Experimental Static Load Test of Concrete Industrial Floor Model

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Abstract—**This article is focused on problematic of interaction between foundation structure and subsoil. This phenomenon is observed through the experimental measurements on the large scale models and these experiments are realized on testing device located at the Faculty of Civil Engineering, VSB-Technical University of Ostrava. In this contribution are presented experimental results of static load test implemented on the concrete industrial floor model.**

Keywords-subsidence of foundation slabs; concrete foundation structures;soil-structure interaction; contact stress

I. INTRODUCTION

Interaction between concrete structure and subsoil is one of the main research direction at the Faculty of Civil Engineering, VŠB – Technical university of Ostrava [1]-[3]. Actually, research is focused on experimental testing of different types of industrial floors. For experimental static load test was concreted model of plain concrete industrial floor. The experimental model was designed as a part of plain concrete industrial floor without reinforcement and static load test was conceived as a simulation of loading by base plate of heavy rack. The experiment served to a better understanding and possible improvement of these technologies from the perspective of interaction with the subsoil.

II. CONCRETE FLOOR MODEL DESCRIPTION

The experimental model simulated a part of plain concrete industrial floor. The elementary dimensions of the experimental model were 2000 x 2000 x 200 mm. The concrete type C35/45 XF1 was used for concreting to the steel formwork.

III. SUBSOIL CHARACTERISTICS DESCRIPTION

The experimental model was settled on homogenized clay layer. Clay layer thickness was 1000 mm and was compacted on prime clay subsoil without greensward [4]. The subsoil characteristics were determined by standard geotechnical measurements. The sliding joint was made from combination of PVC foil and geotextile [5], [7], [9]. The experimental model was situated in outdoor testing device STAND [6].

Subsoil characteristics:

- Subsoil consists of loess loam with F4 consistency.
- Thickness of subsoil layer is about 5 meters.
- Volumetric weight of soil $\gamma = 18{,}5\ \mathrm{kN.m^{-3}}$.
- Poisson coefficient $\nu = 0{,}35$.
- Static Young's modulus $E_{DEF} = 10$ MPa.

IV. TESTING DEVICES AND MEASUREMENTS DESCRIPTION

Experiment was realized on the outdoor testing device "STAND". This device is consists of two frames and crossbeams. Crossbeams enable variability of the press machine location. The frames are anchored with screws into the steel grate based in the reinforced concrete strip foundations. The construction is anchored with 4 m long micropiles. The maximal possible vertical load is 1000 kN [6]. The experimental static loading test on a plain concrete industrial floor model was the assembly of a set of measurements. Measurement gauges completed the experimental measurement line [1], [3].

The experimental measurement line:

- 14 potentiometric position sensors for measurement of vertical deformations (subsidence).
- Built-in pressure sensor for measurement of the vertical load
- 4 strain gauges for measurement on the surface of the slab – tension of concrete.
- 4 strain gauges for measurement inside the experimental slab – tension of concrete.
- 9 geotechnical pressure cells in different height horizons for measurement of the stress on the interface of the slab and subsoil.
- 8 temperature sensors for measurement of temperature inside and on the surface.

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FIGURE I. THE EXPERIMENTAL MEASUREMNT LINE AT WORK.

V. MEASUREMENT PROCESS OF EXPERIMENTAL MODEL SUBSIDENCE

The vertical load was caused by the high tonnage hydraulic cylinder ENERPAC CLRG. The loaded equipment was placed between the experimental model and the steel extension fixed on STAND. The hydraulic system was equipped with the pressure sensor. Potentiometric position sensors were installed on the surface of concrete floor model. These gauges were connected to the same sensor station with automatic scanning and recording. Shape and size of load area simulated base plate of heavy loaded rack. Dimensions of load area were 400 x 400 mm. Fixed interval of loading - 80kN / 30 min was chosen for this experimental testing. Vertical deformations were measured and recorded by the set of 16 potentiometers AHLBORN. FWA100T. Potentiometers were connected with the sensor station ALMEMO 5590. The station was programmed to automatic scanning and recording measured values. Schematic plan of sensors are displayed on Figure 2.

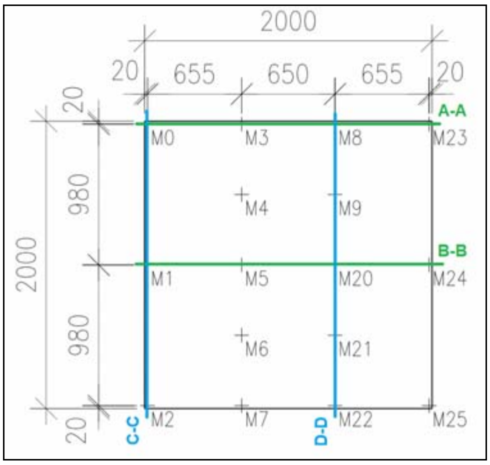

FIGURE II. SCHEMATIC PLAN OF POTENTIOMETRIC SENSORS POSIITION.

VI. MEASUREMENT RESULTS

Potentiometric sensors situated on non-contact surface recorded vertical deformations in particular positions. Graphical results of vertical deformations – subsidence, are visualized on Figures 3-4. The development of vertical deformation in the edge area of experimental model is represented by cross-section A-A and C-C. From the graphs of edge area the lifting in corners of the experimental model is noticeable. The development of subsidence in the central area of experimental model is represented by cross-section B-B and D-D. These graphs showed centralized subsidence in the central part of experimental model. The creation and progression of punching shear is also noticeable from graphs of cross-sections B-B and D-D.

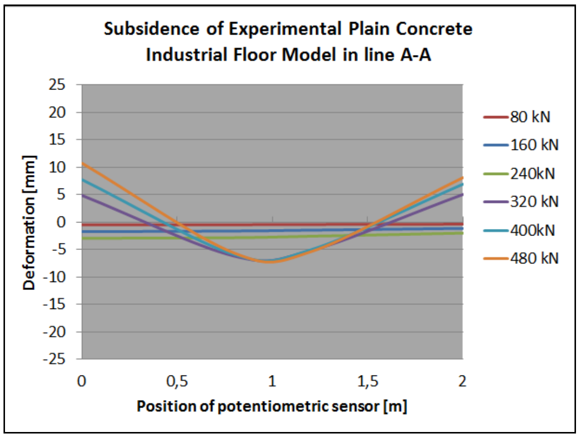

FIGURE III. THE VERTICALA DEFORMATIONS IN CROSS-SECTION A-A (POTENTIOMETRIC SENSORS M0, M3, M8, M23).

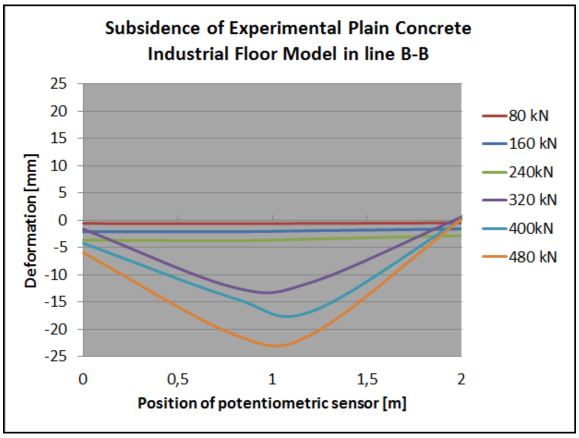

FIGURE IV. THE VERTICALA DEFORMATIONS IN CROSS-SECTION B-B (POTENTIOMETRIC SENSORS M1, M5, M20, M24).

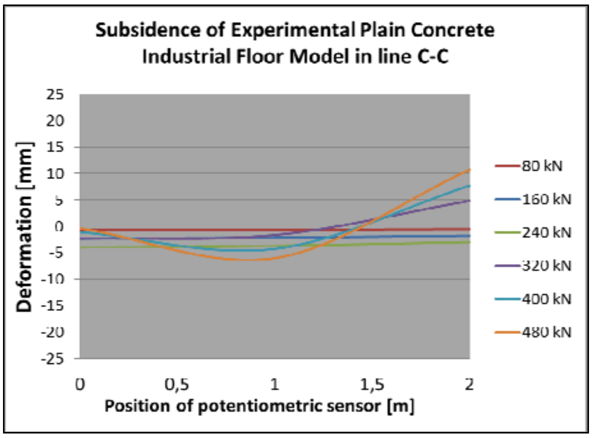

FIGURE V. THE VERTICALA DEFORMATIONS IN CROSS-SECTION C-C (POTENTIOMETRIC SENSORS M0, M1, M2).

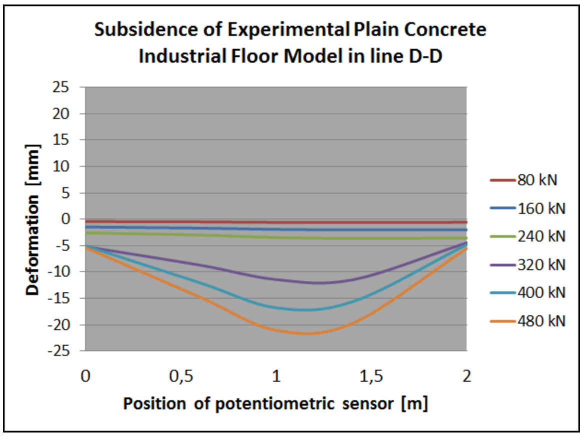

FIGURE VI. THE VERTICALA DEFORMATIONS IN CROSS-SECTION D-D (POTENTIOMETRIC SENSORS M8, M9, M20, M22).

VII. MEASUREMENT RESULTS – MAJOR CRACK DISTRIBUTION

First significant cracks were detected after fourth loading step. Major seven cracks were observed on the lateral side of the experimental model. After every loading step - thickness of cracks were increased. Maximal values of thickness of partial crack after last loading step are sorted in Table 1. Positions of crack are visualized on schematic plan Figure 7.

TABLE I. THE MAXIMAL CRACK THICKNESS.

	Maximal Crack thickness
Crack no. 1	4,50 mm
Crack no. 2	4,50 mm
Crack no. 3	3,50 mm
Crack no. 4	4,00 mm
Crack no. 5	10,00 mm
Crack no. 6	10,00 mm
Crack no. 7	4,00 mm

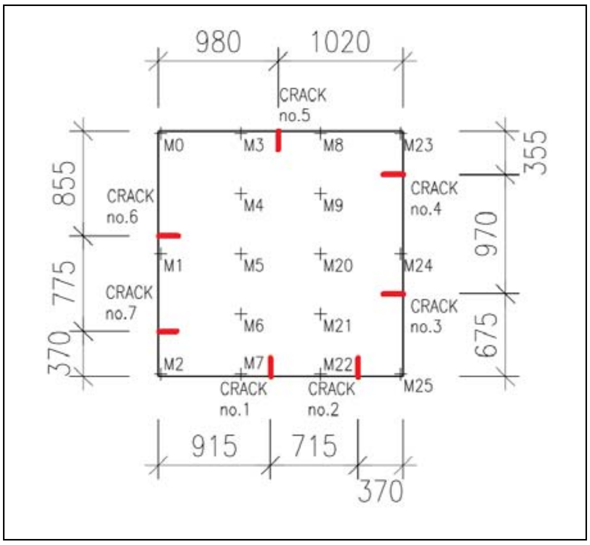

FIGURE VII. SCHEMATIC PLAN OF MAJOR CRACK DISTRIBUTION.

VIII. CONCLUSION

Experimental plain concrete industrial floor model resist the loads exerted after six load cycles and induced maximal load level 480 kN. First significant cracks were detected after fourth loading step. After sixth loading step were detected first signs of punching share. Experiment was ended in moment, when the model was strongly damaged by punching share. This experiment bring many information about influence of punching share phenomenon on slab-on-ground. Measured data will serve for creating of numerical model by FEM (finite element method) [10]-[12].

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