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Investigating the influence of changes in the vibration parameters of precise levellers on the accuracy of vertical displacements measurements for construction objects

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ABSTRACT

The main objective of the doctoral dissertation was to investigate the influence of ambient vibrations on the accuracy and precision obtained when measuring vertical displacements using the precise levelling method. The thesis assumes that not all vibration parameters make such measurements impossible, and that the sensitivity of levellers to vibration is variable depending on the type of leveller and the vibration parameters affecting the measurement. Furthermore, formulating a functional relationship between the vibration parameters and the accuracy of the determined displacements is impossible. A network of controlled benchmarks was established and stabilised by bench marks with an ability to set simulated displacements, which were taken as the true values of the measured displacements. The network was repeatedly measured with three leveller models under variable vibration conditions in the frequency range 0 - 44 Hz and variable amplitude. The vibrations were imposed directly on the tripod with a vibration generator. The observations were adjusted using a rigorous method based on a preidentified reference base. The values of the mean errors of the estimated displacements, the standard errors of a single observation and the correspondence of the obtained displacement values with the simulated values were evaluated. Based on the conclusions of the study, proposed guidelines for surveys under vibration were developed. The examined levellers showed a variable susceptibility to vibrations, which in most of the examined parameter ranges do not reduce the accuracy of the measurements below the standards of precise levelling. In the tested ranges, however, there are conditions that do not allow precise levelling. The estimated values of displacements measured under such conditions are neither precise nor accurate due to high values of the mean errors of these displacements and the significant deviations in relation to simulated displacements. This situation concerns particularly the digital leveller, which is nevertheless the most favourable choice for most vibration parameters.

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