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Introduction

Miss A Client is undergoing a development of a two-storey 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 (Riley and Cotgrave, 2018). 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 the impact of each method on thermal performance (Chudley and Greeno, 2014). The evaluation and analysis will make a recommendation to guide the client's decision.

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 a layer of 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 (Chudley and Greeno, 2014). In older buildings you can see brick and blocks used more as its more thermal resistant and acts somewhat like its own external insulator (brick org 2023).

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

Offsite Construction

Modern construction recently has relied on off-site methods to improve the efficiency, speed and quality of the product (Riley and Cotgrave, 2018). The methods used are divided into four main categories which are volumetric construction, panelised systems, sub-assemblies, and component manufacture (Chudley and Greeno, 2014).

Volumetric construction is the manufacture of three dimensional sections of a building, known as modules (Chudley and Greeno, 2013a). These units are then transported to site and erected to form the building. This method is mainly used for hotels, student accommodation, and healthcare facilities because it speeds up construction time significantly. Although the downsides include careful planning for transportation and heavy lifting on site because of its size and weight.

Panelised systems are based on creating flat building elements- such as walls, floors, or roof panels- off-site (Chudley and Greeno, 2013b). These panels are delivered to the construction site and assembled into the building structure. Panelised construction offers more flexibility than volumetric methods because the panels can be adapted to suit various designs and layouts. Examples include timber frame panels and structural insulated panels (SIPs), which help speed up the building process while maintaining a degree of on-site assembly.

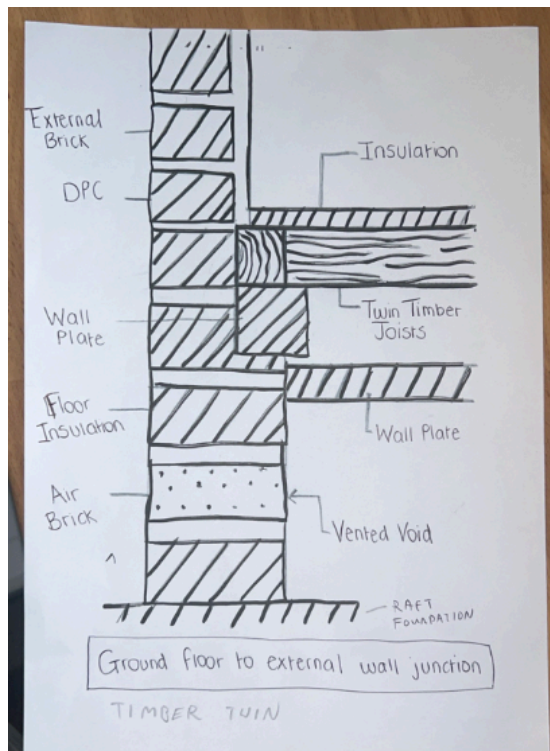
Sub-assemblies are the parts of a building that are prefabricated separately before being formed into the main structure (Chudley and Greeno, 2014). This includes items such as staircases, pods, lifts, or mechanical, electrical, and plumbing (MEP) systems. By creating these complex sections off-site the construction teams can then reduce the time and any errors during the project. This approach is very valuable for large, technically demanding projects.

The Component manufacture and assembly looks at producing smaller, individual building parts away from the site (Riley and Cotgrave, 2018). Items like windows, doors, cladding systems, and other fittings are made in a factory and then put together during the normal construction process. This strategy is the most common to the industry and is used across most projects to improve quality control and lower on-site labour for specific elements without changing the construction method loads.

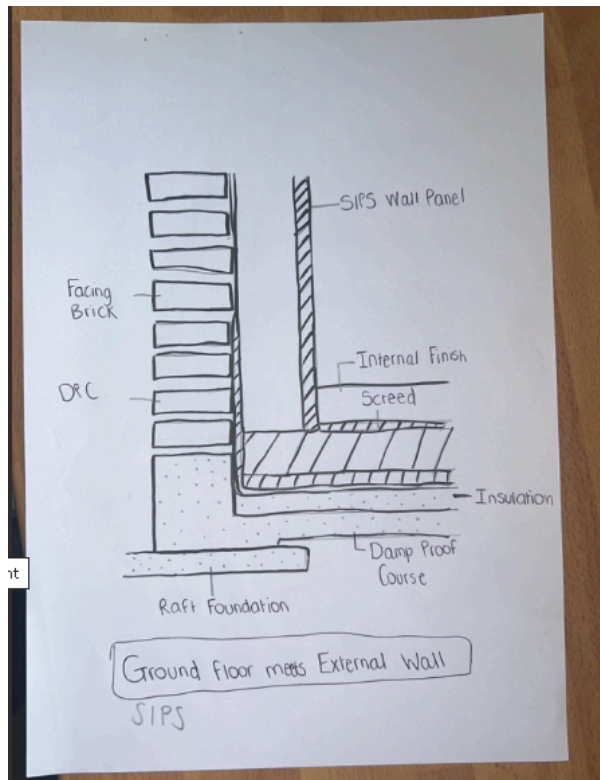
Offsite construction could be effectively used to speed up the project and ensure better quality control. Structural Insulated Panels (SIPs) could be used for the external and internal walls, providing thermal performance and quick assembly on-site. Prefabricated roof trusses could be made offsite and put into position using vehicles such as a crane, reducing the time spent working at height and improving safety (Chudley and Greeno, 2013b). Factory made window units and door sets could also be installed, allowing for better quality finishes and lowering the risk of weather delays. In the end there's no denying that using offsite methods would help achieve a faster, more efficient construction process with fewer problems throughout the project.

Ground Floor to External Wall Junction

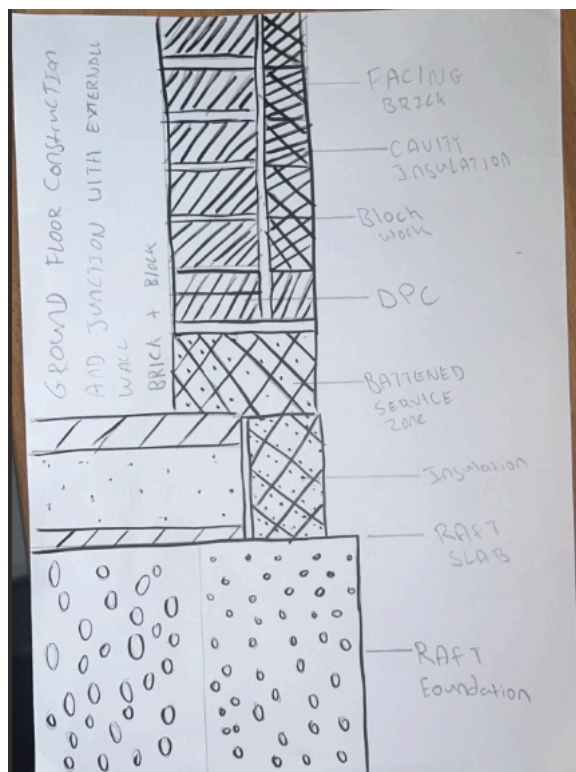
Timber Twin Sketch -

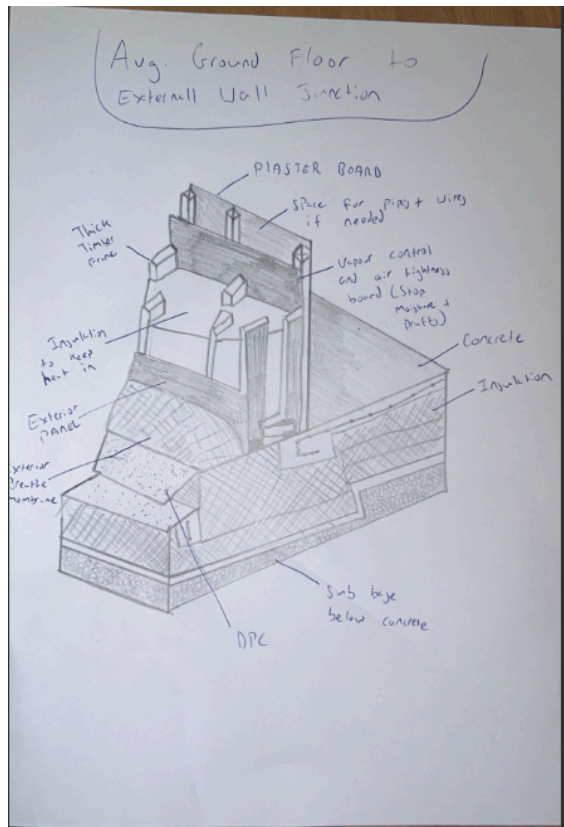


SIPS Sketch -



Brick and Block Sketch -

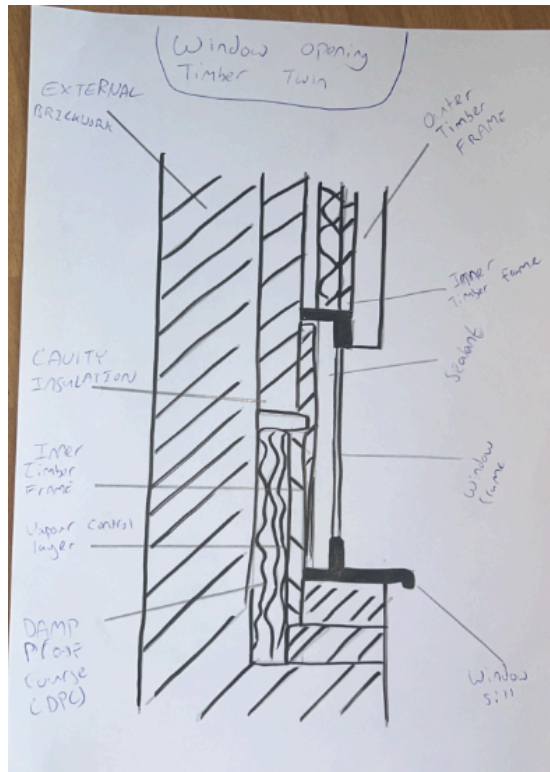




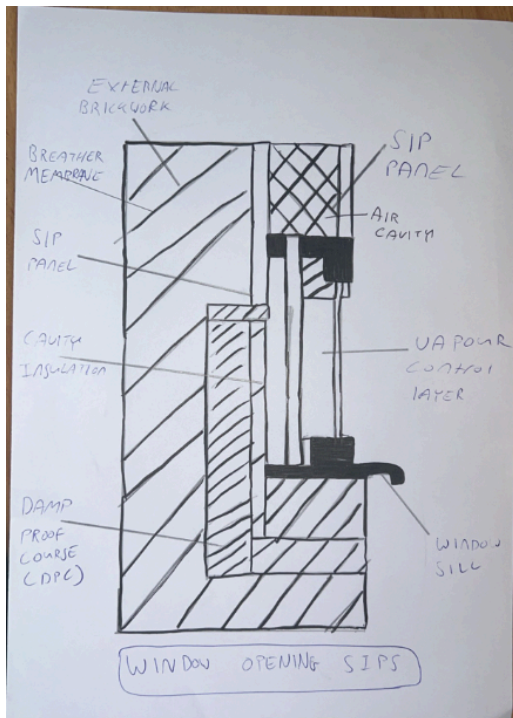
From looking at the ground floor junction, Timber Twin Frame normally uses a treated timber sole plate on the concrete raft foundation, with insulation between the twin studs and a damp proof course (DPC) placed inside to stop any unwanted moisture build up (turnertimber 2013). While it offers thermal performance, there is an increasing risk of cold bridging unless detailed carefully. The next is SIPS in construction and it provides a continued insulation layer throughout the 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. 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. Comparatively, SIPS offers the best thermal performance and airtightness; Timber Frame gives efficiency and flexibility but needs careful detailing and Brick and Block delivers durability but needs extra insulation to meet modern thermal standards.

Window Opening Detail

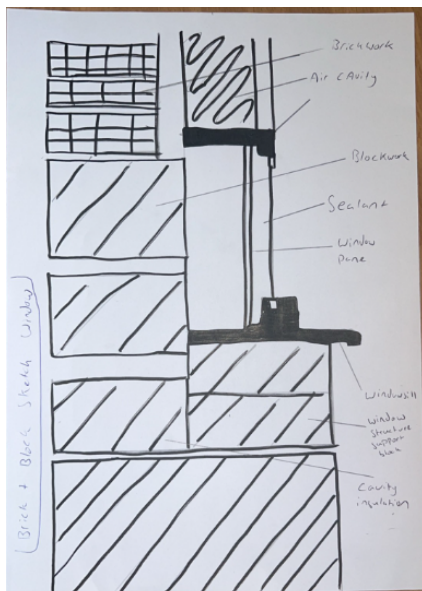
Timber Twin Sketch -



SIPS Sketch -



Brick and Block Sketch -

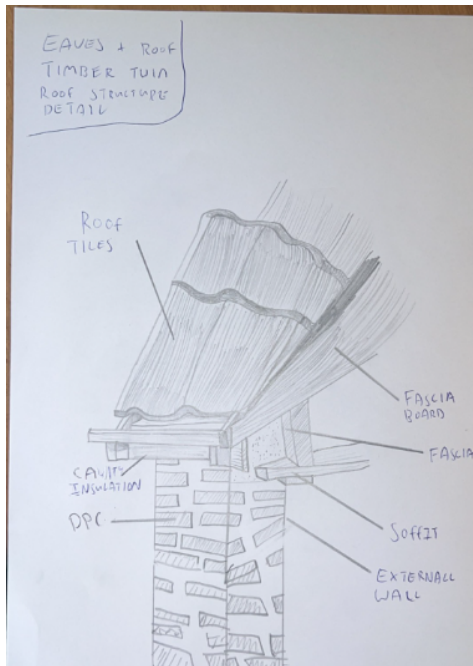


Detailing window openings requires careful measurements and planning as they are the areas that trigger the most heat loss. Timber Twin Frame construction normally forms the opening using doubled-up timber studs, with insulation fitted nicely around the frame and a cavity tray or DPC used to prevent moisture buildup or entering (turnertimber 2013). Whilst

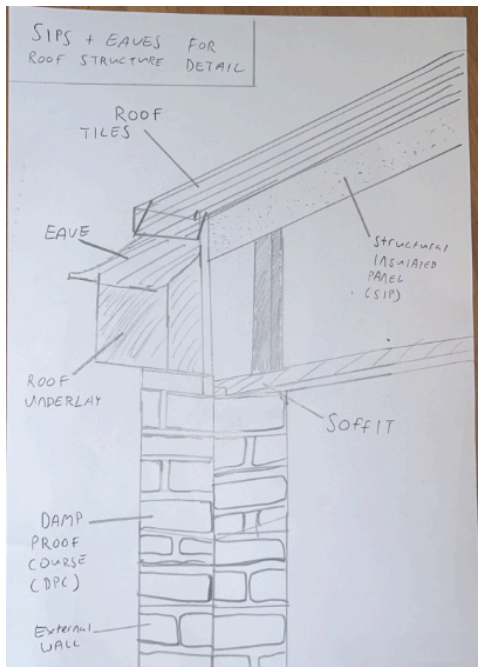
effective, it can create thermal bridging around the window unless properly insulated. SIPS construction simplifies the process by cutting the window opening directly into the insulated panel with the correct fit, (foundationsuk n.d.), maintaining better continuity of insulation and reducing cold bridging, although additional framing around the window may be needed for structural support. Brick and Block construction 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 very durable but weak to thermal breaks unless improved insulation is used. Overall SIPS provides the best thermal properties, Timber Frame allows faster installation but requires strong airtightness, and Brick and Block is sturdy but needs extra insulation to meet thermal standards around windows.

Eaves and Roof Structure Detail

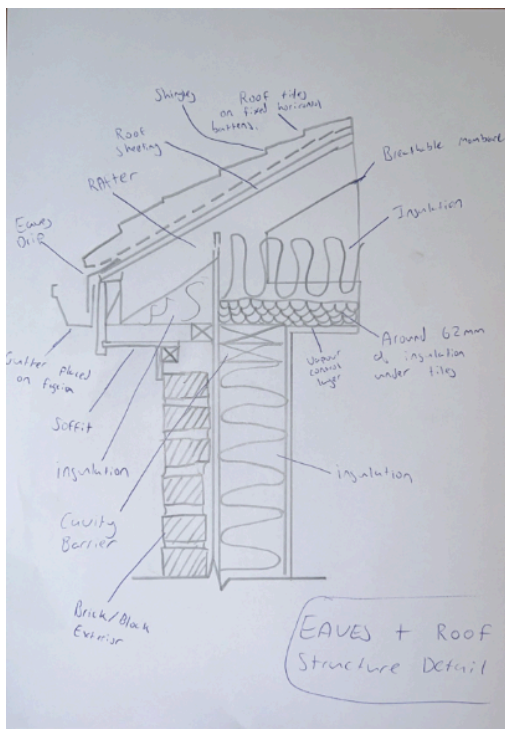
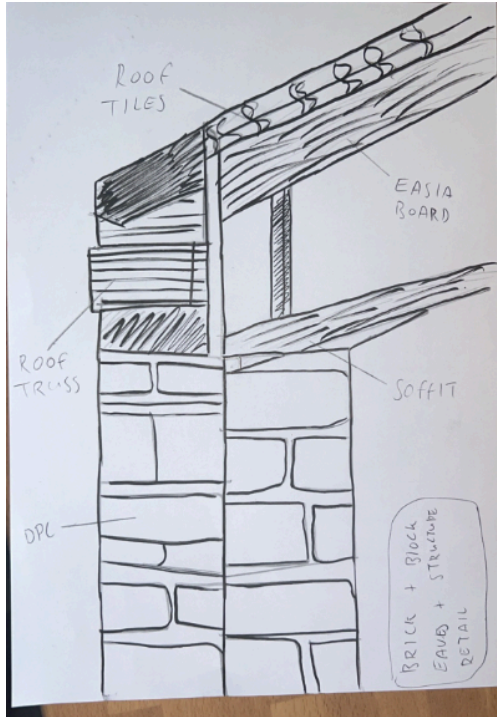
Timber Twin Sketch -



SIPS Sketch -



Brick and Block Sketch -



From looking at these sketches including eaves and roof junctions, Timber Twin Frame construction normally uses timber rafters or trusses sitting on the wall plate, with proper ventilation given through soffit vents and insulation fitted to keep thermal heat in the roof space (turnertimber 2013). The Detailing in these must also allow for good weatherproofing with flashing and overhangs. In SIPS construction, the roof panels often continue the insulated core from the wall panels, offering airtightness and low thermal bridging. Additional sealing and flashings are important to stop any moisture build up as, without this, SIPS are vulnerable to moisture and not suited for flood risk areas (foundationsuk n.d.). Brick and Block construction uses a traditional cut roof or trussed roof resting on the inner blockwork leaf, with cavity barriers, insulation at ceiling level, and ventilation through eaves vents. While familiar, this method can have more thermal bridging at the wall-plate junction unless detailing is enhanced. Overall, SIPS provides the most consistent thermal envelope at the eaves, Timber Frame offers flexible and fast installation, and Brick and Block prioritises durability but needs careful attention to achieve modern insulation and airtightness standards.

Recommendation

This report looked at three differing options for a two story detached house on reclaimed land with a raft foundation meaning uneven ground, the choices were: Timber Twin Frame, Structural Insulated Panels and Brick & Block construction. The main goal of the development is to manage energy efficiency, airtightness, and insulation effectiveness while adhering to UK Building Regulations.

The first part of the house seen was Ground Floor Junctions where the land meets the house. All of the strategies handle thermal bridging at the junction with the foundation. Timber Twin Frame uses two stud walls with an insulated cavity between each other (Turnertimber 2013), with timber on a DPM over the slab and insulation in the slab edge to lower any unnecessary heat loss. SIPS are different however as they sit on a timber plate fixed to the slab, keeping its airtightness and thermal performance. Brick & Block walls have inner and outer blocks with insulation inside them and edge insulation at the slab perimeter to stop any cold bridging, along with a DPC under both layers. These strategies need air barriers and perimeter insulation throughout to meet L standards for energy loss.

The next section that was looked at was window details, Windows are an important area as they have the most 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 and membranes. In SIPS, windows fit into already made openings, with airtightness made from the factory with ensured accuracy and specialist 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 systems can achieve the required window U-values (around 1.4 W/m²K) when installed properly.

The last part we looked at was the Eaves and Roof Construction. Roof construction also needs to meet insulation and airtightness standards to be built. First option was the Timber Twin Frame roofs that use insulated panels, they can either be built on-site or prefabricated

in a factory environment beforehand. Air barriers and insulation continue through the eaves without gaps. SIP roofs are made from large insulated panels with a vapour control layer inside, with some vented and others fully sealed this depends on the design of the clients choosing. Brick & Block roofs typically use timber rafters with insulation between or above them, often with a ventilated roof space to avoid condensation. Insulation is packed at the wall head to prevent bridging. All roof types must achieve a U-value of 0.13–0.16 W/m²K to meet regulations.

Conclusion

From looking at these three choices in depth It is safe to say that Brick & Block is the most recommended for this project. While Timber Twin Frame and SIPs give strong thermal performance and quick build times, Brick & Block stays a reliable, cost friendly and effective option that is easier for contractors and clients with less experience to manage. On a reclaimed site, where ground conditions are unreliable and differing, Brick & Block offers better durability and resistance to moisture and weathering. As well as this it can also give flexibility during construction if plans were to change. Although offsite systems like SIPs and Timber Frame can provide high energy efficiency and speed to the project, they can be confusing for clients unfamiliar with prefabrication. Brick & Block is a method which is widely known throughout the construction industry, is easier to inspect, maintain, and comply with Building Regulations regarding fire safety and thermal performance. While it takes longer to build with higher carbon, modern insulation materials and efficient construction practices make it a reasonable choice. To conclude, Brick & Block offers the best balance of performance, cost, and reliability for the client's development.

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