CONCEPT

Land Surveying for Construction: Total Station, GNSS RTK and Setting Out

21 – 25 December 2026
London - Central London four-star



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Introduction:

Land surveying errors on construction sites rarely show at the instrument: a control point disturbed by plant, an RTK fix accepted without a check shot, or a level loop never closed ends up as a column off grid, a pipe laid against its fall or an earthwork claim nobody can verify. This Core Concept course gives site and survey staff a field method for land surveying on projects, from coordinate frames and control networks through total station traversing, levelling and GNSS RTK to setting out, as-built checks and volume computation. Participants compile a Site Survey Control and Setting-Out File.

Course Objectives:

- Establish and densify a site control network with monumented points, coordinate listings and a documented height reference
- Operate a total station for traverses, resection and free stationing, and adjust closing traverses by the Bowditch rule and least squares
- Run differential and trigonometric levelling to transfer heights, close level loops and apply curvature and refraction corrections
- Observe GNSS RTK and network RTK positions with initialisation, check shots and quality indicators that prove each fix
- Set out building grids, road alignments and utility lines from design coordinates and record tolerance checks
- Produce as-built and topographic surveys, compute cut and fill volumes and assemble a Site Survey Control and Setting-Out File

Target Audience:

- Site engineering staff who set out foundations, structures and services from design coordinates
- Survey engineering staff who design site control, check contractor survey work and sign off as-built records
- Survey technicians who operate total stations, levels and GNSS receivers in daily field work
- Infrastructure field staff who stake road, pipeline and drainage alignments and check levels and falls
- Quantity and earthworks staff who rely on survey data for cut, fill and stockpile measurement

Course Outline:

Day 1: Spatial Reference, Site Grids and Control Network Planning

- Geodetic Datum, Ellipsoid and Map Projection Concepts for Site Coordinates
- Grid Scale Factor, Ground-to-Grid Distance Reduction and Local Site Grids
- Ellipsoidal Height, Geoid Model and Orthometric Height Relationships
- Primary and Secondary Control Point Layout, Monumentation and Witness Diagrams
- Current-State Review of a Project Control Register and Benchmark Schedule

Day 2: Total Station Traversing and Levelling Methods

- Total Station Set-Up: Centring, Levelling, Face Left and Face Right Observations
- EDM Distance Measurement, Prism Constants, Reflectorless and Robotic Modes
- Closed and Link Traverse Field Procedure with Angular Misclosure Checks
- Differential Levelling: Backsight, Foresight, Rise and Fall and Loop Closure
- Trigonometric Height Transfer with Curvature and Refraction Correction

Day 3: GNSS RTK Observation and Construction Setting Out

- RTK Base and Rover Configuration, Radio and Correction Links
- Network RTK and Virtual Reference Station Corrections for Wide Sites
- Integer Ambiguity Fix, Satellite Geometry, Multipath and Check Shot Routines
- Building Setting Out: Grid Lines, Column Centres, Offset Pegs and Profile Boards
- Road and Utility Stakeout: Chainage, Offset, Invert Levels and Gradient Checks

Day 4: Survey Errors, Adjustment and Earthwork Quantities

- Gross, Systematic and Random Error Sources in Field Survey Data
- Bowditch Compass Rule Traverse Adjustment and Coordinate Misclosure Ratio
- Least Squares Network Adjustment, Residuals and Error Ellipses at Practitioner Level
- Surface Models for Cut and Fill: Grid, Cross-Section and TIN Volume Methods
- As-Built Tolerance Checks, Deviation Reports and Resurvey Triggers

Day 5: Field Data Processing, Emerging Capture Tools and the Setting-Out File Build

- Field Code Lists, Raw Data Download and Point Processing into CAD and GIS Layers
- Drone Photogrammetry and Terrestrial Laser Scanning for Site Surveys at Overview
- Case Build: Traverse and Level Network Adjustment from Real Site Observations
- Case Build: Stockpile and Bulk Excavation Volume Reconciliation Between Two Surveys
- Site Survey Control and Setting-Out File Assembly and Peer Review

Skills You Will Gain:

- Site Control Network Design
- Total Station Field Operation
- Level Loop Closure
- RTK Fix Quality Assessment
- Construction Stakeout
- Traverse Adjustment
- Earthwork Volume Computation
- Survey Data Processing

Why Attend This Course:

- Return with a Site Survey Control and Setting-Out File holding control listings, adjusted traverse and level results, stakeout records and a volume report
- Catch disturbed control, bad RTK fixes and unclosed level runs before they turn into rework on structures, roads and pipelines
- Defend earthwork quantities and as-built positions with adjusted, checked survey data rather than single unverified shots
- Compare field survey practice with engineers and technicians from building, road, utility and industrial projects

Conclusion:

Construction work lands in the right place only when survey control, measurement and checks hold together from the first benchmark to the final as-built. The week moves from coordinate frames, heights and control layout through total station traversing, levelling and GNSS RTK to building, road and utility stakeout, then error handling, traverse and network adjustment, and cut and fill volumes. The final day processes field data, reviews drone and scanning capture, and builds a Site Survey Control and Setting-Out File for use on live projects.