Guideline for establishing 3D control network at project site

A. Ties to national geodetic network

Horizontal: at least 2 control points, higher the order, the better, even cadastral control points are acceptable. However, these points should be validated for any movement before being adopted.

Vertical: at least 2 benchmarks with MSL heights. The benchmarks also need to be validated before being adopted.

B. Instruments

Only dual frequency receivers are to be used.

C. Observation Technique

Horizontal Coordination

If the project site is beyond the reach of RTK signals, static observations should be used. The duration of observation should depend upon the baseline length. Even for short baselines, a minimum of 30 minutes observation is essential.

If the project site is within the range of RTK signals, it can be used for coordinating control at the project site. However, only fixed solutions are acceptable. Besides, every point must be observed at least twice, with the observation epochs separated by at least few hours to incorporate redundancy resulting from change in satellite configuration.

Vertical Coordination

MSL height from an existing BM should be transferred to the project site using static observations. A minimum of 3 hours of observation is essential for accurate height transfer. Using this technique, MSL height may be transferred to one or two stations in the project site. For other control points in the project site, reciprocal leveling using total station or digital leveling is recommended for vertical coordination.

D. Data Processing & Adjustment

Any proven software (TTC, TBC, etc) may be used for data processing and adjustment.

Only fixed solutions are acceptable

Only independent baselines are to be used

Check for consistency between known points to ascertain if minimally or fully constrained adjustment should be adopted.

Horizontal and vertical adjustment including reciprocal leveling and digital leveling data can be done together in a combined network adjustment by holding the correct values fixed in a horizontal and vertical sense. However, if this approach becomes sophisticated, a separate and phase-wise approach can be adopted to adjust the horizontal and vertical components separately.

E. Geoid Model

Only DRUKGEOID20 should be used

F. Validation of control network at project site

Validate the newly established points in both horizontal & vertical sense

Use RTK, Total Stations, Digital leveling, etc to validate the network

G. Documentation

Include:

Network diagram

post-processing results

adjustment results

coordinates of known and new stations

accuracy/precision description (error ellipses)

log book

computation book

validation report