ARUP

gleeds

JERSEY FUTURE HOSPITAL

CO004 – SITE OPTION REPORT

APPENDIX 6 Technical Site Appraisal TN-STR-001 - TECHNICAL NOTE – STRUCTURAL CONSIDERATIONS

QUALITY ASSURANCE

Sign off: Peter Thomas

Position: Senior Engineer

April 2015

Subject	Jersey Future Hospital – Change Order 4 – Site Validation TN-STR-001 Technical Note – Structural Considerations Rev P1. Date 02.04.2015. Final Preliminary Issue
Date	2 April 2015
Job No/Ref	237035

1 Introduction

This technical note has been prepared to document the findings associated with structural and related geotechnical input to support the preparation of the Site Validation Exercise that forms Change Request Nr. 4 as part of the Jersey Future Hospital Scheme.

The four options being reviewed are:

Option A - Dual Site Options

Option B - Overdale Hospital Site, 100% New Build Option

Option C - Existing General Hospital, 100% New Build Option

Option D - Waterfront Site, 100% New Build Option

In general, the focus of this section of the report has been to look at the key structural and related geotechnical issues that are relevant to the site selection process and has not focussed on or developed any specific structural designs for the above ground structures at this stage. Either steelwork or concrete frames may be suitable once design stages are commenced, but for the purposes of this note, it is assumed a concrete frame will be used.

Detailed ground investigations will be required to inform appropriate detailed design stratigraphy and parameters for the proposed developments.

2 Commentary

2.1 Option A

This option provides for:

- 100% new build at Overdale (albeit for a smaller building than option B)
- A mixture of new build and refurbished buildings at the existing general hospital site

Rather than repeat the data unduly, the geotechnical parameters available and assessed for each site are shown in the following Option B and Option C sections respectively.

2.1.1 Overdale

For geotechnical parameters refer to Option B

The proposed building is generally one to two storeys in height with no basement.

Given the existing ground conditions, it is likely that a ground bearing slab may be suitable. It is also considered unlikely that gas protection measures will be required given the shallow bedrock, although this would need to be confirmed following a full ground investigation.

2.1.2 Structural assumptions & assessment

We have made an assessment of the likely structural loadings on the site. We have based them on a concrete framed, flat slab structure which is typical for modern healthcare facilities and a typical grid of 7.5 x 7.5m. This gives likely floor loadings of:

- 10kN/m^2 dead load
- 5kN/m^2 imposed load

This leads to typical column working loads of approximately 2500kN.

Based on the available geotechnical information, and assuming a 750mm diameter CFA pile, a typical column is likely to be supported on 4 pile groups of around 3-5m in depth with a 2m deep rock socket. This suggests that there will be approximately 1 pile per 10-15m^2.

Given the proposed architectural layout, it is likely that the structure will be split into two independent blocks with movement joints between each block.

The site slopes generally from East to West and the main entrance is likely to be at or around the existing site level. Therefore, the ground slab of the building will have to be elevated above ground level by approximately 3m at the West edge of the building. This could either be achieved through a retaining wall and compacted fill, or as a suspended slab on columns with cladding to create an undercroft.

To the west edge of the site, the ground falls away steeply into Le Val Andre. Depending on the relative location of the building foundations, it may be necessary to carry out a slope stability

assessment. The outcome of this assessment may require some slope stability works prior to construction of the new building.

It should be noted that, with bedrock close to the existing ground surface, the costs of excavation on the site for foundations and drainage can be expected to be higher than normal. There is insufficient ground investigation data available to make an assessment of the rock strength and 'ripability' and its likely impact on excavation and costs/programme.

2.1.3 Jersey General Hospital

For geotechnical parameters refer to Option C.

The new buildings vary in height from two to five storeys generally with a taller tower to the East of seven storeys. There is no new basement proposed, but the existing basement is assumed to be retained (at least in part).

There is an element of refurbishment required in the original listed building. It is assumed that there will not be any significant structural works required in this element, although this will need further definition during the design stage of the project.

Given the existing ground conditions, it will be necessary to provide piled foundations and potentially a suspended ground floor slab. It is also possible that gas protection measures may be required subject to a detailed ground gas risk assessment.

2.1.4 Structural assumptions & assessment

We have made an assessment of the likely structural loadings on the site. We have based them on a concrete framed, flat slab structure which is typical for modern healthcare facilities and a typical grid of 7.5 x 7.5m. This gives likely floor loadings of:

- 10kN/m^2 dead load
- 5kN/m^2 imposed load

This leads to typical column working loads of approximately 4250kN in the main body of the new build blocks and approximately 5900kN in the taller block.

Based on the available geotechnical information, and assuming a 750mm diameter CFA pile, a typical column is likely to be supported on 4 pile groups of around 15-20m in depth with a 4-5m deep rock socket. The taller block is likely to require 750mm diameter CFA pile, a typical column is likely to be supported on 4 pile groups of around 15-20m in depth with a 6-7m deep rock socket.

This suggests that there will be approximately 1 pile per 10-15m^2.

Given the proposed architectural layout and potential construction phasing, it is likely that the structure will be split into three independent blocks with movement joints between each block. Where structures are adjacent to existing buildings care will need to be taken to avoid damage or affecting their stability during the works.

It is known that some of the existing buildings on the site are piled and as such these will present a constraint to the foundation design of the new buildings such that new piles may not be able to be

placed in the most advantageous positions with a subsequent requirement for a more complex substructure. There is the potential to consider re-use of the existing piles, but this would require detailed investigations after demolition of the buildings. Given the programme requirements, it may not be possible to assess this option and incorporate it into the new build design and maintain programme.

There is a partial, one storey basement on the site and the new design will need to co-ordinate with this element which may complicate the substructure design locally.

It should be noted that groundwater is relatively shallow and may be confined and under pressure. Also, there is a potential risk of running sands on the site. This may affect the methods of excavation and should be noted as a site abnormal.

2.2 Option B

This option provides a 100% new build structure that varies in height between three and four storeys. The building does not require a basement.

Given the existing ground conditions, it is likely that a ground bearing slab may be suitable. It is also unlikely that gas protection measures will be required given the shallow bedrock, although this would need to be confirmed following a full ground investigation.

The geotechnical aspects of the site of relevance to the structural works & foundations are as follows.

2.2.1 Available ground investigation information

2.2.1.1 Stratigraphy

No ground investigation has been undertaken on site. Historical ground investigations were undertaken in 1997 and 2001 (TP1 to TP12) on land to the east of the site.

The assumed stratigraphy is provided in Table 4 below:

Table 4: Assume stratigraphy for initial foundation assessment

Depth	Geology	Summary of log description
GL to 1m	Superficial	Silt, fine sand with gravel.
3m to 6m	Weathered bedrock	Sandy silt with gravel
6m +	Bedrock (mudstone / lavas, tuffs, pyroclastic deposits (blocky) NW - Jersey shale Central - St John's Road Andesite SE - St John's Road Agglomerate	Mudstone / Andesite

2.2.1.2 Groundwater

No groundwater was recorded in the trial pits undertaken to 4.5mbgl, to the east of the site. The site is situated on high ground.

Conservatively, for this initial foundation assessment groundwater is assumed at 3mbgl (interface between superficials and weathered bedrock).

2.2.1.3 Soil parameters

The soils parameters are based on limited ground investigation to the east of the site, (soils are assumed to be predominantly granular) and derived using guidance fromBS8002:1994. The assumed soil parameters for this assessment are provided in Table 5 below.

Table 5: Assumed soil parameters

Stratigraphy	Design parameters
Superficials	Φ = 35° γ = 21 kN/m^2 C' = 0
Weathered bedrock	Φ = 35° γ = 22 kN/m^2 C' = 5
Bedrock	Φ = 35° γ = 22 kN/m^2 C' = 10

A detailed ground investigation will be required to inform appropriate detailed design stratigraphy and parameters for the proposed development.

2.2.2 Structural assumptions & assessment

We have made an assessment of the likely structural loadings on the site. We have based them on a concrete framed, flat slab structure which is typical for modern healthcare facilities and a typical grid of 7.5 x 7.5m. This gives likely floor loadings of:

- 10kN/m^2 dead load
- 5kN/m^2 imposed load

This leads to typical column working loads of approximately 4250kN.

Based on the available geotechnical information, and assuming a 750mm diameter CFA pile, a typical column is likely to be supported on 4 pile groups of around 5-10m in depth with a 4-5m deep rock socket. This suggests that there will be approximately 1 pile per 10-15m^2.

Given the proposed architectural layout, it is likely that the structure will be split into two independent blocks with movement joints between each block.

The site slopes generally from East to West and the main entrance is likely to be at or around the existing site level. Therefore, the ground slab of the building will have to be elevated above ground level by approximately 3m at the West edge of the building. This could either be achieved through a retaining wall and compacted fill, or as a suspended slab on columns with cladding to create an undercroft.

To the west edge of the site, the ground falls away steeply into Le Val Andre. Depending on the relative location of the building foundations, it may be necessary to carry out a slope stability assessment. The outcome of this may assessment may require some slope stability works prior to construction of the new building.

It should be noted that, with bedrock close to the existing ground surface, the costs of excavation on the site for foundations and drainage can be expected to be higher than normal. There is insufficient ground investigation data available to make an assessment of the rock strength and 'ripability' and its likely impact on excavation and costs/programme.

2.3 Option C

This option provides a 100% new build structure that varies in height between five and seven (locally eight) storeys. There is no new basement proposed, but the existing basement is assumed to be retained (at least in part).

There is an element of refurbishment required in the original listed building. It is assumed that there will not be any significant structural works required in this element, although this will need further definition during the design stage of the project.

Given the existing ground conditions, it will be necessary to provide piled foundations and potentially a suspended ground floor slab. It is also possible that gas protection measures may be required subject to a detailed ground gas risk assessment.

The geotechnical aspects of the site of relevance to the structural works and foundations are as follows.

2.3.1 Available ground investigation information

2.3.1.1 Stratigraphy

Historically, ground investigations were undertaken in 1973 (BH1, BH2 and BH3), 1979 (BH1, BH2 and BH3) and 2014 (BH1). Logs are available for 7 No. boreholes and have been reviewed.

The assumed stratigraphy is provided in Table 1 below:

Table 1: Assume stratigraphy for initial foundation assessment

Depth (elevation)	Geology	Summary of log description
GL (13mOD) to 1.5m (11.5mOD)	made ground	made ground – gravelly sand
1.5 (11.5mOD) to 4m (9mOD)	Blown Sand	Fine and medium silty sand.
4m (9mOD) to 10m (3mOD)	Alluvium	Sands and gravels, with laminated silt
10m (3mOD) to 18m (-5mOD)	**North-west corner of site**: Weathered John's Road Andesite Formation	Andesite
	South & south-east part of the site: Weathered Jersey Shale Formation	Mudstone, siltstone, grit

2.3.1.2 Groundwater

Groundwater strikes were typically encountered at 4mbgl, with little or no rise, with the exception of BH1_2014 where groundwater was stuck at 4mbgl and rose to surface.

Consequently, for this initial foundation assessment groundwater is assumed at ground level.

2.3.1.3 Soil Parameters

The soils parameters are based on limited ground investigation, (assumed to be predominantly granular) and derived using guidance from BS8002:1994. The assumed soil parameters for this assessment are provided in Table 3 below.

Table 3: Assumed soil parameters

Stratigraphy	Design parameters
Made ground	$\Phi = 35°$ $\gamma = 18$ kN/m^2 C' = 0
Blown Sand	$\Phi = 35°$ $\gamma = 18$ kN/m^2 C' = 0
Alluvium	$\Phi = 35°$ $\gamma = 19$ kN/m^2 C' = 0
North-west corner of site: Weathered John's Road Andesite Formation	$\Phi = 35°$ $\gamma = 22$ kN/m^2 C' = 5 kPa
South & south-east part of the site: Weathered Jersey Shale Formation	

2.3.2 Structural assumptions & assessment

We have made an assessment of the likely structural loadings on the site. We have based them on a concrete framed, flat slab structure which is typical for modern healthcare facilities and a typical grid of 7.5 x 7.5m. This gives likely floor loadings of:

- 10kN/m^2 dead load
- 5kN/m^2 imposed load

This leads to typical column working loads of approximately 5900kN.

Based on the available geotechnical information, and assuming a 750mm diameter CFA pile, a typical column is likely to be supported on 4 pile groups of around 15-20m in depth with a 6-7m deep rock socket. This suggests that there will be approximately 1 pile per 10-15m^2.

Given the proposed architectural layout and potential construction phasing, it is likely that the structure will be split into four or five independent blocks with movement joints between each block. Where structures are adjacent to existing buildings care will need to be taken to avoid damage or affecting their stability during the works.

It is known that some of the existing buildings on the site are piled and as such these will present a constraint to the foundation design of the new buildings such that new piles may not be able to be placed in the most advantageous positions with a subsequent requirement for a more complex substructure. There is the potential to consider re-use of the existing piles, but this would require detailed investigations after demolition of the buildings. Given the programme requirements, this it may not be possible to assess this and incorporate into the new build design in any case.

There is a partial, one storey basement on the site and the new design will need to co-ordinate with this element which may complicate the substructure design locally.

It should be noted that groundwater is relatively shallow and may be confined and under pressure. Also, there is a potential risk of running sands on the site. This may affect the methods of excavation and should be noted as a site abnormal.

2.4 Option D

This option provides a 100% new build structure that varies in height between three and five storeys. The building does not require a basement.

Given the existing ground conditions, it will be necessary to provide piled foundations and a suspended ground floor slab. It is also possible that gas protection measures will be required given the material underlying the site subject to a detailed ground gas risk assessment.

The geotechnical aspects of the site of relevance to the structural works & foundations are as follows.

2.4.1 Available ground investigation information

2.4.1.1 Stratigraphy

Limited ground investigation has been undertaken on site. Trial pits were undertaken as part of drainage construction works in 2014. Ground investigations were undertaken on land to the east of the site at Marina Car Park in 1997. 10 No. boreholes were advanced to up to 16m bgl.

The assumed stratigraphy is provided in Table 6 below:

Table 6: Assume stratigraphy for initial foundation assessment

Depth	Geology	Summary of log description
GL to 10m	Made ground – landfill	Silty clay, with sand and gravel
10m to 13m	Beach deposit	Soft to firm clay, silt and sand
13m +	Bedrock	Granophyre granite / lamprophyre and dolerite / St Saviours Andesite Formation

2.4.1.2 Groundwater

In boreholes to the east of the site, groundwater was typically encountered at 7m to 8m below ground level.

Consequently, for this initial foundation assessment groundwater is assumed at 5mbgl (within the landfill materials).

2.4.1.3 Soil Parameters

The soils parameters are based on limited ground investigation to the east of the site, (soils are assumed to be predominantly granular) and derived using guidance from on BS8002:1994. The assumed soil parameters for this assessment are provided in Table 5 below.

Table 5: Assumed soil parameters

Stratigraphy	Design parameters
Made ground – landfill	$\Phi = 28°$

Stratigraphy	Design parameters
	γ = 18 kN/m^2 C' = 0
Beach deposit	Φ = 35° γ = 19 kN/m^2 C' = 5
Bedrock	Φ = 35° γ = 22 kN/m^2 C' = 5

A detailed ground investigation will be required to inform appropriate detailed design stratigraphy and parameters for the proposed development.

2.4.2 Structural assumptions & assessment

We have made an assessment of the likely structural loadings on the site. We have based them on a concrete framed, flat slab structure which is typical for modern healthcare facilities and a typical grid of 7.5 x 7.5m. This gives likely floor loadings of:

- 10kN/m^2 dead load
- 5kN/m^2 imposed load

This leads to typical column working loads of approximately 5900kN.

Based on the available geotechnical information, and assuming a 750mm diameter CFA pile, a typical column is likely to be supported on 4 pile groups of around 15-20m in depth with a 3-4m deep rock socket. This suggests that there will be approximately 1 pile per 10-15m^2.

Given the proposed architectural layout, it is likely that the structure will be split into three independent blocks with movement joints between each block.

Given the site location, the structure will need to be designed to deal with an aggressive, marine environment.

3 Risks/Opportunities

The key risks and opportunities are as follows:

3.1 Overdale site

The key risks are:

- Ground contamination – no data available, but a risk remains given previous uses
- Lack of ground investigation leading to longer/larger pile size and/or greater numbers
- Shallow rock affecting excavations
- Adjacent to steep slope of Le Val Andre – may require slope stabilisation works
- Work on a live hospital site

The key opportunities are:

- Potential for use of shallow foundations subject to detailed ground investigation and assessment of rock strength

3.2 Existing general hospital site

The key risks are:

- Ground contamination – no data available, but a risk remains given previous uses
- Lack of detailed ground investigation leading to longer/larger pile size and/or greater numbers
- Relatively shallow ground water under pressure and potential for running sands affecting excavations and pile methods.
- Existing basement providing a constraint to new building
- Existing piled foundations providing a constraint to new substructure design
- Work adjacent to existing buildings and on a live hospital site.
- The level of structural work required for refurbishment areas cannot be assessed at present.

The key opportunities are:

- Potential for re-use of piles at the existing general hospital subject to detailed investigations

3.3 Waterfront site

The key risks are:

- Ground contamination (refer to geo-environmental report)

- Lack of detailed ground investigation leading to longer/larger pile size and/or greater numbers
- Exposed, marine site with potential impact from storm events

The key opportunities are:

- Can be constructed in a single phase and provide a shorter overall programme

4 Derogations

It is assumed that HTM 08.01 will be applied to the structural design, in particular floor vibration limits, to suit the use of specific areas of the hospital which will influence the final slab thickness and method of construction.

There are no identified derogations at this time.