

# DESIGN WASTEWATER COLLECTION AND TREATMENT INFRASTRUCTURE

**UNIT CODE:** CON/OS/CET/CR/09/6/A

## UNIT DESCRIPTION

This unit covers the competencies required to design wastewater collection and treatment infrastructure. It involves collection of wastewater infrastructure design data, analysis of wastewater infrastructure design data, and calculation of wastewater infrastructure design parameters, drawing wastewater infrastructure units and compiling wastewater infrastructure design report.

This standard applies in Water Industry.

## ELEMENTS AND PERFORMANCE CRITERIA

<b>ELEMENT</b> These describe the <b>key outcomes</b> which make up <b>workplace function</b>	<b>PERFORMANCE CRITERIA</b> These are <b>assessable</b> statements which specify the required level of performance for each of the elements.  <i>Bold and italicized terms are elaborated in the Range</i>
1 Apply hydraulic engineering principles	1.1 <i>Properties of fluids</i> are identified based on standards 1.2 <i>Tools and equipment</i> for measurement of pressure, velocity and discharge are identified based on fluid properties 1.3 Hydraulic principles are applied based on the types of fluids
2 Analyse structural elements	2.1 <i>Properties of materials</i> are identified based on the job requirements 2.2 <i>Section properties</i> are analyzed based on the materials, loading and sizes 2.3 <i>Structural elements</i> are analyzed based on material and loadings
3 Design structural elements	3.1 Structural elements are identified based on the requirements 3.2 Structural elements are designed based on design codes 3.3 Structural drawings are produced based on the design.
4 Collect wastewater infrastructure design data	4.1 Area to be surveyed is mapped out based on job requirements/specification. 4.2 <i>Tools for data collection</i> are prepared based on information required. 4.3 <i>Data and information</i> is collected based on tools prepared.

5 Analyse wastewater infrastructure design data	<p>5.1 Data and information is arranged based on various themes.</p> <p>5.2 Data is cleaned as per best practice.</p> <p>5.3 Data is presented based on various themes.</p>
6 Calculate wastewater infrastructure design parameters	<p>6.1 <b>Design Parameters</b> to be calculated are identified based on wastewater design manual.</p> <p>6.2 <b>Tools for parameter calculation</b> are identified based on the parameter to be calculated.</p> <p>6.3 Various wastewater infrastructure design parameters are calculated based on design codes.</p>
7 Draw wastewater infrastructure units	<p>7.1 <b>Drawing tools, equipment, supplies and materials</b> are identified and gathered based on available resources and complexity of the design.</p> <p>7.2 <b>Wastewater infrastructure units</b> are drawn based on the design parameters.</p> <p>7.3 Wastewater infrastructure drawings are submitted for approval as per legal requirements.</p>
8 Compile wastewater infrastructure design report	<p>8.1 Design report format is obtained from the wastewater design manual.</p> <p>8.2 Design report is prepared based on identified format.</p> <p>8.3 Design report is submitted to the client as per best practice.</p>

## RANGE

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

Variables	Range
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<p>Hydraulic principles may include but is not limited to:</p>	<ul style="list-style-type: none"> <li>• Flow in pipes</li> <li>• Flow in open channels</li> <li>• Hydrostatics <ul style="list-style-type: none"> <li>○ Statement of Pascal’s law,</li> <li>○ Hydraulic jack,</li> <li>○ Total pressure and centre of pressure; horizontally immersed plane surface, vertically immersed plane surface, inclined immersed plane surface),</li> </ul> </li> <li>• Hydrodynamics <ul style="list-style-type: none"> <li>○ Basic definitions; area of flow, mean velocity, rate of flow.</li> <li>○ Types of flow in pipes; steady and unsteady, uniform and non- uniform, laminar and turbulent, compressible and incompressible flow.</li> <li>○ Flow equations; discharge equation, continuity equation, Bernoulli’s equation.)</li> <li>○ Flow in pipes</li> </ul> </li> <li>• Flow in open channels</li> </ul>
<p>Structural elements may include but is not limited to:</p>	<ul style="list-style-type: none"> <li>• Stress</li> <li>• strain</li> <li>• General slope and deflection formula,</li> <li>• Double integration</li> <li>• McCauley’s method</li> <li>• Mohr’s theorems</li> </ul>
<p>Fluid properties may include but is not limited to:</p>	<ul style="list-style-type: none"> <li>• Density</li> <li>• Surface Tension</li> <li>• Viscosity</li> <li>• Specific Weight</li> <li>• Specific Gravity</li> <li>• Compressibility</li> <li>• Capillarity</li> <li>• Specific Mass</li> </ul>

<p>Tools and equipment may include but is not limited to:</p>	<ul style="list-style-type: none"> <li>• Manometers</li> <li>• Venturi meter</li> <li>• Orifice meter</li> <li>• Pitot Tube</li> <li>• Weirs</li> <li>• Notches</li> <li>• Mouth Pieces</li> <li>• Orifices</li> <li>• Hydrostatic Bench</li> <li>• Open Channel Models</li> </ul>
<p>Properties of material may include but not limited to</p>	<ul style="list-style-type: none"> <li>• Stress</li> <li>• Strain</li> <li>• Elasticity</li> <li>• Plasticity</li> <li>• Stiffness</li> <li>• Young's modulus</li> </ul>
<p>Section Properties of materials may include but not limited to</p>	<ul style="list-style-type: none"> <li>• Centroids</li> <li>• Centre of gravity</li> <li>• 1<sup>st</sup> moment of area</li> <li>• 2<sup>nd</sup> moment of area</li> <li>• Section modulus</li> <li>• Radius of gyration</li> </ul>

<p>Structural elements may include but not limited to</p>	<ul style="list-style-type: none"> <li>• Beams (Simply supported Beams)</li> <li>• Columns (Short columns, centrally, axially, loaded and eccentrically loaded, uniaxial, biaxial bending)</li> <li>• (Floors) Slabs (one way spanning and two way spanning, suspended slabs)</li> <li>• Foundations (isolated footing/ pad footing and strip footing)</li> <li>• Timber Grading (Visual, machine, stress grading, Stresses: Grade, Basic, wet, dry timber, permissible strength)</li> <li>• Struts</li> <li>• Ties</li> <li>• Purlins</li> <li>• Joists</li> <li>• Steel</li> <li>• Struts</li> <li>• Ties</li> <li>• Purlins</li> <li>• Joists</li> <li>• Connections (welded)</li> </ul>
<p>Wastewater infrastructure units may include but not limited to:</p>	<ul style="list-style-type: none"> <li>• Sewer</li> <li>• Screen</li> <li>• Grit chamber-horizontal, aerated/spiral</li> <li>• Sedimentation tanks</li> <li>• Activated sludge system</li> <li>• Trickling filters(rock and plastic)</li> <li>• Ponds</li> <li>• Oxidation ditch</li> <li>• Aerated lagoons</li> <li>• Storm water drains</li> <li>• Equalization tank</li> <li>• Sequential Batch Reactor</li> <li>• Rotating biological contactors</li> <li>• Oil and grease trap</li> </ul>

<p>Drawing tools, equipment, supplies and materials may include but not limited to:</p>	<ul style="list-style-type: none"> <li>• Software</li> <li>• Pencils</li> <li>• Ruler</li> <li>• T-square</li> <li>• Scale rule</li> <li>• Eraser</li> <li>• Set square</li> <li>• Drawing board</li> <li>• Masking tapes</li> <li>• Drawing paper</li> <li>• Photocopying /printing papers</li> <li>• Computer</li> <li>• Printer</li> <li>• Photocopiers</li> </ul>
<p>Tools for parameter calculation may include but not limited to:</p>	<ul style="list-style-type: none"> <li>• Theodolite</li> <li>• Dumpy level</li> <li>• GPS</li> <li>• Total station</li> <li>• Levelling staff</li> <li>• Booking sheet</li> <li>• Soil sampler</li> <li>• Adequately equipped soil mechanics laboratory</li> <li>• Flow Measuring structures and devices</li> <li>• Stop watch</li> <li>• Questionnaires</li> </ul>
<p>Tools for data collection may include but not limited to:</p>	<ul style="list-style-type: none"> <li>• Stop watch</li> <li>• Checklists</li> <li>• Questionnaires</li> <li>• Stationery</li> <li>• Sampling equipment</li> </ul>
<p>Data and information may include but not limited to:</p>	<ul style="list-style-type: none"> <li>• Population size</li> <li>• Flow rate</li> </ul>

## REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit of competency.

### Required Skills

The individual needs to demonstrate the following skills:

- Communication
- Analytical
- Organizing
- Decision making
- Planning
- Record keeping
- Problem solving
- First aid
- Supervising
- Organizing
- Time management
- Analysis
- Reporting
- Performance appraising
- Trouble shooting
- Data logging
- Surveying
- Technical drawing
- Computer Aided Design

### **Required Knowledge**

The individual needs to demonstrate knowledge of:

- Technical specifications
- Statutory regulations
- Occupational health and safety
- Quality Assurance
- Wastewater treatment technologies
- Statistics
- Wastewater treatment processes
- Soil analysis methods
- Hydraulics skills
- Statutory regulations and legislation in water

### **EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> <li>1.1 Applied hydraulic engineering principles</li> <li>1.2 Analysed structural elements</li> <li>1.3 Designed structural elements</li> <li>1.4 Collected wastewater infrastructure design data</li> <li>1.5 Analysed wastewater infrastructure design data</li> <li>1.6 Calculated wastewater infrastructure design parameters</li> <li>1.7 Drew wastewater infrastructure units</li> <li>1.8 Compiled wastewater infrastructure design report</li> </ul>
<p>2. Resource Implications</p>	<p>The following resources <b>must</b> be provided:</p> <ul style="list-style-type: none"> <li>2.1 Computer lab</li> <li>2.2 Plumbing and pipefitting workshop</li> <li>2.3 GIS Software</li> <li>2.4 Water laboratory</li> <li>2.5 Drawing room</li> <li>2.6 CAD software</li> <li>2.7 Printer</li> </ul>
<p>3. Methods of Assessment</p>	<p>Competency may be assessed through:</p> <ul style="list-style-type: none"> <li>3.1 Practical</li> <li>3.2 Verbal assessment</li> <li>3.3 Written assessment</li> <li>3.4 Design reports</li> <li>3.5 Oral interview</li> <li>3.6 Presentation</li> </ul>
<p>4. Context of Assessment</p>	<p>Assessment may be done:</p> <ul style="list-style-type: none"> <li>4.1 On job training</li> <li>4.2 Course work</li> <li>4.3 Projects (design/research projects)</li> <li>4.4 Industrial assessment</li> </ul>
<p>5. Guidance information for assessment</p>	<p>Holistic assessment with other units relevant to the building sector workplace and job role is recommended.</p>