

# ICTQual AB

## Qualification Specification



### Level 3 Diploma in Civil Engineering 60 Credits – 6 Months



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# ICTQual AB

## Level 3 Diploma in Civil Engineering

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# Qualification Specifications about

## ICTQual Level 3 Diploma in Civil Engineering 60 Credits – 6 Months

### About ICTQual AB

ICTQual AB UK Ltd. is a distinguished awarding body based in the United Kingdom, dedicated to fostering excellence in education, training, and skills development. Committed to global standards, ICTQual AB provides internationally recognized qualifications that empower individuals and organizations to thrive in an increasingly competitive world. Their offerings span diverse industries, including technical fields, health and safety, management, and more, ensuring relevance and adaptability to modern workforce needs.

The organization prides itself on delivering high-quality educational solutions through a network of Approved Training Centres worldwide. Their robust curriculum and innovative teaching methodologies are designed to equip learners with practical knowledge and skills for personal and professional growth. With a mission to inspire lifelong learning and drive positive change, ICTQual AB continuously evolves its programs to stay ahead of industry trends and technological advancements.

ICTQual AB's vision is to set benchmarks for educational excellence while promoting inclusivity and integrity. Their unwavering focus on quality and accessibility makes them a trusted partner in shaping future-ready professionals and advancing societal progress globally.

### Course Overview

The ICTQual Level 3 Diploma in Civil Engineering is a comprehensive 60-credit program designed to be completed in 6 months. This diploma equips learners with foundational knowledge and practical skills essential for entering the dynamic field of civil engineering. It covers key areas such as structural analysis, construction materials, project planning, and sustainability practices. By emphasizing both theoretical understanding and hands-on application, the program prepares students for immediate entry-level roles in civil engineering or further studies in related disciplines.

Graduates of this qualification are well-prepared to contribute to the design, development, and maintenance of critical infrastructure projects. They also gain insight into emerging technologies and sustainable practices, ensuring readiness for modern industry challenges. The program offers a balance of academic rigor and practical experience, making it an ideal stepping stone for aspiring civil engineers.

## Certification Framework

<b>Qualification title</b>	<b>ICTQual Level 3 Diploma in Civil Engineering 60 Credits – 6 Months</b>
<b>Course ID</b>	CE0004
<b>Qualification Credits</b>	60 Credits
<b>Course Duration</b>	6 Months
<b>Grading Type</b>	Pass / Fail
<b>Competency Evaluation</b>	Coursework / Assignments / Verifiable Experience
<b>Assessment</b>	The assessment and verification process for ICTQual qualifications involves two key stages:  <b>Internal Assessment and Verification:</b> <ul style="list-style-type: none"> <li>✓ Conducted by the staff at the Approved Training Centre (ATC). Ensures learners meet the required standards through continuous assessments.</li> <li>✓ Internal quality assurance (IQA) is carried out by the centre's IQA staff to validate the assessment processes.</li> </ul> <b>External Quality Assurance:</b> <ul style="list-style-type: none"> <li>✓ Managed by ICTQual AB verifiers, who periodically review the centre's assessment and IQA processes.</li> <li>✓ Verifies that assessments are conducted to the required standards and ensures consistency across centres</li> </ul>

## Entry Requirements

To enroll in the ICTQual Level 3 Diploma in Civil Engineering 60 Credits – 6 Months, candidates must meet the following entry requirements:

- ✓ A minimum of a Level 2 qualification (e.g., GCSEs, NVQ Level 2, or equivalent). A strong foundation in mathematics and science is highly recommended, as these subjects are integral to civil engineering concepts.
- ✓ Applicants must typically be 16 years or older.
- ✓ Proficiency in English is essential, as the course involves technical terminology, report writing, and communication.
- ✓ Basic computer literacy is advantageous, as some modules may involve software tools like CAD (Computer-Aided Design).
- ✓ While not mandatory, any prior experience in construction, surveying, or a related field can be beneficial.

## Qualification Structure

This qualification comprises 6 mandatory units, totaling 60 credits. Candidates must successfully complete all mandatory units to achieve the qualification.

Mandatory Units		
Unit Ref#	Unit Title	Credits
CE0004-1	Construction Technology and Materials	10
CE0004-2	Structural Mechanics and Design	10

CE0004-3	Site Surveying and Geotechnics	10
CE0004-4	Health, Safety, and Environmental Practices	10
CE0004-5	Project Management Fundamentals	10
CE0004-6	Civil Engineering Drawing and CAD	10

## Centre Requirements

Even if a centre is already registered with ICTQual AB, it must meet specific requirements to deliver the ICTQual Level 3 Diploma in Civil Engineering 60 Credits – 6 Months. These standards ensure the quality and consistency of training, assessment, and learner support.

### 1. Approval to Deliver the Qualification

- ✓ Centres must obtain formal approval from ICTQual AB to deliver this specific qualification, even if they are already registered.
- ✓ The approval process includes a review of resources, staff qualifications, and policies relevant to the program.

### 2. Qualified Staff

- ✓ **Tutors:** Must have relevant qualifications in civil engineering or construction at Level 4 or higher, alongside teaching/training experience.
- ✓ **Assessors:** Must hold a recognized assessor qualification and demonstrate expertise in civil engineering
- ✓ **Internal Quality Assurers (IQAs):** Must be appropriately qualified and experienced to monitor the quality of assessments.

### 3. Learning Facilities

Centres must have access to appropriate learning facilities, which include:

- ✓ **Classrooms:** Modern classrooms equipped with multimedia tools to deliver engaging theoretical instruction on structural design, construction methods, and sustainable engineering practices.
- ✓ **Practical Areas:** Hands-on training areas with advanced equipment for material testing, surveying instruments, concrete mixing, and structural analysis, providing practical experience in real-world civil engineering applications.
- ✓ **Technology Access:** High-performance computers with industry-standard software (e.g., AutoCAD, STAAD.Pro, Revit, and GIS tools) and reliable internet connectivity for drafting, modeling, and project management tasks.

### 4. Health and Safety Compliance

- ✓ Centres must ensure that practical training environments comply with relevant health and safety regulations.
- ✓ Risk assessments must be conducted regularly to maintain a safe learning environment.

### 5. Resource Requirements

- ✓ **Learning Materials:** Approved course manuals, textbooks, and study guides aligned with the curriculum.
- ✓ **Assessment Tools:** Templates, guidelines, and resources for conducting and recording assessments.

- ✓ E-Learning Systems: If offering online or hybrid learning, centres must provide a robust Learning Management System (LMS) to facilitate remote delivery.

## 6. Assessment and Quality Assurance

- ✓ Centres must adhere to ICTQual's assessment standards, ensuring that all assessments are fair, valid, and reliable.
- ✓ Internal quality assurance (IQA) processes must be in place to monitor assessments and provide feedback to assessors.
- ✓ External verification visits from ICTQual will ensure compliance with awarding body standards.

## 7. Learner Support

- ✓ Centres must provide learners with access to guidance and support throughout the program, including:
- ✓ Academic support for coursework.
- ✓ Career guidance for future progression.
- ✓ Additional support for learners with specific needs (e.g., disabilities or language barriers).

## 8. Policies and Procedures

Centres must maintain and implement the following policies, as required by ICTQual:

- ✓ Equal Opportunities Policy.
- ✓ Health and Safety Policy.
- ✓ Safeguarding Policies and Procedures.
- ✓ Complaints and Appeals Procedure.
- ✓ Data Protection and Confidentiality Policy.

## 9. Regular Reporting to ICTQual

- ✓ Centres must provide regular updates to ICTQual AB on learner enrollment, progress, and completion rates.
- ✓ Centres are required to maintain records of assessments and learner achievements for external auditing purposes.

## Support for Candidates

Centres should ensure that materials developed to support candidates:

- ✓ Facilitate tracking of achievements as candidate's progress through the learning outcomes and assessment criteria.
- ✓ Include information on how and where ICTQual's policies and procedures can be accessed.
- ✓ Provide mechanisms for Internal and External Quality Assurance staff to verify and authenticate evidence effectively.

This approach ensures transparency, supports candidates' learning journeys, and upholds quality assurance standards.

## Assessment

This qualification is competence-based, requiring candidates to demonstrate proficiency as defined in the qualification units. The assessment evaluates the candidate's skills, knowledge, and understanding against the set standards. Key details include:

### 1. Assessment Process:

- ✓ Must be conducted by an experienced and qualified assessor.
- ✓ Candidates compile a portfolio of evidence that satisfies all learning outcomes and assessment criteria for each unit.

### 2. Types of Evidence:

- ✓ Observation reports by the assessor.
- ✓ Assignments, projects, or reports.
- ✓ Professional discussions.
- ✓ Witness testimonies.
- ✓ Candidate-produced work.
- ✓ Worksheets.
- ✓ Records of oral and written questioning.
- ✓ Recognition of Prior Learning (RPL).

### 3. Learning Outcomes and Assessment Criteria:

- **Learning Outcomes:** Define what candidates should know, understand, or accomplish upon completing the unit.
- **Assessment Criteria:** Detail the standards candidates must meet to demonstrate that the learning outcomes have been achieved.

This framework ensures rigorous and consistent evaluation of candidates' competence in line with the qualification's objectives.

## Unit Descriptors

### CE0004 -1: Construction Technology and Materials

The aim of this study unit is to provide learners with a comprehensive understanding of the properties, applications, and performance of construction materials commonly used in civil engineering. This unit emphasizes the principles of material selection, evaluation, and testing, fostering the ability to assess their impact on construction sustainability, efficiency, and overall project success.

Learning Outcome:	Assessment Criteria:
<p><b>1. Identify and explain the properties and applications of various construction materials (e.g., concrete, steel, timber, and composites) used in civil engineering.</b></p>	<ul style="list-style-type: none"> <li>1.1. Identify various construction materials, including concrete, steel, timber, and composites, with specific examples of their types (e.g., reinforced concrete, structural steel, laminated timber, fiber-reinforced composites).</li> <li>1.2. Explain the physical properties of each material, such as density, thermal conductivity, and durability, and how this influence material selection.</li> <li>1.3. Describe the mechanical properties of construction materials, including strength, elasticity, toughness, and ductility, and their relevance to engineering designs.</li> <li>1.4. Analyze the suitability of materials for specific applications, such as bridges, buildings, roads, or dams, considering performance requirements.</li> <li>1.5. Compare the advantages and disadvantages of each material in terms of cost, availability, and sustainability in various engineering contexts.</li> <li>1.6. Evaluate the impact of environmental factors (e.g., temperature, moisture, chemical exposure) on the performance and longevity of materials.</li> <li>1.7. Discuss the role of material innovations (e.g., self-healing concrete, lightweight composites) in addressing modern engineering challenges.</li> <li>1.8. Demonstrate understanding of how construction materials perform under different types of loads, such as tension, compression, shear, and bending.</li> <li>1.9. Assess the environmental impact of materials, including embodied energy and carbon footprint, during their life cycle.</li> </ul>
<p><b>2. Evaluate material performance based on factors such as durability, cost, and suitability for different types of construction projects.</b></p>	<p>2.1 Assess the durability of materials by evaluating their resistance to wear, weathering, and degradation over time.</p>



	<ul style="list-style-type: none"> <li>2.2 Compare the initial and lifecycle costs of materials, considering factors such as procurement, maintenance, and replacement expenses.</li> <li>2.3 Evaluate the suitability of materials for specific construction projects, such as residential buildings, industrial facilities, or infrastructure projects.</li> <li>2.4 Analyze material performance under various environmental conditions, including exposure to moisture, temperature fluctuations, and chemical agents.</li> <li>2.5 Assess the ability of materials to meet design requirements for structural integrity and load-bearing capacity in different construction scenarios.</li> <li>2.6 Compare the sustainability of materials based on their recyclability, embodied energy, and impact on the environment.</li> <li>2.7 Justify material choices by weighing trade-offs between durability, cost-efficiency, and project-specific requirements.</li> <li>2.8 Investigate case studies or examples where material selection significantly impacted the success or failure of construction projects.</li> </ul>
<b>Learning Outcome:</b>	
<p><b>3. Understand and apply construction technology techniques, including modern methods of construction and material testing processes.</b></p>	<ul style="list-style-type: none"> <li>3.1 Define key construction technology techniques, including their applications and significance in modern construction projects.</li> <li>3.2 Explain modern methods of construction (MMC), such as off-site construction, modular building, and 3D printing, detailing their processes and benefits.</li> <li>3.3 Identify and describe various material testing processes, including tensile testing, compressive strength testing, and durability testing.</li> <li>3.4 Demonstrate the ability to set up and perform material testing procedures using appropriate tools and equipment.</li> <li>3.5 Analyze and interpret results from material testing to determine material suitability for specific construction applications.</li> <li>3.6 Compare modern construction techniques with traditional methods, focusing on efficiency, cost, and environmental sustainability.</li> <li>3.7 Assess the advantages of integrating modern</li> </ul>

	<p>technology, such as Building Information Modeling (BIM) and automation, into construction practices.</p> <p>3.8 Apply construction technology techniques to solve practical construction challenges, ensuring compliance with industry standards.</p> <p>3.9 Evaluate the role of quality assurance in material testing and its impact on construction project outcomes.</p>
<p><b>4. Assess the impact of material choice on the sustainability and efficiency of a construction project.</b></p>	<p>4.1 Identify key factors influencing the sustainability and efficiency of construction materials, including embodied energy, carbon footprint, and resource availability.</p> <p>4.2 Analyze the environmental impact of materials throughout their lifecycle, from extraction and production to transportation, usage, and disposal.</p> <p>4.3 Evaluate the role of recycled or renewable materials in reducing the environmental footprint of construction projects.</p> <p>4.4 Assess the thermal performance, energy efficiency, and insulation properties of materials in various construction scenarios.</p> <p>4.5 Compare material options based on durability, maintenance needs, and long-term performance in achieving project efficiency.</p> <p>4.6 Justify material selection in terms of their compatibility with sustainable construction certifications (e.g., LEED, BREEAM).</p> <p>4.7 Investigate case studies illustrating the impact of material choices on sustainability outcomes in completed projects.</p> <p>4.8 Discuss trade-offs between cost, sustainability, and efficiency when selecting materials for different types of projects.</p> <p>4.9 Assess the contribution of innovative materials, such as self-healing concrete or bio-based composites, to sustainable construction practices.</p>

**CE0004 -2: Structural Mechanics and Design**

The aim of this study unit is to provide learners with a foundational understanding of structural mechanics principles and their application in designing safe and efficient structures. It focuses on developing the skills required to analyze forces, calculate loads, and design structural systems while adhering to industry standards. By completing this unit, learners will gain the ability to assess structural stability and implement solutions to enhance the safety and resilience of various construction projects.

Learning Outcome:	Assessment Criteria:
<p><b>1. Apply basic principles of structural mechanics to understand how forces (e.g., tension, compression, shear, bending) affect structures.</b></p>	<ol style="list-style-type: none"> <li>1.1. Define and explain the core concepts of force, stress, strain, deformation, and equilibrium, and discuss their significance in structural analysis.</li> <li>1.2. Recognize and differentiate between various forces acting on structures, such as tension (pulling), compression (squeezing), shear (sliding), and bending (curving), and understand how each affects the material's response.</li> <li>1.3. Explain how tensile forces cause elongation and compression forces cause shortening in materials, and calculate the resulting stresses and deformations based on the material properties and dimensions.</li> <li>1.4. Examine the behavior of structural components (e.g., beams) under shear forces, determining the shear stress distribution and its potential to cause shear failure or deformation.</li> <li>1.5. Demonstrate the effects of bending moments on beams and structures, calculating the bending stresses and deflections, and ensuring they are within permissible limits to prevent failure.</li> <li>1.6. Analyze the deformation of structures (e.g., elongation, compression, or bending) under loads, using Hooke's Law, Young's Modulus, and shear modulus to determine how materials respond to applied forces.</li> <li>1.7. Evaluate potential failure modes such as buckling in columns, yielding in beams, and brittle fracture in tension members, and discuss how these can be prevented by adjusting material selection, geometry, and safety factors.</li> <li>1.8. Use the principles of structural mechanics to perform calculations for simple structural elements such as beams, trusses, and columns under various loading conditions to ensure stability and safety.</li> </ol>

	<p>1.9. Apply both manual calculation methods (such as force diagrams, shear force, and bending moment diagrams) and computer-based structural analysis software (e.g., SAP2000, AutoCAD, or STAAD) to simulate and analyze the effects of forces on structures.</p>
<p><b>2. Perform load calculations for structural components such as beams, columns, and foundations, considering factors like dead loads, live loads, and environmental forces.</b></p>	<p>2.1 Identify and classify different types of loads, including dead loads, live loads, wind loads, seismic forces, and other environmental factors.</p> <p>2.2 Explain the principles of load distribution and how loads are transferred through structural components.</p> <p>2.3 Calculate dead loads by analyzing the weight of structural elements and materials.</p> <p>2.4 Compute live loads based on occupancy, usage patterns, and applicable building codes.</p> <p>2.5 Incorporate environmental forces, such as wind and seismic loads, into structural load calculations using relevant standards and guidelines.</p> <p>2.6 Perform load analysis for beams, considering bending moments, shear forces, and deflections under various loading conditions.</p> <p>2.7 Calculate axial loads and stress distribution in columns to determine their capacity and stability.</p> <p>2.8 Evaluate bearing capacity and settlement for foundations under combined loading conditions.</p> <p>2.9 Use structural analysis tools or software to perform and validate load calculations.</p>
<p><b>3. Design simple structural systems following relevant codes and standards to ensure safety and efficiency in the construction of buildings and infrastructure.</b></p>	<p>3.1 Identify the key components of a structural system, including beams, columns, slabs, and foundations.</p> <p>3.2 Explain the principles of structural design, including load paths, stability, and redundancy.</p> <p>3.3 Apply relevant building codes and standards to ensure compliance with safety and design requirements.</p> <p>3.4 Perform preliminary sizing of structural elements, considering factors such as load-bearing capacity and material properties.</p>

	<ul style="list-style-type: none"> <li>3.5 Design beams to resist bending and shear forces, ensuring adequate strength and deflection limits.</li> <li>3.6 Determine column sizes to withstand axial and lateral loads while preventing buckling.</li> <li>3.7 Design foundations to distribute loads safely to the soil, considering bearing capacity and settlement criteria.</li> <li>3.8 Incorporate lateral load-resisting systems, such as bracing, shear walls, or moment frames, into the structural design.</li> <li>3.9 Use structural analysis tools or software to validate the design of structural systems.</li> </ul>
<p><b>4. Assess structural stability and propose solutions to mitigate risks or weaknesses in structures.</b></p>	<ul style="list-style-type: none"> <li>4.1 Identify factors affecting the structural stability of buildings and infrastructure, including material properties, load distribution, and environmental conditions.</li> <li>4.2 Evaluate the stability of structures under various loads, including static, dynamic, and environmental forces (e.g., wind and seismic forces).</li> <li>4.3 Perform stability analysis for structural components, such as beams, columns, and foundations, to identify potential weaknesses or failure modes.</li> <li>4.4 Assess the impact of design flaws, construction errors, or material degradation on structural stability.</li> <li>4.5 Investigate case studies of structural failures to understand their causes and preventive measures.</li> <li>4.6 Propose reinforcement techniques, such as adding bracing, shear walls, or retrofitting with advanced materials, to enhance structural stability.</li> <li>4.7 Recommend modifications to load paths or structural configurations to improve overall stability and safety.</li> <li>4.8 Suggest maintenance practices or inspections to identify and address potential risks in aging structures.</li> <li>4.9 Utilize structural analysis tools or software to model and test proposed solutions for mitigating risks.</li> </ul>

**CE0004 -3: Site Surveying and Geotechnics**

The aim of this study unit is to equip learners with the essential skills and knowledge needed to effectively conduct site surveys and analyze soil conditions for civil engineering projects. This unit will enable students to proficiently use surveying instruments such as total stations, levels, and GPS to collect accurate site data. It will also help them interpret topographical maps and site plans to guide engineering decisions and design.

Learning Outcome:	Assessment Criteria:
<p><b>1. Use surveying instruments (e.g., total stations, levels, GPS) to measure and record site data accurately.</b></p>	<ul style="list-style-type: none"> <li>1.1. Identify and explain the functions of various surveying instruments, including total stations, levels, and GPS, and their applications in construction and civil engineering projects.</li> <li>1.2. Calibrate and set up surveying instruments properly to ensure accurate measurements.</li> <li>1.3. Use a total station to measure horizontal and vertical angles, distances, and elevations, and record data for site analysis.</li> <li>1.4. Operate levels to determine differences in elevation and to establish horizontal control points for construction layout.</li> <li>1.5. Use GPS equipment to establish precise georeferencing points and to monitor real-time positioning for site surveys.</li> <li>1.6. Record and process measurements from instruments accurately, ensuring data reliability for further analysis.</li> <li>1.7. Apply proper techniques for measuring distances, angles, and slopes, and ensure the precision of the data recorded.</li> <li>1.8. Perform field checks and comparisons between different measurement methods (e.g., total station and GPS) to verify data consistency.</li> <li>1.9. Document and organize survey data systematically, ensuring it is suitable for further use in design and construction planning.</li> <li>1.10. Troubleshoot common issues with surveying instruments, such as errors in calibration or instrument malfunction, and correct them as needed.</li> <li>1.11. Interpret survey data to create accurate site plans, maps, and construction drawings.</li> <li>1.12. Ensure compliance with relevant standards, codes, and regulations when using surveying equipment and recording measurements.</li> </ul>

<p><b>2. Interpret topographical maps and site plans to inform engineering decisions and project design.</b></p>	<p>2.1 Understand the basic components of topographical maps and site plans, including contour lines, elevation markings, scale, and symbols.</p> <p>2.2 Identify key features on topographical maps, such as natural landforms (e.g., hills, valleys, rivers) and man-made structures (e.g., roads, buildings, utilities).</p> <p>2.3 Analyze contour lines to determine the slope, gradient, and elevation changes of the land, and assess how these factors affect construction and design decisions.</p> <p>2.4 Interpret site plans to understand the layout of a construction project, including boundaries, access points, infrastructure, and utilities.</p> <p>2.5 Use the scale of topographical maps and site plans to calculate distances, areas, and volumes of land for project planning.</p> <p>2.6 Assess the suitability of a site for specific construction projects, considering factors such as soil type, drainage, and elevation changes.</p> <p>2.7 Incorporate environmental and geographical factors shown on maps (e.g., flood zones, wetlands) into project design and risk assessments.</p> <p>2.8 Evaluate the impact of the terrain on construction methods, material transport, and accessibility during project execution.</p> <p>2.9 Apply topographical data to inform decisions regarding the placement of foundations, roads, drainage systems, and utilities.</p>
<p><b>3. Understand and analyze soil properties, including soil types, compaction, and bearing capacity, for appropriate foundation design.</b></p>	<p>3.1 Identify different soil types (e.g., clay, silt, sand, gravel) and their characteristics, such as texture, permeability, and cohesiveness that influence foundation design.</p> <p>3.2 Analyze soil compaction, including methods to assess compaction levels (e.g., Proctor test) and their impact on the stability and load-bearing capacity of foundations.</p> <p>3.3 Understand the relationship between soil moisture content, compaction, and its effect on soil strength and settlement behavior.</p> <p>3.4 Evaluate soil bearing capacity, determining the maximum load per unit area that the soil can support without failure, using methods such as the plate load test or soil</p>

	<p>classification charts.</p> <p>3.5 Perform geotechnical investigations to assess soil properties at the construction site, including sampling, laboratory testing, and field testing.</p> <p>3.6 Analyze the results of soil tests (e.g., Atterberg limits, shear strength, consolidation) to determine suitability for different foundation types (e.g., shallow, deep, pile foundations).</p> <p>3.7 Assess the impact of soil properties on foundation design, considering factors such as soil settlement, differential settlement, and the potential for soil liquefaction in seismic areas.</p> <p>3.8 Understand the effects of water table fluctuations, soil expansion (e.g., swelling clays), and freeze-thaw cycles on soil behavior and foundation stability.</p> <p>3.9 Use soil property data to design appropriate foundation types and depths that can accommodate the load requirements of a building or infrastructure project.</p>
<p><b>4. Apply geotechnical principles in the assessment of site conditions and in making recommendations for foundation types and soil treatments.</b></p>	<p>4.1 Conduct geotechnical site investigations, including drilling, sampling, and testing, to assess the subsurface conditions and identify soil properties (e.g., soil composition, moisture content, compaction, shear strength).</p> <p>4.2 Analyze soil test results (e.g., borehole logs, laboratory test data) to understand the behavior of different soil layers and determine the suitability for various foundation types.</p> <p>4.3 Evaluate factors such as soil stratigraphy, groundwater conditions, and soil settlement potential to assess the stability of the site for construction.</p> <p>4.4 Use geotechnical principles to assess the bearing capacity of the soil, considering factors like soil type, compaction, and depth of the foundation.</p> <p>4.5 Determine the appropriate foundation type (e.g., shallow, deep, pile, mat) based on soil properties, load-bearing capacity, and project requirements.</p> <p>4.6 Assess the need for soil treatment or improvement methods, such as soil</p>



	<p>compaction, stabilization, grouting, or the use of geosynthetics, to enhance the foundation's performance.</p> <p>4.7 Evaluate the effects of environmental factors, such as groundwater table fluctuations, seismic activity, and freeze-thaw cycles, on the soil behavior and foundation stability.</p> <p>4.8 Provide recommendations for foundation depth, size, and type, ensuring that the design complies with safety standards and minimizes the risk of settlement, tilting, or other foundation-related issues.</p> <p>4.9 Use geotechnical software and tools to model soil behavior under load and predict potential risks like settlement, liquefaction, or lateral movement.</p>
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**CE0004 -4: Health, Safety, and Environmental Practices**

The aim of this study unit is to equip learners with the essential knowledge and skills required to ensure health, safety, and environmental standards are maintained on construction and civil engineering projects. The unit focuses on understanding and applying health and safety regulations to protect workers and the public, as well as implementing effective risk management strategies to minimize hazards.

<b>Learning Outcome:</b>	<b>Assessment Criteria:</b>
<p><b>1. Understand and apply health and safety regulations within construction and civil engineering projects to protect workers and the public.</b></p>	<ol style="list-style-type: none"> <li>1.1. Identify and understand key health and safety regulations, including those outlined in the Occupational Safety and Health Administration (OSHA) standards, local building codes, and industry-specific regulations.</li> <li>1.2. Develop and implement site-specific health and safety plans that address potential hazards and outline safety protocols for workers and the public.</li> <li>1.3. Conduct risk assessments to identify hazards associated with construction activities, such as heavy machinery, working at heights, excavation, and electrical work.</li> <li>1.4. Ensure that appropriate personal protective equipment (PPE), such as helmets, gloves, safety glasses, and fall protection gear, is available and used by workers.</li> <li>1.5. Train workers on safe work practices, emergency procedures, and the proper use of equipment to prevent accidents and injuries.</li> <li>1.6. Implement measures to control hazardous materials and substances on site, such as asbestos, chemicals, or noise, and ensure proper handling, storage, and disposal procedures.</li> <li>1.7. Monitor and enforce compliance with health and safety regulations on-site through regular inspections, audits, and safety meetings.</li> <li>1.8. Establish emergency response plans for potential incidents, such as fires, electrical failures, or medical emergencies, and ensure workers are trained in first aid and evacuation procedures.</li> <li>1.9. Promote a culture of safety by encouraging workers to report unsafe conditions and providing incentives or recognition for good safety practices.</li> </ol>

<p><b>2. Implement risk management strategies to minimize hazards on construction sites, ensuring compliance with local and international safety standards.</b></p>	<ol style="list-style-type: none"> <li>2.1. Identify potential hazards on the construction site, including physical, environmental, chemical, and ergonomic risks, and categorize them according to their severity and likelihood of occurrence.</li> <li>2.2. Conduct thorough risk assessments to evaluate potential threats to worker safety, the public, and the environment, using tools such as hazard identification checklists, risk matrices, and job safety analysis (JSA).</li> <li>2.3. Develop and implement a risk management plan that includes specific measures to prevent or minimize identified hazards, ensuring all necessary controls are in place.</li> <li>2.4. Apply engineering controls (e.g., safety barriers, scaffolding) and administrative controls (e.g., safety protocols, shift rotations) to mitigate risks on-site.</li> <li>2.5. Establish emergency response procedures for different types of accidents, including fire, medical emergencies, or structural failure, and ensure workers are trained on these procedures.</li> <li>2.6. Ensure that workers have access to and use personal protective equipment (PPE) such as helmets, gloves, respiratory protection, and safety boots, tailored to the specific risks of the project.</li> <li>2.7. Implement safety training programs to educate all site personnel on risk awareness, proper equipment usage, and emergency procedures.</li> <li>2.8. Conduct regular safety inspections and audits to identify any potential hazards that may have been overlooked, and ensure compliance with local and international safety standards (e.g., OSHA, ISO 45001).</li> <li>2.9. Monitor the effectiveness of risk control measures and make adjustments as needed to address emerging risks or project changes.</li> </ol>
<p><b>3. Promote sustainable practices within civil engineering projects by assessing environmental impacts and recommending mitigation strategies.</b></p>	<ol style="list-style-type: none"> <li>3.1 Identify and assess the potential environmental impacts of a civil engineering project, including effects on air quality, water resources, biodiversity, soil erosion, noise pollution, and energy consumption.</li> <li>3.2 Conduct environmental impact assessments (EIA) to evaluate how the project may affect</li> </ol>

	<p>the surrounding ecosystem, local communities, and natural resources throughout the project lifecycle.</p> <p>3.3 Incorporate sustainability goals into project planning by considering energy efficiency, waste reduction, and the use of environmentally friendly materials and technologies.</p> <p>3.4 Recommend mitigation strategies to minimize negative environmental impacts, such as using low-carbon construction materials, adopting renewable energy sources, or implementing green infrastructure solutions (e.g., green roofs, permeable pavements).</p> <p>3.5 Promote the use of sustainable construction methods, such as reducing the carbon footprint through energy-efficient machinery, recycling construction waste, and optimizing transportation routes to reduce emissions.</p> <p>3.6 Ensure compliance with environmental regulations and standards (e.g., ISO 14001, local environmental laws) and incorporate them into project design, execution, and monitoring.</p> <p>3.7 Advocate for sustainable land use practices, such as protecting natural habitats, reducing soil compaction, and implementing effective erosion control measures during excavation and construction.</p> <p>3.8 Evaluate water management practices, recommending strategies such as rainwater harvesting, water-efficient systems, and erosion control measures to prevent water pollution and conserve resources.</p> <p>3.9 Promote the use of circular economy principles in construction, encouraging the reuse and recycling of materials, reducing the need for new raw materials, and minimizing waste generation.</p>
<p><b>4. Recognize and apply environmental laws and guidelines in construction projects to reduce the ecological footprint of civil engineering practices.</b></p>	<p>4.1. Identify relevant environmental laws, guidelines, and regulations (e.g., Environmental Protection Agency (EPA) standards, local environmental ordinances, ISO 14001) that govern construction projects and ensure compliance throughout the project lifecycle.</p>

- 4.2. Understand and apply environmental regulations related to air quality, water quality, waste management, and noise control, ensuring that construction activities do not violate environmental protection standards.
- 4.3. Implement practices to reduce the ecological footprint of construction projects, such as using sustainable materials, reducing energy consumption, and minimizing construction waste.
- 4.4. Conduct environmental impact assessments (EIA) at the planning stage to identify potential environmental risks and determine the necessary mitigation measures to minimize adverse effects on ecosystems, water resources, and air quality.
- 4.5. Ensure that all construction activities comply with regulations governing the preservation of natural habitats, wildlife, and biodiversity, including avoiding or minimizing damage to sensitive areas such as wetlands, forests, and protected species habitats.
- 4.6. Develop and implement site-specific environmental management plans (EMP) that outline strategies to comply with legal requirements and reduce environmental impacts during construction, including erosion control, waste management, and pollution prevention.
- 4.7. Ensure proper waste management practices, including segregation, recycling, and disposal, in accordance with local and international waste management regulations.
- 4.8. Apply best practices for soil and water conservation, such as implementing silt fences, sediment basins, and stormwater management systems, to prevent pollution from runoff and protect local water bodies.
- 4.9. Promote the use of low-impact construction techniques, such as minimizing land disturbance, reducing the use of toxic chemicals, and adopting energy-efficient practices in the construction process.

**CE0004 -5: Project Management Fundamentals**

The aim of this study unit is to provide learners with essential project management skills necessary for successfully planning, executing, and monitoring civil engineering projects. This unit focuses on developing the ability to create detailed project schedules, allocate resources effectively, and manage project costs within budget.

Learning Outcome:	Assessment Criteria:
<p><b>1. Apply basic project management principles to plan, execute, and monitor civil engineering projects effectively.</b></p>	<ol style="list-style-type: none"> <li>1.1. Define project scope, objectives, and deliverables to ensure a clear understanding of the project's goals, timeline, and resources required.</li> <li>1.2. Develop a detailed project plan, including tasks, milestones, and timelines, using tools like Gantt charts or project management software (e.g., MS Project, Primavera).</li> <li>1.3. Identify and allocate resources (e.g., labor, materials, equipment) to ensure that the project progresses efficiently and within budget.</li> <li>1.4. Assess and manage project risks by identifying potential issues early on and developing strategies for risk mitigation, such as contingency planning or alternative solutions.</li> <li>1.5. Establish a project budget, accounting for all costs including labor, materials, equipment, and overhead, and monitor expenses throughout the project's lifecycle.</li> <li>1.6. Coordinate and communicate with stakeholders (e.g., clients, contractors, suppliers, and regulatory bodies) to ensure that all parties are aligned with project objectives and timelines.</li> <li>1.7. Implement quality control processes to ensure that construction work meets technical specifications, standards, and regulations.</li> <li>1.8. Monitor project progress regularly through status updates, progress reports, and performance metrics to ensure the project stays on track.</li> <li>1.9. Handle project changes and variations by assessing their impact on time, cost, and resources, and adjusting the plan accordingly.</li> <li>1.10. Ensure compliance with health, safety, and environmental regulations during all stages of the project.</li> <li>1.11. Use project management tools to</li> </ol>

	<p>track progress, manage documentation, and resolve issues that arise during construction.</p> <p>1.12. Close the project effectively by completing all deliverables, obtaining approvals, and conducting post-project reviews to assess performance and identify lessons learned.</p>
<p><b>2. Develop project schedules and timelines, allocating resources (e.g., labor, materials, equipment) efficiently to meet deadlines and budgets.</b></p>	<p>2.1 Break down the project into smaller tasks and deliverables, establishing a clear timeline for each phase and sub-phase of the project.</p> <p>2.2 Use project management tools, such as Gantt charts, critical path method (CPM), or project scheduling software (e.g., MS Project, Primavera); to create a detailed schedule that includes all tasks, dependencies, and milestones.</p> <p>2.3 Estimate the duration for each task, considering the complexity of the work, resource availability, and potential risks or delays.</p> <p>2.4 Identify the critical path, ensuring that the tasks on this path are prioritized to avoid delays and meet overall project deadlines.</p> <p>2.5 Allocate resources (e.g., labor, materials, and equipment) to each task based on project requirements and availability, ensuring that all resources are used efficiently without overloading any team or individual.</p> <p>2.6 Coordinate with suppliers, subcontractors, and other stakeholders to ensure timely delivery of materials and equipment, avoiding delays in the project schedule.</p> <p>2.7 Monitor resource usage regularly to ensure that the project stays within budget and that no resources are being wasted or underutilized.</p> <p>2.8 Adjust the schedule as needed to accommodate unforeseen changes, delays, or resource shortages, ensuring that the project can still meet deadlines without compromising quality or safety.</p> <p>2.9 Plan for contingencies by adding buffer times or resources for high-risk tasks or phases that may experience delays or challenges.</p>

<p><b>3. Monitor project costs and understand financial management techniques, including cost estimation, budgeting, and controlling project expenditures.</b></p>	<p>3.1 Develop a comprehensive project budget that includes all anticipated costs such as labor, materials, equipment, overhead, permits, and contingencies, ensuring alignment with the project scope and objectives.</p> <p>3.2 Use cost estimation techniques, such as analogous estimating, parametric estimating, or bottom-up estimating, to predict costs for each project phase or task.</p> <p>3.3 Break down the budget into categories (e.g., direct and indirect costs) and allocate specific amounts to each category, allowing for more precise tracking and control.</p> <p>3.4 Implement financial tracking systems to monitor actual expenditures against the project budget, using software tools or spreadsheets for regular updates.</p> <p>3.5 Monitor project costs on an ongoing basis, reviewing invoices, receipts, and time logs to ensure that expenses are in line with the budgeted amounts.</p> <p>3.6 Identify cost variances early, assessing the reasons for discrepancies (e.g., scope changes, material price fluctuations, resource inefficiencies), and take corrective action to prevent budget overruns.</p> <p>3.7 Maintain contingency funds to account for unexpected costs, adjusting the project budget as necessary to accommodate unforeseen circumstances without jeopardizing the overall financial health of the project.</p> <p>3.8 Regularly communicate with stakeholders about the financial status of the project, providing clear and concise cost reports that highlight key budget metrics, variances, and financial risks.</p> <p>3.9 Use financial management techniques, such as earned value management (EVM), to track cost performance and forecast potential financial challenges or opportunities.</p>
<p><b>4. Assess and manage risks in civil engineering projects, implementing mitigation strategies to minimize delays or budget overruns.</b></p>	<p>4.1 Identify potential risks early in the project lifecycle, including technical, financial, environmental, and organizational risks, using tools such as risk assessments, brainstorming sessions, and expert judgment.</p>



- 4.2 Categorize risks based on their likelihood and potential impact, using a risk matrix to prioritize them and focus on high-impact, high-probability risks.
- 4.3 Develop a risk management plan that outlines risk mitigation strategies, roles and responsibilities, and procedures for responding to and managing risks throughout the project.
- 4.4 Use qualitative and quantitative risk analysis techniques (e.g., Monte Carlo simulations, sensitivity analysis) to assess the potential impact of identified risks on project timelines, costs, and quality.
- 4.5 Implement proactive risk mitigation measures such as redesigning high-risk components, purchasing insurance, or using contingency funds to cover unforeseen costs.
- 4.6 Monitor risks throughout the project lifecycle, regularly reviewing and updating the risk register to capture new risks and track the status of existing ones.
- 4.7 Establish clear communication channels to ensure that all stakeholders, including contractors, suppliers, and team members, are aware of identified risks and mitigation measures.
- 4.8 Address resource risks by ensuring proper allocation of materials, labor, and equipment, and ensuring that adequate reserves are in place to handle any shortages or delays.
- 4.9 Apply project scheduling techniques, such as buffer times or critical path analysis, to account for potential delays caused by risks and ensure that deadlines can still be met.

**CE0004 -6: Civil Engineering Drawing and CAD**

The aim of this study unit is to equip students with the skills and knowledge required to create precise technical drawings and designs for civil engineering projects using both traditional methods and modern Computer-Aided Design (CAD) software. This unit aims to develop students' ability to interpret complex engineering plans, understand key dimensions and specifications, and produce high-quality design documentation that is essential for planning, permitting, and construction.

Learning Outcome:	Assessment Criteria:
<p><b>1. Create accurate technical drawings of civil engineering designs using traditional drawing methods and modern CAD (Computer-Aided Design) software.</b></p>	<ul style="list-style-type: none"> <li>1.1. Understand the principles of technical drawing, including standard drawing conventions, symbols, and notations used in civil engineering, to ensure clarity and accuracy in design communication.</li> <li>1.2. Create precise and scaled drawings, including site plans, floor plans, elevations, sections, and detail drawings, ensuring that all necessary dimensions, materials, and specifications are clearly represented.</li> <li>1.3. Use traditional drawing methods, such as pencil, ruler, compass, and protractor, to produce clear and accurate hand-drawn designs, especially for initial sketches or conceptual designs.</li> <li>1.4. Apply appropriate line types, hatching, and shading techniques in traditional drawings to represent different materials, structures, and textures.</li> <li>1.5. Transition from hand-drawn designs to digital formats by creating detailed drawings using modern CAD software (e.g., AutoCAD, Revit, Civil 3D) to improve accuracy, efficiency, and ease of modification.</li> <li>1.6. Use CAD software to generate 2D and 3D models, ensuring that all relevant civil engineering components (e.g., roads, drainage systems, buildings, utilities) are accurately represented in the design.</li> <li>1.7. Utilize CAD features like layers, block libraries, and annotation tools to organize the drawing, make updates, and ensure that all elements are clearly labeled for construction or review.</li> <li>1.8. Ensure that CAD drawings adhere to industry standards and project specifications, including alignment with local codes, regulations, and design guidelines.</li> <li>1.9. Produce design variations and alternative</li> </ul>

	<p>options within CAD software, allowing for easy comparisons and facilitating discussions with clients or stakeholders.</p>
<p><b>2. Interpret complex engineering plans and drawings, identifying key components, dimensions, and specifications.</b></p>	<p>2.1 Analyze and interpret engineering plans, identifying key components such as structural elements, utilities, drainage systems, roads, and other critical features within the design.</p> <p>2.2 Review dimensions, scales, and reference points in drawings to ensure that all measurements align with the actual site conditions and project requirements.</p> <p>2.3 Recognize and understand various symbols, notations, and abbreviations used in engineering drawings to represent materials, equipment, and construction methods.</p> <p>2.4 Identify different types of drawings (e.g., site plans, elevations, sections, detail drawings) and understand their specific purpose within the overall project design.</p> <p>2.5 Examine material specifications listed in the drawings, ensuring that the correct materials are chosen and are consistent with project requirements, codes, and standards.</p> <p>2.6 Interpret sectional views and detail drawings to understand the internal components, connections, and assembly of structures, ensuring proper construction methods and material use.</p> <p>2.7 Assess alignment, grading, and leveling information in site plans to ensure proper preparation for construction, taking into account soil conditions, drainage, and elevation changes.</p> <p>2.8 Cross-reference the drawings with project documents (e.g., specifications, contracts, and schedules) to confirm that all design elements are correctly represented and coordinated.</p> <p>2.9 Identify potential conflicts or discrepancies between different engineering disciplines (e.g., structural, mechanical, electrical) in the drawings and propose solutions for coordination.</p>
<p><b>3. Use CAD software to design, modify, and visualize civil engineering structures such as roads, bridges, and drainage systems.</b></p>	<p>3.1 Use CAD software (e.g., AutoCAD, Civil 3D, Revit) to create detailed 2D and 3D models of civil engineering structures, ensuring that</p>

	<p>designs meet project requirements and industry standards.</p> <p>3.2 Design roadways by defining alignment, cross-sections, profile views, and grading, incorporating design parameters such as curve radii, slopes, and road width for safe and efficient traffic flow.</p> <p>3.3 Develop bridge designs, including structural elements such as piers, beams, and foundations, and assess load distribution and support mechanisms to ensure stability and safety.</p> <p>3.4 Model drainage systems using CAD software to design stormwater management features such as culverts, drains, retention basins, and outfalls, ensuring compliance with local codes and hydrological considerations.</p> <p>3.5 Integrate geospatial data, such as topographic maps or survey data, into the CAD platform to create accurate models that reflect real-world site conditions and elevations.</p> <p>3.6 Use CAD tools to calculate and visualize quantities of materials required for construction, such as earthworks, paving, or concrete, to aid in resource planning and budgeting.</p> <p>3.7 Modify existing designs based on project changes, feedback, or new site information, ensuring that all adjustments are accurately reflected in updated drawings and models.</p> <p>3.8 Visualize designs in 3D to evaluate spatial relationships, structural integrity, and aesthetics, providing stakeholders with a clear understanding of the proposed structures.</p> <p>3.9 Perform clash detection and conflict resolution in CAD models, identifying and addressing potential issues where components or systems intersect, such as utility lines, foundations, or structural elements</p>
<p><b>4. Produce clear and detailed design documentation that can be used for project planning, permitting, and construction.</b></p>	<p>4.1 Prepare comprehensive design documentation that includes all relevant drawings, specifications, and calculations necessary for project planning, permitting, and construction.</p> <p>4.2 Develop clear and detailed site plans that</p>

show the layout of structures, utilities, access routes, and landscaping, with appropriate dimensions, scales, and annotations.

- 4.3 Produce accurate structural drawings that include foundations, beams, columns, and other load-bearing elements, ensuring that all structural details are represented with precision.
- 4.4 Create detailed drainage and utility plans that include stormwater management systems, water and sewer lines, and other essential infrastructure, ensuring compliance with local codes and environmental standards.
- 4.5 Include material specifications in the documentation, specifying the types, grades, and quantities of materials required for construction, as well as installation methods and standards.
- 4.6 Provide detailed cross-sections, elevations, and profiles for civil engineering components such as roads, bridges, and retaining walls, ensuring that these components are well-represented from different perspectives.
- 4.7 Ensure that all documentation meets local and international building codes, industry standards, and environmental regulations, incorporating necessary approvals and compliance information.
- 4.8 Include construction sequencing and methodology in the documentation to guide contractors through the construction process, ensuring proper construction techniques and safety procedures.
- 4.9 Compile environmental impact assessments (EIA) or sustainability reports as part of the documentation to address environmental concerns, mitigation strategies, and compliance with regulations.

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