Carry out building LCA options appraisal of 2 to 4 significantly different superstructure design options.	Not Targeted
		Stage 4 - Carry out building LCA options appraisal of 2 to 3 significantly different superstructure design options.	2 Credits targeted
Substructure and hard landscaping LCA	1 credit	Stage 2 - Carry out building LCA options appraisal of a combined total of at least six significantly different substructure or hard landscaping design options (at least two shall be substructure and at least two shall be hard landscaping).	Not Targeted
Core building services LCA	1 Exemplary credit	Stage 2 - Carry out building LCA options appraisal of at least 3 significantly different core building services design options.	Not Targeted
LCA and LCC alignment	1 Exemplary credit	Stage 2 and 4 - Integrate the aligned LCA and LCC options appraisal activity within the wider design decision-making process.	Not Targeted
Third party verification	1 Exemplary credit	Stage 2 and 4 - A suitably qualified third party either carries out the building LCA work or verifies the building LCA work	Not Targeted

6.2 Superstructure option appraisal during Concept Design

The superstructure option appraisal during Concept Design has not been undertaken. A RICS compliant Whole Life Carbon Assessment was undertaken for planning purposes only (Environmental Statement Greenhouse Gas Emissions Chapter) to drive the embodied carbon reduction discussions. However, BREEAM-compliant options appraisals did not take place.

6.3 Superstructure option appraisal during Technical Design

The design team established that examining the roof build up options was a good candidate as an area of the design that had potential for further embodied carbon reduction. A meeting and further correspondence occurred to discuss the options in more detail and design drawings were supplied by the Architects.

The roof build-up options were evaluated in terms of life cycle impacts in the various impact categories, aesthetics, constructability, cost and other factors.

A summary of the roof build-up options discussed are outlined below.

Table 2 - Mat 01 BREEAM Option Appraisal and design team reason for decision

Roof build up - Option 1	Roof build up - Option 2	Roof build up - Option 3
1.5mm Sarnifill membrane	1.5mm galvanised steel liner tray	1.8mm Sarnafil membrane
200mm mineral wool insulation	350mm mineral wool insulation	210mm Sarnafil urethane insulation
Sarnifill membrane	1.5mm Thermo-Purlins	Sarnavap VCL
Composite deck + insitu concrete	22mm Samsox board	110mm concrete slab 40%GGBS
100mm Rockwool insulation panels	Rainwater barrier	22mm Sasmox board
15mm fibre cement boards	1.2mm Sarnifill membrane	100mm mineral wool insulation
100mm Rockwool insulation panels	200mm mineral wool insulation	150mm mineral wool insulation
	1mm steel liner tray	1.5mm Thermo-Purlins
	150mm mineral wool insulation	200mm mineral wool insulation
	100mm mineral wool insulation	1.5mm galvanised steel liner tray
CHOSEN – Lowest GWP	REJECTED – GWP too high	REJECTED – GWP too high
9,101 tCO2e	9,643 tCO2e	10,192 tCO2e

Regarding the superstructure the following opportunities to reduce emissions were discussed:

- Option 1 is the baseline design where the outer layer consists of a roofing membrane, rigid thermal insulation, vapour control membrane over a composite in-situ concrete deck. The inner layer is plasterboard surrounded by medium density mineral fibre insulation with a perforated liner system.
- Option 2 looks to explore a similar design with the main alterations being the use of prefabricated roof cassettes attached to an additional steel frame.
- Option 3 – this option is a hybrid of the previous two where the inner roof build up is prefabricated and the outer roof build up is constructed in-situ.

It was determined that neither of the alternative options for the roof build-up performed better than the original design in terms of embodied carbon. It has therefor been recommended that the design team stick with the original design.

6.4 BREEAM NC 2018 Mat 01/02 Submission Tool

Two credits can be awarded under BREEAM Mat 01. A copy of the Mat 01/02 submission tool can be found in Appendix 2.

6.5 Next Steps

Further opportunities for reducing the environmental impact of the building will be taken on within procurement and the construction phase.

7 Conclusion

An LCA options appraisal was undertaken during Stage 4 Technical Design for the Co-op Live project. This study was used to provide feedback to the design team to inform the decision-making process and provide valuable insights to help the design team to further reduce the embodied life cycle impact of the project. All LCAs undertaken, comply with the BREEAM NC 2018 requirements and the results will be submitted to the BRE via the Mat01 tool in pursuit of the Mat01 credits available at this design stage.

The proposed Stage 4 design has been used as a baseline for the LCA, covering the sub-/super-structure and hard landscaping (but excluding the MEP systems and their replacement). The embodied carbon footprint of Co-op Live over the lifespan of the building (60 years) is 613 kgCO₂e /m² (BREEAM Superstructure Scope, Baseline).

Regarding the findings of the Stage 4 options’ LCA studies for the following conclusions were made:

7.1 Superstructure – Roof Build-up

The optioneering discussed in this LCA report was aimed at evaluating the embodied carbon of three different roof build-up options for Co-op Live. The roof was selected as it is responsible for a large proportion of the embodied carbon and still had realistic capacity to change at Stage 4 design.

From the data it has been established that the original design performed best in terms of embodied carbon. Therefore, we recommend sticking with the original design rather than implementing either of the two alternative designs.

7.2 Selected options

A design team meeting to discuss these results was held where it was decided that roof build-up Option 1 will be further developed at the next stages.

Table 2 - Superstructure option appraisal during Technical Design

Roof build up - Option 1	Roof build up - Option 2	Roof build up - Option 3
1.5mm Sarnifill membrane	1.5mm galvanised steel liner tray	1.8mm Sarnafil membrane
200mm mineral wool insulation	350mm mineral wool insulation	210mm Sarnafil urethane insulation
Sarnifill membrane	1.5mm Thermo-Purlins	Sarnavap VCL
Composite deck + insitu concrete	22mm Samsox board	110mm concrete slab 40%GGBS
100mm Rockwool insulation panels	Rainwater barrier	22mm Sasmox board
15mm fibre cement boards	1.2mm Sarnifill membrane	100mm mineral wool insulation
100mm Rockwool insulation panels	200mm mineral wool insulation	150mm mineral wool insulation
	1mm steel liner tray	1.5mm Thermo-Purlins
	150mm mineral wool insulation	200mm mineral wool insulation
	100mm mineral wool insulation	1.5mm galvanised steel liner tray
CHOSEN – Lowest GWP	REJECTED – GWP too high	REJECTED – GWP too high
9,101 tCO ₂ e	9,643 tCO ₂ e	10,192 tCO ₂ e

7.3 BREEAM Mat 01

Two credits can be awarded under BREEAM Mat 01. A copy of the Mat 01/02 submission tool can be found in Appendix 2.

8 Information Sources

The material quantities were provided by the design team based on other design documents. More specifically:

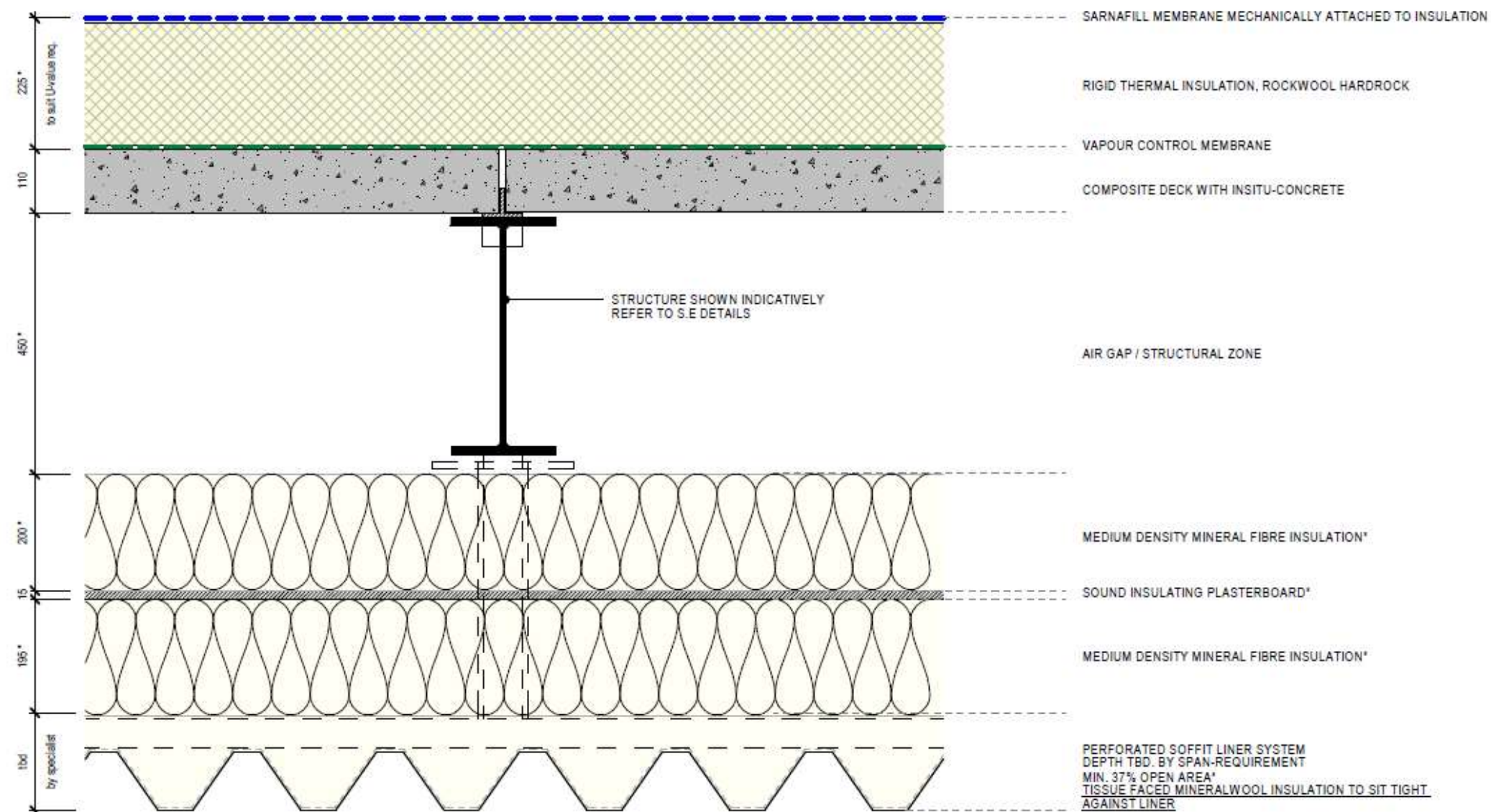
- Material quantities were provided at Stage 4 by BAM Construction Ltd, Buro Happold Structures team and Populous: Architectural Design.
- Populous: Architectural Design (Architect) provided the Stage 4 roof options build-up. See email from Bianca Binder dated 17.03.21 with the following attachments:
 - POP-BRA- Traditional roof proposal - Option 1
 - BRA-PRA-ZZ-01-DR-Y-21005 - Opt.2 - fully prefab
 - BRA-PRA-ZZ-RF-DR-27006 - Opt. 3 - hybrid
- BAM Construction Ltd (Principal contractor) provided the roof area to which the above optioneering was based on. See email from Alan White dated 12.12.21 with the following attachment:
 - BRA-POP-XX-RF-DR-A-5000 - Roof area mark-up

The analysis has been performed relying on the following data sources for building information:

Data type	Data source
Material quantities (A1-A3)	Contractors and design team
Material transport distances (A4)	Regionally applicable transportation scenarios from One Click LCA. Those represent regionally typical transportation distances and methods for product types, which are relevant when no decisions on suppliers are made.
Construction and installation (A5)	Impacts are based on conservative default values from One Click LCA. or on the estimated utility consumption for the site.
Material impacts in use (B1-B5)	Material service lives are based on the typical values for the materials in question, which have been reviewed for relevance for the project. The values have been adjusted where necessary. Material maintenance and repair activities have not been included in the scope; materials have been assumed to be replaced in their entirety at the end of their service life.
End of life impacts (C1-C4)	End of life impacts are based on One Click LCA's scenarios which represent the typical end of life processing for material types in compliance with the requirements of the EN 15804+A1.

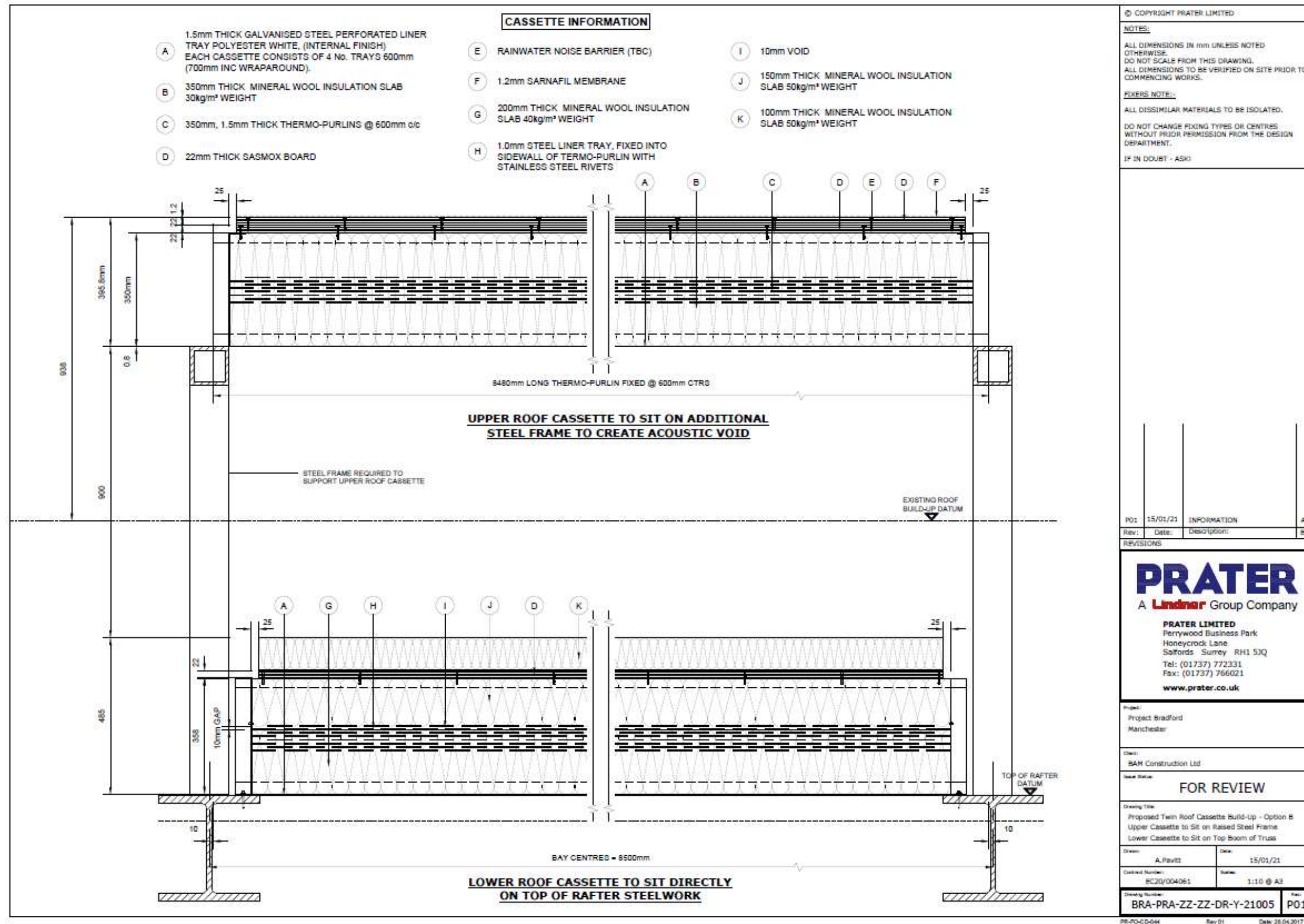
9 Appendix 1 – Design Drawings

9.1 Option 1 – Fully on-site build up

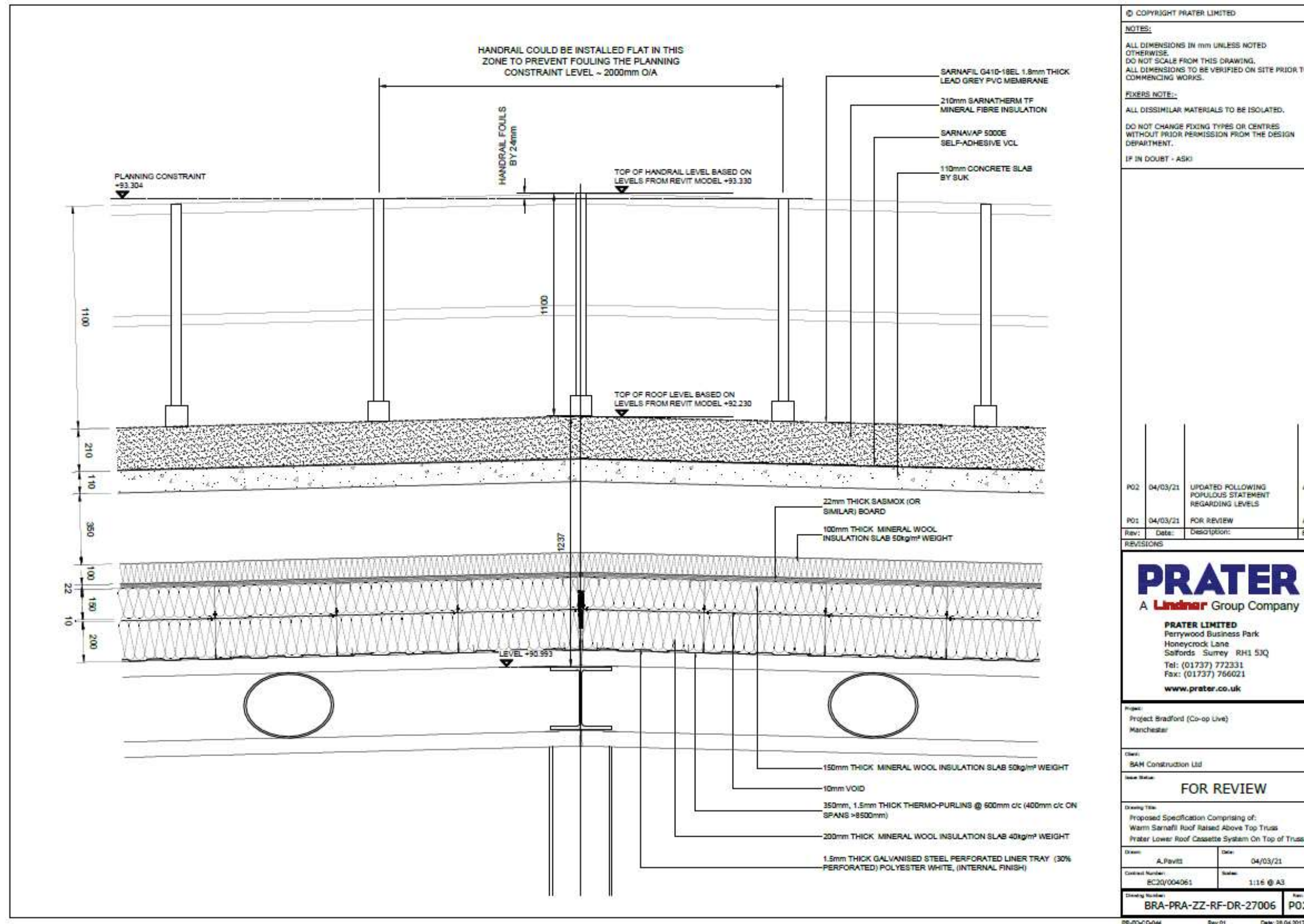


POPULOUS STAGE 4A -
ROOF BUILD-UP
TRADITIONAL PROPOSAL
(ALL INSITU)

9.2 Option 2 – Fully prefabricated cassettes



9.3 Option 3 – Hybrid design, top section insitu and bottom section prefabricated cassettes



10 Appendix 2 – BREEAM NC 2018 Mat 01/02 Submission Tool

BREEAM UK NC (2018) Mat 01/02 Results Submission Tool

BREEAM[®] UK

delivered by bre

[Concept Design Sheet](#)[MAT 02 EPD schedule sheet](#)

Building LCA during **Technical Design**

Assessment details

BREEAM assessment building use type (selected on the Concept Design sheet for both Concept Design and Technical Design stages)

Assembly and leisure

Is the project part new-build, part refurbishment OR defined as a BREEAM 'Simple Building'?

No

Functional quantity 1 during Technical Design (m2 net internal area):

61082

Functional quantity 2 during Technical Design (n/a (no value required)):

Has comparison with the BREEAM benchmark during Technical Design been done? Select tool used or leave blank.

Tools

Has superstructure option appraisal during Technical Design been done?

Yes

Tool to use for options appraisal during Technical Design:

ToolsOne Click LCA (LCA for BREEAM UK)

Range of indicators provided by tool:

CO2e AND other environmental categories.

Recognised by BREEAM for superstructure options appraisal at this stage

Yes

Environmental impact indicator used for comparisons:

Kg CO2e

Superstructure - Comparison with the BREEAM benchmark

Comparison with the benchmark not done. This section n/a. A blank 'Mat01_DD_SuperS_B' data file shall be saved in the same folder as this file.

Design option		Option data file link	m2 net internal area	BRE EN ecopoints/m2 net internal area (60 year study period)							
ID	Name			2.1 Frame	2.2 Upper floors	2.3 Roof	2.4 Stairs and ramps	2.5 External walls	2.6 Windows and external	2.7 Internal walls and	Total

Result from tool (BRE EN ecopoints / m2 NIA):

Benchmark value for this building type (BRE EN ecopoints / m2 NIA):

Percentage better than benchmark:

Credits awarded:

Superstructure - Options appraisal summary table

Complete rows 'ID 14' and 'ID 15' or more (according to the number of options done) in the following table base on option data files from the 'One Click LCA (LCA for BREEAM UK)' tool. The completed data files shall be saved in the same folder as this file.

Design option		Option data file link	m2 net internal area	Kg CO2e/m2 net internal area (60 year study period)								Description of changes sheet link	Option chosen, and summary reasons for not choosing the other options (Further details provided in description of change sheets)	The following is completed for this option:- - The option data file - The Description of changes sheet
ID	Name			2.1 Frame	2.2 Upper floors	2.3 Roof	2.4 Stairs and ramps	2.5 External walls	2.6 Windows and external	2.7 Internal walls and	Total			
	Concept Design option results													
14	Mat01_DD_SuperS_Opt1	Link	61082	318.69	87.26	148.99	3.79	53.73	0.31	Not in scope	612.76	N/A - 1st option	CHOSEN OPTION	Yes
15	Mat01_DD_SuperS_Opt2	Link	61082	318.69	87.26	157.87	3.79	53.73	0.31	Not in scope	621.65	Link	Life cycle costs too high	Yes
16	Mat01_DD_SuperS_Opt3	Link	61082	318.69	88.96	166.86	3.79	53.73	0.31	Not in scope	632.33	Link	Life cycle costs too high	Yes

Technical Design option ID chosen ('CHOSEN OPTION' selected):

14

Question n/a - leave blank.

Options appraised

3

Credits awarded

2.00

Technical Design (final) results

Total credit score at Technical Design (Final)

2

Submission of the BREEAM MAT 01/02 Results Submission Tool to BREEAM by the end of Technical Design

Confirm the following (which comprise the BREEAM Mat 01/02 Results Submission Tool) are included and that the submission method is understood:-

This file.

Yes

The 'Mat01_DD_SuperS_B.xlsx' data file and all the associated option data files (including files that are not used).

Yes

The method for submission to BREEAM is to upload to BREEAM Projects. It may not be checked by BREEAM (unless and until the assessment undergoes QA).

Yes

Date the above sent to BREEAM during Technical Design:

18/12/2021

Co-op Live, Manchester
Detailed Design LCA Options Assessment- Stage 4
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12 January 2022
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