



University of Wales  
Trinity Saint David

# ***REPORT*** ***FUNDAMENTALS OF*** ***CONSTRUCTION*** ***TECHNOLOGY*** ***ACBA4022***

Course: HNC Quantity Surveying

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## Site investigation Case Study: Proposed Restaurant, Ice Cream Parlour and Manager's Apartment-Swansea foreshore.

### Objectives

1. To describe appropriate site evaluation, site and soil investigation techniques.
2. To identify the different types of sub-structure available for a range of building systems and their production.

### Introduction

This report presents a preliminary geotechnical appraisal of a proposed commercial development site in Swansea. The study aims to inform the selection of a suitable foundation system based on anticipated ground conditions. The nearby Meridian Tower, a 29-storey residential structure, is considered as a relevant case study due to its geographical proximity. It is therefore assumed that broadly similar subsurface conditions may be encountered, although this assumption must be validated through detailed site investigation. The building is to contain a restaurant, café bar, ice cream parlour, a fully fitted kitchen and food stores, etc. on the ground floor. At second floor level, there is to be a self-contained manager's apartment, meeting rooms and staff welfare facilities. The front of the building will open out onto the promenade, and a glass façade has been requested.



Figure 1. Proposed Development Site Location Plan

The site is positioned between the Swansea Marriott Hotel and the County Hall Swansea, currently forming part of a shared car park adjacent to the promenade.

The proposed building will have an approximate Gross Internal Area (GIA) of 2000 m<sup>2</sup> at ground floor level. Due to the site's coastal location and historical industrial use, a comprehensive understanding of ground conditions is essential to inform safe foundation design and construction (British Standards Institution, 2015).

## Historical Background and Desktop Study

The site forms part of the Swansea waterfront, an area that has undergone extensive industrial and post-industrial transformation since the mid-19th century. During the 1850s, Swansea was a major industrial port, particularly associated with copper smelting and maritime trade. As a result, large areas of the foreshore were reclaimed using industrial waste and imported fill materials.

This process created extensive areas of made ground, which is typically heterogeneous and may contain contaminants (Craig, 2004). Such materials often exhibit poor load-bearing characteristics and high variability, posing challenges for construction.

By the late 20th century, the decline of heavy industry led to regeneration projects, including the development of Swansea Marina. While redevelopment improved the urban environment, it did not eliminate underlying geotechnical risks associated with historic land use (Natural Resources Wales, 2023).

Additionally, the site's proximity to the coastline introduces marine influences, including elevated groundwater levels and potential tidal effects, which must be considered during design and construction.

## Site Constraints and Access Considerations

The proposed development site presents several physical and logistical constraints that must be considered during both the investigation and construction phases. The site is located between the Swansea Marriott Hotel and County Hall Swansea, with direct frontage onto the Swansea promenade. As shown in the site plan, the development area currently occupies part of an existing shared car park, which may restrict access for construction vehicles and specialist geotechnical equipment.

The surrounding infrastructure creates logistical challenges, particularly due to public pedestrian movement along the promenade and vehicular circulation associated with adjacent commercial properties. Temporary traffic management strategies may be required during site investigation works.

Furthermore, the coastal exposure of the site may create additional construction challenges due to wind loading, salt exposure and potential flooding events. According to Natural Resources Wales (2023), developments located in coastal zones should consider long-term flood resilience measures.

The restricted nature of the site may also influence the selection of foundation equipment, as larger piling rigs may require temporary adjustments to surrounding parking areas.

## Geology of the Swansea District

The Swansea district extends from Gower and Llanelli in the west to Port Talbot and Neath in the east, with the city of Swansea occupying the central part. The area is underlain mainly by Carboniferous rocks, particularly the Pennant sandstones of the Warwickshire Group, while Coal Measures dominate the drift-covered coastal zone from Swansea Bay eastwards. In Gower, limestones of the Pembroke Limestone Group crop out, and the Upper Old Red Sandstone quartz pebble conglomerates of Late Devonian age forming the Cefn Bryn Anticline represent the oldest exposed rocks. The youngest strata are Triassic mudstones found in a small drift-covered outcrop in the southeast (Barclay, in press).

Coal mining was the economic foundation of the district from the 16th century until the 1940s, but the industry has since declined, leaving only minor opencast operations. The tinplate works at Swansea and Llanelli and the steelworks at Port Talbot remain as vestiges of the once-thriving mineral smelting industry. The Llandarcy refinery, operated by British Petroleum, closed in 1998. Today, light industry, services, and tourism dominate the economy, with Swansea serving as the gateway to the beaches of the Gower Peninsula (Strahan, 1907a; Barclay, in press).

Geologically, the district is significant for Quaternary research in the United Kingdom. The caves and raised beaches of Gower preserve a record of Pleistocene climatic oscillations, possibly dating back to the Anglian glaciation (478,000 years ago). During the Late Devensian, the region was affected by valley glaciers from the north and Irish Sea ice from the west. Industrial

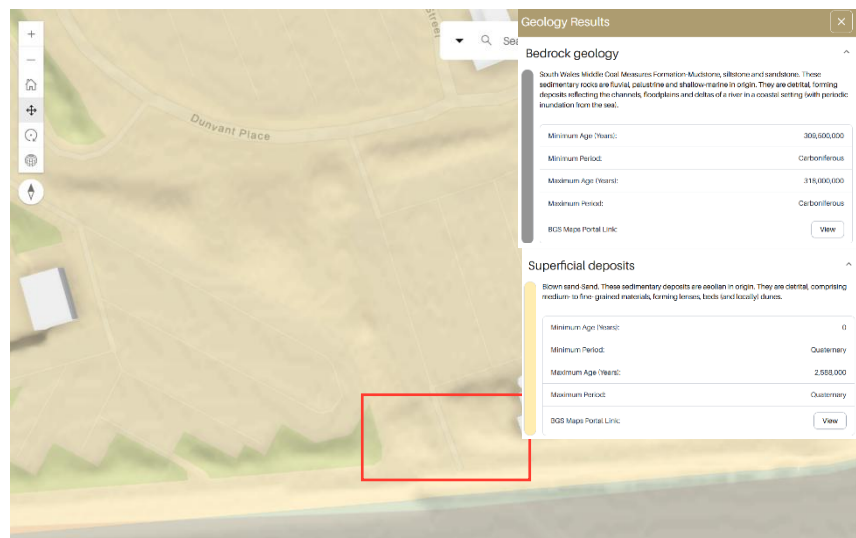


Figure 2. BGS Geology viewer.

activity has left extensive artificial deposits, including colliery spoil and smelting waste, contributing to land contamination in former industrial zones (Campbell & Bowen, 1989; Bowen, 2005).

The geological study of Swansea has a long history. The first survey was conducted in the mid-19th century by W. E. Logan and De La Beche (1846), followed by detailed mapping at scales of 1:10,560 and 1:63,360 between 1896–1902 and 1946–1954. The 1:50,000 Bedrock and Superficial Deposits edition was published in 2011. Notable research includes T. N. George's work on the Carboniferous limestones and structural geology of Gower, Kelling's sedimentological studies of the Pennant Sandstone Formation, and Bowen's synthesis of Quaternary deposits and raised beaches, which document climatic and sea-level changes extending back over 400,000 years (George, 1932; Kelling, 1964; Bowen, 1999).

## Site Investigation Recommendations

A detailed site investigation is required to assess the geotechnical and environmental conditions of the site in accordance with best practice (British Standards Institution, 2015).

### Ground Conditions

Based on nearby investigations, including developments within Swansea Marina, the expected ground profile includes:

- Made ground
- Alluvial deposits (soft clays and silts)
- Glacial deposits
- Glaciofluvial deposits
- Bedrock at depth

Made ground presents a significant risk due to its variability and unpredictable engineering properties (Craig, 2004).

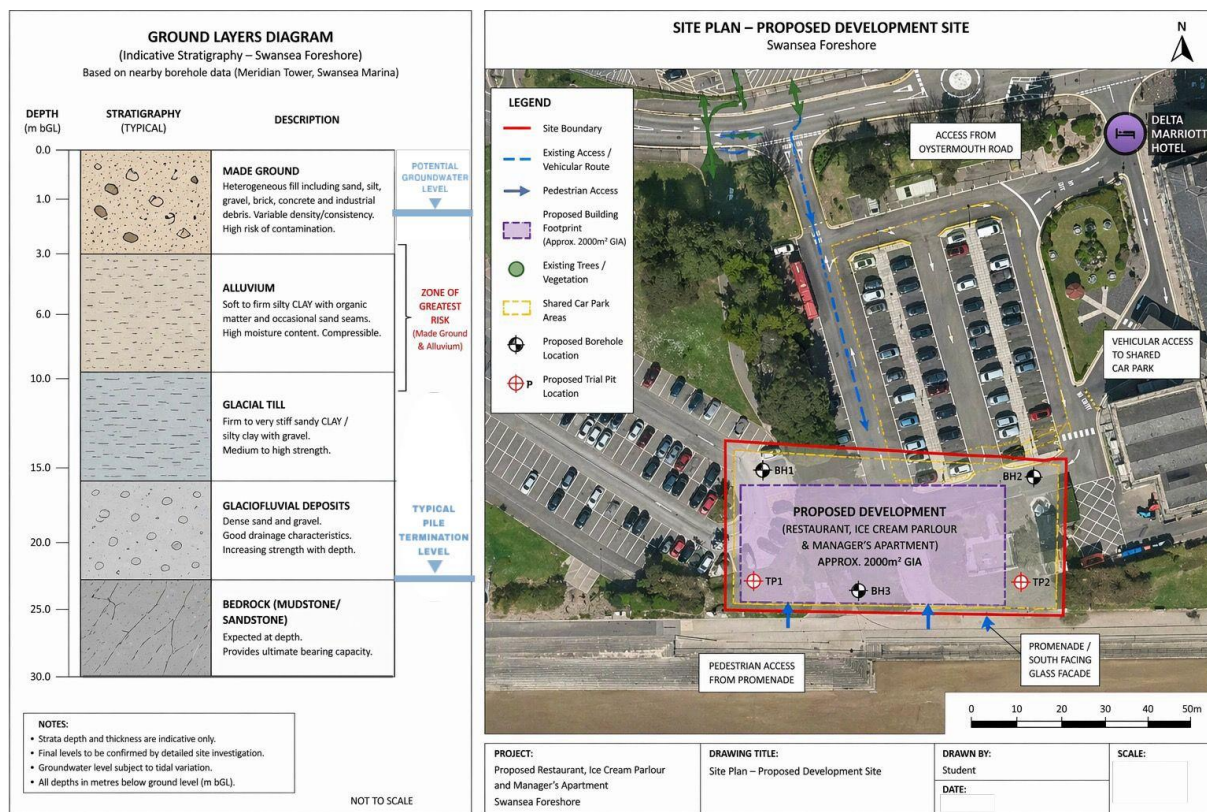


Figure 3. Geotechnical Diagram

## **Groundwater Conditions**

The coastal location suggests a high groundwater table, potentially influenced by tidal fluctuations. High groundwater levels can reduce soil strength, and complicate excavation works, requiring careful monitoring and management (BS EN 1997, 2004).

## **Contamination Risk**

Given the industrial history of the site, there is a strong likelihood of contamination. Potential contaminants include heavy metals and hydrocarbons, which may pose risks to both construction workers and future occupants (Natural Resources Wales, 2023).

## **Recommended Site Investigation Techniques**

In accordance with BS 5930 (2015), the following methods are recommended:

- Boreholes to determine soil stratigraphy
- Trial pits for shallow investigation
- Standard Penetration Tests (SPT)
- Groundwater monitoring
- Soil and water contamination testing

These investigations will provide the necessary data to inform foundation design and risk mitigation.

## **Risk Assessment**

The key risks identified include:

- Made ground instability → risk of settlement
- High groundwater levels → construction challenges
- Contamination → environmental and health risks

Among these, the variability of made ground presents the greatest structural risk due to its impact on load-bearing capacity (Craig, 2004).

## **Drainage and Flood Risk Considerations**

Due to the site's immediate proximity to Swansea Bay, flood risk assessment forms an important aspect of the preliminary feasibility study. Coastal developments are increasingly exposed to flood risk caused by storm surges, tidal changes and rising sea levels.

The high groundwater table identified within the preliminary geotechnical assessment may create drainage difficulties during excavation works. Temporary dewatering systems may be required during foundation construction to maintain dry working conditions (BS EN 1997, 2004).

Surface water drainage should also be carefully managed to prevent excessive runoff into adjacent public areas. Sustainable drainage systems (SuDS), such as permeable paving and attenuation systems, may help reduce flood risk while complying with planning requirements.

Consultation with Natural Resources Wales and Swansea Council would be necessary to ensure compliance with local flood management policies.

## **Regulation and Authorities**

The recommendations within this report are based on the following standards and regulations:

- Building Regulations 2010
- Eurocode 7
- BS 5930

These documents establish requirements for structural safety, site investigation, and foundation design (BS EN 1997, 2004).

Key stakeholders include:

- Swansea Council – Planning and Building Control
- Natural Resources Wales – Environmental regulation

Their involvement is essential to ensure compliance with planning, environmental, and construction regulations.

## Foundation Recommendation

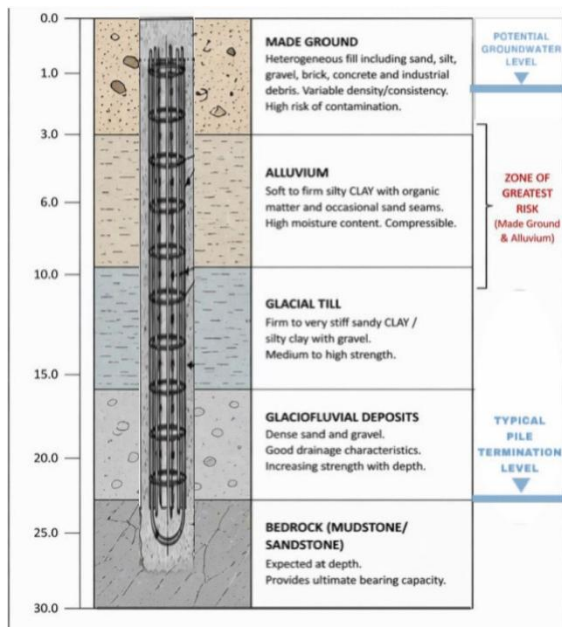


Figure 4. **Bored Pile Foundation System.** Diameter: 600-900 mm. Pile length: to competent bedrock (variable, 20-25 m total).

Given the similarities in ground conditions between the proposed site and nearby waterfront developments such as Meridian Tower, deep piled foundations remain the most appropriate solution. Bored reinforced concrete piles are considered preferable due to reduced vibration impacts on adjacent infrastructure, including the Swansea Marriott Hotel and surrounding public areas. The design and spacing of the proposed bored pile foundation system has been informed by BS 8004 (2015), which recommend that pile spacing should typically range between 2.5 and 3 times the pile diameter to avoid adverse group interaction effects and ensure efficient load transfer.

## Justification and Advantages

The site is expected to consist of made ground overlying alluvial deposits, underlain by more competent glacial strata and potentially bedrock at depth. These upper soil layers are likely to exhibit low bearing capacity and high compressibility, making them unsuitable for shallow foundation systems.

According to BS EN 1997 (2004), foundations must be designed to safely transfer structural loads to strata capable of supporting them without excessive settlement. In this context, the presence of weak near-surface soils necessitates the use of deep foundations to achieve adequate load-bearing performance.

## Proposed Solutions

A bored or driven pile system is proposed, extending through weak soils into stronger glacial deposits or bedrock. This approach aligns with the recommendations of BS EN 1997 (2004) and BS EN (2015). The recommendation for piled foundations is further supported by nearby developments such as Meridian Tower, located within the same waterfront area. Publicly available project information confirms that the tower was constructed within the reclaimed marina zone of Swansea, which presents similar geotechnical challenges including made ground and high groundwater conditions. Although detailed foundation records are not publicly available, high-rise developments of this scale typically require deep foundation systems to transfer structural loads to competent bearing strata (BS EN 1997, 2004).

## Comparison with Meridian Tower

However, unlike Meridian Tower, the proposed restaurant and apartment development is significantly lower in height and structural loading. Therefore, while both developments require deep foundations due to similar ground conditions, the proposed scheme would likely require smaller diameter bored piles rather than the high-capacity deep pile system associated with high-rise developments.

## Pile Spacing and Arrangement

The arrangement and spacing of piles are critical to ensuring efficient load transfer and avoiding adverse group interaction effects.

In accordance with BS 8004 (2015), pile spacing should typically be between 2.5 and 3 times the pile diameter (D), with 3D generally adopted as best practice. For example, for piles with a diameter of 600 mm, a spacing of approximately 1.8 m to 2.4 m would be appropriate. Piles are proposed to be arranged in a *square grid formation beneath reinforced concrete pile caps*, as illustrated in Figure X. This configuration provides uniform load distribution and enhances overall structural stability.

Closer spacing may result in group effects, where overlapping stress zones reduce the efficiency of the pile system. Therefore, maintaining adequate spacing is essential to ensure optimal performance (BS EN 1997, 2004).

## Conclusion

This report has demonstrated that the proposed site at Swansea foreshore presents significant geotechnical challenges due to its historical development and coastal location.

The presence of made ground, high groundwater levels, and potential contamination highlights the need for a comprehensive site investigation in accordance with BS 5930 (2015). Based on the available information, piled foundations are identified as the most suitable solution to ensure structural stability and long-term performance.

This study demonstrates the importance of integrating historical analysis with geotechnical investigation to reduce uncertainty and inform effective design decisions.

## References

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## Appendices

### Appendix-A Classification of piles according to ground disturbance caused by installation

BRITISH STANDARD

BS 8004:2015

Table 7 Classification of piles according to ground disturbance caused by installation

| Pile class                      | Examples                                                                                                                                                                          | Classification <sup>A)</sup> for the purpose of selecting partial factors from BS EN 1997-1 |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| High displacement <sup>B)</sup> | Driven cast-in-place concrete piles<br>Precast concrete piles of solid section<br>Closed-ended tubular steel piles<br>Timber piles                                                | Driven                                                                                      |
| Low displacement <sup>B)</sup>  | Displacement auger piles (not screw piles) <sup>C)</sup><br>Steel bearing piles of H-section <sup>D)</sup><br>Open-ended tubular steel piles <sup>D)</sup><br>Helical steel piles | Driven                                                                                      |
| Replacement                     | Bored cast-in-place concrete piles (installed using a continuous flight auger [CFA])                                                                                              | CFA                                                                                         |
|                                 | Bored cast-in-place concrete piles (installed using casing and drilling tools)<br>Micro piles                                                                                     | Bored                                                                                       |

<sup>A)</sup> BS EN 1997-1 provides partial factors for driven, CFA, and bored piles only.

<sup>B)</sup> The words "high" and "low" here refer to the degree of disturbance of the ground during installation.

<sup>C)</sup> May be classified as large displacement in dense, coarse soils or stiff, fine soils.

<sup>D)</sup> If these piles plug, then they should be re-classified as large displacement piles.

#### 6.1.2 Bored cast-in-place concrete piles

Bored cast-in-place concrete piles may be constructed in supported or unsupported borings that are created by rotary drilling or continuous flight auger (CFA) equipment.

#### 6.1.3 Driven cast-in-place concrete piles

Driven cast-in-place concrete piles may be constructed with or without permanent casing.

#### 6.1.4 Prefabricated piles

##### 6.1.4.1 Precast concrete piles

###### COMMENTARY ON 6.1.4.1

*Prefabricated concrete piles are also commonly termed "precast concrete piles". Precast concrete piles may be reinforced or prestressed.*

**6.1.4.1.1** Precast concrete piles should be manufactured in accordance with BS EN 12794.

**6.1.4.1.2** Precast concrete piles should be formed from one of the following sectional shapes:

- prismatic section;
- circular section with a solid core; or
- circular section with a hollow core.

**6.1.4.1.3** The cross-section of a precast concrete pile may be constant or tapered over all or part of its length.

**6.1.4.1.4** Precast concrete piles may be manufactured in single lengths or in segments connected with cast-in joints.

**6.1.4.1.5** Precast concrete piles should be manufactured using normal weight concrete conforming to BS EN 206.