10.2478/v10160-012-0014-6

Transactions of the VŠB – Technical University of Ostrava

No. 2, 2012, Vol. XII, Civil Engineering Series

paper #10

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EXPERIMENTAL MEASUREMENT OF GROUND BASE PLATE

EXPERIMENTÁLNÍ MĚŘENÍ ZÁKLADOVÉ DESKY NA PODLOŽÍ

Abstract

Analyses of interaction between the foundation slab and the subsoil has been developed for many years. For the determination of stress in foundation structure is needed to determine the influence of the stiffness respectively pliability of subsoil to structural internal forces, and vice versa, how the stiffness of the foundation structure affects the resulting subsidence. At the Faculty of Civil Engineering testing device was constructed so that the phenomena could be examined and then compared with numerical models.

Keywords

Test Equipment, Subsoil, Foundation, Static Load Test, Numerical Model.

Abstrakt

Řešení úloh interakce mezi základovou deskou a podložím se rozvíjí již řadu let. Pro výstižnější stanovení napjatosti základových konstrukcí je zapotřebí stanovit, jaký vliv má tuhost resp. poddajnost podloží na vnitřní síly konstrukce a naopak, jak ovlivňuje tuhost základové konstrukce výsledné sedání. Na stavební fakultě bylo vyrobeno zkušební zařízení, na kterém je možné měřit a zkoumat tyto zákonitosti a následně provádět porovnání s numerickými modely.

Klíčová slova

Zkušební zařízení, podloží, základ, statická zatěžovací zkouška, numerický model.

1 INTRODUCTION

In 2010 testing equipment was built in the campus of Faculty of Civil Engineering, VSB –TU Ostrava. This equipment has been designed for static load test according to CSN 736190 and other experiments for investigation into the stress/strain relations for soil/structure interaction.

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Fig. 1: Testing equipment over view

In June 2012 pilot testing was realised. The aim of this experiment was primarily functionality of measuring devices check and detection of possible defects. As a specimen precast concrete tile was used with dimensions 500 x 500 x 48 mm. During exposure to vertical load vertical subsidence and tile deformations were measured together with stress variation on the tile surface and value of vertical force.

2 MEASURMENT DESCRIPTION

2.1 Description of the testing equipment structure

Load Bering structure of testing equipment consist of two frames, Fig. 1. Crossbeams enable variability of press machine location. The frames are anchored with screws into steel grate based in reinforced concrete strip foundations. The structure is anchored with system of micro piles with the length 4 m. The highest possible vertical load is 1 MN. More details about the testing equipment is in [1].

2.2 Description of the measurement

As the specimen precast concrete tile was used with dimensions 500 x 500 x 48 mm. According to ES certificate of conformity (number 05 A/12) concrete pavement tile for exterior use has following parameters according to EN 1339:

Flexural strength > 4,0 MPa (grade 2, designation T),

Fracture load > 3,0 kN (grade 30, designation 3).

It is supposed that flexural strength according to EN 1339 respond approximately to 1/10 of concrete cylindrical compressive strength according to EN 206-1, presumed concrete grade is C45/55. However, this value is tentative, as the tile is made of two layers with different concrete quality (tile core and surface layer).

Fig. 2: Measuring of subsidence and concrete tile deformations

The slab was laid on original subsoil without greensward and was under laid with geotextile and asphalt belt to protect the strain gauge sensors. The load area of vertical force was 100/100 mm. The subsoil characteristics were tested in cooperation with geotechnics specialists. Original subsoil was evaluated as clay F2-F4 with deformation modulus E_{DEF} = 2.65 MPa, E_{OED} = 4.27 MPa and poisons coefficient ν = 0.35 according to CSN 731001. Vertical force was induced by hydraulic device placed between concrete tile and steel extension hanged on crossbeam, (Fig. 1 and Fig. 2). The specimen was exposed to vertical load gradually and the load bearing capacity was reached with force 18.64 kN [2].

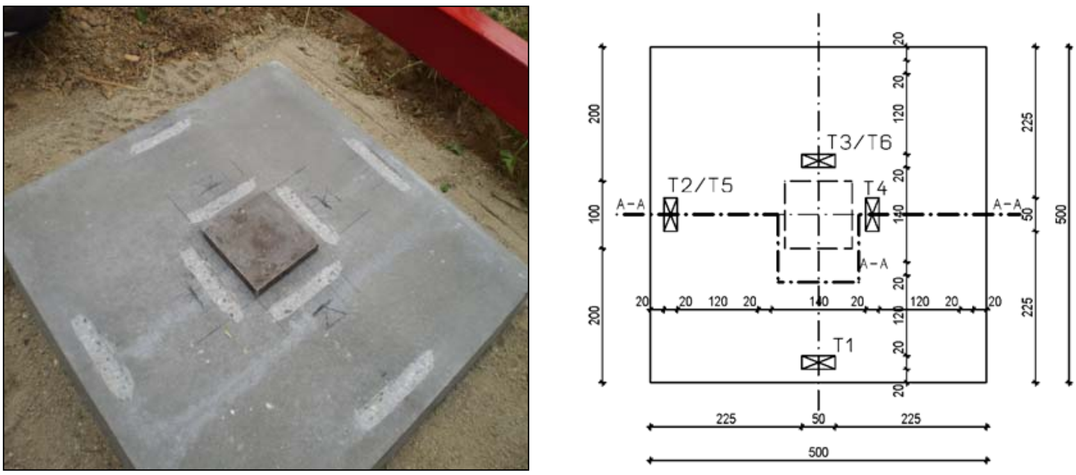

Fig. 3: Concrete tile prepared for tensionmetrical measurement, schema of tensionmeters location

During the loading the total deformations and vertical subsidence were measured with system of 10 potentiometric sensors (Fig. 2). The discreet values of total vertical deformation were approximated with bicubic spline area which represent the deformations continuously, (Fig. 4).

The stress variance was observed at selected points both at upper and bottom side of the pavement tile with 6 the strain gauge sensors (T1 – T6) 1-LY41-20/120 (Fig. 5). Gauge sensors T5 and T6 were placed on the upper side, T1 to T4 on the bottom side (Fig. 3).

The concrete tile was exposed to load gradually and the load rate was approximately constant according to the hydraulic equipment possibilities. The duration of the measurement was 85 s.

2.3 Test results

During the load exposure the pavement concrete segment was pressed into the subsoil as it was expected. As the specimen dimensions were small and the subsoil nonhomogeneous the pavement tile deformations are inclined. Deformations of the pavement tile itself are smaller but noticeable, (Fig.4).

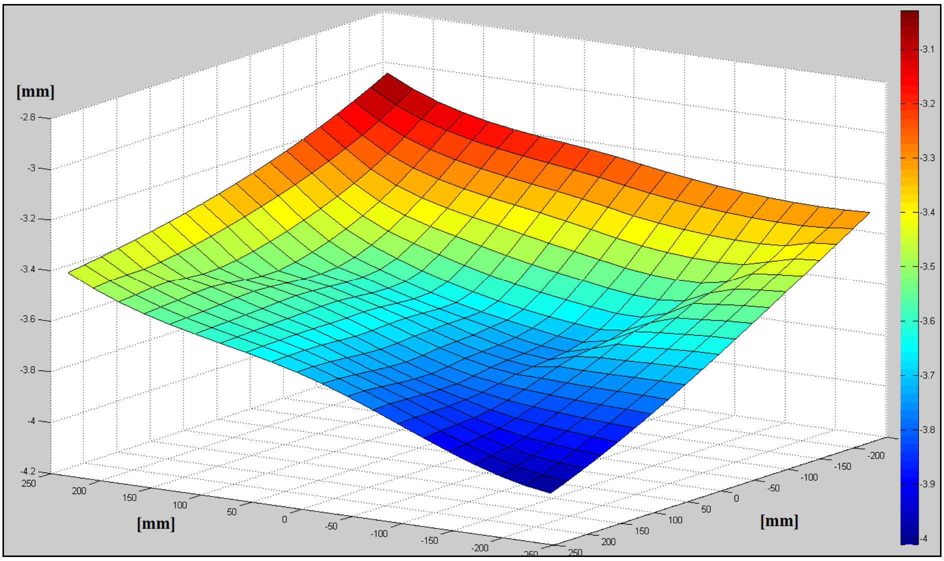

Fig. 4: Measured vertical deformations before tile break – approximation with bicubic spline area

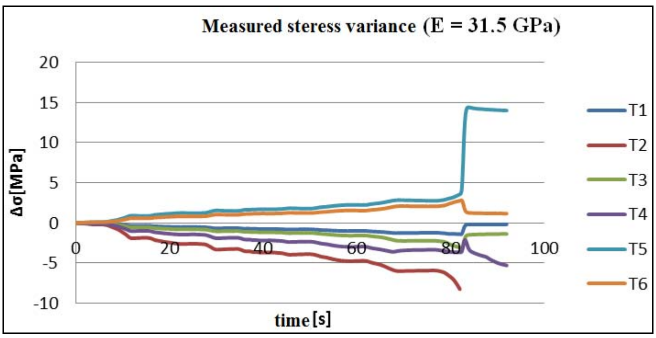

Fig. 5: Measured stress variance

3 NUMERICKÉ MODELOVÁNÍ

Numerical modelling of soil-structure interaction is performed as 2D using the Nexis32 software based on FEM with Soilin module. The subsoil is considered as elastic with deformation modulus obtained from geotechnics testing. Next input is the coefficient of soil matrix stiffness *m* according to Czech code and in the analysis is considered with values $m = 0.1$, $m = 0.2$ and $m = 0.3$, (Fig. 6, Fig. 7). Particular parameters were neglected, e.g. inhomogeneity of the tile, protecting layers of geotextile and asphalt belt [3, 5, 6, 7, 8].

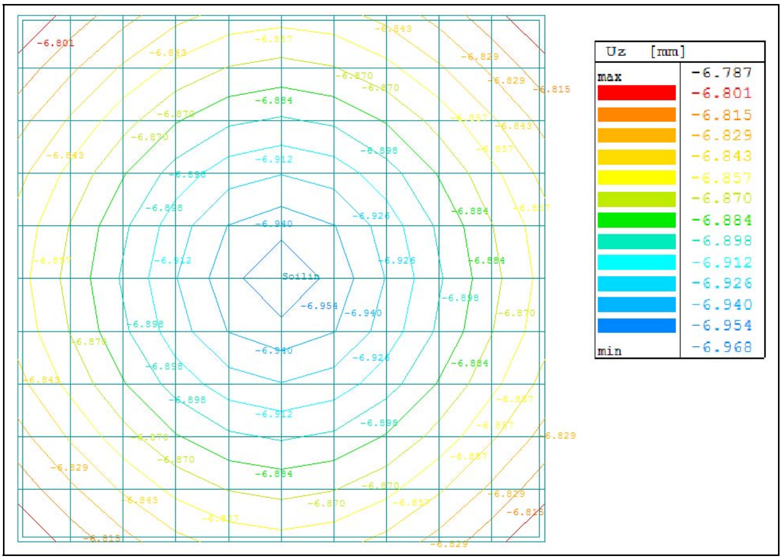

Fig. 6: Calculated deformations of concrete tile using NEXIS 32 FEM software

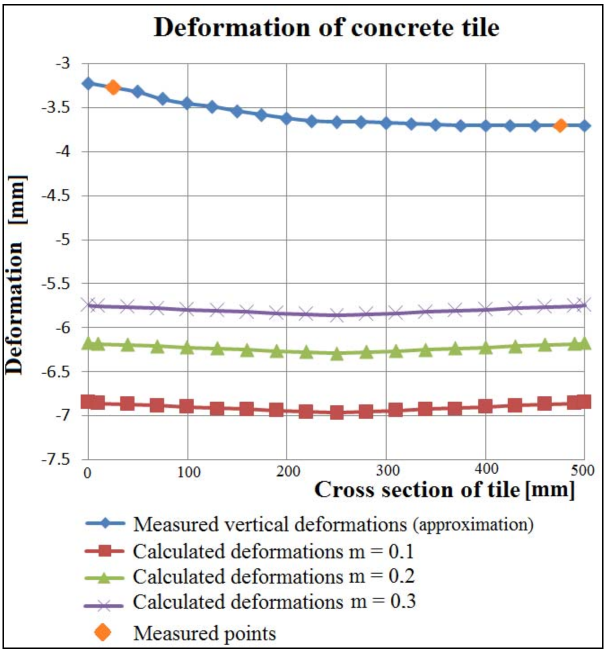

Fig. 7: Measured and calculated vertical deformations

4 CONCLUSION

The aim of this measurement was primarily functionality of measuring devices check and detection of possible defects. However the test result were analysed and were compared with values obtained from numerical modelling of the tile. Calculated deformations are significantly higher than measured deformations. The difference between values obtained from numerical modelling and measured values could be influenced with simplification of the numerical analysis (the concrete tile is made of two layers of concrete with different quality, neglect of protective layers). One of the significant factors is also climatic changeability. Testing equipment is not protected against climatic influence effect and the measured values could vary depending on the weather, (e,g. after the rain the soil is more plastic and the subsidence is higher). Weather parameter is not included in this numerical model. The other factor is that there was only one tile tested and it is necessary to test more specimens for getting the needy statistical data.

Next tile testing is being prepared as the loading equipment was not able to provide the load growth continuously and record the values. Improvement of the hydraulic equipment has been planed so that the data could be at disposal. In the future the reinforced concrete slab with significantly higher dimensions will be tested so that the dimensions approximate the dimensions of real foundation structures used in engineering practise.

ACKNOWLEDGEMENT

This paper has been created with financial support of SGS grant number SP2012/92.

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