

Module: Construction Technology 2
Module Code: ACBA5019
Lecturer: Rhodri Thomas
Assignment Title: Building Evaluation



Student Name: Tomos Williams
Student Number: 2319571

Table of Contents

1. Introduction

- Purpose and Scope of the Report
- Assumptions and Missing Information

2. Structural Frame and Foundations

- Site Analysis and Ground Conditions
- Choice of Structural Frame
- Foundation Design
- Structural Strength and Stability Considerations
- Fire Safety

3. Building Envelope

- Design of the Building Envelope
- Materials Selection
- Aesthetics and Sustainability Considerations
- Environmental Impact

4. Prefabrication vs. On-Site Construction

- Advantages and Disadvantages of Prefabrication
- Choosing Prefabrication or On-Site Construction for Different Elements

5. Facilities and Additional Spaces

- Accommodation Design (Rooms and Common Areas)
- Additional Facilities (Students' Union, Study Areas, etc.)
- Accessibility

6. Conclusion

- Summary of Key Design Elements
- Final Justifications

7. Reference List

1. Introduction

Purpose and Scope of the Report

This report's objective is to present a thorough design plan for a medium-to-high-rise student housing complex located on a piece of property in the SA1 area. With a variety of housing options catered to different student tastes and basic shared amenities like a student union, study rooms, and recreational areas, this building aims to satisfy the housing needs of the university's student body. The report will evaluate and explain the major design decisions made during the project, with particular attention to the building envelope, foundations, structural frame, and construction process. Aesthetic appeal, fire safety, stability, and structural strength will all be taken into account in the overall design. The plan will also address environmental issues, with a focus on sustainability and lowering the carbon impact of the building. All of these elements will work together to guarantee the building's safety, functionality, and urban integration.

Assumptions and Missing Information

It is assumed for the sake of this design that the land is appropriate for construction and that medium-to-high-rise buildings are permitted by the zoning (Swoop UK, 2024). Although more thorough geotechnical studies would be necessary for an exact design, specific ground conditions, such as soil type and groundwater level, will be approximated based on average data for similar urban sites.

2. Structural Frame and Foundations

Site Analysis and Ground Conditions

To guarantee a safe and appropriate foundation design, the site's ground characteristics will be evaluated using standard urban geotechnical data. The choice of foundation system may be influenced by the site's presumed soft to medium soils with a moderate bearing capacity. Water management must be carefully considered during construction because groundwater is expected to be located around two meters below ground level. To verify these hypotheses and ascertain whether more actions, such as piling, soil stabilisation, or other ground improvement methods, are required to guarantee structural stability and safety, a thorough soil investigation report will be needed.

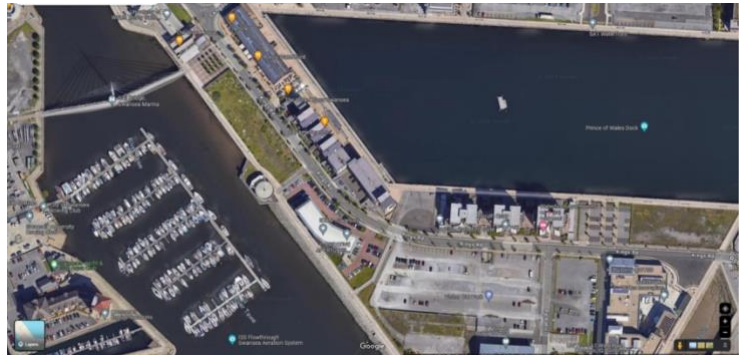


Figure 1 – Site screenshot from Google Maps (Maps, 2025)

(FirstinArchitecture, 2018)

Choice of Structural Frame



Figure 2 – Concrete frame diagram
(Construction, n.d.)

For this project, a reinforced concrete frame will be used because of its remarkable strength, adaptability, and suitability for tall buildings. This structural solution maintains durability and fire resistance while ensuring effective load distribution and stability against lateral stresses like wind and seismic activity. In addition to being reasonably priced, reinforced concrete provides superior acoustic insulation, which raises the comfort and seclusion of separate spaces. Furthermore, because of its versatility, plumbing, HVAC, and electrical conduits, among other crucial building services, can

be seamlessly integrated into the structural framework. This method guarantees a strong, secure, and useful design that is suited to the requirements of the building.

(Designingbuildings.co.uk, 2017)

Foundation Design

A raft foundation is a suitable option for the construction given the presumed ground conditions because it minimises the chance of settling in soft or variable soils by distributing the weight of the structure uniformly throughout the site. Deep foundations like bored piles could be taken into consideration as a backup plan in the event that more difficult site circumstances arise. By offering a consistent base that lessens differential settling, the raft foundation provides several important benefits, one of which is stability. It is a sensible option for this project since it is also an affordable option for urban locations with minimum excavation and no need for extensive foundations.



Figure 3 – Raft Foundation (LABC, 2018)

(Jewson, 2024)

Structural Strength and Stability Considerations

Local construction laws and regulations, including those relating to wind loads, seismic forces, live loads, and other structural requirements, will be properly complied with by the structure's design. The overall stability and safety of the building will be guaranteed by the structural frame's incorporation of suitable safety factors to handle uncertainties concerning material strength, applied loads, and environmental variables. Steel reinforcement will be

incorporated into the reinforced concrete frame to increase strength and resilience and avoid cracking. This method guarantees that the construction is not only sturdy and long-lasting, but also able to tolerate changing environmental conditions and dynamic forces.

(www.designingbuildings.co.uk, 2022)

Fire Safety

In complete accordance with local fire safety requirements, the building will be developed with a heavy focus on fire safety, utilising fire-rated doors and fire-resistant materials such as reinforced concrete. Advanced smoke ventilation systems, fire-rated partitions, and well-placed fire exits will be installed on each floor to promote a safe evacuation and lessen the spread of smoke and fire. A thorough sprinkler system will also be put in place throughout the structure to guarantee quick fire detection and suppression, reducing possible damage and protecting residents. Together, these actions will give all locals a secure, resilient, and law-abiding environment.

(Health and Safety Executive, 2015)

3. Building Envelope

Design of the Building Envelope

In order to ensure energy efficiency and a visually appealing look, the building envelope will be meticulously planned to provide thermal insulation, airtightness, and aesthetic appeal. High-performance steel and glass components will be combined in the facade to meet energy performance standards and provide a sleek, contemporary appearance (Glazingcentre.co.uk, 2024). The building's total energy efficiency will be greatly increased by using insulated panels and high-performance windows to minimise heat gain in the summer and reduce heat loss in the winter (admin, 2023). By letting enough of natural light into interior spaces, glass will improve sustainability and lessen the need for artificial lighting during the day. In addition to providing structural support and longevity, steel components will enhance the modern look that complements the university's branding and the current campus setting. Functionality, energy efficiency, and superior design will come together to create a structure that is both environmentally friendly and blends in with its surroundings (www.designingbuildings.co.uk, 2023).

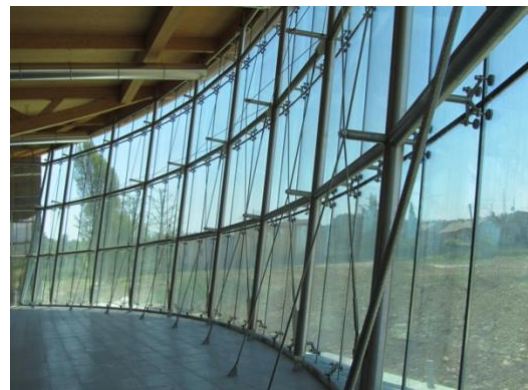


Figure 4 – Steel and glass façade
(Lucia, 2014)

Material Selection

Performance, durability, and sustainability have all been carefully considered in the selection of materials for the building envelope. A crucial element will be high-performance, low-emissivity glass, which minimises heat absorption and loss from the sun while permitting an

abundance of natural light to enter the building. By increasing daylighting, decreasing the need for artificial lighting, and increasing overall energy efficiency, this cutting-edge glazing will create an interior space that is both comfortable and environmentally conscious (Glazingcentre.co.uk, 2024).

Steel, which is utilised in components like columns, beams, and cladding, will be essential to the structure. Steel, which is well-known for its strength, flexibility, and ability to be recycled, is the perfect material to guarantee the building's structural stability while preserving a sleek, contemporary appearance (Steelconstruction, 2017).

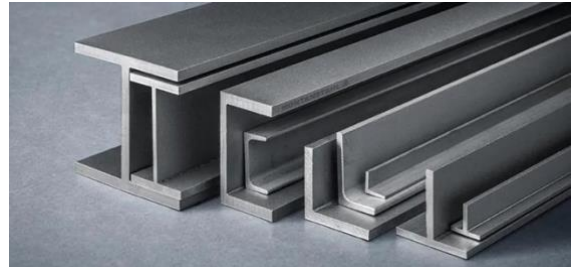


Figure 5 – Steel (Montanstahl, n.d.)

Insulation will be integrated into the roof and walls for thermal performance. To minimise thermal bridging, save energy usage, and maintain constant indoor temperatures, materials like mineral wool or rigid foam board will be used. By increasing energy efficiency, these insulating materials not only effectively reduce the need for heating and cooling but also support the sustainability of the structure (Norton, 2022).

When combined, these carefully chosen materials will produce a building envelope that guarantees thermal comfort, structural integrity, visual appeal, and compliance with energy and environmental performance standards.

Aesthetics and Sustainability Considerations

The building envelope design ensures that the structure is aesthetically pleasing while reducing its impact on the environment by combining contemporary aesthetics with a strong emphasis on environmental sustainability (LetsBuild, 2023). Because so much natural light may enter the building through the wide use of high-performance glass, the interior will be light, airy, and welcoming. This lessens the need for artificial illumination during the day, improving energy efficiency and giving residents a cosier, healthier environment. The glass facade's sleek, modern look, enhanced by steel elements, complements modern architectural trends and reflects the university campus's forward-thinking character.

Steel is a sustainable material choice for the building's life cycle because of its reputation for strength and recyclability, which will also help the building last longer and require less maintenance (Baker, 2023). The building envelope will be planned to maximise passive heating and cooling in order to further improve sustainability. By placing glazing, insulation, and shading devices strategically, indoor temperatures can be controlled and heating and cooling systems use less energy (www.breathe.com.au, n.d.). The design guarantees that the building not only satisfies the demands of its residents but also conforms to the more general objectives of environmental responsibility and sustainable urban development by striking a balance between functional performance, energy efficiency, and aesthetic appeal.

Environmental Impact

From construction to operation and eventual adaption, all phases of the building's lifecycle will incorporate sustainable design concepts. While energy-efficient systems like LED lighting, high-performance HVAC, and renewable energy sources will lower operating energy demands, low-emission materials will be chosen to minimise the environmental effect during construction. The building's carbon footprint will be further reduced by using passive design techniques like thermal insulation, daylighting, and optimal natural ventilation. Future flexibility will also be given top priority in the design, guaranteeing that the structure may be readily modified or repurposed to accommodate evolving needs throughout time, extending its lifespan and lowering the need for resource-intensive alterations.

(Monkey, 2018)

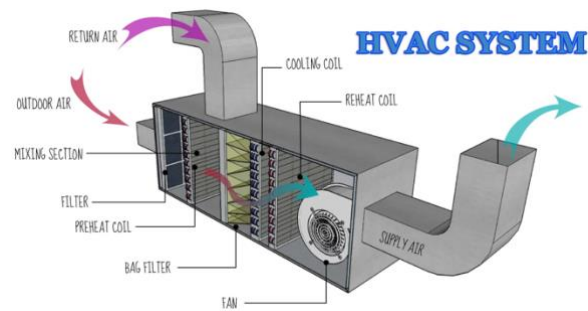


Figure 6 – HVAC System (Frost Heating Cooling, 2022)

4. Prefabrication vs. On-Site Construction

Advantages and Disadvantages of Prefabrication

Among the many benefits of prefabrication include quicker building times, less waste, and better quality control. The construction process is streamlined and made more effective by off-site production of parts like modular room sections, bathroom pods and even full floor systems. These prefabricated components may be swiftly assembled on location and transported, greatly lowering the amount of labour and related expenses needed on-site. In addition, compared to conventional on-site building techniques, off-site manufacturing occurs in controlled settings, guaranteeing greater accuracy and constant quality. For large-scale projects like student housing structures, prefabrication is a more economical and environmental method because it reduces material waste and construction interruptions.

(UK Construction Week 2024, n.d.)

Advantages

Because of its many advantages, prefabrication is the best method for contemporary building projects. Time savings is a key benefit since site preparation and foundation work can be done concurrently with the off-site manufacturing of components like modular units, bathroom pods or structural systems. By cutting down on overall building time, this parallel approach speeds up project completion.



Figure 7 – Offsite Prefabrication (Designing Buildings Wiki, 2022)

Cost effectiveness is still another important advantage. By using accurate cutting and assembly techniques in regulated production settings, prefabrication reduces material waste. Shorter on-site building timelines further cut labour costs, and the decreased chance of construction faults also lessens the need for expensive repair.

Quality control is yet another important benefit. Prefabricated parts are subject to strict inspections and uniform production standards because they are constructed in tightly regulated factory environments. Compared to conventional on-site construction processes, where environmental conditions and variations in workmanship can affect the final result, this ensures higher quality.

Prefabrication is a creative and sustainable approach that increases construction efficiency while producing high-quality results by combining quicker delivery, financial savings, and increased quality. Because of these benefits, it is especially well-suited for large-scale projects where consistency in quality, timeliness, and cost control are crucial, such as student housing.

(LetsBuild, 2022)

Disadvantages

Prefabrication has many advantages, but there are drawbacks as well that need to be considered. Logistics are a major drawback because it can be difficult and expensive to carry huge prefabricated components to the construction site. It can be especially challenging to manoeuvre large components, like modular modules or full floor systems, in city environments with restricted access, narrow streets, or high traffic. Road closures, specialised equipment, or more planning would be needed for this, which could result in delays and higher expenses.

Design constraints are another disadvantage because prefabrication frequently requires exact component standardisation and planning. Although this guarantees effectiveness and uniformity, it could limit the design process's flexibility. Using prefabricated techniques to create custom or complex architectural features may be more difficult or costly. Compared to conventional on-site construction, late-stage design modifications can also be more expensive and challenging to execute.

Regardless these difficulties, prefabrication can still provide its time- and money-saving advantages while preserving project quality and functionality with the support of careful site planning, efficient project management, and cooperation between the design and construction teams.

(Team, 2023)

Choosing Prefabrication or On-Site Construction for Different Elements

To maximise effectiveness and quality, the construction strategy will find a balance between prefabrication and on-site techniques. Elements such as steel frame components, modular room units and bathroom pods will be prefabricated to enable speedy and effective on-site

assembly while preserving quality and cutting down on construction time. On the other hand, because of their complexity and requirement for exact integration with the building's overall structure, complex parts like the concrete frame, foundation, and facades will be built on-site. This integrated strategy addresses the particular difficulties of on-site construction for complex building components while utilising the benefits of prefabrication where practical.

(Pressmach.com, 2024)

5. Facilities and Additional Spaces

Accommodation Design

To meet the varied needs of students, the facility will provide a range of choices for accommodation, including shared and single rooms. To promote social interaction and a feeling of community among residents, shared kitchens and lounge areas will be available on each floor. Additionally, each level will include dedicated study spaces to meet the academic demands of the pupils. A bigger common area on the bottom floor will work as a lively heart, including a café, a students' union, and areas for socialising and resting. With amenities like lifts, wide doorways, and accessible facilities, the building will completely adhere to accessibility regulations, guaranteeing wheelchair access to all floors, rooms, and communal areas. All students will live in a welcoming and encouraging atmosphere thanks to our inclusive design strategy, which strikes a balance between private areas and communal facilities to boost academic achievement and overall well-being.



Figure 8 – Shared Kitchen (Hart, 2017)

(Pride, Ritchie -Mjp and Architects, 2017)

6. Conclusion

This medium-to-high-rise student housing complex blends contemporary aesthetics, fire safety, environmental sustainability, and structural integrity. A balance between cost, speed, quality, and environmental impact is ensured by the structural frame's use of reinforced concrete, the envelope's use of steel and glass, and the rigorous evaluation of prefabrication versus on-site construction. This structure will give students a contemporary, cosy, and environmentally friendly living space that will foster community development and academic achievement.

Reference list

admin (2023). Choosing 'High energy performance' glazing in windows. [online] Glass for Europe. Available at: <https://glassforeurope.com/choosing-high-energy-performance-glazing-in-windows/>.

Baker, T. (2023). 5 Reason Why Structural Steel is Such a Sustainable Material. [online] <https://www.bakersteeltrading.co.uk/>. Available at: <https://www.bakersteeltrading.co.uk/is-structural-steel-sustainable/>.

Construction, U. (n.d.). Concrete frame diagram. [Online image] Understand Building Construction. Available at: https://www.understandconstruction.com/concrete-frame-structures.html#google_vignette [Accessed 15 Jan. 2025].

Designing Buildings Wiki (2022). Offsite Prefabrication. [Online image] Designing Buildings Wiki. Available at: https://www.designingbuildings.co.uk/wiki/Off-site_construction [Accessed 15 Jan. 2025].

Designingbuildings.co.uk. (2017). Concrete frame. [online] Available at: <https://www.designingbuildings.co.uk/wiki/Concrete%20frame>.

FirstinArchitecture (2018). Architecture Site Analysis Guide. [online] First In Architecture. Available at: <https://www.firstinarchitecture.co.uk/architecture-site-analysis-guide-2/>.

Frost Heating Cooling (2022). HVAC System. [Online image] Frost HVAC. Available at: <https://frosthvaccooling.com/what-is-hvac-and-what-does-hvac-stand-for/> [Accessed 15 Jan. 2025].

Glazingcentre.co.uk. (2024). Steel Glass Facades – Glazing Centre. [online] Available at: <https://glazingcentre.co.uk/steel-glass-facades/> [Accessed 15 Jan. 2025].

Hart, L. (2017). Shared Kitchen. [Online image] Independent. Available at: <https://www.independent.co.uk/student/student-life/accommodation/university-accommodation-halls-advice-pros-cons-home-tips-renting-campus-a7598506.html> [Accessed 15 Jan. 2025].

Health and Safety Executive (2015). Construction - Fire safety risk assessment industry health & safety. [online] Hse.gov.uk. Available at: <https://www.hse.gov.uk/construction/safetytopics/generalfire.htm>.

Jewson (2024). Raft foundations | Jewson. [online] www.jewson.co.uk. Available at: <https://www.jewson.co.uk/expert-advice/safety-regulations/raft-foundations>.

LABC (2018). Raft Foundation. [Online image] LABC. Available at: <https://www.labc.co.uk/news/raft-foundation-basics> [Accessed 15 Jan. 2025].

LetsBuild (2022). Ten benefits of prefabricated construction. [online] LetsBuild. Available at: <https://www.letsbuild.com/blog/ten-benefits-of-prefabricated-construction>.

LetsBuild (2023). Green building techniques: How you can make your construction projects more environmentally friendly. [online] Letsbuild. Available at: <https://www.letsbuild.com/blog/green-building-techniques-how-you-can-make-your-construction-projects-more-environmentally-friendly>.

Lucia, P. (2014). Steel and glass facade. [Online image] archilovers. Available at: <https://www.archilovers.com/projects/117814/righetti-s-winegrower-stainless-steel-glass-facade.html> [Accessed 15 Jan. 2025].

Maps, G. (2025). Site screenshot from Google Maps. [Online image] [googlemaps.co.uk](https://www.google.co.uk/maps/place/Swansea+SA1/@51.6172903,-3.9401045,15.59z/data=!4m6!3m5!1s0x486e5e2be2fb1ec7:0x7f5ec1736e16ef26!8m2!3d51.6291204!4d-3.9065562!16s%2Fg%2F11ckqk1g7m?entry=ttu&g_ep=EgoyMDI1MDExMC4wIKXMDSoASAFQAw%3D%3D). Available at: https://www.google.co.uk/maps/place/Swansea+SA1/@51.6172903,-3.9401045,15.59z/data=!4m6!3m5!1s0x486e5e2be2fb1ec7:0x7f5ec1736e16ef26!8m2!3d51.6291204!4d-3.9065562!16s%2Fg%2F11ckqk1g7m?entry=ttu&g_ep=EgoyMDI1MDExMC4wIKXMDSoASAFQAw%3D%3D [Accessed 15 Jan. 2025].

Monkey, S. (2018). 5 ways to reduce the carbon footprint of a large building. [online] Sotham Engineering. Available at: <https://www.sotham.co.uk/6-ways-to-reduce-the-carbon-footprint-of-a-large-building/>.

Montanstahl (n.d.). Steel. [Online image] Montanstahl. Available at: <https://www.montanstahl.com/blog/stainless-steel-structural-sections/> [Accessed 15 Jan. 2025].

Norton, P. (2022). Types of Insulation. [online] Energy.gov. Available at: <https://www.energy.gov/energysaver/types-insulation>.

Pressmach.com. (2024). Deciding Between Prefabrication And On-Site Fabrication. [online] Available at: <https://www.pressmach.com/blog/site-fabrication-vs-prefabrication>.

Pride, L., Ritchie -Mjp, M. and Architects (2017). The design of student accommodation - supporting their experience of university. [online] Available at:

https://srhe.ac.uk/downloads/public/event-presentations/320_TheDesignofstudentaccommodation.pdf.

Steelconstruction (2017). Steel material properties. [online] www.steelconstruction.info. Available at: https://www.steelconstruction.info/Steel_material_properties.

Swoop UK. (2024). What are zoning laws: Who do they affect? | Swoop. [online] Available at: <https://swoopfunding.com/uk/business-glossary/zoning-laws/>.

Team, P.I. (2023). Prefabricated Buildings: Are They Worth It? Weighing the Pros and Cons! [online] Real Estate Sector Latest News, Updates & Insights - PropertyPistol Blog. Available at: <https://www.propertypistol.com/blog/prefabricated-buildings-are-they-worth-it-weighing-the-pros-and-cons/>.

UK Construction Week 2024. (n.d.). REVOLUTIONISING CONSTRUCTION: THE PROS AND CONS OF PREFAB AND MODULAR CONSTRUCTION. [online] Available at: <https://www.ukconstructionweek.com/blogs/revolutionising-construction-pros-cons-prefab-modular-construction>.

www.breathe.com.au. (n.d.). Passive design in sustainable architecture. [online] Available at: <https://www.breathe.com.au/guides/houses/passive-design>.

www.designingbuildings.co.uk. (2022). Structural principles. [online] Available at: https://www.designingbuildings.co.uk/wiki/Structural_principles.

www.designingbuildings.co.uk. (2023). Energy efficiency of buildings. [online] Available at: https://www.designingbuildings.co.uk/wiki/Energy_efficiency_of_buildings.