The First Knowledge of Electronic Heating of Sliding Joint

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***Abstract*—Sliding joints are very often used to reduce shear stress in foundations if this shear stress arises. This paper explains and demonstrates reasons for application of sliding joint in to foundation structures and its basic function. The laboratory tests of modern sliding joint are introduced too. At the long term experiments it was verified that the ambient temperature has a heavy effect of sliding joint behavior. For this reason the new experiments will be deal with electronic temperature control direct in the sliding joint.**

Keywords-sliding joint; undermining; asphalt belt; shear stress

I INTRODUCTION

Sliding joint into foundation structure helps to solve problems associated with horizontal deformation of subsoil or into foundation. Problems with effect of undermined areas and need to know behavior of used materials are main reason to testing sliding joint in our region. The most used material to create sliding joint is an asphalt belt. It is known that the temperature influences properties of asphalt product and due to this fact the laboratory test were performed. At first modern asphalt belt was tested at the common laboratory temperature [1]. In the second step modern materials at the controlled ambient temperature were tested [2, 3, 4, 5, 6, 7, 8]. In the third step are conducted experimental tests with sliding joint which is directly heated using electronic heating.

II THE BASIC PRINCIPLE OF THE SLIDING JOINT

Shear stress on the surface between foundation and soil can be very danger for the foundation structure because it can create great tensile forces in foundation structure. These forces can be reduced using sliding joint. Sliding joint is usually applied as layer of suitable material between foundation structure and concrete base layer. The basic principle of sliding joint function is explained on the course of shear stress along the foundation on the Figure 1.

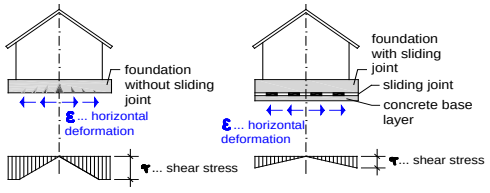

FIGURE I. THE COURSE OF SHEAR STRESS ALONG FOUNDATION WITHOUT AND WITH SLIDING JOINT.

III THE BASIC PRINCIPLE OF THE TESTS

The aim of all test sets is to simulate behavior of concrete structure with sliding joint which is loaded with shear stress. The test sample which consists from three concrete blocks 300x300x100mm with two sliding joints is shown on the Figure 2. Both sliding joints are filled with test material. A steel structure is used for introducing vertical and horizontal load which is also shown in Figure 2.

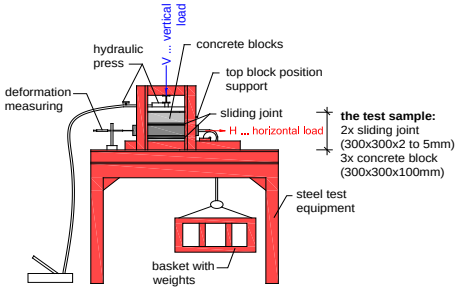

FIGURE II. THE TEST SAMPLE AND THE STEEL TEST EQUIPMENT.

The test has two parts. In the first part the test sample is loaded with vertical load (V) and after one day it is introduced horizontal load (H) on the middle concrete block. The entire test takes one week. During whole test it is monitored horizontal deformation of the middle block. The vertical load is introduced using a hydraulic press and the horizontal load is carried out using a basket with weights, which is attached to the middle concrete block. The top and lower blocks are fixed.

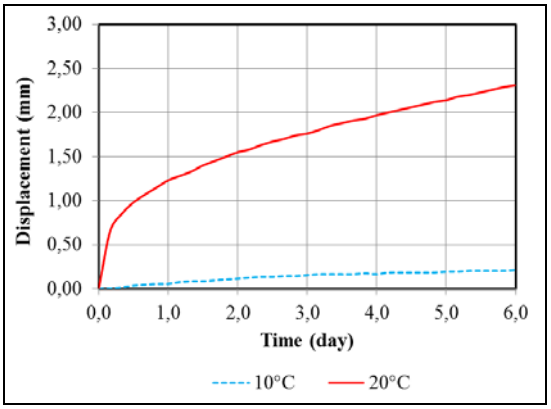

FIGURE III. RESULT DEFORMATION FOR SHEAR STRESS 5,28KPA, VERTICAL STRESS 500KPA AND DIFFERENT TEMPERATURES.

A great attention is also focused on thermal sensitivity of majority of used materials. An air conditioned room was constructed due to the impact of the influence of ambient temperature and tests were carried out in this room. More information on these tests can be found in [2, 3, 4, 5, 6, 7, 8].

This research relates to interaction between foundation and subsoil. Because of strong influence of contact stress, contact stress in the foundation bottom with or without sliding joint is measured at VŠB Technical University of Ostrava too [9,10,11]. More information about other solutions of problems with horizontal deformation can be found in [12, 13]. Results from tests are used to determine friction parameters for stress calculating of foundation structures [14, 15, 16].

Partial result from the test show graphs on the Figure 3. Modified asphalt belt (thickness 4,2mm, weight 4,93kg/m2) was chosen to comparison with new test. Curves in this graph represent total horizontal deformation on the middle concrete block during the test for different load combination - at the contact stress 500kPa, shear stress 5,28kPa and different temperatures. It is necessary to remark that higher deformation means that the material is more pliant and a smaller shear resistance arises in the sliding joint. Then smaller deformation means higher shear resistance. It was also confirmed that a temperature plays a significant role and at the higher temperatures arise higher deformation and that means also smaller shear resistance.

IV FIRST RESULTS FROM NEW TESTS

Because of confirmation positive effect of higher temperature the heating grid was constructed to regulate temperature directly into sliding joint. Newly it is sliding joint heated using electronic heating system to the desired temperature. On the Figure 4 it is shown heating grid into sliding joint. Heat of hydration can be used to heating of sliding joint too [17].

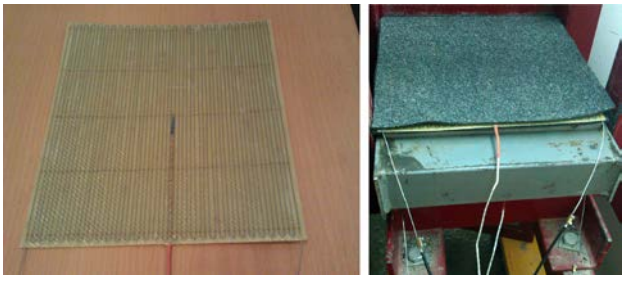

FIGURE IV. HEATING GRID (LEFT) AND HEATING GRID INTO SLIDING JOINT (RIGHT).

The modified asphalt belt with thickness 4,2mm and weight 4,93kg/m2 was chosen for the first experimental test with heating grid. Every sliding joint was consisting of two these belts and one heating grid between belts. The original results for this belt without heating into sliding joint and for one asphalt belt in sliding joint are presented above. The test equipment with tested sample was placed into air conditioned room where were maintained the temperature 4°C. It is average temperature in the foundation bottom during whole year. Graph on the Figure 5 shows first result from the sliding joint heating.

It is clear from the graph that the asphalt belt reacts to temperature change according to assumptions which were achieved in the test into air conditioned room. At the higher temperature (25°C) higher velocity of deformation was reached and vice versa. It is also clear from the graph that the velocity of deformation returns to original velocity at the temperature 4°C after cooling to original temperature.

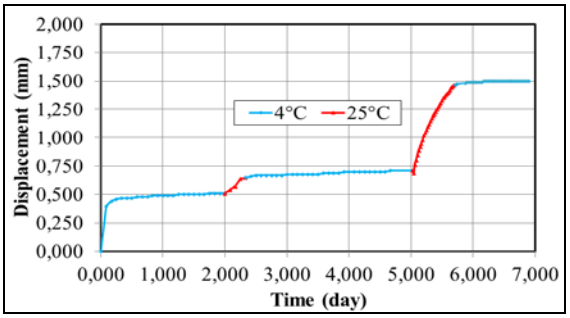

FIGURE V. RESULT DEFORMATION FOR MODIFIED ASPHALT BELT WITH VARIABLE TEMPERATURE DURING TEST.

V CONCLUSION

It was described the basic function of sliding joint and the advantages of its using. There was introduced behavior of asphalt belt at the different temperature. Tests also show that the total deformations and also analogical shear response are dependent on temperature. These findings are very important for masonry or concrete structures because sliding joint can be used to reduce shear stress under masonry or concrete structure by its pre-stressing if they need it to increase their service life. The first results from new tests with electronic heating show that heating of sliding joint can be very positive effect of sliding joint function. In this field will be carried out sets of measurement and evaluation off economic aspects of heating will carried out based on results of new tests.

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