PREPARATION AND DEVELOPMENT OF GEOTECHNICAL MAP OF ALBA IULIA TOWN, ALBA DISTRICT

Ecaterina BALANEANU, Victor ARAD**, Letitia Susana ARAD***, Flavius BALANEANU**

Abstract

The continuous change of the legislation dealing with the geotechnical domain, the orientation toward the European legislation through EUROCODES and the endless intervention of man in the given landscape, determines a permanent need for updating the maps, no matter their type. The ecology and environmental protection together with the terrain structure in depth must be correlated all the time so as to allow a positive cohabitation of all citizens.

In order to draw up and make a geotechnical map, it is compulsory to take into consideration several elements that will work together in the process of reaching the final result. The final result must grant the requests and the complex needs of all parts involved-including the environmental requirements.

The geotechnical dividing of the Alba Iulia town will be made according to the three existent morphological elements, id est: the meadow area-of the Mures River and the common meadow of the Mures River and the Ampoi River relating to the old town, the terrace area of the Mures River-where the fortress is located together with all its contiguous constructions; and thirdly, the deluvial sediments area-identified in the western part of the town where there are no building regulations set.

The present work wants to draw up and make a geotechnical map that presents the foundation layers and the geotechnical framing of each and every area in Alba Iulia town, Alba county.

Thus, there will be a summarization of the geotechnical data that can be used as a starting point when carrying the geotechnical studies for every planned objective considered alone.

Keywords: *ecology, geotechnics, terrain structure, geotechnical risk, geotechnical map*

1. Introduction

The present work intends to make a geotechnical map of Alba Iulia town so as to exist a database sufficient to become a starting point for making the geotechnical study for every objective that is to be built.

The present work will be structured according to each morphological element encountered in the geomorphology of Alba Iulia town.For each element there will be considered the following aspects: location, stratification, recommended foundation terrain, recomended basic pressure and placing the element in the appropriate geotechnical category following the present regulations.

2. The geomorphologic categorization

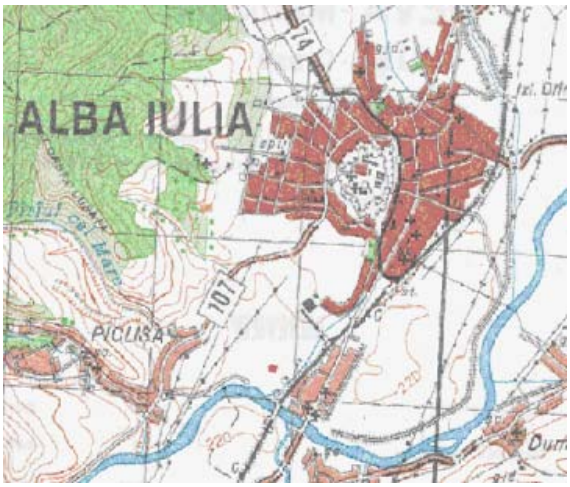

Fig. 1 *The geomorphological categorization of Alba Iulia town*

From a geomorphological point of view, Alba Iulia town is to be related to the chute of the Mures River. This develops alongside the Mures River and comprises landforms dug and shaped by the river course or meandered.

In the course of time, the shape of its river course changed producing beaches and eroding shores. These iterative phenomena led to the change and migration of the river course resulting in sediments of alluviations on one side and erosion in the opposite direction.

Fig. 2 *The meandered course of the Mures River*

* *Eng.Ph.D stud. University of Petroşani*
** *Prof.eng.Ph.D University of Petroşani*
*** *Assoc.prof.eng.Ph.D University of Petroşani*

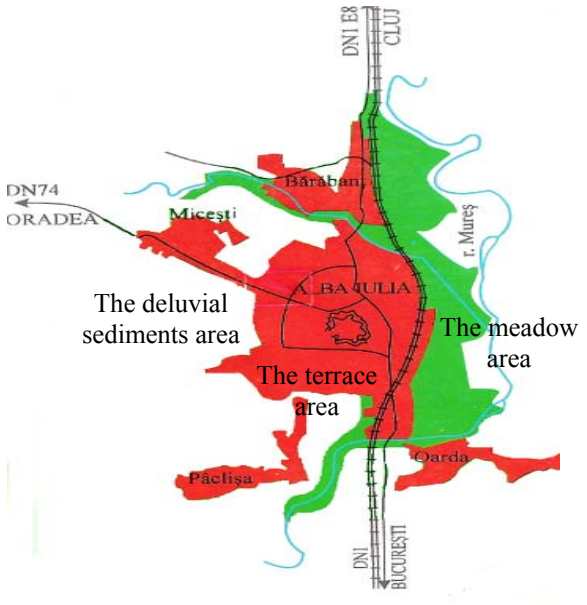

Fig. 3 *The geotechnical map of Alba Iulia town*

The paper refers strictly to the built-up area of the Alba Iulia town without considering the localities that are part of it.

We encounter the following land levels:

- Zone I – the meadow area of the Mures River and the common meadow of the Mures River together with the Ampoi River ;
- Zone II – the terrace area of the Mures River- where the fortress is located together with all its contiguous constructions;
- Zone III - the deluvial sediments area-identified in the western part of the town where there are no building regulations set.

Location

The meadow area is divided into two sections related to the river courses that cross it.

Fig. 4 *The meadow area of the Mures River*

The meadow area has been flooded numerous times, the old buildings have been weakened by the water penetrating the walls. For this area there is a need to take also into account the Geotechnics of the Environment because water, as an environmental factor, concurred to the deterioration of the characteristics related to the foundation layers of the existing buildings .[1]

At the same time, the migration of the underground water toward the surface through coarse and mixed layers leads to degradation- the pollution of the environment and human habitat due to the direct link between the river courses and the the level of the underground water .[1]

Thus, we have: the meadow area of the Mures River and the common meadow of the Mures River together with the Ampoi River .

Zone I – the meadow area

The meadow area of the Mures River

This area comprises the "downtown"-named like this because the first houses were built here.

The area is located in the newer neighbourhoods of the town, named after the Ampoi River.

The floods of 1970 caused significant damages to the buildings and affected the entire town of that time.

The dams built alongside the Mures River and the climate change of the past few years have led to the stabilization of the underground water of this side of the town.

The common meadow area of the Mures River together with the Ampoi River

The common meadow area of the Mures River together with the Ampoi River is bordered by the watercourse of the two rivers.

The Watercourse of the Ampoi River does not present a significant flow but enough to maintain the level of the underground water constant in that perimeter.

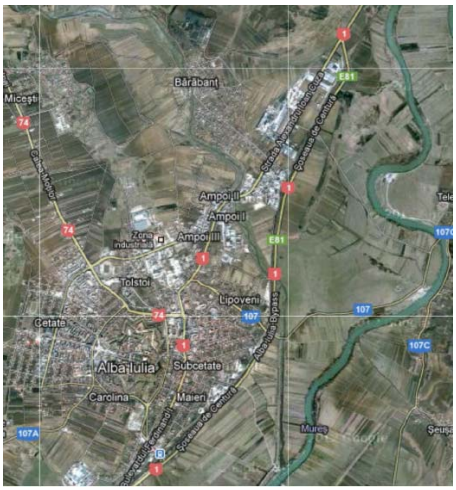

Fig. 5 *The common meadow area of the Mures River together with the Ampoi River*

Stratification

In all the undergone drillings the stratification presents the pattern of the meadow areas :

- Vegetative layer or filling;

- The fine Complex : Brown silty sand;
- The mixed Complexul:Silty sand with gravel;
- The coarse Complex: Gravel with sand.

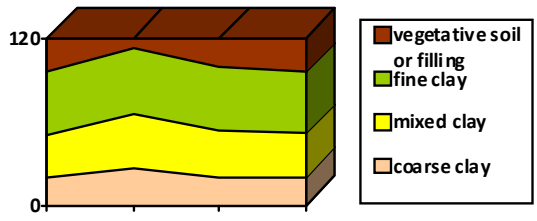

Fig. 6 *The distribution of stratification in the meadow area [2][3][6][7]*

In all the layers mentioned above there are insertions of organic materials presenting different thickness. These insertions must be identified and clearly defined because it is not allowed to found on them. They must be taken out and then found deeper entering 0.20 m in the good foundation terrain existing in that location.

The undergorund water appears at a depth of -2.00-2.50 m from the natural terrain to the contact between the fine Complex and the mixed one. To its superior part, it becomes flooded. The variation of the underground water level are closely connected to the flow amountof the surface water in the area and the rainfall. Thus, it is taken into account an increase with +50 m from the altitude where it is encountered.

The recommended foundation terrain

According to the Regulatory document INDICATIV NP 074 - 2007[4] , it is recommended to consider the following foundation layers:

- The fine Complex: Brown silty sand- without taking further measures,
- The mixed Complex: Silty sand with gravel- with extra measures to support diggings accoringly and
- The coarse Complex: Gravel with sand-with both extra measures to support diggings accordingly and measures related to dewatering.

It is not allowed to found on vegetative soil and local fillings. Also, it is forbidden to cast concrete if coming across muddy ground or with organic material. These will be dug out and the diggings deepened.

The recommended basic pressure

It is allegedly considered that the layers presented below are clean and do not contain muddy intercalations. The calculating values of the conventional pressure are determined according to Stas 3300/2-85 [5] from the natural terrain level.

For each layer, we will have the following values:

- The fine Complex: Brown silty sand : P_{conv} =220 KPa
- The mixed Complex: Silty sand with gravel: P_{conv} =250 KPa
- The coarse Complex: Gravel with sand: P_{conv} =350 KPa

Geotechnical categorization

According to the Regulatory document INDICATIV NP 074-2007 [4] the foundation terrain will be placed into the adequate geotechnical category, thus resulting the geotechnical risk.

Table 1 *Geotechnical categorization [Table A3][2][4]*

Terrain conditions	**Good terrains** **2 pts**	**Medium terrains** **3 pts**	Difficult terrains 6 pts
Underground water	**No dewatering** **1 pt.**	**With normal dewatering** **2 pts**	With exceptional dewatering 4 pts
The building classification according to the importance class	**Reduced** **2 pts**	**Normal** **3 pts**	Particularly exceptional 5 pts
Vicinity	**No risks** **1 pt.**	**Moderate risk** **3 pts**	Major risk 4 pts
			Overall score = **7 - 10**

According to the table above, the geotechnical risk is reduced and the geotechnical category is 1 – 2 .

Table 2 *Geotechnical risk [Table A4][2][4]*

Nr.crt	Geotechnical risk		Geotechnical category
	Type	Score limits	
1	Reduced	6…….9	**1**
2	Moderate	10……14	**2**
3	Major	15..……..21	**3**

Zone II – the terrace area

Location

The terrace area of the Mures River comprises the fortress with all the contiguous constructions- located in the centre of Alba Iulia town. The area gathers all the terraces of the Mures River. This area has undergone the most intense town planning. In the plans dealing with the enlargement of the town it was necessary to join the "downtown" to the fortress lying above. As a result of consulting the specialists of that period, it was stated that fillings resulting were the best solution. Thus, all the fillings resulting from constructions were stored in this zone.

The thickness of the fillings is big. In some areas it is even as thick as 3.00 m, the blocks of flats built afterwards having wide foundations in order to resist.

Fig. 7 *The terrace area*

Stratification

The stratification encountered is as follows:

- Filling layer;
- The fine Complex: Brown silty clay
- The mixed Complex: Silty sand with gravel
- The coarse Complex: Gravel with sand.

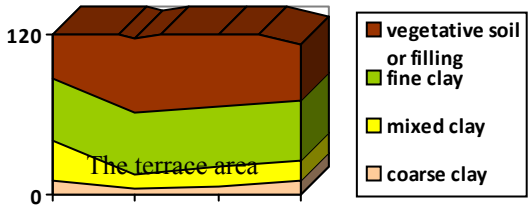

Fig. 8 *The distribution of the stratification in the terrace area [2][3][6][7]*

The tickness of the filling is evident. The exact thickness of the fillings must be known because the process of founding on them takes place under special conditions.

The underground water appears at a depth of – 8.00 – 10.00 m from the natural terrain to the contact between the fine Complex and the mixed one. To its superior part, the mixed Complex is moist whereas to its inferior part it becomes flooded. Of course, it is necessary to mention the streams in the area. There are streams even in the ditches existing alongside the fortress.

The recommended foundation terrain

According to the Regulatory document INDICATIV NP 074-2007 [4] , the following foundation layer is recommended:

The fine Complex: Brown silty clay – without taking further measure.

The mixed Complex: Silty sand with gravel, and the coarse one: Gravel with sand appear at great depths. It is not considered a foundation layer except for objectives requiring great depths.

Since the thickness of the filling layers is big and there are already finished constructions, this may be taken as a foundation layer as well.

The recommended basic pressure

For the fine Complex: Brown silty clay; the values of the conventional pressure are to be considered. This is calculated according to Stas 3300/2-85 from the level of the natural terrain [5].

We will have the following values:

➢ The fine Complex: Brown silty clay: P_{conv} =240 KPa

➢ Filling – older than 25 years but not compacted under control: P_{conv} =180 KPa

Geotechnical categorization

According to the Regulatory document INDICATIV NP 074-2007 [4] the foundation terrain will be placed into the adequate geotechnical category, thus resulting the geotechnical risk.

Table 3 *Geotechnical categorization [Table A3] [2][4]*

Terrain conditions	**Good terrains 2 pts**	**Medium terrains 3 pts**	Difficult terrains 6 pts
Underground water	**No dewatering 1 pt.**	**With normal dewatering 2 pts**	With exceptional dewatering 4 pts
The building classification according to the importance class	**Reduced 2 pts**	**Normal 3 pts**	Particularly exceptional 5 pts
Vicinity	**No risks 1 pt.**	**Moderate risk 3 pts**	Major risk 4 pts
			Overall score = **7 - 9**

According to the table above the geotechnical risk is reduced and the geotechnical category is 1.

Table 4 *Geotechnical risk [Table A4] [2][4]*

Nr.crt	Geotechnical risk		Geotechnical category
	Type	Score limits	
1	Reduced	6…….9	**1**
2	Moderate	10……14	**2**
3	Major	15..……..21	**3**

Zone III – the deluvial accumulations area

Location

Zone III presenting deluvial accumulations can be identified in the western part of Alba Iulia town where there are no building regulations yet. These areas are proposed to be inserted within the build-up zone, currently being the zone for building holiday cottages.

The vegetative soil is thick – aproximately 1.00 or even 1.50 m. The presence of tree roots takes its toll. For this area as distinctiveness appears the possibility to control the process of building in the area.

Even though in the I-st and II-nd geotechnical zones it is not possible to impose a regulation, discipline concerning building, the III-rd zone is ideal for this thing.

Stratification

The stratification encountered is as follows:

- Layer of vegetative soil with thick roots;
- The mixed Complex: Silty sand with gravel
- The fine Complex: Clayey marly silt.

The recommended foundation terrain

According to the Regulatory document INDICATIV NP 074-2007 [4], the following foundation layer is recommended :

The mixed Complex: Silty sand with gravel; in this case, it is of deluvial origin and has high percentage of gravel. Its deluvial origin resulting from erosion and hard material transportation makes it suitable for becoming a foundation layer.

Fig. 9 *The distribution of stratification in the deluvial accumulations area*

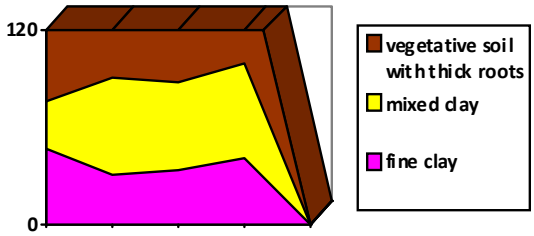

Fig. 10 *The distribution of stratification in the deluvial accumulations area [2][3][6][7]*

The recommended basic pressure

For the mixed Complex: Silty sand with gravel; the values of the conventional pressure are to be considered. This is calculated according to Stas 3300/2-85 from the level of the natural terrain [5].

We will have the following values:

- The mixed Complex: silty sand with gravel: P_{conv} =250 KPa

Geotechnical categorization

According to the Regulatory document INDICATIV NP 074-2007 [4] the foundation terrain will be placed into the adequate geotechnical category, thus resulting the geotechnical risk.

Table 3 *Geotechnical categorization [Table A3] [2][4]*

Terrain conditions	**Good terrains 2 pts**	**Medium terrain 3 pts**	Difficult terrains 6 pts
Underground water	**No dewatering 1 pt.**	**With normal dewatering 2 pts**	With exceptional dewatering 4 pts
The building classification according to the importance class	**Reduced 2 pct**	**Normal 3 pts**	Particularly exceptional 5 pts
Vicinity	**No risks 1 pct**	**Moderate risk 3 pts**	Major risk 4 pts
		Overall score = 7	

According to the table above the geotechnical risk is reduced and the geotechnical category is 1.

Table 4 *Geotechnical risk [Table A4] [2][4]*

Nr.crt	Geotechnical risk		Geotechnical category
	Type	Score limits	
1	Reduced	6…….9	1
2	Moderate	10……14	2
3	Major	15..……..21	3

3. Conclusions

In the present work there has been crafted a geotechnical map of Alba Iulia town based on the data related to the stratification determined by drillings and the morphology of the terrain in Alba Iulia.

The database that resulted is sufficient to become a starting point for making the geotechnical studies for every objective that is to be built.

Of course, the data put together are not comprehensive enough to replace a geotechnical study but they offer the possibility to become aware of the nature of the terrain at the desired depth. Furthermore, the recommended basic pressure and geotechnical categorization may be used according to the existing regulations.

The geotechnical categorization is made at the initial level and asks for special attention to: the terrain conditions, the possibility of emergence of underground water, the class of the constructionand especially to the the vicinity.

The vicinity is a very important factor in the context of determining the geotechnical risk for the future building.

References

1. **Arad, S., Arad, V., Chindris, G.**
Environmental geotechnics, Polidava Publishing house, Deva, 2000;
2. **Arad, V., Bogdan, I.**
Geotechnics and foundations, Solness Publishing house, Timişoara, 2001;
3. **Arad, V.**
Rock mechanics, Didactic and Pedagogic Publishing house, Bucureşti, 2004;
4. *Regulatory document NP 074/2007 regarding the elaboration and verification of Geotechnical studies from 08/05/2007* Published in the Official Journal, Part I no. 381 from 06/06/2007;
5. *Stas 3300/2-85* – for determining the basic pressure- i.e. conventional, calculated according to Appendix B, for foundations with B=1.00 m and foundation depth Df= 2.00 m
6. *SR EN ISO – 14688 – 1st – November 2004– The identification and classification of soils. Part 1: Identification and description ;*
7. *SR EN ISO – 14688 – 2nd – September 2005 – The identification and classification of soils.* Part 2: Principles for classification (from a granulometric perspective).
8. www.google.ro
9. http://alba-iulia-ab.pe-harta.ro/