

Railroad Construction, Rail network infrastructure / geotechnical planning

Geological on-site assessments are key in determining the time and cost requirements and the feasibility of any tunnel construction project. Success critical factors are the development of a strong understanding of soil materials and rock formations, including identification of geological fault zones affecting tunnel excavation efforts. Measurement data on groundwater, water-bearing rocks, and seismic activity are critical in preventing water intrusion or methane gas emissions into tunnel sections. Therefore, any new tunnel is to be designed earthquake-proof and requires an in-depth geological analysis before the project starts.

Site Investigations, Subsurface Examination Report, Geotechnical Assessment

Site investigations need to consider the specific geological conditions at the tunnel location and can contain:

1. Field Mapping: e.g., surface mapping, including data recording of surface rock formations, surface layer inclinations, screening of existing geological reports, maps, etc.
2. Geophysical Examinations: Using non-invasive geophysical measurement methods such as seismic, electromagnetic, ultrasonic measurement, and ground-penetrating radar to obtain precise insights on subterranean rock formations, groundwater situation, soil anomalies, etc.
3. Geotechnical Field Tests: e.g. soil penetration soundings for determination of soil strength and soil dynamics through the measurement of soil resistance using a rod system, exploratory probe drillings in a defined bore hole matrix for collection of soil and rock samples, digging for visual soil inspections and/or in-situ groundwater measurement procedures.
4. Geochemical Lab Analysis: Determination of soil material, rock minerals, including: shear resistance, soil cohesion, and soil water content from gathered probe samples in exploratory drillings.
5. Quantitative Rock Classification, including rock consistency, compressive strength, discontinuities, crack formation and fracture, degree of weathering by application of a classification system such as the Rock Mass Rating (RMR)/Bieniawski, Q-System/Barton or Geological Strength Index (GSI).

Recorded data in the subsurface examination report is the basis for further geotechnical calculations, 3D modeling, and computer simulations. Technical solutions, e.g., drainage and air ventilation systems, are designed to address identified challenges and integrated into the tunnel design. Overall, the site investigation is a crucial step in the tunnel construction process as it provides critical information for planning and construction of a secure and effective tunnel, including the determination of the final tunnel design, required construction methodology for underground excavations, e.g., type of automated tunnel boring machine (TBM) vs. conventional equipment, tools.

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