Training Course on Digital Elevation Model (DEM) and Terrain Analysis

Professional Development Training Course Outline

Category	GIS	**Duration**	5 Days
Base Fee	$1,500 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

Training Course on Digital Elevation Model (DEM) and Terrain Analysis equips professionals with essential skills to leverage geospatial data for informed decision-making across diverse sectors. Participants will gain a deep understanding of DEM generation, processing, and application, alongside advanced techniques in **geospatial analysis** to extract critical insights from **topographic data**. The curriculum focuses on practical, hands-on experience with industry-standard **GIS software**, ensuring participants can immediately apply their knowledge to real-world challenges in fields like **environmental management, civil engineering, urban planning, and disaster preparedness.**

The course delves into the fundamental principles of **digital terrain modeling**, exploring various data sources, acquisition methods, and the nuances of **DEM quality and accuracy**. Beyond foundational concepts, the training emphasizes **advanced terrain analytical techniques** such as **hydrological modeling, viewshed analysis, and geomorphological feature extraction**. Through engaging case studies and practical exercises, participants will develop proficiency in interpreting and utilizing terrain derivatives for site suitability analysis, flood risk assessment, infrastructure planning, and natural resource management, ultimately enhancing their **spatial analytical capabilities** and contributing to more sustainable and resilient solutions.

Programme Curriculum

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Course Objectives

1. Comprehend the core concepts, data structures (raster, TIN), and various types of Digital Elevation Models (DEM, DTM, DSM).
2. Identify and evaluate diverse DEM data sources, including **LiDAR, Photogrammetry, Satellite Imagery (e.g., SRTM, ASTER), and UAV data**.
3. Implement effective techniques for DEM pre-processing, including **noise reduction, interpolation, and datum transformations**.
4. Calculate and interpret essential terrain parameters such as **slope, aspect, curvature, hillshade, and contour lines**.
5. Apply DEMs for **watershed delineation, stream network extraction, flow accumulation, and hydrologic modeling** for flood risk and water resource management.
6. Execute and interpret viewshed and intervisibility analyses for applications in **telecommunications, urban planning, and security**.
7. Utilize terrain analysis for **landform classification, geomorphometric mapping, and understanding landscape evolution**.
8. Integrate DEM-derived products with other geospatial data for **multi-criteria decision analysis and optimal site selection**.
9. Create compelling **3D visualizations** and animations of terrain data for effective communication and stakeholder engagement.
10. Understand methods for evaluating the **vertical and horizontal accuracy** of DEMs and their impact on analysis.
11. Leverage DEM and terrain analysis for **landslide susceptibility mapping, flood inundation modeling, and disaster preparedness**.
12. Seamlessly incorporate DEM and terrain analysis techniques into broader **Geographic Information Systems (GIS)** workflows.
13. Gain practical experience with leading **open-source GIS software** (e.g., QGIS, GRASS GIS) for DEM processing and terrain analysis.

Organizational Benefits

- Provide data-driven insights for strategic planning, resource allocation, and risk mitigation across various departments.

- Streamline workflows in engineering, construction, and environmental projects by leveraging accurate terrain data.
- Better understand and manage natural resources, including water, land, and forests, through advanced spatial analysis.
- Develop robust strategies for natural hazard assessment, emergency response, and post-disaster recovery.
- Minimize errors, optimize site selections, and plan more effectively, leading to significant cost savings.
- Encourage the adoption of cutting-edge geospatial technologies and analytical methods within the organization.
- Differentiate by offering advanced spatial analysis capabilities for complex projects and client needs.

Target Audience

1. GIS Professionals & Analysts.
2. Environmental Scientists & Ecologists
3. Civil Engineers & Urban Planners.
4. Hydrologists & Water Resource Managers.
5. Geologists & Geomorphologists.
6. Disaster Management & Emergency Response Personnel.
7. Surveyors & Cartographers
8. Academics & Researchers.

Course Outline

Module 1: Introduction to DEM and Geospatial Fundamentals

- Understanding the concepts of DEM, DTM, and DSM.
- Overview of geospatial data types: raster and vector.
- Introduction to coordinate systems and projections relevant to elevation data.
- Review of essential GIS software interfaces (e.g., QGIS, ArcGIS).
- **Case Study:** Examining different DEM products (SRTM, ASTER, USGS DEM) and their suitability for regional-scale mapping in East Africa.

Module 2: DEM Data Sources and Acquisition

- Principles of LiDAR data acquisition and processing for DEM generation.
- Photogrammetric techniques for creating DEMs from aerial imagery.
- Satellite-based DEMs: resolution, accuracy, and availability.
- UAV (drone) photogrammetry for high-resolution local DEMs.
- **Case Study:** Comparing DEMs derived from LiDAR and drone photogrammetry for a detailed construction site survey in Nairobi, Kenya, assessing accuracy and cost-effectiveness.

Module 3: DEM Pre-processing and Quality Control

- Data cleaning: identifying and correcting errors, voids, and anomalies in DEMs.
- DEM interpolation techniques (e.g., IDW, Kriging, Spline).
- Resampling and mosaicking multiple DEM datasets.
- Assessing vertical and horizontal accuracy of DEMs using ground control points.
- **Case Study:** Pre-processing and integrating various DEM tiles to create a seamless elevation model for a large-scale infrastructure project, such as the Standard Gauge Railway in Kenya.

Module 4: Basic Terrain Attributes Derivation

- Calculating slope: understanding different units (degrees, percent) and applications.
- Determining aspect: identifying flow direction and solar radiation exposure.
- Generating hillshade and shaded relief maps for visualization.
- Extracting contour lines at desired intervals for topographic representation.
- **Case Study:** Using derived slope and aspect maps to identify suitable areas for solar panel installation and agricultural terracing in a hilly region of Rwanda.

Module 5: Advanced Hydrological Terrain Analysis

- Watershed delineation and sub-basin analysis.
- Stream network extraction and flow direction/accumulation mapping.
- Calculating Topographic Wetness Index (TWI) for soil moisture assessment.
- Introduction to flood inundation modeling using DEMs.
- **Case Study:** Delineating critical watersheds and modeling potential flood zones along the Tana River basin in Kenya to inform disaster preparedness and land-use planning.

Module 6: Viewshed Analysis and Visibility Studies

- Principles of viewshed analysis from single and multiple observer points.
- Calculating intervisibility for line-of-sight analysis.
- Applications in telecommunications network planning and optimal tower placement.
- Utilizing viewshed for urban planning (e.g., aesthetic impact, security).
- **Case Study:** Performing viewshed analysis to optimize the placement of communication towers for improved mobile network coverage in a rural part of Uganda.

Module 7: Geomorphological and Applied Terrain Analysis

- Landform classification based on terrain attributes (e.g., peaks, ridges, valleys).
- Analysis of terrain roughness and dissection for geomorphological interpretation.
- Application of terrain analysis in soil mapping and erosion assessment.
- DEMs for landslide susceptibility zoning and hazard mapping.
- **Case Study:** Using geomorphometric parameters to identify areas highly susceptible to landslides in the mountainous regions of Ethiopia, informing early warning systems.

Module 8: Integration, Visualization, and Emerging Trends

- Integrating DEMs with other geospatial data (e.g., satellite imagery, land cover).
- Creating compelling 3D terrain scenes and animations.
- Introduction to Python scripting for automating DEM processes.
- Emerging trends: Machine learning in terrain analysis, cloud-based GIS for DEM.
- **Case Study:** Developing an interactive 3D terrain model of a proposed urban development site in Dar es Salaam, Tanzania, integrating architectural plans and environmental data for stakeholder visualization.

Training Methodology

Our training methodology combines **interactive lectures, practical hands-on exercises, and real-world case studies** to ensure a deep understanding and application of concepts.

- **Instructor-Led Sessions:** Engaging presentations covering theoretical foundations and practical applications.

- **Software Demonstrations:** Live demonstrations of DEM and terrain analysis tools within industry-standard and open-source GIS software (e.g., QGIS, ArcGIS Pro, Google Earth Engine).
- **Practical Exercises:** Hands-on activities and guided tutorials using diverse geospatial datasets to reinforce learning.
- **Case Study Discussions:** In-depth analysis of real-world scenarios, fostering critical thinking and problem-solving skills.
- **Group Projects:** Collaborative tasks to apply learned techniques to complex spatial problems.
- **Q&A and Troubleshooting:** Dedicated sessions for addressing participant queries and technical challenges.
- **Resource Sharing:** Provision of comprehensive course materials, datasets, and reference guides for continued learning.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	27 Nov 2026	Online	$1,000
23 Nov 2026	27 Nov 2026	Physical	$1,500
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$4,500
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$6,000

Ready to enroll or request a customized program? Book online or contact us:

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