Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

BDCSS001

STONE STRUCTURES CONSTRUCTION

Competence: CONSTRUCT STONE STRUCTURES

RQF Level: N/A

Learning Hours 120

Credits: 12

Sector: CONSTRUCTION AND BUILDING SERVICES

Program: MASONRY

Module Type: SPECIFIC

Curriculum: DUAL TRAINING SHORT COURSE IN MASONERY

Issue Date: February 2023

<table>
<tr><td>Purpose statement</td><td colspan="6">This Core module describes the skills, knowledge and attitude required to construct stone structures which includes foundations, walls, stairs, water tanks, open channels, dams and inspection chambers. At the end of this module, the student will be able to prepare the construction site, prepare mortar, erect stone structures and clean the workplace. It is destined to a trainee pursuing the dual training program in masonry.</td></tr>
<tr><td>Learning assumed to be in place</td><td colspan="6">Safety, Health and environment at workplace; Construction basic technical drawing; Building Set out</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>25%</td><td colspan="2">Formative assessment in school</td><td>30%</td><td rowspan="4">50%</td></tr>
<tr><td colspan="2">Delivered in company</td><td rowspan="3">75%</td><td colspan="2" rowspan="3">Workplace comprehensive assessment in company</td><td rowspan="3">70%</td></tr>
<tr><td>• Demonstration and practice</td><td>20%</td></tr>
<tr><td>• Individual project /Independent Work</td><td>55%</td></tr>
<tr><td colspan="3"></td><td colspan="3">Summative Assessment</td><td>50%</td></tr>
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Elements of Competency and Performance Criteria		
Elements of competence	**Performance criteria**	**Learning site**
1. Prepare materials, tools and equipment	1.1. PPEs are correctly selected according to the safety and security measures	School
	1.2. Tools and equipment are adequately selected according to the work to be done.	School
	1.3. Materials are appropriately selected according to their use and required quality.	School
2. Prepare the construction site	2.1. Construction site is adequately cleaned by removing trees, bushes and other hazardous objects	School & Company
	2.2. Excavation site is appropriately leveled with respect to the desired structure	School
	2.3. Map out for foundation outlines are accurately positioned in accordance with design dimensions	School
	2.4. The trenches are dug efficiently with respect to the marked dimension	School
3. Prepare mortar	3.1. Ingredients for mortar mix are appropriately selected	School &

	according to the types of mortar	Company
	3.2.Mix ratio and method of mixing are correctly applied in accordance with Rwanda Standards requirements and design considerations	School
	3.3. Mixing mortar is conveniently carried out at required place according to the required mixing methods	School
4. Erect stone structures	4.1. Stones are shaped with respect to standard shapes, size and its use	
	4.2. Retaining walls are erected with respect to the structural design and applicable standard.	
	4.3. Stone finishes are applied on erected stone structure.	
5. Clean the workplace	5.1. Tools and equipment are correctly cleaned by respecting cleaning method.	School
	5.2. Working area is adequately cleaned by respecting cleaning method.	School & Company
	5.3. Storage of tools and equipment are Appropriately cleaned according to the standard.	School & Company

Course content

Learning outcomes	**At the end of the module the trainee will be able to:** 1. Prepare materials, tools and equipment 2. Prepare the construction site 3. Prepare mortar 4. Erect stone structures 5. Clean the workplace

Tools, materials and equipment preparation

Learning outcomes	**Indicative content**	**Learning Hours: 5**	
		School	Company

1. Prepare tools, materials and equipment	**•Identification of tools used to construct stones** ✓ Tools used to construct stones ✓ Uses of tools ✓ Maintenance of tools **•Identification of equipment** ✓ Equipment used to construct stones ✓ Uses of equipment ✓ Maintenance of equipment ✓ PPE used **•Identification of materials used to construct stone masonry complying with Rwanda Standards**	5	
Resources required for the learning outcome		School	Company
Equipment	RS ISO 13688: Protective clothing — General requirements, RS ISO 20347: Personal protective equipment — Occupational footwear, RS ARS 1697: Personal protective equipment — Face shield — Specification, RS ISO/TR 2801: Clothing for protection against heat and flame — General recommendations for selection, care and use of protective clothing, ISO 21420: Protective gloves-General requirements and test methods, RS ISO 4007: Personal protective equipment — Eye and face protection — Vocabulary, ISO 3873: industrial safety helmet		
Materials	Cement, Fine aggregate, Coarse aggregate, Water, Stone, Bricks, Internet, handouts, RS 107 : Building sand from natural sources — Specification, RS ARS 1304 : Guidelines for use of various types of cement, RS EAS 18-1 : Cements — Part 1 : Composition, specification and conformity criteria for common cements.		
Tools	Trowel, Spirit level, Squares, Building line, Tape measure, Wheelbarrow, Roller brush, Hand brush, Scrapper, Tray , Steel float, Sand paper, Pan/bucket, Extension pole, Mixing stick, Strings (Road marking line), Brushes, Paint Scrapper, Roller, Roller tray and Bucket/pan.		
Facilitation techniques / learning activities	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion		
Formative assessment methods	• Written assessment • Oral assessment		

Construction site preparation

Learning outcomes	Indicative content	Learning Hours: 10	
		School	Company
2. Prepare the construction site	•**Cleaning of construction site**. ✓ Removing unwanted elements on working area ✓ Removing hazardous objects • **Excavation and levelling the construction Site** ✓ Method of excavation ✓ Levelling working area • **Setting of signs mark out for foundation outlines** ✓ Procedure of mark out foundation outlines	5	
	• **Dig out foundation trenches** ✓ Digging out trenches' methods ✓ Timbering of trenches		5
Resources required for the learning outcome		School	Company
Equipment	RS ISO 13688: Protective clothing — General requirements, RS ISO 20347: Personal protective equipment — Occupational footwear, RS ARS 1697: Personal protective equipment — Face shield — Specification, RS ISO/TR 2801: Clothing for protection against heat and flame — General recommendations for selection, care and use of protective clothing, ISO 21420: Protective gloves-General requirements and test methods, RS ISO 4007: Personal protective equipment — Eye and face protection — Vocabulary, ISO 3873: industrial safety helmet, Wheelbarrow		
	RS ISO 13688: Protective clothing — General requirements, RS ISO 20347: Personal protective equipment — Occupational footwear, RS ARS 1697: Personal protective equipment — Face shield — Specification, RS ISO/TR 2801: Clothing for protection against heat and flame — General recommendations for selection, care and use of protective clothing, ISO 21420: Protective gloves-General requirements and test methods, RS ISO 4007: Personal protective equipment — Eye and face protection — Vocabulary, ISO 3873: industrial safety helmet,		

	Wheelbarrow		
Materials	Water		
	Water		
Tools	Building line, tape measure, pick axe, axe, spade, machete, shovel, hoe, forked hoe, rake.		
	Building line, tape measure, pick axe, axe, spade, machete, shovel, hoe, forked hoe, rake.		
Facilitation techniques and learning activities	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion		
	• Demonstration • Practical work		
Formative assessment methods	• Written assessment • Oral assessment • Performance assessment		
	• Product Evidence • Performance • evidence		

Mortar preparation

Learning outcomes	**Indicative content**	**Learning Hours: 10**	
		School	Company
3. Prepare mortar	• **Identification of mortar mix ingredients** ✓ Binding or cementing materials ✓ Fine aggregate ✓ Water ✓ Types of mortar Cement mortar Lime mortar Lime cement mortar Special mortar ✓ Precautions in the use of mortars ✓ Test for mortars ✓ Selection of mortars for stone structures	2 1 2	

	• **Apply mixing ratio and mixing methods** ✓ Mixing ratio - Meaning of mixing ratio - Proportion of mixing ratio - Application of mixing ratio ✓ Preparation of mixing batch - Meaning of batching - Methods of batching - Application of batching • **Mixing ingredients** ✓ Quantification method ✓ Properties of good mortar ✓ Apply methods of mixing mortar		
	• **Application of mixing mortar method** ✓ Types of Mortar with reference from Rwanda Standards ✓ Mixing process ✓ Mortar mixing methods and tips		5
Resources required for the learning outcome		**School**	**Company**
Equipment	RS 175: wheelbarrow specifications, ISO 18650-1: Building construction machinery and equipment-concrete mixers-part1; RS EAS 1020: Shovels and spades specifications, RS ISO 3310-1: Test Sieves-Technical requirements and testing		
	RS 175: wheelbarrow specifications, ISO 18650-1: Building construction machinery and equipment-concrete mixers-part1: commercial specifications, ISO 19711-1: Truck mixers-part 1: terminologies and commercial specifications, RS EAS 1020: Shovels and spades specifications, RS ISO 3310-1: Test Sieves-Technical requirements and testing		
Materials	Cement, Fine aggregate, Coarse aggregate, Water, Internet, handouts, RS 107: Building sand from natural sources — Specification, RS ARS 1304: Guidelines for use of various types of cement, RS EAS 18-1: Cements — Part 1 : Composition, specification and conformity criteria for common cements.		
	Cement, Fine aggregate, Coarse aggregate, Water, RS 107: Building sand from natural sources — Specification, RS ARS 1304: Guidelines for use of various types of cement, RS EAS 18-1: Cements — Part 1: Composition, specification and conformity criteria for common cements.		
Tools	Trowel, Spade, hoe, Pan/bucket, gauge box, shovel		
	Trowel, Spade, hoe, Pan/bucket, gauge box, shovel		

Facilitation techniques and learning activities	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion		
	• Practical work • Demonstration		
Formative assessment methods	✓ Written assessment ✓ Oral based assessment		
	✓ Product Evidence ✓ Performance evidence		

Erection of stone structures			
Learning outcomes	**Indicative content**	**Learning hours: 85**	
		School	Company
4. Erect stone structures	**•Identification of types of stone of good quality** ✓ Identification of Stone qualities by Complying with Rwanda standards ✓ Classification of stones ✓ Identification of types of stone structures ✓ Shapes of stone structures ✓ Types of stone bonds ✓ Rules of stones bonding	35	
	• Selection of types of stone of good quality ✓ Selection of Stone to be use according to the type of work		2
	•Shaping and cutting the stone to be used ✓ Stone dressing. ✓ Various shapes of stones.		18
	•Construction of stone structures ✓ Foundation ✓ Walls/ retaining walls ✓ Stairs ✓ Open channels ✓ Water reservoirs		30
Resources required for the learning outcome		**School**	**Company**
Equipment	RS ISO 13688: Protective clothing — General		

	requirements, RS ISO 20347: Personal protective equipment — Occupational footwear, RS ARS 1697: Personal protective equipment — Face shield — Specification, RS ISO/TR 2801: Clothing for protection against heat and flame — General recommendations for selection, care and use of protective clothing, ISO 21420: Protective gloves- General requirements and test methods, RS ISO 4007: Personal protective equipment — Eye and face protection — Vocabulary, ISO 3873: industrial safety helmet.		
Materials	Cement, Fine aggregate, Coarse sand, Water, Stone, Bricks, Internet, handouts,		
	Cement, Fine aggregate, Coarse sand, Water, Stones, admixtures (RS 107: Building sand from natural sources — Specification, RS ARS 1304 : Guidelines for use of various types of cement)		
Tools	Trowel, Spirit level, Squares, building line, Tape measure, Plumb bob, stone hammer		
	Trowel, Spirit level, Squares, building line, Tape measure, Plumb bob, chisels, mallet hammer, stone hammer, sledge hammer, Stone dressing tools		
Facilitation techniques and learning activities	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion		
	• Practical work • Demonstration		
Formative assessment methods	✓ Written assessment ✓ Oral assessment ✓ Performance assessment		
	✓ Product based assessment ✓ Project based assessment		

Cleanup activities

Learning outcomes	**Indicative content**	**Learning Hours: 10**	
		School	Company

5. Conduct cleanup activities	• **Cleaning tools and equipment** ✓ Identification of tools and equipment to be cleaned ✓ Mention methods of cleaning • **Cleaning erected stone structure area** ✓ Identification of tools and equipment to be cleaned ✓ Methods of cleaning	5	
	•**Clean and store tools, materials and equipment.** ✓ Collection of remaining materials ✓ Proper handling and storage of materials, tools and equipment		5

Resources required for the learning outcome		**School**	**Company**
Equipment	RS 175:wheelbarrow specifications, PPEs		
	RS 175:wheelbarrow specifications, PPEs, air compressor		
Materials	Water, Oil		
	Water, Oil		
Tools	Trowel, Hand brush, Spade, Scrapper, broom		
	Trowel, Hand brush, Spade, Scrapper, broom		
Facilitation techniques and learning activities	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion		
	• Practical work • Demonstration		
Formative assessment methods	✓ Written assessment ✓ Oral assessment ✓ Performance assessment		
	✓ Performance assessment		

Integrated situation

MUHABURA INTEGRATED POLYTECHNIC COLLEGE (MIPC) is a College located in northern Province, Musanze

District. MIPC surrounded by fence of 110 m long, this fence is facing a problem of landside which may later destroy some building of the MIPC. The Management of MIPC has decided to sign a Contract with SJAP Company Ltd to protect against the above said landslide starting from the front side of main public road by stepped stone retaining wall of 60 m long, 2m height and 0.5 m thick. As a Mason from contracted company, you are requested to erect the foresaid retaining wall of 2.5m long within 7 hours. MIPC is requested to use well shaped stone for ashlar masonry bond.

Given That:

a. All materials tools and equipment are available on site

b. Drawings are provided

c. Blinding Concrete is poured and hardened in the bottom base of the trench.

d. The gradient slope to be applied during the execution of stepped stone retaining Wall is 90% as Shown on the drawings.

Resources

Tools	Wood floater, Steel floater, Tape measure, Spirit level, Spades, Steel squares, Trowel, Notch trowel, Steel ruler, Hammer, Scraper, Straight edge, Mason's line, Mortar pan, Stones, Dampy level, Calibrated Gauge Box, Wheelbarrow
Equipment	PPE, concrete mixer
Materials/ Consumables	Sand, Cement, Water, Lime, Lime, Nails, Timber

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
1. Prepare materials, tools and equipment (10%)	1.1. Right PPE is selected according to the safety and security measures	Strong boots are selected			4
		Glooves are selected			
		Helmet , and overall is selected			
	1.2. Tools and equipment are adequately selected according to the work to be Done.	Tape measure is selected			3
		Spirit level is selected			
		Spades is selected			
		Steel squares is selected			
		Trowel is selected			
		Club Hammer is selected			
		Straight edge is selected			
		Calibrated Gauge Box is selected			
	1.3. Materials are identified according to the required quality.	Sand is selected			3
		Cement is selected			
		Water is selected			
		Timber is selected			
		Admixture is selected			

		Nails are selected			
		Stones are selected			
2. Prepare the construction site (10%)	2.1. Construction site is cleaned by removing trees, bushes and other hazardous objects	Unwanted trees are removed			2
		Hazardous elements are removed			
		Bushes are removed			
		Unwanted organic matter are removed			
	2.2 Adequately excavate and level the construction area with respect to the desired structure	Required dimensions are respected			2
		Soil bearing capacity is obtained			
		Trenching are angled finished			
	2.3. Map out accurately the foundation in accordance with design dimensions	Lines are stretched			3
		Pegs are positioned			
		Profiles are fixed			
	2.4. The trenches are dug efficiently with respect to the marked dimensions	Trenching dimension is respected			3
		Trenching straightness are achieved			
		Deep of trenches are respected			
3. Mix mortar (10%)	3.1. Ingredients for mortar mix are appropriately selected.	Sand is selected			3
		Binder is selected			
		Water is selected			
		Admixture is selected			
	3.2. Mix ratio and method of mixing are correctly applied in accordance with Rwanda Standards requirements and design considerations.	Mixing ratio is respected			3
		Mixing ratio is Kept			
		Mixing method is respected			
	3.3. Mixing mortar is carried out at the convenient place	Mixing steps are respected			4
		Mixing process is completed			
		Properties of mixed mortar is observed			
4. Erect stone structures (60%)	4.1. Stones are shaped with respect to standard shapes, size and its use	Steps of shaping stone are respected			17
		Tools for shaping stone are kept			
		Equipment for shaping stone are manipulated			

		Stone are shaped at regular shape			
	4.2. Retaining walls are erected with respect to the structural design and applicable standard.	Types of bond is respected			23
		Sloping angle is respected			
		Height of retaining wall is respected			
		Thickness are respected			
		Length is respected			
		Straightness of the wall is observed			
		Horizontality is observed			
	4.3. Stone finishes are applied on erected stone structure.	Jointing is applied			20
		Piping are applied into the wall			
		Excess mortar are removed			
		Joint are laid for pointing			
5. Clean the workplace (10%)	5.1 Tools and equipment are correctly cleaned by respecting cleaning method.	Tools are cleaned			3
		Equipment are cleaned			
		Tools and equipment are maintained			
	5.2 Adequate cleaning of working area	Stonework surface are cleaned			3
		Dust are cleaned			
		Wastage are removed			
	5.3 Appropriate storage of tools and equipment by respecting storage method.	Tools are stored			4
		Equipment are stored			
		Storing method are respected			
Total marks					**100**
Percentage Weightage					**100%**
Minimum Passing line % (Aggregate): 70%					

References

1. RozzAlgar W," Technology and Engineering" ,2010, Routledge House

2. John Ashurst, "Conservation of Building and Decorative Stone Structure",2001, Taiwast House

3. T.F. Fwa," Highway Engineering ,2005, CRC Press

4. Atlantic Publishing Group, "Building with Rocks and Stone", 2010,

5. David Doran "Construction Materilas,2013, Routledge House

6. James Gage, "Guide to new England stone Structure", 2016, Powwow-River.