

1 Terms of Reference for Topographical Survey

1.1 Scope of Work

To carry out the topographical (topo) survey using latest topographic survey equipment (Total Station, Auto Level, Digital level, differential GPS (DGPS), and Global Navigation Satellite System (GNSS)), preparation of layout map and digital terrain model for rehabilitation of the last stretch of Salang Corridor Road Project from Jabal-e-Seraj in the south to Khinjan in the north, a distance of about 90km (the project road). The terrain between these locations is mountainous with limited access along the existing route. The proposed highway alignment will follow, or be in close proximity, to the existing highway along the majority of the alignment. The survey will be carried out in stages, with the lower level alignment carried out initially and higher elevations carried out at a later stage. The subsequent stage of topographic survey will be completed within a month after commencement to allow time for completion of the site works.

Topo mapping shall be carried out for a minimum width of 60m from centerline on each side of the road (total width 120m) along 87 Km road, approximately area (200m x 200m) for each tunnel portal and the survey shall cover river section adjacent/ parallel to the road.

Also, the survey extent shall be increased based on consultant requirement.

If additional survey will require during the detailed design stage due to changes in alignment or any other purpose, the contractor shall perform the survey based on consultant requirement.

Coordinates of proposed alignment shall be provided to the survey team for all required areas.

The contractor shall fulfil any changes required in Topo Survey during the design stage.

The sections shall be taken every 10m spacing along the proposed alignment. The UTM coordinates system shall be followed for the survey work.

Due to the nature of the terrain and climatic conditions along the proposed alignment the site works will be carried out within the accessible summer season, with site works to be completed within two months.

1.2 Technical Specifications

Topographic survey is to be carried out using latest topographic survey equipment (Total Station, Auto Level, Digital level, differential GPS (DGPS) and GNSS), the horizontal and vertical accuracy shall be $\pm 5\text{mm}$. The equipment shall be checked periodically for horizontal and vertical collimation. Vertical control must be done by Auto/ Digital level machine.

1.3 Primary survey control point

Dual reference pillars shall be established once in every 1 km using GNSS Static method having valid calibration certificate. Reference pillars shall be in the form of concrete blocks of size 40 X 40 X 120cm with proper foundation as per the instructions of the Engineer in charge of the site and shall be embedded to a depth of minimum 40cm in to the ground. The transfer time shall be such that the accuracy achieved shall be better than 1 in 20000.

1.4 Benchmark Pillars Specifications

Benchmark (BM) pillars shall be established at 250m intervals in the form of precast concrete blocks of size 30 X 30 X 60cm and shall be embedded to a depth of 30cm in to the ground. The BM pillars shall be painted in yellow and details such as BM number and reduced level shall be clearly marked on it with red paint. All BM pillars shall be numbered sequentially as per the instruction of the Engineer in charge of the site. Wherever the new benchmark pillars are laid, the level traverse shall be closed and the closing errors shall be in accordance with Section 4 of this ToR.

1.5 Methodology

The Contractor shall provide details of resource (professional surveyors and labour), specialist survey sub-contractors (if required) and plant (calibrated and sufficient to provide the specified accuracy along with the bid.

The Contractor will submit a program of the site survey teams, which are anticipated to be a minimum of 4No, such that the works can be completed within the limited time period available for site access. The program, including plant and survey teams will be submitted with the bid to provide assurance that the contractor is capable of completing these works within the limited access period.

The topographical survey shall consist of the following:

- Fixing of Primary survey control with static method use GNSS adjustment and GNSS salutation software;
- Fixing of Secondary survey control with RTK fixed and AutoCAD Civil 3D 2018 & related Software;
- Vertical Controls by Auto level/ Digital level machine;
- Details topographic survey, and
- Data analyse and preliminary survey drawing provide A3 Size (including plan, profile and cross sections).

Level Traversing shall be conducted using Auto level/ Digital level and having accuracy of +/- 5mm in 1 km double run. Benchmark pillars shall be connected to nearest bench mark. Benchmark level also to be transferred on major permanent structures at least once in every 250m with sequential numbering and as per the instructions of the Engineer in charge of the site.

The Total station traverse shall be closed with the nearest pillar. Traversing shall be carried out using (having an accuracy of two sec.) to fix the co-ordinates on the benchmark pillars. Two rounds of angle measurements to be taken on both left and right face in both clockwise and anticlockwise direction. The angle spread between observed round shall not be more than 5 sec. Traverse shall be closed within an accuracy of 1 in 20000.

Feature survey is detailed in section 5.

1.6 Detail Survey of Topographical Features

Based on the requirement of the consultants, the existing features shall be mapped for a minimum width of 60m from centerline on each side of the road along 87 Km road, approximately area (200m x 200m) for each tunnel portal and the river section adjacent/ parallel to the road.

Survey shall be carried out as per the code list provided by the consultant

- Electrical Poles, Telephone Poles, Lamp Poles and any other Private/Unauthorized utility Poles with their routing network.
- Water / Sewerage / Oil / Gas Pipe Lines with diameter and material of the pipe.
- All Utility lines, both overhead and underground.
- Manholes – with their actual size and shape (ex. rectangular or square or circular)
- Trees with girth more than or equal to 0.3m - while surveying the trees, care has to be taken to exactly classify the trees according to its girth.
- Building lines indicating the type of buildings (shops or houses), Right of Way boundary if available at site by presence of boundary stones.
- Sufficient road center points, edge points and shoulder points shall be taken to define the existing layout of the roadway. The cross section points shall be taken as detailed in sub-section “cross sections”.
- Approach road details of 60m width to be recorded on either side of the road. But on important junctions, length of road to be surveyed shall be as per the instruction of the Engineer in charge of the survey subjected to a minimum length of 300m.
- Location of traffic islands, median, channelizing islands, rotaries, police chowkis, (top and bottom levels are must for all these) with its locations, and dimensions.
- Location of bus bays / bus stops, lorry - parking areas: taper length, roadway width.
- Special emphasis shall be laid in identifying all religious places - its locations, boundary lines and clear dimensions of compound walls and entrances.
- Locations of roadside drain clearly identifying the type (Built-up / Earthen, Rectangular / Trapezoidal etc., and whether Open / Closed), width of drain (waterway width and wall width in case of built-up drain) including the beginning and end of drain. While surveying the existing drains, care has to be taken to take the top and bottom points of the drain to get the true contour and shape of the drain. All water features such as ponds, tanks, lakes, streams, canals and wells etc. shall be mapped.
- Roadside cultivation viz., agricultural, residential, commercial, shops and business established areas etc.
- Identification of all bridges and culverts along the project road - shall include location (chainage) and reference number, width of bridge / culvert (width of slab or diameter of pipe, no of pipes/spans), course of water path, skew of bridge / culvert, span arrangement.
- Any other Structure/Utility, (i.e., anything else which is not available in the code list) if found at site should also be recorded as per the instructions of the Engineer in site.

1.7 Cross - Sections

Based on the requirement of the consultants the cross-section shall be taken at every 10m in each directions for the full survey along 87 Km road and approximately area (200m x 200m) for each tunnel portal and the river section adjacent/ parallel to the road.

The cross-section shall be taken based on the requirement of the consultants as follows:

- For Existing carriageway at 10m interval:
Top edge and bottom edges of central median.
Center of pavement and edges of pavement (Paved Shoulder/ Earthen shoulder/
Footpath edges Side ditches/ other longitudinal structures).
- For the full 60m from the centerline to each side of the road at 10m interval, in addition to carriageway points:
Intersection of embankment / cut with natural ground;
Hill top / valley edge;
Spot Levels beyond embankment / cut bottom at maximum 5m interval or as required to depict the ground variation up to the survey corridor.

1.7.1 Cross Sections at Horizontal Curves

At curves, the pavement cross-sections should be taken at closer intervals to get the arc to chord tolerance within an acceptable limit (say 0.1 m). In any case, it shall not be more than 5m.

1.7.2 Cross Drains at culverts/bridges & Rivers

The cross sections shall be taken as detailed below.

For small drains across CD works, at least three cross sections shall be taken, namely one at the selected site, one upstream and one downstream. For major bridge, drains and streams cross sections shall be taken as follows:

- The survey shall be carried out for bridges along 250m upstream and 200m downstream, at 25m interval on upstream and downstream sides, and the river bed level, river bank level, HFL (high flood level) and existing bridge elevations shall be taken. In case of bend in the river alignment additional cross section shall be taken to represent the bend.
- The survey shall be carried out for the culvert and causeway which have furnace run off and the bed and bank elevations of stream along 50m upstream and 50m downstream shall be taken.
- The survey shall be carried out for irrigation culverts and the bed, the bank elevation of channel, inlet and outlet elevations along 30m upstream and 30m downstream shall be taken.

For major drains/streams (catchment up to 3.0 sq.km), cross sections shall be taken for a distance of 100m on both upstream and downstream side. Survey work of the river / stream shall be fully complied with the abovementioned detail and data requirement for hydraulic analysis.

1.8 Survey record and report

The contractor shall submit the following

- Work program for the investigations duly approved by engineer in-charge at site.
- The report shall consist of topo survey soft copy of drawings including plan, profile and cross sections, field book / level book, and all relevant details of the survey. Report shall be handed over to the Engineer in-charge at site, approved and certified for work or to send the same to the Consultants office as advised by Engineer in-charge at site.
- Method used for survey and brief note on procedure followed.
- Input parameters, if any.
- Comments / discussion on results, including a note on accuracy achieved, standard deviation.
- Survey network diagram inclusive of control points (traverse points) and BM positions with their number and abbreviations.
- Final coordinate and elevation list
- Field observation if any

Report shall include the following:

- A coma separated ASCII file contains Easting, Northing, Level and Code.
- Three-dimension Auto Cad Civil 3D drawings of the survey including plan, profile and cross sections. Scale of the drawing should be 1 in 1000. These drawings shall also contain additional details like names of villages, names of approach roads, road destinations & directions, names of junctions & interchanges, names of major buildings, structures, river, stream, water-bodies and other landmark points, in separate AutoCAD Layer.
- Details of reference pillars, benchmark pillars, and control points are to be submitted as a separate Excel file with their location landmarks and also as a 3d drawing file.

1.9 Safety Precautions

Contractor is responsible for the safety of his / her staffs and equipment's deployed at site during survey work. Adequate safety precautions shall be taken for working during night viz., providing lamps with red light reflectors, safety reflectors with red band / strips, torches and red jacket for crew.

1.10 Accuracy of the Survey

The contractor is fully responsible for the accuracy of the survey. The maximum permissible error in co-ordinate measurement shall be 1 in 20000 and error in levelling survey should not be more than 12 (k) 0.5.