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GEOTECHNICAL (SOIL ENGINEERING) FOLDER

(EXPLICIT EXPERT'S OPINION OF SOIL MECHANICS)

IN CONCERN TO

THE OFFICE AND CONDOMINIUM COMPOUND

TO BE SITED AT

22 *MEZŐKÖVESD* ST.

ON THE EMBANKMENT OF RIVER DANUBE

IN

THE SO-CALLED *ÚJBUDA* URBAN QUARTER

BUDAPEST, JUNE 2008

Ref. No.: 179/08

1./ Project and Antecedents

L.B. VETUS ARCHITECT Kft. (business domicile: H-1112 Budapest, Törökbálint út 2.) as Project Owner has assigned our engineering services agency to implement this part of the siting project on the site specified above. Our assignment includes the following: to implement an explicit expert's opinion of soil mechanics linked to the compound as subject of the siting project rested on soil mechanical boring, dynamic sounding and the laboratory testing of soil and groundwater samples, and on computed data to be included in charts and diagrams.

According to plans, the compound would be constructed with a multi-storey car park (two storeys) plus many (five to seven) storeys. The ±0.00 level of the compound equals to the top level of the river embankment functioning as a flood defence facility.

The assigning Client has not provided explicit plans or load/bearing capacity data.

The assigning Client has provided the following data indeed:

• master plan key plan

• plan

• sections and views

2./ Local Conditions

The compound is planned to be sited on the *Mezőkövesd* St. – *Dr. Papp Elemér* (*Árasztó*) St. area on the embankment of River Danube within the city limits of Budapest. The construction site is located outside the flood defence embankment on the side fully defended. It is surrounded by industrial sites in the north, River Danube in the east, an uncovered area in the south, and some more industrial sites in the west as well. The plot subject to engineering assessment is partly covered (industrial facilities to be demolished), is partly covered with

partly demolished buildings, and is covered with concrete paving on a large area. There are archaeological excavations in progress currently.

As regards the terrain (topography), the construction site can be defined as plain.

3./ Geological Conditions

According to geological literature, the bedrock within the limits of the construction site subject to engineering assessment is composed of Oligocene gravelly sand, aleurit sand, psammite, sand, arenarious clay, clay (the so-called *Kiscell*-type) covered with layers of fill.

4./ Soil and Groundwater Conditions

On June 6, 2008, as many as three large-diameter soil mechanical boreholes of 15 m in length each were bored. In addition, on June 13 and 17, 2008, further six BORRO type dynamic sounding of 12 m in length each were also bored. Both disturbed and undisturbed samples that were subject to laboratory assessment had been taken from the boreholes. Levelled at a known point of altitude (103.20 mBf) of the *Szerémi* St. – *Mezőkövesd* St. area, the altitude of the excavations was defined by levelling in the absolute altitude system.

The attached appendix includes the drawing of the location of the excavations and the layering (of the soil).

[*N.B.: 4.1/ and 4.2/ not to be translated according to Client's request – the translator*.]

5./ Recapitulation and Recommendations

This recapitulation can conclude that the construction site subject to engineering assessment is beneficial in a geotechnical view.

Fills and clay layers of varying bearing capacity are located on the surface, but relatively close to the level of the terrain, and layers of grit sand and psammite sand are located from a depth of 4 to 5 m, the bearing capacity of which is good, despite the loose and intermediary solid state of them. The bottom of foundation can be set up in such a layer.

The impermeable clay surface is located near the level of terrain (8 to 9 m underneath such level) that is beneficial to the limitation of impermeable siting.

The level of groundwater fluctuates by virtue of the proximity of River Danube, so its location can be near the surface.

5.1/ Foundation

The foundation of the multi-storey compound planned to be composed of two basements is expedient/recommended to be flexibly filter blanketed foundation (base) slab underneath the basement on the bottom of foundation to be constructed in view of the required thickness of such slab. According to the master plan, a foundation (base) slab of 70 cm in thickness will serve as a foundation on a bottom of foundation of – 6, 7 -7.0 m (≈98-98.5 mBf). In this given case, the bottom of foundation lies on the upper limit of the layer of sandy gravel, gravelly sand, and sand mud.

In the case of flexibly filter blanketed foundation (base) slab, a filter blanket layer of min. 25 cm in thickness, but under all circumstances conform to the loads of use, is recommended. On the surface of such filter blanket layer, the value of E2 ≥ 60 MN/m^2 is recommended to be reached, while that of E2 ≥ 30 MN/m^2 should be reached on the surface of the original soil. Since the bottom of foundation will be constructed onto the boundary of the clay and granular layers, it is recommended, for the purpose of safety, to construct such bottom of foundation 0.5 m deeper or to construct a thicker layer of filter blanket (500 to 70 cm) in order to install said bottom of foundation homogeneously into the layer(s) of sandy gravel and gravelly sand.

As regards calculations, deformation moduli included in the charts in Section 4.1 hereabove can be considered. Sandy gravel lying on the bottom of foundation may be used as a filter blanket, but compaction must be applied and the E2 value specified above in concern to the filter blanket must be produced.

Such foundation (base) slab must be dimensioned against plume and groundwater pressure in consideration of the effective (critical) water level. The compound subject to this siting

project must be equipped with damp proof course against groundwater pressure all around in consideration of the effective (critical) water level as well.

5.2/ Settlements

Referring to settlement calculations completed in knowledge of the structure and the loads, the effects of calculated settlements and relative settlement differences on the superstructure must be analyzed.

If the results cause unallowable removing to the superstructure, the foundation (base) slab may have to be made thicker locally underneath columns and/or building sections of incidentally higher bearing capacity, or the construction of a deep foundation (piling, caisson, slurry trench walls) to be connected with the base slab may be required.

Soil physical parameters and deformation moduli that may be considered in concern to the calculation of settlements have been included in the charts in Section 4.1 hereabove.

5.3/ Excavation and Water Removal

The bottom of the excavation lies on a level of around 95-96 mBf, if the two-storey car park, the expected thickness of the foundation slab, and the stratification are considered. Grounded on initial piezometric levels (98.3-98.75 mBf) identified in the course of excavations, a groundwater level settlement of cca. 3-4 meters (might be more depending on the water stages of River Danube) will be required. This, in view of massive excavation (as deep as 6-7 meters) and the proximity of River Danube, can be implemented only if defensive impermeable limitation of the construction site has been implemented. Such defensive impermeable limitation of the construction site is recommended to be implemented by impermeable slurry trench walls that should be installed into the impermeable clay bedrock.

The temporary durability of such slurry trench walls must be inspected, and if necessary, secured by earth / ground anchoring / anchor piling or any other type of strutting. Water accumulated in the excavation hence implemented can be removed by pumping.

Slurry trench walls are recommended to be constructed with as less turning as possible along a straightforward line in order to maintain increasing impermeability and economical construction/implementation.

Precipitation and/or other waters accumulated around the compound must be collected both in the course of siting and in the final construction phase and drained into the sewage system or any other receptacle.

5.4/ Other Structures

A layer of min. 0.25 m of good quality and well compactible sandy gravel or any other good quality grained material as a filter blanket layer up to a degree of compaction of $T_{rp} \geq 95\%$ must be installed underneath the paving to be set out around the compound. Gravelly sand and sandy gravel excavated in the course of siting can be recycled for this purpose.

5.5/ Excavation Capability and Compactibility

Soils to be excavated from the excavation are categorized into Excavation Classes II and III. Higher classes (e.g.: IV) are also conceivable incidentally. The concrete paving covering a large area, the remains of demolished buildings, the footing of buildings to be demolished, and other public utilities and structures left inside must be dealt with by great care.

Fills and clay soils to be excavated cannot or might be compacted unsatisfactorily, so that their recycled use is not recommended at all. Gravelly sand and sandy gravel can be recycled though.

Dated; Budapest, July 2008

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Civil Engineer

Árpád Petik

Chartered Engineer, GT-1

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