

LEVEL 4 ASSIGNMENT

Student Name:	MOHAMED ELHADI HUSSIEN SALIM
Student ID number:	2511440
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Lecturer:	Allan Nantel
Internal Verifier:	Rhodri Thomas
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Site Investigation

Introduction

Establishing guidelines for foundation and substructure design as well as evaluating any contamination threats to people, property and the environment are the main goals of site investigation.

Each investigation's design and scope will vary depending on the site's unique conditions. The proposed construction, the expected geology, and the site's prior use.

Although there are many different methods and approaches that can be employed a site investigation report usually consists of four stages.

Part 1: Historical Appraisal and Archival Desktop Study (1850s to Present)

The historical development of the site location between county hall (Civic Centre) and the Marriott Hotel on the Swansea foreshore from the 1850s to the present is covered in the desktop investigation that follows. Site context and current use located on the Swansea foreshore; the study area is current used as surplus land and the civic centre parking area. With plan to transform it into new restaurant and ice-cream parlour.

Historical overview (1850s to present) 1850s-1880s: South dock construction and industrialization by the middle of the 19th century the site location was a vital part of Swansea's developing maritime infrastructure. In order to support the south dock's construction which was finished in 1859, it was heavily developed.

Ground conditions and environmental legacy archival borehole data from nearby meridian quay tower provides a representative stratigraphic sequence for the area: The ground comprises variable made ground 2.5-3m deep consisting of heterogeneous fill like brick, concrete sand and gravel due to its history as dockland there are recorded hydrocarbon odours and oil staining within these layers highlighting a high risk of contamination from historical industrial use.

In relation to the historical background of the Swansea foreshore site regarding industry and seafaring, the following recommendations for the detailed site investigation the preliminary study prepared as part as of the feasibility stage for the proposed restaurant and ice cream parlour development utilizes archival data and the representative stratigraphic sequence from the Meridian Tower borehole log to advise on the most suitable foundation solution.

Part 2: Geotechnical Recommendations and Risk Significant Assessment for Detailed Site Investigation

Geotechnical Stratigraphic Analysis

Based on the borehole information from the nearby Meridian Quay Tower the subsurface conditions at the site are characterized by following strata:

0m-3m Variable Made Ground.

This layer consists of heterogeneous fill including sand, gravel, and anthropogenic debris such as brick and concrete it contains recorded hydrocarbon contamination and oil staining

3m-6m Soft alluvium a highly significant layer for engineering design the stratum consists of very soft clay with organic matter and peat lenses these alluvial deposits are highly compressible and exhibit poor engineering properties

6m-12m Rivere terrace Deposits

These comprise dense sands and gravels

While they provide higher strength than the overlying alluvium they may still settle under high structural loads.

25m+ Bed rock competent bedrock typically chalk is located at depth representing at most stable founding stratum

1: boring and sampling

The recommended strategy would be to utilize a boring grid layout where the spacing will be between 10m and 30m based on standard specifications for building development. Due to the soil stratigraphy obtained in relation to the Meridian Quay, it is important the boreholes are capable of penetrating down to bed rock expected to be 25m deep

Methodology:

Recommended methodologies include cable percussion and rotary drilling methods.

Sampling:

Undisturbed samples such as Shelby tubes or piston samplers need to be obtained to determine the strength propertied of the soft alluvium.

Disturbed samples should be obtained for classification purposes in regard to the made ground.

2: Geotechnical Assessment Strength and settlement potential

The focus needs to be on determining the engineering properties of the soil strata with particular emphasis placed on their bearing capacity and settlement potential.

Settlement:

Both equal and differential settlement must be assessed, and the main issue relates to the 6m thickness of the soft alluvium layer due to the inclusion of peat lenses, there is a risk of significant settlement taking place under the weight of any structures erected here.

Bearing Capacity:

It is necessary for the specialists to conduct assessment on the loading capacity of the soil layers especially those that are located beneath the pressure bulbs that the building foundation may exert on existing structures like the Marriott hotel and county Hall.

3: Contamination Assessment Geo Environment

Given the industrial history of the site as part of the Swansea South Dock complex the geotechnical analysis is to be accompanied by a geo environmental study.

Chemical testing:

This is essential whereby soil and groundwater must be tested for various parameters.

Of particular interest is the testing for metals especially lead, arsenic PAHs and petroleum hydrocarbons TPH.

Ground Gas:

Ground gas investigation is to be carried out with recommended to undertake at least six rounds of monitoring. Ricks posed by methane gas are of major concern due to the organic content of the alluvium and the presence of nearby historical landfilling.

4: Physical Hazards and Underground Interferences

From archival information in relation to the presence of railway goods sheds engine beds and demolished residential streets there is a significant likelihood of massive foundations buried underground.

Trial Pitting:

Trial pits are recommended for the uppermost 2-5m in order to observe the variations in the made ground. The purpose is to detect potential obstacles that may affect pile driving operation

UXO Risk:

As the site was severely damaged during the 1941 blitz an unexploded ordnance UXO investigation is essential to take place prior to any groundbreaking works.

5: Utilities and Structural Constraints

With the site located in an urban environment it is vital for specialists to any utilities present and stability of surrounding structures must be evaluated the Marriott Hotel for example, especially when using vibrating drilling equipment.

Risks and Recommendations:

The following aspects are most risk significant

Contamination Pathways:

The greatest environmental risk will relate to the vertical pathways for hydrocarbon movement. This is supported by previous evidence of contamination in both shallow fill material and the lower level 26.5m soil layers. Any new pathways for such pollutants should not be formed during the investigation.

Compressible Alluvium:

The greatest risk associated with the engineering properties of the strata concerns the 6m thick alluvium layer with poor physical characteristics.

Deep piled foundations will most likely be necessary to prevent structural failures and settlement.

Industrial Obstructions:

Historical foundations railways and other related installations are major source of unforeseen circumstances that may lead to significant construction delays and mechanical damages.

Recommendation: Foundation Type to be Used {Piled foundation}

Considering the geological conditions and the type of the construction piled foundations are to be used as means of transmitting the structure loads through the superficial deposits to the stronger deposits beneath.

The piles should reach the dense river terrace sands approx. 12m depth or preferably the bedrock 25m depth.

Explanation for Choosing Piled Foundations

A: Avoiding Settlement of Building Structure

The key geotechnical problem of the building construction will be the presence of the 6m deposit of soft alluvium which makes a highly compressible layer.

Any structure erected on the soft soil and placed inside the made ground may suffer from the settlement due to the applied load.

Using piling method helps avoiding such an effect as the dead and live loads of the building are transmitted to the strong ground.

B: Brittleness of the Glass Facade

The requirement for the construction of the glass facade is one of the important reasons why piles need to be used.

Being a brittle substance, glass may crack in case the building experiences movement.

The pile foundations provide a necessary rigidity of the building to avoid settlement.

C: Effective Distribution of Loads

Taking into consideration the large area of the building and the additional loads related to the presence of the manager's apartments and conference rooms on the second floor, piling may help distribute the loads effectively without overlapping pressure bulbs of the adjacent structures' County Hall and Marriott Hotel.

D: Environmental Protection Measures and Contamination Management

The Dock history of the building site resulted in contamination of shallow deposits with the hydrocarbons.

This contamination could affect the groundwater in case the contaminated deposit comes in direct contact with the water bearing deposit of sands.

Therefore, the deep piling method allows preventing vertical contamination of the groundwater. A Piling Risk Assessment should be conducted and submitted to NRW prior to construction to confirm that method does not create new pathways for gas or liquid pollutants.

Part 3: Regulatory Compliance, Codes of Practice and Local Authority Engagement

The following Building Regulations, Code of Practice and relevant local authority involvement support the recommendations for the Swansea foreshore site investigation.

Building Regulation and Code of Practice:

The site investigation and any resulting foundation design needs to comply with the following recognized codes stated below sourced as follows:

BS 5930:2015: Code of Practice for Ground Investigations. This document sets out the recognized standard for collating and interpreting information to understand the context of a site in terms of its history, geology and environment.

BS 8004:2015; Code of Practice for Foundations. This code sets out best practice guidelines for designing and constructing foundations.

BS EN 1997-2:2007: Eurocode 7 – Geotechnical Design. This document represents the European standard for ground investigation and testing.

BS 10175 & BS 8576: Mandatory in situations involving the presence of ground gases and soil contamination such as the former industrial dockyard site.

BS 8008: Safety precautions for working in excavations.

PS 128: This document specifies the procedures for detecting underground utilities.

BRE Special Digest SD1: Assessment of risk to buried concrete from aggressive chemical environments such as exposure to sulphates and pH levels.

BRE 365: This document contains the recognized methodology for assessment of soil infiltration and soakaway design.

Series 600 of the Specification for Highway Works: Earthworks and Engineering Fill Placement.

Necessary Local Authority Involvement:

Given the nature of this particular site, the following authorities need to be consulted:

Swansea Council Planning & Building Control: Necessary for development permission for the site including consulting on previous use of the land and excavation in the vicinity.

Natural Resources Wales NRW: Must be consulted regarding protection of ground water resources, vertical migration issues when installing piles and gas detection and monitoring.

Environment Agency: Regulating body responsible for waste management and protection of water quality.

Health and Safety Executive HSE: Governing regulations for overhead power lines and buried high voltage services.

West Glamorgan Archive Service: Management and provision of historical local archives and record keeping.

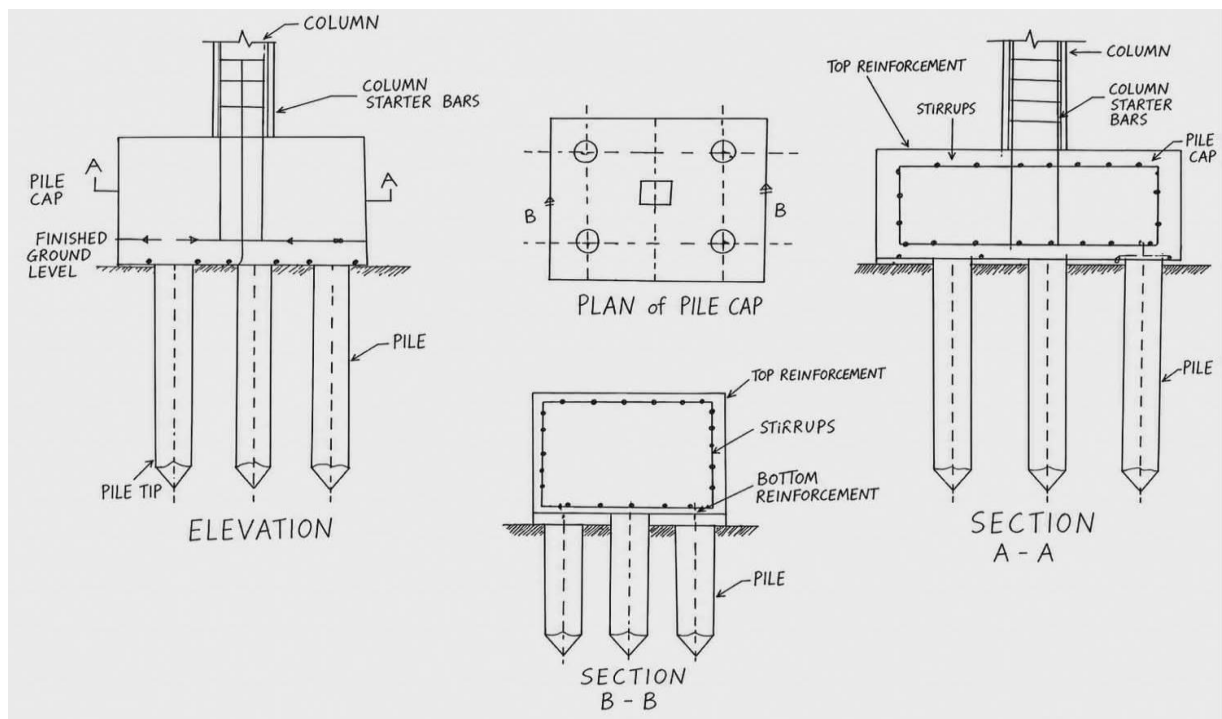
Contact Details for Relevant Authorities

Authority	Address	Contact Information
Swansea Council	Civic Center Oyetermouth Road Swansea SA1 3SN	Website: www.swansea.gov.uk
Natural Resources Wales	Ty Cambria 29 Newport Road Cardiff CF24 0TP	Tel: 03000653000 Email: enquiries@naturalresourceswales.gov.uk
Environment Agency NCCC	PO Box 544 Templeborough Rotherham S60 1BY	Tel: 03708506506 Email: enquiries@environment-agency.gov.uk.
Health and Safety Executive	5S.2 Redgrave Court Merton Road Bootle L20 7HS	Website: www.hse.gov.uk
British Geological Survey	Environmental Science Center Keyworth Nottingham NG12 5GG	Tel: 01159363143 Email: Enquiries@bgs.ac.uk

Part 4: Proposed Foundation Strategy: Deep End Bearing Piled Solution and Technical Justification

According to the archival review of the site geotechnical data obtained from the Meridian Tower borehole logs and structural requirements unique to planned 2000 sqm development I have put forward the following technical recommendation on the type of foundation that should be adopted.

Deep End Bearing Piled Foundations will be the most suitable type of foundation for this construction project.



The piles should be designed using reinforced concrete to pass through the soft strata layers to reach the competent bedrock which is expected to be chalk at depth of more than 25 meters.

Geotechnical and Archival Justifications:

A: Mitigation of the Alluvium layer

The greatest challenge to construction in this location would be associated with the existence of the soft alluvium layer 3m-6m thick consisting of soft clay and peat lenses the soil layer's engineering characteristics include high compressibility, low bearing capacity and low engineering characteristics.

Settlement Issues:

Using shallow pads or raft foundation the load will directly affect the pressure bulb effect of this stratum leading to high total and differential settlements

End bearing Approach:

To transfer the structural load through this layer to the stiffer material underneath the piles must be used.

B: Structural Challenges with Glass Facade Stability

Due to architectural reasons, the new building will contain a glass facade. It is very sensitive to any deformation or displacement.

Differential Settlement:

Small discrepancies in settlement might lead to deformation and thus cracking in the brittle material in the glass facade.

Structural Stability:

As it has been mentioned above, piling would be the appropriate approach to ensure stability and levelness of the building.

C: Solving the Problem with Site Legacy

Buried Structures: Based on the archival analysis, it could be concluded that this site had previously been used as engine sheds and sidings.

Therefore, it is likely to find some structures buried there.

These structures would be rather big and before piling operations the contractors would face significant problems of clearing the dense made ground up to 3m depth.

Contamination:

There have been found several locations contaminated with hydrocarbons within shallow made ground as well as at the depth of 26.4m.

The piling technology must be able to re-mould the soft alluvium layer in order to provide it with a watertight seal that would prevent the upward migration of the fluid contaminants.

Conclusion

From the initial desktop survey and geotechnical assessment of the development plan for the restaurant and ice cream parlour on the Swansea foreshore it is evident that the proposed project can be viable if a sound deep foundation system is used in addressing the site's difficult geology and industrial background.

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