Analele Universităţii din Craiova, seria Agricultură – Montanologie – Cadastru (Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series) Vol. 55/2025

FEED KITCHEN DESIGN BASED ON THE GEOTECHNICAL STUDY IN AN AGRICULTURAL FARM

Dragomir BRUMAR, Marius Nicolae CIOBOATA

University of Craiova, 19 Libertății street, Craiova, Romania
author email: dragomir.brumar@edu.ucv.ro

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

Abstract

The geotechnical study presents the ground conditions regarding the location intended for the future construction and includes geotechnical data that constitute the basis for the calculation and analysis of the foundation soil. The calculation of the foundation soil based on the geotechnical study is based on information obtained from direct observations and geotechnical surveys, in the area of the site in Poiana Mare, Dolj, followed by laboratory analysis of samples taken from the intercepted stratification and the establishment of geotechnical parameters.
The geotechnical study includes geotechnical in order to provide data regarding: the stratification of the land on the site, the physical-mechanical characteristics of the identified soils, the admissible pressures at different foundation levels, the framing of the excavations according to the TS standard, the freezing depth, the seismic framing, the hydrogeological data.
Key words: geotechnical study; field geotechnical works; place; feed kitchen

INTRODUCTION

The economic effectiveness of small-scale farms is much discussed and analyzed, but the integration of a forage kitchen within the farm is an important aspect for achieving an efficient production cycle.
The studied site is located in Poiana Mare, which tectonically belongs to the Valaha platform. The ground in the foundation site is made up of rocks belonging to the Quaternary. Two boreholes were carried out to investigate it, from which samples were collected and laboratory analyses were performed.

MATERIALS AND METHODS

The study comprises geotechnical works made within the establishment zone in order to get the data needed for the solving the basis problems that includes: 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. The exploration of the soil has been made by: direct observation, geological survey; the performing of two drills (FG1, FG2).
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;
- 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

The conventional pressures are determined taking account of the basis values P_{conv} from the tables.

The basic values of calculated conventional pressure, correspond to the conventional pressures for foundations with a base width B=1.0m and a foundation depth above the systematized ground level Df=2.0 m. For other base widths or other foundation depths, the conventional pressure is determined by the relationship:

Pconv = P`conv + CB + CD , kPa

where:Pconv = the basic value of the conventional pressure in kPa tabulated according to the type of soil and the Ic, Ip and e values (it is 250kPa); CB=width correction in kPa; CD=depth correction in kPa.

The width correction CB for B ≤ 5.0 m is determined by the relationship:

CB = P`conv · K1 · (B-1)

where: K1 = coefficient equal to 0.1 for non-cohesive soils except for silty sands or 0.05 for silty sands and cohesive soils; B = foundation width < 5 m

The width correction CB for B < 5.0 m is determined differently, as follows:

- for non-cohesive soils except for silty sands: CB = 0.4 · P`conv
- for silty sands and cohesive soils: CB = 0.2 · P`conv

The depth correction CD is determined differently, as follows:

- for Df < 2.0 m we have CD =P`conv [(Df-2)/4]
- for Df > 2.0 m we have CD = K2·γ (Df-2)

where: Df = foundation depth (m); K2 = coefficient depending on the nature of the soil (table 8.9);γ = design volume weight of the layers located above the foundation footing level calculated as a weighted average with the thickness of the layers (kN/m^3).

RESULTS AND DISCUSSIONS

Location and morphological data

The studied site is located in Poiana Mare, which tectonically belongs to the Valaha platform. The ground in the foundation site is made up of rocks belonging to the Quaternary. Two boreholes were carried out to investigate it, from which samples were collected and laboratory analyses were performed.

The climate is temperate continental, with very hot summers and poor precipitation in the form of showers, with moderate winters and rare blizzards.

The seismicity falls within zone E with: ag=0.15 g; Tc=1.0 s; seismicity degree 7_1.

Classification in the geotechnical category

Considering the factors related to the ground conditions (weak foundation soils), groundwater (normal depletion), the importance of the construction (normal) and the vicinity (no risks) and respectively the E seismic zone, the result is a classification in geotechnical category 2 with a moderate geotechnical risk (table 1).

Factors	Conditions	Score
Ground conditions	Dusty sands, clayey dusts and weak foundation	3
Groundwater	Normal depletion	2
Construction importance	Normal	3
Type of neighboring land	No risks	1
Seismic zone	E	1
Geotechnical risk	Moderate	10

Table 1. Establishing the geotechnical category

Investigation of the foundation ground

The investigation of the foundation ground was carried out through land prospecting works: direct observations (geological mapping), the execution of two geotechnical boreholes (figure 1 and 2).

The land on the site falls into the semi-hard category, respectively mechanical class III, according to its digging behavior (TS standard).

According to the surface geological mapping and the boreholes carried out, it is found that the ground has a uniform stratification; the physical and mechanical characteristics of the soil are centralized in the geotechnical files of the drillings (table 2 and table 3).

Lithological data and physical and mechanical characteristics of the site terrain

The determination of the geotechnical characteristics of the lithological types was carried out on disturbed and undisturbed samples collected from the FG1 and FG2 boreholes.

Thus, we have the following particle size (figure 3 and 4), physical and mechanical characteristics of the soils:

- the surface layer is made up of loose, yellowish brown dusty clays, with the following average geotechnical parameters: natural humidity w=20-30%; bulk density at natural humidity Ww=18.6-18.8 KN/m^3; porosity n=42.64%; internal friction angle fi=18-21^0; cohesion c=8.0-9.0 kPa; average compressibility M2-3=84-95 daN/cm^2; Poisson's ratio μ=0.30.

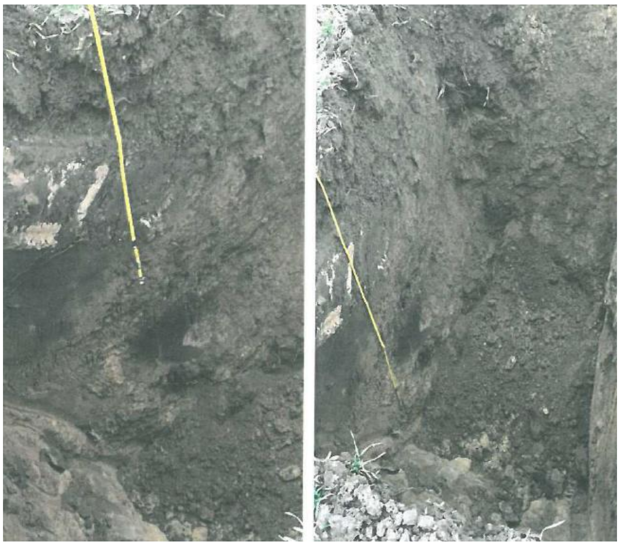

Figure 1. Drilling 1

- the next layer is of a soft, plastic, highly compressible brown sandy dust nature, with the following average geotechnical parameters: natural humidity w=16.0-18.5%; bulk density at natural humidity Ww=18.8-18.9 KN/m^3; porosity n=42.64%; internal friction angle μ=8-10^0; cohesion c=11.0-13.0 kPa; average compressibility M2-3=79-87 daN/cm^2; Poisson's ratio miu=0.30.

Figure 2. Drilling 2

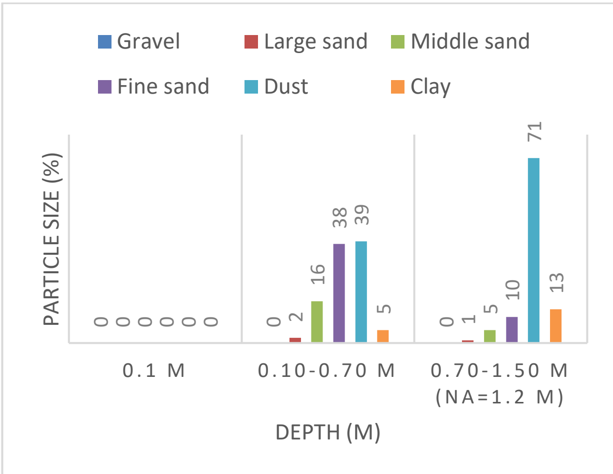

Figure 3. FG1 Drilling geotechnical sheet

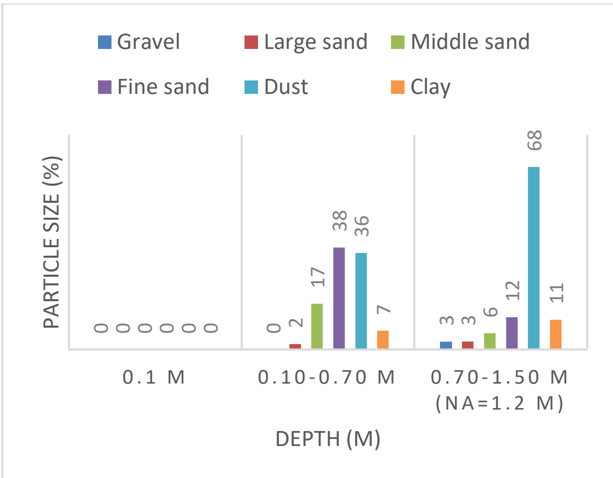

Figure 4. FG2 Drilling geotechnical sheet

The aquifer horizon was identified at 1.2 m depthf. During heavy rainfall, maybe puddles appear that cause infiltrations in conditions of improper execution of waterproofing and depletion.

Foundation conditions

Considering the nature and physical condition of the foundation soil, the type of construction to be executed, and correlating the data obtained through the geotechnical investigation of the foundation ground on site with the reference data of the area, the following foundation conditions were established:

- the ground is stable and approximately flat
- the groundwater was intercepted by depths of 1.2 m from TN and has an aggressiveness towards concretes of intense carbonic and very weak magnesian nature
- the aggressiveness of groundwater requires the use of reinforced concrete grade C16/20
- the peak value of the ground acceleration for design ag=0.15 g
- the corner period Tc=1.0 s
- the snow load on the ground is 2.0 kN/m^2
- the freezing depth is 0.80 m
- the minimum foundation depth Df= 1.10 m
- the reference value of the dynamic wind pressure qb=0.40 kPa
- according to the norms for embankment constructions, the ground is hard and very hard
- in relation to the geotechnical indices established by analyzing the samples from the boreholes, the basic value of The conventional pressure used to calculate the foundation soil is Pconv=250 kPa
- Pconv corrected for the values B=0.6 m and Df=1.10 m is Pconv=194 kPa
- it is recommended to improve the foundation soil by incorporating and compacting (minimum 98%) a layer of 0.20 m of crushed stone on top of which a layer of ballast will be placed
- the concrete will be poured continuously to avoid segregation and casting joints

Construction of the feed kitchen

Due to the aggressiveness of groundwater, it is necessary to use reinforced concrete grade C16/20.

The feed kitchen is a ground floor building with the following technical characteristics (figure 5 and 6):

- rectangular shape
- built area 200 m^2 (length = 20.00 m; width 10.00 m and height 7.00 m)
- height at the eaves 6.10 m
- height at the ridge 7.80 m
- made of metal structure, with closures with corrugated sheet metal panels for the walls
- the resistance structure is made of concrete foundations, pillars and metal beams on which the panels and the covering are supported
- the roof is in two waters with a sandwich sheet metal covering with polyurethane thermal insulation (5 cm)
- water collection will be done by installing gutters and downpipes made of sheet metal painted in an electrostatic field
- natural lighting will be provided by PVC windows with thermal insulation glass
- the construction costs and related equipment are estimated at 1,400,000.00 lei

Table 2. FG1 drilling geotechnical sheet

Depth	Particle size						Lithological interpretation
	Gravel	Large sand	Middle sand	Fine sand	Dust	Clay	
m	%						
0.10	-	-	-	-	-	-	Clayey topsoil
0.10-0.70	0	2	16	38	39	5	Brown dusty sands
0.70-1.50 (NA=1.2 m)	0	1	5	10	71	13	Brown sandy dust

Lithological interpretation	Physical characteristics									
	γ_a	γ_s	Wc	Wf	Ip	Ic	W	Sr	n	e
	kN/m³	kN/m³	%	%	%	-	%	-	%	-
Clayey topsoil	-	-	-	-	-	-	-	-	-	-
Brown dusty sands	18.9	26.2	-	-	-	-	18.5	0.76	39	0.64
Brown sandy dust	18.7	26.3	30.1	11.2	18.9	0.48	21.0	0.85	39	0.65

Lithological interpretation	Mechanical characteristics						
	Ø	c	M_{2-3}	av_{2-3}	ep_2	Penetration	Dynamic penetration
	^{0}	kPa	daN/cm²	daN/cm²	cm/m	strikes	daN/cm²
Clayey topsoil	-	-	-	-	-	-	-
Brown dusty sands	19	9	92	0.02	3.08	-	-
Brown sandy dust	8	13	84	0.02	3.16	15	35

Table 3. FG2 drilling geotechnical sheet

Depth	Particle size						Lithological interpretation
	Gravel	Large sand	Middle sand	Fine sand	Dust	Clay	
m	%						
0.10	-	-	-	-	-	-	Clayey topsoil
0.10-0.70	0	2	17	38	36	7	Brown dusty sands
0.70-1.50 (NA=1.2 m)	3	3	6	12	68	11	Brown sandy dust

Lithological interpretation	Physical characteristics									
	γ_a	γ_s	Wc	Wf	Ip	Ic	W	Sr	n	e
	kN/m³	kN/m³	%	%	%	-	%	-	%	-
Clayey topsoil	-	-	-	-	-	-	-	-	-	-
Brown dusty sands	18.8	26.3	-	-	-	-	21.0	0.81	39	0.65
Brown sandy dust	18.6	26.3	-	-	-	-	23.0	0.93	40	0.66

Lithological interpretation	Mechanical characteristics						
	Ø	c	M_{2-3}	av_{2-3}	ep_2	Penetration	Dynamic penetration
	^{0}	kPa	daN/cm²	daN/cm²	cm/m	strikes	daN/cm²
Clayey topsoil	-	-	-	-	-	-	-
Brown dusty sands	18	9	84	0.02	3.21	13	10
Brown sandy dust	9	11	79	0.02	3.21	13	30

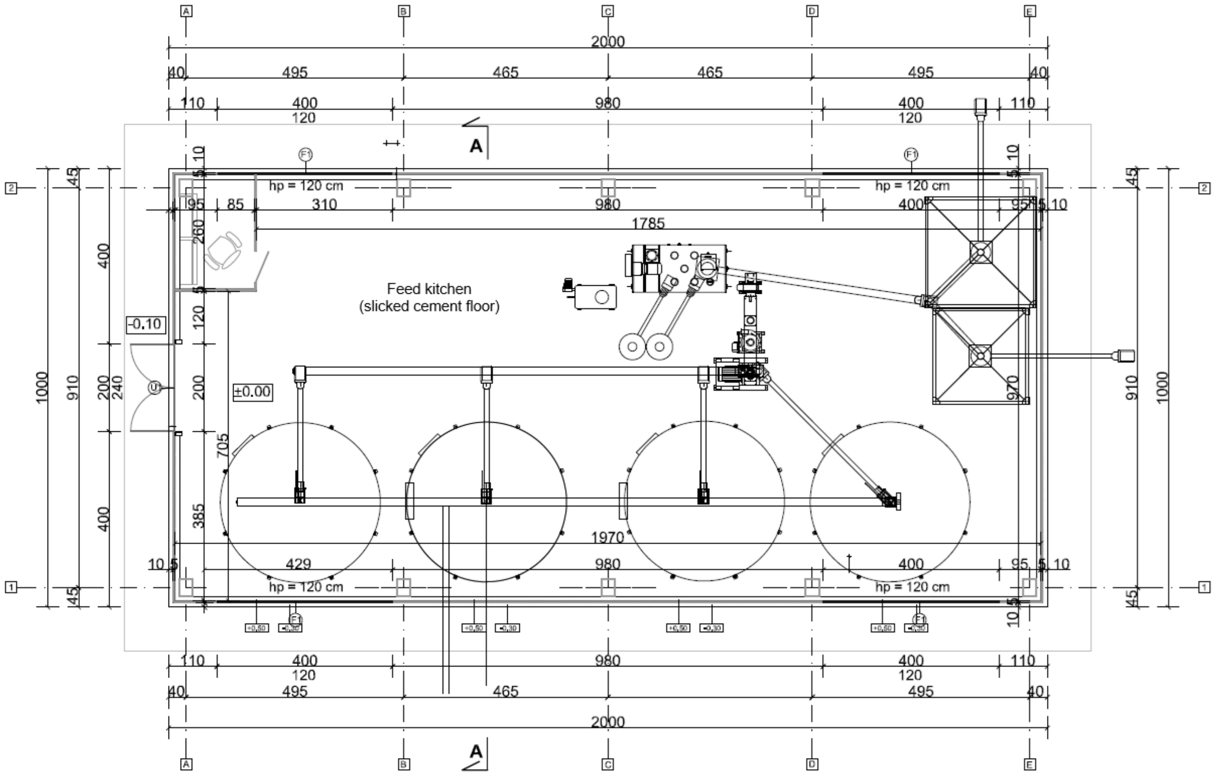

Figure 5. Construction of the feed kitchen

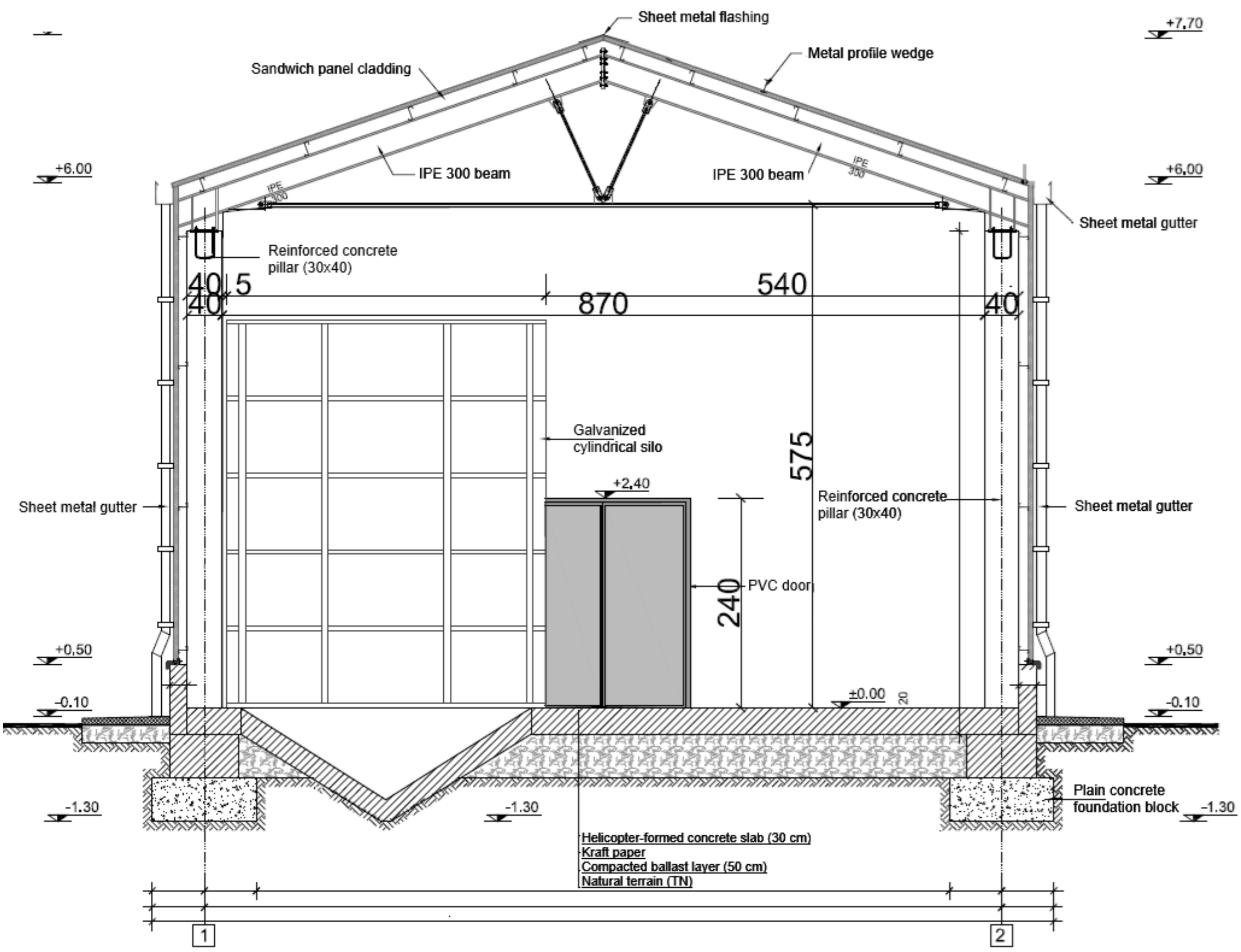

Figure 6. Cross section through the feed kitchen

CONCLUSIONS

From a morphological perspective, the site is stable and approximately flat.

The climate is temperate continental, with very hot summers and poor precipitation in the form of showers, with moderate winters and rare blizzards.

The seismicity falls within zone E with: ag=0.15 g; Tc=1.0 s; seismicity degree 7_1.

The aggressiveness of groundwater requires the use of reinforced concrete grade C16/20.

The peak value of the ground acceleration for design ag=0.15 g.

The corner period Tc=1.0 s.

The snow load on the ground is 2.0 kN/m^2.

The freezing depth is 0.80 m.

The minimum foundation depth Df= 1.10 m.

The reference value of the dynamic wind pressure qb=0.40 kPa.

According to the norms for embankment constructions, the ground is hard and very hard.

In relation to the geotechnical indices established by analyzing the samples from the boreholes, the basic value of the conventional pressure used to calculate the foundation soil is Pconv=250 kPa.

Pconv corrected for the values B=0.6 m and Df=1.10 m is Pconv=194 kPa.

It is recommended to improve the foundation soil by incorporating and compacting (minimum 98%) a layer of 0.20 m of crushed stone on top of which a layer of ballast will be placed.

The concrete will be poured continuously to avoid segregation and casting joints.

Made of metal structure, with closures with corrugated sheet metal panels for the walls.

The resistance structure is made of concrete foundations, pillars and metal beams on which the panels and the covering are supported.

The roof is in two waters with a sandwich sheet metal covering with polyurethane thermal insulation (5 cm).

REFERENCES

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

Brumar, D., & Croitoru, A., 2022, *Geotechnical study and calculation of thefoundation land for the location of raising chickens farm*. " Annals of the University of Craiova-Agriculture Montanology Cadastre Series", 52(2), 190-193. https://doi.org/10.52846/*aamc*.v52i2.1383.

Călina, A., Calina, J., & Croitoru, A, 2015, *Study on building of planimetric network stakeout for a commercial space using combined technology GPS-Total Station.* Scientific Papers. Series E. Land Reclamation, Earth Observation & Surveying, Environmental Engineering, 4, 127-134.

Călina, J., Călina, A., Iancu, T., & Vangu, G. M., 2022, *Research on the Use of Aerial Scanning and Gis in the Design of Sustainable Agricultural Production Extension Works in an Agritourist Farm in Romania.* Sustainability, 14(21), 14219. https://doi.org/10.3390/su142114219

Ida Nordin, Katarina Elofsson, Torbjörn Jansson, *Optimal localisation of agricultural biofuel production facilities and feedstock: a Swedish case study*, European Review of Agricultural Economics, Volume 49, Issue 4, September 2022, Pages 910–941, https://doi.org/10.1093/erae/jbab043.

Miluț, M., Călina, J., Călina, A., & Bădescu, G.. 2019, *Utilization of total stations in the work of detachment a property*. Annals of the University of Craiova-Agriculture, Montanology, Cadastre Series, 48(2), 328-331.

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

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

Plătică D., *Elemente generale privind proiectarea fundaţiilor. Editura Matrix-Rom. Bucureşti, 2004.*

Popa H., *2001-Indrumător de proiectare pentru fundaţii. Editura Matrix-Rom. Bucureşti.*

Şmuleac, A., Mărgelu, C., Paşcalău, R., Mărgelu, N., & Şmuleac, L. I, 2022, *Specific cadastral regulations to obtain construction permit*. Research Journal of Agricultural Science, 54(1). https://www.rjas.ro/paper_detail/3618.

Tassinari, P., & Torreggiani, D., 2006, *Location planning: a methodological approach for agro-industrial buildings in rural territory*. Transactions of the ASABE, 49(2), 505-516. DOI: 10.13031/2013.20405