

SECTION 22

LAND AND TRACKWORK SURVEYS

Survey control generally

- 1** Survey control shall be established by the Contractor at a density sufficient to achieve the specified accuracy.

All surveys shall be in SI metric units, and shall be co-ordinated by northings and eastings referenced to Ordnance Survey National Grid.

(22.001)

Permanent ground markers

- 2** Permanent ground markers (P.G.M.) intended for survey control shall be constructed at all control stations and primary and subsidiary traverse stations and shall be placed in stable and protected locations out of trafficked areas and suitable for frequent access and possible use for future setting out. Where practicable, P.G.M.s shall not be located within 3.0 metres of any rail. P.G.M.s may also be used as bench marks.

Where a preferred marker location is away from the main survey area, or outside the Railtrack boundary in private lands, the Contractor shall agree the marker location with the land owner before such markers are installed.

For string line survey pegs, the taping offset dimension shall not exceed 5.0 metres without triangulation to the pegs, and string line pegs shall be placed not more than 2.0 metres from the nearest rail. Unmarked pegs shall not be left so as to constitute a tripping hazard.

Where possible ground markers shall be positioned at a density of at least two stations per hectare in open ground, and at approximately 100 metres intervals for longitudinal trackwork surveys. The distance between permanent ground markers may be increased in open locations, but the interval used shall allow for survey closure to the specified accuracy utilising the survey equipment proposed by the Contractor.

New instrument stations shall be established either by conventional traversing or by GPS baselines between adjacent stations. Each instrument station shall be visible from and connected to at least two other survey stations.

New instrument stations shall be established to better than $\pm (3 \text{ mm} + \text{one part in } 30,000)$ horizontally and $\pm (3 \text{ mm} + 3 \text{ mm /km})$ vertically relative to the nearest P.G.M.

Domed brass rivets of suitable design shall be placed in permanent structures by drilling and fixing with an epoxy resin compound or internal clamping device. Earth anchors and ground markers shall be used in open ground. Other designs for survey stations may be used subject to prior agreement by the Employer's Representative.

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The grid to which the site survey shall be related shall be **(INSERT)**.

The accuracy to which the survey grid shall be fixed to the Ordnance Survey National Grid shall be ± 20 mm. ± 150 mm. /
(22.002)

Accuracy

- 3** A closed ground control network shall be established prior to linking individual survey detail elements.

The survey method shall be appropriate to the required accuracy. Adequate checks such as equipment calibration, survey closure methods and calculations shall be carried out for all survey techniques used to maintain the specified accuracy.

Unless specified otherwise in the relevant Clause, the maximum error between permanent survey control stations shall not exceed 1 in 20,000. For distances between adjacent survey control stations of less than 200 metres, the maximum error shall not be greater than ± 10 mm.

Unless specified otherwise in the relevant Clause, the height difference between any two points used as permanent bench marks shall not be in error by more than $\pm (12k^{1/2})$ mm, where k is the distance in kilometres between the two points being considered, or ± 5 mm, whichever is the greater, except for river to lake bed levels which shall be measured to ± 50 mm.

The accuracy achieved in longitudinal distance, and height shall be quoted on all survey plans.
(22.003)

Schedule of survey control stations

- 4** A series of individual indexed diagrams shall be prepared by the Contractor detailing for each permanent survey control station:

- (i) general location,
- (ii) description of marker type,
- (iii) control station designations,
- (iv) survey grid co-ordinates,
- (v) reduced level to scheme datum,
- (vi) tie dimensions to at least three easily recognisable and durable features located within, if possible, 50 metres of the control station.

A copy of the schedule of permanent ground markers shall be provided to the Employer's Representative.
(22.004)

Control diagrams for survey markers

- 5** A control network diagram defining the horizontal and vertical interrelationship between permanent survey control stations, including designation, distance, angles, reduced level, type etc shall be prepared by the Contractor.

(22.005)

Level datum

- 6** All levels shall be related to Ordnance Datum Newlyn height datum except for isolated surveys where a level datum proposed by the Contractor may be used with the agreement of the Employer's Representative.

The value of the datum bench mark to which the survey is related shall be confirmed by check levelling out and back to at least one other existing permanent bench mark.

The location, designation and value of the datum bench marks used shall be quoted on each survey plan.

(22.006)

Site bench marks

- 7** A minimum of three site bench marks shall be established on existing stable features at, where possible a minimum density of one per map sheet.

A diagram shall be prepared for each site bench mark showing its location dimensioned to at least three easily recognisable and durable points located, if possible within 5.0 metres of the site bench mark.

A simple plan shall be provided to the Employer's Representative showing the vertical control network and the inter-relationships between bench marks.

(22.007)

Site details to be surveyed generally

- 8** The planimetric features to be surveyed shall be:

- (i) control points,
- (ii) buildings and structures,
- (iii) boundary features,
- (iv) roads, tracks and footpaths,
- (v) street furniture and visible service features,
- (vi) water, drainage and coastal features,
- (vii) slopes and earthworks,
- (viii) woods, trees and recreational areas,
- (ix) industrial features,
- (x) trackwork, bridges, structures, train operating equipment.

The absolute plan position of any well defined point of detail shall be correct to within ± 0.3 mm root mean squared equivalent at the plan scale checked from the nearest survey control station.

Co-ordinates and levels shall be obtained by direct measurement of each point except as follows:

- (i) where the ground surface is obscured by thick vegetation,

- (ii) where there are expanses of water, the water level at the time of the survey shall be used, unless soundings have been specified,

When height points are to be interpolated from a surveyed framework of levels, details of the Contractor's proposed method shall be submitted with the Tender. The method used shall define the ground surface to the same accuracy as direct measurement.

Mature trees shall be identified by species and girths and spreads plotted. Overall extent of the canopy shall be shown where it is not possible to identify individual trees.

Features which cannot be surveyed to the specified accuracy without extensive site clearance shall either be surveyed approximately and annotated accordingly or where specified in the Contract, arrangements shall be made to clear the Site to enable the survey to the specified accuracy to be undertaken.

(22.008)

Height information

- 9 Sufficient spot levels shall be surveyed such that true ground configuration is accurately represented on the plans.

The maximum distance between adjacent spot levels shall be **(INSERT)**.

Ground survey spot levels on hard surfaces shall be correct to ± 10 mm r.m.s.e. except on ploughed or otherwise broken surfaces.

Where specified, contours shall be shown at vertical intervals of 1.0 metre.

At least 90% of all contours shall be correct to within one half of the specified contour interval. Any contour which can be brought within this vertical tolerance by moving its plotted position in any direction by an amount equal to 0.1 of the horizontal distance between contours, or 0.5 mm at plan scale, whichever is the greater, shall be considered as correct.

Contours which cannot be surveyed to the specified accuracy without extensive site clearance shall be surveyed approximately and annotated accordingly on the plan.

In flat areas where the horizontal distance between contours exceeds 50 mm at plan scale, supplementary spot levels shall be surveyed at intervals not exceeding 50 mm at plan scale, parallel to the contours.

(22.009)