Site Investigation Report

PROPOSED BAIT DAJAN SCHOOL BUILDING

Basin No. ??? Plot No. ???

Bait Dajan

Nablus District – Palestine

Requested by:

????? Engineering Company

Ramallah - Palestine

November 2009

1. Introduction

This report is to provide the geotechnical situation and parameters for the proposed Biat Dajan School Building, Bait Dajan, Nablus District, Palestine. This site investigation is requested by ???? Engineering Company, Ramallah, Palestine. The proposed site is located at Basin No. ??? and Plot No. ????. The site has an area of ???? square meters and the proposed building has a plan area of about ??? square meter. The proposed building consists of at most of four stories.

The site is located at Bait Dajan Village and it is almost leveled and located at valley area. The site was used as an agricultural land. There are no electrical, telephones, water or wastewater lines passes through the site. The site was excavated about 3 m below the original ground surface for the preparation of construction of the proposed school.

Two boreholes were dug out in site to carry the subsurface investigation. One soil stratum was found within the site, which reddish silty clay of high plasticity with pebbles and boulders of varying sizes.

The subsurface investigation was necessary to determine the geotechnical conditions and the suitable solutions to ensure that the proposed building will be designed and constructed properly.

2. Purpose

The purpose of this investigation is to determine the following:

- Description of the subsurface soil strata of the site.
- Proposed type and depth of foundations most suitable and practical to be constructed at the proposed site.
- Bearing capacity for the proposed foundation.
- Settlement coefficients.
- Parameters required for designing retaining walls.

3. Procedure

The procedure that was carried out to determine the above purpose was as follows:

- Two boreholes were dug out in the site using specialized boring machine. These boreholes gave the opportunity for determining the description of subsurface strata, eye exams, and taking the needed samples that were tested ????? Engineering laboratories.
- Unfortunately, Standard Penetration Test (SPT) was unable to be performed due to the existing of boulders.
- Correlations were used to determine the geotechnical parameters as will be seen later.

4. Site Description

From the boreholes logs and the geological section (Appendix A) through the boreholes, the site has one distinct soil stratum, which is reddish silty clay of high plasticity with pebbles and boulders of varying sizes. This layer extends from the excavated ground level to the end of boring which 10 m. It is worth mentioning that the excavated ground level is about 3 m below the original ground level.

It is important to note that the site is leveled and located at valley and low land which is susceptible to impound rainfall water, and hence, it is very important to have the suggested building elevated from the ground surface.

Ground water table was not encountered during the time of investigation (November 2009).

5. Geological Condition of Our Region

In order to understand the geological condition of the site, it is recommended to look at the stratigraphy of the whole area. This part of the Middle East which includes Palestine and Jordan reveals similar geological development since most of this land was covered by sea water long time ago. Rock formations from Precambrian, Paleozoic, Mesozoic, and Cenozoic ages are available in different parts of the area. In fact, Cretaceous formations (especially those of the Upper Cretaceous), which are the newest and the latest of the three Mesozoic divisions, are the most common in Palestine including the investigated site. The Upper Cretaceous formations are divided into six different units, the latest of them is the Chalk-Marl unit.

The soils that cover the bedrock are formed by the weathering of various rocks. The most general types of weathering are mechanical and chemical weathering. The soil that is produced by the weathering process of rocks can be transported by physical processes to other places. These soils deposits are

called transported soils. In contrast, soils stay in the place of their formation and cover the rock surface from which they derive, are referred to as residual soils.

6. Laboratory Test Results

The following is the summary of the results that obtained from laboratory tests. More details for each test may be found in Appendices B and C.

BH. No.	Sample No.	Depth m	Nature Moisture %	Liquid Limit %	Plastic Limit %	Plasticity Index	Cohesion (from unconfined compression test) kg/cm^2 (kN/m^2)
1	1	0.0 – 1.5	16				
	2	1.5 – 3.0	30				0.6 (60)
	3	3.0 – 5.5	31				
	4	5.5 – 7.0	20				1.25 (125)
	5	7.0 – 8.5	24	61	35	26	1.3 (130)
	6	8.5 – 10.0	19				1.55 (115)
2	1	0.0 – 2.5	24				1.6 (160)
	2	2.5 -5.5	31	63	34	29	1.4 (140)
	3	5.5 – 7.5	19				
	4	7.5 – 10.0	6				

Unfortunately, Standard Penetration Test (SPT) was unable to be performed due to the existing of boulders all over the stratum.

Detailed results are shown in Appendices B and C.

7. Geotechnical Conditions

According to site description and laboratory test results the following geotechnical conditions prevail:

7.1 Swelling Pressure and Swelling Potential

The soil existing at the site is mainly reddish silty clay of high plasticity; this type of soil has very high swelling potential and may cause severe problems. Precaution regarding swelling problems should be taken into consideration.

After concreting the foundations, the excavation should be filled and compacted with selected backfill materials according to compaction criteria as will be mentioned later. This is to prevent the infiltration of water to the foundations. However, if the excavation will be limited to the footings locations, then, protection of the ground slab from possible heave of the underlying ground material should be considered. 50 cm layer of compacted and selected fill material must be provided beneath the ground floor slab or a gap of 20 cm should be done.

7.2 Settlement and Differential Settlements

The allowable bearing capacity and the type of foundations provided later are evaluated based on the settlement limits. This means that the settlement of the proposed foundation would be within the acceptable limits if the allowable bearing capacity provided is used.

7.3 Type of Foundations

Pile foundation is recommended for this site. This is due to the low bearing capacity and the very high swelling potential of the soil existing at the proposed site. The allowable capacity of a single pile based on undrained cohesion (C_u) = 60 kN/m^2 as an overall average value is given in the following table.

	Allowable Capacity of Single Pile ton (kN)			
Pile Length M	**Diam = 600 mm**	**Diam = 700 mm**	**Diam = 800 mm**	**Diam = 1000 mm**
8	18 (177)	20 (203)	25 (246)	35 (350)
10	22 (219)	25 (252)	30 (302)	42 (412)
12	26 (260)	30 (300)	36 (357)	49 (481)
14	30 (300)	35 (348)	42 (412)	55 (550)

An alternative foundation type may be considered for this site is shallow foundation such as isolated, continuous or mat foundation. The allowable bearing capacity is 1.2 kg/cm^2 (120 kN/m^2). The foundation depth is 0.5 m below the existing ground surface.

This bearing capacity would control the settlement to be within the acceptable limits.

Water regime at the site must be controlled. Surface water must be adequately drained from the site and water pipes must be protected against leakage.

7.4 Retaining Walls

For designing the retaining walls of the proposed building, the coefficient of the lateral earth pressure at rest (K_o) is equal to **0.55**.

Good drainage systems behind the retaining walls with weephole and perforated drainage pipes have to be provided, so that pore water pressure behind the retaining walls will not develop.

The backfill materials must be adequately selected.

7.5 Excavation

The excavation at this site will be through silty clay soil. Hence, conventional excavation methods and equipments such as loaders and bulldozers will be adequate for the excavation at this site.

Open excavation in this site will stand vertical without support provided the height of the face will not exceed the critical height, which is about 5 m. This height could not be adopted for periods exceeding 4 weeks. In general, foundation excavation should not be exposed for long time neither to the sun nor to rainfall. To be in the safe side, the temporary excavation should be cut in a face inclination not steeper than one horizontal to three vertical (1H:3V).

Long term foundation excavation should has a face inclination not steeper than one horizontal to one and a half vertical (1H:1.5V).

In the case that open excavation has to be supported, especially for deep excavations, then the sides of excavation may be supported using sheet piling (temporary or permanent), line of bored piles, nailing, soldier beams (or piles) with or without lagging, wales and struts or rakers, or any other available and practical method.

7.6 Surface Drainage

It is recommended to protect the foundation ground and excavation form surface water both during and after construction by providing proper drainage and protection system. Surface water should be diverted away from the edges of the excavations. This is especially due to the location of the site at valley area (low land).

It is recommended to have the proposed building elevated from ground surface and this is due to topography of the site which is considered as low land and is susceptible for impounding rainfall water.

Water supply and sewer pipes should be sufficiently flexible, or have flexible connections, to accommodate movements. This is to prevent leakage from these pipes. Water and septic tanks should be located away from the foundation or below the depth of foundation.

7.7 Construction Dewatering

In case that water flows into an excavation, the recommended method of dewatering in this site is to create a nearly impervious water barrier around the excavation and provide sump holes (small pits below the bottom of the excavation) at selected locations, pump the remaining seepage inflow, and simultaneously monitor the groundwater level outside the excavation.

As mentioned earlier water table was not encountered at this site and it is expected to cause no problems for construction.

7.8 Over All Stability Considerations

Since the site is leveled of valley area, then the stability of the site would not be a problem. Vertical cuts would stay stable provided the precautions mentioned above. Therefore, problems due to natural slope or proposed structure are minimal at this site. The cutting slopes should be in according to what have been mentioned earlier.

7.9 Backfill Material and Compaction Criteria

The selected backfill materials to be used behind the retaining walls and under the ground slabs should be according to the standards. For example, backfill materials may be soil or soil-rock mixture with sizes not more than 15 cm and not more than 15% larger than 7 cm. Also, it should be free from organic matter or any other deleterious substances.

The selected backfill materials should be spread in lifts not exceeding 25 cm in uncompacted thickness, with moisture content equals to optimum and not less than 95% relative compaction according to the lab proctor test.

7.10 Chemicals Properties of Soils and Water

No indications of excessive chemicals concentrations of the soil and water in the site (sulfate, chloride, calcium carbonate, etc). The odor and color of the soils are normal. Hence, no chemical problems, such as corrosivity, are

expected from the site's soils and/or surface water.

As mentioned earlier the water table was not encountered, therefore, no problems due to chemicals in ground water are expected.

The recommended type of cement to be used in the construction in this site is type I (ordinary Portland cement).

Typical method of insulation of the underground structure may be used, such as, covering by thin film of asphalt, providing a gab using bricks or using other insulation materials.

7.11 Site Seismicity

According to Israeli Seismic Risk Map, the proposed site lies in zone with an acceleration coefficient of **0.15g.**

8. Recommendations

From the above mentioned geotechnical conditions and parameters, we do recommend the following:

1. Pile foundation is recommended for the proposed site.
2. An alternative foundation type may be used is shallow foundations (isolated, continuous (strip) or mat).
3. Settlement and differential settlement would be within the acceptable limits if the provided allowable bearing capacities for pile and shallow foundations are used.
4. Water table was not encountered.
5. Retaining walls with adequate drainage systems and good backfill materials is recommended.
6. The cutting slope for this site is reviewed in details earlier.
7. A drainage system should be designed to avoid the effect of uplift pressure caused by water. Also, the structure should be isolated properly from surface and internal water.
8. Type I cement (normal Portland cement) may be used in the construction at this site. Common practice of insulation of the underground structures is adequate.
9. No chemical problems are expected neither form the soils nor from the water exiting at this site.
10. The acceleration coefficient of the proposed site may be taken as 0.15g.
11. If during construction other geotechnical conditions appear, please contact us for remedial measures.

Sincerely Yours,

9. Appendix A

Borehole Logs
and
Geological Sections

10. Appendix B

Natural Moisture Content, Liquid Limit and Plastic Limit Test Results

11. Appendix C

Unconfined Compression Test Results of Soil

13. Appendix D

Laboratory Tests Standards

Laboratory and/or field tests have been used to determine the physical and mechanical properties of the soils and rocks of the proposed site. The following standards have been used to perform the tests:

- ASTM D 2216-92, ’Laboratory determination of water (moisture) content of soil, rock and soil aggregate mixture‘.
- ASTM D 4318-93, ’ Liquid limit, plastic limit and plasticity index of soils.‘
- ASTM D 854-92,’ Determination of particle size distribution‘.
- ASTM D 422-63 (Re-approved 1990), ’Standard test method for particle size analysis of soils - Hydrometer method‘.
- ASTM D 2166-66(1979), ’Test for unconfined compressive strength of Rock‘.
- ASTM D 2435-93,’Determination of the one-dimensional consolidation properties of soil‘.
- ASTM D 853-92,’Determination of particle specific gravity of soils‘.
- ASTM D 2166-91,’ Test for unconfined compressive strength of cohesive soil‘.
- B.S. 1377: Part 3: 1990, Test 5, ’Determination of the sulphate content of soil and ground water‘.
- B.S. 1377: Part 3: 1990, Test 7.3, ’Determination of Acid-soluble chloride content‘.