GEOTECHNICAL STUDY AND DIMENSIONING FOR THE STRUCTURE OF THE AGRICULTURAL ROAD 122, FROM GODINEŞTI COMMUNE, GORJ COUNTY

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***Abstract**: The modernization of roads in Poiana Lacului, a commune in Argeș County, is a crucial improvement for local residents, providing safer and more comfortable roads along a total length of 5.59 km. Known for its beautiful landscapes and active community, this commune is home to numerous households and adjacent properties that require swift and easy access to the county's road infrastructure. The upgraded roads will connect Poiana Lacului to the network of county and communal roads, thereby enhancing regional connectivity. Additionally, the asphalted roads will increase road safety by reducing the risk of accidents caused by potholes and uneven surfaces, while overall driving comfort will improve, offering passengers a more pleasant travel experience. By significantly reducing airborne dust and emitted pollutants, the paving will also positively impact residents' health and air quality. Moreover, the modernization reduces noise and vibrations experienced by homes located near the roads. Daily travel times will decrease, enabling faster access to local services, saving fuel, and lowering vehicle maintenance costs. In emergencies, the rapid intervention of rescue teams will be facilitated, a crucial advantage for protecting the lives and property of the Poiana Lacului community. Thus, this road modernization brings substantial benefits to residents and supports the sustainable development of the commune.*

***Keywords**: Rural development, asphaltic structure, pollution reduction, reduced costs, accessibility, modernization*

INTRODUCTION

Poiana Lacului is a commune in Argeș County, Muntenia, Romania, consisting of the villages of Cătunași, Cepari, Dealu Orașului, Dealu Viilor, Dinculești, Gălețeanu, Gărdinești, Gâlcești, Metofu, Păduroiu din Deal, Păduroiu din Vale, Poiana Lacului (the commune's administrative center), and Sămara.

The locations of specific roads within Poiana Lacului commune are as follows:

- Cătunași Alley is located within the village of Cătunași and starts from D.C.161 (paved).
- D.C.1644 communal road is situated within the village of Dealu Orașului, connecting the Dealul Bării – Piscul Popii area.
- Church Alley is located within the village of Dealu Viilor, starting from D.C.1165 (paved).
- Church Alley in the village of Dinculești begins at D.C.147 (paved).
- Briceag Alley (Piscul Borzii) is within the village of Poiana Lacului, starting from D.J.703A (paved).
- La Fane Alley is located within the village of Păduroiu din Deal and begins at D.N.67B (paved).
- Ghiță Stelian Alley is in the village of Păduroiu din Deal, starting from D.N.67B.
- Popești Alley is in the village of Sămara, beginning at D.J.731B.
- Police Alley is located within the village of Poiana Lacului and starts from D.N.67B.

MATERIAL AND METHODS

Topography and geomorphology of the region

The studied site is located in the Carpathian Foreland, with a stratigraphic succession comprising Paleogene, Neogene, and Quaternary formations. At the surface, deposits from the Upper Pleistocene (qp32) are present, represented by gravels and sands associated with the upper terrace, as well as loess-like deposits characteristic of high terraces. Additionally, in the Upper Holocene (qh2), gravels, sands, sandy clays (associated with floodplain formations), and other loess-like deposits corresponding to the lower terrace are found. These formations provide evidence of the region's complex geological history, highlighting sedimentation and erosion stages characteristic of this area. A detailed stratigraphic study enables a better understanding of soil stability, essential for development and modernization projects.

Hidrology

Groundwater is contained within sand and gravel layers, with the water table closely aligned with that of the Argeș River. In deeper layers, water sometimes exhibits slight pressure, giving it an ascending character. Most of this groundwater shows mild carbonic aggressiveness toward concrete, an important factor in evaluating construction durability.

Climate and natural phenomena specific to the area

The territory of Poiana Lacului commune falls within the continental climate sector. The average annual air temperature is approximately 9–10°C, with an absolute maximum of 38°C and an absolute minimum of -27°C. Average annual precipitation varies between 600 and 700 mm, with average monthly values of 60–70 mm in January and 30–40 mm in July. The snow layer lasts between 40 and 50 days per year, with a thickness of 35–40 cm. According to STAS 1709/1-90, streets in the area are characterized by a frost index of 325 (expressed in °C x days), typical of a "non-rigid" road system. Based on STAS 6054/77, the maximum natural ground frost depth is 80–90 cm. According to the Thornthwaite Moisture Index (Im) map, the area falls into climate type II, with an Im index between 0 and 20. As per SR 174-1 from July 1997, this area is classified as a "warm zone." These climatic characteristics are essential for evaluating and planning local infrastructure.

Geology, seismicity

The site is located in the Pitești Plain at altitudes ranging from 300 to 400 meters. According to the P 100-1/2013 seismic code, for a recurrence period of 225 years and a 20% probability of exceedance in 50 years, the area is characterized by a ground seismic acceleration of a_g=0,25g, with a corner period of T_c=1,0 s. Seismic coefficients are determined as follows: k_s=0,5*y_l*a_g/g, k_s = 0,5*ks.

Studii de teren

The investigation program was designed to comprehensively cover the site, including specific geotechnical works in accordance with NP 074/2014, the normative for geotechnical documentation for construction projects. The primary objectives were:

- Identifying the stratigraphic sequence of the soil;
- Determining the physical-mechanical properties of the soil;
- Establishing the position of the water table;
- Assessing soil stability in the analyzed area.

To obtain this information, geotechnical drilling was conducted, with detailed findings provided in the Geotechnical Study attached to the current documentation.

RESULTS AND DISCUSSIONS

Dimensioning of the road structure

The technical analysis was conducted by SC POLITEH'S CONSULT SRL, under the coordination of Assoc. Prof. Dr. Eng. Laurențiu Stelea. Three options for road structures were evaluated, considering construction complexity, duration, costs, and community impact.

Road Structure Options

Option 1:Structure:

- 30 cm sand ballast
- 15 cm crushed stone
- 7 cm wearing course BAPC16

Option 2: Structure:

- 25 cm ballast
- 12 cm stabilized ballast
- 6 cm binder course BADPC22.4
- 4 cm asphalt concrete BAPC16

Option 3: Structure:

- 30 cm ballast
- 8 cm base layer AB2
- 6 cm binder course BADPC22.4
- 4 cm asphalt concrete BAPC16

Technical and Safety Aspects

Rainwater Collection: Design of drainage devices in line with current regulations. Measures for unclogging and re-profiling as needed.
Road Signage:

- Requirement for traffic signs to prevent accidents
- Compliance with specific standards (SR 1848)

Option 1 proves to be the most efficient in terms of time and community impact. The final decision should consider technical requirements, available budget, and feedback from the local community.

Planned Situation

1. **Cătunași Alley**

-**Route Plan**: Length 1,100.31 m, average speed 20 km/h. Compliant with STAS 2900/1989 and STAS 863/1985.
-**Longitudinal Profile:** Maximum gradient of 2.22%, minimum gradient of 0.78%.
-**Cross Section:** Technical Class V road, minimum platform width 5.50 m, carriageway 4.50 m, shoulders 2 x 0.25 m, with drainage ditches.
-**Road System:** Sand ballast (30 cm), crushed stone foundation (15 cm), wearing course BAPC16 (7 cm).
-**Water Drainage**: Trapezoidal earth ditches for rainwater.
-**Traffic Safety**: Horizontal and vertical signage, with 8 traffic signs.

2. **DC164A (Dealul Bării - Pisc Pului)**

-**Route Plan:** Length of 1,221.54 m, average speed of 20 km/h.
-**Longitudinal Profile**: Maximum gradient of 9.82%, minimum gradient of 0.50%.
-**Cross Section:** Similar to Cătunași Alley; Technical Class V road.
-**Road Structure**: Same specifications as mentioned above.
-**Water Drainage:** Earthen ditches and lined ditches, with culvert pipes at intersections.
-**Traffic Safety:** Horizontal and vertical signage, 7 traffic signs.

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3. Bisericii Alley (Dealul Viilor)

-**Route Plan:** Length of 493.09 m, average speed of 20 km/h.
-**Longitudinal Profile**: Maximum gradient of 5.34%, minimum gradient of 1.27%.
-**Cross Section:** Technical Class V road; specifications similar to the previous roads.
-**Road Structure**: Same specifications as mentioned above.
-**Water Drainage:** Trapezoidal earthen ditches.
-**Traffic Safety**: Horizontal and vertical signage, 5 traffic signs.

4. Bisericii Alley, Dinculești

-**Route Plan**: Length of 246.09 m, average speed of 20 km/h.
-**Longitudinal Profile**: Maximum gradient of 5.17%, minimum gradient of 1.08%.
-**Cross Section**: Similar, with variable widths.
-**Road Structure**: Same specifications as mentioned above.
-**Water Drainage:** Trapezoidal earthen ditches.
-**Traffic Safety**: Horizontal and vertical signage, 6 traffic signs.

5. Briceag Alley (Pisc Borzii), Poiana Lacului

-**Route Plan**: Length of 441.89 m, average speed of 20 km/h.
-**Longitudinal Profile**: Maximum gradient of 4.28%, minimum gradient of 0.95%.
-**Cross Section:** Technical Class V road; varied specifications.
-**Road Structure:** Same specifications as mentioned above.
-**Water Drainage**: Trapezoidal ditches and culverts.
-**Traffic Safety:** Horizontal and vertical signage, 7 traffic signs.

6. La Fane Alley, Păduroi din Deal

-**Route Plan:** Length of 325.64 m, average speed of 20 km/h.
-**Longitudinal Profile:** Maximum gradient of 5.82%, minimum gradient of 0.25%.
-**Cross Section**: Technical Class V road.
-**Road Structure:** Same specifications as mentioned above.
-**Water Drainage**: Concave profile for stormwater.
-**Traffic Safety:** Horizontal and vertical signage, 5 traffic signs.

7. Ghiță Stelian Alley, Păduroi din Deal

-**Route Plan:** Length of 963.85 m, average speed of 20 km/h.
-**Longitudinal Profile**: Maximum gradient of 3.67%, minimum gradient of 0.61%.
-**Cross Section:** Similar, with specifications for signage.
-Road Structure: Same specifications as mentioned above.
-**Water Drainage:** Earthen and lined ditches.
-**Traffic Safety:** Horizontal and vertical signage.

EVALUATION OF DATA FROM A ROAD SYSTEM PERSPECTIVE

The purpose of the analysis is to determine optimal road system solutions for the modernization of homogeneous road sections that comprise the analyzed street. The CALDEROM software will be utilized according to standards AND 550 and PD 177/2001 to determine the load-bearing capacity of each section.

Road system dimensioning involves establishing design traffic based on a detailed study, evaluating the load-bearing capacity of the foundation soil according to its type, climate, and hydrological regime. The road structure must comply with current technical standards, with verification conducted through an analysis of layer thicknesses and material characteristics. Calculations for deformations and stresses are performed at critical points within the road complex using the CALDEROM 2000 software. Finally, the traffic performance check compares the calculated values of deformations and stresses with permissible values, based on the behavioral properties of the materials.

Verification Criteria

A road system can withstand the anticipated traffic loads over the projected period if the following criteria are met:

1.Specific Strain Deformation Criterion

The rate of degradation due to fatigue (RDO) must be less than or equal to the permissible RDO:

$$\text{RDO} \leq RDO_{admisibil}$$

where:

R_c = design traffic in million standard axles of 115 kN (m.s.a.)

Nadm = allowable number of load repetitions in m.s.a.

Vertical Specific Deformation Criterion

The condition is met if : $\varepsilon_z < \varepsilon_{z_{admisibil}}$

where:

ε_z= vertical specific compressive strain at the foundation soil level (microstrains)

$\varepsilon_{z_{admisibil}}$= allowable vertical specific strain at the foundation soil level, given by: $\varepsilon_{z_{admisibil}} = 600 \times {N_c}^{-0,28}$

CONCLUSIONS

Road safety, improved access, and the positive impact on the community make this road modernization project in the Poiana Lacului commune an essential element for local development. First and foremost, the modernization works will provide better connectivity between the component villages and the network of county and national roads, facilitating residents' access to essential services and nearby areas, thereby reducing the time and resources required for daily commutes.

By paving and strengthening the road structure, the risk of accidents will be significantly reduced, protecting passengers and minimizing vehicle wear and tear. Drainage systems and appropriate signage are essential elements that will enhance road safety, creating safer traffic conditions for all residents.

Another important advantage of the project is its positive impact on the environment and the health of residents. Paving the roads will reduce dust and noise, thereby improving air

quality and decreasing daily discomfort, which contributes to protecting community health and enhancing the quality of life.

Moreover, with the proposed road structures and drainage works, the modernized roads will be more durable and better able to withstand heavy traffic and climatic conditions. Rigorous technical checks and the use of appropriate materials ensure that the roads will require less maintenance and reduce long-term costs.

Additionally, the new infrastructure will bring economic benefits by reducing fuel consumption and saving maintenance costs for users. Furthermore, easy access and modern road infrastructure will attract new investments in the area, contributing to local economic development.

In conclusion, this road modernization project will positively transform the Poiana Lacului community, improving safety and quality of life, encouraging economic development, and increasing the region's attractiveness.

BIBLIOGRAPHY

Legea nr. 177/2015 pentru modificarea si completarea Legii 10/1995 privind calitatea in constructii;
Legea 137/1995 a protectiei mediului;
HG nr. 445/2009 Hotararea Guvernului privind evaluarea impactului anumitor proiecte publice si private asupra mediului;
Legea 319/2006 privind Securitatea si Sanatatea in Munca;
Ordinul 536/1997 al Ministerului Sanatatii actualizat pana la data de 30.04.2008;
Legea 307/2006 privind apararea impotriva incendiilor;
Ordinul M.T. nr. 45/1998 pentru aprobarea ,,Normelor tehnice privind proiectarea, construirea si modernizarea drumurilor''
Legea 50/1991 privind autorizarea executarii lucrarilor de constructii;
C 56 – 85 – Normativ pentru verificarea calitatii si receptia lucrarilor de instalatii aferente constructiilor;
Regulamentul privind controlul de stat al calitatii in constructii, aprobat prin H.G. nr. 273/1994;
Ordin AND nr. 116/1999 – Instructiuni proprii de securitate muncii pentru lucrari de intretinere, reparare si exploatare a drumurilor si podurilor;
P118/1999 – Norme tehnice de proiectare si realizare a constructiilor privind protectia la actiunea focului;
Normativ AND 584 – 2012 – Traficul de calcul pentru proiectarea drumurilor din punct de vedere al capacitatii portante si al capacitatii de circulatie;
Normativ AND 602/2012 – Metode de investigare a traficului rutier;
PD 189/2012 – Normativ pentru determinarea capacitatii de circulatie a drumurilor locale;
PD 177-2001 – Normativ pentru dimensionarea sistemelor rutiere suple si semirigide;
Normativ NP 126-2010 - ,,Normativ privind fundarea constructiilor pe pamanturi cu umflari si contractiimari'';
SR 4032-1:2001: Lucrari de drumuri. Terminologie;
STAS 863-85 - Lucrari de drumuri. Elemente geometrice ale traseelor. Prescriptii de proiectare;
STAS 2914-84 - Lucrari de drumuri. Terasamente. Conditii tehnice generale de calitate;
STAS 2900-89 - Lucrari de drumuri. Latimea drumurilor;
SR EN 13242 Agregate din materiale nelegate sau legate hidraulic pentru utilizare in inginerie civila si in constructii de drumuri;
SR EN 13285:2011 Amestecuri de agregate nelegate. Specificatii.
SR EN 12620+A1:2008: Agregate pentru beton;
SR EN 197-1:2011 – Ciment;
SR EN 933-1: 2012 – Incercari pentru determinarea caracteristicilor geometrice ale agregatelor. Partea 1: Determinarea granulozitatii. Analiza granulometrica prin cernere.
SR EN 1008:2003 – Apa de preparare pentru beton.
STAS 3349/2-83 Betoane de ciment, prescriptii pt. stabilirea gradului de agresivitate;
CP 012/1-2007 – Cod de practica pentru producerea betonului;

NE 012-1:2007 – Normativ pentru producerea betonului si executarea lucrarilor din beton, beton armat si beton precomprimat.
SR EN 13043 ,,Agregate pentru amestecuri bituminoase si pentru finisarea suprafetelor utilizate in constructiasoselelor, a aeroporturilor si a altor zone cu trafic'';
SR EN 13108-1 – Mixturi asfaltice. Specificatii pentru materiale. Partea 1. Betoane asfaltice;
Indicativ AND 605 – Normativ mixturi asfaltice executate la cald. Conditii tehnice privind proiectarea, prepararea si punerea in opera;
STAS 10796/1-77 - Lucrari de drumuri. Constructii anexe pentru colectarea si evacuarea apelor. Prescriptii generale de proiectare.
SR 11100/1-93 Zonarea seismica. Macrozonarea teritoriului Romaniei
SR EN ISO 14688 -2:2005 ,,Cercetari si incercari geotehnice. Identificarea si clasificarea pamanturilor. Partea 2. Principiu pentru o clasificare'';
STAS 1913/1-9,12,13,15,16 „Teren de fundare. Determinarea caracteristicilor fizice'';
STAS 10796/1/77 Lucrari de drumuri. Constructii pentru colectarea apelor. Drenuride asanare. Prescriptii de proiectare si amplasare.
STAS 1709/1-90 Actiunea fenomenului de inghet – dezghet la lucrari de drumuri. Adancimea de inghet in complexul rutier. Prescriptii de calcul;
STAS 1709/2-90 Actiunea fenomenului de inghet – dezghet la lucrari de drumuri. Prevenirea si remedierea degradarilor din inghet – dezghet. Prescriptii tehnice;