

Structural & Envelope Design Strategy for Medium-/High-Rise Hotel at Singleton Hospital, Swansea

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1. Introduction

This report aims to explain and support the recommended choices for the structural frame, foundations, building envelope and construction method for a new medium to high-rise hotel planned opposite Singleton Hospital in Swansea.

The report is written in simple language so the client can easily understand it, while still following good engineering and environmental practices. Illustrative sketches or CAD drawings will be included in the Appendices and, where helpful, in the main text.

The main factors influencing the design choices are structural strength and stability, fire safety, appearance, environmental impact and sustainability. The proposed hotel will be around nine storeys high and built on an urban or suburban site in Swansea, Wales.

2. Site Context & Environmental Conditions



The proposed development site is located opposite Singleton Hospital, in the Sketty Lane and Singleton Park area of Swansea. This area is characterised by gently sloping terrain with established buildings, including Singleton hospital, car parks, roads and green spaces. The site benefits from proximity to both the Swansea Bay coastline and a large green park, which creates a unique combination of environmental and urban considerations. Geologically, Swansea sits within an area dominated by sedimentary rocks such as sandstone, mudstone and siltstone (webapps.bgs.ac.uk, n.d.). These bedrock layers are often covered by superficial deposits, such as glacial till, alluvial soils and clay, which can vary in depth and stiffness (Waters et al., n.d.).

In many parts of Swansea, superficial soils are relatively soft and can present challenges related to settlement and bearing capacity, which must be addressed during foundation design. Groundwater levels are often relatively high in this part of the city, particularly given the proximity to the coast, and this may influence both foundation design and the waterproofing of lower structures.

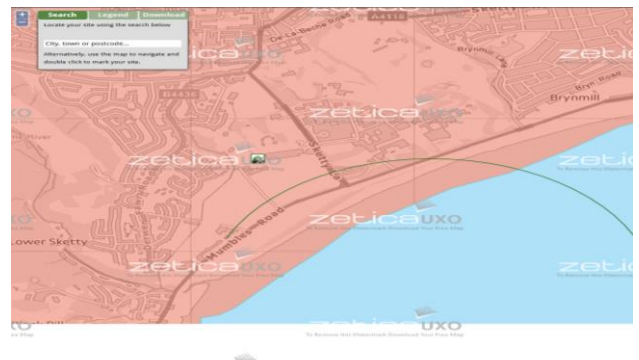
A borehole log of the Welsh international pool 8 was recorded at 10m in 1999. The ground was made up of silty sand to gravel. (British Geological Survey, 2025)

Swansea has a temperate maritime climate, with mild temperatures, high humidity and frequent rainfall throughout the year. The city is exposed to south-westerly Atlantic winds, which can bring wind-driven rain and occasional storms. Annual rainfall is among the highest in Wales, and strong gusts can particularly impact taller buildings (Climate Change Risk: Swansea, n.d.).

Because of these conditions, the building must be designed to resist moisture and wind while maintaining a high thermal performance and comfort for the occupants. This makes a robust and efficient building envelope essential.

Additionally, the site's proximity to Singleton Hospital means construction must carefully manage logistics, site access and control noise and vibration to minimise disruption.

A short historical survey of site has been analysed. The data shows that the land has no previous industrial or commercial use (Digimap, 2025). Data obtained from UXO records indicates that there is no evidence of historical bombing activity on or near the site (Zetica UXO, 2024)



3. Structural Frame & Foundations

3.1 Structural frame

The structural frame must provide adequate strength, stability and long-term durability for a medium to high-rise hotel, while allowing efficient and safe construction. Three structural frame options were studied: reinforced concrete, structural steel and hybrid composite systems. Reinforced concrete offers strong performance, and it has the highest fire resistance (class A1 non-combustible classification) (The Concrete Centre, 2019) but it can take more time and heavier on labour to construct on site.

Structural steel frames are lighter and can be erected faster, however they require additional fire protection and can be more open to thermal expansion. A hybrid composite system combines the advantages of both, and for this project, a steel and concrete hybrid frame is recommended.

This system would typically include a reinforced concrete core providing more lateral stability, combined with a steel beam, column frame and composite concrete floor slabs. The concrete core acts as a shear wall (Designingbuildings.co.uk, 2016), resisting wind loads and providing overall stability, while the steel structure allows for larger spans and quicker assembly. Composite slabs help to reduce the overall structural weight, lowering the foundation loads and potentially reducing construction costs. The concrete core also provides inherent fire resistance, and steel members can be treated with intumescent coatings or protected with fire-resistant boards to meet fire safety requirements. The hybrid system is well-suited to modern methods of construction, supporting a high level of prefabrication and off-site assembly, which is particularly advantageous on a constrained site located next to an operational hospital.

3.2 Foundation design

The foundation design must respond to the ground conditions of the site. The superficial soils are expected to have variable stiffness and may not provide sufficient bearing capacity, while competent bedrock lies at greater depth. To address this, a piled raft foundation is recommended (British Geological Survey, 2025). This involves a reinforced concrete raft slab at ground level combined with piles that are driven or bored into the stronger strata below. The raft distributes the building's load evenly across the site, while the pile foundations transfer most of the load to stable ground, controlling total and differential settlement. This method provides both structural reliability and cost efficiency. The raft also offers a stable platform for the superstructure and can be designed to include waterproofing measures, which is particularly important in Swansea, where groundwater levels can be high due to the coastal setting.

3.3 Foundation System Choice

Structural stability under both vertical and lateral loads is a critical consideration for a building of this scale. The proposed composite frame and piled raft foundation will ensure the building can resist strong wind loads coming from the sea. The concrete core, acting as shear walls, together with the steel frame, will distribute forces efficiently through the structure and into the foundations. Fire safety is equally important, particularly in a hotel where safe evacuation routes and fire compartmentation are legal requirements. The concrete core and floor slabs can be designed to provide at least 120 minutes of fire resistance (Concrete Centre, n.d.), while steel members can be protected to achieve the necessary standards. The use of non-combustible materials ensures compliance with UK Building regulations Parts A and B. Sustainability objectives can be supported by using steel with a high recycled content and low-carbon concrete mixes incorporating supplementary cementitious materials, helping to reduce the embodied carbon of the structure.

4. Building Envelope – Materials & Method Choices

4.1 Weather/Climate loads & Site-Specific Impacts.

The proposed hotel is situated in Swansea city, which experiences high annual rainfall and strong driven wind coming from the sea (Climate Change Risk: Swansea, n.d.). These environmental conditions are particularly important when designing a medium-high-rise building.

Due to the building's location, the building's envelope must have a high resistance to moisture while maintaining a good thermal performance and occupant comfort. Poorly detailed facades could lead to water penetration, heat loss and long-term durability issues.

A drained and ventilated façade system would be a suitable option for a medium-high rise building. As it would allow moisture to escape and reduce the risk of water reaching the internal structure.

4.2. External Wall system and Roof construction

A non-load bearing, non-combustible rainscreen cladding system is fixed to a steel framing system (SFS) backing wall is proposed for the external skin of the build. This

system is used across city on medium-high-rise projects, Singleton hospital adjacent to the development is using a similar cladding making it well suited to the area (Swansea Bay University Health Board, 2024).



Singleton Hospital front facade

The external wall design consists, from outside to inside, using non-combustible rainscreen cladding panels, a ventilated cavity using fire barriers at each floor level and around window/door openings and using a non-combustible mineral wool to achieve the correct thermal and acoustic performance (NHBC, 2023). A breather membrane is installed to protect the internal skin from wind driven rain, followed by external sheathing board that will provide strength and fire resistance.

The wall structure is formed using a steel framing system spanning between floor level, with a vapour control and air tightness layers positioned on the warm side of the build. Internally the wall is finished with two layers of fire-rated plasterboard. Overall, this system provides effective weather protection, good thermal efficiency, and compliance with fire safety requirements appropriate to the building's height and use.

The roof is designed using a warm flat roof construction (NHBC, 2023), with insulation above the structural deck and beneath the waterproofing membrane. This arrangement minimises the risk of condensation, enhances thermal performance, and is particularly well suited to the high rainfall conditions experiences in Swansea.

4.3. Fire safety, Thermal Performance & Sustainability

Fire safety is a critical consideration for hotel developments due to the presence of sleeping occupants who may be unfamiliar with the building's layout. The proposed external wall is using a non-combustible cladding and insulation materials. Reducing the risk of fire spread along with the installed fire barriers on openings. Ensuring compliance with (Approved Document B, Gov.Wales).

Thermal performance is achieved through continuous insulation and careful detailing at junctions to minimise thermal bridging (Zero Carbon Hub, 2015). A target U-value approximately 0.18W/m²k is proposed for the external walls, supporting compliance with the (Approved Document L, Gov.Wales) and reducing operational carbon.

From a sustainability perspective, the use of durable materials and replaceable cladding reduces the long-term maintenance requirements and extends the service life of the building's envelope. This approach supports whole-life environmental performance by reducing the need for early replacement or major refurbishment.

4.4. Aesthetic considerations and local context

Rainscreen cladding follows flexibility in colour and texture, enabling the building to respond sensitively to the surroundings. Netrul or brick inspired finishes can reference local architectural character while maintaining a modern hotel appearance.

The façade design can also be coordinated with window proportions and shading elements to create a visual balance elevation that enhances the buildings relationship with both the hospital and nearby park.

5. Prefabrication Vs On-site construction

5.1. Elements Suitable for prefabrication.

Prefabrication is recommended for several of the building's elements, especially those that benefit from factory-controlled conditions and repetitive production. These include steel beams and columns, Bathroom pods, precast stair units, cladding panels and mechanical, electric and plumbing (MEP) service modules.

Off site manufacturing allows improved quality control, reduces the on-site labour requirements and shortens the construction time (BRE, 2020). Bathroom pods are particularly well-suited to the hotel developments due to the nature of room layouts and the need for high-quality finishes.

5.2 Elements Better for On-site construction

Certain elements are more suited to on-site construction due to their relationships with site-specific conditions. These include the piled foundations, reinforced concrete core and raft slab.

These components must be adapted to the actual ground conditions encountered on site and integrated carefully with the surrounding environment. Constructing these elements on site also allows greater flexibility during the early stages of the construction.

5.3 Impacts on Time, Cost, Quality & Sustainability

The use of prefabrication can significantly reduce the overall programme duration by allowing elements to be manufactured off-site while groundworks and structural works are ongoing. This reduces site congestion and disruption, which is particularly important given the proximity of Singleton Hospital.

Improved factory quality control leads to more consistent finishes and reduces defects. In addition, prefabrication reduces material waste and site deliveries, contributing to improved sustainability and lower environmental impact. Overall, a hybrid approach using prefab and on-site construction offers the most efficient solution for the development.

6. Summary of recommendations

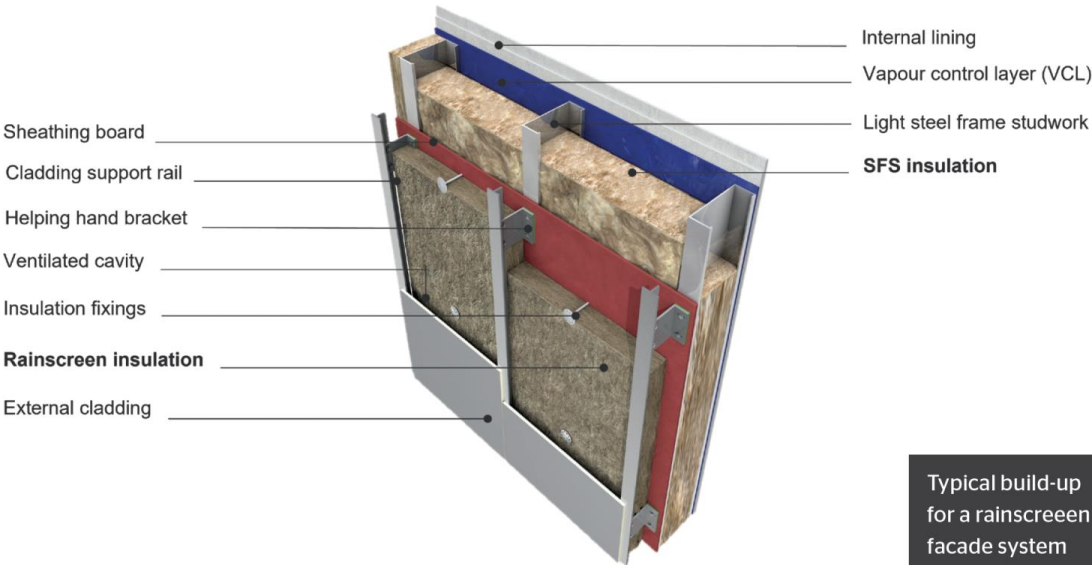
This report has outlined a construction strategy for the medium-high rise hotel development located opposite Singleton hospital in Swansea, the proposed design is using a hybrid structural system consisting of reinforced concrete core and a steel frame, providing strength, stability and fire resistance suitable for a hotel building.

A piled raft foundation is the recommended choice to address these variables ground conditions and high ground water levels. The buildings envelopment is based on a non-combustible rainscreen cladding system on an SFS backing wall, offering robust weather resistance, fire safety and thermal performance in performance in response to Swansea's coastal climate.

A hybrid construction approach is proposed. Utilising prefabrication where appropriate to improve the build quality, reduce programme duration and minimise disruption to the hospital. Overall, the recommended strategies provide a safe, durable and sustainable solution that responds effectively to the site constraints and functional requirements of the proposed hotel development.

Appendices

Appendix A:



Appendix B: Assumptions and limitations

The proposed hotel is assumed to be approximately nine storeys in height, with a regular floor plan typical of hotel developments.

Ground conditions have been inferred from published geological data and nearby borehole records; no intrusive ground investigation has been undertaken as part of this report.

Structural member sizes and foundation dimensions are indicative only and have not been calculated in detail.

Fire resistance periods are based on typical guidance and are subject to confirmation through a detailed fire strategy.

Building envelope build-ups are representative and may be refined during detailed design.

Thermal performance values are indicative and would be confirmed through full SAP or SBEM calculations.

Sustainability measures discussed are qualitative and do not include a full life-cycle carbon assessment.

Appendix C: Preliminary Environmental Checklist

Aspect	Strategy / Consideration
Structural materials:	Use of steel with high recycled content and low-carbon concrete mixes to reduce embodied carbon.
Foundations:	An efficient piled raft system to minimise material quantities while maintaining performance.
Building envelope :	High-performance insulation and durable non-combustible façade to reduce operational energy use and maintenance.
Construction method:	Use of prefabrication to reduce waste, site disruption, and transport movements.

Aspect	Strategy / Consideration
Waste management:	Off-site manufacturing improves material efficiency and reduces on-site waste.
Durability:	Selection of materials suited to coastal exposure to extend service life.
Operational energy:	Improved airtightness and thermal performance to reduce heating demand.

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