Where is the plastic and how do we reduce it? A case study of Millers Quay in Wirral Waters

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December 2023

Project funded by Peel Waters

Why is it important for us to identify plastic in buildings?

There is now a consensus that plastic pollution poses a significant threat to many different forms of life. Given its durability and resistance to degradation, these plastic-based materials pose a long-term threat to the ecological balance in different natural environments.

If we look at the amounts of plastic produced and the sectors consuming this plastic, we find that the construction industry is the second largest consumer of plastic product in the UK after the retail sector. Whilst the retail sector has begun to identify sources of plastic and to reduce plastic consumption, such measures are lacking in the construction industry.

Since 2018, Changing Streams CIC has been working closely with the construction industry to identify barriers to plastic reduction. Through this engagement, Changing Streams has identified industry leaders committed to this agenda.

If we are to make this transition, we must start by understanding how much plastic we use in the buildings we design and construct. Ideally, we would be able to identify the weight of plastic used in a building for each square metre of built space calculated as gross external area. We can imagine that such data could be used to compare buildings in a fair and equitable way. It would also provide us with the basis for establishing benchmarks, best practice, and regulations.

But, whilst we know that buildings contain a significant amount of plastic, at present there are no tools or mechanisms to help us make these kinds of assessment. There are two important reasons why this is the case.

The first lies in our ability to access specifications and detailed drawings for live projects in the detailed design, contract and construction phases. For the most part, this data is not publicly accessible. In cases where this data is made available, much of the information needed to form a detailed qualitative and quantitative assessment is missing. This is often owing to the way projects are procured. In many projects, a full NBS specification and complete Bill of Quantities is not produced at the contract stage. Some of this information is produced as the building is procured and by a range of designers including architects and sub-contractors. This means that real-world building projects can only provide us with some of the information we would need to audit plastic use.

The second limitation lies in our ability to obtain information about the products specified. Even if we had a detailed specification and a Bill of Quantities, we would be unable to quantify the amount of plastic used in these products. There are currently two sources of information we could use for this purpose. The first are Environmental Product Declarations. These documents are focused on embodied carbon, and product lifecycles. EPDs have been fundamental to the progress made in assessing embodied carbon. But for those of us interested in ‘embodied plastic’, these EPDs are not sufficiently detailed to accurately calculate plastic content. Product data sheets offer us a second source of information. These data sheets provide us with important insight into the complete range of materials needed to install a given product. But they rarely tell us what these are made of or the quantities of materials used. These two kinds of document (EPDs and Data sheets) provide us, therefore. with a partial insight into plastic content.

Executive Summary:

Where is the Plastic and How Do We Reduce It?

The problem

It is difficult not to notice the growing concern about plastic pollution. We now know that plastic pollution poses a significant threat to many different forms of life. The unique characteristics of plastic that have made it so appealing to us – its durability and resistance to degradation - are now posing a long-term threat to the ecological balance in different natural environments.

If we look across all main sectors in the UK, we find that the construction industry is the second largest consumer of plastic products after the retail sector. The construction industry in the UK generates a staggering 50,000 tons of plastic packaging waste annually. Alarmingly, if current trends persist, plastic pollution in construction could triple by 2060, surpassing 1.1 billion tons of waste. But there is an important difference between these two sectors. Whilst the retail sector has started to focus efforts on identifying and reducing plastic consumption, such measures are lacking in the construction industry.

The problem is that we have no real idea how much plastic goes into the buildings that surround us; the buildings we might call 'home'. Until we can assess these buildings, we cannot work out how to improve them.

Addressing the problem

In June 2021, Dr. Gareth Abrahams, from the Changing Streams Research Centre at the University of Liverpool, undertook a ground-breaking case study at Millers Quay within the Wirral Waters development to conduct the first comprehensive plastic audit of a new-build residential scheme. The objective was to identify the extent of plastic usage, explore opportunities for reduction, and propose actionable measures to mitigate plastic's environmental impact.

Millers Quay is located within the Wirral Waters regeneration project and is already one of the most ambitious and innovative projects in the North-West. The project team's decision to focus on Millers Quay was about pushing this innovation even further; much further than had been planned at its inception.

This audit focused on the kinds of information produced for a typical project at the detailed design stage. These included outline specifications and detailed drawings. To undertake the audit the research followed three simple stages. The first stage was to identify all plastic-based products in the scheme. The second stage was to assess the amount of plastic they introduced into the scheme. To make this as fair as possible it was important not to only consider the amount of plastic in a single product but also consider the number of products in the scheme. This information was then used to position these products in a scale.

This scalar review of plastic formed the basis for a third step, which considered whether it was possible to swap high plastic products for other, plastic free or plastic reduced alternatives. If swap outs were not possible, then the research explored and documented the barriers to such changes and opportunities to develop or test products for this purpose.

Key Findings

The comprehensive plastic audit at Millers Quay unveiled critical insights into the distribution and usage of plastic within the development. The initial specifications revealed a discrepancy, with interior finishes heavily reliant on plastic-based products compared to the exterior envelope. Three primary categories emerged as significant contributors to plastic consumption: membranes, insulation, and surface finishes. While surface finishes presented opportunities for relatively straightforward substitutions with plastic-reduced alternatives, membranes were found to be more challenging owing to limited alternatives and their integral position within architectural detailing.

Some of the most notable swap-outs identified include exchanging modern artificial resin paint for mineral paint, nylon carpets for natural wool or seagrass carpets. The study also identified opportunities to exchange load bearing phenolic or polyisocyanurate insulations below the floor screed for cellular glass insulation, and to exchange a plastic sheet vapour control and airtightness membrane for rigid OSB board. The study showed that these swap outs offered other advantages. In some instances, these alternative specifications would provide greater robustness during construction and ease of installation / build-ability and opportunities to remove other design risks such as cold bridging.

Recommendations:

Based on the findings, several actionable recommendations are proposed to address plastic reduction in construction:

- Implement measures to identify and specify plastic-reduced alternatives across all design aspects, with particular emphasis on interior finishes.
- Extend the plastic audit methodology to assess plastic usage in all schemes within Wirral Waters, integrating findings into the design process and RIBA stage completion reports.
- Establish a comprehensive plastic reduction approach throughout the construction supply chain, considering factors such as transportation impact and plastic packaging.

Next Steps and Considerations:

To facilitate effective implementation and further research, the following steps and considerations are suggested:

- Develop a comprehensive communication strategy to disseminate the report findings among stakeholders, fostering collaboration and awareness.
- Explore the broader context of plastic reduction in construction, including legislative change and improving the way product data is recorded in Environmental Product Declarations (EPDs).
- Investigate the feasibility of developing standardised metrics for quantifying plastic content in buildings, facilitating comparisons and informing design decisions.
- Conduct in-depth research into the cost implications of plastic reduction strategies, examining trade-offs between plastic reduction, carbon reduction, and operational energy efficiency.

Conclusion:

The plastic audit at Millers Quay underscores the urgent need for concerted action to reduce plastic consumption in construction. By implementing the recommended measures and embracing a holistic approach to plastic reduction, developers can play a pivotal role in mitigating environmental harm while enhancing project sustainability and resilience. Addressing plastic pollution in construction is not only a moral imperative but also a strategic imperative for future-proofing the industry against escalating environmental challenges.

The aim of this study

The overall aim of this study is to work within these limitations to:

Establish the first plastic audit of a complex, real-world, new-build residential scheme

Given these limitations and the novelty of the approach, this study is offered as a pilot for subsequent studies to develop in greater depth and accuracy. With this in mind, this study will seek to achieve the following objectives:

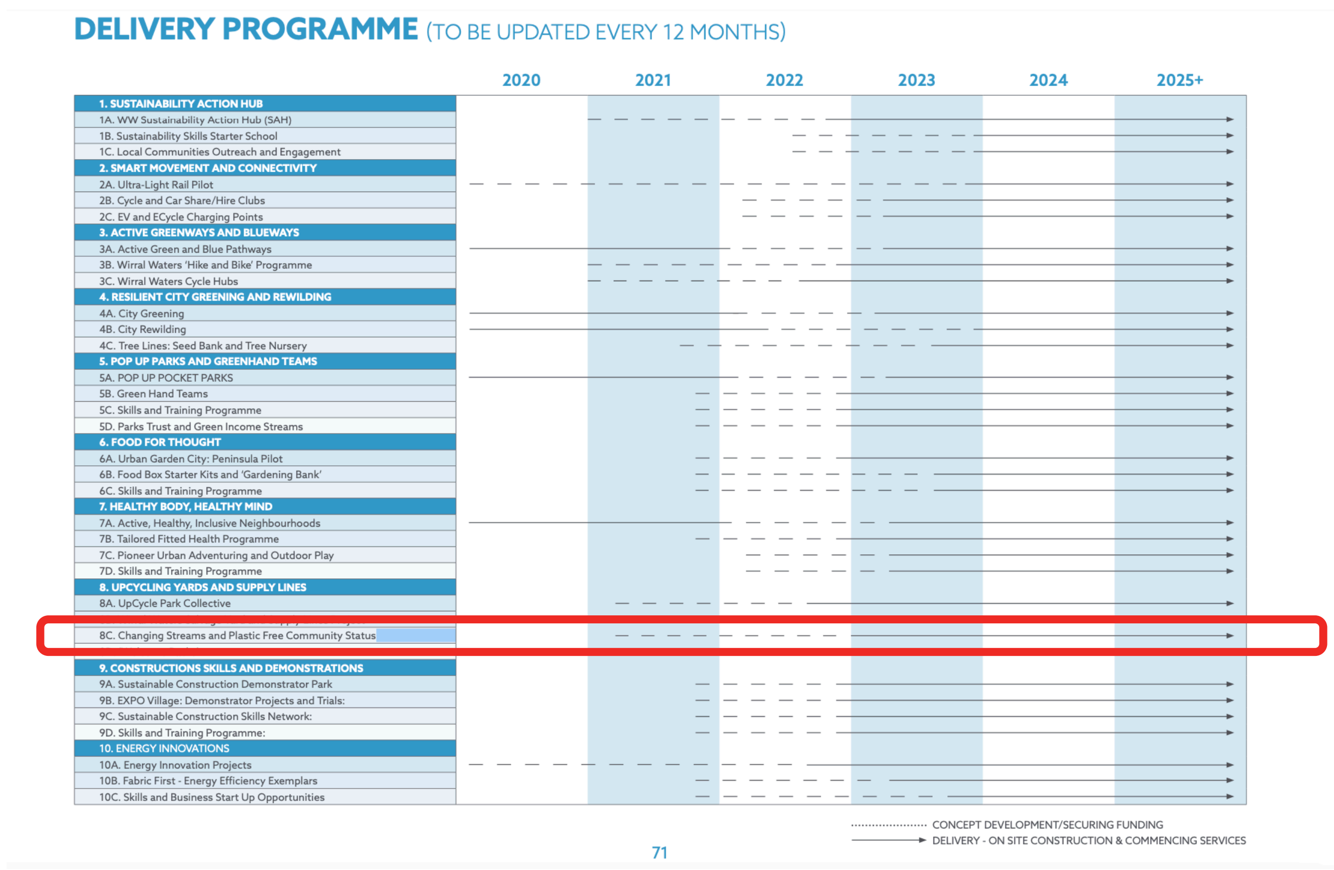
(i) To identify areas of plastic reduction specific to the project

(ii) To identify opportunities to reduce plastic in other projects

(iii) To identify opportunities for future research into specific design details and more general product development

(iv) To establish a set of principles and an outline methodology for auditing other schemes.

MILLERS QUAY : A CASE STUDY



Why Millers Quay?

Representative:

Millers Quay is a unique design in a unique setting. But in terms of the size and scale of the design, and the procurement method used in it construction, Millers Quay is a good representation of most large residential schemes in the UK. This means that some of the general lessons drawn from this study should be transferable to other schemes in a local, national or international setting.

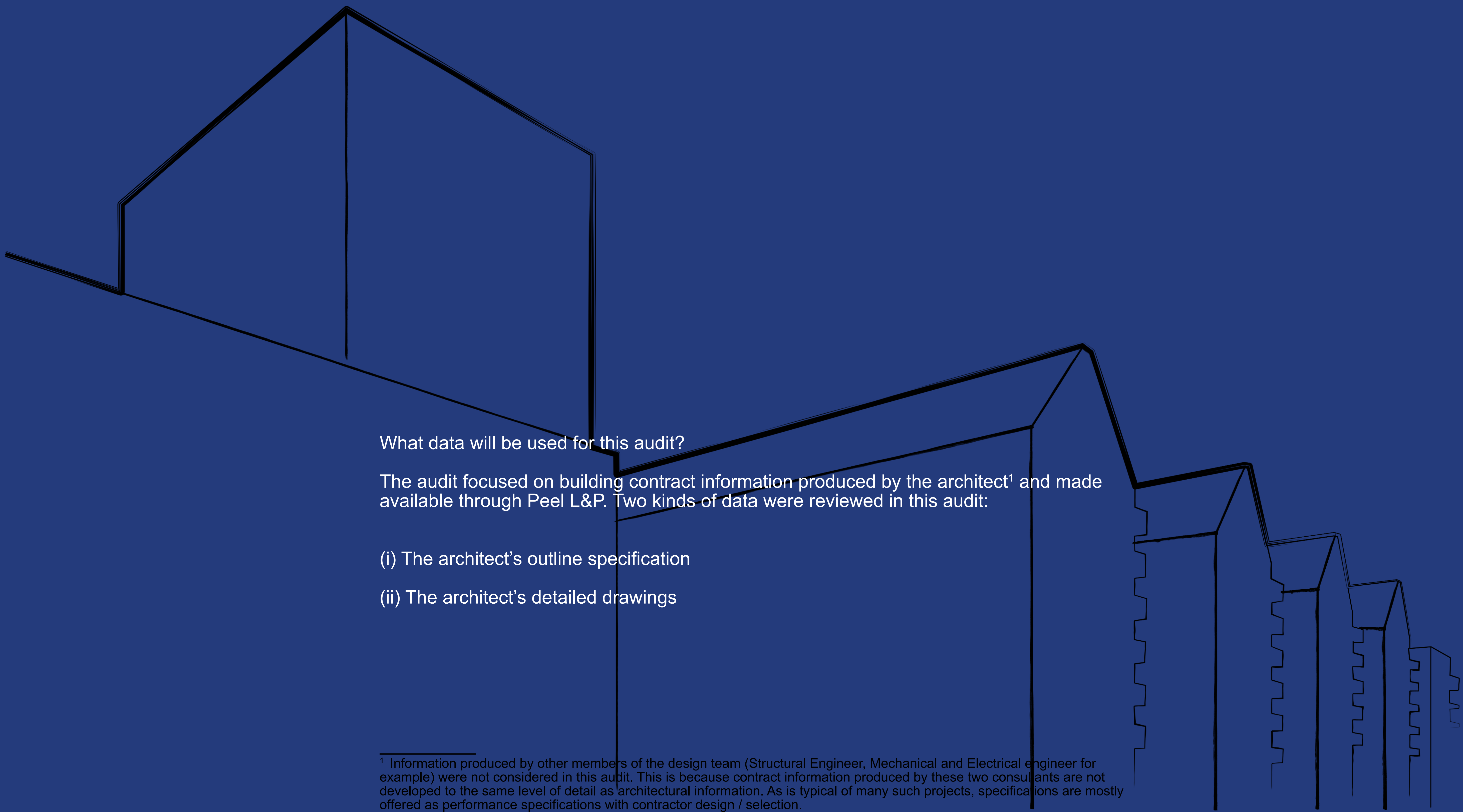
Accessing information:

The second reason is a practical one. In order to undertake an audit, it is fundamental that the research team has access to the right kind of information. In many commercial projects, project teams are reluctant to share detailed design and specification information contained in a legal building contract. Over the last 3 years, the Wirral Waters development team from Peel L&P formalised their commitment to actively working with Changing Streams CIC and the University of Liverpool to reduce plastic in construction. It is out of this unique partnership between industry and academia that Peel L&P have agreed to share all contract information to assist the study.

Making an impact:

The third, and arguably the most important consideration lies in the capacity for this project to make a true, and demonstrable impact. The Millers Quay project was conceived to be a landmark, pioneering project for the wider regeneration of Wirral Waters (hence why it was originally name 'the Legacy project'). Peel L&P intend to use this scheme to establish innovative approaches to environmental design and delivery that can be introduced and rolled-out through other upcoming schemes in the wider regeneration strategy.
Based on the partnership between Peel L&P, Changing Streams CIC and The University of Liverpool, Millers Quay was selected as a case study to explore plastic reduction measures that can be rolled out across the Wirral Waters site. This commitment is evidenced in the Wirral Waters Sustainability reports and the Wirral Waters Sustainability Action plan.

A plastic audit of Millers Quay



What data will be used for this audit?

The audit focused on building contract information produced by the architect[1] and made available through Peel L&P. Two kinds of data were reviewed in this audit:

(i) The architect's outline specification

(ii) The architect's detailed drawings

[1] Information produced by other members of the design team (Structural Engineer, Mechanical and Electrical engineer for example) were not considered in this audit. This is because contract information produced by these two consultants are not developed to the same level of detail as architectural information. As is typical of many such projects, specifications are mostly offered as performance specifications with contractor design / selection.

Structure of the study

Part 1: Stage 1

Identifying plastic within the proposed scheme.

The aim of Stage 1 was to identify where plastic-based materials have been specified or inferred within the data. This aim was achieved by:

(i) Reviewing the outline specification to identify building components / products containing plastic; identify plastic-reduced alternatives identified in the specification; establish if and where a preference is indicated in the specification or/and drawings.

(ii) Reviewing key detailed drawings / interface details to identify plastic content not covered in the outline spec; identify any alternatives if provided.

Part 2: Stage 2

Reviewing the extent of plastic in each case.

Building on the information from Stage 1, the aim of Stage 2 was to understand the extent of plastic in each instance and to establish a range of priorities for focusing attention on plastic reduction measures. This was achieved in the following sub-stages:

(i) Compile information from Stage 1 to form a table of plastic-based components.

(ii) Quantify / qualify these components as highly or low plastic content (1-5)

(iii) Quantify / qualify the extent of the product use in the scheme (1-5)

(iv) Use these scores to establish three levels of priority / impact

Part 3: Stage 3

Identifying plastic-reduced swap outs within the proposed scheme.

The aim of Stage 3 was to consider if and how the products identified in Stage 2 can be exchanged for products with a lower plastic content. This third stage was directed by the following questions:

(i) Could these plastic-based products be swapped out for alternatives? (Y/N)

(ii) If so, can we qualify the amount of plastic in these alternatives for comparison?

(iii) What are the implications of making these exchanges?

Part 4

Discussion and conclusion.

In Part 4, we will bring together the principle observations identified in all three stages and use this to answer the following questions:

(i) What specific and general lessons can be learned from this study?

(ii) Can we use this insight to improve the design process and to audit other schemes?

(iii) What future research is suggested by this audit? How might these be explored and what would the likely benefits / limitations be?

Part 1: Stage 1

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(ii) Reviewing key detailed drawings / interface details to identify plastic content not covered in the outline spec; identify any alternatives if provided.

	WINDOWS, DOORS AND FRAMES	Outline spec 4.3; Implied Datasheets	Finish options as: ○ Anodised aluminium ○ PVDF (polyvinylidene fluoride coating) ○ Marine grade powder coated aluminium	Y: Anodised aluminium
	RAIN SCREEN CLADDING	Outline spec 4.2	Finish options as: ○ Anodised aluminium ○ PVDF ○ Marine grade powder coated aluminium	Y: Anodised aluminium
EXT components	**BALUSTRADE AND BALCONY CLADDING:**	Outline spec 4.4	Finish options as: ○ PPC (polyester powder coating) ○ Steel [presumably stainless marine grade]	Y: Steel
WALL / CLG FINISHES	**PARTITIONS**	Outline spec 5.1	Finish options ○ 3mm skim finish or ○ Tape and jointed	Y: 3mm skim
			Slab edge: Foamglas	Or similar approved
			Slab edge: EPDM over Foamglas	Or similar approved
FLOORS	**TYPE 1** (within Thermal envelope) Ref:	Drawings: 16 and 33 series	DPM over concrete base	To contractor's design
			110mm Kingspan Kooltherm K103 to achieve 0.11 W/m2K over DPM	
	TYPE 3 (lift pit)	Drawings: 16 and 33 series	Waterproofing beneath lift pit	To contractor's design.

Figure 1: Extracts from Tables 1 and 2 (see Appendix). Source: Author

Plastic alternatives identified:

Of the all the plastic-based components identified in the outline specification and shown in the above tables, only four components identified lower plastic-based options.

Whilst the outline specification did not identify a preference for any of these options, the drawings used to accompany the outline specification did.

In 3 of these 4 cases, the drawings showed the higher-plastic based option. As shown in the marked up extracts from this table:

(i) Drawing notes showed PVDF instead of the lower-plastic option, Anodised aluminium for the balustrade and the rainscreen cladding.

(ii) Drawing notes showed PPC instead of the lower-plastic option Steel for balustrading and balcony cladding.

(iii) The only instance where a plastic-reduced option was shown in the drawings / notes was for the introduction of 3mm plastic skim instead of tape and jointing to all plasterboard.

All 4 cases revealed an inherent preference for industry norms / conventions. PPC and PVDF coatings are more common than anodised aluminium and steel. Plastic skim finish is more commonly specified in architectural drawings than tape and jointed.

Contractor selection:

In other instances, the specification and drawings noted that the contractor could identify an alternative product which may or may not have a lower plastic content. As per standard practice, this was identified as ‘or similar approved’ and ‘contractor design’. As shown in the marked-up extracts:

(i) The former was shown for the waterproofing and insulation to the concrete slab edge

(ii) The latter was in reference to waterproofing only.

Conclusion:

These observations reveal several points of interest:

(i) Plastic-reduced products are rarely considered as options for further design / cost review.

(ii) Where alternatives are provided, they seem to align more with industry norms / conventions than conscious consideration of plastic content.

(iii) Where the contractor is provided with an opportunity to specific alternative products there is no suggestion that these should be directed towards plastic-reduced options. More specifically, this study shows that these opportunities are limited to waterproofing products / systems

Part 2: Stage 2

Reviewing the extent of plastic in each case.

Building on the information from Stage 1, the aim of Stage 2 was to understand the extent of plastic in each instance and to establish a range of priorities for focusing attention on plastic reduction measures. This was achieved in the following sub-stages:

(i) Compile information from Stage 1 to form a table of plastic-based components.

(ii) Quantify / qualify these components as high or low plastic content (1-5)

(iii) Quantify / qualify the extent of the product use in the scheme (1-5)

(iv) Use these scores to establish three priority / impact

Existing strip section

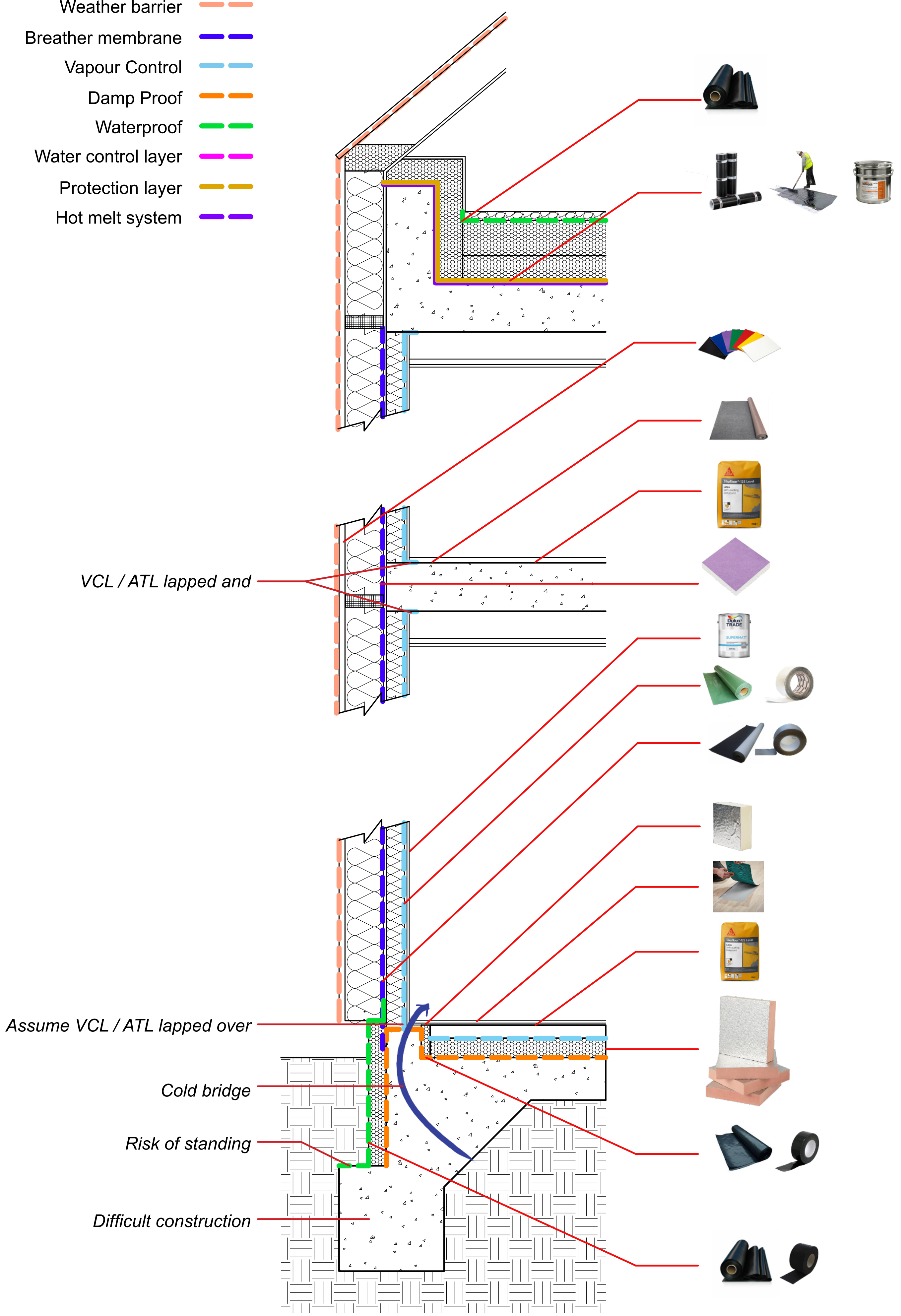


Figure 2: Mark-up of existing strip section. Source: Author (re-drawn from contract set)

Three kinds of product with high plastic content

The above tables and the marked-up strip section show that the greatest quantities of plastic in this scheme are contained within three groups of products:

(i) Membranes

(ii) Insulation

(iii) Surface finishes (walls and floors)

These product groups contain large quantities of plastic as individual products but also in the quantities of products used in this scheme.

DPM over concrete base	HIGH	HIGH	HIGH
Separation layer	HIGH	HIGH	HIGH
Slab edge: EPDM over Foamglas	HIGH	MEDIUM/LOW	MEDIUM
Waterproofing beneath lift pit	HIGH	MEDIUM	HIGH
Horizontal DPC within course taken down and dressed over concrete slab edge, lapped into EPDM and DPM	HIGH	HIGH	HIGH
Breather membrane over full area of cement particle board to outer face of SFS [assume taped and jointed at sheet positions and around fixing angles]	HIGH	HIGH	HIGH
Vapour Control Layer to inner face of SFS infill over full area [assume taped and jointed at sheet positions and around fixing angles]	HIGH	HIGH	HIGH
Bakor 790-11 Hot applied membrane roofing system to conc slab:	HIGH	HIGH	HIGH
Bauder Primer and X4S Protection layer	HIGH	HIGH	HIGH
Water control layer	HIGH	HIGH	HIGH

Figure 3: Extracts from Tables 3 and 4 (see Appendix). Source: Author

The above extracts and the drawing overleaf show several different kinds of plastic-based membrane specified in this scheme:

These membranes are all used to control water movement:

(i) Waterproofing membranes: to prevent or control the movement of water into and through the building

(ii) Breather membrane to allow water to escape from inside the building

(iii) Vapour control layer to reduce water transfer from the inside of the building into the envelope.

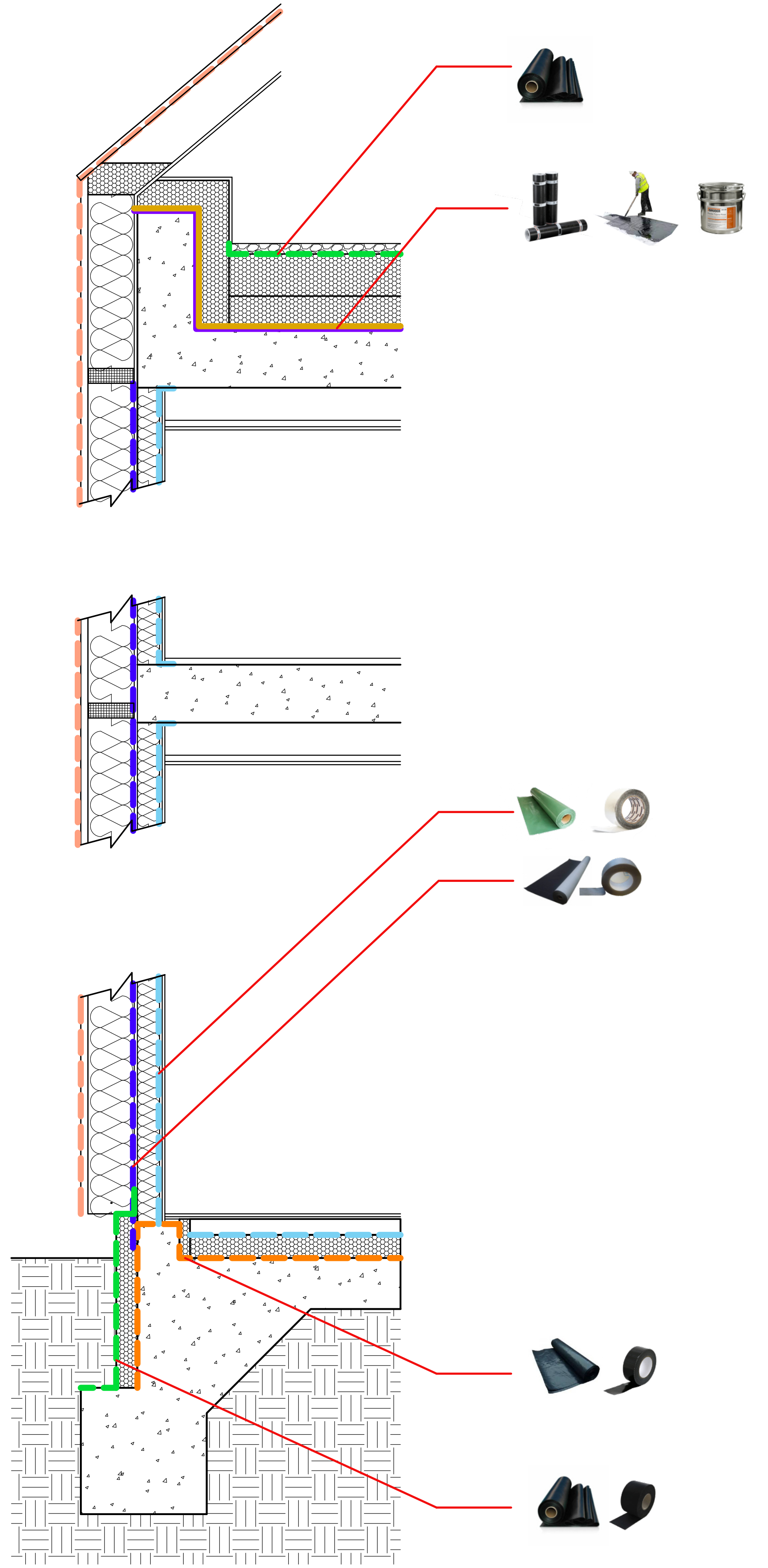


Figure 4: Mark-up of existing strip section. Source: Author

Insulation

110mm Kingspan Kooltherm K103 to achieve 0.11 W/m2K over DPM	HIGH	HIGH	HIGH
Rigid Perimeter insulation (assumed PIR) to be 0.8 W/m2K U value to avoid thermal bridging	HIGH	MEDIUM	HIGH

Figure 5: Extracts from Tables 3 and 4 (see Appendix). Source: Author

Whilst the specification and drawings allow for mineral wool insulation in the wall build-up, all floors and roofs are designed using phenolic or polyisocyanurate (PIR) rigid insulation boards. These have a very high plastic content. Given the former covers the full heated footprint of the building at ground floor and the full footprint of the building at roof level, this represents a large quantity of specified plastic within the scheme.

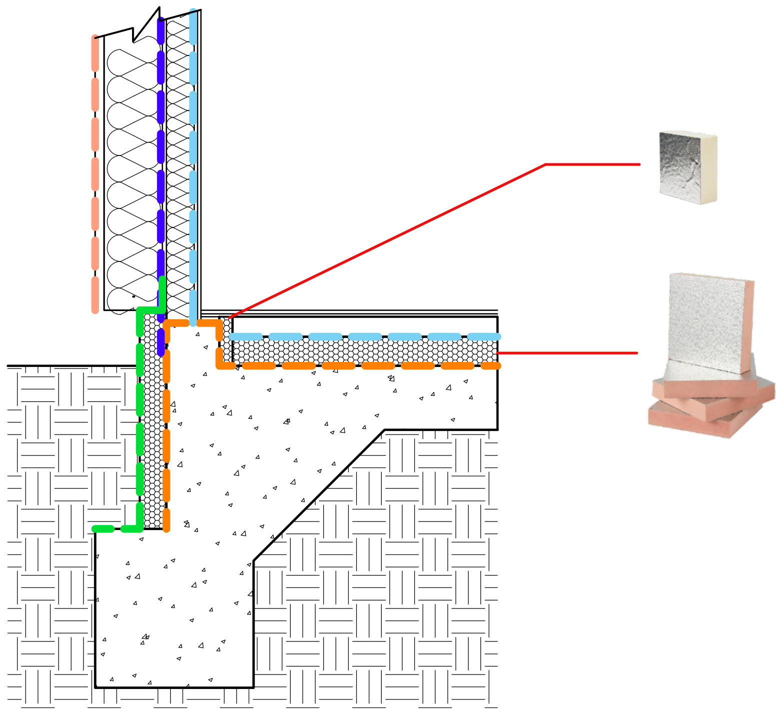


Figure 6: Mark-up of existing strip section. Source: Author

Finishes

7.5mm or 10mm or 12.5mm latex screed over (drawings 33)	HIGH	HIGH	HIGH
Carpet tile Forbo Tessera Nexus. 100% dyed polyamide on Polyester primary backing and modified bitumen and polyester fleece secondary backing. Adhesive bonded.	HIGH	MEDIUM	HIGH
Shaw 100% nylon carpet with polypropylene primary backing and glued installation	HIGH	HIGH	HIGH
Wood effect vinyl Karndean Fixed to Regipol 4515 acoustic underlay	HIGH	HIGH	HIGH
Eggar laminate – melamine finish	HIGH	HIGH	HIGH
Dulux trade eggshell	HIGH	HIGH	HIGH

Figure 7: Extracts from Tables 3 and 4 (see Appendix). Source: Author

Internal floor and wall finishes represent a significant contribution to the overall plastic content of the building. Floor finishes include nylon carpets with a polyester backing. Wall finishes are all based on modern paint systems containing artificial resins.

These finishes have very high plastic content. Given that these floor finishes cover large parts of the floor area and paint is used to cover most internal wall surfaces, these products make a significant contribution to the overall plastic content of the building design.

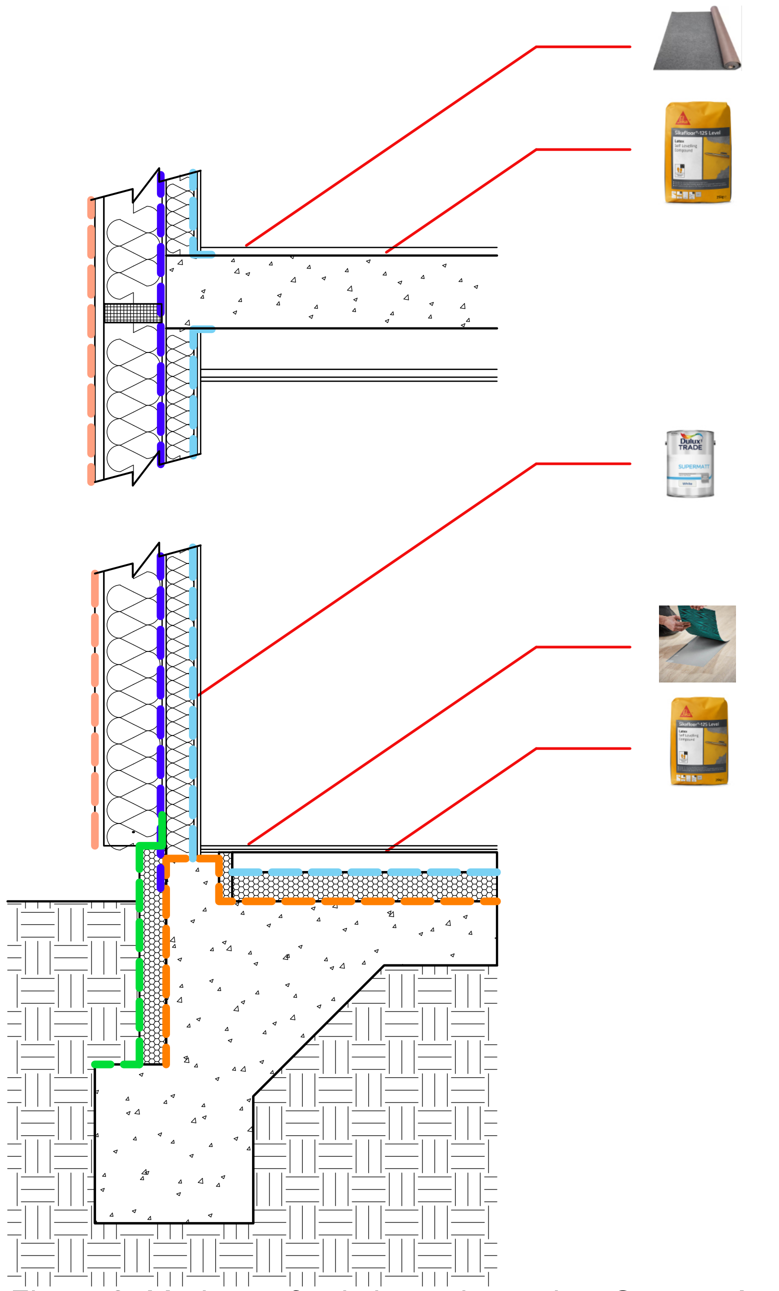


Figure 8: Mark-up of existing strip section. Source: Author

Part 3: Stage 3

Identifying plastic-reduced swap outs within the proposed scheme.

The aim of Stage 3 was to consider if and how the products identified in Stage 2 can be exchanged for products with a lower plastic content. This third stage was directed by the following questions:

(i) Could these plastic-based products be swapped out for alternatives? (Y/N)

(ii) If so, can we qualify the amount of plastic in these alternatives for comparison?

(iii) What are the implications of making these exchanges?

Focusing on three kinds of product with high plastic content

In Stage 2 we showed that the greatest quantities of plastic in this scheme are contained within three groups of products:

(i) Membranes

(ii) Insulation

(iii) Surface finishes (walls and floors)

These product groups contain large quantities of plastic as individual products but also in the quantities of products used in this scheme.

The following pages will focus on these groups specifically.

DPM over concrete base	HIGH	**Swap plastic membrane DPM for admixture:** Waterproofing characteristics of the membrane could be achieved by introducing a plant-based crystalline admixture like Sika® WT-240 P into the concrete specification.	
Separation layer	HIGH		Foamglas has been tested as a secondary waterproof layer. Is the separating layer necessary if Kingspan is swapped with Foamglas? If not, could Foamglas torched finish serve as separating layer?
Slab edge: EPDM over Foamglas	MEDIUM	**Swap-out EPDM over Foamglas with Foamglas Perisave** Foamglas Perisave face can be torch finished to act as waterproofing. Cut and adapt product to include all edges as necessary.	Foamglas has a low plastic content, but the bitumen finish has a high petroleum content. Could this Foamglas product be adapted to include a natural alternative to bitumen such as Kraft Lignin asphalt?
Waterproofing beneath lift pit	HIGH	**Swap plastic membrane DPM for admixture:** Waterproofing characteristics of the membrane could be achieved by introducing a plant-based crystalline admixture like Sika® WT-240 P into the concrete specification.	
Horizontal DPC within course taken down and dressed over concrete slab edge, lapped into EPDM and DPM	HIGH	**No swap-outs identified:** In current design configuration there are no low-plastic alternative currently available that can be used as a horizontal DPC within course and used as vertical dressing over concrete slab edge.	Could detail be modified to allow the Foamglas to extend up to the horizonal DPC? Waterproofing over the Foamglas (or Foamglass adapted to be used as waterproofing – see floor entry) could then be lapped into the horizontal course. Horizontal DPC could be replaced with two layers of slate with cement bonding (see detail below).
Breather membrane over full area of cement particle board to outer face of SFS [assume taped and jointed at sheet positions and around fixing angles]	HIGH	**No swap-outs identified:** No low-plastic alternative currently available with vapour resistance required (assumed 0. Sd). Solution should focus on minimising coverage.	Could a lime render solution replace the breather membrane given potential low Sd values?
Vapour Control Layer to inner face of SFS infill over full area [assume taped and jointed at sheet positions and around fixing angles]	HIGH	**Swap VCL membrane with Smartply Propassiv:** Exchange VCL and ATL plasticated membrane with T+G structural OSB board or with specialist OSB board like Smartply Propassiv. Coating on this board contains paraffin but preferable to a petrochemical membrane. [NB also reduces risks of puncturing the ATL during construction and operation]	Is it possible to develop a structural T+G OSB board to act as ATL and VCL that is not covered with paraffin – perhaps a natural wax such as soy wax?
Bakor 790-11 Hot applied membrane roofing system to conc slab:	HIGH	**Swap hot applied membrane system for Foamglas system** Foamglas system includes 2 layer bitumen roofing sheets rather than plastic membrane.	2 layer bitumen roofing sheets is petrol based: (i) Could these be removed or swapped with non-plastic, non-bitumen alternative? (ii) Foamglas is watertight – and identified as a secondary waterproofing system. Could this be adapted to serve as primary waterproofing and remove need for bitumen sheet? (iii) Could bitumen sheet be exchanged for a sheet or coating that includes a natural alternative to bitumen such as Kraft Lignin asphalt?
Bauder Primer and X4S Protection layer	HIGH		See above
Water control layer	HIGH		Could plastic membrane waterproofing layer be swapped with a plant-based crystalline admixture like Sika® WT-240 P? This would reduce the use of plastic based membrane across the entire roofing area.

Figure 9: Extracts from Tables 5 and 6 (see Appendix). Source: Author

This extract shows that three of the seven kinds of membrane can be exchanged for widely available plastic free / reduced products.

This extract shows that two of the seven kinds of membrane can be exchanged for products with reduced plastic content but in this instance, these alternatives rely on a torched bitumen (fossil fuel-based) coating.

The extract shows that two of the seven products could not be exchanged for widely available plastic-reduced products.

The blue column identifies opportunities for further research to resolve some of the limitations identified.

As this extract demonstrates, whilst many products cannot be swapped out, there are research opportunities that may lead to a viable solution.

Membranes

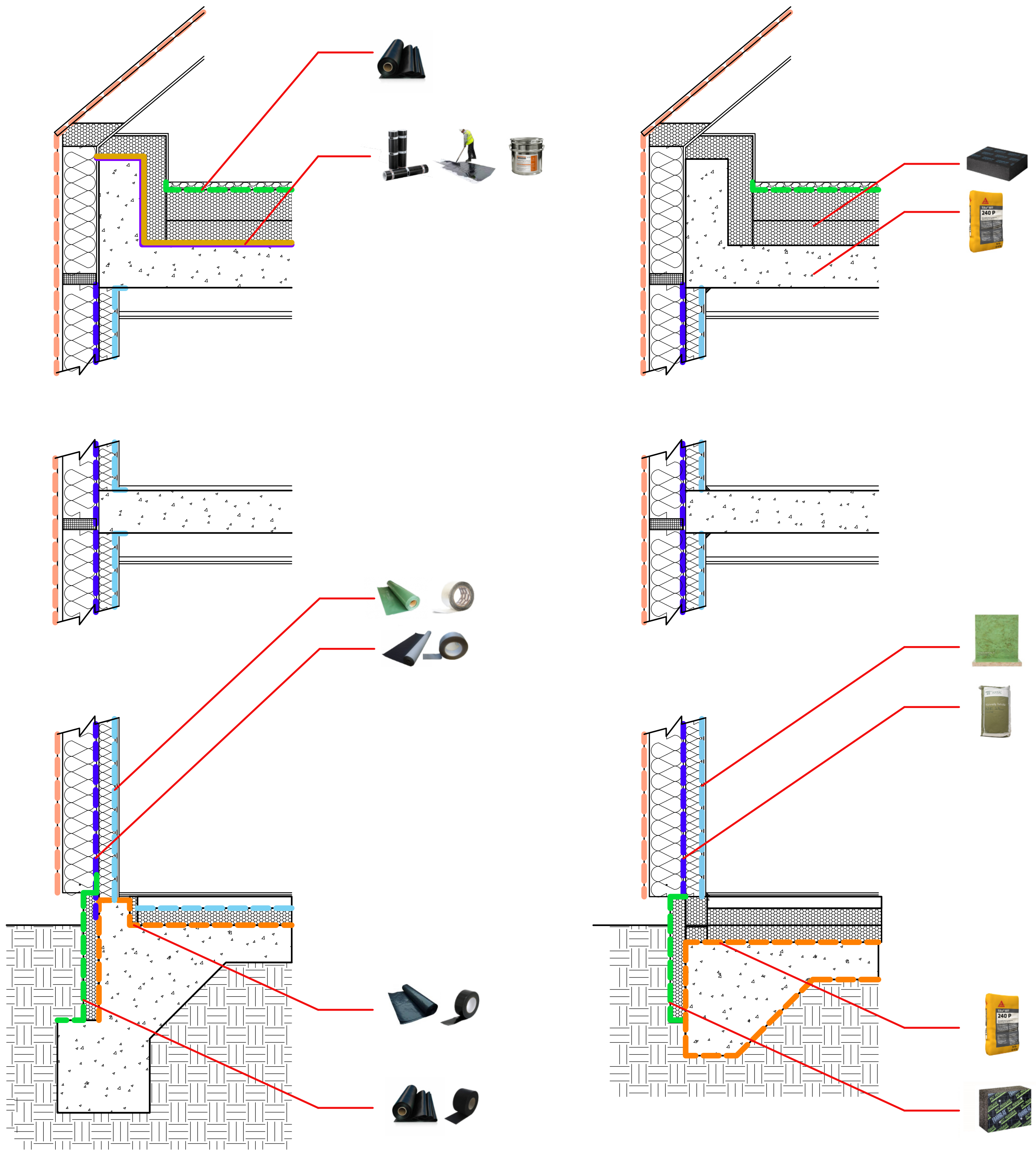


Figure 10: Mark-up of existing strip sections. Source: Author

110mm Kingspan Kooltherm K103 to achieve 0.11 W/m2K over DPM	HIGH	**Swap Kingspan for Foamglas:** Foamglas is a plastic reduced alternative to phenolic insulation. Thermal conductivity is higher for Foamglas but could possibly achieve same U-value with deeper insulation zone. Foamglass to be laid over sand levelling layer over concrete slab.	
Rigid Perimeter insulation (assumed PIR) to be 0.8 W/m2K U value to avoid thermal bridging	HIGH	**Swap PIR insulation with Foamglas:** Foamglas is a plastic reduced alternative to PIR insulation. Thermal conductivity is higher for Foamglas but could possibly achieve same U-value with thicker insulation.	Foamglas is loadbearing and can be used as structural support. By exchanging floor insulation and perimeter insulation with Foamglas, could the SFS could be fixed directly to Foamglas blocks – potentially designing out the thermal bridge? (see detail below)

Figure 11: Extracts from Tables 5 and 6 (see Appendix). Source: Author

This extract shows that both of the two kinds of insulation specified can be exchanged for a plastic free / reduced alternative.

The blue column identifies opportunities for further research to resolve some of the limitations identified. Whilst PIR insulation can be exchanged for plastic reduced alternative, the extract shows that further research is needed to verify this as a viable detail in this instance.

Insulation

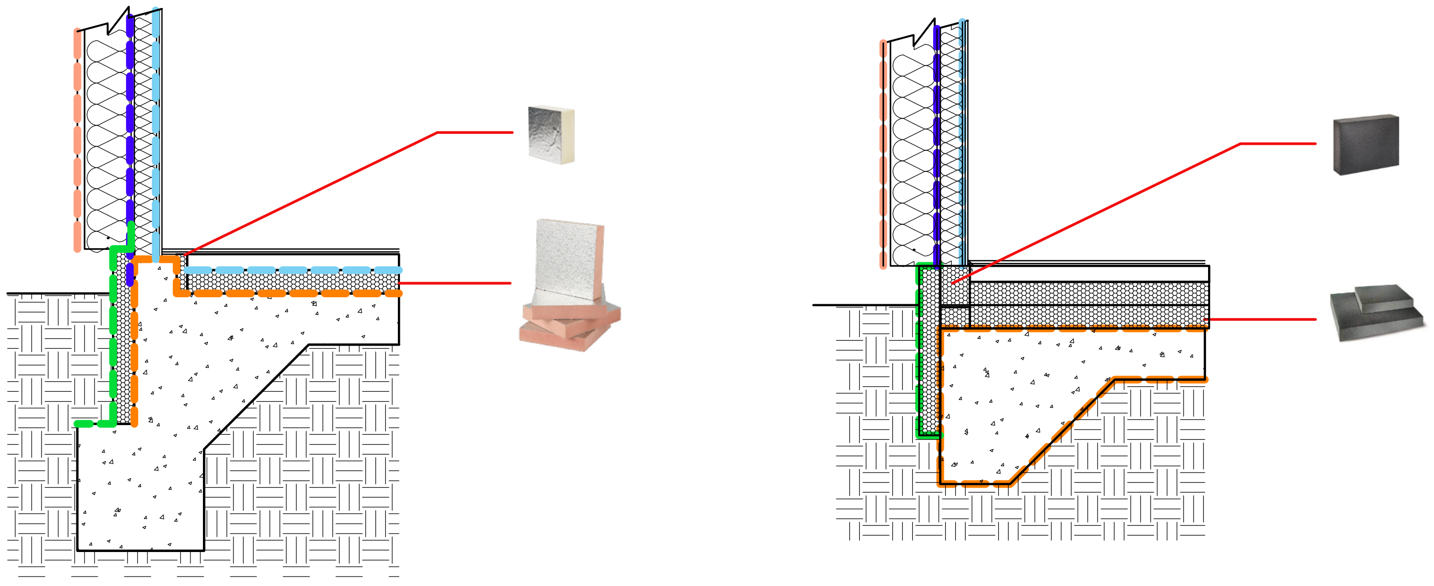


Figure 12: Mark-up of existing strip sections. Source: Author

7.5mm or 10mm or 12.5mm latex screed over (drawings 33)	HIGH	**Swap-out latex screed (in part) with different finishes** Latex screed is presumably used to achieve higher tolerance for substrate to floor finishes.	
Carpet tile Forbo Tessera Nexus. 100% dyed polyamide on Polyester primary backing and modified bitumen and polyester fleece secondary backing. Adhesive bonded.	HIGH	**Swap polyester carpet tiles with coir tiles.** Coir tiles are highly durable and natural fibre without plastic.	
Shaw 100% nylon carpet with polypropylene primary backing and glued installation	HIGH	**Swap nylon carpet with a pile looped wool carpet or seagrass.** Pile looped wool carpet is not for commercial use. Given specification is intended for residential there is no need to include high impact commercial grade carpets. Seagrass would provide a tougher use option if needed.	
Wood effect vinyl Karndean Fixed to Regipol 4515 acoustic underlay	HIGH	**Swap vinyl flooring in living area and dining area for seagrass** **Swap vinyl flooring in kitchen and possible in dining area for ceramic tiles over cork acoustic underlay.**	
Dulux trade Super matt emulsion	HIGH	**Swap artificial resin paint for durable lime-based paint** Graphenstone paint would be a possible alternative.	
Dulux trade moisture resistant	HIGH	**Swap artificial resin paint for durable lime-based paint** Graphenstone paint would be a possible alternative.	

Figure 13: Extracts from Tables 5 and 6 (see Appendix). Source: Author

This extract shows that three of the five of the six kinds of finishing product can be exchanged for widely available plastic free / reduced products.

This extract shows that one of the six kinds of finishing product can be exchanged for products with reduced plastic content but in this instance, these alternatives cannot be exchanged in all instances

As this extract demonstrates, there are few research opportunities identified to further reduce the plastic content of these finishes.

Finishes

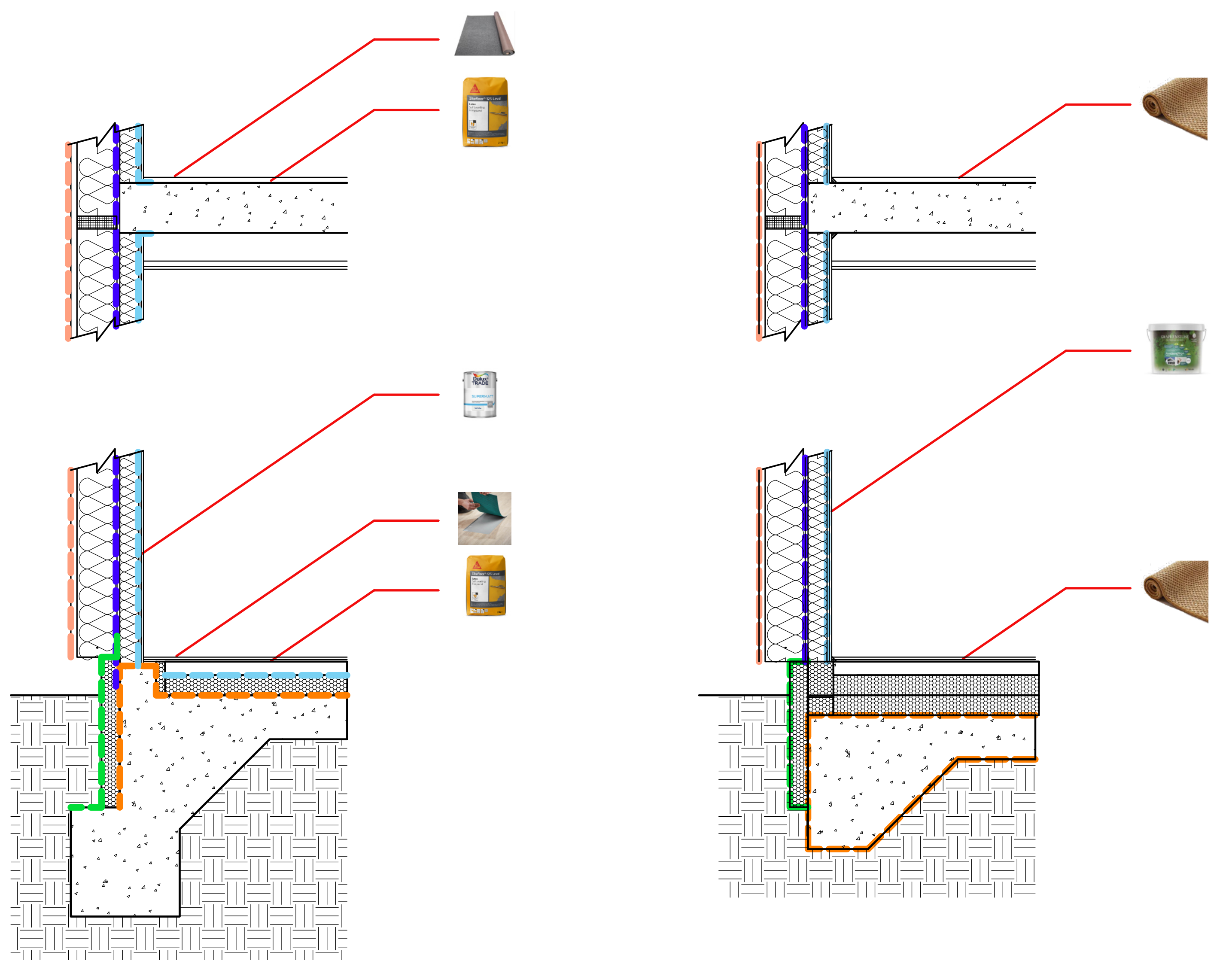
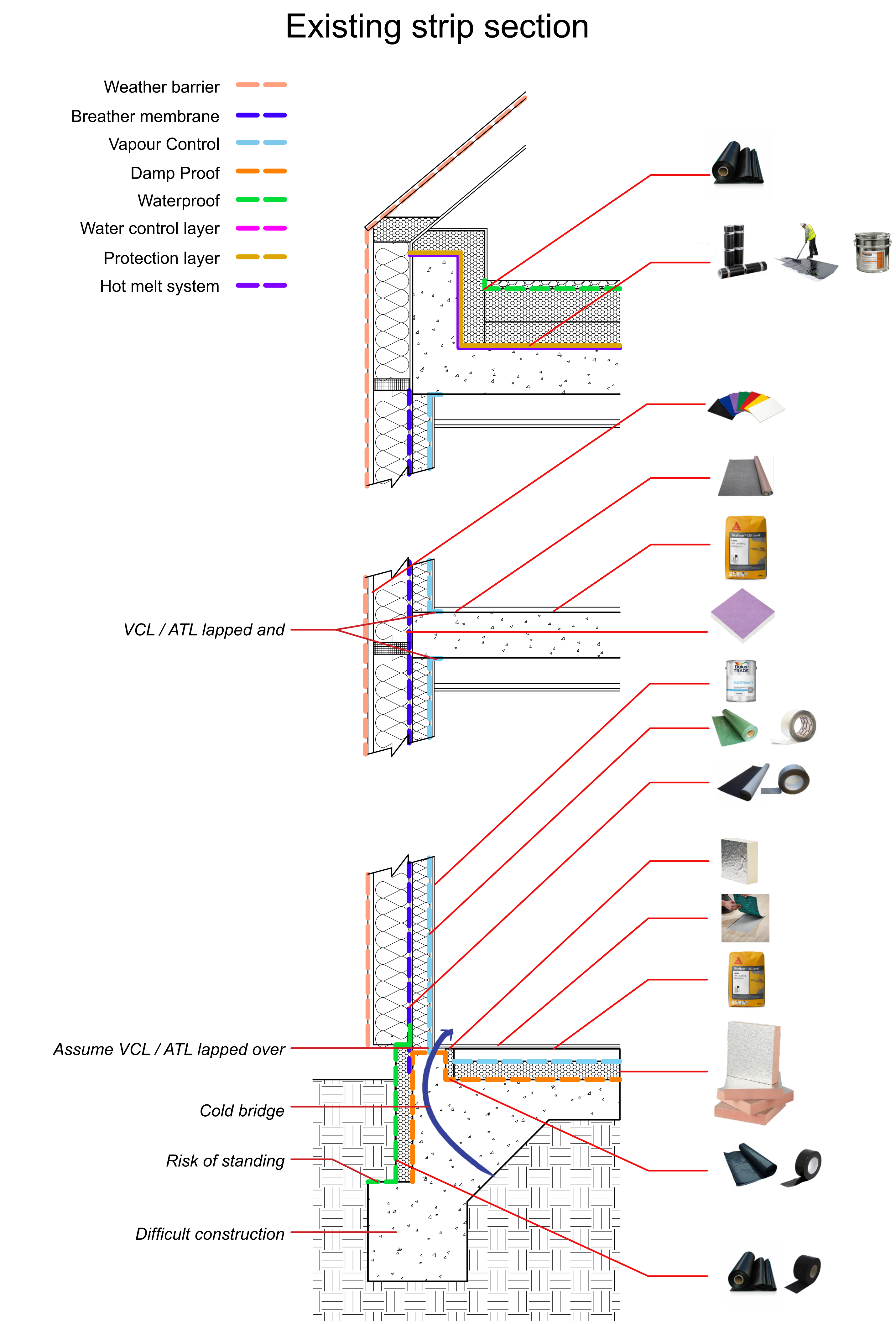


Figure 14: Mark-up of existing strip sections. Source: Author



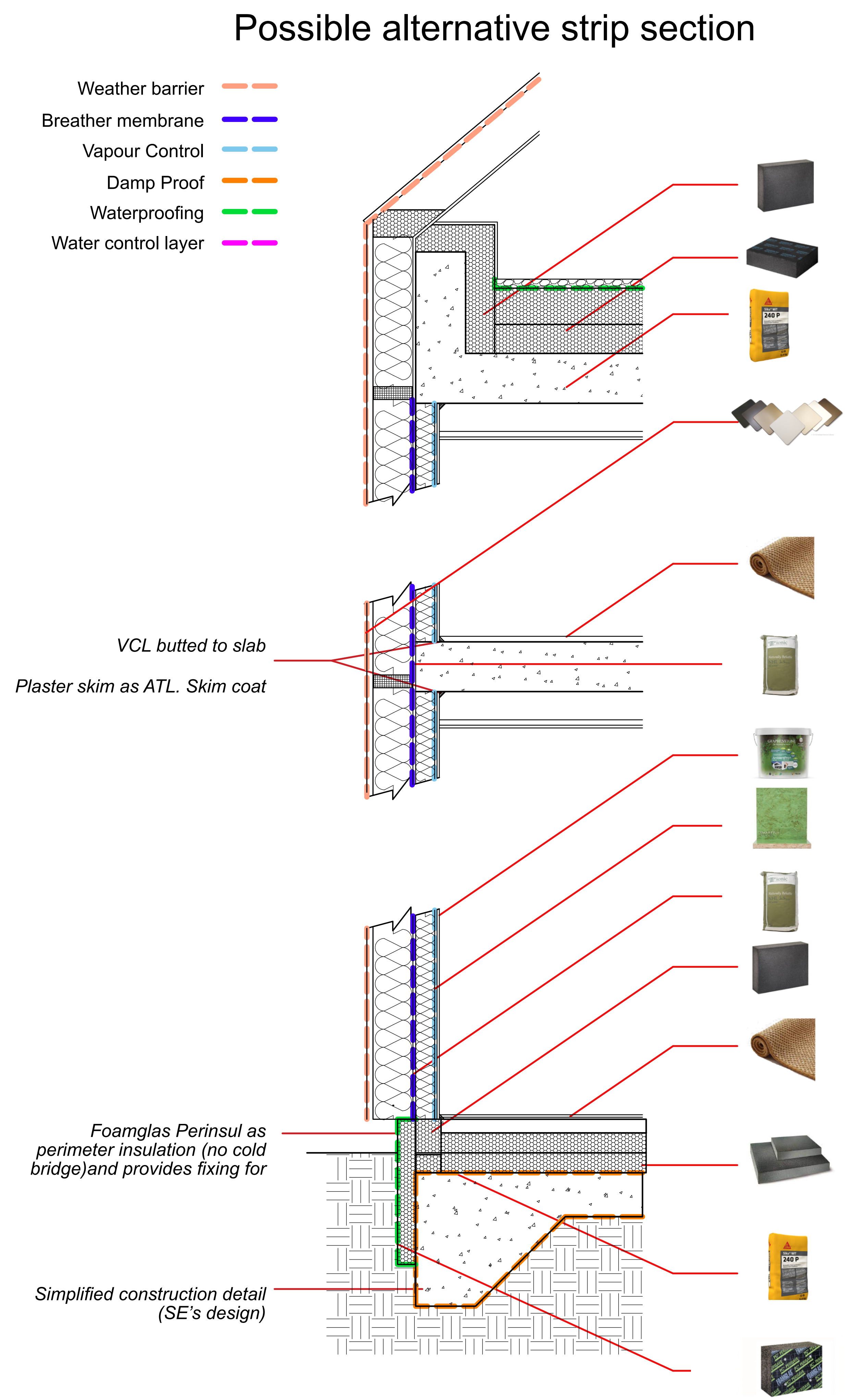


Figure 15: Mark-up of existing strip sections. Source: Author

Part 4

Discussion and conclusion.

In Part 4, we will bring together the principle observations identified in all three stages and use this to answer the following questions;

(i) What specific and general lessons can be learned from this study?

(ii) Can we use this insight to improve the design process and to audit other schemes?

(iii) What future research is suggested by this audit? How might these be explored and what would the likely benefits / limitations be?

(i) What specific and general lessons can be learned from this study?

(ii) Can we use this insight to improve the design process and audit other schemes?

Observation

Firstly, this audit found that the outline specification and drawings present different options regarding the specification of plastic-based products. In the specification the architect had specified several options for key features of the building. These options contained products with varying quantities of embedded plastic. Only one of these options has been represented in the drawings. In most instances this showed one of the higher plastic-based options. Looking at these details, it seems fair to assume that these drawings were not intended to show a preference for plastic-based materials but, rather, reflect industry conventions and norms.

Suggestion

This suggests that plastic content could be reduced if the design team put in place specific measures to consider and identify plastic-reduced options. These may be specified as a single option or, where this is not possible, could be offered as a group of options in the specification. Given that only one option can be used to form the drawings, it may benefit the sustainability of the scheme by only showing the plastic-reduced product in all detailed drawings. This would provide a clear message of design intent to the contractor team.

Observation

Secondly, this audit has shown that the options for higher or lower plastic-based products in this scheme is only evident in the specification of the external envelope. No options were identified in the interior finishes. This audit has also shown that there are more plastic based products specified for the interior finishes than for the exterior envelope. This suggests that a different design approach used to develop the exterior envelope and the interior design.

Suggestion

This suggests that plastic could be reduced by establishing a plastic-reduction approach across all aspects of the design and to focus specific efforts at embedded this approach amongst designers responsible for designing and specifying the interior. Given these are the materials that will be most visible to the future tenants, this approach would not only provide a strong message within the design profession but also provide a strong message to the intended user groups.

Observation

Thirdly, this audit has identified three groups of products that made the greatest impact on the quantity of plastic within the scheme. These groups are: membranes, insulation, surface finishes. These product groups vary in the ease with which they can be exchanged for low plastic alternatives. This study suggests that surface finishes are the easiest group to exchange, and membranes are the most difficult.

Suggestion

This suggests that the greatest impacts on a scheme will be achieved by exchanging these three groups of products for plastic reduced / free alternatives. If there are limitations posed on plastic-reduced measures, it suggests that focus should start with exchanging surface finishes, before considering alternatives for insulation and membrane products.

Observation

Finally, this study has not only identified opportunities for changing the way we design projects to reduce plastic content. It also serves as a pilot for the way we assess plastic content in such schemes.

There is no reason why the process used to assess Millers Quay could not be transferred onto other projects.

Suggestion

On this basis, we would like to suggest that all schemes are assessed using the tabular formats presented in this report. Given that these assessments rely on specification data and detailed design, these assessments will prove most useful from the point when the design team commences the initial detail design process. The assessments could perform two primary functions: they could serve as a design aid to ensure plastic reduction is embedded in the design process; they could be included in RIBA stage completion reports. Whilst the former would be undertaken by members of the design team and discussed as an agenda item in design team meetings, the latter would be best undertaken by an independent assessor employed by the client / developer. This would ensure an impartial assessment process.

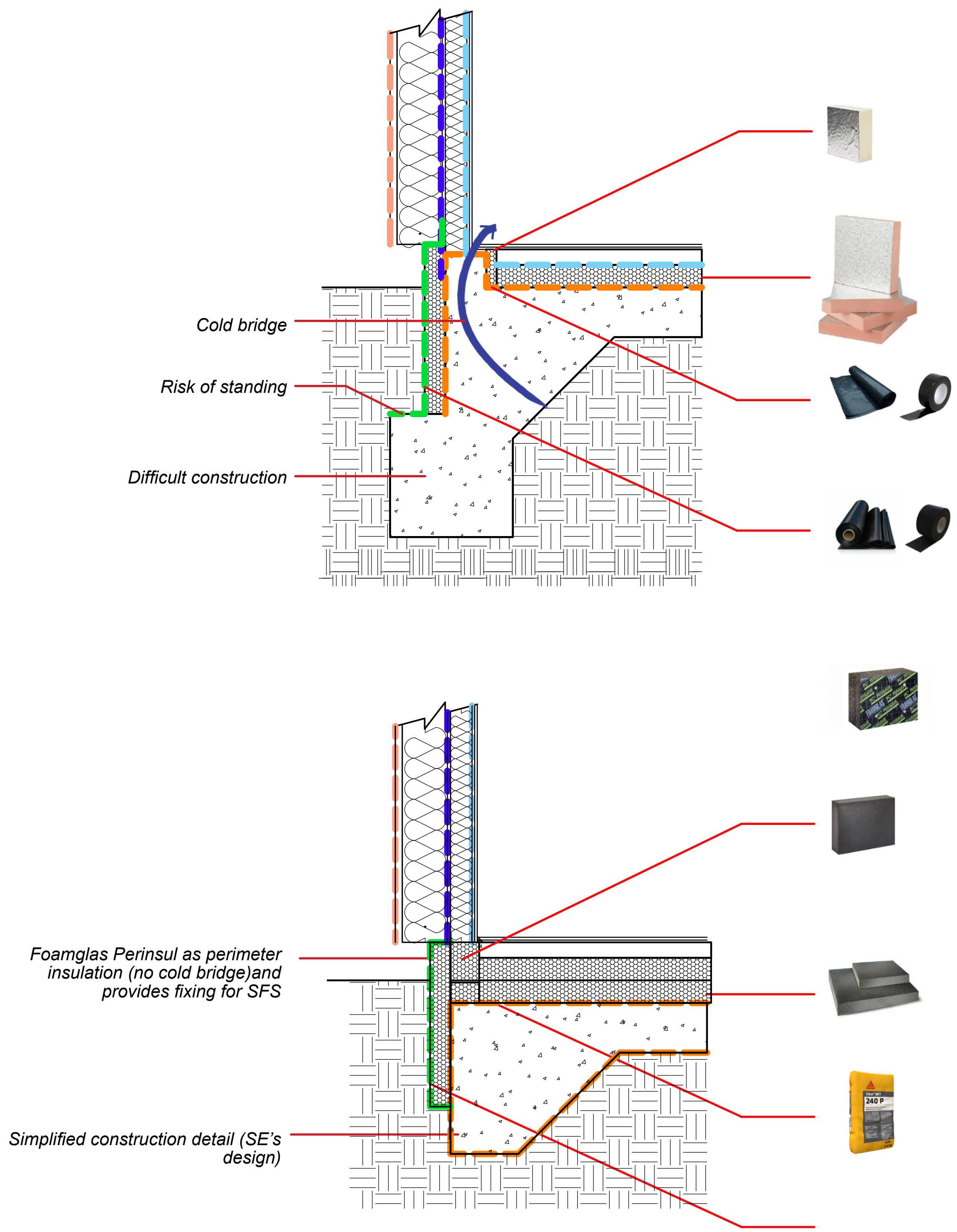


Figure 16: Mark-up of existing strip sections. Source: Author

(iii) What future research is suggested by this audit? How might these be explored?

Future research

Tables 5 and 6 identify several possibilities for developing new research projects based on the specific details and products identified in this scheme.

Some of these proposals, such as the development of a membrane or coating for Foamglas (or similar product) based on Kraft lignin as a natural alternative to bitumen is directed towards researchers working in the field of product innovation.

But this table also identifies research opportunities that rely on products that are currently available.

The drawings overleaf show two wall to floor interface details. The drawing to the top is the detail used in this scheme. The mark up shows that this detail is currently designed using a range of plastic-based membranes and insulation. But it also shows that this configuration introduces a cold bridge through the concrete up-stand that would reduce the thermal performance of the envelope.

It also shows that the use of membranes and insulation in this configuration produces a shelf in the base detail that could lead to standing water over this concrete which would put pressure on the integrity of the membrane and particularly the sealants used to fix lapped membranes together.

The drawing below shows an alternative detail. This detail includes swap outs for the plastic membranes and insulation.In this detail, we have considered the advantage of swapping phenolic insulation for a load bearing insulation block like FoamGlas. As the detail shows this arrangement would eliminate the cold bridge. Not only would this reduce plastic content it would also improve thermal performance and thus the operational energy (carbon) used to heat this building.

The drawing also shows this Foamglas as a secondary watertight layer within the floor zone and as a primary watertight layer to the perimeter (by torching the bitumen coating). This proposal would remove / reduce the waterproofing membranes in the original configuration. This proposal is based on the fact that Foamglas is effectively water resistant and is offered as a secondary waterproofing layer. The extent of this would be subject to testing and research. By using this arrangement for the perimeter the proposal would reduce the risk of standing water and the difficulties in building this shelf on site.

This detail would be subject to review, testing and costing. It may also require some research directed specifically at product innovation / adaptation.

But this arrangement also highlights another more general and arguably more significant point. It shows us that reducing plastic content in a scheme can also offer other sustainability benefits by reducing operational energy. This arrangement thus provides us with a prompt for a much larger research questions:

Are plastic-reduction measures compatible with and perhaps complementary to other sustainability benefits?

Can we combine plastic-audits with other sustainability audits based on operational energy and embodied carbon?

And can we use these assessments and audits to demonstrate mutual benefits and areas of compromise?

Appendix

TABLE 1: Assessing the outline specification and drawings: Components identified with plastic content within the envelope.

EXTERIOR / ENVELOPE						
Component		**Reference**	**Plasticated Specification**	**Alternative**		**Notes**
				Y	**N**	
FLOORS	**TYPE 1** (within Thermal envelope) Ref: Dwgs: 16 and 33 series	Drawings: 16 and 33 series	DPM over concrete base	To contractor's design		Damp Proof Membrane is not specified. We can assume a plastic membrane: high plastic content
			110mm Kingspan Kooltherm K103 to achieve 0.11 W/m2K over DPM		X	This is a phenolic insulation: high plastic content
			Rigid Perimeter insulation (assumed PIR) to be 0.8 W/m2K U value to avoid thermal bridging		X	Perimeter insulation is likely to be polyisocyanurate (PIR) insulation: high plastic content
			Separation layer		X	As per the Mapei datasheet, the separation layer is a polyethylene sheet: high plastic content.
			75 Mapei floating screed with Admixtures like super-plasticisers to screed reduce drying time		X	Floating screed is not specified but likely to include admixtures like super-plasticisers to reduce drying time: likely to have some plastic content.
			7.5mm or 10mm or 12.5mm latex screed over (drawings 33)		X	Contains latex resin: high plastic content.
			Slab edge: Foamglas	Or similar approved		Note: Foamglas (system is not specified but seems to be as per system 1.2.3). Foamglas is recycled glass material: no plastic content. Adhesive required for system (PC 56) used to bond boards together contains plastic: low plastic content. Foamglas needs to be fixed to bitumen primer coat and waterproofing to concrete - not plastic but high petrol-based content.
			Slab edge: EPDM over Foamglas	Or similar approved		Specification notes that Foamglas is to be covered with adhesive PC56 and the synthetic rubber Ethylene Propylene Diene Monomer (EPDM) bonded over: high plastic content.
	TYPE 2 (outside Thermal envelope)	Drawings: 16 and 33 series	DPM over concrete base	To contractor's design		Damp Proof Membrane is not specified. Can assume plastic membrane: high plastic content
			Structural screed over separation layer		X	Separation layer is polyethylene sheet: high plastic content. Structural screed is not specified but likely to include admixtures like super-plasticisers to reduce drying time: likely to have some plastic content
			Admixtures like super-plasticisers to screed reduce drying time		X	Structural screed is not specified but likely to include admixtures like super-plasticisers to reduce drying time: likely to have some plastic content
			Slab edge: Foamglas	Or similar approved		Note: Foamglas (system is not specified but seems to be as per system 1.2.3). Foamglas is recycled glass material: no plastic content. Adhesive required for system (PC 56) used to bond boards together contains plastic: low plastic content. Foamglas needs to be fixed to bitumen primer coat and waterproofing to concrete - not plastic but high petrol-based content.
			Slab edge: EPDM over Foamglas	Or similar approved		Specification notes that Foamglas is to be covered with adhesive PC56 and the synthetic rubber Ethylene Propylene Diene Monomer (EPDM) bonded over: high plastic content.
	TYPE 3 (lift pit)	Drawings: 16 and 33 series	Waterproofing beneath lift pit	To contractor's design.		Note: No details for this. Likely to be a membrane applied waterproofing system given membrane waterproofing used elsewhere: high plastic content
WALLS	**BUILD-UP 1:** Blockwork infill (to bin store for eg: dwg 16_012_P02)	Drawings: 16, 21 and 22 series	Horizontal DPC within course taken down and dressed over concrete slab edge, lapped into EPDM and DPM		X	Plastic sheeting used as damp-proof membrane: high plastic content.
	BUILD-UP 2: SFS infill (most Ext façade)	Drawings: 16, 21 and 22 series	Breather membrane over full area of cement particle board to outer face of SFS [assume taped and jointed at sheet positions and around fixing angles]		X	No specification for breather membrane other than reference to Euroclass B-s3,d0. Assumed to be a plasticated membrane: high plastic content.
			Vapour Control Layer to inner face of SFS infill over full area [assume taped and jointed at sheet positions and around fixing angles]		X	No specification for Vapour Control Layer other than to reference to Euroclass A2-s1,d0. Given that the inner finish is plasterboard it is assumed that the VCL also serves as the ATL. Likely to be taped and jointed throughout. As ATL and VCL this will need to be a plastic sheeting: high plastic content. All tape and jointing will be Butyl Air tightness tape. VCL shown lapped over slab (21 dwgs) so assume taping is also used as ATL to wall slab interface. Also lapped into window assumed to be through AT tape: high plastic content. NB insulation between SFS shown as mineral wool see drawing 600_P03 (very low plastic content)
			VCL / ATL taped and jointed at each penetration, to overlap between sheets, slab interface and window jambs	Not specified		
			Siniat Weather defence boarding to Insitu Concrete downstand at floor positions (not ground) (see DWG 21-002)		X	Weather defence boarding is made from polymer and glass fibre: moderate plastic content. Siniat datasheet states that outer face of boards needs to be sealed if used for weathertightness. Sealing to be GTEC Fire Rated Silicone Sealant: high plastic content.

	WINDOWS, DOORS AND FRAMES	Outline spec 4.3; Implied Datasheets	Finish options as: ○ Anodised aluminium ○ PVDF (polyvinylidene fluoride coating) ○ Marine grade powder coated aluminium	Y: Anodised aluminium		Polyvinylidene fluoride coating (PVDF) is a highly resistant / durable plastic. An alternative is provided in the specification, but all drawings show PVDF: high plastic content as coating.
	RAIN SCREEN CLADDING	Outline spec 4.2	Finish options as: ○ Anodised aluminium ○ PVDF ○ Marine grade powder coated aluminium	Y: Anodised aluminium		Alternative provided in specification, but all drawings show PVDF: high plastic content as coating. NB insulation behind rainscreen shown as 225 mineral wool - see drawing 600_P03 (P03.1) (very low plastic content). However, also note that drawing 21_004 (P04) shows this insulation as rigid insulation (high plastic content). For the sake of this audit wall types have been assumed as correct.
ROOF	**TYPES A and B**	Drawings: 27 series (27_104_P02); Outline spec 4.6	Bakor 790-11 Hot applied membrane roofing system to conc slab:		X	Data sheet states that this system contains: Refined bitumen, synthetic rubbers, recycled rubber, and additives. Synthetic rubber is a polymer with high plastic content. System requires additional polyester reinforced sheet (membrane): high plastic content. System also requires accessories which include Butyl flashing etc… All accessories noted are polymer based: high plastic content.
			Bauder Primer and X4S Protection layer		X	Not specified in the drawings but this is noted in the datasheet including in the specification. Bauder primer is a synthetic rubber-based primer: high plastic content. Bauder protection layer has Mica top, polyethylene bottom with a polyester fleece reinforcement: high plastic content.
			BauderGlas T3_ tapered insulation		X	BauderGlas is, itself, made of recycled glass and natural materials similar to Foamglas. System has a 0.5mm Bitumen top film: fossil fuel (petroleum) based.
			BauderGlas bonding between all sheets		X	BauderGlas must be bonded using a polyurethane-based adhesive: high plastic content.
			Water control layer		X	Plastic sheeting as waterproofing layer: high plastic content. But this is not the only option. Can be applied over other waterproofing options such as paving or ballast which has a much lower plastic content.
	TYPE C	Drawings: 27 series (27_104_P02); Outline spec 4.6	Bakor 790-11 Hot applied membrane roofing system to conc slab:		X	Data sheet states that this system contains: Refined bitumen, synthetic rubbers, recycled rubber, and additives. Synthetic rubber is a polymer with high plastic content. System requires additional polyester reinforced sheet (membrane): high plastic content. System also requires accessories which include Butyl flashing etc… All accessories noted are polymer based: high plastic content.
			Bauder Primer and X4S or hot bitumen Protection layer over primer bitumen coat.		X	Not specified in the drawings but this is inc in the datasheet including in the spec. Bauder primer is a synthetic rubber-based primer: high plastic content. Bauder protection layer has Mica top, polyethylene bottom with a polyester fleece reinforcement: plastic content high. Note: the specification for the hot melt roofing system identifies Bauder system. But the drawings show Foamglas insulation. The datasheets for foamglas show hot bitumen as protective layer. This is petroleum based but has a lower plastic content than the Bauder protection layer.
			Foamglas T3+		X	Note: It is not clear why roof type C shows Foamglas whilst the other roof types show BauderGlas. Foamglas is, also made of recycled glass and natural materials.
			Bitumen membrane to calcium cement facing board		X	Note: The Foamglas standard detail (system 4.1.1) does not show calcium cement board. It shows 2 layers pf bitumen membrane over insulation.
	RAINWATER PIPES	Outline spec 4.6	Internal rainwater pipes to be high density Polyethylene (HDPE) or similar alternative.		X	High density Polyethylene (HDPE) has a high plastic content.
EXT components	**BALUSTRADE AND BALCONY CLADDING:**	Outline spec 4.4	Finish options as: ○ PPC (polyester powder coating) ○ Steel [presumably stainless marine grade]	Y: Steel		Polyester powder coating (PPC) is a plasticated coating. Alternative provided in specification, but all drawings show PPC: high plastic content as coating.
	EXPOSED STEELWORK	Outline spec 4.4	Galvanised steel to be painted [presumably with acrylic paint]		X	No specification for paint to exposed steel. Assumed to be acrylic paint: high plastic content as coating.

TABLE 2: Assessing the outline specification and drawings: Components identified with plastic content within the interior finishes.

INTERIOR FINISHES						
Component		**Reference**	**Plasticated Specification**	**Alternative**		**Notes**
				Y	**N**	
FLOOR FINISHES	**FINISH TYPE 1**	Outline spec: finishes schedule	Gradus esplanade 1000 barrier matting - Nylon wipers (finish) over aluminium base with PVC-u linking strips		X	
	FINISH TYPE 2	Outline spec: finishes schedule	Carpet tile Forbo Tessera Nexus. 100% dyed polyamide on Polyester primary backing and modified bitumen and polyester fleece secondary backing. Adhesive bonded.		X	
	FINISH TYPE 3	Outline spec: finishes schedule	Natural tile to Regupol 4515 acoustic underlay		X	
	FINISH TYPE 4	Outline spec: finishes schedule	Shaw 100% nylon carpet with polypropylene primary backing and glued installation		X	
	FINISH TYPE 5	Outline spec: finishes schedule	Wood effect vinyl Karndean Fixed to Regipol 4515 acoustic underlay		X	
	FINISH TYPE 6	Outline spec: finishes schedule	Havwoods PurePlank engineered timber with Bonding agent		X	
WALL / CLG FINISHES	**PARTITIONS**	Outline spec 5.1	Finish options ○ 3mm skim finish or ○ Tape and jointed	Y: 3mm skim		Alternative provided in specification as 3mm skim. All drawings show 3mm skim.
	FINISH TYPE 1	Outline spec: finishes schedule	Dulux trade eggshell		X	
	FINISH TYPE 2	Outline spec: finishes schedule	Dulux trade Super matt emulsion		X	
	FINISH TYPE 3	Outline spec: finishes schedule	Dulux trade moisture resistant		X	
	FINISH TYPE 4	Outline spec: finishes schedule	AMF Mondena grid system – PPC metal		X	
DOOR / FINISHES	**DOORS**	Outline spec 5.0	Finish options: ○ softwood painted [artificial resin paint] ○ hardwood	Y		Specifications for paint finish are shown under door finishes. This implies a preference for the painted softwood option.
	FINISH TYPE 1	Outline spec: finishes schedule	Eggar laminate – melamine finish		X	
	FINISH TYPE 2	Outline spec: finishes schedule	Dulux trade eggshell		X	
JOINERY	**TYPE 1**	Outline spec: finishes schedule	Timber painted		X	Assumed to be Dulux Trade eggshell
	TYPE 2	Outline spec: finishes schedule	kitchen units– Eggar laminate		X	
	JOINERY 3	Outline spec: finishes schedule	kitchen carcass – laminate faced chipboard with laminated plinth		X	
	JOINERY 4	Outline spec: finishes schedule	kitchen worktop – Eggar laminate		X	
	JOINERY 5	Outline spec: finishes schedule	bathroom shelving – Eggar laminate		X	
SIGNAGE	**SIGNAGE 1**	Outline spec: finishes schedule	aluminium PPC.		X	
SANITARY	**ITEM 1**	Outline spec: finishes schedule	acrylic bath by Ideal Standard		X	
	ITEM 2	Outline spec: finishes schedule	Mstone rectangular shower tray is stone resin		X	
	ITEM 3	Outline spec: finishes schedule	Sandringham seat and cover (plastic)		X	
	ITEM 4	Outline spec: finishes schedule	Wall hung mirror		X	No specification for this, but image shows a plastic surround.

TABLE 3: Assessment of plastic within the external envelope

EXTERIOR / ENVELOPE						
Component		**Reference**	**Plasticated Specification**	**Plastic Level**	**Plastic Quantity**	**Priority Rating**
FLOORS	**TYPE 1** (within Thermal envelope) Ref: Dwgs: 16 and 33 series	Drawings: 16 and 33 series	DPM over concrete base	HIGH	HIGH	HIGH
			110mm Kingspan Kooltherm K103 to achieve 0.11 W/m2K over DPM	HIGH	HIGH	HIGH
			Rigid Perimeter insulation (assumed PIR) to be 0.8 W/m2K U value to avoid thermal bridging	HIGH	MEDIUM	HIGH
			Separation layer	HIGH	HIGH	HIGH
			75 Mapei floating screed with Admixtures like super-plasticisers to screed reduce drying time	LOW	LOW	LOW
			7.5mm or 10mm or 12.5mm latex screed over (drawings 33)	HIGH	HIGH	HIGH
			Slab edge: Foamglas	LOW	LOW	LOW
			Slab edge: EPDM over Foamglas	HIGH	MEDIUM/LOW	MEDIUM
	TYPE 2 (outside Thermal envelope)	Drawings: 16 and 33 series	DPM over concrete base	HIGH	HIGH	HIGH
			Structural screed	LOW	LOW	LOW
			Admixtures like super-plasticisers to screed reduce drying time	LOW	LOW	LOW
			Slab edge: Foamglas	LOW	LOW	LOW
			Slab edge: EPDM over Foamglas	HIGH	MEDIUM/LOW	MEDIUM
	TYPE 3 (lift pit)	Drawings: 16 and 33 series	Waterproofing beneath lift pit	HIGH	MEDIUM	HIGH
WALLS	**BUILD-UP 1:** Blockwork infill (to bin store for eg: dwg 16_012_P02)	Drawings: 16, 21 and 22 series	Horizontal DPC within course taken down and dressed over concrete slab edge, lapped into EPDM and DPM	HIGH	HIGH	HIGH
	BUILD-UP 2: SFS infill (most Ext façade)	Drawings: 16, 21 and 22 series	Breather membrane over full area of cement particle board to outer face of SFS [assume taped and jointed at sheet positions and around fixing angles]	HIGH	HIGH	HIGH
			Vapour Control Layer to inner face of SFS infill over full area [assume taped and jointed at sheet positions and around fixing angles]	HIGH	HIGH	HIGH
			VCL / ATL taped and jointed at each penetration, to overlap between sheets, slab interface and window jambs	HIGH	LOW	LOW
			Siniat Weather defence boarding to Insitu Concrete downstand at floor positions (not ground) (see DWG 21-002)	MEDIUM / HIGH (Board is medium Sealing is high)	MEDIUM/ LOW	MEDIUM
	WINDOWS, DOORS AND FRAMES	Outline spec 4.3; Implied Datasheets	Finish options as: ○ Anodised aluminium ○ PVDF (polyvinylidene fluoride coating) ○ Marine grade powder coated aluminium	HIGH	MEDIUM/LOW (Given thickness of coating)	MEDIUM
	RAIN SCREEN CLADDING	Outline spec 4.2	Finish options as: ○ Anodised aluminium ○ PVDF ○ Marine grade powder coated aluminium	HIGH	MEDIUM Given thickness of coating	MEDIUM
ROOF	**TYPES A and B**	Drawings: 27 series (27_104_P02); Outline spec 4.6	Bakor 790-11 Hot applied membrane roofing system to conc slab:	HIGH	HIGH	HIGH
			Bauder Primer and X4S Protection layer	HIGH	HIGH	HIGH
			BauderGlas T3_ tapered insulation	LOW	LOW	LOW
			BauderGlas bonding between all sheets	HIGH	LOW	LOW
			Water control layer	HIGH	HIGH	HIGH
	TYPE C	Drawings: 27 series (27_104_P02); Outline spec 4.6	Bakor 790-11 Hot applied membrane roofing system to conc slab:	HIGH	HIGH	HIGH
			Bauder Primer and X4S or hot bitumen Protection layer over primer bitumen coat.	LOW [but Petrol based]	LOW	LOW
			Foamglas T3+	LOW	LOW	LOW
			Bitumen membrane to calcium cement facing board	LOW [but Petrol based]	LOW	LOW
	RAINWATER PIPES	Outline spec 4.6	Internal rainwater pipes to be high density Polyethylene (HDPE) or similar alternative.	HIGH	LOW	MEDIUM
EXT components	**BALUSTRADE AND BALCONY CLADDING:**	Outline spec 4.4	Finish options as: ○ PPC (polyester powder coating) ○ Steel [presumably stainless marine grade]	HIGH	LOW	LOW
	EXPOSED STEELWORK	Outline spec 4.4	Galvanised steel to be painted [presumably with acrylic paint]	HIGH	LOW	LOW

TABLE 4: Assessment of plastic within the interior finishes

INTERIOR FINISHES						
Component		**Reference**	**Plasticated Specification**	**Plastic Level**	**Plastic Quantity**	**Priority Rating**
FLOOR FINISHES	**FINISH TYPE 1**	Outline spec: finishes schedule	Gradus esplanade 1000 barrier matting - Nylon wipers (finish) over aluminium base with PVC-u linking strips	HIGH	MEDIUM	MEDIUM
	FINISH TYPE 2	Outline spec: finishes schedule	Carpet tile Forbo Tessera Nexus. 100% dyed polyamide on Polyester primary backing and modified bitumen and polyester fleece secondary backing. Adhesive bonded.	HIGH	MEDIUM	HIGH
	FINISH TYPE 3	Outline spec: finishes schedule	Natural tile to Regupol 4515 acoustic underlay	LOW	MEDIUM	MEDIUM/LOW
	FINISH TYPE 4	Outline spec: finishes schedule	Shaw 100% nylon carpet with polypropylene primary backing and glued installation	HIGH	HIGH	HIGH
	FINISH TYPE 5	Outline spec: finishes schedule	Wood effect vinyl Karndean Fixed to Regipol 4515 acoustic underlay	HIGH	HIGH	HIGH
	FINISH TYPE 6	Outline spec: finishes schedule	Havwoods PurePlank engineered timber with Bonding agent	LOW	LOW	LOW
WALL / CLG FINISHES	**PARTITIONS**	Outline spec 5.1	Finish options ○ 3mm skim finish or ○ Tape and jointed	LOW	LOW	LOW
	FINISH TYPE 1	Outline spec: finishes schedule	Dulux trade eggshell	HIGH	HIGH	MEDIUM
	FINISH TYPE 2	Outline spec: finishes schedule	Dulux trade Super matt emulsion	HIGH	HIGH	HIGH
	FINISH TYPE 3	Outline spec: finishes schedule	Dulux trade moisture resistant	HIGH	HIGH	HIGH
	FINISH TYPE 4	Outline spec: finishes schedule	AMF Mondena grid system – PPC metal	LOW	MEDIUM	LOW
DOOR / FINISHES	**DOORS**	Outline spec 5.0	Finish options: ○ softwood painted [artificial resin paint] ○ hardwood	LOW [assume hardwood]	LOW	LOW
	FINISH TYPE 1	Outline spec: finishes schedule	Eggar laminate – melamine finish	HIGH	HIGH	HIGH
	FINISH TYPE 2	Outline spec: finishes schedule	Dulux trade eggshell	HIGH	HIGH	HIGH
JOINERY	**TYPE 1**	Outline spec: finishes schedule	Timber painted	HIGH	LOW	LOW
	TYPE 2	Outline spec: finishes schedule	kitchen units– Eggar laminate	HIGH	HIGH	HIGH
	JOINERY 3	Outline spec: finishes schedule	kitchen carcass – laminate faced chipboard with laminated plinth	MEDIUM	HIGH	MEDIUM
	JOINERY 4	Outline spec: finishes schedule	kitchen worktop – Eggar laminate	HIGH	HIGH	HIGH
	JOINERY 5	Outline spec: finishes schedule	bathroom shelving – Eggar laminate	HIGH	MEDIUM	MEDIUM
SIGNAGE	**SIGNAGE 1**	Outline spec: finishes schedule	aluminium PPC.	MEDIUM	LOW	LOW
SANITARY	**ITEM 1**	Outline spec: finishes schedule	acrylic bath by Ideal Standard	HIGH	HIGH	HIGH
	ITEM 2	Outline spec: finishes schedule	Mstone rectangular shower tray is stone resin	LOW	LOW	LOW
	ITEM 3	Outline spec: finishes schedule	Sandringham seat and cover (plastic)	HIGH	MEDIUM	MEDIUM
	ITEM 4	Outline spec: finishes schedule	Wall hung mirror	MEDIUM	MEDIUM	MEDIUM

TABLE 5: Identifying plastic-reduced swap-outs within the external envelope

EXTERIOR / ENVELOPE						
Component		**Reference**	**Plasticated Specification**	**Priority Rating**	**Swaps Outs**	**Further Research**
FLOORS	**TYPE 1** (within Thermal envelope) Ref: Dwgs: 16 and 33 series	Drawings: 16 and 33 series	DPM over concrete base	HIGH	**Swap plastic membrane DPM for admixture**: Waterproofing characteristics of the membrane could be achieved by introducing a plant-based crystalline admixture like Sika® WT-240 P into the concrete specification.	
			110mm Kingspan Kooltherm K103 to achieve 0.11 W/m2K over DPM	HIGH	**Swap Kingspan for Foamglas:** Foamglas is a plastic reduced alternative to phenolic insulation. Thermal conductivity is higher for Foamglas but could possibly achieve same U-value with deeper insulation zone. Foamglass to be laid over sand levelling layer over concrete slab.	
			Rigid Perimeter insulation (assumed PIR) to be 0.8 W/m2K U value to avoid thermal bridging	HIGH	**Swap PIR insulation with Foamglas:** Foamglas is a plastic reduced alternative to PIR insulation. Thermal conductivity is higher for Foamglas but could possibly achieve same U-value with thicker insulation.	Foamglas is loadbearing and can be used as structural support. By exchanging floor insulation and perimeter insulation with Foamglas, could the SFS could be fixed directly to Foamglas blocks – potentially designing out the thermal bridge? (see detail below)
			Separation layer	HIGH		Foamglas has been tested as a secondary waterproof layer. Is the separating layer necessary if Kingspan is swapped with Foamglas? If not, could Foamglas torched finish serve as separating layer?
			75 Mapei floating screed with Admixtures like super-plasticisers to screed reduce drying time	LOW	**Swap-out / design-out admixtures:** Some plasticated admixtures could be removed if the build programme was adapted to accommodate a longer curing period.	
			7.5mm or 10mm or 12.5mm latex screed over (drawings 33)	HIGH	**Swap-out latex screed (in part) with different finishes** Latex screed is presumably used to achieve higher tolerance for substrate to floor finishes. If finishes are replaced as below this tolerance could be accommodated in some of these finishes especially through underlays.	
			Slab edge: Foamglas	LOW	NA	
			Slab edge: EPDM over Foamglas	MEDIUM	**Swap-out EPDM over Foamglas with Foamglas Perisave** Foamglas Perisave face can be torch finished to act as waterproofing. Cut and adapt product to include all edges as necessary.	Foamglas has a low plastic content, but the bitumen finish has a high petroleum content. Could this Foamglas product be adapted to include a natural alternative to bitumen such as Kraft Lignin asphalt?
	TYPE 2 (outside Thermal envelope)	Drawings: 16 and 33 series	DPM over concrete base	HIGH	**Swap plastic membrane DPM for admixture**: Waterproofing characteristics of the membrane could be achieved by introducing a plant-based crystalline admixture like Sika® WT-240 P into the concrete specification.	
			Structural screed over separation layer	LOW	**No swap out identified**	
			Admixtures like super-plasticisers to screed reduce drying time	HIGH	**Swap-out / design-out admixtures:** Some plasticated admixtures could be removed if the build programme was adapted to accommodate a longer curing period.	
			Slab edge: Foamglas	LOW	NA	
			Slab edge: EPDM over Foamglas	MEDIUM	**Swap-out EPDM over Foamglas with Foamglas Perisave** Foamglas Perisave face can be torch finished to act as waterproofing. Cut and adapt product to include all edges as necessary.	Foamglas has a low plastic content, but the bitumen finish has a high petroleum content. Could this Foamglas product be adapted to include a natural alternative to bitumen such as Kraft Lignin asphalt?
	TYPE 3 (lift pit)	Drawings: 16 and 33 series	Waterproofing beneath lift pit	HIGH	**Swap plastic membrane DPM for admixture**: Waterproofing characteristics of the membrane could be achieved by introducing a plant-based crystalline admixture like Sika® WT-240 P into the concrete specification.	

WALLS	**BUILD-UP 1:** Blockwork infill (to bin store for eg: dwg 16_012_P02)	Drawings: 16, 21 and 22 series	Horizontal DPC within course taken down and dressed over concrete slab edge, lapped into EPDM and DPM	HIGH	**No swap-outs identified:** In current design configuration there are no low-plastic alternative currently available that can be used as a horizontal DPC within course and used as vertical dressing over concrete slab edge.	Could detail be modified to allow the Foamglas to extend up to the horizonal DPC? Waterproofing over the Foamglas (or Foamglass adapted to be used as waterproofing – see floor entry) could then be lapped into the horizontal course. Horizontal DPC could be replaced with two layers of slate with cement bonding (see detail below).
	BUILD-UP 2: SFS infill (most Ext façade)	Drawings: 16, 21 and 22 series	Breather membrane over full area of cement particle board to outer face of SFS [assume taped and jointed at sheet positions and around fixing angles]	HIGH	**No swap-outs identified:** No low-plastic alternative currently available with vapour resistance required (assumed 0. Sd). Solution should focus on minimising coverage.	Could a lime render solution replace the breather membrane given potential low Sd values?
			Vapour Control Layer to inner face of SFS infill over full area [assume taped and jointed at sheet positions and around fixing angles]	HIGH	**Swap VCL membrane with Smartply Propassiv:** Exchange VCL and ATL plasticated membrane with T+G structural OSB board or with specialist OSB board like Smartply Propassiv. Coating on this board contains paraffin but preferable to a petrochemical membrane. [NB also reduces risks of puncturing the ATL during construction and operation]	Is it possible to develop a structural T+G OSB board to act as ATL and VCL that is not covered with paraffin – perhaps a natural wax such as soy wax?
			VCL / ATL taped and jointed at each penetration, to overlap between sheets, slab interface and window jambs	LOW	**No swap-outs but quantity reduced** T+G boarding reduces extent of tape used especially given tape can be applied to solid substrate	
			Siniat Weather defence boarding to Insitu Concrete downstand at floor positions (not ground) (see DWG 21-002)	MEDIUM	**No swap-outs identified**	Could weather boarding be swapped out with an external lime-based render?
	WINDOWS, DOORS AND FRAMES	Outline spec 4.3; Implied Datasheets	Finish options as: ○ Anodised aluminium ○ PVDF (polyvinylidene fluoride coating) ○ Marine grade powder coated aluminium	MEDIUM	**Swap PVDF with anodised aluminium** Options as identified in the outline spec	
	RAIN SCREEN CLADDING	Outline spec 4.2	Finish options as: ○ Anodised aluminium ○ PVDF ○ Marine grade powder coated aluminium	MEDIUM	**Swap PVDF with anodised aluminium** Options as identified in the outline spec	
ROOF	**TYPES A and B**	Drawings: 27 series (27_104_P02); Outline spec 4.6	Bakor 790-11 Hot applied membrane roofing system to conc slab:	HIGH	**Swap hot applied membrane system for Foamglas system** Foamglas system includes 2 layer bitumen roofing sheets rather than plastic membrane.	2 layer bitumen roofing sheets is petrol based: (i) Could these be removed or swapped with non-plastic, non-bitumen alternative? (ii) Foamglas is watertight – and identified as a secondary waterproofing system. Could this be adapted to serve as primary waterproofing and remove need for bitumen sheet? (iii) Could bitumen sheet be exchanged for a sheet or coating that includes a natural alternative to bitumen such as Kraft Lignin asphalt?
			Bauder Primer and X4S Protection layer	HIGH		See above
			BauderGlas T3_ tapered insulation	LOW		See above
			BauderGlas bonding between all sheets	LOW		
			Water control layer	HIGH		Could plastic membrane waterproofing layer be swapped with a plant-based crystalline admixture like Sika® WT-240 P? This would reduce the use of plastic based membrane across the entire roofing area.
	TYPE C	Drawings: 27 series (27_104_P02); Outline spec 4.6	Bakor 790-11 Hot applied membrane roofing system to conc slab:	HIGH	**Swap hot applied membrane system for Foamglas system** Foamglas system includes 2 layer bitumen roofing sheets rather than plastic membrane.	2 layer bitumen roofing sheets is petrol based: (i) Could these be removed or swapped with non-plastic, non-bitumen alternative? (ii) Foamglas is watertight – and identified as a secondary waterproofing system. Could this be adapted to serve as primary waterproofing and remove need for bitumen sheet? (iii) Could bitumen sheet be exchanged for a sheet or coating that includes a natural alternative to bitumen such as Kraft Lignin asphalt?
			Bauder Primer and X4S or hot bitumen Protection layer over primer bitumen coat.	LOW		See above
			Foamglas T3+	LOW		See above
			Bitumen membrane to calcium cement facing board	LOW		See above
	RAINWATER PIPES	Outline spec 4.6	Internal rainwater pipes to be high density Polyethylene (HDPE) or similar alternative.	MEDIUM	**Swap HDPE with galvanised steel waterpipe.** Higher grade galvanised steel has similar lifespan to HDPE.	
EXT components	**BALUSTRADE AND BALCONY CLADDING:**	Outline spec 4.4	Finish options as: ○ PPC (polyester powder coating) ○ Steel [presumably stainless marine grade]	LOW	**Swap PPC for marine grade steel** as identified in the outline spec	
	EXPOSED STEELWORK	Outline spec 4.4	Galvanised steel to be painted [presumably with acrylic paint]	LOW	**Swap galvanised steel with marine grade stain steel** or with in-situ or pre-fab concrete structure in exposed conditions.	

TABLE 6: Identifying plastic-reduced swap-outs within the internal finishes

INTERIOR FINISHES						
Component		**Reference**	**Plasticated Specification**	**Priority Rating**	**Swaps Outs**	**Further Research**
FLOOR FINISHES	**FINISH TYPE 1**	Outline spec: finishes schedule	Gradus esplanade 1000 barrier matting - Nylon wipers (finish) over aluminium base with PVC-u linking strips	MEDIUM	**Swap Gradus matting with heavy duty Coir.** Product is very tough, traditional, and natural fibre. Made from coconut shells. Set within recess so can be replaced if damaged.	
	FINISH TYPE 2	Outline spec: finishes schedule	Carpet tile Forbo Tessera Nexus. 100% dyed polyamide on Polyester primary backing and modified bitumen and polyester fleece secondary backing. Adhesive bonded.	HIGH	**Swap polyester carpet tiles with coir tiles.** Coir tiles are highly durable and natural fibre without plastic.	
	FINISH TYPE 3	Outline spec: finishes schedule	Natural tile to Regupol 4515 acoustic underlay	MEDIUM/LOW	**Swap Regupol 4515 with APC Cork rolls.** Regupol 4515 Is offered as an eco-option because of high recycled content and cork, but still contains PUR foam. Can only be used with ceramic tiles. APC Cork rolls can be used with natural stone and ceramic tiles – no thickness limitation given.	
	FINISH TYPE 4	Outline spec: finishes schedule	Shaw 100% nylon carpet with polypropylene primary backing and glued installation	HIGH	**Swap nylon carpet with a pile looped wool carpet or seagrass.** Pile looped wool carpet is not for commercial use. Given specification is intended for residential there is no need to include high impact commercial grade carpets. Seagrass would provide a tougher use option if needed.	
	FINISH TYPE 5	Outline spec: finishes schedule	Wood effect vinyl Karndean Fixed to Regipol 4515 acoustic underlay	HIGH	**Swap vinyl flooring in living area and dining area for seagrass** **Swap vinyl flooring in kitchen and possible in dining area for ceramic tiles over cork acoustic underlay.**	
	FINISH TYPE 6	Outline spec: finishes schedule	Havwoods PurePlank engineered timber with Bonding agent	LOW	-	
WALL / CLG FINISHES	**PARTITIONS**	Outline spec 5.1	Finish options ○ 3mm skim finish or ○ Tape and jointed	LOW	**Swap tape and jointed for 3mm skim** As per drawings	
	FINISH TYPE 1	Outline spec: finishes schedule	Dulux trade eggshell	MEDIUM	**Swap artificial resin paint for durable lime-based paint or exposed unpainted or oiled timber boarding / skirting** Graphenstone paint would be a possible alternative.	
	FINISH TYPE 2	Outline spec: finishes schedule	Dulux trade Super matt emulsion	HIGH	**Swap artificial resin paint for durable lime-based paint** Graphenstone paint would be a possible alternative.	
	FINISH TYPE 3	Outline spec: finishes schedule	Dulux trade moisture resistant	HIGH	**Swap artificial resin paint for durable lime-based paint** Graphenstone paint would be a possible alternative.	
	FINISH TYPE 4	Outline spec: finishes schedule	AMF Mondena grid system – PPC metal	LOW	-	
DOOR / FINISHES	**DOORS**	Outline spec 5.0	Finish options: ○ softwood painted [artificial resin paint] ○ hardwood	LOW	**Swap artificial resin paint with natural timber oil / stain**	
	FINISH TYPE 1	Outline spec: finishes schedule	Eggar laminate – melamine finish	HIGH	**Swap melamine laminate with natural timber oil / stain** Option to use Accoya laminate over softwood if more durability required.	
	FINISH TYPE 2	Outline spec: finishes schedule	Dulux trade eggshell	HIGH	**Swap artificial resin paint with natural timber oil / stain**	

JOINERY	**TYPE 1**	Outline spec: finishes schedule	Timber painted	LOW	**Swap artificial resin paint with natural timber oil / stain**	
	TYPE 2	Outline spec: finishes schedule	kitchen units– Eggar laminate	HIGH	**Swap laminate with natural oil** All kitchen units, carcass, and shelving to be softwood finished with hard wearing natural oil finish. Better quality wood to visible surfaces and lower grade for carcass. Worktop to be in Accoya wood finished with hard wearing natural oil finish. Option to use Accoya for carcass and units if more durability required.	
	JOINERY 3	Outline spec: finishes schedule	kitchen carcass – laminate faced chipboard with laminated plinth	MEDIUM	**Swap laminate with natural oil** As above	
	JOINERY 4	Outline spec: finishes schedule	kitchen worktop – Eggar laminate	HIGH	**Swap laminate with natural oil** As above	
	JOINERY 5	Outline spec: finishes schedule	bathroom shelving – Eggar laminate	MEDIUM	**Swap laminate with natural oil** As above	
SIGNAGE	**SIGNAGE 1**	Outline spec: finishes schedule	aluminium PPC.	LOW	**Swap PPC aluminium with laser-cut Accoya timber treated with Linseed oil.**	
SANITARY	**ITEM 1**	Outline spec: finishes schedule	acrylic bath by Ideal Standard	HIGH	**Swap acrylic bath with vitreous (porcelain) enamelled steel bath**	
	ITEM 2	Outline spec: finishes schedule	Mstone rectangular shower tray is stone resin	LOW	**Swap stone resin with vitreous (porcelain) enamelled steel shower tray**	
	ITEM 3	Outline spec: finishes schedule	Sandringham seat and cover (plastic)	MEDIUM	**Swap plastic seat and cover with timber seat and cover**	
	ITEM 4	Outline spec: finishes schedule	Wall hung mirror	MEDIUM	**Swap plastic frame with frameless mirror** Metal clips direct fixed to wall.	

Wirral Waters

PEEL WATERS
WATERSIDE REGENERATION

Changing Streams

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