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BUGESERA DISTRICT

TSS 2nd TERM DISTRICT COMPREHENSIVE ASSESSMENT
SCHOOL YEAR: 2024-2025

SECTOR: Construction and building services.

...../100 MARKS

TRADE: Building construction

RQF LEVEL: 3

MODULE CODE AND TITLE: BDCSS301: Construction of stones structures.

DURATION: 3hours

DATE: / / 2025

INSTRUCTIONS TO CANDIDATE:

- ✓ This exam has three sections.
- ✓ Maximum marks.../100 Marks
- ✓ Attempt all Questions in A
- ✓ Choose only two questions in section B.
- ✓ Choose only one question in section C.

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SECTION A: Attempt all Questions /55marks

Q1. Define the following terms /**3marks**

- a. Construction stones
- b. Construct
- c. Stone masonry

ANSWER

- a. Means any rock or mineral, which is used as building or construction material. /**1mark**
- b. This is the art of construction in which building units are arranged systematically and bonded to form a homogeneous mass. /**1mark**
- c. is a type of building masonry construction that uses stones and mortar. This construction technique is used for building foundations, floors, retaining walls, arches, walls and columns. The stones used for masonry construction are natural rocks. /**1mark**

Reference: L.O.1.Prepare materials, tools and equipment on

Indicative content: 1.1. Right PPE is selected according to the safety and security measures

Q2. Q2. Match the types of work to its corresponding mortar recommended /**4marks**

Types of work	Mortar recommended
1. The structure members that are heavily stressed	A. 1:3 cement mortar or 1:1:3 lime cement mortar
2. Plastering of walls outside	B. 1:1 ^{1/2} cement mortar
3. Plastering of walls inside	C. 1:4 cement mortar
4. Stones masonry in foundations and super structure of ordinary buildings	D. 1:1 cement mortar

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5. 10cm partition walls and bricks pillars, dams, retaining walls, lining of reservoirs, pointing	E. 1:5 to 1:6 cement mortar or 1:2 lime mortar
6. Plastering underside of ceiling	F. 1:3 to 1:4 cement mortar
7. Water retaining structure like water tanks	G. 1:4 cement mortar
8. Masonry work below ground level, especially in water logged areas.	H. 1:3 to 1:6 cement mortar or 1:2 lime mortar

ANSWER

- 1 → D **0.5mark**
2 → E **0.5mark**
3 → C **0.5mark**
4 → H **0.5mark**
5 → F **0.5mark**
6 → G **0.5mark**
7 → B **0.5mark**
8 → A **0.5mark**

Reference: L.O.3. Prepare mortar on indicative on

Indicative content: 3.1. Ingredients for mortar mix are appropriately selected.

Q3. Answer by True or False /5marks

- Stay bracing method this types of timbering used when loose soil and depth of excavation not more than 4m.
- Vertical sheeting method this types of timbering is used when soil is loose and excavation depth is more than 10m

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- c. Sheet piling method this types of timbering used when excavation depth is more than 10m.
- d. Runners method are hammered into the ground to the of 60cm from the bottom of the trench.
- e. Check the excavation each day before starting work and after any event that may affect its stability.

ANSWER

- a. False (F) /1mark
- b. False (F) /1mark
- c. True (T) /1mark
- d. False (F) /1mark
- e. True (T) /1mark

Reference: L.O.2. Prepare construction site on

Indicative content: 2.2. Adequately excavate and level the construction area with respect to the desired structure.

Q4. List the names of following tools used in stones construction and its function for each /3marks



a)



b)



c)

ANSWER

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- a. **Brick hammer:** is used in cutting bricks, fixing the nails and for demolishing works. **/1mark**
- b. **Pointed trowel:** is used for jointing, pointing and for scraping the excess mortar. **/1mark**
- c. **Masonry chisels:** are specialised tools used for cutting , shaping , and splitting hard materials like stone ,brick ,concrete, and mortar. **/1mark**

Reference: L.O.1. **Prepare materials, tools and equipment on**
Indicative content: 1.2.Tools and equipment are adequately
selected according to the work to be done.

Q5.Complete the sentences below by using the following words: Raft foundation, isolated footing, deep foundation, shallow , footing, sub soil, settlement, combined footing, drilled caisson foundation, pad footing. **/5marks**

- a. According to TERZGHI, a foundation is if its depth is equal to or less its width.in case of, the depth is equal to or greater than its width.
- b. is the lowermost part of the foundation contact with the sub soil.
- c. A spread footing, for a single column is either known as
- d. A spread footing which supports two or more column is termed as
- e. are good solution if the soil has a poor bearing capacity.

ANSWER

- a. According to TERZGHI, a foundation is **shallow** if its depth is equal to or less its width .in case of **deep foundation**, the depth is equal to or greater than its width. **/1mark**
- b. **Footing** is the lowermost part of the foundation contact with the sub soil. **/1mark**
- c. A spread footing, for a single column is either known as **isolated footing**. **/1mark**

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- d. A spread footing which supports two or more column is termed as **combined footing.**/ 1mark
- e. **Raft foundation** are good solution if the soil has a poor bearing capacity./ 1mark

Reference: L.O.4. Erect stones structures on

Indicative content: Foundation and stairs are erected efficiently accordance with structural design and applicable standard

Q6. Choose the letter corresponding to the correct answer in each statement: / **4marks**

1. The following are causes of settlement, except
 - a. Ground water lowering
 - b. Plastic compression of underlying soil
 - c. The lower part of the foundation contact with the sub soil
 - d. All answer are correct
2. The conditions which may affect the selection of foundation, except
 - a. The load bearing of the foundation
 - b. Large water front structures such as pump houses
 - c. The total weight of the building
 - d. Both a and c is correct
3. Piles used for building foundation may be of four (4) types, except
 - a. End bearing pile
 - b. friction piles
 - c. Combined friction pile and compacted piles
 - d. compacted piles
4. The followings are the functions of foundation, except.
 - a. To give a levelled surface and hard to elevate the super structure

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- b.** Is the vertical down ward movement of the base of structure and it strongly affects the structure.
- c.** To increase the stability of the structure against overturning.
- d.** both a and b are correct

ANSWER

1. **c** /1mark
2. **b** /1mark
3. **c** /1mark
4. **b** /1mark

Reference: L.O.4. Erect stones structures on

Indicative content: 4.5. Foundation and stairs are erected efficiently accordance with structural design and applicable standard

Q7.What are things that can be removed and cleaned from site during site preparation. /2marks

ANSWER

- | | |
|--------------------------|----------------|
| Bushes/vegetation | 0.5mark |
| Scrubs | 0.5mark |
| Trees | 0.5mark |
| Roots of trees | 0.5mark |
| Termites | |
| Stones/rocks | |
| Others unwanted features | |

Reference: L.O.2. Prepare the construction site on

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Indicative content: 2.1. Construction site is cleaned by removing trees, bushes and other hazardous objects.

Q8. If water cement ration is 0.3, calculate quantity of water required for one bag of cement/ **2marks**

ANSWER

Calculate the quantity of water = water cement ratio $\times$ weight of cement **/2marks**

Quantity of water = $0.3 \times 50 \text{ kg} = 15\text{kg}$.

Since the density of water is 1kg /L , this is equivalent to 15 liters of water.

It means for one bag of cement (50kg), 15 liters of water is required when the cement ratio is 0.3.

Reference: L.O.5. Prepare mortar

On Indicative Content: 3.2. Mix ratio and method of mixing are correctly applied in accordance with Rwanda standards requirements and design considerations.

Q9. Building stones are obtained from rocks occurring in nature and classified in three ways. State the any three (3) classification of rocks based on chemical. **/3marks**

ANSWER

- ✓ **Siliceous rocks:** In these rocks, silica is predominating. The rocks are hard; durable and not easily effected by weathering agencies. Ex: Granite, Quartzite, etc./**1mark**
- ✓ **Argillaceous Rocks:** In these rocks, clay predominates. The rocks may be dense and compact or may be soft. Ex: slates, Laterites etc./**1mark**
- ✓ **Calcareous rocks:** In these rocks, calcium carbonate predominates. The durability to these rocks will depend upon the constituents present in surrounding atmosphere. Ex: Lime Stone, marble/**1mark**

Reference: L.O.4. Erect stones structures on

Indicative content: 4.1. Types of stone structures are identified properly.

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Q10. Organize the following procedures for proper mechanical mixing of mortar so that they have the best sequences: / **3marks**

- ✓ Pour out and make the next batch.
- ✓ Mix together until it all looks the same color.
- ✓ Discharge next, then make next batch.
- ✓ Start or turn on the mixer.
- ✓ Mix for another 2 minutes.
- ✓ Put in about 2/3 of the water you need.
- ✓ Add the sand, gravel and then the cement.
- ✓ Add the rest of the water a bit at a time until you get a mix that is workable but not too wet.

ANSWER

Procedure for proper mechanical mixing:

1. Start or turn on the mixer. **(0.5mark)**
2. Put in about 2/3 of the water you need **(0.5mark)**
3. Add the sand, gravel and then the cement **(0.5mark)**
4. Mix together until it all looks the same colour**(0.5mark)**
5. Add the rest of the water a bit at a time until you get a mix that is workable but not too wet. **(0.5mark)**
6. Mix for another 2 minutes **(0.5mark)**
Pour out and make the next batch. **(0.5mark)**
7. Pour out and make the next batch. **0.5mark**
8. Discharge next, then make next batch. **0.5mark**

Reference: L.O.3.Prepare mortar on

Indicative content: 3.2 Mix ratio and method of mixing are correctly applied in accordance with Rwanda standards requirements and design considerations.

Q11. What do you understand by term “stair”? / **1mark**

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ANSWER

A Stair is a system of steps by which people and objects may pass from one level of a building to another. /1mark

Reference: L.O.4. Erect stones structures on

Indicative content: 4.5. Foundation and stairs are erected efficiently accordance with structural design and applicable standard.

Q12. Outline any five (5) the essential factors to be considered when designing a stair case in building. /5marks

- ✓ **Dimensions and comfort:** dimensions of the steps (tread and riser) should provide comfortable use for all users including children, elderly individuals , and people with disabilities .if necessary , include ramps or wider landings to accommodate accessibility needs. /1mark
- ✓ **User safety:** the design should prioritize safety with non-slip surfaces, proper lighting, and clear visibility and secure handrails. /1mark
- ✓ **Location:** they should be located near the main entrance to the buildings. /1mark
- ✓ **Structural integrity:** the stairs must be structurally sound, with proper support and load bearing capacity. /1mark
- ✓ **Materials of construction:** the materials should have fire resistance and sufficient strong. /1mark

Reference: L.O.4. Erect stones structures on

Indicative content: 4.5. Foundation and stairs are erected efficiently accordance with structural design and applicable standard.

Q13. Enumerate any three (3) requirements for safe design of retaining walls. /3marks

ANSWER

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- To prevent overturning of wall about toe /1mark
- To prevent sliding of the wall at its base /1mark
- To prevent tension anywhere in the base soil /1mark
- To prevent bearing failure of the base soil

Reference: L.O.4. Erect of stones structures on

Indicative content: 4.6. Retaining walls are erected with respect to the structural design and applicable standard.

Q14. Mention any three (3) demerits of using mechanical plant in excavation. /3marks

ANSWER

- Involve larger running and maintenance costs. /1mark
- Require a larger operating area. /1mark
- Access provision to working area. /1mark
- Less flexible in work planning.
- Increase cost of work.

Reference: L.O.2.prepare construction site on

Indicative content: 2.2. Adequately excavate and level the construction area with respect to the desired structure.

Q15. Differentiate valley-dammed from bank-side reservoirs as types of water reservoir. /3marks

ANSWER

Valley-dammed: A dam constructed in a valley relies on the natural topography to provide most of the basin of the reservoir. /1.5mark

While Bank-side reservoirs are reservoirs that are made by diverting water from local rivers or streams to an existing reservoir. / 1.5mark

Reference: L.O.4. Erect stones structures on

Indicative content: 4.4. Stone water reservoirs and open channels are constructed with respect to the given shape, water holding capacity and applicable standard requirements.

Q16. Compare the precast from cast in situ of piles in terms of their definition and quality control. / **4marks**

ANSWER

	Precast piles /2mark	Cast in situ piles /2mark
Definition	These are piles manufactured in a controlled factory environment before being transported to the construction site. The piles are made from concrete and are usually produced in standardized sizes.	Also known as bored piles , these are constructed on site by drilling hole into the ground and then pouring concrete into the bore hole .reinforcement is placed in the hole before concrete is poured.
Quality control	Consistency: the precast piles tend to be more consistent in terms of quality, as they are manufactured under controlled conditions ,reducing the possibility of defects such as voids or air pockets.	Site specific conditions : Quality control for cast in situ piles is influenced by the site conditions , such as weather , soil type , and workability of the mix.

Reference: L.O.4. Erect stones structures on

Indicative content : 4.5. Foundation and stairs are erected efficiently accordance with structural design and applicable standard.

Q17. Give any two (2) Procedures of mark out foundation. **2marks**

ANSWER

Marking out foundation and wall thicknesses / **1mark**

Marking out on the ground from the profiles / **1mark**

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Reference: L.O.2. Prepare the construction site on

Indicative content: 2.3. Map out accurately the foundation in accordance with design dimensions.

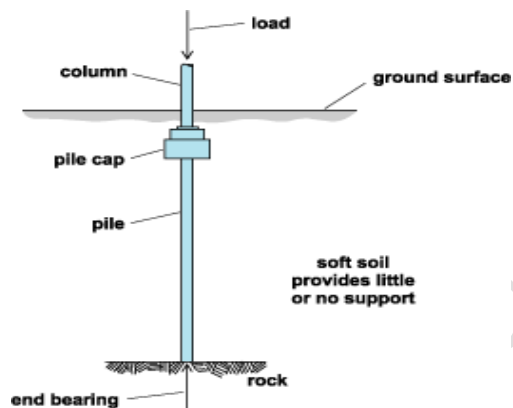
SECTION B: Attempt any three (3) questions /30marks

Q18. With a good, clearly sketches differentiate types of piles used in building foundation. /10marks

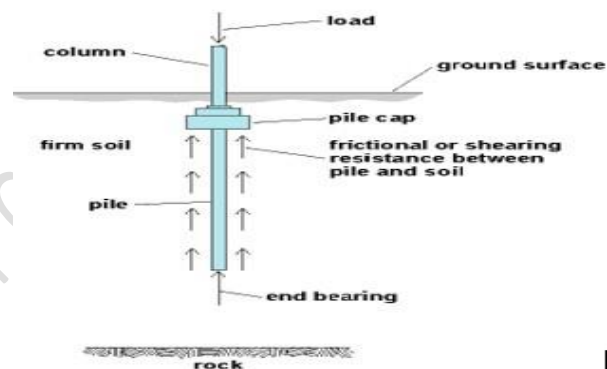
ANSWER

Piles used for building foundation may be of four types:

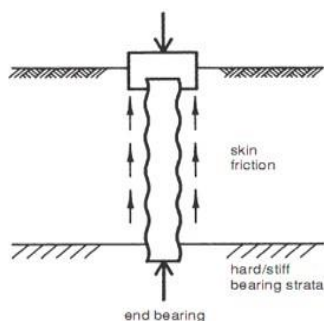
(i) End bearing pile [Fig.3.8(a)]



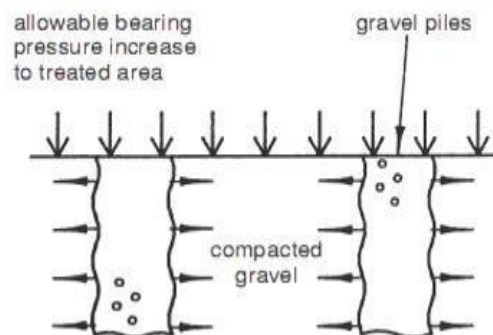
(ii) Friction pile [Fig.3.8(b)]



iii) Combined end bearing and friction pile [Fig.3.8(c)]



iv) Compaction piles [Fig.3.8(d)]



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Reference: L.O.4. Erect stones structures on

Indicative content : 4.5. Foundation and stairs are erected efficiently accordance with structural design and applicable standard.

Q19.After define angle of repose, discuss eight (8) procedures that are involved in marking out foundation outlines. /10marks

ANSWER

Definition: angle of repose: refer to the maximum slope measured from horizontal at which loose solid materials will remain in place without sliding. /2marks

ANSWER

(8)Procedures that are involved in marking out foundation outlines

1. Site preparation and cleaning.

- Before any marking can begin, the site needs to be cleaned of vegetation , debris ,and any other obstacles that could interfere with the marking process.

2. Establish a reference point or benchmark.

- Select a permanent and easily identifiable reference point such as corner of the site or existing structures.
- This point will serve as the origin from which all measurements are taken .

3. Set up a base line

- Use surveying instrument to establish a straight reference line for the foundation such as theodolite, laser level.
- Base line should be parallel to the direction of the foundation and can be marked with stakes or string.

4. Determining building dimensions

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- The dimensions of the building are then marked on the site based on the architectural drawings.

5. Use string and stakes to mark the corners

- Mark the corners of the foundation using stakes , measuring tape and string.
- Ensure that layout follows the building plans , including angles and dimensions
- For rectangular foundation use the (3-4-5 method) or right triangle method to verify the corners are square (90 degree)

6. Checking squareness of corners

- It is important to check that the corners of the marked outline are square.

7 .Marking the excavation lines

- The foundation excavation lines are then drawn, marking the limits of the trench or the area to be dug. Where the excavation for the foundation will begin and where the footing will be placed.

8. Double checking measurements and final adjustments.

Once all the marking are done, double-check all measurements and angles to ensure that the foundation outline is correct.

Reference: L.O.2. Prepare the construction site on

Indicative content: 2.3. Map out accurately the foundation in accordance with design dimensions.

Q20. a. Define the term “stone dressing”. /2marks

b. Demonstrate the process of shaping a rough stone into usable construction materials. / 4marks

c. Explain the importance of shaping and cutting stones in construction. / 4marks

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ANSWER

- a. **Stone dressing:** Is the working of quarried stone into the shape and size required for use. This can be necessary, as stones obtained from quarrying generally do not have the exact required dimension or finish. Or is the process of smoothing and refining the shape of the stone. **/2marks**
- b. The process of shaping a rough stone into usable construction materials.
1. **Extraction:** the first step in shaping a rough stone is to extract it from a quarry or natural deposit. Depending on type (e.g. Granite, limestone, sandstone). **/1mark**
2. **Rough shaping or primary cutting :** after the rough stone is extracted , next step is to shape it into manageable sizes, this can be done by: **/1mark**
- Manual tools: workers used tools like hammers, chisels, and pick axes to break the stone into rough, larger pieces.
 - Mechanical cutting: a stone saw or diamond blade is used to cut the rough stone into standardized blocks or slabs for further shaping.
3. **Stone dressing:** is the process of smoothing and refining the shape of the stone. Here 's how it works : **/1mark**
- Hammer and chisels
 - Pointing
 - Finer tools
4. **Polishing and finishing :** once the stone has been shaped it may need to be polished or further finished , this usually done with : **/1mark**
- Grinders
 - Polishing compounds
5. **Sizing** for construction: after dressing and finishing , the stone blocks are sized to fit construction needs, this can involve :

- Cutting to specific dimensions
- Masonry work

7. **Transportation and placement:** finally, once the stone blocks are shaped and sized they are transported to the construction site using cranes, trucks, or even manual labor.

c. Importance of shaping and cutting stones in construction.

- **Strength and durability:** when stones are cut and shaped accurately, they maintain their inherent strength. **/1mark**
- **Aesthetic appeal or appearance:** uniformity and visual appeal in decorative and architectural applications, such as flooring, facades.
- **Customization for design:** shaping and cutting allow for customization making it possible to carve intricate designs. **/1mark**
- **Ease of installation:** stones that are cut to specific sizes and shapes are much easier to handle, transport, and install during construction. **/1mark**
- **Cost efficiency:** minimizing labor and time. **/1mark**

Reference: L.O.4. Erect stones structures on

Indicative content: 4.3. Stones are shaped with respect to standard shapes, size and its use.

Q21. I. Name and give the uses of the following mechanical excavation plant. /8marks



a).....



b).....



c).....



d).....

II. During excavation of foundation trenches we can use manual and mechanical method, when will you prefer to use mechanical method? /2marks

ANSWER

I.

- a. A bulldozer: can quickly push the topsoil /2marks**
- b. Tipper truck: for transporting large amount of soil / 2marks**
- c. Dump truck :for transporting small quantity of soil at a short distance. /2marks**
- d. Draglines: for digging deep foundations. /2marks**

II. If you want to achieve more speed, then you can use machines like back actor. /2marks

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Reference: L.O.2. Prepare the construction site on

Indicative content: 2.2. Adequately excavate and level the construction area with respect to the desired structure.

Q22. Describes the classifications of opened channel based on boundary and based on occurrence and give any one (1) example for each. **/10marks**

ANSWER

Classification of Open Channel Based on Boundary: Based on Boundary open channel has two types as below -

Rigid Channel **/1mark**

Mobile Channel **/1mark**

Rigid channel: In this type of channel boundary of channel, do not change. **/1mark**

Example - Lined Channel **/0.5mark**

Mobile Channel: In this type of channel, boundary of channel will change. **/1mark**

Example - River Unlined Channel. **/0.5mark**

And

. Classification Of Open Channel Based On Occurrence: Based on occurrence open channel has two types as below-

Natural Channel **/1mark**

Artificial/Men Made Channel **/1mark**

Natural Channel: A Channel which made by nature is call as natural channel. **/1mark**

Example – River **/0.5mark**

Artificial Channel: A channel which made by Men power is call as artificial channel. **/1mark**

Example – Canal **/0.5mark**

Reference: L.O.4. Erect stones structures on

Indicative content: 4.4. Stone water reservoirs and open channels are constructed with respect to the given shape, water holding capacity and applicable standard requirements.

SECTION C: Attempt only one (1) question

15marks

Q23.a. what safety precautions should be taken when handling and mixing mortar?
/8marks

- b. Rephrase three (3) factors affecting the durability of foundation. **/3marks**
- c. Identify at least four (4) mortar-mixing tips. **/4marks**

ANSWER

a. safety precautions should be taken when handling and mixing mortar?

1. Wear personal protective equipment such as **/1mark**

- Gloves
- Safety goggles
- Dust mask
- Over all

2. Ventilation: ensure you are working in a well-ventilated area, preferably outdoors, to prevent inhaling cement dust, which can be harmful to your respiratory system. **/1mark**

3. Correct mixing and handling **/1mark**

4. Proper proportions: always follow the manufactures guidelines for mixing the right ratio of water, sand, and cement. **/1mark**

- Mechanical mixers: if mixing large quantities, use a mechanical mixer to avoid excessive manual handling.

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5. **Avoid skin contact:** mortar, especially wet, is highly alkaline and can cause skin irritation, burns or dermatitis. **/1mark**
6. **Be careful of slips and falls:** wet mortar can be very slippery, so ensure your work area is clear of spills, and wear slip resistant footwear to avoid slipping. **/1mark**
7. **Store materials properly:** keep bags of mortar in a dry, cool place to prevent moisture from affecting the mix's effectiveness. **/1mark**
8. **Disposal of waste:** dispose of leftover mortar properly. **/1mark**

Reference: L.O.3. Prepare mortar on

Indicative content: 3.3. Mixing mortar is carried out at the convenient place.

b. Three factors that affecting the durability of a foundation are:

1. **Soil Conditions:** The type and stability of the soil affect the foundation's strength and longevity. **/1mark**
2. **Material Quality:** The durability of the foundation depends on the strength and resilience of the construction materials used. **/1mark**
3. **Water and drainage management:** Proper drainage prevents water damage and erosion, which can weaken the foundation over time. **/1mark**

Reference: L.O.4. Erect stone structures on

4. Indicative content : 4.5. Foundation and stairs are erected efficiently accordance with structural design and applicable standard.

c. Identify at least four (4) mortar-mixing tips. **/4marks**

- Always wear eye protection and waterproof gloves when mixing mortar.
- If the mortar starts to dry during application, add more water. Do not add water once the mortar begins to set.
- Use a good grade of fine sand in your mortar mix. The sand should be free of clay material; otherwise, it will create a paste that could expand and contract as the water dries up.

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- Cover the sand during storage so it does not absorb water, which could change your mortar mix water requirements.
- Each type of mortar mix contains different quantities of material. Be sure to use the correct type of mortar mix for the application.
- Waterproofing agent may be added to mortar for brick fences to prevent damp.
- To colour mortar, add dye before mixing the mortar.
- Successful mortar mixing relies on consistency. Try to use the same materials and use the exact amount of material batch after batch. You can use a pail or bucket to make sure you are using the same amount of material for subsequent batches.

• **Reference: L.O.3. Prepare mortar on**

• **Indicative content: 3.3. Mixing mortar is carried out at the convenient place.**

Q24. How does the Rwandan standard address the safety factor for retaining wall design, especially in areas with high water pressure or load bearing demands? **/15marks**

ANSWER

1. Global Stability and Safety Factors /2marks

- The standard recommends a minimum factor of safety (FoS) of 1.5 for sliding, overturning, and bearing capacity under normal loading conditions.
- In cases of seismic loading or high water pressure, a higher factor of safety (typically 1.75 to 2.0) is required.

2. Sliding Resistance /2marks

- The safety factor against sliding ($FoS \geq 1.5$) is determined by ensuring that the resisting forces (friction and cohesion) exceed the driving forces (lateral earth pressure and water pressure).
- Drainage provisions, such as weep holes or drainage blankets, help reduce hydrostatic pressure, which can significantly impact stability.

3. Overturning Stability /2marks

- The retaining wall must resist overturning moments caused by lateral earth and water pressures.

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- The standard ensures a minimum overturning safety factor of 1.5, increasing in areas with saturated soils or seismic activity.

4. Bearing Capacity

/2marks

- The bearing capacity factor of safety ($FoS \geq 3.0$) ensures that foundation soils can support the imposed loads without excessive settlement or failure.
- This is particularly critical in weak or compressible soils, where additional reinforcement (deep foundations, soil improvement techniques) may be needed.

5. Water Pressure and Drainage Considerations

/2marks

- High groundwater levels increase hydrostatic pressure, reducing the wall's stability.
- The standard emphasizes proper drainage measures, such as filter fabrics, backfill with coarse materials, and geotextile layers, to minimize water buildup.
- Pore water pressure calculations are also required to assess the wall's response under different moisture conditions.

6. Seismic Design Considerations

/2marks

- Rwanda, being in an area of seismic activity, requires additional checks for earthquake-induced lateral forces.
- The seismic factor of safety is increased, and walls may need additional reinforcement, such as geogrids or tiebacks.

7. Material Strength and Durability

/3marks

- The design follows strength reduction factors for concrete, masonry, and reinforced earth walls to ensure long-term durability.
- In high load-bearing zones, the use of reinforced concrete walls with higher compressive strength is mandated.

. Reference: L.O.4. Erect stones structures on

Indicative content: 4.6. Retaining walls are erected with respect to the structural design and applicable standard.