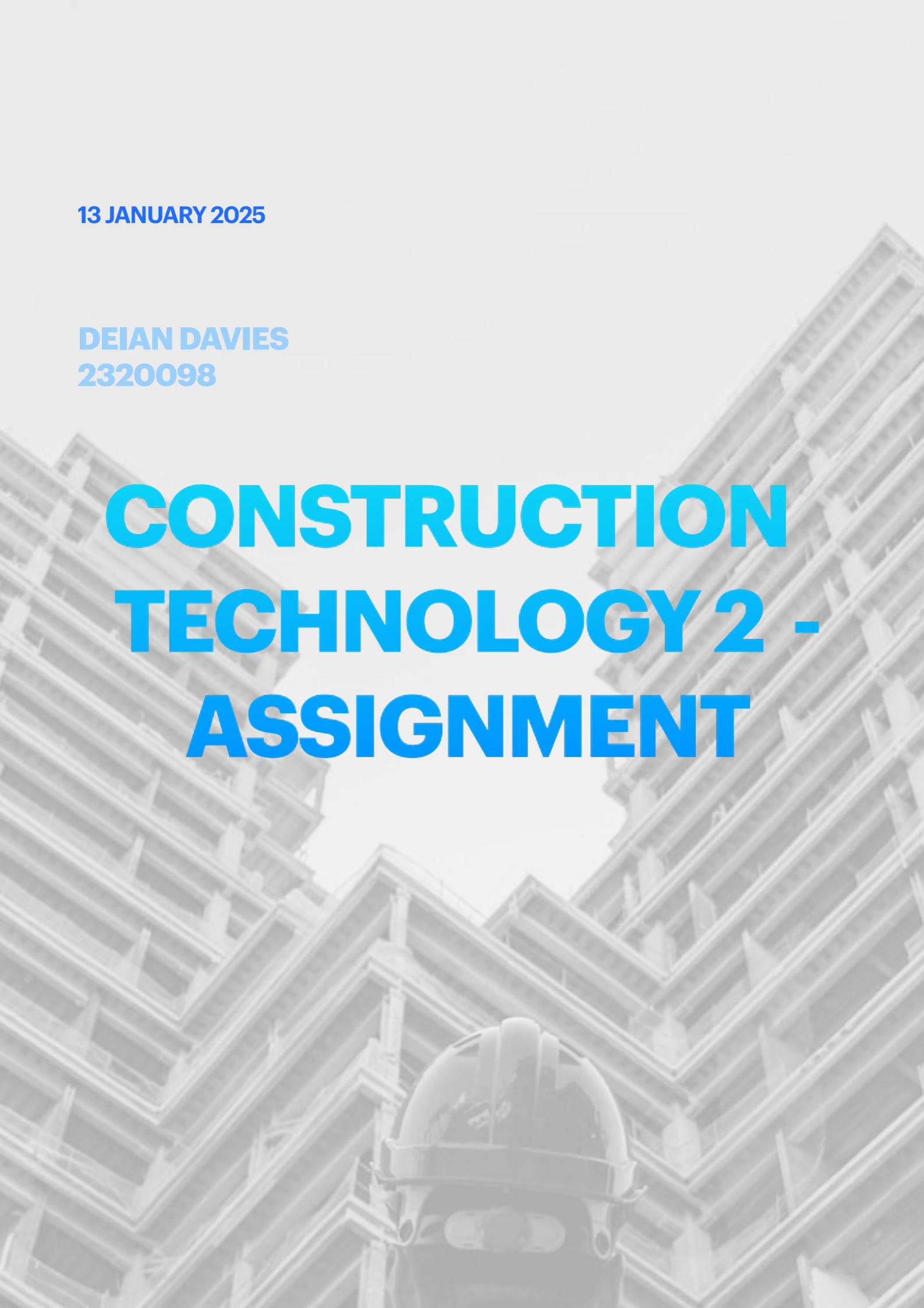
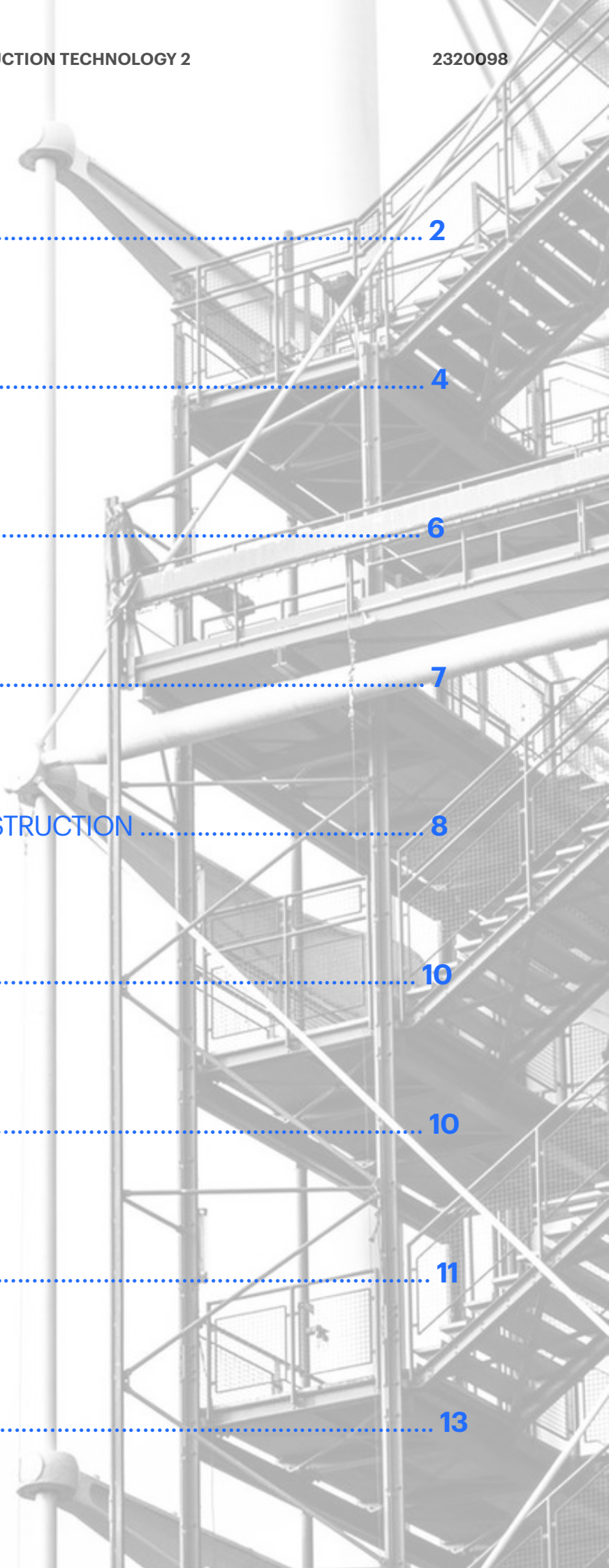
13 JANUARY 2025

DEIAN DAVIES
2320098

CONSTRUCTION TECHNOLOGY 2 - ASSIGNMENT





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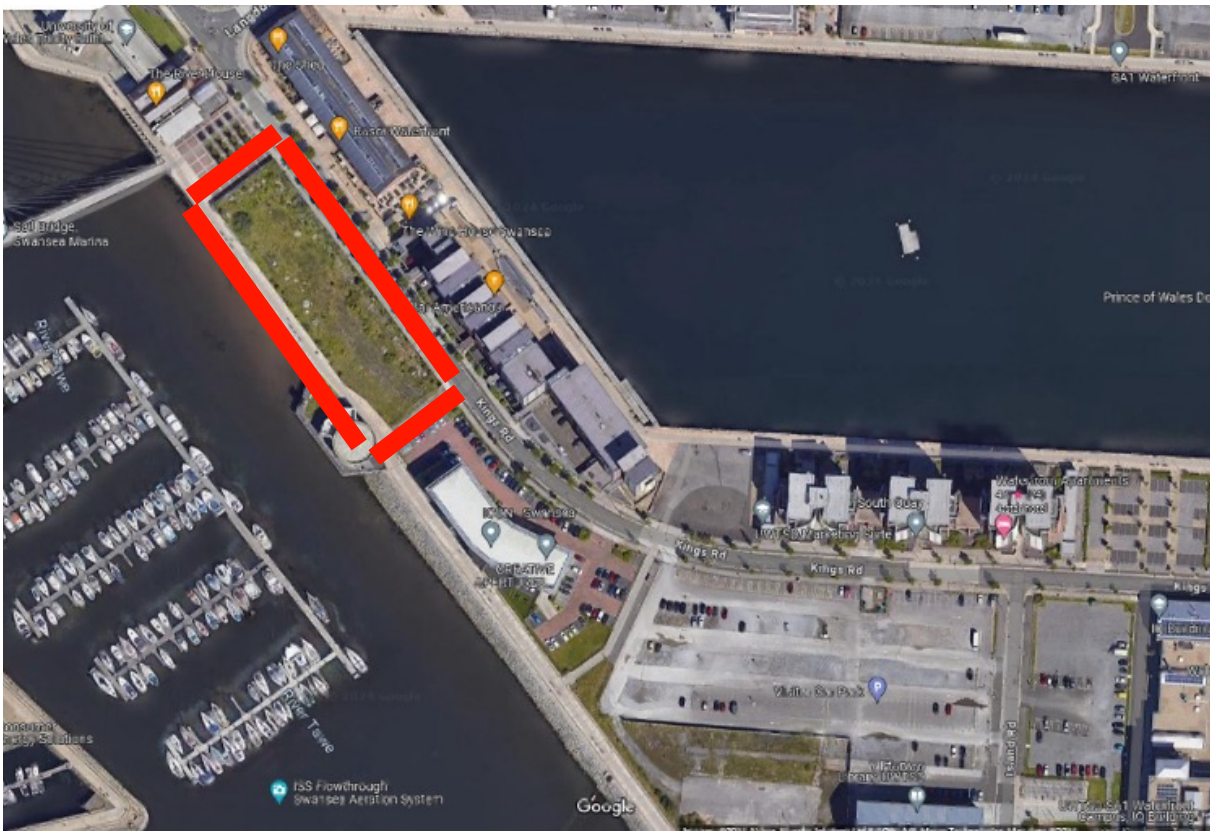
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INTRODUCTION

This report presents the design concept for a medium to high-rise student accommodation building located in SA1, developed to meet the needs of the University community. The design aims to provide modern, comfortable, and sustainable living spaces for students, complemented by additional facilities such as a student union or other communal amenities to enhance the overall student experience. I will be researching and talking about structural frames and foundations, the building envelope and prefabrication/on-site construction.

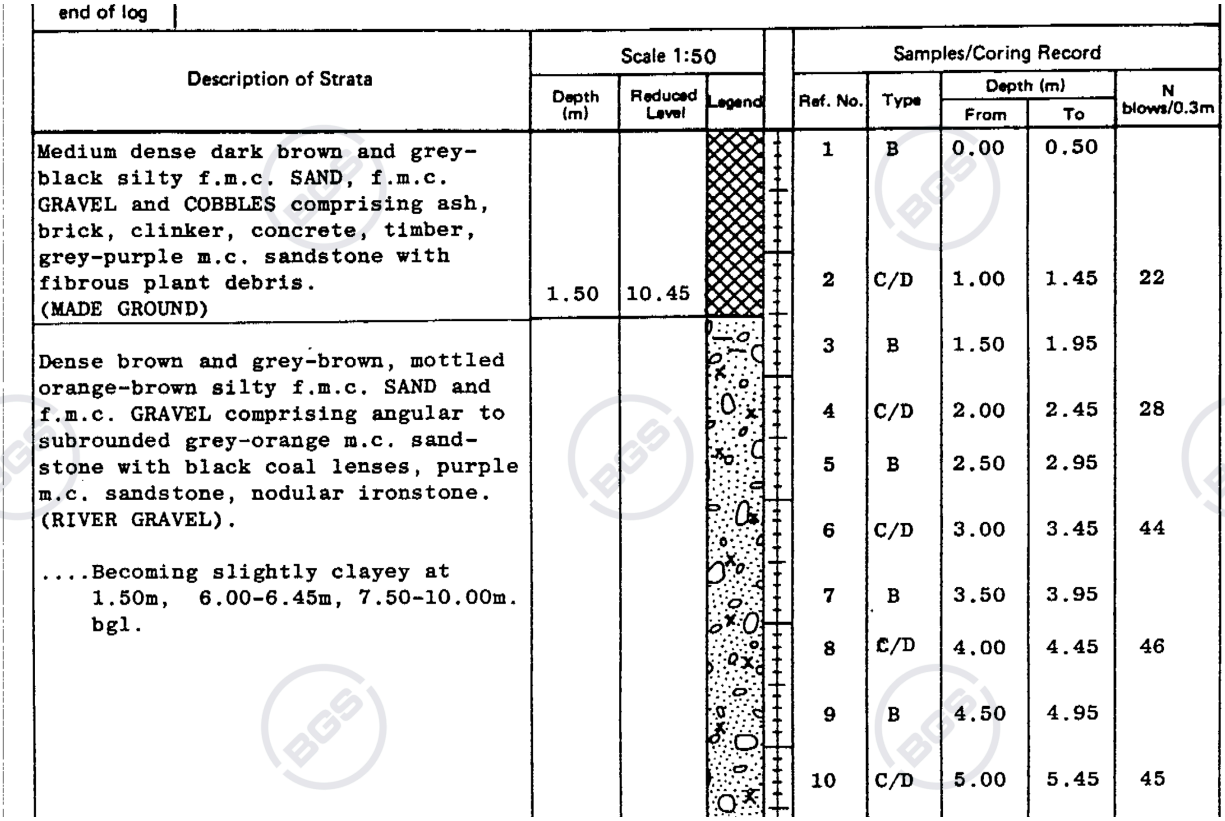


Developing plot of land (SA1)

Throughout the assignment, emphasis is placed on achieving a balance between robust structural performance, appropriate facade, fire safety, and environmentally responsible design.

SITE INFORMATION

Swansea Waterfront (SA1) is a brownfield site located in the southeast of Swansea City Centre, bordered by the Fabian Way to the North, including the prince of Wales Dock. Brownfield involves land that has either been developed or is currently in use. The redevelopment of previously developed land often incurs higher build costs. This manmade dock consists of a numerous materials forming made up ground. According to a Borehole Survey found on the British Geological Survey (https://www.bgs.ac.uk/information-hub/borehole-records/)



end of log

Description of Strata	Scale 1:50 Depth (m)	Scale 1:50 Reduced Level	Legend	Samples/Coring Record Ref. No.	Type	Depth (m) From	Depth (m) To	N blows/0.3m
Medium dense dark brown and grey-black silty f.m.c. SAND, f.m.c. GRAVEL and COBBLES comprising ash, brick, clinker, concrete, timber, grey-purple m.c. sandstone with fibrous plant debris. (MADE GROUND)	1.50	10.45		1	B	0.00	0.50	
				2	C/D	1.00	1.45	22
Dense brown and grey-brown, mottled orange-brown silty f.m.c. SAND and f.m.c. GRAVEL comprising angular to subrounded grey-orange m.c. sandstone with black coal lenses, purple m.c. sandstone, nodular ironstone. (RIVER GRAVEL).				3	B	1.50	1.95	
				4	C/D	2.00	2.45	28
				5	B	2.50	2.95	
....Becoming slightly clayey at 1.50m, 6.00-6.45m, 7.50-10.00m. bgl.				6	C/D	3.00	3.45	44
				7	B	3.50	3.95	
				8	C/D	4.00	4.45	46
				9	B	4.50	4.95	
				10	C/D	5.00	5.45	45

FOUNDATIONS

RAFT

Raft foundations are often used where the ground has poor load-bearing capacity. It's a type of structural foundation that spreads the entire load of the structure or building over a large area.

The typical raft foundation is constructed as a thick, reinforced concrete slab, often incorporating beams or ribs for added strength. A disadvantage of constructing a raft foundation is that it requires a significant amount of concrete and reinforcement. In addition it is complex to design and construct for larger or highly loaded structure.

Although raft foundations are suitable for poor soil conditions and is great for load distributions on poor ground, this would not be the appropriate foundation to use for the construction of a high rise building. It's limited to withstand horizontal and moment loads of very tall buildings.

An exception of this is a Piled raft foundation. This is an uncommon foundation used on domestic properties, but is the ideal foundation to use on High rise building as well as in structures that require a single foundation element such as silos, tanks and chimneys. But according to the blog (https://heatonmanufacturing.co.uk/raft-foundations-uses-types-cost/#:~:text=Piled raft foundations are less,on top of these pilings.) this type of foundation is typically used when the water table is close to the ground surface or if the ground conditions are extremely poor. Is could possibly be a contestant for the proposed high rise building in SA1.

PILE

A pile foundation are used when the soil of the building site is of poor quality and would not be able to support the proposed structure. For example, SA1 has very poor ground conditions, and any load bearing structure would subside. Unless correct measures are in place to implicate the correct foundation. Failure to do so will result of the leaning tower of pisa, where a subsidence of 5.5 degrees has been recorded due

to settling of its foundations. https://www.britannica.com/topic/Leaning-Tower-of-Pisa .

The pile foundation is most commonly used for high rise buildings and commonly used on poor ground condition for any given building. This would allow the load of the structure to transfer its load through either end-bearing, where the pile rests on a stronger layer, for example Shanghai Tower. Or through skin friction, where the load is transferred through friction between the pile surface and surrounding soil, for example Burj Khalifa.

Due to the high success rate pile foundation has had in high rise construction on sites with soft ground conditions, this foundation type is a should be a no brainer. But as the ground in SA1 isn't as extreme as some case studies mentioned. The only barrier resisting this construction method is cost. Heavy operating machinery is needed to construct this type of foundation.

COMBINED PILE AND RAFT FOUNDATION (CPRF)

In a CPRF, both the raft and piles share the structural load. The raft provides shallow load distribution while the piles enhance load-carrying and control differential settlement. Therefore by combining both foundations mentioned above, combined pile and raft foundations creates a solid, firm foundation for our proposed SA1 site. Although cost was a consideration mentioned above, its impossible to put a price on safety. The Incheon Tower in South Korea, is a perfect example of where this foundation type has been used.

In conclusion, the Combined pile and Raft Foundation will be used for the foundations of my proposed High Rise student accommodation here in SA1. This will ensure a solid foundation for the structure using both pile and raft foundations in the poor ground conditions on site researched by borehole logs mentioned above. This would come to a significant cost, but will enhance the buildings safety from subsidence.

STRUCTURAL BODY/FRAME

High-rise buildings require strong and efficient structural systems to support vertical and lateral loads, ensuring stability and safety. The choice of structural frame depends on the height, function, architectural design, and environmental conditions. Therefore the proposed building at SA1 will require a strong structural frame due to it's coastal location and its poor built-up soil.

BRACED FRAME SYSTEM

A braced frame system is a structural system that uses diagonal members to resist lateral forces like wind and seismic activity. Braced frames are a common construction method that are economical and easy to analyse according to (https://steelconstruction.info/Braced_frames#:~:text=Braced frames are a very,system carries all lateral loads.)

A braced frame system has limited flexibility in design as the cross section braces has a potential to obstruct windows. This is important as a well designed building takes into consideration of the user, in this case the students. This also interferes with the façade of the building as the cross sections would not match the buildings environment as numerous buildings in the area have an old-fashioned façade, as it's used red engineering bricks on the outer wall. In summary, while braced frame systems offer excellent lateral stability and are cost-effective for certain heights, they pose challenges in design flexibility.

OUTRIGGER STRUCTURE

An outrigger structure is a highly effective system used in high-rise construction to enhance lateral stiffness and reduce building sway under wind and seismic loads. This system connects a central core to perimeter columns using horizontal elements known as outriggers, typically located at mechanical floors. Outriggers help distribute

lateral loads more effectively therefore reducing the required size and reinforcement of the core and columns. By using outrigger structure for the buildings frame, it provides better economic use of building materials if constructed correctly. https://www.designingbuildings.co.uk/wiki/Outrigger

BUILDING ENVELOPE

A building envelope refers to the physical barrier between the interior and exterior environments of a building. It plays a critical role in controlling the flow of air, heat, moisture, light, and sound into and out of the structure. The building envelope includes all the elements of a building that separate conditioned (heated or cooled) spaces from unconditioned spaces or the outdoors. https://www.designingbuildings.co.uk/wiki/Building_envelope

CLADDING AND EXTERIOR WALLS

Cladding is critically important for high-rise buildings as it serves multiple functional and aesthetic purposes. It is the outermost layer of the building envelope, protecting the structure while contributing to its performance and visual appeal.

I will be using triple-glazed glass for transparency for natural light. This will also improve thermal efficiency during the day, a greenhouse effect will take place heating up the internal structure during the day. It will be used as a curtain wall protecting the internal walls of weather, adding a aesthetically pleasing façade to the construction. https://www.guardianglass.com/gb/en/why-glass/build-with-glass/applications-of-glass/glass-for-facades/curtain-wall

INSULATION

Insulation is crucial for high-rise buildings because it plays a vital role in enhancing energy efficiency, indoor comfort, and structural durability. The unique demands of tall buildings, such as greater exposure to wind and temperature fluctuations, make insulation even more important compared to low-rise structures. Additionally, the

climate fluctuates in the location of the building therefore its imperative for the insulation to be of correct regulation.

Therefore, ridged foam insulation will be used in the construction for its high thermal resistance and is light weight, as the construction of the building will consist of a heavy structural frame. The insulation will be within the internal walls, ceilings and in the exterior walls.

PREFABRICATED OR ON-SITE CONSTRUCTION

ON-SITE CONSTRUCTION

On-site construction involves fabricating and assembling building components directly at the construction site, where all construction activities take place. This traditional method allows for more flexibility in how buildings are designed and constructed, without the limitations that come with prefabrication. Due to the structural frame proposed, on site construction would be a time consuming task and can possibly delay works.

One of the main advantages of on-site construction is design flexibility. Transportation needs are reduced because components are fabricated and assembled on-site and as the location in SA1 is very narrow, this will be a great advantage. On-site construction also supports the local workforce, providing jobs to local workers.

However, on-site construction does come with challenges. The project is more susceptible to weather delays, which can disrupt the work schedule. Furthermore, quality control can vary, depending on site conditions and the skill level of the workers, leading to potential defects and the need for rework, this will prove expensive as the materials proposed are to a specific spec needed for the construction. On-site construction also requires a larger number of skilled workers, which drives up labor

costs, and there are more safety risks due to the increased activity on-site, raising the potential for accidents.

PREFABRICATION

Prefabrication involves manufacturing building components in a factory or off-site location, then transporting them to the construction site for assembly. By doing so increases the speed of construction as components are manufactured as the site preparation occurs, improving time scale of completion.

Cost efficiency and quality control plays a significant role in prefabricated buildings as factor controlled environments solidifies consistent quality and precision whiles reducing dependency on weather conditions. Prefabricated products lower labor costs and minimise waste wile mitigating human error during the construction phase.

One downside of prefabrication in high-rise construction is the transportation costs, since large prefabricated parts need special equipment to move them, making logistics more complicated. There are also design limits, as the size of the prefabricated modules may restrict creative design options, and custom designs can be costly. Additionally, coordination can be tricky, as the schedules for making the parts and assembling them on-site need to match up. If they don't, it can cause delays in the project. Therefore I believe prefabricated construction will prove beneficial as it proposes a more accurate approach whilst constructing.

FIRE SAFETY AND REGULATIONS

Fire safety in high-rise buildings in the UK is controlled by strict rules to keep people safe in case of a fire. The main laws include the Regulatory Reform (Fire Safety) Order 2005 and the Building Regulations (Part B – Fire Safety). These laws require building owners to assess fire risks, put in place safety measures, and design the building to stop fires from spreading, allow safe evacuation, and protect everyone inside. https://www.gov.uk/government/publications/fire-safety-approved-document-b

High-rise buildings must have fire compartments and escape routes to keep fires contained and allow people to safely leave the building. Escape routes should be clearly marked and kept clear, and fire-resistant doors and emergency lighting must be installed. Fire alarms and smoke detectors must be placed in common areas like hallways, and sprinkler system required in buildings taller than 30 meters to help control fires.

After the Grenfell Tower fire in 2017, stricter rules were put in place regarding the materials used for cladding (the outer layer of the building). The Building (Amendment) Regulations 2018 now limit the use of flammable materials in cladding on buildings over 18 meters to reduce the risk of fire spreading quickly. Buildings must also have proper firefighter access, including special lifts, stairwells, and water hydrants, to help firefighters respond to emergencies.

Finally, evacuation plans and regular maintenance are essential for fire safety. Buildings should have clear plans for people to leave in case of fire, including special plans for those with mobility issues. Fire drills should be done regularly so people know what to do. All fire safety systems, like alarms, sprinklers, and emergency lights, must be checked and maintained to make sure they work properly in case of a fire. The goal of these rules is to reduce the risk of fires and ensure everyone can be safely evacuated if needed.

CONCLUSION

To conclude, for the proposed high rise student accommodation in SA1 the foundations will consist of combined raft and pile foundation due to the poor ground conditions conducted by the research found in the borehole report. This foundation will prove more that capable of supporting the proposed structure. Outrigger structure with be the structural body of the student accommodation. The building envelope will consist of a triple glazed class curtain wall to prevent weather to penetrate the external wall. This will increase thermal properties during the day, especially during the summer time, creating a green house effect.

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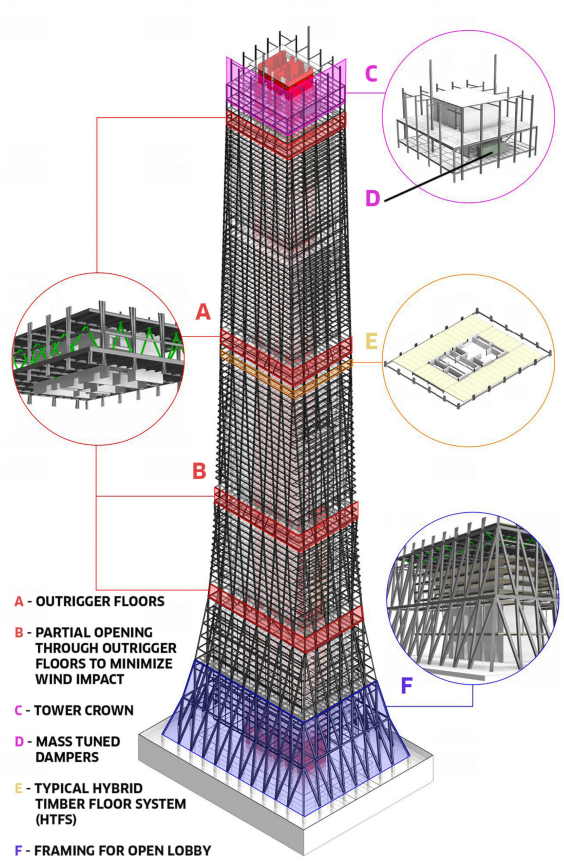
APPENDICES










C
D
A
E
B
F
A - OUTRIGGER FLOORS
B - PARTIAL OPENING THROUGH OUTRIGGER FLOORS TO MINIMIZE WIND IMPACT
C - TOWER CROWN
D - MASS TUNED DAMPERS
E - TYPICAL HYBRID TIMBER FLOOR SYSTEM (HTFS)
F - FRAMING FOR OPEN LOBBY

