CONSTRUCTION MATERIALS TESTING COURSE

General Learning Outcome: Students will learn how to: identify various construction materials; classify various construction materials; state the use of construction materials; apply sampling procedures for various construction materials; identify testing methods and equipment; receive, handle and store samples; prepare construction materials samples for testing; carry out tests on materials; prepare test results.

Conditions: The trainee must have access to:
- Materials testing laboratory
- Samples of construction materials
- Standard specifications and procedures
- Protective wear
- Library
- Internet
- Scientific calculator

Attitudes/values - Sober Minded
- Safety conscious
- Good communication
- Patience
- Minimum supervision
- Neatness
- Confidentiality

Assessment Methods: To achieve the above assessment the trainee will be given
- Individual/group assignment
- Class tests
- Exercises
- Practical
UNIT A1.1 IDENTIFYING VARIOUS CONSTRUCTION MATERIALS

Learning Activities: The Trainer must ensure that the learning activities for the trainee include the following:

1. Identifying different types of construction materials
   - **Metals**
     - Atomic structure of iron and aluminium; Alloys of iron and aluminium; Crystalline structure of metals
   - **Timber**
     - Structure of wood
     - Properties and use of timber
   - **Soils**
     - Structure of soils; Formation of soils; Bulk properties
   - **Masonry**
     - Distinguish between blocks and bricks
   - **Concrete**
     - Mixture of cement, aggregate and water
     - Admixtures
   - **Bituminous products**
     - Bitumen - sources (natural, petroleum), types,
     - Asphalt - its constituents, Hot mix, cold mix
   - **Polymers**
     - Explanation of polymerization
     - Types of polymers (thermosetting and thermoplastic)
     - Uses eg dust arrester, soil stabilization, prevent setting of cold asphalt

2. Characteristics and properties of construction materials.
   - **Metals**
     - Mechanical properties (tensile strength); ductility; softness; young’s modulus
   - **Timber**
     - Weight; thermo conductivity
   - **Soils**
Compressive strength; Water absorption

- **Concrete**
  Compressive strength; soundness

- **Bituminous products**
  Viscosity; Penetration; Softening point

- **Polymers**
  Viscosity; temperature

3. **Testing the strength of construction materials.**

  - **Metals**
    Tensile tests

  - **Timber**
    Moisture content; Weight; Tensile strength

  - **Soils**
    Atterberg limits; Density, (laboratory and field); California Bearing Ratio; Unconfined Compression stress

  - **Masonry**
    Compressive strength; Water absorption

  - **Concrete**
    Destructive tests (compressive strength); Non-destructive tests (schmidt hummer); Slump test

  - **Bituminous products**
    Viscosity (saybolt, Brookfield); Penetration; Softening point; Binder extraction

  - **Polymers**
    Viscosity; Temperature

4. **Production of construction materials.**

  - **Bitumen**
  - **Asphalt**
  - **Slurry**
  - **Concrete**
    Classes of concrete and their different units eg C25
• Bricks
  o Raw materials; Manufacture by heating and stabilisation; Standards
• Blocks
  o Raw materials; Standards

Assessment Criteria
• Different types of metals identified correctly
• Characteristics and properties of metals identified correctly
• Structure of metals appreciated
• Strength of metals examined correctly
• The behaviour of metals in service explained correctly
• Metallic materials for construction selected correctly
• Different types of construction materials identified correctly.
• Characteristics and properties of construction materials analysed correctly.
• Strength of construction materials examined correctly.
• Production of construction materials explained correctly

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UNIT A1.2: CLASSIFYING VARIOUS CONSTRUCTION MATERIALS

Nominal Duration:

Learning Activities: The Trainer must ensure that the learning activities for the trainee include the following:

  o Classifying different types of steel
    Mild steel; High tensile steel
  • Classifying different types of soil
    Gravel; Sand; Silt; Clay
  • Classifying different types of bitumen
    Emulsions; penetration grade
  • Classifying different types of timber
    Softwood; hardwood
  • Classify different types of concrete
    Structural concrete; lean concrete

Assessment Criteria
• Soil types identified correctly
• Formation and sampling of soils shown correctly
• Bulk properties defined correctly
UNIT A1.3: STATING THE USE OF CONSTRUCTION MATERIALS

Nominal Duration:

Learning Activities: The Trainer must ensure that the learning activities for the trainee include the following:

- **State the usage of steel**
  - Reinforcement in e.g. beams, columns, slabs, foundations.
  - Metal fabrication

- **State the appropriate soil to use**
  - Gravel
    - Roads; Foundations
  - Clay
    - bricks
  - Sand
    - Mortar; Making blocks; plastering

- **State the appropriate type of bitumen to use**
  - Emulsions
    - Slurry; Priming; Sprays eg fog spray
  - Penetration grade
    - Asphalt; roof seals

- **State the appropriate timber to use**
  - Softwood
    - Roof; Doors; Scaffolding; Electric poles; Ceiling; Formwork
  - Hardwood
    - rail line sleepers; furniture; flooring

- **State the use of different types of concrete**
  - Lean concrete
    - Floors; kerbs; Structural concrete; Beams; Suspended slabs; Columns; beams

Assessment Criteria

- State the usage of steel accordingly
- State the appropriate soil to use correctly
- State the appropriate type of bitumen to use correctly
- State the appropriate timber to use correctly
- State the use of different types of concrete as required
UNIT A2.1: APPLYING SAMPLING PROCEDURES

Nominal Duration:

Learning Activities: The Trainer must ensure that the learning activities for the trainee include the following:

- Definition of sampling
- Identification of appropriate standard methods for sampling. e.g. BS 1377
- Apply sampling procedures
  - Steel
    - Random sampling
  - Soil
    - Rifling and Quartering
    - Equipment and tools, e.g. hand auger; boring; Rifle Box
- Bituminous products
  - Random sampling
- Timber
  - Random sampling
- Concrete
  - Random sampling from fresh concrete
- Masonry
  - Random sampling; blocks and bricks

Assessment Criteria

- Applying sampling procedure for steel correctly
- Applying sampling procedure for soils correctly
- Applying sampling procedure for Bitumen correctly
- Applying sampling procedure for Timber as required
- Applying sampling procedure for Concrete correctly
- Applying sampling procedure for Masonry correctly
UNIT A2.2 RECEIVING, HANDLING AND STORING SAMPLES

Nominal Duration:

Learning Activities: The Trainer must ensure that the learning activities for the trainee include the following:

- Receiving samples
  - Capture details of the client and the sample; Labelling

- Handling and storage
  - Steel and the Moisture free environment
  - Soil - Disturbed and undisturbed samples

- Bituminous products
  - Asphalt
    - Tight containers
    - Away from heat sources
  - Bitumen
    - Tight containers
    - Away from heat sources

- Timber
  - Moisture free environment

- Fresh Concrete
  - Prepare & curing of cubes

- Masonry
  - Bricks & Blocks

Assessment Criteria

1. Receiving of samples correctly explained
2. Handling samples correctly explained
3. Storing samples correctly explained

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UNIT A2.3 PREPARING SAMPLES FOR TESTING

Nominal Duration:

Learning Activities: The Trainer must ensure that the learning activities for the trainee include the following:
Preparing steel samples for testing
Cutting; measurements
Preparation soil samples for testing
Drying; Quartering and rifling; Washing; Soaking; weighing
Preparation Bitumen samples for testing
Weighing; Heating; Cooling
Preparation Timber samples for testing
Cutting; weighing
Preparation Concrete samples for testing
- Fresh concrete: Cubes; measurements; weighing
- Hardened concrete: Core; measurements; weighing
Preparation Masonry samples for testing
Measurements; weighing

Assessment Criteria
1. Prepare steel samples for testing correctly
2. Prepare soil samples for testing correctly
3. Prepare Bitumen samples for testing correctly
4. Prepare Timber samples for testing correctly
5. Prepare Concrete samples for testing correctly
6. Prepare Masonry samples for testing correctly.

MODULE MAT-03-A MATERIALS TESTING
UNIT 3.1 IDENTIFYING TESTING METHODS AND EQUIPMENT

Nominal Duration:

Learning Activities: The Trainer must ensure that the learning activities for the trainee include the following:

- Identifying testing methods and equipment for steel
  - Test: tensile stress
    - Equipment: UTM; Tensometer

- Identifying testing methods and equipment for soil
  - Tests: Density of soil particles; Moisture content; Particle size distribution; Atterberg Limits; Compaction; California Bearing Ratio (CBR); Density by Sand replacement; Unconfined compression test
    - Equipment: Pyknometer; Oven; Balance; Sieves; Sieve shaker; Desiccators; Glass plate; Casagrande; Cone Penetrometer;
Identifying testing methods and equipment for Bitumen

Tests: - Penetration; Softening Point; Marshall stability; Extraction; Saybolt; Binder content;

Equipment: - Bitumen penetrometer; Ring and Ball; Water bath; Thermometers; Marshall machine; Saybolt Viscometer; Hot plate; Asphalt centrifuge extractors; Reflux extractor; Core drilling machine

Identifying testing methods and equipment for Timber

Tests: - Moisture content; Density

Equipment: - Oven; Balance

Identifying testing methods and equipment for Concrete and aggregates

Tests: - Density of aggregates; Water absorption; Sieve analysis; Soundness Sodium Sulphate; Flakiness; Elongation; Aggregate crushing value; Ten percent fines value; Loss Angeles abrasion; Slump; Compressive strength

Equipment: - Balance; Tamping rods; Slump cone sets; Moulds; Compression machine; Flakiness gauge; Elongation gauge; Loss Angeles abrasion machine

Identifying testing methods and equipment for Masonry

Tests: - Compressive strength; Water absorption

Equipment: - Compression machine; Balance; Water bath

Assessment Criteria

1. identify testing methods and equipment for steel correctly
2. identify testing methods and equipment for soil correctly
3. identify testing methods and equipment for Bitumen correctly
4. identify testing methods and equipment for Timber correctly
5. identify testing methods and equipment for Concrete correctly
6. identify testing methods and equipment for Masonry correctly

UNIT 3.2 CARRYING OUT TESTS ON CONSTRUCTION MATERIALS

Nominal Duration:

Learning Activities: The Trainer must ensure that the learning activities for the trainee include the following:

- Carry out the following tests on steel
  Tensile stress
Carry out the following tests on soil
- Moisture content; Particle size distribution; Atterberg Limits; California Bearing Ratio (CBR); Density by Sand replacement; Unconfined compression test; Density by Sand replacement

Carry out the following tests on Bitumen
- Penetration; Softening Point; Marshall stability; Extraction; Say bolt; Binder content; Compressive strength

Carry out the following tests on Timber
- Moisture content; Density

Carry out the following tests on Concrete
- Density of aggregates; Water absorption; Sieve analysis; Soundness; Sodium Sulphate; Flakiness; Elongation; Aggregate crushing value; Ten percent fines value; Loss Angeles abrasion; Slump; Compressive strength

Carry out the following tests on Masonry
- Compressive strength; Water absorption

Assessment Criteria
- identify testing methods and equipment for steel correctly
- identify testing methods and equipment for soil correctly
- identify testing methods and equipment for Bitumen correctly
- identify testing methods and equipment for Timber correctly
- identify testing methods and equipment for Concrete correctly
- identify testing methods and equipment for Masonry correctly

UNIT 3.3 PREPARING TEST RESULTS

Nominal Duration:

Learning Activities: The Trainer must ensure that the learning activities for the trainee include the following:

- Recording test results
  Recording of experiment results; Calculation record forms; Computer data input

- Analysing test results
  Basic Calculations; Plotting; Computer applications and analysis of data

- Reporting test results
  Contents of the test report/certificates; Produce test reports; Produce test certificates
Assessment Criteria

- Test results correctly recorded
- Test results correctly analysed
- Test results correctly reported
- Test results correctly handled

Recommended Books:

- Elements of soil mechanics, &7th edition, G.N. Smith
- Soil mechanics, Robert craig
- Solving problems in Soil mechanics, B.H.C. Sutton
- Strength of materials and structures, John Case and A.H. Chilver
- Concise handbook of Civil Engineering V.N. Vazirani, S.P Chandula

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Conditions: The trainee must have access to:
- Library
- Literature
- Internet
- Hand outs

Assessment Methods: To achieve the above assessment the trainee will be given
- Assignment of project work,
- Written tests,
- Practical tests
Nominal Duration:

General Learning Objective: Apply construction safety standards

Learning Outcomes: On completion of this unit the trainee should be able to:
Identify causes of accidents; Explain how accidents can be avoided; Apply first aid; Apply safety; Recognise the effects of health/HIV AIDS on the industry; Identify occupational related accidents; Identify risks related to the environment

Learning Activities: The Trainer must ensure that the learning activities for the trainee include the following:

- Identifying causes of accidents
- Explaining how accidents can be avoided
- Applying first aid
- Applying safety
  Compliance and regulations; Posting of danger signs; Housekeeping; Clearing walkways; Storage of materials; Wearing protective clothing
- Identifying occupational related accidents
  - Human errors
  - Machinery
- Identifying risks existing in the environment
  Naturally courses; Process generated; Individual neglected
- Recognising the effects of health/HIV AIDS on the industry
  Impact of Environmental health on employees; Impact on productivity; Impact on family

Assessment Criteria:
- Identify causes of accidents correctly
- Explaining correctly how accidents can be avoided
- Applying first aid practically
- Applying safety practically
- Mentioning the effects of health/HIV AIDS on the industry
- Identify various occupational related accidents correctly
- Identify risks related to the environment
UNIT 4.2.A  DEMONSTRATING SAFETY PROCEDURES

Nominal Duration:

General Learning Objective:  DEMONSTRATE SAFETY PROCEDURES

Learning Outcomes: On completion of this unit the trainee should be able to:

List types of fires; Identify fire fighting equipment; Handle materials and equipment; Transport material and equipment

Learning Activities: The Trainer must ensure that the learning activities for the trainee include the following:

Listing the types of fire; Identify the various types of fire fighting equipment; Demonstrating how to handle and store materials & equipment; Demonstrating how the transport and store materials & equipment

Assessment Criteria:

- List the types of fire correctly
- Identify the various types of fire fighting equipment correctly
- Demonstrate how to handle and store materials & equipment safely
- Demonstrate how the transport and store materials & equipment safely

UNIT 4.3.A  APPLYING ENVIRONMENTAL PROTECTION MEASURES

Nominal Duration:

General Learning Objective:  APPLY ENVIRONMENTAL PROTECTION MEASURE

Learning Outcomes: On completion of this unit the trainee should be able to:

Apply environmental protection measure; State the methods of waste disposal; Explain management of waste; Recognize environmental standards

Learning Activities: The Trainer must ensure that the learning activities for the trainee include the following:
Applying environmental protection measure; Explaining the methods of waste disposal; Explaining management of waste; Outlining various environmental standards and interpreting

Assessment Criteria:

- Applying environmental protection measure correctly
- Employing methods of waste disposal correctly
- Explain how management of waste is done correctly
- Recognize environmental standards correctly

UNIT 4.4.A APPLYING QUALITY CONTROL PRACTICES

Nominal Duration:

General Learning Objective: APPLY QUALITY CONTROL PRACTISES

Learning Outcomes: On completion of this unit the trainee should be able to:

Apply Quality assurance; Apply Quality control; Apply statistical models; Apply technical aspects of quality control

Learning Activities: The Trainer must ensure that the learning activities for the trainee include the following:

- Applying Quality assurance
  - Principles
  - Standards
  - Applications

- Applying Quality control
  - Principles
  - Standards
  - Applications

- Applying statistical modes
  - Frequency Distribution
  - Average
  - Variability

- Applying technical aspects of quality control
  - Brain storming
Assessment Criteria:

- Apply Quality assurance correctly
- Apply Quality control correctly
- Apply statistical modes correctly
- Apply technical aspects of quality control correctly

Recommended Texts/Books: