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NEW SOIL PRESSURE SENSOR APPLIED IN GEOMECHANICS

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Paper describes new pressure sensor based on conductive rubber for using in geomechanics by measurement in physical rock models. This sensor has miniature dimension and big sensitivity.

Knowledge of strain distribution in structures is basic requirement by adjudicate their reliability and safety [3]. Strain and stress distribution in neighbourhood of underground structures and their change monitoring in time is very important in geomechanics. Physical models are often used to this purpose beside of numerical methods. Large territories are modelling by means of these models, which makes for high reduction of the model dimensions in comparison with reality [7]. This poses high requirements on experimental methods and measuring devices [1]. Dimensions of sensors represent non-homogeneity in model, which can negative impress results of model experiments. Sensors have to be small as to their thickness and area. Technical and economic arguments and availability of conductive rubber used to tactile sensors make us to using one in geomechanics.

Tendency to the most miniature sensor makes us to production of plane sensor with dimensions 4x4 mm and the thickness under 1 mm. This sensor was very difficult to place by sufficient accuracy to choose position (horizontal or vertical) in model. Therefore sensors of the same thickness with dimensions 8x8mm and 10x10mm were produced as optimal. These ones were tested again. Construction of this sensor PTS 1.4 shows Fig. 1. The conductive elastic material 6 lies between couple of the electrodes 4 and 5. Both electrodes are covered by metal layers 1 and 3. The layer 1 transfers axial pressure force to the conductive material 6. The distance insert 2 serves for an adjustable working range of the sensor and for the protection of the conductive material against overloading, too. As converter pressure - electric signal is used conductive material Yokohama Rubber (Japan) [2], [4], [5].

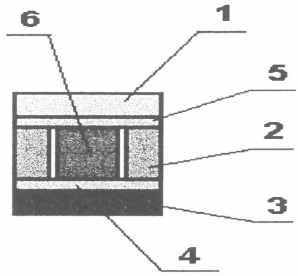

Fig. 1 The construction of PTS 1.4

All tests were made with sensors inserted to accidentally select model material (mixture sand + bentonit + fat A00). Three sensors PTS 1.4 of dimensions 8x8mm were tested together with three semiconductive sensors types TM 440 F (producer TESLA Ltd. Valašské Meziříčí-Czech Republic) as normal to compares with new sensors PTS 1.4 in testing models. Till now sensors TM 440 F are effectually used with good results to strain measuring in models, but they have big dimensions for models.

More characteristics were tested. Signal value time and temperature stability and sensitivity of sensor were tested in first step. Data were registered every 5 min during 6 days from all six sensors by changes of loading conditions. Tested sensors PTS 1.4 embody little decrease electric output signal compared with sensors TM 440 F. This decrease is not important considering dynamics of loading. The dynamics of conductive rubber sensor is ten times higher than of semiconductive ones. Response of sensor to loading change were observed, too. The reaction rate is comparable for both types of sensors.

The testing sensor PTS 1.4 based on conductive Yokohama rubber are full applicable for measurement of strain changes in physical models in geomechanics [6], if we summary qualitative and quantitative value of results, technology and also economy aspects (price of sensor PTS 1.4 is 35 times lower as price in this time used semiconductive sensors). Great spectrum of geometric, technologic and operating properties of pressure sensors based on conductive rubber Yokohama Rubber gives definite positive answer to using of this sensor for model experiments in geotechnics.

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