STORAGE-CONDITIONING WAREHOUSE LOCATION AGRICULTURAL PRODUCTS

Dragomir BRUMAR[1], Marius ClOBOATĂ[1]

[(1)]University of Craiova, 19 Libertății street, Craiova, Romania

author email: dr.brumar@yahoo.com

Corresponding author email: marius.cioboata@edu.ucv.ro; cnmarius2@yahoo.com

Abstract

The proper placement of the construction requires specific geotechnical research in the site area, with the aim of providing the data necessary to solve the basic problems and specify the aspects related to: stratification of the land on the site; physical-mechanical characteristics of existing soils; admissible pressures at different foundation levels; probable settlements; framing of field excavations according to TS regulations; frost depth; seismic framing; hydrogeological data.

Key words**: **geotechnical study; field geotechnical works; place; warehouse

INTRODUCTION

The present study resulted from the need to know the foundation land in order to properly locate the warehouse for storing and conditioning agricultural products.

The researched site is located in Maglavit township, Dolj county. From a morphological point of view, the location is a relatively flat plateau, it is good for foundation, having the stability ensured, the location area having a temperate-continental climate without special natural phenomena.

MATERIALS AND METHODS

The specific geotechnical research resulted from the need to know the foundation land for the proper location of the investment and includes the geotechnical exploration works carried out in the site area, with the aim of providing the data necessary to solve the basic problems specifying the aspects related to: the stratification of the land on the site; physical-mechanical characteristics of existing soils; admissible pressures at different foundation levels; probable settlements; framing of field excavations according to TS regulations; frost depth; seismic framing; hydrogeological data.

Geotechnical drilling was carried out for the survey of the land, from which samples were collected and laboratory analyzes were carried out (Brumar D. et al., 2018).

The exploration of the soil has been made by: direct observation, geological survey; the performing of two drills (FG1, FG2) with 100 mm diameter and the depth 5.0 m according with the project; the performing of penetrometer trying at different depths within the bulb zone and the foundation pressures using the light penetrometer; the collecting of disturbed and not disturbed samples and their analysis.

The nature and the phisical status of the foundation has required the calculation of the terrain from the drills, for several depths (0.8; 1; 1.5; 2; 2.5; 3) and for several widths of the foundations (1; 2; 3) according to STAS 3300/1-85 and 3300/2-85.

The calculus of the foundation terrain on the basis of the conventional pressures.

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 (Popa H., 2001):

- 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.

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}) (Brumar D., 2010).

Within the very compresibile lands are: the loosened sands and the cohesive lands (clays) with lc< 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:

$P_{ef} < P_{pl}$; $P_{ef\ max} < 1.2\ P_{pl}$; $P_{ef\ max} < 1.4\ P_{pl}$

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

- for buildings without basement: $P_{pl} = ml\ (\gamma xBxNl + qxN2 + cxN3)$ kPa
- for buildings with basement: $P_{pl} = ml\ (\gamma xBxNl + (2qe+qi)/3xN2 + cxN3)$ kPa,

The absolute probable compaction can be calculated with the formula:

$S = 100 \times \beta\ (\Sigma\sigma^{med}_{zi} \times hi)/Ei$ cm,

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

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:

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

In the case of the presence under the foundation of a stratification were the shearing features 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 strata, there will be verified the portent capacity as the foundation would stay directly upon the weak layer.

RESULTS AND DISCUSSIONS

The researched site is located in Maglavit township, Dolj county. From a morphological point of view, the location is a relatively flat plateau, it is good for foundation, having the stability ensured, the location area having a temperate-continental climate without special natural phenomena. The wind site is in zone B and

has a dynamic wind pressure value qb = 0.5 kN/m^2.

The action due to snow is characteristic of zone C, the value of the snow load on the ground being 2.0 kN/m2.

The seismicity of the area where the construction is located is characterized by the peak acceleration ag = 0.15 g and a corner period Tc = 1.0 s

The frost depth is 0.85 m from the level of the natural terrain, the terrain is flat, does not require significant vertical systematization works, and no building networks have been identified that require relocation or protection.

The geotechnical survey did not intercept the aquifer horizon, the local estimate identifying its presence at a depth of over 4.0 meters.

The nature of the foundation land indicates the following lithological sequence: 0.00-0.30 m topsoil; 0.30-4.00 m dusty, sandy, brick-brown clay with medium plasticity.

Based on the previous characteristics, the conventional base pressure Pconv = 150 KPa was established and for the ballast cushion a value of Pconv = 200 KPa will be considered.

The constructive technical characteristics recommended for construction are: 12.75 m opening; 8x5.00 m span; 42.00 m long; 13.00 m wide (fig. 1).

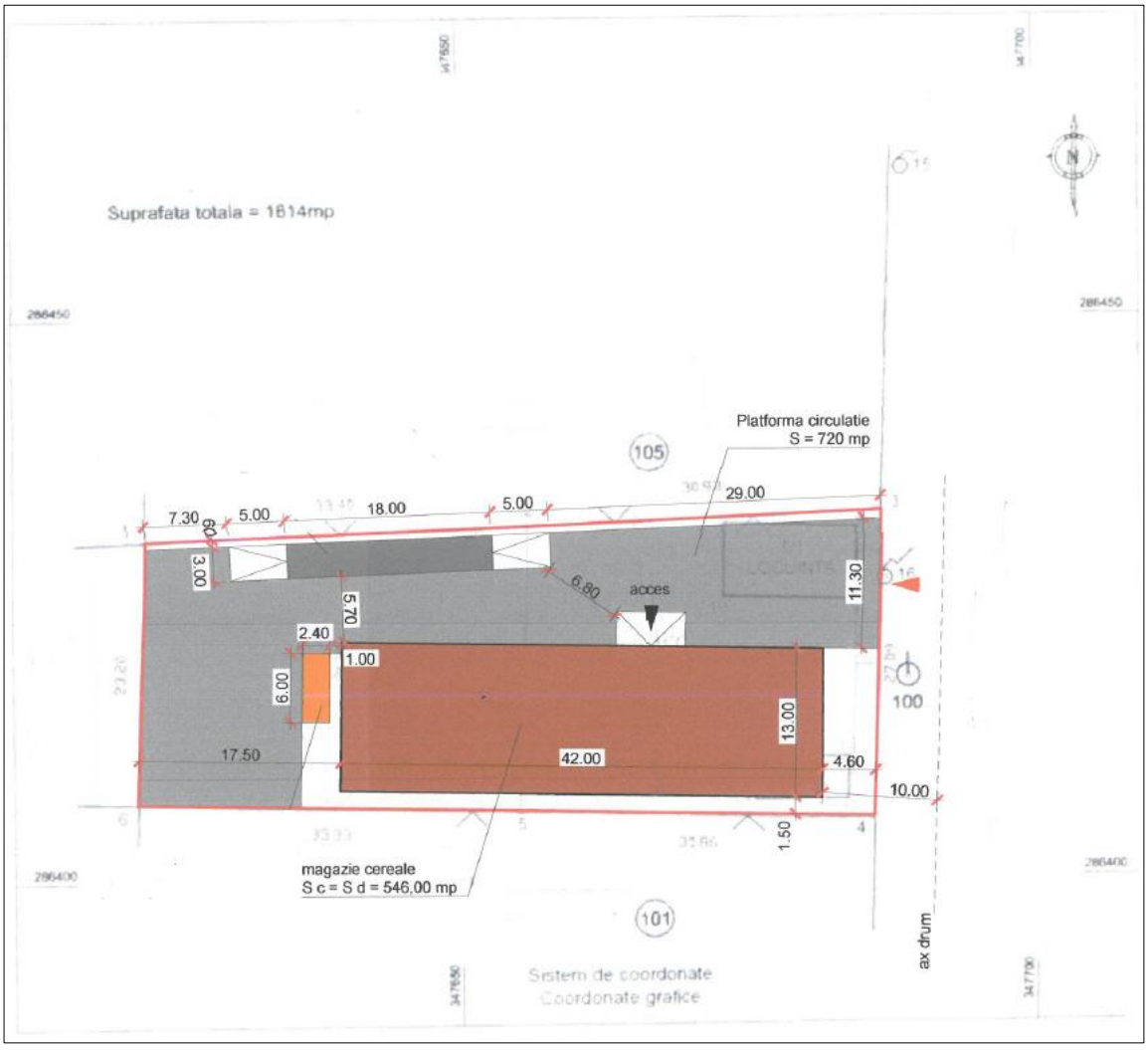

Figure. 1 - Grain warehouse construction location

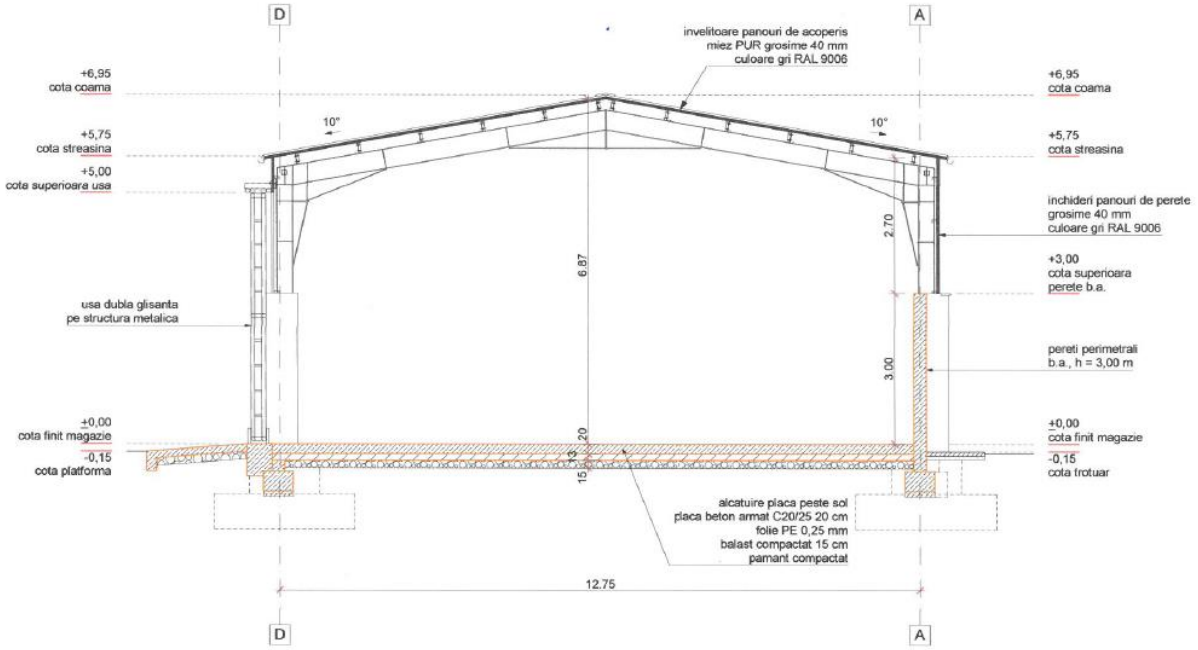

Figure. 2 - Grain warehouse superstructure

The construction will be put into operation on a continuous foundation under the walls with the plate at the height of 0.00 m made of reinforced concrete class C16/20 with a thickness of 15 cm.

The superstructure is metal, with metal columns HEA profile, metal beams IPE profile, metal wedges for walls and roof (fig. 2).

The lateral closures will be made of reinforced concrete (up to a height of 3.00 m) and the upper part of thermal insulating panels (sandwich type wall with polyurethane foam core) with a thickness of 40 mm.

The covering is made of heat-insulating roof panels with a thickness of 40 mm. Rainwater will be systematically collected through gutters and downspouts, being directed to the ground level.

The concrete platform related to the construction has a constructive system consisting of 20 cm thick B350 concrete, double-layer PE film, 30 cm thick compacted ballast, compacted soil. Rainwater will be collected through 500x500 mm flat grate and frame manholes (load D400) and will be discharged through sewer pipes laid below the freezing point on a 15 cm sand bed.

Table 1. Physical-mechanical characteristics of soils

The land nature	Depth (m)	The physics-mechanicals features						
		w %	Ic	E	γ kN/mc	M_{2-3} daN/cm^2	Ø grade	c kPa
Vegetal soil	0.10-0.30	-		-	-	-	-	-
Dusty, sandy, brick brown clay with medium plasticity	0.30-4.00	23.0-23.5	0.52-0.55	0.76	18.2-18.4	130-140	14-15	16-17

The determinations in the laboratory regarding the physical-mechanical characteristics of the soils (the nature of the land) took into account (table 1): humidity w%; consistency index (Ic); pore index E; apparent volumetric weight γ; average compressibility M2-3; internal friction angle ø; cohesion c.

The dominant fraction is represented by clays, therefore they give the formations the general character of cohesive rocks.

The results of the calculations are centralized in table 2 for conventional design pressures, table 3 for pressures at the limit state of deformations (Ppl) and at the limit state for bearing capacity (Pcr).

Table 2. Conventional Calculation Pressures (P_{conv}) for different foundation depths and foundation widths (kPa)

Drilling number	Foundation depth (m)	The conventional pressures of calculus for different widths of B (m)			The land nature
	(m)	1	2	3	
1	0,8	152	161	165	Dusty, sandy, brick brown clay with medium plasticity
	1	167	176	181	
	1.5	176	185	191	
	2	180	189	198	
	2.5	189	214	223	
	3	207	216	226	

Table 3. Pressures at SLD (Ppl) and SLCP for different foundation widths and depths

Depth calculus (m)	γ kN/mc	ϕ gr	c kPa	ml	Ppl (kPa)			Pcr (kPa)		
					1	2	3	1	2	3
0.8	18.3	15	14	1.5	156.7	161.4	166.2	224.2	237.8	251.3
1	18.0	15	14	1.5	168.1	172.8	177.5	237.2	250.5	263.8
1.5	18.0	14	13	1.5	183.2	187.1	191.1	242.0	253.0	264.1
2	18.0	14	11	1.5	198.4	202.3	206.3	253.5	264.6	275.6
3	13.0	14	11	1.5	207.1	209.9	212.7	261.1	269.1	277.1

CONCLUSIONS

Following the field research and the analyzes carried out, it follows:

- from a morphological point of view, the location is relatively flat
- the layer of soil prospected from the surface (0-4 m), is good for foundation, stable in terms of sliding behavior, with the lithological sequence: 0.00-0.30 m topsoil; 0.30-4.00 m dusty, sandy, brick-brown clay with medium plasticity.
- the geotechnical drilling did not intercept the aquifer horizon, the groundwater level being over 4.00 m deep.
- conventional pressures vary between Pconv = 152 kPa, for foundation depth Df = 0.8 m and foundation width B = 1.0 m and Pconv = 226 kPa for Df = 3.0 m and B = 3.0 m (table 2).
- the admissible pressures at the limit state of deformation (fundamental loads), vary between Ppl = 156.7 kPa for Df = 0.8 m and B = 1.0 m and Ppl = 212.7 kPa, for the foundation depth Df = 3.0 m and the foundation width B = 3.0 m (table 3).
- the admissible pressures at the limit state of bearing capacity (special loads) vary from Pcr = 224.2 kPa, for the foundation depth Df = 0.8 m and the foundation width B = 1.0 m and Pcr = 277.1 kPa for the foundation depth Df = 3.0 m and foundation width B = 3.0 m (table 3).
- the last 10 cm of the excavation will be done manually on the day of pouring the leveling concrete under the foundations
- from the point of view of seismicity, the investigated surface is characterized by ag = 0.15 and Tc = 1.0 s (grade 7 with a return period of 50 years);
- the actions due to the wind place the site in zone B

- the actions due to the snow place the site in zone C;
- according to STAS 6054, the freezing depth of the area is 0.80 m
- according to the way of behavior when digging, the lands in the studied area fall into the 1st medium land category.
- the construction will be put into operation on a continuous foundation under the walls with the plate at the height of 0.00 m made of reinforced concrete class C16/20 with a thickness of 15 cm.
- the superstructure is metal, with metal pillars HEA profile, metal beams IPE profile, metal wedges for walls and roof.

REFERENCES

Brumar D., (*2010). Construcţii civile-industriale-agricole.* Editura Sitech. Craiova.

Brumar, D., & Cioboata, M. (2018). Placement cell based storage agricultural products geotechnical study. Annals of the University of Craiova-Agriculture, Montanology, Cadastre Series, 47(2), 280-285

Mihai D., (*2000). Construcţii agricole şi amenajări rurale.* USAMVB Timişoara,.

Mirel Delia., (2004). *Construcţii. Subansambluri constructive.* Editura Matrix-Rom. Bucureşti.

Popa H., (2001). *Îndrumător de proiectare pentru fundaţii. Editura Matrix-Rom. Bucureşti, 2001.*