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4.0 SURVEYING AND SETTING-OUT WORK

4.1 EXISTING SURVEY CONTROL POINTS


- i) A basic survey map of project area in digitised form consisting of contours in 2 m interval shall be provided by the OWNER to the Contractor. This map will serve as a base for the setting-out and checking work for the Contractor's Package.
- ii) Prior to commencing any construction work, a Contractor shall undertake a survey for the purpose of checking these reference data and in order to satisfy himself as to their accuracy. Should he have any objections to these data and the relevant drawings, he shall inform the Project Manager in writing within two (2) weeks of receiving them from the Project Manager.

4.2 OBLIGATIONS OF THE CONTRACTOR

4.2.1 GENERAL

- i) Contractor shall perform all calculations, surveys and setting-out necessary to establish the accurate location of the structures as shown on the Construction Drawings and shall carry out all necessary surveys to verify the topographical data used by the Project Manager for the project design and measuring purposes of his Package.
- ii) Within 28 days after the day of receipt of the Notice to Commence, a Contractor shall submit his proposed survey plan to the Project Manager. The proposed plan shall indicate the order of accuracy for the Contractor's surveys.
- iii) In advance of any setting-out work associated with all principal project features, Contractor shall submit to the Project Manager for approval a description of the method and procedures he intends to use in establishing additional benchmarks and base lines.

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- iv) If a Contractor chooses to use triangulation points or benchmarks other than those furnished by the Project Manager, he shall do so at his own expense and risk.
- v) A Contractor shall carry out topographical surveys of the original ground surface in each sector of his Works where surface excavation will be necessary, and produce sufficient and adequate cross-sections, which will permit later to evaluate the volume of excavation for measurement purposes and for payment of excavation.
- vi) A Contractor shall entrust surveying works only to persons who by their training and experience have sufficient qualifications and knowledge to ensure proper fulfilment of the survey tasks assigned to them. For the performance of the survey, a Contractor shall provide a sufficient number of reliable and accurate instruments.


4.2.2 BENCHMARKS AND TRIANGULATION STATIONS


- i) Existing survey control point benchmarks and base lines shall be verified and new benchmarks and base lines established as necessary to construct each portion of the Works.
- ii) Permanent survey control points shall be established prior to starting the work and such permanent points shall be preserved during construction.
- iii) If not already in existence, a minimum of 2 permanent benchmarks shall be established for each major structure, and referenced to data established by survey control points. The location of such points, with horizontal and vertical data, shall be recorded on the construction record drawings by the Contractor.
- iv) From the primary survey control points the construction surveys shall be performed as required to locate, layout and construct each portion of the Works.
- v) Complete and adequate logs of all control and survey work shall be maintained as it progresses. Such logs shall be available for the Project Manager's inspection at all times.

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<div> <div>vi)</div> <div>A Contractor shall protect, preserve and keep accessible the bench marks and triangulation stations of the basic survey and those provided by him. Any damage or removal of benchmarks and stations, including those of other parties shall be prevented. Any accidental damage shall immediately be brought to the attention of the Project Manager. It is expressly stated that the Contractor will be made responsible for the damages he causes and for their consequences.</div> </div> <div> <div>vii)</div> <div>Benchmarks shall be of stainless steel or cast iron. In softer soil, the steel bolt shall be embedded in a block of concrete of suitable size, and absolutely stable. Inscriptions shall be durable and clearly legible. Underground benchmarks shall be installed at suitable locations and adequately protected.</div> </div> <div> <div>viii)</div> <div>Subordinate points may be marked by steel pipes or pegs, subject to the approval of the Project Manager. Every newly fixed point shall be checked, as far as possible through other elements than those that served to establish the point.</div> </div> <div> <div>4.2.3</div> <div><u>ACCURACY OF SURVEYING</u></div> </div> <div> <div>i)</div> <div>Horizontal distances shall normally be measured with optic or electronic distance measuring instruments. Chaining with metallic tape shall be restricted to measuring of short distances and will be rejected for use in survey of traverse nets.</div> </div> <div> <div>ii)</div> <div>Elevations shall be determined by differential horizontal levelling.</div> </div> <div> <div>iii)</div> <div>Angles shall be measured by theodolite / total station.</div> </div> <div> <div>iv)</div> <div>Closing errors shall be maintained within the Parameters as under: -</div> <div> <div>Precise Control</div> <table> <tr> <td>Planimetric</td> <td>-</td> <td>+/-2.5 cm</td> </tr> <tr> <td>Height</td> <td>-</td> <td>12 mm per km</td> </tr> </table> <div>Secondary Control</div> <table> <tr> <td>Planimetric</td> <td>-</td> <td>+/-10 cm</td> </tr> </table> </div> </div>			Planimetric	-	+/-2.5 cm	Height	-	12 mm per km	Planimetric	-	+/-10 cm
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<div><div>Height</div><div>-</div><div>25 mm per km</div></div> <div>Total Station Details Survey</div> <div><div>Planimetric</div><div>-</div><div>+/-20 cm</div></div> <div><div>Height</div><div>-</div><div>50 mm per km</div></div> <div>DT Levelling</div> <div><div>24\overline{K}</div><div>i.e. 24mm in 1 km</div></div> <div>Fly Levelling</div> <div><div>24\overline{K}</div><div>i.e. 24mm in 1 km</div></div> <div>Here K is the distance between two neighbouring stations in km.</div> <div>Pari - Passu quality checks were done by field manager throughout the area.</div> <div>v) Levelling shall be checked by closing the loop to the initial benchmark.</div> <div>4.2.4 <u>AUXILIARY WORKS</u></div> <div>i) Contractor shall perform auxiliary works with regard to surveying which include, but not be limited to, the following:</div> <div><div>a) Perform all necessary calculations with clear presentation of calculations and results in order to facilitate verification,</div><div>b) Expose covered benchmarks,</div><div>c) Provide benchmarks in lieu of and/or in addition to those in existence,</div><div>d) Remove machinery and obstructions from the required sight-lines,</div><div>e) Provide adequate ventilation in tunnels to ensure the necessary clear view,</div><div>f) Provide adequate lighting or shut off sources of interfering light to ensure the necessary clear view,</div></div>		
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<div> <div> g) Provide adequate labour, and materials as deemed necessary and suitable by the Project Manager for the control and auxiliary surveys, h) Remove all obstructive accumulation of water, i) Carry out additional topographical surveys in cases where the existing topographical data is, in the opinion of the Project Manager, insufficient for accurate measurement of the Works, j) Carry out all necessary topographical surveys for the incorporation of measuring equipment and instrumentation located in the Permanent Works, k) Carry out all necessary topographical surveys for the observation of the behaviour of structures during construction. </div> <div> ii) Contractor Package shall not interfere with the surveying work of other Contractors if any; if two Contractors cannot agree to the scheduling of their Works in order as to not interfere with surveying work, precedence shall be given to the surveying work; unless the Project Manager decides otherwise. </div> <div> 4.2.5 <u>DAMAGE TO CROPS AND VEGETATION</u> </div> <div> i) No trees or crops of economic value existing at the Site shall be damaged or removed by a Contractor during survey and cross-sectioning works prior to their enumeration and evaluation. ii) Throughout the surveying and setting-out a Contractor shall work closely with the authorised local appraisers of crops and vegetation in question and shall provide them with facilities necessary for the expeditious performance of their duties. iii) As soon as a section of work has been defined and valued, the Contractor shall delineate the boundaries of the areas to be cleared by approved markings. </div> </div>		
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4.3 CHECKING OF CONTRACTOR'S WORK BY THE PROJECT MANAGER


4.3.1 REGULAR CHECKING

- i) All elements of a Contractor's survey work associated with the setting-out of principal project features will be regularly checked by the Project Manager during the course of the work, and the Contractor shall provide assistance at any time as required in the performance of such control work.
- ii) A Contractor shall provide the Project Manager with any information, readings or computations for checking that is requested.
- iii) The regular checks will usually be made during work breaks, but in case of urgency, a Contractor shall restrict or stop the affected work.
- iv) Any checks by the Project Manager shall not relieve a Contractor of his sole responsibility for the accuracy of structures and parts of them with regard to their position and dimensions for his Package.

4.3.2 CONFIRMATION SURVEY OF THE TUNNEL ALIGNMENT

- i) In addition to the regular check surveys described above, the Project Manager will perform confirmation survey of the alignment of the tunnels in the course of excavation progress. Starting from the duly surveyed fix points at the portals, a traverse net (combination of traverse and gyroscopic measurements) and a levelling will be carried out in each case.
- ii) The first confirmation survey is likely to be performed after the first 100 m of tunnel have been excavated. The following controls will be carried out after every subsequent 200 m of excavation. Each confirmation survey will require about 2 days.
- iii) Contractor will be notified in writing in advance about the date of such confirmation. Contractor shall cooperate and provide any assistance as required.
- iv) The Project Manager and the Contractor will mutually arrange to carry out such confirmation survey at a time and in such a manner, so as to limit as far as possible any delay or inconvenience to underground work. But

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notwithstanding the above, the Project Manager may arrange such superior control to be performed at any time and notify the Contractor accordingly.

- v) Such work will have to be temporarily halted which will, in the opinion of the Project Manager, cause excessive vibration or noise such as drilling, mucking, hauling persons, materials or rock spoil in or out of the tunnel, installing permanent or temporary support or any similar work. The contractor will not have any claim due to stoppage of work on this account.
- vi) The Project Manager will normally give the Contractor written notice of such stoppage at least 48 hours in advance and will state the approximate time at which work must cease and the approximate duration of such stoppage. The Contractor must promptly acknowledge receipt of any such written notice and confirm this acknowledgement in writing.
- vii) Irrespective of the times given, the Project Manager shall not be bound to adhere strictly to these times but will attempt to do so in so far as it is feasible. The Project Manager's decision in all cases will be final.

4.4 MEASUREMENT AND PAYMENT


4.4.1 SURVEY WORK PERFORMED BY THE CONTRACTOR

No extra measurement for payment or payment will be made for a Contractor's survey and setting-out work and the entire cost thereof shall deemed to be included in the Unit Prices for other items of the Works.

4.4.2 TEMPORARY SUSPENSION OF WORKS IN UNDERGROUND

No extension of time for the Completion of Works will be granted to a Contractor due to temporary suspension of work required for the performance of the confirmation surveys of the tunnel alignment by the Project Manager. The Contractor shall take into account the number and time of these surveys indicated above in his construction time schedules and include all expenses, delays, disruptions, loss of production and

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<div> <div>inconvenience resulting from such temporary stoppage in the Unit Prices for other items of the Works.</div> <div>End of Chapter</div> </div> <div data-bbox="1398 2033 1495 2125"> ISSUE P0 </div>		