

Quarterly report - covers the period from 01/04/2020 to 30/06/2020.

I. Task 1. Organisation of scientific visits for UTP employees and students and Partner representatives

In connection to SARS-CoV-2 pandemic, UTP University of Science and Technology has introduced the Regulation of UTP Rector (No. Z.110.2019.2020 from 11/03/2020) regarding: *preventing the spread of SARS-CoV-2 virus among the academic community of UTP University of Science and Technology*. The Regulation suspended all international mobilities. Also, Partner Universities in Italy, USA, Portugal, Turkey and Germany either closed or started working remotely, and now trying to gradually switch to normal mode of operation. The only University that operates normally is Aarhus University.

Due to the inability to carry out foreign mobilities, the meetings of Recruitment Team for Mobilities are suspended until the Regulation of UTP Rector is cancelled.

At present, due to the epidemiological situation, contact with Partners is carried out only remotely.

II. Task 2. Subsidising common scientific publications.

In the second quarter of 2020, no meetings of Publications Assessment Team occurred due to the lack of applications made via the project website.

Publishing activities of individual Departments are as follows:

Faculty of Civil and Environmental Engineering and Architecture:

- PhD Eng. Magdalena Dobiszewska, prof. UTP, has sent the article to the scientific Journal. Article is prepared with the cooperation with prof. Ahmet Beycioğlu from Adana Alparslan Türkeş Science and Technology University, Adana, Turkey. Article is under review and paper once accepted will be most likely financed from other university sources.



- Between 2 and 10 June 2020 the 28th Conference SCEgeo „Surveying, Civil Engineering, Geoinformation in Sustainable Development” took place. UTP University of Science and Technology, the Faculty of Civil and Environmental Engineering and Architecture, Section of Engineering Geodesy of the Association of Polish Surveyors and the Association of Polish Surveyors, Branch in Bydgoszcz organized the conference. The conference was held in the form of a continuous poster session combined with the discussion that was held in comments sections of each poster. A total of 74 posters were presented (out of which 29 were from the field of geodesy, 12 geoinformation and 33 from construction and environmental engineering. Participants from WBAiIŚ presented 2 posters, that were prepared in cooperation with prof. Ahmet Beycioğlu from Adana Alparslan Türkeş Science and Technology University, Adana, Turkey:
- PhD Eng. Jacek Sztubecki, PhD Eng. Szymon Topoliński: “Analysis of object cracks dilation caused by thermal changes”
 - PhD Eng. Szymon Topoliński: “Some Properties of Clayey Soils Improved with Drinking Water Treatment Sludge”

Analysis of object cracks dilation caused by thermal changes

Jacek Sztabecki¹, Szymon Topoliński¹, Maria Mrówczyńska², Baki Bağrıaçık³, Ahmet Beycioğlu⁴

¹UTP University of Science and Technology in Bydgoszcz, Poland, email: jaceks@utp.edu.pl; szymont@utp.edu.pl ²University of Zielona Góra, email: m.mrowczynska@ib.uz.zgora.pl ³Çukurova University, Adana, Turkey, email: bbagriacik@cu.edu.tr ⁴Adana Alparslan Türkeş Science and Technology University, Adana, Turkey, email: abeycioglu@atu.edu.tr

INTRODUCTION

Correctly performed measurements, together with the correct interpretation of results, allow us to obtain reliable information on building movements. Based on correctly selected methods, they allow us to determine the dynamics of object displacement and deformation. Current systems for monitoring and diagnosing the condition of buildings allow, depending on the size of the object, to determine the object's geometry in full (laser scanning) and examine the behavior of its structural elements. It is essential to choose research methods to define factors that affect the geometry of the object. Correct diagnostics of the technical condition of the building defining the factors causing negative changes of the object to allow to minimize them, determine how the building will behave in the future, estimate how much it will cost to modernize it, and plan its further safe use. The article shows the use of two separate measurement methods to identify factors affecting the deteriorating condition of the object. An analysis was made of the changes in crack widths created at the research facility (above-ground passage of the main buildings of the UTP in Bydgoszcz). The method used in the study is based on the SHM X crackmeter from SHM. Simultaneously, the geometry of the connector was observed using the geodetic method of determining displacements, establishing a measurement, and control network on the object. This method uses the Leica TDRA 6000 total station. The combination of these technologies has allowed the definition of the factors causing the formation of scratches. Such solutions can be successfully used in monitoring deformations and displacements of both small and larger objects.

RESEARCH METHOD

After eighteen years of use, scratches and cracks were noted on the walls and floor of this structure. They indicate the presence of deformation in its structure. The scratches were examined on an object located on the UTP campus in Bydgoszcz. It was built in 2001 and has since served as an above-ground passage connecting University buildings. The outside and shape of the structure are shown in Figure 1.



Fig. 1. The outside and shape of investigated object

Deformations that cause scratches may have been associated with the foundation of the object because it was found that there were expansive soils under the test object. The geotechnical cross-section showing the subsoil under the investigated object is shown in Figure 2.

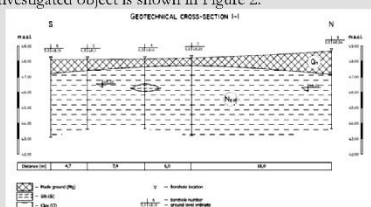


Fig. 2. Geotechnical cross-section under the investigated object

Expansive soil is especially susceptible to changes in humidity. This property should also be considered when determining displacements and deformations. During the comprehensive investigations of the object, this feature was eliminated as conditioning the occurrence of any changes in its geometry.

As part of the investigations in the places of structure cracks, the SHM X crackmeter was used to measure the crack width. At the same time, geodetic measurements of the displacement and control network were made. Measurements using the TDRA6000 laser station with instrumentation allowed us to obtain submillimeter accuracy of determining point displacements. The network-controlled points were also placed in places where the crack opening was directly observed. This gave the opportunity to observe the displacements of the scratches in a uniform spatial coordinate system. The results of opening the scratches obtained from both methods were also compared. Figure 3 shows the location of the measuring network of two methods (pins and washers) next to the resulting cracks.



Fig. 3. The location of the measuring network of two methods next to the resulting cracks

Construction monitoring covered three seasons. During this time, 35 series of measurements of crack openings were made in relation to pins and four series of geodetic measurements. Detailed analysis of the results will be presented in the article.

CONCLUSIONS

The research presented in the article is an extension of the existing ones, in which several factors that could have a destructive effect on the structure were excluded. The analysis of the test results compiled from both methods showed a significant impact of thermal changes on this type of structure. It also confirmed the thesis about the benefits of conducting research using several methods simultaneously. It is worth noting that regardless of the results and their interpretation, it should be remembered that in the case of continuous or periodic monitoring of displacements, the choice of measurement method and data processing methods depends on the nature of the object and specific environmental conditions. Qualitative and quantitative analyses of displacement measurement data presented in this study confirm that the methods used to obtain information, and the calculation procedure used were adequate.

Summary: The article presents the synthesis of the results of structure tests carried out using two measurement methods: crackmeter SHM X and geodetic method for determining displacements. As part of the research, measurements of the measuring and control networks were carried out. The research used TDRA6000 laser station measurement technology, which together with the applied calculation scheme showed submillimeter accuracy of determining 3D displacements of controlled points. The control points were also placed in places where the gap opening was directly observed. This gave the opportunity to compare the obtuse results with those obtained from a crackmeter. The use of these methods in parallel gives a more complete picture of the changes taking place in the places of construction, where under the influence of stresses there are signs of destruction. The object adopted in the research connects the buildings of the UTP University of Science and Technology in Bydgoszcz. Due to its function it is a heavily exploited object. Objects of this type require the necessity to perform periodic tests of their stability. Interpretation of test results and identification of possible hazardous conditions that may indicate the danger of a construction accident is extremely important.

Keywords: a technical structure condition, geodetic displacement measurements, building structure failures, cracks

„This article/material has been supported by the Polish National Agency for Academic Exchange under Grant No. PPI/APM/2019/1/00003”

Some Properties of Clayey Soils Improved with Drinking Water Treatment Sludge

Baki Bagriacik¹⁾, Esra Deniz Güner²⁾, Ahmet Beycioğlu³⁾, Szymon Topolinski⁴⁾

¹⁾Cukurova University, email: bbagriacik@cu.edu.tr ²⁾Cukurova University, email: eguner@cu.edu.tr ³⁾A.A.T Science and Technology University, email: abeycioglu@atu.edu.tr ⁴⁾UTP University, email: szymon.topolinski@utp.edu.pl

INTRODUCTION

One of the main problems in civil engineering concerns the improvement of weak soils that do not meet the mechanical performance required to meet the demands of the construction sector. Generally, geotechnical engineers mix some additional materials into weak soils to give desired properties [1-3]. In some applications, these additional materials can be waste materials. Recently used waste materials in soil improvement are cement [4], lime [5], fly ash (FA) [6-7-8], ground granulated blast furnace slag (GGBS) [9], rice husk ash (RHA) [10-11], recycled concrete aggregates (RCA) [12-13], geopolymer based on recycled glass powder (RGP) [14-15], randomly distributed glass fibers (GRC) and recycled glass fibers (RGF) [16-17], kenaf fiber (KFRS) [18] have been used as additives or substituting materials. Drinking water treatment sludge (DWTS), a by-product of the drinking water treatment plant, has become an important issue worldwide within the scope of disposal management. Useful reuse of this waste as a potential alternative material in the construction industry can provide safe disposal [19, 20, 21]. DWTS is used extensively as filler components in construction-based industries. Rodríguez, Martínez-Ramírez, Blanco-Varela, Guillem, Puig, Larrocha and Flores [22] used in cement clinker production, Hu, Hu and Fu [23] studied on light aggregate production with DWTS, Frias, De La Villa, De Soto, García and Balao [24] studied on mortar containing DWTS, Tantawy [25] used DWTS in concrete, Benlalla, Elmoussaoui, Dahhou and Assafi [26] bricks with DWTS. However, due to their increasing amount, these applications are not sufficient to completely consume the produced DWTS. In this respect, this research focused on evaluating the DWTS for clayey soil improvement.

MATERIALS and METHODS

In the experiments, clayey soil passed from 0.074 mm sieve was used. The liquid and plastic limit values of the soil were obtained as 42% and 24%, respectively. Soil type was classified as clay with intermediate plasticity, according to ASTM D2487 [27]. The DWTS used in this research was taken from Drinking Water Treatment Plant located in Adana City. The water content of DWTS samples used in this study is 85.4 wt%. The amount of volatile matter in the DWTS was found to be low (3.01%). This low volatile matter content can be attributed to the inorganic in nature of DWTS. Also, loss on ignition and ash content were found as 8.78% and 88.79%, respectively. In the experimental process, a consolidation test was applied according to ASTM D2435/D2435M [28] and ASTM D4546 [29] in order to determine of swelling pressure and consolidation parameters.

The first loading for vertical pressure was applied as 0.25 kg/cm² and consolidation settlements of each sample in the time intervals 0.25, 0.5, 1, 2, 4, 8, 15, 30, 60, 120, 240, and 1440 minutes were recorded. After first loading, 50, 100, 200, 400, and 800 kPa loads were applied on the samples to observe the effect of each loading stage on the consolidations settlements of samples. Each loading level was used to samples for 24 hours. Then an unloading process was performed by decreasing the load to 200 kPa. After this unloading, a vertical pressure of 5 kPa was applied again to observe in increasing data to complete the testing process. Finally, the moisture of samples was measured after the oven-drying process. Swelling pressures, Consolidation coefficients (C_v) and coefficients of volume compressibility (m_v) have been determined.

RESULTS and DISCUSSION

The test apparatus and results of swelling pressure and consolidation parameters were given in Fig. 1. As seen in Fig.1, the swelling pressure was found as 31.3 kPa for 100% clayey soil. The swelling pressures of the clayey soil decreased from 31.3 kPa to 28 kPa by DWTS substitution in the ratios of 2%, 4%, 6%, 8%, 10%, 12%, 14%, 16%, 18%, 20% and 22%. According to these results, it was seen that an increase in the ratio of DWTS substitution caused 1.12 times to decrease in swelling pressures. Similar to the swelling pressure, coefficients of volume compressibility (m_v) decreased by DWTS substitution (1.59 times decrease). Also, DWTS substitution increased the consolidation coefficients as 1.6 times.

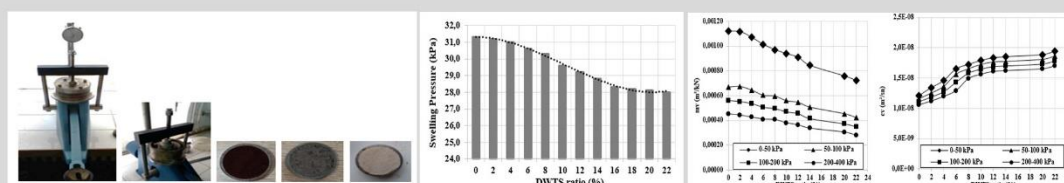


Figure 1. The Test Apparatus and the Graphs of Swelling Pressure and Consolidation parameters for different DWTS Ratio

CONCLUSIONS

- I. When DWTS was substituted in the ratio of 22 %, the value of swelling pressure and the coefficient of volume compressibility were decreased as 1.12 times 1.59, respectively. Moreover, the value of the consolidation coefficient increased 1.60 times in the same substitution ratio of DWTS.
- II. The increase in the consolidation coefficient indicates that the use of DWTS may be useful to decrease the total consolidation time of soil.
- III. The decrease in coefficients of volume compressibility indicates that a remarkable reduction in total consolidation can be achieved by using DWTS.
- IV. As a result, it can be interpreted from all findings of this experimental research that DWTS usage in clayey soil may be very useful to decrease deformations of any superstructure constructed on clayey soil.

This article/material has been supported by the Polish National Agency for Academic Exchange under Grant No. PPI/APM/2019/1/00003

Summary: This paper presents the results of an experimental investigation carried out to study the usability of drinking water treatment sludge (DWTS) for soil improvement. For this purpose, the DWTS was substituted to the mixtures as 2%, 4%, 6%, 8%, 10%, 12%, 14%, 20% and 22% by weight of clayey soil. Consolidation tests were performed on these samples in accordance with standards and swelling pressure, coefficients of consolidation, and coefficients of volume compressibility were determined. Results showed that the increase in the ratio of DWTS substitution caused 1.60 times increase in the coefficient of consolidation and 1.59 times a decrease in the coefficient of volume compressibility. Swelling pressures decreased by 1.12 times with DWTS substitution.

Keywords: Soil improvement, Drinking water treatment sludge, Swelling pressure, Consolidation parameters.



Faculty of Animal Breeding and Biology:

- PhD Eng. Magdalena Kolenda has sent the article to the scientific Journal. Article is prepared with the cooperation with prof. Barry D. Lambert, Tarleton State University, Stephenville. Article is under review.
- PhD Eng. Szymon Różański, prof. UTP, has sent the article to the scientific Journal. Article is prepared with the cooperation with Donald McGahan, PhD, Tarleton State University, Stephenville. Article is under review.

Partners of the project continue to contact remotely and more articles are being prepared in cooperation with Partners.

III. Task 3. Subsidising UTP employees' participation in international conferences combined with presentation of achievements in form of a lecture or a poster.

Faculty of Civil and Environmental Engineering and Architecture:

International conference **WMCAUS 2020 5th World Multidisciplinary Civil Engineering – Architecture – Urban Planning Symposium** that was originally planned on June 2020 has been postponed till September 2020.

The organizers, due to the epidemic situation and numerous requests from participants, offer the possibility of remote participation. WBAiŚ employees intend to take advantage of this opportunity. Moreover, the flights to Prague in the original dates were cancelled by the carrier (PLL LOT), therefore, two corrective invoices were obtained (K/006/06/2020 and K/007/06/2020). The invoices refund the cost of airline tickets, however, WBAiŚ will cover the transaction fee (PLN 0.02 in total).

In addition, Project Management Team decided to finance an additional article by Iga Grześkow PhD entitled „The role of green public spaces of the Old Canal in downtown Bydgoszcz and its impact on the city's cultural landscape in 1773-1971”.

Faculty of Animal Breeding and Biology:

International conference **70th Annual Meeting of the European Federation of Animal Science** that was originally planned on August 2020 has been postponed till December 2020. The organizers, due to the epidemic situation decided to hold the conference remotely,

therefore, the Project Beneficiary will not bear the costs of flights and accommodation. A total of 4 abstracts were submitted to the conference, and they will be presented in the form of posters.

International conference **16th World's Poultry Congress 2020** that was originally planned on August 2020 has been postponed till August 2021, therefore, the costs of flights and accommodation will be incurred in the following calendar year. A total of 2 abstracts were submitted.

IV. Task 4. Organisation of a closing conference to sum up the Project.

No action was taken in the second quarter of 2020.

- **Other activities:**

- ✓ 27/04/2020 – a Change Card no. 1 was sent to the Project Supervisor Ms. Anna Długołęcka. The Card was accepted on 29/04/2020.

The Card included the change in the number of mobilities (change from 92 to 75). The funds saved by the change were transferred to the following tasks:

- The costs of publishing articles in high-ranking international journals
 - The costs of remuneration of members of the Publications Assessment Team
 - The costs of remuneration of members of the Recruitment Team for Mobilities
 - The costs of remuneration for graphic designer responsible for preparing the project's visual identification system as well as for the author and moderator of the project website
 - The costs of materials needed to organize an exhibition of works during the closing conference (materials needed to organize an exhibition of works of students and/or employees of WBAiŚ Architecture and Interior Design)
- ✓ 14/05/2020 – a partial report was submitted to National Agency for Academic Exchange via means of an IT system (submission deadline: 10 working days from the end of the reporting period i.e. 15/05/2020). The report awaits approval.



- ✓ 20/05/2020 – new Project Supervisor Mr. Radosław Podgrudny sent survey that aimed at determining whether the implementation dates of projects should get extended beyond 30/09/2021. Answers were sent back to NAWA on 22/05/2020, asking for the permission to extend the project by 12 months till 30/09/2022. On 4/06/2020 NAWA sent information that it was agreed that the period of implementation of the International Academic Partnerships projects has been extended to 30/09/2022. The Change Card that changes the dates of project implementation will be prepared in September 2020.
- ✓ The summary of costs broken down by Faculties and tasks are prepared.