

Relative Study of the Accuracy of Spirit Levelling and GNSS Levelling

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Key words: Engineering survey; GNSS/GPS; Positioning

SUMMARY

ABSTRACT

Spirit levelling is the traditional and more reliable practice in geometric geoid determination. In recent times, wider range national and regional geoid determinations are carried out with more rapid survey techniques. The rigors and time consumption of spirit levelling make it very expensive, particularly when dealing with a larger area with more number of points. On the other hand, GNSS techniques are faster and easier to operate, but are affected by such factors as signal attenuation, multipath, geometry of satellites, etc. which reduces the accuracy achievable in GNSS levelling operation irrespective of the observational method used. In this study, the least squares method was applied in calculating the error range in both observational methods as well as their accuracy level. After propagation of errors within the adjusted observations from both techniques, the spirit levelling was found to have better observational accuracy with standard deviation ranging from $\pm 0.0001\text{m}$ – $\pm 0.0075\text{m}$ and propagated error ranging between 0.0001m – 0.0004m within the study area. The GNSS/Leveling is also able to produce observed height to about $\pm 0.4\text{m}$ residual from the spirit leveled heights with standard deviation ranging from $\pm 0.003\text{m}$ – $\pm 0.382\text{m}$ and propagated error ranging between 0.00065m – 0.03027m . The inference of this study however indicate that though greater accuracy is obtainable from spirit levelling operation, the GNSS levelling technique also provides reliable range of accuracies for height determination of non-geodetic ramifications.

Keywords: error propagation, precision, accuracy, spirit levelling, GNSS.