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EXPANSION INFUENCE OF THE ARGILLACEOUS SOILS ON THE BUILDINGS, STABILITY

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ABSTRACT

In this paper are treated detaily the causes of the defects in the buildings of the village Izvor (Tepelena) supporting on the analysis of the defects. Mineralogical analysis, physical properties and on the experimental data about the pression of the expansion of the earth. That serve as a basement we have concluded that the cause of their damage is the presence of the phenomenon of the expansionas and of opposite one of the contraction of the argillaceous soils.

Knowing these phenomenos, in this paper are given and the manier, of their repairing in the way of the augmentation of the basis' resistence. In these conditions is recommended that for such zones, the project ors must to know the properties of the basis' soils to ensure better the resistance of the buildings.

INTRODUCTION

Building in different towns and villages of Albania, has evidenced some phenomena, which till now not been taken into consideration, such as ceding, expansion, fissures due to the underground cultural activity, landslides etc. These buildings are generally one or two-floors houses and exrt through their foundations loads on the argilleceous soils.

The building of such houses needs the investigation of the objects from the construction point of view. But it is also important to investigate the reciprocal influence between them and the basement on which they have been constructed. One of the most typical cases is the damage of the houses in the village Izvor in District Tepelena. This village has been built in 1969. The new houses are one-floor houses being built with stone construction and partially with brick construction. After some years in these houses the first damages were observed, such as wall fissures, which being gradually increased and disturbing the population. The conclusion of the investigation carried out in years 1984, 1985 and 1987 to determine the causes of these defects is that the main factors are the hillside landslide, the underground mine activity in the coal exploitation and the expansion as a second hand one.

GEOLOGICAL DATA OF THE AREA

The village Izvor is situated on the western flank of the syncline of Memaliaj with Neocene and Quaternary formation (fig. 1). The Neocene formation include Helvetian and Tortonian ones (Kuci et al, 1975) which from the western flank of the syncline of Memaliaj which strike and deepage 60-90° and 35-60° respectively.

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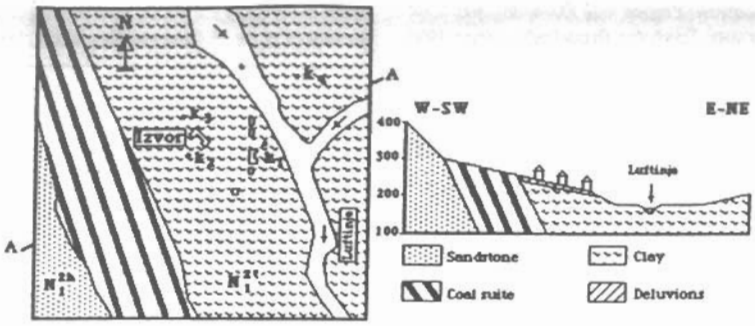

Fig. 1: The geological map and the geological section in Izvor village.

Upper Helvetian (sandstone suit of Zhabokika). This suit lays normally over the formation of the Lower Helvetian, not being outcropped. These formations are generally represented by sandstone packs of various thicknesses, which nare alternated with rare argillaceous and alevrolitic sublayers.

Tortonian. The Tortonian formations are represented by three packs, which differ in their petrographic composition:

1- Coal-bearing suit of Memaliaj,
2- Dark argillaceous suit of Qafe-Mirica,
3- Sandstone suit of Cicaj and many-colored suit of Luftinja.

Coal-bearing suit of Memaliaj is located on the western flank of the coal field, its thickness is about 200-300m. It lays normally over the suit habokika and its formations are represented by argillaceous and alevrolitic formations, which are alternated with polymineral sandstones. Within this suit are located the coal layers, which are actually under the exploitation mine activity.

Dark argillaceous suit of Qafe-Mirica lays over the previously mentioned one, its thickness series. Within it are observed some rare thin 20 - 30 cm sandstone and marne sublayers.

Sandstone suit of Cicaj and many-colored suit of Luftinja lay over the second Tortonian suit. In its lower part some sandstones are encountered. The upper part is represented by gray to purple clays which are alternated with alevrolites and sandstones that have a thickness of 1 - 3. The suit thickness is up to 150 m.

Quaternary formations. These sediments cover as overburden over the Neogenic formations creating a gentle and smooth relief with smaller dip angle than the lower sediments. In the village area these sediments are represented by brown to gray argillaceous formations with mean moisture (humidity) and compression. This formation have generally preserved the composition of the forming rocks. The alteration is very small due to the new conditions after their formation. The thickness of these sediments varies from 1.0 m in the upper part of the village to 5 - 6 m in lower part (MINGA and MUKA, 1990).

BUILDING DEFECTS

The observations carried out for different cases have shown that one ore two floors buildings are more sensible towards the expansion due to the fact that their influence on the soils in higher than the dilatation influence (Marioti 1981; MINGA 1989). It can be noticed in the force distribution curves in soils for buildings with different weights, (fig. 2). From the observations carried out in the village and the study of the materials concerning the presence of the underground mine works it can be directly concluded about the causes of the

buildings defect.

Our field observations have shown that the landslide phenomenon is not present in the area. There have been no indicators observed as step-like terrain, trees deviation from their vertical position, ground water, which could be a sign of its presence. The low slope up (10-12°) of the hillside is also favorable for its stability, while the water saturated argillaceous formations have angle value of internal friction of 20-23° and cohesion of 0,4 bar as resulted from analysing the physical properties .

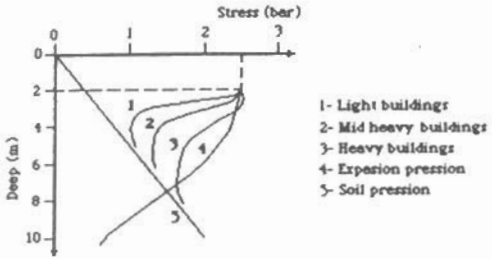

Fig. 2: The curves of the distribution of the efforts for the buildings with shallow basis and their ratio with the potential of the expansion.

The detailed investigation of the underground mine activity shows that its influence on the houses built on the surface is present only if these objects are within the influence zone of the underground work itself. In the case of the village under the study according our calculation, the border of the influence zone of the underground work is still far away, therefore this influ-ence is not to be taken into consideration (Minga and Muka 1990), (fig.3). All the constructed houses have been damaged. The more sensible houses were there which have been constructed earlier. The houses constructed in these last years have only small damages, and this fact is due to the presence of the ex-pansion and deciccation phenomena, of the argillaceous soils. The expansion was appeared some years after the construction of the houses, so after some cycles of the expansion and desiccation. These cycles caused the tiredness of the damage of the surface (Marioti 81).

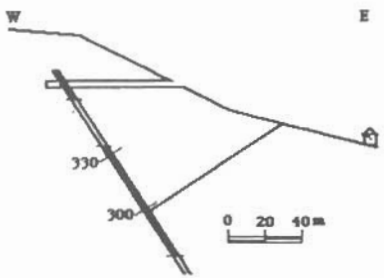

Fig. 3: Bundeday of the influence of the mine on the buildings.

The observations of the damaged houses show the highest damage scale for the walls exposed to the sun (oriented to south-east, south and south-west).The foundation of these walls has undergone a continuous humidity change during the various seasons. The humidity variation has caused the variation of the mechanical behavior of the foundation clays which in winter undergo the expansion, and in summer the desiccation. The clay desiccation is associated with the decrease in the clay volume, vertical fissures of the basement clay and its descent, which itself has caused the creation of the parts, that do not uniformly rest on the basement. This situation has led to the foundation bending, which, when it was stronger than, the bending that the construction material could resist, caused the foundation and wall fissures (fig. 4).

These were observed the desiccation fissures in the basement delluvial argillaceous soils. This desiccation is associated with the fissures in the basement clays themselves located at the depth 1.4 m. More prominent these fissures have been in the years 1985 and 1987. It is already known that these are the years of the prolonged dryness. The observed fissures in walls are oriented

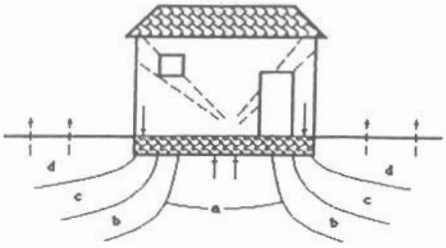

Fig. 4: Line of defects in the objects as a result of the dimination of the earth's humidity.

with an angle of 45 to the horizon and are mostly in the wall corners or in the weakest parts of the construction such as doors and windows just typical for the expansion and desiccation phenomena (MARIOTI, 1976; KONOMI and MINGA, 1988).

The strongest development of this phenomenon is especially observed in the houses with week fastening and without antiseismic belts. The presence of such belts would be very helpful to avoid the damages or at least to reduce them.

Building of the houses with shallow foundations (60-100 cm) has led to the higher compression force value (fig. 5). This depth of the houses foundations corresponds to that part of soils, which is always under the influence of the humidity variations during various seasons.

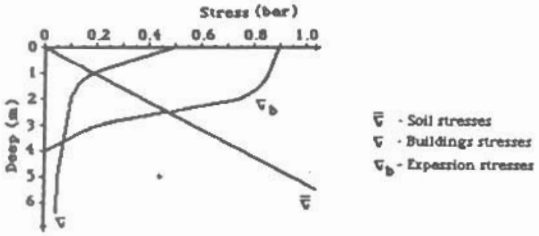

Fig. 5: The curves of the distribution of the efforts in Izvor village

ESTIMATION OF THE EXPANSION PHENOMENON ON THE BASIS OF THE INVESTIGATIONS IN THE VILLAGE IZVOR

To evaluate the presence of this phenomenon and to determine the force of the basement on the foundations of the objects we have collected samples from unaltered natural structures in the area of the actual village and in the area where it is thought to expand it in future. The samples were analyzed for their physical properties, mineralogical composition and compression pressure of the soils. The compression probes were carried out after the method of the compression in free volume for various pressure values. The results were processed in computers and than it was not difficult to determine analytically the value of the compression pressure.

It was also applied the method of the preliminary turgidity (bloatness) to control the results being obtained with the first method. It was observed that the soils are argillaseous, which grain composition varies in different samples. The variation of the argillaceous fraction content is negligible (fig. 6).

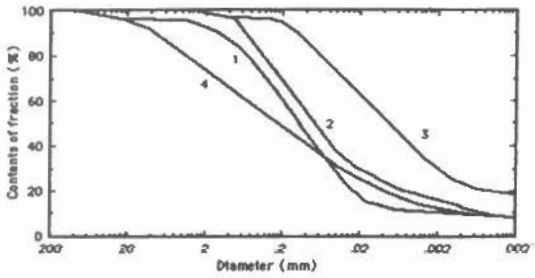

Fig. 6: The curves of granulometric composition.

Based upon the results of the mineralogical analyses it was concluded that the main argillaceous minerals of the soils are montmorillonite and illyte (fig. 7). The content of these minerals is 62 - 80% of the total amount of the argillaceous minerals. The presence of these minerals allows the house

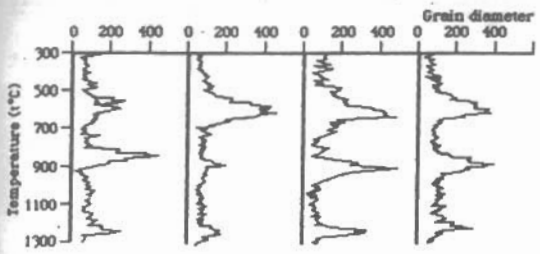

Fig. 7: The curves of clays, mineralogical composition of Izvor.

foundations (0.4 - 1.1 bar) while the house itself exercises a pressure of 0.4 - 0.5 bar. These calculations have been made basing upon the construction and the materials used to build it up. The physical state of the soils shows a high compression level which is also related to the high argillaceous minerals content. The soil humidity level is lower than the low plasticity limit, allowing these soils to be highly expandable. It leads to high values of volume variation difference during expansion and desiccation.

The lack of the antiseismic belts is mainly responsible for the low stability in bending and pulling and, consequently, for the houses damage. Based upon the results of the sample analysis and the investigation of the underground mine activity level it was concluded that the influence of this activity and of the landslide effect is negligible. The main factor, which has caused the damage of these houses, is the expansion and desiccation of the argillaceous soils that build the ground of this village.

RECOMANDATIONS TO AVOID DEFECT

The repair of the houses damaged due to the expansion phenomenon is a real problem which can be treated in two aspects for first the house stability is to be assured, and second the influence of this phenomena to be removed. It was recommended to build new houses with armed beton construction foundations, which will have the form of window. The internal part must be filled with stone walls. This kind of constructions is more stable in bending and can resist to bigger charges compared to the stone construction. It was also recommended to realize the foundation a compressed filling at depth more than 1m, which composition is of soils with compression capability to overcome the zone with intensive evaporation of the humidity (0,4 - 0,8m).

For the damaged buildings there were recommended steps to increase the foundations solidity and to avoid the factors which could cause the expansion or desiccation phenomenon such as preserving the humidity level of the soils, building of pavements 2-2,5m breit and 10cm high over the ground surface laced on fillings with thickness 20-30cm (which could serve as a thermoinsulating cover)and channel opening at the adzes of this pavements just to collect and remove the rain water.

The building of houses according to the above mentioned recommendations has shown their normal function.

CONCLUSIONS

1. The main factor causing the damage of social-cultural objects in the village is the presence of expansion and destination of the argillaceous soils.

2. The presence of this phenomenon is due to variation of the humidity level in soils during various seasons and the high content of the argillaceous minerals, which have capability to be expanded such as montmorillonite and illyte.

3. The steps to avoid this phenomenon are to be taken before the building of the objects selecting the foundation type, its depth and the constructions.

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