

Project Control by RTK-GPS

Project control using RTK follows a general pattern of a primary network for RTK base stations from which a secondary network of working control is coordinated within the survey limits. Tertiary, or temporary control may be set from the secondary as needed.

Primary (Base Station) Network

1. Select RTK Base Station positions in areas that are:
 - well outside of the proposed construction limits but within a mile of the proposed secondary monumentation,
 - in areas of good sky with no obstructions higher than 15° above the horizon,
 - at least 100 feet from any source of multipath which is higher than the GPS receiver,
 - amenable to installation of permanent and stable monumentation,
 - readily accessible by motor vehicle, but
 - not so accessible as to be vulnerable to theft.
2. Monument the base station positions with a permanent monument no less substantial than an 18" long no. 4 rebar with plastic cap. Longer, heavier rebar much preferred, augmentation with concrete advisable.
3. Determine coordinates for the primary (base station) control using redundant OPUS observations of no less than 2 hours. 4 hour sessions highly preferred. Redundant sessions should be time offset and the receiver must be tripod mounted for the recording session.
4. Where the project requires more than one base station collect redundant RTK vectors (time offset by 4 hours) between base adjacent base stations. These vectors are to be collected :
 - at 1 second intervals for
 - 3 minutes per mile of vector length
 - with GDOP > 3
 - between tripod mounted receivers

Anything that reflects light will also reflect GPS signals. So if you can see it, it is a multipath source. The ground is a major multipath source so GPS receivers are shielded from signals coming from below.

Note that OPUS data may be collected concurrently with the collection of RTK vectors. By this means redundant OPUS data may be collected every day of the GPS data collection program.

"Time offset" means data collected at a different time of day so that a different collection of satellites is observed. Data collected at the same time of day on successive days is not time offset.

Once EST possesses static vector resolution capability this process will be replaced with a program of static vector collection, resolution, and least squares adjustment.

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5. If elevations are critical it is highly desirable that base stations be linked by differential levelling and that such levelling include, at a minimum, one elevation benchmark known to be reliable.
6. The collected vectors between base station and OPUS positions are to be least squares adjusted, with the OPUS positions given an error value commensurate with that shown in the OPUS data sheet.

Secondary (Mapping) Control

1. Select station positions in areas as required for topographic and boundary data collection using the total station. Install sufficient monuments such that at least 2 other such stations can be “seen” from each instrument setup (backsight plus third point check). Such stations need have “good sky” and minimal multipath.
2. Monument the mapping station with a No. 4 rebar and plastic cap, or similar.
3. Observe redundant RTK vectors from the base under the following conditions:
 - rod mounted receiver stabilized by a bipod,
 - GDOP > 3
 - 1 second epochs,
 - 3 minutes observation, paired with a second 3 minute observation after rotating the rod 180 degrees and re-plumbing,
 - Redundant, time offset re-observation,
 - perform the re-observation from an alternate base station.
4. RTK observations should be amalgamated in LGO such that covariance vector quality data is used to weight the various observations.
5. Differential levelling between mapping stations is highly desirable.

Tertiary (Temporary) Control

4. Temporary stations are to be set using the total

OPUS positions aren't perfect. The OPUS data sheet includes an accuracy estimate for the data.

Positions with questionable sky and multipath conditions may be improved by levelling from adjacent stations with better sky conditions.

Alternatively the vectors may be LS adjusted. Such adjustment incorporates the covariance matrix data.

If the needs of the project demand vertical accuracy better than $\pm 0.05'$ it is imperative that differential levelling be included. Any elevation derived from RTK with a relative accuracy that exceeds this limit is purely coincidental.

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station in areas where RTK observation is not practical due to occluded sky, extreme multipath. Such control may be monumented with a wood hub, 60d nail, mag nail, or similar. At least one set (F/R) of angles and distances should be collected.

