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12 SURVEY AND SETTING OUT OF THE WORKS

12.1 GENERAL REQUIREMENTS

12.1.1 General

1 A method statement for the survey and the setting out of the Works shall be submitted to the Engineer for a SONO. This method statement shall include, but not be limited to:

(a) Surveying Equipment;

(b) Inspection and testing regime and acceptance criteria;

(c) Details of the pre start surveys, surveys during construction and the as built surveys for underground, elevated and at grade works;

(d) Specific strategy for Site conditions including but not limited to:

(i) Climatic conditions;

(ii) Dusty environment.

(e) Calibration of instruments and certification;

(f) Details of protection and security of all survey markers.

2 Records of all raw and processed survey data shall be kept for inspection by the Engineer.

3 All survey data shall be recorded and submitted in accordance with the Employer's Requirements.

12.2 SURVEY CONTROL

12.2.1 Survey Markers

1 Survey Markers shall be durable, appropriate to location and intended use and shall have an unambiguous centre point. For installation of a Survey Marker into reinforced concrete no clash with steel reinforcement is permitted.

2 Benchmarks shall have a domed surface.

12.2.2 Control Observation, Adjustment and Presentation.

1 The method statement shall contain proposals for conducting regular surveys of all existing survey control including the benchmarks.

12.2.3 General Setting Out

1 A comprehensive level survey of the Contract area shall be conducted before any work commences on the Site.

12.2.4 Pre-Start Survey

1 For tunnel alignment a list of coordinates (easting, northing & elevation) shall be generated at one-meter chainage intervals along the length of the design tunnel alignment.

12.2.5 Survey during Construction

1 Survey control (horizontal and vertical) shall be installed progressively along the alignment.

2 During tunnel construction the entire tunnel survey control scheme shall be re-observed from the shaft bottom at intervals to be proposed by the Contractor in his method statement.

12.3 FINAL AS-BUILT SURVEY

12.3.1 Underground Works

1 Upon completion of tunnelling, when the breakthrough has been made, the survey connection shall be made and the survey misclosure determined. A survey report shall be prepared detailing the final adjusted values for all the survey control to remain in the tunnel for the purpose of track laying.

2 A final as-built survey to determine the 3D coordinates of the tunnel lining at least 8 points, at even intervals around the circumference of the leading edge, of each alternate ring shall be carried out. The best-fit centre of the ring and its minimum radius shall be determined. The computed horizontal, vertical and radial offset of the centre of each surveyed ring relative to the design centre shall be plotted for the entire tunnel, giving an indication of potential out of tolerance zones.

3 A detailed report for each completed tunnel drive shall be submitted to the Engineer, for SONO. Each report shall be prepared and submitted within four (4) weeks of tunnel breakthrough.

12.3.2 Elevated and At Grade Works

1 A detailed report for each completed section of works shall be submitted to the Engineer, for SONO. Each report shall be prepared and submitted within four (4) weeks of completion of the section of works.

12.3.3 General

1 As-built surveys of all platform edges, columns and any other adjacent structures shall be conducted to ensure that there is no infringement of the structure gauge. All out of tolerance areas shall be highlighted.

12.4 MONITORING SURVEYS

12.4.1 General

1 As a minimum requirement, the design of a monitoring scheme shall take into consideration the likely range of movements to be incurred, accuracy required, accessibility to the area of interest, instrumentation to be used, the use of any special accessories, frequency of monitoring, particular Site conditions, safety, data collection/processing techniques, real time or post process, maintenance of the system, stability of the points of reference and the presentation format.

2 All 2D and 3D monitoring schemes shall be coordinated on the Project grid and datum. All elevation monitoring shall be conducted on the Project datum. All monitoring points shall be clearly identified.

END OF PART