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Introduction

Miss A Client is doing a development of a two-story detached house on a reclaimed site, using a raft foundation. Three construction strategies have been considered: Timber Twin Frame, Structural Insulated Panels (SIPS), and Brick and Block construction. This case study will compare these options, examining their approaches to ground floor to wall junctions, window installation details, and eaves and roof structures. Specific attention is given to compliance with current Building Regulations and Thermal Performance.

Timber Twin Frame construction uses two timber frames built closely together to make a strong, highly insulated wall. It is lightweight, can vary in design, and provides better thermal performance compared to traditional masonry (TurnerTimber 2013).

Structural Insulated Panels (SIPS) are factory-made panels with insulation between two sections, usually OSB (oriented strand board). These are quick and simple to make on site, very energy efficient, and turn them into airtight buildings (foundationsuk n.d.).

Brick and Block construction is the traditional method and most used; using an outer brick wall and an inner block wall with insulation in between. Positives of this include its durability, fire resistance, and longevity. Its downside is that it takes longer to build than timber systems. In older buildings you can see brick and blocks used more as it is more thermal resistant and acts somewhat like its own external insulator (brick org 2023).

The purpose of this report is to evaluate the three construction methods, to assess their key features and performance concluding in a recommendation of the most suitable option.

Offsite Construction

Modern construction recently relies on off-site methods to improve efficiency, speed, and product quality. These are divided into four main categories: volumetric construction, panelised systems, sub-assemblies, and component manufacture

Volumetric construction is the manufacture of 3D building sections, known as modules. These are transported to site and erected to form the building. It's often used for hotels, student accommodation, and healthcare because it speeds up construction. Downsides include the need for careful transport planning and heavy lifting on site.

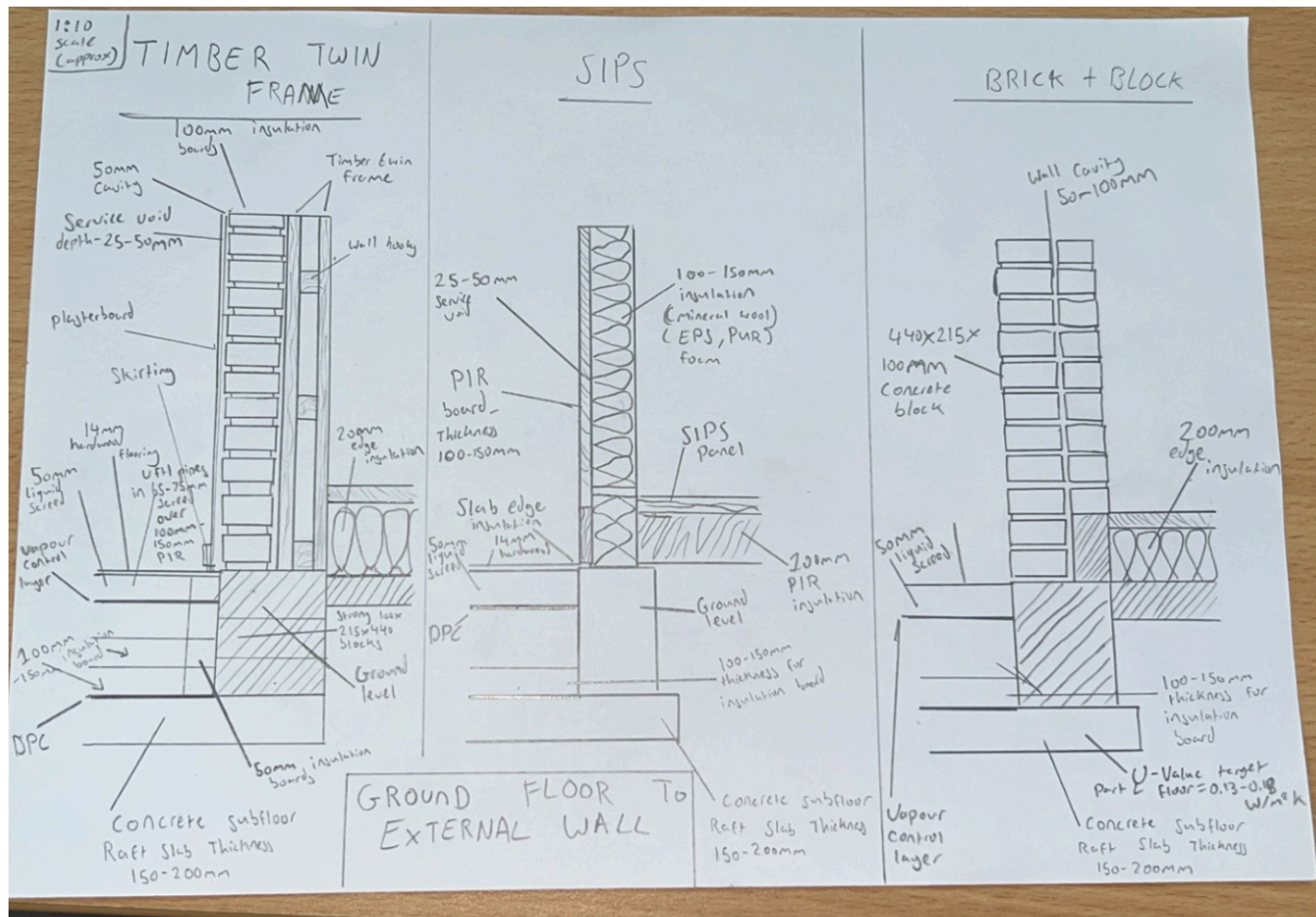
Panelised systems involve creating flat building elements like walls, floors, or roofs off-site. These are delivered and assembled on site. Panelised construction is more flexible than volumetric because the panels suit different designs. Examples include timber frames and SIPS, which help speed up builds while keeping some on-site work. Sub-assemblies are building parts prefabricated separately, like staircases, pods, lifts, or MEP systems. Making these off-site reduces time and errors during construction. This method is ideal for complex, technical builds.

Component manufacture focuses on making smaller building parts off-site. Items like windows, doors, and cladding systems are factory-made, then installed during normal construction. It's common across the industry to improve quality and reduce on-site labour.

Offsite construction would help this project by speeding up work and improving quality. SIPs could be used for walls, offering thermal performance and fast assembly. Prefabricated roof trusses can be installed with cranes, saving time and improving safety. Factory-made windows and doors give better finishes and reduce weather delays. Offsite methods would help to achieve a quicker build with less issues.

This report responds to Miss A Client's request for a proper comparison of Timber Twin Frame, SIPs, and Brick and Block construction for her two-storey house. The home is on a reclaimed site with a raft foundation, which affects which method will work best. Each option is compared based on how it handles the ground floor, windows, and roof/eaves. The report gives a recommendation by looking at thermal performance, moisture protection, Building Regulations, and ease of construction on this site.

Ground Floor to External Wall Junction



Timber Twin Sketch - Figure 1

SIPS Sketch - Figure 2

Brick and Block Sketch - Figure 3

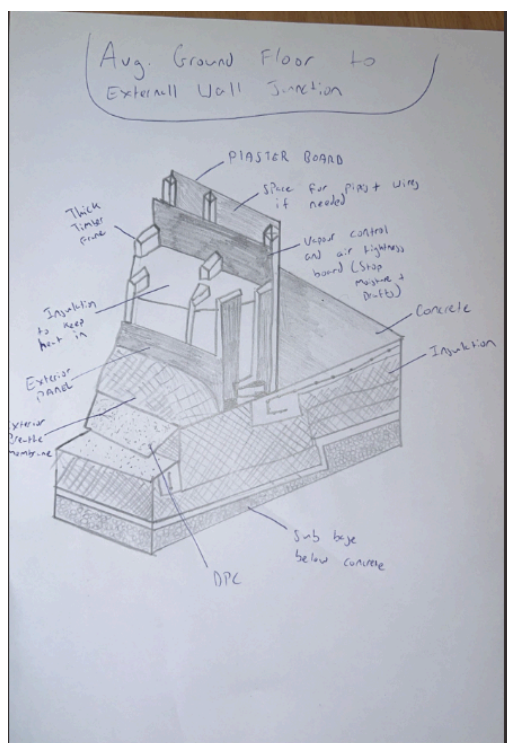
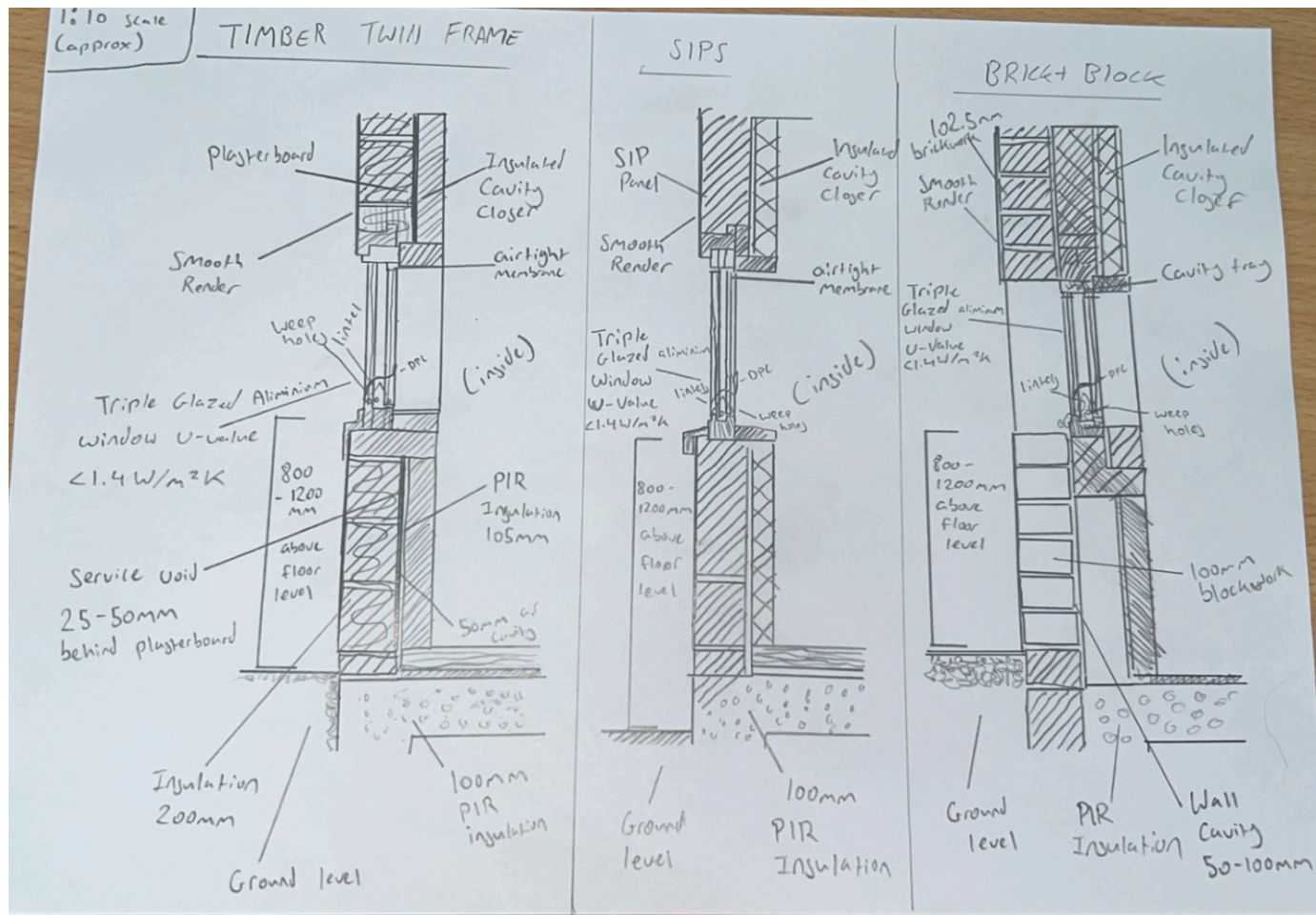


Figure 4
(3D drawing of Ground floor to external wall junction)

Timber Twin Frame (Figure 1) normally uses a treated timber sole plate on the concrete raft foundation, with insulation between twin studs and damp proof course (DPC) placed inside stopping any unwanted moisture build up (turnertimber 2013). While it offers thermal performance, there is greater risk of cold bridging unless fitted carefully. The next is SIPS (Figure 2) it provides an insulation layer throughout panels (Foundationsuk), reducing thermal bridging at the floor junction and improving airtightness. Careful sealing at the base is important to meet Building Regulations for air permeability. From looking at figure 3 which shows a brick and block construction features a more original creation, with the blockwork interior and brick exterior directly placed onto the raft foundation, adding cavity or internal insulation (brickorg 2023). While it is strong and highly durable, it carries a larger risk of thermal bridging unless insulation measures are put in for extra protection. SIPS offers the best thermal performance and airtightness; Timber Frame gives efficiency and flexibility but needs detailing and Brick and Block delivers durability but needs extra insulation to meet modern thermal standards. Figure 4 shows a 3d version of a wall meeting the ground for a different view of what's happening.

When comparing them, SIPS gives the best insulation all the way through with minimal heat loss. Brick & Block is strong but needs more insulation around the edges of the slab. Timber Twin is flexible to build with, but can leak heat and air when fitted wrong. All of them have to meet floor insulation targets of around 0.13 to 0.18 U-value (Part L), so airtightness and slab edge insulation are important. (Welsh Government, 2019)

Window Opening Detail



Triple-glazed unit – U-value $\leq 1.4 \text{ W/m}^2\text{K}$

Timber Twin Sketch - Figure 5

SIPS Sketch - Figure 6

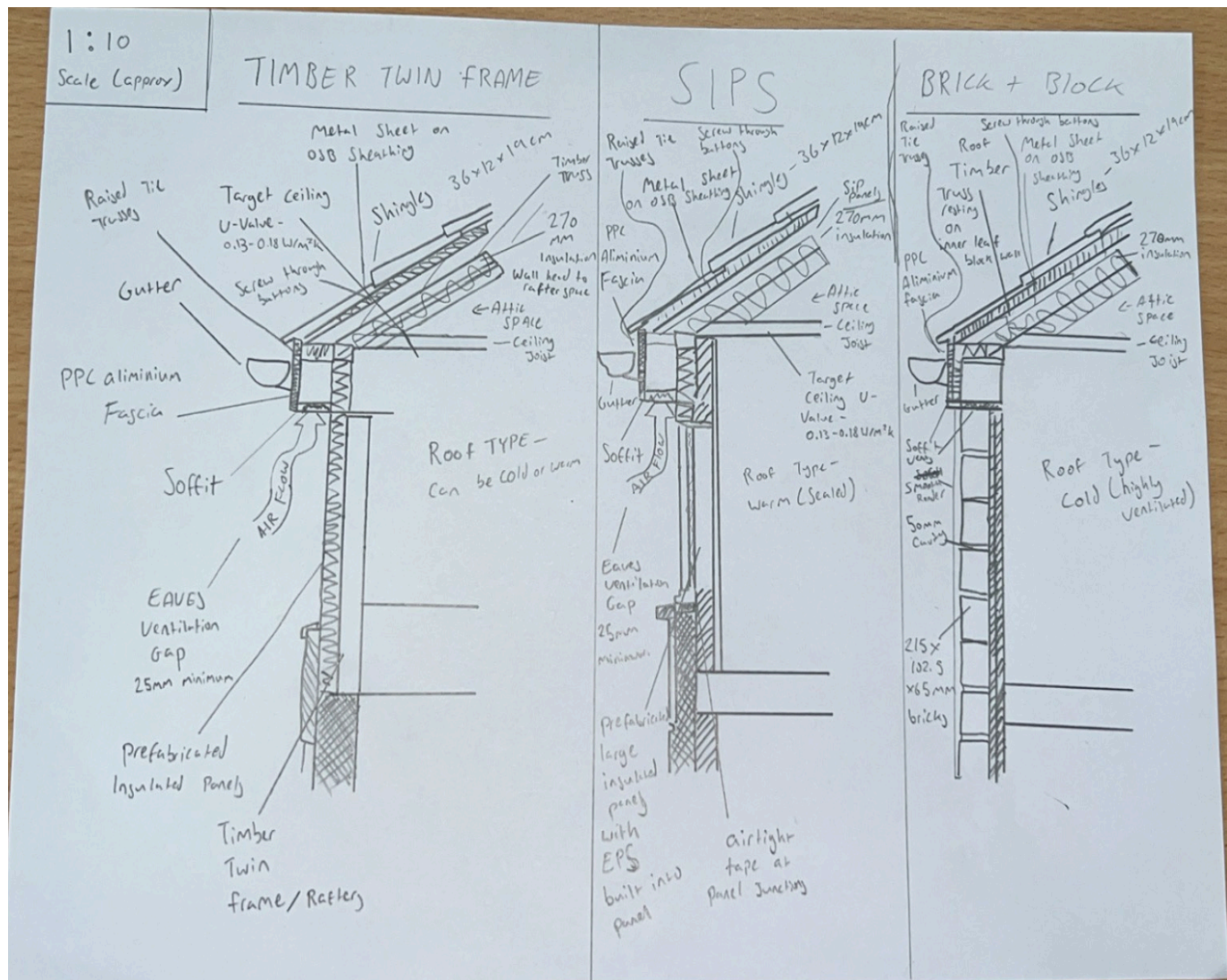
Brick and Block Sketch - Figure 7

Detailing window openings requires careful measurements and planning, as they trigger the most heat loss. Timber Twin Frame construction as shown in Figure 5 forms the opening using doubled-up timber studs, with insulation fitted around the frame and a cavity tray or DPC used to prevent moisture buildup (turnertimber 2013). Whilst effective, it creates thermal bridging around the window unless properly insulated. Figure 6 shows a SIPS construction eases the process by cutting the window opening into the insulated panel with the correct fit, (foundationsuk n.d.), keeping continuity of insulation and reducing cold bridging, additional framing around the window may be needed for structural support. Brick and Block construction as seen in Figure 7 involves forming the window opening with lintels across the cavity wall, using cavity trays, weep holes, and internal insulation to manage

moisture input and output and thermal performance. This is durable but weak to thermal breaks unless proper insulation is used. SIPS come with openings already cut, so they're more airtight with best thermal properties. Timber needs proper sealing and tapes to stop heat leaking out. Brick and Block needs cavity closers and DPCs to deal with cold spots and moisture.

Windows are one of the main spots where heat escapes, so Part L says they need to have a U-value of 1.4 or lower.

Eaves and Roof Structure Detail



Insulation to achieve U-value 0.13–0.16 W/m²K

Timber Twin Sketch - Figure 8

SIPS Sketch - Figure 9

Brick and Block Sketch - figure 10

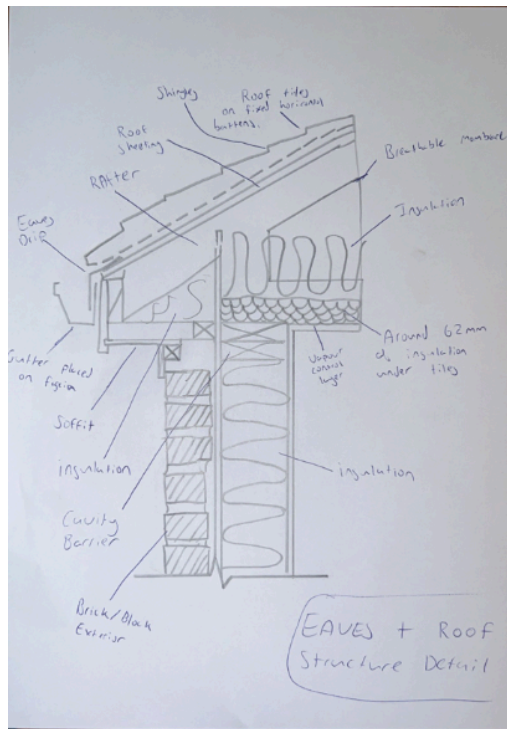


Figure 11

From the eaves and roof junction sketches, Timber Twin Frame (Figure 8) typically uses timber rafters/trusses on a wall plate, with ventilation throughout soffit vents and insulation to keep heat in the roof space (TurnerTimber 2013).

SIPS construction (Figure 9) uses insulated roof panels that continue the thermal core from the walls, giving airtightness and minimal thermal bridging. Proper sealing is essential, as SIPS is weak to moisture if sealed incorrectly (FoundationsUK n.d.).

Brick and Block (Figure 10) uses trussed roof on the inner blockwork, with insulation at ceiling level, cavity barriers, and ventilation through eaves vents. This method can have more thermal bridging at the wall plate unless detailing is added.

SIPS gives a consistent thermal envelope at the eaves. Timber is quick to install and flexible. Brick and Block is strong but needs detailing for airtightness and insulation.

Eaves must include ventilation to prevent condensation. This could mean leaving around a 35mm ventilation gap between the insulation and the roof. Solid insulation such as PIR boards or foam boards is the choice here, as traditional insulation materials like mineral wool can stop airflow if fitted incorrectly, another choice that could be used is radiant barriers in the attic that wrap around the room and trap heat.. Continuity of insulation is needed to meet U-values between 0.13–0.16 W/m²K. SIPS maintain insulation up to the roof with no gaps. Timber allows for prefabricated roof panels. Brick and Block requires extra insulation at the top of the walls and ceiling to stop heat loss.(Welsh Government, 2024)

Recommendation

The main goal of the development is to manage energy efficiency, airtightness, and insulation whilst following UK Building Regulations.

The first part of the house looked at was the Ground Floor Junction, where the land meets the super structure. The three strategies deal with thermal bridging at the junction. Timber Twin Frame uses two stud walls with an insulated cavity between them (Turnertimber 2013), with timber on a DPM over the slab and insulation at the slab edge to lower heat loss. SIPs sit on a timber plate fixed to the slab, maintaining airtightness and thermal performance. Brick & Block walls have inner and outer leaves with cavity insulation and edge insulation at the slab perimeter, plus a DPC under both layers. They all need air barriers and slab edge insulation to meet Part L energy standards.

The next section that was looked at was window details. Windows are an important area as they have high heat loss and air leakage. Timber Twin Frame windows are placed into stud frames with wide reveals, with air and weather tightness achieved using tapes. In SIPs, windows fit into already made openings, with airtightness made from the factory with tapes and sealants. Brick & Block windows are fixed to the inner leaf, with DPCs and cavity barriers to prevent moisture issues and cold bridging. Foam insulation and sealants create the air barrier. All of these systems can reach the window U-value target of around 1.4 W/m²K when fitted properly.

The last part we looked at was the Eaves and Roof Construction. Roof construction must meet insulation and airtightness standards to be built. Timber Twin Frame roofs use insulated panels, which can be built on-site or in a factory. Air barriers and insulation continue through the eaves with no gaps. SIP roofs are made from big insulated panels with a vapour control layer inside, and depending on the design, some are vented and others are sealed. Brick & Block roofs use timber rafters with insulation between them, with a ventilated roof space to avoid condensation. Insulation is full at the wall head to stop thermal bridging. All roof types must meet the U-value target of 0.13–0.16 W/m²K.

Conclusion

All construction drawings were made with guidance from current UK Building Regulations, allowing for thermal efficiency, moisture protection, and buildability to be maintained across all three methods, throughout this study we looked at SIPs brick and block and timber twin from these three my recommendation would be to go with SIPs as its best suited for this project as it offers strong thermal performance, air tightness and quick build times with offsite construction. Being built beforehand in a factory setting ensures accuracy and quality. Timber Twin frame also has that advantage of being prefabricated off site with the option for building on site giving it freedom, known as builders preference as its lightweight and performs well thermally if fitted properly. However brick and block is the least preferred although its familiar to UK builders and gives durability on reclaimed ground its downsides outweigh its positives with high carbon emissions, longer build times and needing skilled workers to avoid thermal bridging. On a reclaimed site where ground conditions can vary, SIPs offer the best balance of performance, efficiency and long term sustainability for the client.

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