



# Geodesy and Geodetic Infrastructure Course: Datums, GNSS CORS Networks and Transformations

9 – 20 August 2027

London - Central London four-star



## Geodesy and Geodetic Infrastructure Course: Datums, GNSS CORS Networks and Transformations

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### Introduction:

Geodesy and geodetic infrastructure, covering datums, GNSS CORS networks and transformations, is a 2-week course for survey authority, utility and megaproject geospatial units that ends with a Geodetic Reference and CORS Service Plan for a case organisation. Organisations lose money and trust when design, GIS, BIM and construction data sit on different datums, epochs or height systems, so coordinates that look correct place assets metres apart. Nominees already manage control, GNSS data or spatial reference work, and learning is by modelling build on frame, geoid, transformation and network worksheets. CoreConcept Training Center delivers this geodesy and geodetic infrastructure course.

### Course Objectives:

- Explain how ITRS, ITRF realisations, WGS 84 and national datums relate, and state any coordinate with its frame and reference epoch
- Propagate station coordinates between epochs with velocity and plate motion models and apply 14-parameter Helmert transformations
- Convert between ellipsoidal, orthometric and tide-gauge-referenced heights using geoid undulation grids and a defined vertical datum
- Select map projections, grid transformation methods and coordinate operation chains that move data between datums without silent error
- Design, operate and monitor a GNSS CORS network delivering RINEX archives, NTRIP correction streams and network RTK services
- Produce a Geodetic Reference and CORS Service Plan that sets frames, height systems, network service levels and datum governance for a case organisation

### Target Audience:

- Geodetic control units responsible for national or organisational reference frames, control marks and coordinate registers
  - CORS network operations units responsible for reference station uptime, correction streams and subscriber support
  - Utility geospatial units responsible for keeping network asset records on one consistent datum and height system
  - Megaproject survey control units responsible for project grids, control densification and contractor coordinate checks
  - Spatial data standards units responsible for coordinate reference metadata across GIS, BIM and engineering systems
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## Course Outline:

### Day 1: Figure of the Earth, Reference Surfaces and Coordinate Types

- Reference Ellipsoid Parameters and Geodetic Latitude Longitude Definition
- Earth-Centred Earth-Fixed Cartesian Coordinates and Topocentric Frames
- Geoid as Equipotential Surface and Mean Sea Level Relationship
- Static Versus Dynamic Datums for Moving Tectonic Plates
- Organisational Coordinate Reference Inventory and Datum Usage Baseline

### Day 2: ITRS, ITRF Realisations, WGS 84 and National Datums

- ITRS Conventions Versus ITRF Realisations and Reference Epochs
- ITRF Station Positions, Velocities and Seasonal Signal Terms
- WGS 84 Realisations Aligned to ITRF at Centimetre Level
- National and Regional Frames Tied to ITRF Compared
- Frame and Epoch Labelling Rules for Every Published Coordinate

### Day 3: Epoch Propagation, Helmert Transformations and Projections

- Plate Motion Models and Station Velocity Field Epoch Propagation
- 14-Parameter Helmert Transformation Between Frames at Stated Epochs
- Grid-Based Datum Shift Files Versus Parameter Transformation Accuracy
- Transverse Mercator Projection Zones, Scale Factor and Convergence
- Coordinate Operation Chain Design from Frame to Project Grid

### Day 4: Height Systems, Geoid Models and Vertical Datums

- Ellipsoidal, Orthometric and Normal Height Definitions Compared
- Geoid Undulation Grids and Interpolation of Separation Values
- Global Geopotential Models from Spherical Harmonic Coefficients
- Gravimetric Geoid with Stokes Integration and Satellite Gravity
- Tide Gauge and Levelling Network Ties for Vertical Datums

### Day 5: Guided Case Study on Transforming a Mixed-Datum Control Register

- Case Control Register with Mixed Frames, Epochs and Heights
  - Epoch Propagation Worksheet for Case Passive Control Marks
  - Helmert and Grid Transformation Results Compared Against Check Points
  - Geoid Separation Applied to Convert Case GNSS Heights
  - Week-One Transformation Note for the Survey Control Lead
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## **Day 6: GNSS CORS Network Design and Real-Time Correction Services**

- CORS Site Selection, Monumentation, Antenna and Sky-View Criteria
- Station Spacing Design for Network RTK and VRS Coverage
- RTCM MSM Observation Messages and SSR Correction Streams
- NTRIP Caster Architecture, Mountpoints and Subscriber Access Control
- PPP-RTK Service Concepts Combining Precise Orbits and Local Atmosphere

## **Day 7: GNSS Quality Control, Integrity Monitoring and Geodetic Data Governance**

- RINEX Archive Quality Checks for Multipath, Cycle Slips and Gaps
- Daily CORS Coordinate Time Series and Station Displacement Alerts
- Network RTK Integrity Indicators and Rover Check Point Testing
- Ionospheric Disturbance and Interference Detection in Correction Services
- Coordinate Reference Change Control and Datum Governance Register

## **Day 8: Datum Alignment Across GIS, BIM and Construction Users**

- Datum Mix-Up Patterns Between GIS, BIM and Survey Files
- BIM Survey Point and Project Base Point Georeferencing Checks
- Local Engineering Grid to Geodetic Frame Calibration Records
- User Advisories for Frame Updates and Coordinate Reprocessing
- CORS Subscriber Onboarding Guides and Service Desk Scripts

## **Day 9: Service Performance Metrics and Network Improvement Reviews**

- CORS Availability, Latency and Fix Rate Service Indicators
- Positioning Accuracy Benchmarks Using Independent Control Check Points
- Frame Maintenance Cycle Planning After New ITRF Realisations
- Network Densification Business Case and Cost Driver Analysis
- Benchmarking CORS Service Levels Across Utility and Authority Networks

## **Day 10: Modelling Build Capstone on the Geodetic Reference and CORS Service Plan**

- Case Organisation Frame, Epoch and Height System Selection
  - Case Transformation Chain and Geoid Model Specification Build
  - Case CORS Layout, Correction Products and Service Level Targets
  - Case Datum Governance Register and User Communication Schedule
  - Geodetic Reference and CORS Service Plan Completion and Review
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## Skills You Will Gain:

- Reference Frame Selection
- Epoch Propagation
- Datum Transformation Design
- Geoid Height Conversion
- CORS Network Design
- GNSS Data Quality Screening
- Coordinate Metadata Governance
- Positioning Service Benchmarking

## Why Attend This Course:

- Deliver a Geodetic Reference and CORS Service Plan to the head of survey and the geospatial data owner for approval
- Decide which frame, epoch, geoid model and transformation method each project, network or data set must use
- Avoid misplaced assets, rework and contract disputes caused by unlabelled datums, stale epochs and mixed height systems
- Share transformation worksheets, RINEX quality checklists and datum advisory templates with survey and GIS colleagues

## Conclusion:

Back at work, the participant gives the head of survey and the geospatial data owner a Geodetic Reference and CORS Service Plan that fixes the reference frame, epoch policy, height system, transformation chain and CORS service levels for the organisation. Project, GIS and BIM teams use it to accept or reject incoming coordinates, and the network operations unit uses its targets to run the reference stations. After the first frame update or major project handover, the unit should review check point residuals, fix rates and datum incidents against the plan and revise it.

## Frequently Asked Questions FAQ:

### What should participants know before a geodesy and geodetic infrastructure course?

Participants should already handle survey control, GNSS observations or coordinate reference settings in GIS or engineering software, and be comfortable with spreadsheets. Bringing a sample control register or CORS service description from their own organisation helps them apply the modelling build to real data.

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## **How does geodesy and geodetic infrastructure differ from a construction surveying or GIS course?**

It works at the level of frames, epochs, geoid models and CORS networks that every survey and map depends on. Construction surveying courses set out works with total stations and RTK, and GIS courses analyse and map spatial layers.

## **Why do geodesy and geodetic infrastructure teams track coordinate epochs?**

Tectonic plates move by centimetres each year, so a coordinate in a global frame changes with time. Stating the epoch and propagating positions with a velocity model keeps GNSS results, passive control and stored data consistent across years of project and asset records.

## **What do participants take back from the geodesy and geodetic infrastructure course?**

Participants take back a Geodetic Reference and CORS Service Plan for a case organisation, with epoch propagation and transformation worksheets, geoid height conversion steps, CORS quality checklists and a datum governance register they can adapt to their own networks.

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