A GEOTECHNICAL STUDY FOR CONSTRUCTION IN CARACAL, OLT COUNTY

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ABSTRACT

Geotechnical study comprises the work carried out by the geotechnical exploration within the area of site area 660 sq.m., located in Caracal, B.P. Hasdeu Street. To determine the geotechnical characteristics of the lithological types encountered were harvested and undisturbed samples from troubled drilling executed and performed specific tests, being employed in geotechnical risk reduced category. Conventional pressure calculation base p^{-}_{conv} was set at 300 kPa, for basic grouping key, being observed condition $p_{ef} \leq p_{conv}$ because 2.051 Y 2.25.

Studiul geotehnic cuprinde lucrarea de explorare geotehnică executată în zona amplasamentului cu suprafaţa de 660 m^2, situat în Caracal, str. B.P. Haşdeu. Pentru determinarea caracteristicilor geotehnice ale tipurilor litologice întâlnite, s-au recoltat probe tulburate şi netulburate din forajul executat și s-au efectuat analizele specifice, terenul fiind încadrat în categoria de risc geotehnic redus. Presiunea convenţională de calcul de bază p^{-}_{conv} a fost stabilită la 300 kPa, pentru gruparea fundamentală, fiind respectată condiția $p_{ef} \leq p_{conv}$ respectiv 2,051 Y 2,25.

INTRODUCTION

Geotechnical study represents a complex analysis of the conditions to be fulfilled and its ability to sustain a safe target. In the same study to make calculations on the weight which it supports land and it presents solutions for the arrangement of it both on location and place the lens in the vicinity.

The realization and the construction of any objective, geotechnical study is necessary to prevent any degradation in time of construction but also to protect neighbouring buildings.

Geotechnical study represents the basic documentation necessary for geotechnical design of any building, and this is part of the technical project and is presented in the annex to the draft for authorizing execution of construction works (CAP).

MATERIALS AND METHODS

Geotechnical study comprises the work carried out by the geotechnical exploration within the area of site area 660 sq.m., located in Caracal, B.P. Hasdeu Street.

The method used includes the stages of realization of the geotechnical study according to the rules in force.

Exploring the terrain was carried out through: direct geological observations of the area studied; performance of a geotechnical drilling (FG1) with a diameter of 127 mm and depth of 6.0 m positioned according to plan (figure 1); penetrometrice test execution at different depths in the bulb area foundations, pressures with dynamic easy automatic hammers; sampling and analysis of undisturbed and tormented them.

To determine the geotechnical characteristics of the lithological types encountered were undisturbed samples collected from drilling and troubled.

Physical and mechanical properties of the soil depend on their structure and interaction phases. Quantitative structure of the soil is presented through the indices that express the geotechnical proportions which components are included in phases the soil: granulosity, porosity, pore index (e), humidity (w%), degree of saturation (Sr), volumetric

weight of soil (γ), the volumetric weight of the mineral skeleton (γs), volumetric weight of dry soil (γd), the weight of the solid phase, Atterberg limits for his clay lands, plasticity index (IP) criterion of plasticity (CP), consistency (IC), density (ρ), compressibility, load capacity index (CBR).

To categorize and define the geotechnical risk geotechnical will correlate all previous factors, most unfavorable factor will determine the level of risk in the geotechnical and Geotechnics highest category. Employment categories and geotechnical boreholes shall be carried out to establish the risk according to the total score.

Minimum depth of soil is determined (Df_{min}) depending on the intended use of the building: technological, frost depth, load carrying capacity of the land and deformability soil, its share of the neighbouring buildings and the character of stratificaţiei and location of groundwater levels.

Conventional pressure is determined by the relationship:

$$p_{conv} = \bar{p}_{conv} + C_B + C_D \quad , kPa$$

where: $\bar{p}_{conv}$ = basic value to conventional pressure in kPa (table 1); CB = width correction in kPa; CD = correction of depth in kPa.

Table 1

Basic values of conventional pressures for cohesive soils

Soil foundation		Pore index (e)	Consistency	
			I_C =0,5	I_C =1,0
			$\bar{p}_{conv}$ (kPa)	
Cohesive soils	with low plasticity (≤ 10%) Ip: Sandy loamy sand, dust, dust	0,5	300	350
		0,7	275	300
	with plasticity (10% < Ip ≤ 20%): loamy sand, sandy clay, powdered clay dust, clay dusty clay loam, loam-clay dusty	0,5	300	350
		0,7	275	300
		1,0	200	250
	with high and very high plasticity (Ip > 20%): sandy clay, dusty clay, clay, fat clay	0,5	550	650
		0,6	450	525
		0,8	300	350
		1,1	225	300

$C_{B\leq 5,0\ m} = \bar{p}_{conv} K_1$ (B-1)

where: K1 = equal 0.1 coefficient for land non-cohesive except with dusty sands or 0.05 for dusty sands and cohesive soils; B = width of the foundation (m).

$C_{B,\ B>5,0} = 0,4\ \bar{p}_{conv}$ or else $C_{B,\ B>5,0} = 0,2\ \bar{p}_{conv}$

$C_{D,\ Df<2,0} = \bar{p}_{conv}\ [(D_f\text{-}2)/4]$ or else $C_{D,\ Df>2,0} = K_2\ \bar{\gamma}(D_f\text{-}2)$

where: Df = soil depth (m); K2 = coefficient depending on the soil nature; γ = specific weight matte for the layer above this level the foundation calculated as weighted average layer thickness (KN/m^3).

RESEARCH RESULTS

The study comprises the work carried out by the geotechnical exploration within the area of site area 660 sq.m., located in Caracal, B.P. Hasdeu Street, in order to provide the data required for the substantiation of the optimum technical solution in order to the location of a private housing estate in which a research drill boreholes, from which samples have been collected and were being carried out laboratory analysis (figure 1).

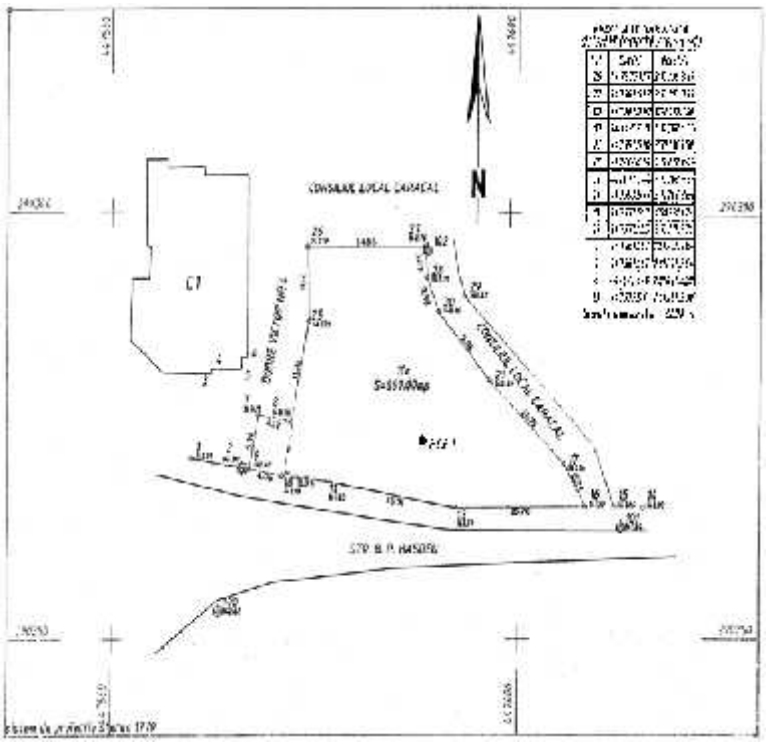

Figure 1 - Location and delimitation of property in Caracal, B. P. street (extract: sc 1:500)

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Site characterization. The location of the future construction is located in Caracal, B.P. Hasdeu Street and was characterized by reference to: geomorphology, geology, hydrostatic level, depth of freeze-thaw, wind speed, loads due to snow, seismicity and climatology.

Geomorphology. Location investigated is part of the Caracal field, part of the Romanian Field area of Olt County, located toward the base of the Olt terrace wall of the centre, on the left bank of the Caracal, on the ground in light slope and fall onto the terrace.

Geology. The Quaternary deposits of the Pleistocene, investigated belong to intermediate and higher education, being composed of alternations of clay deposits, pelitice, impermebile, with business deposits (gravel and sand) with permeable aquifer potential. Soil horizon is represented by clay deposits, dusty, or loamy-dusty, brown or grey, with limestone formations, with a thickness ranging from 5.00 and 6.00 m.

Hydrostatic level. It was intercepted by the executed on site drilling, depth of 2.90 m and having level and seasonal fluctuations of 1.00 m depending on rainfall volume. with a clusty calcareous thickness ranging from 6.00 5.00 and m.

Depth of freeze-thaw. Depth of freeze-thaw for the location of the land has been established in accordance with the zoning map the depth of frost is 0,80-0,90 m.

Wind speed. According to reference maps for IMR of 50 years and 2% annual probability of overtaking it was established that wind speed over a minute on mediated 10.0 m above land is 35.0 m/sec and the pressure of the wind on the 10th minute mediated 10.0 m above ground level is 0.5 kPa.

Snow load time. Design and code of the map specifice task given in the location area of the land is of 2.0 kN/m^2.

Seismicity. Seismic design code indicates a seismic hazard zone of constant value of ag = 0,16g cm/sec and Tc = 1 sec, value for the term period of response spectrum control. From the point of view of zoning falls within the perimeter of the macroseismic area corresponding to degree 7 MSK.

Climatology. From the climatic point of view, the perimeter under scrutiny belong to temperate continental type, being situated between the isotherm 100 to the North and South of isotherm 11.50 (annual average). The absolute maximum temperatures have been recorded in august: 40.5 ^{0}C at Strehareţ Station, and the absolute minimum was registered in January -31 ^{0}C from the same station. Rainfalls posing the same continental influence as the air temperature; they fall mostly in the form of annual average rainfall amounts being variable between 453.0 mm 515.7 mm in the South and at Slatina. Noted that in the last three years were in the rainfall volume greater than the annual averages for the last hundred years, but it fell mostly in the form of showers (large amounts in a short period of time), this phenomenon by encouraging the rapid infiltration of water into the ground and thus decrease its consistency, noting that last year we had a prolonged dry period.

Lythology. For construction works, the type of soils is defined based on the forces between the particles, and thus land divided into two major categories (non-cohesive and cohesive). Feature rich to be cohesive or not is very important because it is the technological characteristic to be taken into account in determining the solution of execution of excavations with or without sprijiniri.

Considering the previous elements, through on-site drilling FG1 executed, one has been identified lythology, as follows:

- between 0.00 and 1.50 m: very heterogeneous countries fillings (rubble, gravel, sand and vegetable soil).
- between 1.50 and 3.80 m: dusty clay loam, plastic, rarely with gravel.
- between 3.80 and 6.00 m: dusty clay, brown-grey, with regular plastic carbonates consistent alteration.

Hydrostatic level was intercepted at 2.90 m depth. In order to establish consistency declare land have been conducted with penetrations PDU (m=10 kg) in drilling FG 1 penetrations that confirmed the results of geotechnical research laboratory; thus:

- between 1.50 and 3.80 m were given between 9 and 11 kicks/10 cm, indicating a medium consistency of deposits.
- between 3.80 and 6.00 m were given between 12 and 14 kicks/10 cm on average, indicating a consistency somewhat better than deposits from the roof.

Physical-mechanical characteristics. The foundation terrain below with the lythology presented previously, was analyzed and determinations were made concerning laboratory: natural humidity (w%); the kneading limit (WP); yield strength (WL); plasticity index (IP), consistency index (IC); the criterion of plasticity (Cp); volumetric weight in their natural state (γ); dry volumetric weight (γd); porosity (n); index of porosity (e); the degree of humidity of the internal friction angle (σ); global deformation response module (E2-3); (c) cohesion; specific settlement (ep2); module compresabilitate (M2-3), table 2.

Depending on the IP values resulting from the calculation (table 2) is 20.75%, for the layer 1 and 24.65% for layer 2 shows that soil is plastic, declare values obtained fits between 15% and 40% for land in clay (clay, clay loam and dusty clay).

In relation to the conditions of stability and strength for the construction and operation of a foundation under normal conditions, soil land falls under the category of lands with high plasticity cohesive (Ip $>$ 20%), such as clay, sandy clay, clay and dusty who have e $<$ 1.1 and 0.5 $<$ Ic $<$ 0.75 in uniform horizontal stratification and practically. In

this context, on the basis of determinations made on the basis that the location is a below-average pitch, because clay deposits is Ip > 20% and Ic > 0.50.

Table 2

Physical-mechanical characteristics of the foundation soil

Characteristics	Layer name		
	(1) stuffing very heterogeneous (vegetable soil, rubble, gravel, sand)	(2) dustyclay loam with plastic, rarely fine gravel	(3) dusty clay brown-grey plastic consistent
Depth (m)	0,00-1,50	1,50-3,80	3,80-6,00
Content of clay	25	75	80
Dust content,%	35	17	20
Sand content %	40	8	-
Humidity (w%)	22,19	25,45	-
Yield strength (W_L, %)	33,66	38,43	-
Kneading (W_P limit, %)	12,91	13,78	-
Plasticity index (I_P, %)	20,75	24,65	-
The criterion of plasticity (H_P)	9,97	13,45	-
Consistency index (I_C)	0,55	0,53	-
Volumetric weight in their natural state (γ)	18,59	19,20	-
Volumetric weight dry (γd)	15,21	15,31	-
Volumetric weight of the skeleton (γs)	27,18	27,8	
Porosity (n), %	44	45	-
Porosity index (s)	0,79	0,82	-
Humidity saturation (w_{max})	35,22	35,35	-
Degree of saturation (Sr)	0,63	0,72	-
The angle of internal friction (ϕ)	12^0	$13^030'$	-
Cohesion (c), daN/cm^2	12	15	-
Concrete-stone coefficient (μ)	0,30	0,30	-
Settlement specifies (e_{p2}), cm/m	4,40	5,10	-
Global deformation response coefficient (ν)	0,35	0,35	-
Compresabilitate module ($_{M2-3}$), kPa	6600	8300	-

From the perspective of values criterion of the resulting plasticity following C_P:

- C_P values obtained are 9.97% for layer 1 and 13.45% for layer 2.

- since the IP values are higher than the values of C_P, it follows that the soildeclare is not characterized as an soil with bulging and contractions.

Consistency index values indicate a I_C characterized by land to the plastic layers 1 and 2 because the values obtained are within the boundaries of hearty appreciation of specific software (0.51-0.75).

Analyzing the degree of saturation (Sr), it appears that the site has a grounded clammy because the values obtained (0.63 for layer 1 and 0.72 to layer 2) falls within the boundaries of $0.80 < Sr < 0.40$ a wet ground in terms of the degree of saturation.

Geotechnical risk calculated for land settlement on location was appreciated at 9 points, and fall into the category of geotechnical risk (first geotechnical category), as follows, from the viewpoint of:

- geotechnical categories fall into the category field: 3 points.
- ground water, coming from the land without drainings: 1 point.
- view of classification of construction, normal category: 3 points.
- neighbourhood is a land without risk: 1 point.
- seismic zone with ag = 0, 16g and falls into the category of good land: 1 point.

For first category, the following geotechnical correlations between geotechnics and category types: includes small and relatively simple works which can be based on experience and geotechnical investigations and qualitative works with negligible risk for goods and people; methods are sufficient only for the conditions of land recognized as sufficient and not require excavation below the level of groundwater.

The land falls excavation as follows:

- for the heterogeneous fillings: category III for mechanized excavation and very hard to manually excavation.
- for layers of clay and dusty sandy clay: class II for mechanized excavation and hard to manually excavation.

In this context, and in light of the depth of thaw-frost zone (Hî = 0,80-0,90 m) and ground subsidence (0.20 m) it is recommended that a minimum depth of soil Df = 1.10 m, concrete class Bc7,5 density of 2400.

Conventional basis pressure calculation $\bar{p}_{conv}$ (for Df = 2.0 m and B = 0.10 m), was determined according to table 1 to 300 kPa, for basics grouping.

Corrected value of conventional pressure (p_{conv}) is:

$p_{conv} = \bar{p}_{conv} + C_B + C_D$, în kPa

$C_B = \bar{p}_{conv} K_1 (B-1) = 300 \times 0,05 (0,5-1,0) = -7,5$ kPa

$C_D = \bar{p}_{conv} [(D_f-2)/4] = 300 [(1,1-2,0)/4] = - 67,5$ kPa

$p_{conv} = 300 + (- 7,5) + (- 67,5) = 225$ kPa = 2,25 daN/cm^2

For a pressure at 300 kPa and Bc7,5 we have tg α = 1,3 then the result as the tare weight of the foundation (G_f) is:

$G_f = tg\ \alpha \times l_{foundation} \times h_{foundation} \times \rho_{concrete} = 1,3 \times 0,5 \times 1,1 \times 2400 = 1716$ daN

The condition for the GF is: $p_{ef} \leq p_{conv}$

$p_{ef} = Q_{total} / A_f = (Q + G_f)/A_f$

$A_f = b \times l$

$p_{ef} = (8540 + 1716) / 50 \times 100 = 2,051$ daN/cm^2

Conclusion: $2.051 < 2.25 \Rightarrow$ compliance with condition for GF, the foundation being sized properly

CONCLUSIONS

1. The location cannot be flooded and is stable.
2. Relief is on the ground in light slope dropping onto the terrace and features.
3. Initial value of $\bar{p}_{conv}$ = 300 kPa = 3.0 daN/cm²
4. Corrected value of $\bar{p}_{conv}$ = 225 kPa = 2.25 daN/cm^2
5. Characteristic elements of the foundation are: H = 1.1 m; B = 0.5 m; concrete class Bc7,5; Gf = 1716 dN
6. Compliance with the condition for GF $p_{ef} \leq p_{conv}$: $2.051 < 2.25$

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