On the non-stationary reaction of a granular medium to periodic shear deformations

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The experiments were carried out on a simple shear device [1] with a chamber size of 90x90x130 mm. Dry quartz sand with an average particle size of 0.8 mm was used as the test material. The height of the sample was 120 mm. The loading program included cyclic shears of the chamber relative to the central position by an angle of plus-minus 2.5 deg. at the angular velocity 0.5 deg./s. The forces of the loading plate, normal stresses inside the sample and its height were measured.

It is usually believed that after 30–50 cycles of shear deformations the bulk material passes into a stationary state and the stress and dilatancy diagrams become periodic. However, the previously obtained results on long-term weak dynamic effects on the geomaterial allow to assume the existence of deviations in the process stationarity. In the presented work, experiments were carried out with 20 thousands loading cycles after reaching the "stationary state". Experiments have shown that the diagrams are indeed non-stationary - an increase of number of cycles leads to fluctuations in the maximum stresses relative to the average value. The amplitude of these fluctuations reached plus or minus 15%.

The result obtained allows to believe that long-term weak periodic effects in other situations, as in the experiments described above, also give non-periodic reactions. So, in experiments on dynamic weak impact, stress fluctuations were recorded, reaching 50% of the rock weight [2]. When evaluating limit states such effects must be taken into account.

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