Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

DRAINAGE STRUCTURES CONSTRUCTION

PWODS301

CONSTRUCT DRAINAGE STRUCTURES

Competence

RQF Level: 3

Learning Hours: 50

Credits: 5

Sector: Construction and Building Services

Trade: Public works

Module Type: Specific

Curriculum: CBSPWO3001-TVET CERTIFICATE III in Public Works

Issue Date: May 2022

1200

Purpose statement	This module describes the skills, knowledge and attitudes required to perform the construction of drainage structures. It is intended for learners who have successfully completed ordinary level and pursuing level 3 in Public Works or applying for recognition of prior learning or other related qualifications. At the end of this module, learners will be able to prepare the work, excavate the trench, construct drainage system structures and apply erosion control method. Qualified learners deemed competent to this competency shall have ability to take responsibility for the carrying out of a range of defined activities in Public Works under non- directive supervision.
Leaning assumed to be in place	Safety, Health and environment at workplace; Basic technical drawing; Public works resources; Set out road alignment; Field excavation works; Masonry Works.

Delivery modality

Training delivery		**100%**	**Assessment**		**Total 100%**
Theoretical content		30%	Formative assessment	30%	50%
Practical work:		70%		70%	
• Group project and presentation	30%				
• Individual project /Work	70%				
			Summative Assessment		50%

Elements of Competency and Performance Criteria

Elements of competency	Performance criteria
1. **Prepare for work**	**1.1. Materials are properly selected in accordance with type of work**
	1.2. Tools and equipment are properly selected in accordance with type of work
	1.3. Workplace is conveniently prepared according to the work to be done
2. Excavate the trench	**2.1. Drainage structures are adequately Set according to the drawing**
	2.2. Trenches are conveniently excavated in accordance to the measurement of structure
	2.3. Trench shields are properly installed according to the site condition
3. Construct	**3.1. Subsurface drainage is properly installed according to the specification**

drainage system structures.	**3.2. Masonry drainage is adequately constructed according to the type of drain**
	3.3. Backfilling is systematically executed in accordance with specification
4. Apply erosion control method	**4.1. Erosion is properly identified according to their types**
	4.2. Vegetation are properly planted according to the types of soil
	4.3. Tools, equipment and workplace are correctly cleaned

Course content

Learning outcomes	**At the end of the module the learner will be able to:** 1. Prepare for work 2. Excavate trenches 3. Construct drainage system structures. 4. Apply erosion control method
Learning outcome 1: **Prepare for work**	**Learning hours: 10**

Indicative content

Based on the performance criteria and the extent of the learning outcome: *What, Up to, and How:*

- **Selection of materials**
  - ✓ Drain Materials and their use
  - ✓ Trench shield materials
- **Selection of tools and equipment** ***(Refer to RS ISO 45001; RS 175; RS EAS 188; RS EAS 1020; RS ISO 20347)***
  - ✓ PPE
    - Usage
    - Maintenance
  - ✓ Classification of tools and equipment for drainage and erosion control works
- **Preparation of workplace**
  - ✓ Clearing of workplace
  - ✓ Relocation of existing utilities
  - ✓ Installation of new utilities

Resources required for the learning outcome

Equipment	Helmet, Gloves, Dust mask, Overall, Safety shoes, Dump Truck, Wheelbarrow.
Materials	Warning tape, Fuel, Lubricants
Tools	Marker pen, Chalks, Spade, Pan, Hoe, Machete, Trowel, Hammer, Floats, Crown bar, Tape measure

Facilitation techniques	• Lectures • Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 2: **Excavate trenches**	**Learning hours: 10**
Indicative content	
Based on the performance criteria and the extent of the learning outcome: *What, Up to, and How:* • **Setting out of drainage structures** (Refer to RS EAS 914; RS EAS 132; RS 409,RS ISO 45001,RS ISO 14015) ✓ Methods of setting out drainage structure 3-4-5 Method Surveying Instruments ✓ Interpretation of drainage Drawings • **Excavation of trenches** ✓ Excavation procedures ✓ Interpretation of surveying data • **Installation of trench shield** ✓ Elements of trench shield ✓ Fixing trench shield Elements ✓ Safety hazards in trench ✓ Trench supports types	
Resources required for the indicative content	
Equipment	Excavator, tracked excavator, Backhoe excavator, Dragline excavator, Rammer, Trucks, stamper
Materials	Marker pen, Chalks, Blackboard, Timber, Nails, Fuel, Lubricants, Water, Intertermities
Tools	Hoe, pick axe, Spade, Wheelbarrow, Building lines, Hammer, Spirit level, Square, Plumb bob
Facilitation techniques	• Lectures

	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 3: **Construct drainage system structures**	**Learning hours: 20**
Indicative content	
(Based on the performance criteria and the extent of the learning outcome: *What, Up to, and How):* • **Installation of subsurface drainage** ✓ Types of subsurface drainage ✓ Subsurface drainage installation procedures • **Construction of masonry drainage** (Refer to RS 426-1; RS EAS 18-1; RS 107; RS 373; RS ISO 6935-1; RS ISO 6935-2,RS ISO 45001,RS ISO 14015) ✓ Types of drainage shapes ✓ Types of bonds • **Execution of backfilling** ✓ Backfill materials Specifications ✓ Backfill procedures	
Resources required for the indicative content	
Equipment	Rammer, Trucks, Stamper, Concrete mixer, Bulldozer, Concrete vibrators
Materials	Cement, Stones, Sand, Water, Nails, Aggregate, Fuels, Lubricants, Steel bar, timber
Tools	Spade, Trowel, Hoe, Pan, Wheelbarrow, Tape measure, Spirit level, Square, Hammer, Float, Plumb bob

Facilitation techniques	• Lectures • Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 4: **Apply erosion control method and cleaning workplace**	**Learning hours: 10**

Indicative content

Based on the performance criteria and the extent of the learning outcome: *What, Up to, and How:*

- **Identification of erosion** (Refer to RS ISO 14015)
  - ✓ Types of erosion
  - ✓ Source of erosion
- **Erosion control method**
  - ✓ Planting of vegetation
  - ✓ Water catchment pits
- **Cleaning of tools, equipment and workplace**
  - ✓ Process of storing tools and equipment
  - ✓ Points to follow in storing tools and equipment
  - ✓ Method of storing tools and equipment

Resources required for the indicative content

Equipment	Tree Planting machine, High pressure water equipment, Air splaying equipment
Materials	Plant, Water, Fertilizers, Building line, Nails, Fuel, Lubricants, timber

Tools	Hoe, Spade, Sprit level, Pick axe, Tape measure, square, trowel, hammer, wheel barrow, Rake, Watering can, shears
Facilitation techniques	• Lectures • Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Integrated/Summative assessment

Integrated situation

CRC Ltd constructed road from KAYONZA to GATSIBO in Eastern province. After one year the road started to be damaged by water due to lack of drainage structures. CRC Ltd then subcontracted AZ Construction Ltd to perform drainage system works. The damaged section is at 15 PK, along the road side.

The works to be done include the installation of geotextile on a wetland, the construction of a trapezoidal evacuation channel and controlling water surrounding from upstream catchment.

As a drainage system technician from AZ Construction Ltd, you are assigned to construct a 2m long trapezoidal evacuation channel, install geotextile under drain and controlling erosion by planting grasses around the channel. all tasks will be done within 6 hours.

Necessary data and information are given below:

i. The drainage drawings are provided on site
ii. The trapezoidal channel should be in stone masonry
iii. The mixing ratio of mortar in joints is 400kg/m3
iv. The Blinding concrete mix ratio: 1:2:3
v. Perforated pipe, Geotextile filter fabric, Aggregates to be used are available on site
vi. Other drainage materials, tools and equipment will be provided on site immediately upon your request
vii. Erosion control materials are available on site
viii. Cleaning the workplace after work according to EIA is mandatory

Resources

Tools	Hoe, Spade, Sprit level, Pick axe, Tape measure, square, trowel, hammer, wheel barrow, Rake, Watering can, shears
Equipment	Rammer, Trucks, Stamper, Concrete mixer, Bulldozer, Concrete vibrators
Materials/ Consumables	Cement, Stones, Sand, Water, Nails, Aggregate, Fuels, Lubricants, Steel bar, timber, Plant, Water, Fertilizers, Building line, Nails, Fuel, Lubricants, timber

	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
Learning outcome 1: Prepare for work (20%)	1.1. Materials are properly selected in accordance with type of work	Ind.1. Materials are properly selected			2
	1.2. Tools and equipment are properly selected in accordance with type of work	Ind.1. Tools are properly selected			4
		Ind.2. Equipment are properly selected			4
	1.3. Workplace is conveniently prepared according to the work to be done	Ind.1. Bushes and trees are well cleared			2
		Ind.2. Workplace is well demarcated			2
		Ind.3. Other utilities are identified			2
		Ind.4. Existing utilities are relocated			2
Learning outcome 2: Excavation (30%)	2.1. drainage structures are adequately Set according to the drawing	Ind.1. Convenient setting method is well used			2
		Ind.2. Pegs are well fixed			2
		Ind.3. Lines are well fixed			2
		Ind.4. Dimensions are well marked			3
	2.2. Trenches are conveniently excavated in accordance to the measurement of structure	Ind.1. Trench is well marked with lime			3
		Ind.2. Trench width sizes are well respected			3
		Ind.3. Trench depth sizes are well respected			3
	2.3. trench shield are properly installed according to the site condition	Ind.1. Trench shields materials are well selected			3
		Ind.2. Trench shields materials are well fixed			3
		Ind.3. Trench sides are well supported			2
Learning outcome 3: Construct drainage system structures.	3.1. Subsurface drainage is properly installed according to the specification	Ind.1. Base surface is well prepared			3
		Ind.2. Subsurface drainage is properly selected			3

(40%)		Ind.3. Steps are correctly followed			3
		Ind.4. Subsurface drainage is properly installed			3
	3.2. Masonry drainage is adequately constructed according to the type of drain	Ind.1. Drainage materials is properly selected			2
		Ind.2. Drainage construction tools are properly selected			2
		Ind.3. Drainage construction equipment are properly selected			2
		Ind.4. Drainage construction steps are correctly followed			2
		Ind.5. Masonry drainage is adequately constructed			2
		Ind.6. Masonry joint is properly done			2
		Ind.7. drainage width sizes is properly respected			2
		Ind.8. Drainage depth size is properly respected			2
		Ind.9. Drainage slope is properly respected			2
	3.3. Backfilling is systematically executed in accordance with specification	Ind1. Backfilling is done			2
		Ind2. Backfilling is systematically executed			2
		Ind.3. Backfilling materials are well cured			2
		Ind.4. Backfilling materials are correctly compacted			2
	3.4. Tools, Equipment and workplace are correctly stored and cleaned	Ind.1.Tools are correctly cleaned and stored			2

		Ind.2. Equipment are correctly cleaned and stored			2
		Ind.3. Workplace is correctly cleaned			2
4. Apply erosion Control method and cleaning workplace. (10%)	4.1. Erosion is properly identified according to their types	Ind.1. Erosion source is properly identified			2
		Ind.2. Erosion method is properly chosen			2
	4.2. Vegetation are properly planted according to the types of soil	Ind.1. Suitable planting materials are well selected			2
		Ind.2. Vegetation are properly planted			1
	4.3. tools, equipment and workplace are correctly cleaned	Ind.1. Tools are correctly cleaned			1
		Ind.2. Equipment is correctly cleaned			1
		Ind.3. work place is correctly cleaned			1
		Time is well respected			1
Total marks					**100**
Percentage Weightage					**100%**
Minimum Passing line % (Aggregate):					**70%**

References:

1. http://www.fao.org/docrep/006/W2406E/W2406E10.htm
2. https://hgic.clemson.edu/factsheet/ornamental-grasses-and-grass-like-plants/
3. https://www.lawinsider.com/dictionary/drainage-structure
4. https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/content2/roadway/ppmmanual/2016/volume2/v2chap14.pdf?sfvrsn=dea97ea5_0
5. https://cementconcrete.org/environmental-engineering/road-highway-surface-drainage-system/2919/
6. RS ISO 45001: Occupational Health and Safety Management system— Requirements;
7. RS 175: Wheelbarrow specifications;
8. RS EAS 188: Machete — Specification;
9. RS EAS 1020: Shovels and spades — Specification;
10. RS ISO 20347: Personal protective equipment — Occupational footwear)
11. RS EAS 914: Mild steel nails — Specification;
12. RS EAS 132: Hoe — Specification;
13. RS 409: School chalks — Specification
14. RS 426-1: Masonry Cement — Part 1: Composition, Conformity criteria and Specifications;
15. RS EAS 18-1: Cements — Part 1: Composition, specification and conformity criteria for common cements;
16. RS 107: Building sands — Specifications;
17. RS 373: Aggregates for concrete — Specification;
18. RS ISO 6935-1: Steel for the reinforcement of concrete — Part 1: Plain bars;
19. RS ISO 6935-2: Steel for the reinforcement of concrete — Part 2: Ribbed bars
20. RS ISO 14015: Environmental management systems — Environment Assessment of Sites and Organisations