Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

FULL SOIL IDENTIFICATION AND IN SITU DRY DENSITY TEST

PWOSI401

Perform full soil identification and in situ dry density tests

Competence

RQF Level: 4

Learning Hours



80

Credits: 8

Sector: Construction and Building Services

Trade: Public Works

Module Type: Specific

Curriculum: CBS PWO4001 TVET CERTIFICATE IV in Public Works

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<table>
<tr><td>Purpose statement</td><td colspan="6">This module describes the knowledge, skills, and attitudes required to conduct full soil identification tests and in situ density test. It is intended for learners pursuing RQF Level IV in public works. At the end of this module, learners will be able to take material samples, select tools and equipment, prepare samples, perform sieve analysis test, Perform Moisture Content test, Perform Specific Gravity Test, Perform Atterberg Limits Test, Perform Proctor Test, Perform CBR Test, and Perform In Situ Dry Density Test (sand replacement).</td></tr>
<tr><td>Learning assumed to be in place</td><td colspan="6">N/A</td></tr>
<tr><td rowspan="6">Delivery modality</td><td colspan="2">Training delivery</td><td>100%</td><td colspan="2">Assessment</td><td>Total 100%</td></tr>
<tr><td colspan="2">Theoretical content</td><td>30%</td><td rowspan="4">Formative assessment</td><td>30%</td><td rowspan="4">50%</td></tr>
<tr><td colspan="2">Practical work:</td><td rowspan="3">70%</td><td rowspan="3">70%</td></tr>
<tr><td>• Group work and presentation</td><td>30%</td></tr>
<tr><td>• Individual work</td><td>40%</td></tr>
<tr><td colspan="3"></td><td colspan="2">Summative Assessment</td><td>50%</td></tr>
</table>

Elements of Competency and Performance Criteria

Elements of competency	Performance criteria
1. Perform Sieve Analysis Test	1.1. Standard test method is properly identified according to the material to be tested.
	1.2. Tools, materials and equipment are properly selected in reference with the standards.
	1.3. Soil material is correctly sampled in reference with the standards.
	1.4. Soil sample is properly prepared in reference with the standards.
	1.5. Sieve analysis test data are correctly analyzed in accordance with the recorded data.
	1.6. Sieve analysis test results are properly reported in accordance with the standards.
2. Perform Moisture Content Test	2.1. Standard test method is properly identified according to the material to be tested.

	2.2. Tools, materials and equipment are properly selected in reference with the standards.
	2.3. Soil sample is correctly sampled in reference with the standards.
	2.4. Soil sample is properly prepared in reference with the standards.
	2.5. Moisture content test data are correctly analyzed in accordance with the recorded data.
	2.6. Moisture content test results are properly reported in accordance with the standards.
3. Perform Specific Gravity Test	3.1. Standard test method is properly identified according to the material to be tested.
	3.2. Tools and equipment are properly selected in reference with the standards.
	3.3. Soil sample is correctly sampled in reference with the standards.
	3.4. Soil sample is properly prepared in reference with the standard.
	3.5. Specific gravity test data are correctly analyzed in accordance with the recorded data.
	3.6. Specific gravity test results are properly reported in accordance with the standards.
4. Perform Atterberg Limits Test	4.1. Standard test method is properly identified according to the material to be tested.
	4.2. Tools and equipment are properly selected in reference with the standards.
	4.3. Soil sample is correctly sampled in reference with the standard.
	4.4. Soil sample is properly prepared in reference with the standard.
	4.5. Atterberg limits test data are correctly analysed in accordance with the recorded data.
	4.6. Atterberg limits test results are properly reported in accordance with the standards.
5. Perform Proctor Test	5.1. Standard test method is properly identified according to the material to be tested.
	5.2. Tools and equipment are properly selected in reference with the standards.
	5.3. Soil sample is correctly sampled in reference with the standards.
	5.4. Soil sample is properly prepared in reference with the standards.

	5.5. Optimum moisture content and maximum dry density values test data are correctly analyzed in accordance with the recorded data.
	5.6. Optimum moisture content and maximum dry density values results are properly reported in accordance with the standards.
6. Perform CBR Test	6.1. Standard test method is properly identified according to the material to be tested.
	6.2. Tools and equipment are properly selected in reference with the standards.
	6.3. Soil sample is correctly sampled in reference with the standards.
	6.4. Soil sample is properly prepared in reference with the standards.
	6.5. CBR test data are correctly analyzed in accordance with the recorded data.
	6.6. CBR test results are properly reported in accordance with the standards.
7. Perform In Situ Dry Density Test (Sand Replacement)	7.1. Standard test method is properly identified in accordance to the material to be tested.
	7.2. Tools, equipment and materials are properly selected in reference with the standards.
	7.3. Testing points are correctly selected in reference with the standards.
	7.4. In situ dry density test value data are correctly analyzed in accordance with the recorded data.
	7.5. In situ dry density test results are properly reported in accordance with the standards.

Intended Knowledge, Skills, and Attitude

Knowledge	Skills	Attitude

✓ Test methods and standards of soil test ✓ Classify laboratory tools and equipment ✓ Interpret Mechanical Physics ✓ Determine quantities required during sampling ✓ Identify units of measurement ✓ Identify Soil properties	✓ Take Sample ✓ Perform Sieve Analysis Test ✓ Carry out soil tests ✓ Report soil test results ✓ Perform Moisture Content Test ✓ Perform Specific Gravity Test ✓ Perform Atterberg Limits Test ✓ Perform Proctor Test ✓ Perform CBR Test ✓ Perform In Situ Dry Density Test(Sand Replacement) ✓ Analyse test results ✓ Apply ICT in reporting ✓ Make a report	✓ Communicate actively at workplace ✓ Demonstrate professionalism in taking samples ✓ Be careful while performing tests ✓ Respect time in reporting

Course content

Learning outcomes	At the end of the module the learner will be able to: 1. Perform Sieve Analysis Test 2. Perform Moisture Content Test 3. Perform Specific Gravity Test 4. Perform Atterberg Limits Test 5. Perform Proctor Test 6. Perform CBR Test 7. Perform In Situ Dry Density Test(sand replacement)
Learning outcome 1: Perform Sieve Analysis Test	**Learning hours: 10hrs**

Indicative content
• **Identification of standard test methods** ✓ Definitions of terms ✓ Applicable standards ✓ Objectives of sieve analysis test ✓ Applications of sieve analysis test • **Selection of tools, materials and equipment** ✓ Classification of tools ✓ Classification of equipment ✓ Types of materials • **Sampling of soil material** ✓ Sampling techniques ✓ Characteristics of sample • **Preparation of soil sample** ✓ Sample size ✓ Sample quartering • **Analysis of Sieve analysis test data** ✓ Test procedures of sieve analysis ✓ Calculation of sieve analysis test ✓ Drawing of sieve analysis curves • **Reporting sieve analysis test results** ✓ Identification of reports elements ✓ Elaboration of test report

Resources required for the learning outcome	
Equipment	Sieves, mechanical sieve shaker, drying oven, balance, fans, sample splitters, Computer ,hydrometer, thermometer, hygrometer
Materials	Soil, water, oil ,papers, Pens
Tools	Trowels, spatulas, Scoop, Metal pans, Trays, data sheets, log books, Wire Brush, shovel, buckets, Buckets, Sieve brushes, wire and bristle brushes.
Facilitation techniques	Group discussion and presentation, Trainer guided, brainstorming , demonstration and simulation, individual and group work, practical exercise
Formative assessment methods /(CAT)	Written assessment, oral presentation, performance assessment, Product based assessment.

Learning outcome 2: Perform Moisture Content	Learning hours: 5hrs

Indicative content

- **Identification of Standard test method of materials**
  - ✓ Definitions of terms
  - ✓ Applicable standards
  - ✓ Objectives and principals of moisture content test
  - ✓ Applications of moisture content test
- **Selection of tools, materials and equipment**
  - ✓ Classification of tools
  - ✓ Classification of equipment
  - ✓ Types of materials
- **Sampling soil materials**
  - ✓ Sampling techniques
  - ✓ Characteristics sample
- **Preparation of Soil sample**
  - ✓ Sample size
  - ✓ Sample quartering
- **Analysis of moisture content test value**
  - ✓ Test procedures of moisture content of soil
  - ✓ Calculations of moisture content value
- **Reporting moisture content test results**
  - ✓ Identification of reports elements
  - ✓ Elaboration of test report

Resources required for the learning outcome

Equipment	Drying oven, Balance
Materials	Soil specimen, water
Tools	Cans with their lids; Containers , tin or aluminium moisture cans with lids, Desiccators, riffle box, gloves, tongs, knives, spatulas, scoops, quartering cloth, sample splitters
Facilitation techniques	Group discussion and presentation, Trainer guided, brainstorming , demonstration and simulation, individual and group work, practical exercise
Formative assessment methods /(CAT)	Written assessment, oral presentation, performance assessment, Product

	based assessment.

Learning outcome 3: Perform Specific Gravity Test	**Learning hours: 15hrs**

Indicative content

- **Identification of Standard test method of materials**
  - ✓ Definitions of terms used
  - ✓ Standard method to follow
  - ✓ Objectives and principals
  - ✓ Applications of Specific gravity test
- **Selection of tools and equipment**
  - ✓ Class of tools
  - ✓ Class of equipment
- **Sampling soil materials**
  - ✓ Techniques of sampling
  - ✓ Characteristics sample
- **Preparation of Soil sample**
  - ✓ Simple size
  - ✓ Sample quartering
- **Analysis of specific gravity test value**
  - ✓ Procedures of specific gravity test
  - ✓ Calculation of specific gravity value
- **Reporting specific gravity test results.**
  - ✓ Identification of reports elements
  - ✓ Elaboration of test report

Resources required for the learning outcome

Equipment	Weighting scale, Drying oven, Vacuum pump, sample splitters
Materials	Distilled water, Soil
Tools	Spatula, Funnel, Volumetric flask (graduation mark)
Facilitation techniques	Group discussion and presentation, Trainer guided, brainstorming , demonstration and simulation, individual and group work, practical exercise
Formative assessment	Written assessment, oral presentation, performance assessment, Product

methods /(CAT)	based assessment.

Learning outcome 4: Perform Atterberg Limits Test	**Learning hours: 10hrs**

Indicative content

- **Identification of Standard test method of materials**
  - ✓ Definitions of terms
  - ✓ Applicable standards
  - ✓ Objectives and principals of Atterberg limits test
  - ✓ Applications of Atterberg limits test
- **Selection of tools, materials and equipment**
  - ✓ Select types of tools
  - ✓ Select types of equipment
  - ✓ Select types of materials
- **Sampling soil**
  - ✓ Techniques of sampling
  - ✓ Characteristics sample
- **Preparation of Soil sample**
  - ✓ Simple size
  - ✓ Sample quartering
- **Analyzing Atterberg limits test data**
  - ✓ Procedures of Atterberg limits test
  - ✓ Calculation of Atterberg limits values
- **Reporting Atterberg limits test results**
  - ✓ Identification of reports elements
  - ✓ Elaboration of test report

Resources required for the learning outcome

Equipment	Dry oven, penetrometer, Casagrande apparatus, balance, sample splitters
Materials	Soil materials ,water, oil, papers
Tools	Sieve, airtight container, flat glass plate, spatulas, Trowels stainless steel cone, metal cup, evaporating dish, wash bottle, stopwatch, grooving tool
Facilitation techniques	Group discussion and presentation, Trainer guided, brainstorming , demonstration and simulation, individual and group work, practical exercise

Formative assessment methods /(CAT)	Written assessment, oral presentation, performance assessment, Product based assessment.

Learning outcome 5: Perform Proctor Test	**Learning hours: 20hrs**
Indicative content	

- **Identification of Standard test methods**
  - ✓ Definitions of terms
  - ✓ Applicable standards
  - ✓ Objectives and principals of Proctor test
  - ✓ Applications of proctor test
- **Selection of tools, materials and equipment**
  - ✓ Selection of tools
  - ✓ Selection of equipment
  - ✓ Selection of materials
- **Sampling soil materials**
  - ✓ Sampling techniques
  - ✓ Characteristics sample
- **Preparation of Soil sample**
  - ✓ Simple size
  - ✓ Quartering sample
- **Analyzing proctor test results**
  - ✓ Procedures of proctor test
  - ✓ Calculation of MDD and OMC
- **Reporting Proctor test results.**
  - ✓ Identification of reports elements
  - ✓ Elaboration of test results report

Resources required for the learning outcome

Equipment	Dry oven ,balance ,Proctor Cylinder mould, sample splitters
Materials	Water, Soil ,Paraffin paper , Oil
Tools	Metal rammer, Spatulas, Straightedge, Test sieves, Water proof containers, Scoop, Measuring cylinder, trowels Trays, data sheets, log books, shovel, plastic fibber bag, Galvanized bushel tubs, Buckets, brushes

Facilitation techniques	Group discussion and presentation, Trainer guided, brainstorming , demonstration and simulation, individual and group work, practical exercise
Formative assessment methods /(CAT)	Written assessment, oral presentation, performance assessment, Product based assessment.

Learning outcome 6: Perform CBR Test	**Learning hours: 10hrs**
Indicative content	

- **Identification of Standard test methods**
  - ✓ Definitions of terms
  - ✓ Applicable standards
  - ✓ Objectives and principals of CBR test
  - ✓ Applications of CBR test
- **Selection of tools, materials and equipment**
  - ✓ Selection of tools
  - ✓ Selection of equipment
  - ✓ Selection of materials
- **Sampling soil materials**
  - ✓ Sampling techniques
  - ✓ Characteristics of sample
- **Preparation of Soil sample**
  - ✓ Sample size
  - ✓ Sample quartering
- **Analyzing CBR test results**
  - ✓ Procedures of CBR test
  - ✓ Calculation of CBR test Value
- **Reporting CBR test results.**
  - ✓ Identification of report elements
  - ✓ Elaboration of test report

Resources required for the learning outcome	
Equipment	Dry oven, Balance, CBR compaction machine, sample splitters, Desiccators, Swelling gauge
Materials	Filter papers, Soil, water, Oil, Papers, pen

Tools	CBR Cylinder moulds, metal rammer, trowels, Soaking tank, Spatulas, Dial gauges, Straight edge, test sieves, water proof containers, Scoops, Measured cylinder, Trays, data sheets, log books, shovel, plastic fibber bag, brushes, Spacer disk, Surcharge weights, Slotted disk, stopwatch
Facilitation techniques	Group discussion and presentation, Trainer guided, brainstorming , demonstration and simulation, individual and group work, practical exercise
Formative assessment methods /(CAT)	Written assessment, oral presentation, performance assessment, Product based assessment.

Learning outcome 7: Perform in Situ Dry Density Test (Sand replacement)	**Learning hours: 10hrs**

Indicative content

- **Identification of Standard test methods**
  - ✓ Definitions of terms
  - ✓ Applicable standards
  - ✓ Objectives and principals of in situ dry density test
  - ✓ Applications of in situ dry density test
- **Selection of tools, materials and equipment**
  - ✓ Selection of tools
  - ✓ Selection of equipment
  - ✓ Types of materials
- **Selection of testing point**
  - ✓ Selection techniques
  - ✓ Testing interval
  - ✓ Mark selected points
- **Analyzing in situtest results**
  - ✓ Calculation of MDD
  - ✓ Degree of compaction result
- **Reporting in situ test results.**
  - ✓ Identification of in situ dry densityreports elements
  - ✓ Elaboration ofin situ dry density test report

Resources required for the learning outcome

Equipment	Sand replacement cone densitometer, membrane densitometer, balance

Materials	Sand ,soil, water, march box, gas
Tools	Spatulas, scoop, trowels, gloves, data sheets, hammer, logbooks ,plastic fibber bag, chisel
Facilitation techniques	Group discussion and presentation, Trainer guided, brainstorming , demonstration and simulation, individual and group work, practical exercise
Formative assessment methods /(CAT)	Written assessment, oral presentation, performance assessment, Product based assessment.

Integrated/Summative assessment

Integrated situation

Rwamagana District wants to upgrade its access from the main road because the existing unpaved road is too slippery in wet and dusty in dry seasons.

The project consists of raising the existing poor road by constructing additional layers. To perform this task, relevant soil tests should be conducted to determine the compaction parameters.

As a technician from ECOGIS Ltd (Contractor), you are required to perform, in 7 hours timeframe (including the presentation), In situ dry density (using sand replacement test).

Note that the Proctor test, sieve analysis test, Atterberg limits test, Specific gravity test and CBR test should have been performed before the assessment day, and their demonstration will be part of your presentation.

Other information:

- Use Light Compaction
- Refer to BS standards
- All equipment and tools are available in soil laboratory

Resources

Tools	Trowels, shovel, buckets, plastic fibber bag, Scoop, Metal pans, data sheets, brushes, sieves, march box, CBR Cylinder moulds, metal rammer, trowels, Soaking tank, Spatulas, Dial gauges, Straightedge, test sieves, water proof containers, Scoops, Measured cylinder, Trays, data sheets, log books, Spacer disk, Surcharge weights, Slotted disk, sample splitters, Trowels stainless steel cone, metal cup, evaporating dish, wash bottle.

Equipment	Dry oven, Casagrande apparatus, balance, Sand replacement cone densitometer, CBR compaction machine, Desiccators (airtight container), Swelling gauge, Vacuum pump.
Materials/ Consumables	Soil, Water, sand, papers, Oil, gas

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
1. Perform Sieve Analysis Test (10%)	Tools, materials and equipment are properly selected in reference with the standard	Tools, materials and equipment are selected			1
	Soil material is correctly sampled in reference with the standard	Sampling techniques are applied			1
	Soil sample is properly prepared in reference with the standard	Taken sample size is quartered			1
	Sieve analysis test data are correctly analyzed in accordance with the recorded data.	Sample is washed and dried			1
		Sieves shaker is set			1
		Test results are calculated			2
	Sieve analysis test results are properly reported in accordance with the standard.	Sample details and Reference procedure are reported			1
		Results curves are drawn			2
2. Perform	Tools and	Tools, materials and			1

Moisture Content Test (10%)	equipment are properly selected in reference with the standard.	equipment are selected			
	Soil sample is correctly sampled in reference with the standard.	Sampling techniques are applied			1
	Soil sample is properly prepared in reference with the standard.	Taken sample size is quartered			1
	Moisture content test data are correctly analyzed in accordance with the recorded data.	Wet sample in container is weighted			1
		Oven dried sample is weighted			1
		Moisture content is calculated			1
	Moisture content test results are properly reported in accordance with the standard.	Sample details and reference procedure are reported			1
		Moisture content is reported			2
3. Perform Specific Gravity Test (10%)	Tools and equipment are properly selected in reference with the standard.	Tools, materials and equipment are selected			1
	Soil sample is correctly sampled in reference with the standard.	Sampling techniques are applied			1
	Soil sample is properly prepared in reference with the standard.	Taken sample size is appropriately quartered			1
	Specific gravity test	Volumetric flask kit is set			1

	data are correctly analyzed in accordance with the recorded data.	Specific gravity test procedure is applied			2
		Specific gravity is Calculated			2
	Specific gravity test results are properly reported in accordance with the standard.	Sample details and Reference procedure are reported			1
		Specific Gravity is reported			1
4. Perform Atterberg Limits Test (10%)	Tools and equipment are properly selected in reference with the standard.	Tools, materials and equipment are selected			1
	Soil sample is correctly sampled in reference with the standard.	Sampling techniques are applied			1
	Soil sample is properly prepared in reference with the standard.	Taken sample size is quartered			1
	Atterberg limits test data are correctly analyzed in accordance with the recorded data.	Cassagrande kit is set			1
		Moisture content is measured			1
		Atterberg limits values and Plasticity index are calculated			2
	Atterberg limits test results are properly reported in accordance with the standard.	Sample details and Reference procedure are reported			1
		Liquid limit curve is presented			1
		Plasticity index is reported			1
5. Perform Proctor Test	Tools and equipment are	Tools, materials and equipment are selected			1

(20%)	properly selected in reference with the standard.				
	Soil sample is correctly sampled in reference with the standard.	Sampling techniques are applied			1
	Soil sample is properly prepared in reference with the standard.	Taken sample size is quartered			1
	Optimum moisture content and maximum dry density values test data are correctly analyzed in accordance with the recorded data.	Sample watering, mixing and desiccation are applied			2
		Proctor mould is filled with soil sample			2
		Sample is compacted in three layers			2
		OMC is measured and calculated			2
		maximum dry density is calculated			2
	Optimum moisture content and maximum dry density values results are properly reported in accordance with the standard.	Sample details are reported			1
		Reference procedure and method used are reported			2
		Proctor curve is drawn			2
		OMC is reported			2
		Maximum dry density is reported			2
6. Perform CBR Test (20%)	Tools and equipment are properly selected in reference with the standard.	Tools, materials and equipment are selected			1

	Soil sample is correctly sampled in reference with the standard.	Sampling techniques are applied			1
	Soil sample is properly prepared in reference with the standard.	Taken sample size is quartered			1
	CBR test data are correctly analyzed in accordance with the recorded data.	The sample in the mould is compacted			2
		Soil soaking is applied			2
		Penetration is applied			2
		Dry density value is calculated			2
		CBR value is calculated			2
		CBR value is indicated on the drawn curve			2
	CBR test results are properly reported in accordance with the standard.	Sample details and Reference procedure are reported			2
		Penetration curve is drawn			2
		CBR value is reported			2
7. Perform In Situ Dry Density Test (Sand Replacement) (20%)	Tools, equipment and materials are properly selected in reference with the standard.	Tools, materials and equipment are selected			1
	Testing points are correctly selected in reference with the standard.	Sampling technic is identified			1
		Sampling technic is applied			1
	In situ dry density test value data are	All apparatus are calibrated			2

	correctly analyzed in accordance with the recorded data.	Soil sample is excavated			2
		Soil sample is collected			2
		Wet soil sample is weighed			2
		soil sample is dried			2
		Ottawa sand is filled in a hole			2
		Ottawa sand on a glass plate is measured			2
		Workplace is cleaned			1
		MDD is calculated			2
		Degree of compaction is calculated			2
	In situ dry density test results are properly reported in accordance with the standard.	Sample details and Reference procedure are reported			2
		MDD is reported			2
		Degree of compaction is reported			2
Total marks					**100**
Percentage Weightage					**100%**
Minimum Passing line % (Aggregate):					**70%**

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