LOCATION OF THE REFRIGERATION HALL ON THE BASIS OF THE GEOTECHNICAL STUDY IN THE PERIURBAN AREA OF CRAIOVA

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ABSTRACT

The geotechnical exploration works performed in the site area aim to provide the data necessary to solve the issues related to location and morphological data, classification in the geotechnical category, investigation of the foundation land, data on lithology and physical-mechanical characteristics of the land, foundation conditions. In this sense, two geotechnical drillings were performed, dynamic penetration tests and the stratification, granulometry and physical and mechanical characteristics were studied. From the analysis of the obtained results it results that the site has a slight slope with EV orientation, it is stable when sliding, the ground is good for foundation on 0.0-6.0 m depth, the aquifer horizon is over 7.0 m depth, the values of conventional pressure are of 189 kPa for Df = 0.8 m and B = 0.6 m and respectively 288 kPa for Df = 4.0 m and B = 2.0 m, the land presents a moderate geotechnical risk and a degree of seismicity 8_2.

INTRODUCTION

The present study has resulted from the necessity to know the foundation terrain in order to properly locate the refrigeration hall. The site under investigation is located in the south-western part of the peri-urban area of Craiova, Dolj County.

Morphologically, the location is relatively plain, good for the foundation, with good stability; tectonically features, this place belongs to the Valaha Platform, the Moesic Domain and this zone incorporates neogenical and quaternary formations (neogenical formations was not intercepted by the drills).

MATERIALS AND METHODS

The geotechnical study shall be used to determine the strength and stability of foundation fields and earth stocks, with a view to properly locating the investment, on the basis of geotechnical exploration work carried out in the site area, in order to provide the necessary data to address the underlying problems, specifying aspects relating to: the stratification of the terrain; the physics-mechanical features of the soil; the admissible pressures at different levels; the probable compaction; the classification of the digging operations; the freezing depth; the seismically classification; hydrogeological data.

There have been made two geotechnical drills and there were taken samples and there were made analyses, with a diameter of 150-200 mm and a depth of 6.0 m from which samples have been taken and laboratory tests carried out.

The exploration of the soil has been made by: direct observation, geological survey; the performing of two drills (FG1, FG2) with a diameter of 150-200 mm and a depth of 6,0 m according with the project; performing penetrometric cone tests using the mean dynamic penetrant (PDM); collecting disturbed and undisturbed samples and analyzing them.

The calculation of the dynamic penetration resistance on the cone has been

performed with the relationship:

$R_d = 1/A[(G_1^2\ h \cdot N)/10(G_1+G_2)]$

In which: A=cross-section of cone, cm^2; G1=weight of ram, daN; G2=weight of rods, anvil and cone, daN; h=weight drop height, cm; N=number of strokes required for a cone penetration of 10 cm.

The allowable pressure for plastic deformation has been established with the relationship $P_a=R_d/20$

The nature and the phisical status of the foundation has required the calculation of the terrain from the drills, for several depths (0,8-4,0 m) and for several widths of the foundations (0,6;1,0; 2,0) according to STAS 3300/1-85 and 3300/2-85.

With the preliminary or definitive calculus of the foundation terrain on the basis of the conventional pressures there have to be complied the following conditions;

- with centrically loadings:
  - $P_{ef} < P_{conv}$ şi $P'_{ef} < 1.2\ P_{conv}$
- with excentrical loadings on one direction:
  - $P_{ef\,max} < 1,2\ P_{conv}$ in the fundamental grouping
  - $P'_{ef\,max} < 1,4\ P_{conv}$ in the special grouping
- with loadings with excentricities on both directions:
  - $P_{efmax} < 1,4\ P_{conv}$ in the fundamental grouping;
  - $P'_{ef\,max} < 1,6\ P_{conv}$ in the special grouping

where: P_{ef}, P'_{ef} = the average vertical pressure on the base plate derived from the calculation charges in the fundamental grouping, respectively; P_{conv} = conventional calculation pressure; $P_{ef\,max}$; $P'_{ef\,max}$ = the maximum effective pressure on the base plate resulting from the calculation loads in the fundamental grouping and the special grouping.

For lands that are very compresible, the preliminary set up of the foundation dimensions can be made on the basis of the $P_{conv.\ min.}$ for the respective class but it is compulsory the subsequent verification at the limit deformation status (P_{pl}) and of portent capacity (P_{cr}).

Within the very compresibile, lands are the loosened sands and the cohesive lands (clays) with Ic< 0.5 or e>0.90.

The conventional pressures are determined taking account of the basis values P_{conv} from the tables. The basis values from tables correspond to the conventional pressures, with the width of the sole B=2 m. and the depth of foundation Df=2.0 m.

The calculus of the foundation terrain with the limit status of deformation (P_{pl})

In order to accomplish the calculus there must be fulfilled the following conditions:

- for centrical loaded foundations: $P_{ef} < P_{pl}$
- for excentrical loaded foundations: $P_{ef} < P_{pl}$; $P_{ef\,max} < 1.2\ P_{pl}$; $P_{ef\,max} < 1.4\ P_{pl}$

in which: P_{ef} = vertical pressure on the base plate, derived from the calculation charges in the fundamental grouping; $P_{ef\,max}$ = maximum vertical pressure on the base plate derived from the calculation charges in the fundamental grouping in case of excentricity in a single direction; $P_{ef\,max}$ = maximum vertical pressure on the base plate derived from the calculation charges in the fundamental grouping, in case of excentricity in both directions; P_{pl} = pressure corresponding to a limited extension of the plastics area in the field of foundation

For rectangular foundations in P_{pl} it is calculated as follows:

- for buildings without basement: $P_{pl} = ml\ (\gamma \cdot B \cdot N1 + q \cdot N2 + c \cdot N3)$,kPa
- for buildings with basement: $P_{pl} = ml\ (\gamma \cdot B \cdot N1 + (2qe+qi)/3 \cdot N2 + c \cdot N3)$,kPa

where: *ml* = coefficient of working conditions; γ = weighted average of the volumetric calculation weight of the underfloor layers contained within a depth of B/4 measured from the foundation base (kN/m^3); B = small edge of the foundation (m); q = calculation

overload at the base plate, lateral foundation (kPa); qe,qi = calculation overload at the base plate on the outside and inside of the basement, respectively (kPa); c = calculation value of the cohesion of the underfloor layer, (kPa); N1,N2,N3 = dimensionless coefficients in relation to the value of calculating the inner friction angle of the land under foundation base

The calculus of the terrain at the limit status of portent capacity must ensure the following condition: $Q < m \cdot R$

where: Q = calculation load on the foundation ground derived from the actions in the special groups; this may be of the nature of effective pressure, slip force, tipping moment, etc.; R = the load capacity for calculating the ground floor, may be critical pressure, shear resistant, moment of stability, etc.; m = coefficient of working conditions.

When the resultant of the loading calculus has a declination over the vertical less than 5^0 in the conditions of horizontal stratification, the critical pressure, can be calculated with the following relation:

$$P_{cr} = \gamma^* \cdot B' \cdot N_\gamma \cdot \lambda_\gamma + q \cdot N_q \cdot \lambda_q + c^* \cdot Nc \cdot \lambda_c \quad , kPa$$

where: γ^* = the volumetric weight of the ground layers under the base plate (kPa); B = reduced width of the base plate (m); N_γ, Nq , Ne = load capacity coefficients depending on the calculation value of the internal friction angle, ∅* of the layers under the base plate; q = calculation overload acting at the base of the foundation, (kPa); c = calculation value of the cohesion of the earth layers under the base of the foundation,(kPa); λ_γ, λ_q, λ_c = coefficients of the shape of the foundation.

In the case of the presence under the foundation of a stratification were the shearing strength characteristics (ϕ^*, c^*, λ^*)do not vary more than 50% over the average values, there can be adopted for the calculus of the portent capacity the weighted average.

When, within the active zone there appears a weak layer, with a shearing resistance less than 50% the value of the shearing resistance of the superior strate, there will be verified the portent capacity as the foundation would stay directly upon the weak layer.

RESULTS

The site under investigation is located in the south-western part of the peri-urban area of Craiova, Dolj County. From a morphological point of view the site is a relatively flat plateau within the geologic unit the Getic Plateau. From a tectonic point of view, the area belongs to Moesic, namely the "Valaha Platform", Moesic field.

In geological terms, there have been developed pliocens formations (not intercepted by geotechnical drilling) and quaternary formations that are most important for characterizing the construction site are quaternary formations that consist of dusty clays, sand clays and clay dust.

The exploration of the soil has been made by: direct observation, geological survey; the performing of two drills (FG1, FG2) with a diameter of 150-200 mm and a depth of 6,0 m according with the project (figure 1).

The formations intercepted by the geotechnical forages are of allumvial holocene age at the medium pleistocene and upper pleistocene and are made of dusty brown sands clays in the thick plastic cafes with medium compressibility in the first 1.0 to 1.7 m of dusty clays and clumsy powders in solid plastic cafes, with medium compressibility below.

The area is part of the continental climate sector (climate type 1) characterized by very warm summers with rainfall to poor falling mainly in the form of averse and moderate winters with rare blizzles.

The wind action in the studied area has a basic dynamic pressure of 0.5 kN/m^2.

The actions due to the snow have a load on the ground of 2.0 kN/m^2 with a recurrence period of 50 years.

The seismicity area is D with values of ag=0.20 g and IMR=25 years and a corner period Tc=1.0 s (degree 8_2 seismicity).

The freezing depth of the natural terrain in the area is 1.0 m.

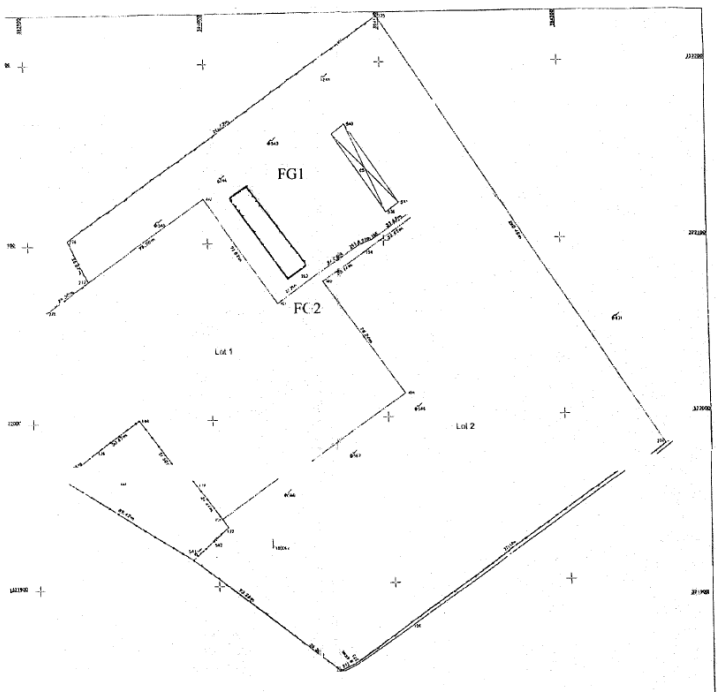

Figure 1 - Location of geotechnical drilling

Given the studied factors (ground conditions, groundwater level above 7,0 m deep, importance of construction, neighborhood and seismic area), this location is classified as geotechnical category 2 and has a moderate geotechnical risk.

Disturbed and undisturbed samples were taken to determine the geotechnical characteristics of the lithological types on the construction site and analyzed for the physical and mechanical characteristics of the earth.

Laboratory determinations on samples taken consisted of particle size determinations, lithological interpretation and determination of physical and mechanical characteristics (table 1-2).

Table 1

FG1 drilling geotechnical sheet

Depth	Particle size						Lithological interpretation
	Gravel	Large sand	Middle sand	Fine sand	Dust	Clay	
m	%						
0.25	-	-	-	-	-	-	Vegetal cover, dusty, dusty-clay, brown-tan
0.25-1.5	-	3	9	14	41	33	Dusty clay, brown to tan, solid plastic with medium compressibility, moist for the first 1.0 to 1.5 m
>1.5	-	4	10	12	39	35	Dusty clay, yellowish, solid plastic with medium compressibility, moist from 1.5 m down

Lithological interpretation	Physical characteristics									
	γ_a	γ_s	Wc	Wf	Ip	Ic	W	Sr	n	e
	kN/m^3	kN/m^3	%	%	%	-	%	-	%	-
Vegetal cover, dusty, dusty-clay, brown-tan	-	-	-	-	-	-	-	-	-	-
Dusty clay, brown to tan, solid plastic with medium compressibility, moist for the first 1.0 to 1.5 m	18.9	26.2	32.1	12.1	20.0	0.69	18.2	0.71	40	0.67
Dusty clay, yellowish, solid plastic with medium compressibility, moist from 1.5 m down	19.4	26.2	32.4	12.2	20.2	0.60	18.3	0.82	30	0.65

Lithological interpretation	Mechanical characteristics						
	Ø	c	M_{2-3}	av_{2-3}	ep_2	Penetration	Dynamic penetration
	^{0}	kPa	daN/cm^2	daN/cm^2	cm/m	strikes	daN/cm^2
Vegetal cover, dusty, dusty-clay, brown-tan	-	-	-	-	-	-	-
Dusty clay, brown to tan, solid plastic with medium compressibility, moist for the first 1.0 to 1.5 m	13	25	114	0.01	2.86	20	45
Dusty clay, yellowish, solid plastic with medium compressibility, moist from 1.5 m down	16	28	124	0.01	2.76	21	49

Table 2

FG2 drilling geotechnical sheet

Depth	Particle size						Lithological interpretation
	Gravel	Large sand	Middle sand	Fine sand	Dust	Clay	
m	%						
0.25	-	-	-	-	-	-	Vegetal cover, dusty, dusty-clay, brown-tan
0.25-1.5	-	2	8	13	41	36	Dusty clay, black to yellow brown, solid plastic with medium compressibility, moist
>1.5	-	0	11	16	40	33	Dusty clay, yellowish, solid plastic with medium compressibility, moist

Lithological interpretation	Physical characteristics									
	γ_a	γ_s	Wc	Wf	Ip	Ic	W	Sr	n	e
	kN/m^3	kN/m^3	%	%	%	-	%	-	%	-
Vegetal cover, dusty, dusty-clay, brown-tan	-	-	-	-	-	-	-	-	-	-
Dusty clay, black to yellow brown, solid plastic with medium compressibility, moist	19.1	26.2	33.0	12.3	20.6	8.69	18.8	0.75	40	0.66
Dusty clay, yellowish, solid plastic with medium compressibility, moist	19.2	26.2	31.9	12.1	19.9	0.62	19.6	0.80	39	0.64

Lithological interpretation	Mechanical characteristics						
	Ø	c	M_{2-3}	av_{2-3}	ep_2	Penetra-tion	Dynamic penetra - tion
	grade	kPa	daN/cm^2	daN/cm^2	cm/m	strikes	daN/cm^2
Vegetal cover, dusty, dusty-clay, brown-tan	-	-	-	-	-	-	-
Dusty clay, black to yellow brown, solid plastic with medium compressibility, moist	14	28	121	0.01	2.79	21	48
Dusty clay, yellowish, solid plastic with medium compressibility, moist	17	27	132	0.01	2.68	23	52

Taking into account the nature and physical condition of the foundation ground and the type of construction, calculations were made based on drilling performed at different foundation depths (0,8-4,0 m) and different foundation widths (0,6;1,0; 2,0).

The results of the calculations are presented in table 3 for conventional calculation pressures and table 4 for deformations limit conditions (P_{pl}) and load capacity limit

conditions (P_{cr}).

Table 3

The conventional calculation pressures (Pconv), for different foundation depths and widths (kPa)

Nr. foraj	Depth	Conventional pressures calculation for different width B (m)			Soil description
	(m)	0.6	1	2	
FG1	0,8	189	191	195	Clay, dusty brown solid plastic with medium wet compressibility
	1	194	198	206	
FG2	1.5	212	215	224	
	2	216	220	231	
	3	244	249	260	
	4	273	277	288	

Table 4

The pressures at the limit deformation status (P_{pl}) and at the limit of the portent capacity for different widths of the foundations and to different depths of foundation (FG1 and FG2 drills)

Depth (m)	γ kN/m³	ϕ gr	c kPa	ml	Ppl (kPa)			Pcr (kPa)			Soil description
					0.6	1	2	0.6	1	2	
0.8	18.7	12	20	1.7	201	203	206	234	237	244	Clay, dusty brown solid plastic with medium wet compressibility
1	18.7	12	20	1.7	214	215	218	245	248	255	
1.5	18.2	12	20	1.6	228	229	232	270	273	280	
2	18.2	11	20	1.5	230	231	233	277	279	284	
3	14.4	11	23	1.4	250	251	252	321	323	327	
4	12.7	11	23	1.4	269	270	271	341	343	346	

CONCLUSIONS

After the researches, can be formulated the following conclusions:

- Morphologically speaking the site is relatively flat and stable regarding slip behavior.
- The prospective earth layer of the surface (0-6 m), is good for foundation, stable in gliding behavior, and consists of: vegetal cover, dusty, dusty-clay, brown-tan (0.0 to 0.25 m); dusty clay, brown to tan, solid plastic with medium compressibility, moist for the first 1.0 to 1.5 m (0.25 to 1.50 m) and dusty clay, yellowish, solid plastic with medium compressibility, moist (± 1.5 m).
- Geotechnical forages did not intercept the aquifer horizon, with the groundwater level above 7.0 m.
- Conventional pressures vary between P_{conv} = 189 kPa, for the foundation depth Df = 0.8 m and the foundation width B = 0.6 m and P_{conv} = 288 kPa pentru Df = 4.0 m şi B = 2.0 m (tabelul 3).
- The admissible pressures at the limit deformation status (fundamental

loading) vary between Ppl = 201 kPa for Df = 0.8 m and B = 0.6 m and Ppl = 271 kPa, for the foundation depth Df = 4.0 m and the width of the foundation B = 2.0 m (table 4).

- The admissible pressures at the limit status of portent capacity vary from (special loads) vary from Pcr = 234 kPa for the foundation depth Df = 0.8 m and the foundation width B = 0.6 m and Pcr = 346 kPa for Df = 4.0 m and B = 2.0 m (table 4).
- It is recommended to foundation beams balancing isolated and armed continuing foundations
- The minimum foundation depth is 1.0 m from the natural terrain level.
- The last 10 cm of the digging will be made manually during the day when the concrete will be put.
- For a B=1.0 m is recommended Ks=2.5-2.7 daN/cm^3.
- Regarding the seismicity, the researched surface is located in the D zone with the coefficient ag=0.20 g, the corner period Tc=1.0 s, the 8_2 degree (8_2 degree with a period of return of 100 years).
- The site under study is part of geotechnical category 2 and has a moderate geotechnical risk.
- After the digging behavior, the land is classified in the II-nd category of medium
- The land falls into the 2-nd geotechnical category and has a moderate geotechnical risk.
- The wind actions classify the location in the zone B (0.50 kN/m^2) și v_{2m}=26.0 m/s
- The snow actions classify the location in the zone C (2.0 kN/m^2)

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