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Construction Technology 2 Assignment

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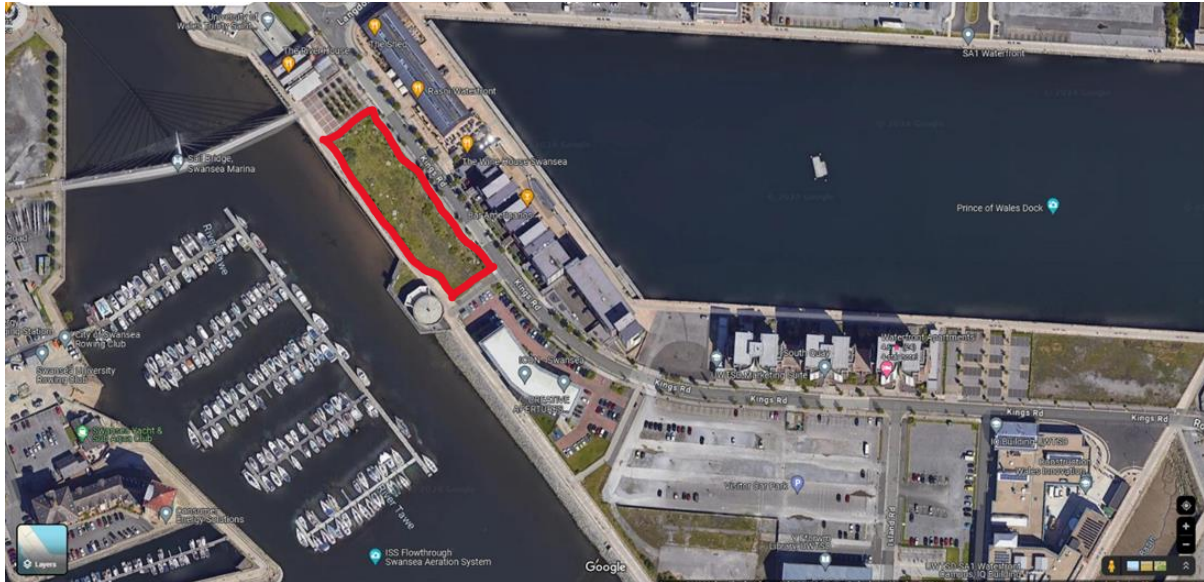


[19]

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Introduction



To construct a medium to high rise student accommodation building many considerations must be considered prior to works to ensure that the building is designed suitably for its lifetime as well as planned use. In this report I will design a medium to high rise building on the below highlighted plot in King's Road, Swansea.

When discussing the design of the building the following elements will have to be considered:

- Structural Frame and Foundations
- Building Envelope, materials and method choices
- Prefabrication or on-site construction of different elements

Other considerations to include are about the elements of the building are:

- Strength and Stability
- Fire Safety
- Aesthetics

- Environmental Impact and Sustainability

Structural Frame and Foundations

To identify suitable foundations, we must first know the quality of ground we are erecting a structure on, in this case King's Road is a brownfield site and using borehole surveys of nearby areas we can conclude that the ground would not be able to bear a medium rise building. Due to the poor bearing capacity of the ground Driven Piled foundations may be used to provide suitable stability for the building.

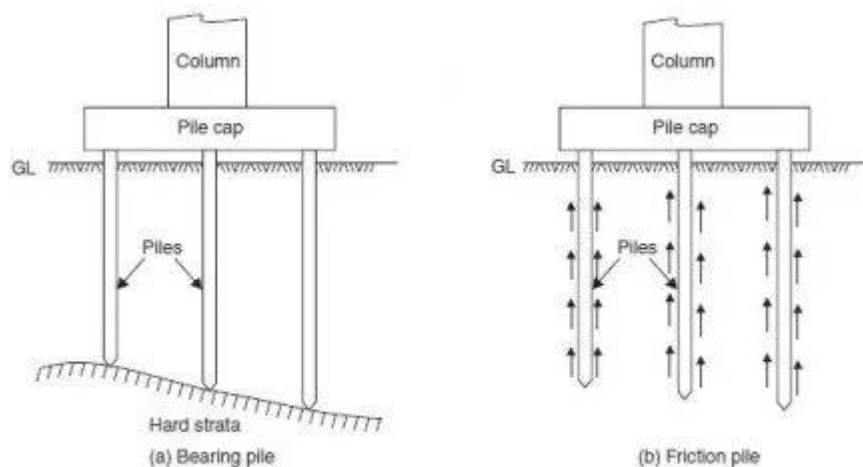


Fig. 7.9. Pile foundations

[8]

Piled foundations provide an effective solution to poor bearing capacity ground, as the piles can reach suitable ground further down, “Pile foundations are principally used to transfer the loads from superstructures, through weak, compressible strata or water onto stronger, more compact, less compressible and stiffer soil or rock at depth” [10]. Due to the lower-level ground being stronger and having greater bearing capacity piles are used to go past ground with poor bearing capacity and use the more suitable ground. Piles are driven into the ground and displace the material to below or around the piles instead of removing the material, this allows them to densify loose material increasing its bearing capacity. Driven Piles can also be fabricated offsite, this allows for

an efficient installation once onsite and will allow for greater quality control.

Piled Foundations are not without faults, for instance due to the depth they must be driven to heavy and noisy machinery must be used this can cause complaints from neighbours and an additional cost for the hiring of heavy machinery. Piled Foundations are also expensive, “As of 2024, the average cost for piling in the UK could range from £150 to £300 per linear meter for driven piles”^[12], this cost range of £150 to £300 would be for a domestic dwelling where the heavy machinery needed to reach the depth our building would require is not necessary, this in turn would increase the cost in our case.

In terms of sustainability most Piles used are concrete which is a high carbon material which “is responsible for approximately 8% of global carbon dioxide emissions”^[1], another estimate of carbon use is “A wide estimate for a typical year among Federation of Piling Specialists (FPS) members would be approximately 550,000m³ of concrete placed per annum, equivalent to approximately 137,500t of CO₂”^[16]. The amount of carbon used in concrete would make concrete piled foundations unsustainable however, in recent years Piling Contractors have made strides to use lower carbon concrete that can reduce carbon emissions by 70%, this significantly reduces the effect on global carbon dioxide emissions.



For a medium to high rise building typically steel is used for the framing due to its versatility allowing for a wide range of building uses. “One of the main advantages of using steel in construction is its strength... This strength also allows for longer spans, providing architects and builders with more flexibility in their designs” ^[22]. Due to the strength and durability of steel, it is widely used in commercial buildings because it allows the designer freedom to be more flexible with their designs, as well as providing a strong frame with no requirement for load-bearing walls. Due to the durability of steel less maintenance is required throughout the lifespan of the building helping to save money in the future maintenance. Steel can also be more flexible as it can be made offsite which allows them to be made to order for specific loadings as required.

Steel frames are also more sustainable than the likes of concrete as evidenced by “Some 86% of structural steel is recycled as scrap charge used in furnaces and 13% is dismantled and used directly for new structures. Only 1% of all steel that is made is lost to landfill or rust” ^[15]. This is beneficial as when the building eventually reaches its end of life almost all of the steel used in the building can be recycled and reused. Pricing per SQM is also an advantage as steel is cheaper than the concrete alternative.

Cost provided item	Unit	Average cost
Steel building construction	Per m2	£200-300

[5]

Although steel frames have large advantages it also has some disadvantages, for instance, the potential of corrosion due to moisture. “Steel is prone to rusting when exposed to moisture, which can compromise its structural integrity. However, this can be mitigated by using corrosion-resistant coatings or proper insulation.”^[22] This can cause issues as defect in the external cladding or weathering can cause structural issues which can compromise the stability of the building and can be costly to make right, however this risk can be reduced by ensuring that a corrosion resistant coating is used.

Another disadvantage would be, its thermal conductivity, this makes the building harder to heat and can cause issues in a fire. “The transfer of heat in steel studs is extremely high. This causes a lot of waste of energy. Various measures need to be taken to prevent thermal conductivity in these steel members”^[4] and “In high temperatures or in the case of fire, the steel members are prone to failure. Mostly these steel columns are encased in concrete in order to prevent them from failure.”^[4] Both disadvantages would contribute to increased costs during construction, with a requirement to fireproof the steel with a concrete encapsulation as well as insulating the steel to ensure that it doesn’t waste energy when heating the building.

Building Envelope, Materials and Method Choices



[25]

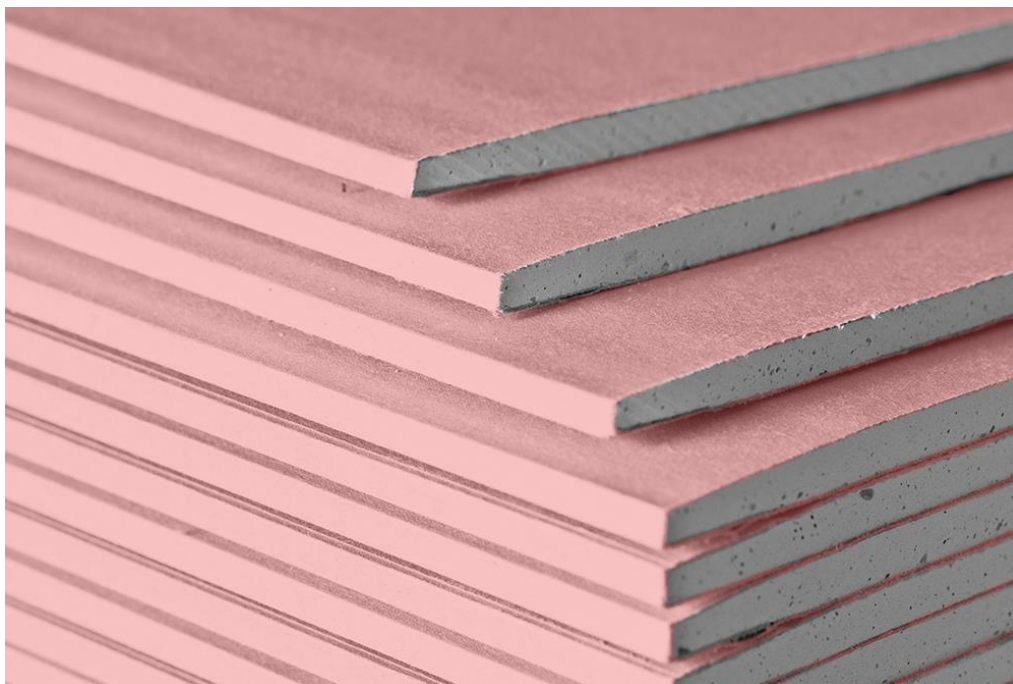
Due to the area the building is being erected in it will have to resist harsh weather due to being so exposed to the elements. This is a major consideration during design to reduce the amount of future maintenance required. It is also in keeping with other buildings in the area, this will help to maintain the current theme and aesthetic of the surrounding buildings. Steel can also be used for the roof of the building. Due to this steel cladding and roofing will be chosen.

As discussed above steel cladding is highly resistant to the weather due to its durability. “One of the significant advantages of metal cladding is that it lasts for about a lifetime for a homeowner. Depending on the type of metal cladding you choose, you can expect it to stay strong for 35-100 years”.^[7] This is advantageous as it can help to reduce the further maintenance of the building due to the long lifespan of the steel cladding. It also benefits us as the cladding will be able to resist the weather conditions experienced in the area.

Another advantage of steel cladding is the sustainability of the material, as it can be made up from recycled materials. “Metal cladding panels can be made of post-consumer recycled products, making them environmentally friendly and reducing the amount of material that goes to landfill. This is a

great opportunity for contractors to reduce the carbon footprint in the environment”^[6] This is a major reason the choice was made to use metal cladding over a brick cladding, despite the better weathering quality of brick cladding the high amount of carbon produced in making them meant looking for a more sustainable alternative.

Despite it's strong weather quality metal claddings do have the possibility of suffering with rust. “Cladding sheets are coated when they are manufactured to protect them from the elements. When these sheets are cut to size, the edges aren't re-coated, leaving them exposed. Over time, the edges of the cladding sheets are likely to rust. This can lead to leaks and eventually lead to the cladding panels needing to be replaced”^[6]. Due to the cause of this being onsite cuts, we can reduce the risk of this occurring by ensuring that edges are re-coated prior to installation or having the cladding prefabricated to the required length ensuring that no adjustments are made onsite.



[14]

For the internal finish plasterboard will be used due to its advantageous qualities, two different types of plasterboard will be used due to the use of the building. These are Fire Resistant Plasterboard and Soundproofing Plasterboard; these will be used double layered to prevent disturbance for

occupants and to allow for sufficient fire protection as per Approved Document B.

A major advantage of plasterboard is that it is a sustainable material. “Plasterboard is a highly sustainable product: new plasterboard may have a recycled content of almost 100% and nearly all plasterboard is 100% recyclable after use. As a result, plasterboard often has the highest recycled content of any of the construction products in a new building.” ^[14] Due to plasterboard being completely recyclable we can use it with the knowledge that when the building reaches its end of life all plasterboard used can be recycled and used again.



[2]

Wood fibre insulation can be used as a more sustainable alternative to more traditionally used insulation like PIR. Wood fibre insulation is made up of waste soft wood material like sawdust and chips, this means that it's made up of what would otherwise be waste products. It is also recyclable which makes it a better choice as when the building reaches its end of life or is renovated the materials can be reused. It is also fire resistant and

rated class E as a combustible material, this is important as it would aid in preventing the spread of fire.

Wood Fibre Insulation does however have a lower thermal performance than man-made alternatives, this would require thicker walls, floors and roofs to reach the same thermal performance as an equivalent man-made product. “they tend to have K values of between 0.038 - 0.043 W/mK compared with a foam PIR board of around 0.023 W/mK” ^[13] This lower K value may increase the cost more as thicker insulation would be required to meet the same thermal performance.

Thickness (mm)	Weight (kg/sqm)	Board dim. (mm)	Number of Boards per pallet	Pallet covers (sqm)	Per pallet (kg)	single board cost	board cost in full pallets
60	9.6	1275 x 765, 0.975m ²	30	29.25	300	£27.30	£24.57
80	12.8	1275 x 765, 0.975m ²	22	21.45	300	£34.57	£31.11
100	16	1275 x 765, 0.975m ²	18	17.55	300	£43.03	£38.72
120	19.2	1275 x 765, 0.975m ²	15	14.625	300	£47.90	£43.11

[2]

Fire Safety

Fire resistance has been considered with all building elements, however, to ensure sufficient compartmentalisation a specialist contractor may be required to ensure that the building has sufficient fire protection. This would include highlighting which areas would require longer protection due to a higher risk as well as where fire doors are required to ensure that the fire does not spread. Sprinklers will also be fitted to the building as required by Approved Document B.

Considerations to Sustainability and Energy Efficiency

In order to increase the energy efficiency of the building we will thoroughly insulate the building and use tri this will help it to retain heat as to not waste energy, we should also try to use windows facing the sun to increase the amount of heating the building has without expending energy.

We can also use solar panels with internal battery storage fitted to the building this allows for all the energy produced by the PV to be used regardless of the time of day. More energy efficient appliances can be used

to help to reduce the amount of energy that the building uses further increasing the efficiency.

Considerations have also been made on the sustainability of elements used in the construction of the building as well as their recyclability when they reach end of life, this helps to reduce the carbon footprint of the building.

Prefabricated or Onsite Construction

Prefabricated elements should be used over onsite construction where applicable, this is due to the benefits of prefabricated construction. Prefabricated construction allows for greater quality control as they are produced in a controlled environment where they can be checked over prior to coming to site. It can also help to reduce the risks onsite as less time is required to fabricate elements therefore, less chance of an accident onsite. It also allows construction to be faster, this is due to only having to install the prefabricated element.

The elements that can be prefabricated for this construction project are the piles for the foundations, the steel frame and the steel cladding. These elements being prefabricated will allow for a watertight structure to be built in a lower amount of time than onsite construction which allows for internal works to start sooner.

Conclusion

In conclusion, piled foundations will be used due to their excellent bearing capacity even when on poor quality soil, steel framing and cladding will be used for its versatility and durability and all internal finishes will be plasterboard due to its sustainability and versatility. Using these methods and materials will allow us to retain the existing design language of the area whilst also providing long lasting sustainable student accommodation.

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Appendices



British
Geological
Survey

BGS ID: 370023 : BGS Reference: SS69SE122
British National Grid (27700) : 266224,193253

SS 69 SE 122 SS69SE 122

OSIRIS - CESCO LTD.				BOREHOLE No. 5				
SITE INVESTIGATION DIVISION				REPORT No. D83137				
LOCATION PROPOSED SECOND TAFE BRIDGE, SWANSEA SITE INVESTIGATION CONTRACT NO. 2				Ground/Bed Level 11.95m. O.D.				
Client WEST GLAMORGAN COUNTY COUNCIL				Coordinates 266224.877E 193253.217N				
Method/Diameter Shell & Auger Percussion boring using a Pilcon 1500 'Wayfarer' rig with 300mm dia equip. from GL to 7.00m and 250mm dia equip. from 7.00 to 10.00m. bgl.				Boring Commenced 3/9/83 Boring Completed 5/9/83				
Ground Water observations are given at end of log		Remarks						
Description of Strata	Scale 1:50			Samples/Coring Record				
	Depth (m)	Reduced Level	Legend	Ref. No.	Type	Depth (m)		N blows/0.3m
						From	To	
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
				3	B	1.50	1.95	
				4	C/D	2.00	2.45	28
				5	B	2.50	2.95	
				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
				11	B	6.00	6.45	
				12	C/D	6.55	7.00	35
				13	D	7.50		
				14	C/D	8.00	8.45	39
				15	D	9.00		

Key: SAMPLES: U=Undisturbed, B=Bulk Disturbed, D=Disturbed, P=Patton, W=Water.
STANDARD PENETRATION TEST: S=Hollow shoe, C=Cone point, R=Refer to text or explanatory data sheet.
() No. of blows to drive U sample.
f = fine, m = medium, c = coarse.

Sheet 1 of 2

Contact BGS: ngdc@bgs.ac.uk

[3]

British
Geological
Survey

BGS ID: 370023 : BGS Reference: SS69SE122
British National Grid (27700) : 266224, 193253

SS 69 SE 122 SS69SE122

OSIRIS - CESCO LTD.				BOREHOLE No. 5				
SITE INVESTIGATION DIVISION				Continuation Sheet No. 1				
LOCATION PROPOSED SECOND TAFE BRIDGE, SWANSEA				REPORT No. D83137				
Description of Strata		Scale 1:50		Samples/Coring Record				
	Depth (m)	Reduced level	Legend	Ref. No.	Type	Depth (m)		N blows/0.3m
						From	To	
(As above)	10.00	1.95		16	C/D	9.55	10.00	41
GROUND WATER OBSERVATIONS								
Inflow observed at (m)		Visual rate of inflow		Water sealed off by casing at (m)				
NOT ENCOUNTERED								
Date	Time	Hole Depth (m)	Casing Depth (m)	Water Level (m)				
Hole completed at 10.00m bgl.								

Key: SAMPLES: U=Undisturbed, B=Bulk Disturbed, D=Disturbed, P=Piston, W=Water.
STANDARD PENETRATION TEST: S=Hollow shoe, C=Cone point, R=Refer to text or explanatory data sheet.
() No. of blows to drive U sample.
f = fine, m = medium, c = coarse.

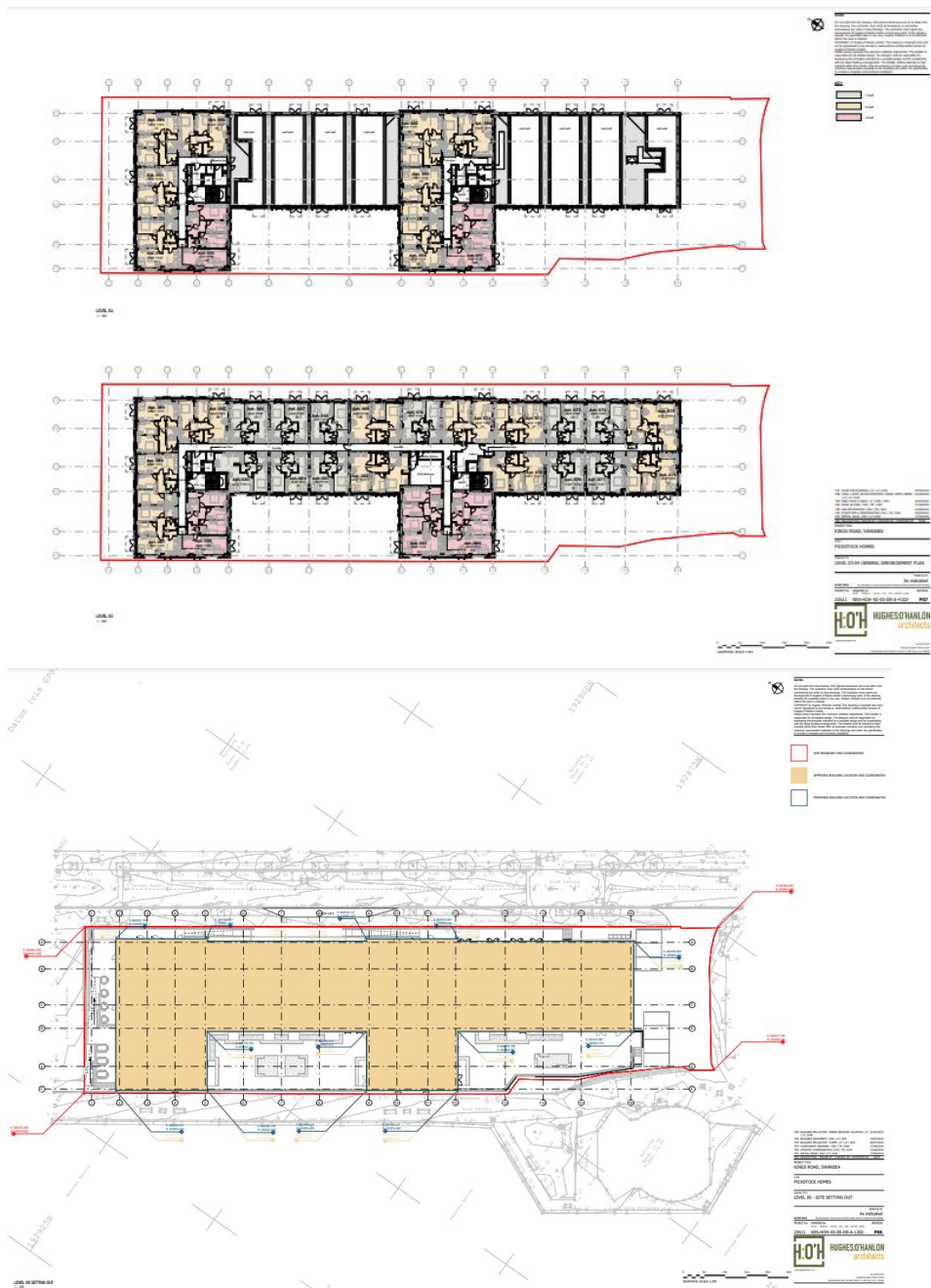
Sheet 2 of 2

Contact BGS: ngdc@bgs.ac.uk

[3]

The two attached documents are borehole investigations completed to a nearby site, these will allow us to gauge the ground composition at our projected site. Borehole survey shows ground does not have sufficient bearing capacity.







Potential floor plans, site plan and topographical plan of projected site. Site plan includes pile locations.



