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**PLB - Drainage system
installation**

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**Monday, 26/7/2021
08:30 - 11:30 AM**

TVET NATIONAL EXAMINATION, RTQF LEVEL 5, 2020-2021

**OPTION/TRADE: PLUMBING
SUBJECT: Drainage system installation**

DURATION: 3 hours

INSTRUCTIONS TO CANDIDATES: PART II

The paper is composed of two (2) Sections as follows:

Section I: Attempt all the Twelve (12) questions (60 marks)

Section II: Attempt any Four (4) questions out of Six (6) (40 marks)

MARKING GUIDE

(01) Define the following terms/5marks

Marking scheme:

- a. **Drainer:** a person who explores drains, tunnel and /or sewer
- b. **Grade:** The grade is the slope or fall of a pipe in reference to a horizontal plane. In drainage it is usually expressed as the fall in mm per m length of pipe.
- c. **Manhole:** An opening through which a man may enter or leave a drain, a sewer or other closed structure for inspection, cleaning and other maintenance operations, fitted with a suitable cover. Sewage
- d. **Stack:** A stack is the vertical main of a system of soil, waste, or vent piping.

(02) Distinguish two categories of discharge pipes. /5marks

Marking scheme: Discharge pipes are of two categories: Soil pipe' and 'waste pipe'.

Soil pipe was connected to a WC while a waste pipe is connected to an ablutionary fitting.

(03) What is the difference between Soil fittings and Waste Fittings? /5marks

Marking scheme:

Soil fittings: These are for the disposal of foul mater and these include the following: WCs, urinals, sloop sinks and bedpan washers etc.

Waste Fittings: These are for disposal mainly of soapy waste water and they also include: Baths, showers, lavatory basins, bidets wash tubs, washing fountains etc. The branch pipes from the soil and waste fittings are connected to separate soil and waste stack hence the term

(04) calculate the fall in a 50 meter section of foul water pipework if the gradient is to be 1 in 80. /5marks

Marking scheme:

$$1 / 80 = 0.0125$$

Fall = Gradient x Distance

$$\text{Fall} = 0.0125 \times 50, \text{ Fall} = 0.625 \text{ meters or } 625\text{mm}$$

(05) Differentiate the three (3) types of underground drainage and give their advantages and disadvantages. /5marks

Marking scheme:

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Separate system

In this system there are two separate drains i.e. one drain to carry away foul water etc. from sanitary fittings and another to carry away rain water from the roofs and paved areas

Advantages of Separate System:

- (a) Load on treatment units become less
- (b) The natural water is not unnecessary polluted.
- (c) The sewers are small in size.
- (d) The storm water can be discharged into natural streams without any treatment.
- (e) The system proves to be economical when pumping is required for the lifting of sewage.

Disadvantages of Separate System:

- (a) The cleaning of sewer is difficult, as they are of small size.
- (b) The maintenance cost is high.
- (c) They self-cleaning velocity is not easily achieved.
- (d) The system requires two sets of sewer end hence; it may prove to be costly.
- (e) The storm water sewers will come into operation during monsoon only. Hence, they may become the dumping places for garbage during summer and winter and may thus be choked.

Combined system

In this system foul water from sanitary fittings and rain water from roofs and paved areas is carried in a single drain to the treatment area. There is a saving in drainage cost, but treatment at the sewage works cost more.

Advantages of Combined of Single Sewer System:

- (a) It is easy to clean a combined sewer as it is of large size.
- (b) The maintenance costs are reasonable
- (c) The storm water reduces the strength of sewage by dilution.
- (d) This system requires only one set of sewers and it may thus prove to be economical.

Disadvantages of Combined of Single Sewer System:

- (a) During ordinary heavy storms, the combined sewers may overflow and it may thus put public health in danger.
- (b) The combined sewer, if not properly designed, gets easily silted and it may even become foul in dry weather.
- (c) The load on treatment plant increases.
- (d) The sewers are huge in diameter.
- (e) The storm water is unnecessary polluted:
- (f) The system proves to be uneconomical when pumping is required for the lifting of sewage.

Partially separated system

In this system, arrangement is made to permit early washings by rain into the sewers carrying sewage. But when the quantity of storm water exceeds a particular limit, it is collected and conveyed in open drains to the natural river or stream. For

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individual dwellings which are built on suitable ground a partially separate system will use soak away or natural water courses to dispose of rainwater.

Advantages of partially Separate System:

- (a) It combines the advantages of both the above systems.
- (b) The entry of storm water avoids silting in sewers.
- (c) The problem of disposing storm water from houses is simplified.
- (d) The sewers are of reasonable size.

Disadvantages of Partially Separate System:

- (a) The quantity of storm water admitted in sewer may increase the load on pumping & treatment unit.
- (b) The velocity of flow is low in dry weather.

(06) List any five (5) types of pipe used in drainage system. / **5marks**

Marking scheme:

- Cast iron pipes
- Vitrified clay pipes or salt glazed pipes
- Pre-cast concrete pipes
- Pitch fibers pipe
- Asbestos

(07) differentiate the septic tank from soak pit by using their function / **5marks**

Marking scheme:

septic tank is a watertight settling tank which receives the discharge of a drainage system or part thereof and is designed and constructed so as to separate solids from the liquid,

while A **soak pit**, also known as a **Soak way** or Leach pit, is a covered, porous-walled chamber that allows water to slowly soak into the ground.

(08) Complete the following Table of drainage pipe size and gradient / **5marks**

Marking scheme:

Diameter of pipe	Gradient
32 mm	1 in 20
65 mm diameter and under	1 in 30
100 mm and under	1 in 40
150 mm	1 in 60
230 mm	1 in 90

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(09) List down any five (5) types of gutter used in rain water harvesting /5marks

Marking guide:

1. Vinyl Gutters
2. Aluminium Gutters
3. Steel and Copper Gutters
4. Stainless Steel
5. Wood Gutters

Reference: L.U.2 – Distribute water

(10) Give any five (5) Criteria to be considered while selecting rainwater harvesting technologies/5marks

Marking guide:

- type and size of catchment area
- local rainfall data and weather patterns
- family size
- length of the drought period
- alternative water sources
- cost of the rainwater harvesting system

(11) Write down any five (5) Processes for installing rain water pipes /5marks

Marking Scheme:

1. Mark the position for the rain water pipe
2. Fix clips
3. Join pipes
4. Connect pipes to gutters
5. Connect the rain water pipe to the reservoir /storage tank

Reference: L.U.1 – Connect pipes/eave gutter

(12) A Department of 30 rooms is occupied by 60 tourists for 1 year, 1 tourist consumer 25 litres per day. Calculate the water demand to comfort all tourists accommodate in this department

Marking scheme:

Given data: /1mark

Water /cap/day = 20 l = 0.02 m³

Number of users = 60 tourists

Number of days = 365days

Unknown: water demand /1mark

WD= 0.02 * 60 * 365 = 438 m³/year /3marks

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Section II: Attempt any Four (4) questions out of Six (6)

(40 marks)

(13) Explain working principal of septic tank /10marks

Marking scheme:

A septic tank is a watertight settling tank which receives the discharge of a drainage system or part thereof and is designed and constructed so as to separate solids from the liquid, digest organic matter through a period of detention, and allow the liquids to discharge into the soil outside the tank through a system of open joint or perforated piping or disposal pit.

A septic tank can have single or multiple compartments. Single- and two-compartment septic tanks generally are used with individual home sewage treatment systems. Household wastewater enters the septic tank through the house discharge sewer pipe (Figure 8). After passing through the inlet baffle, the solids separate from the liquid as the sewage flows slowly through the septic tank. Some solids settle to the bottom of the tank and others float in the scum layer at the top. Bacterial action partially decomposes the solids.

Septic tanks are generally installed by isolated communities like schools, hospitals & institutions. Septic tank may be defined as primary sedimentation tank. Having capacity to remove 60 to 70% dissolved matter.

(14) Explain the following elements: 10marks

Marking scheme:

- **Evaporation:** This is the most common natural cause of seal loss. The warmer and drier the air becomes, the greater will be the rate of evaporation.
- **Capillary action:** Capillarity can result in the rapid destruction of a seal due to panicles of dish-cloths being deposited over the weir of the trap. A similar effect will be seen if a cloth is left hanging over the edge of a bucket of water.
- **Wind:** The effects of wind currents and pressures at the vent terminal can cause 'waving' out of traps especially those of larger diameter. Unstable atmospheric conditions in the vent pipe due to this cause sometimes produce a wave movement of the water in the trap allowing it to gradually wash over the weir. It can sometimes be remedied by extending the vent upward or terminating it with a bend.
- **Momentum:** is the term used to describe the effect of a sudden discharge of water from a bucket into a WC or gully trap. Due to the velocity of the discharge, it sometimes also carries away the water which should form the trap seal.

(15) Discuss about regulations governing a drainage system in Rwanda. /10marks

Marking scheme:

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- ✓ Any drain must have sufficient strength and capable of carrying loads which may be subjected.
- ✓ The drain must be protected against injury
- ✓ All drain must be constructed of durable materials which will not only resist corroding action of ground and sub soil water but also soil water which passes in it.
- ✓ All joints must remain water tight and air tight under all working condition.
- ✓ All drain must be of adequate size to carry the maximum volume of water that may be discharged into them.
- ✓ All drain must have of adequate ventilation.
- ✓ No drain should pass under the building unless it becomes unavailable in which case the section under building should be arched (encased with concrete not less than 150mm or cast-iron pipes must be used.
- ✓ There should be an inspection chamber where there is a change of direction, change of gradient and at about 30 to 45.7m interval on straight line drain.
- ✓ Before a main drain enters a public sewer an interceptor must be filled into intercepting chamber to prevent fall faces from coming back into the building.

(16) Identify any ten (10) principles of digging trenches in drainage system

- The trench should be straight, with vertical sides centered on the pipe center line
- Trench excavation should not extend too far ahead of pipe laying
- No trenching should be allowed to start and proceed without the required warning devices, barricades and signals
- Local regulations should be observed
- If trench is below asphalt or concrete pavements, power saws should be used to ensure smooth edge cuts
- All asphalt or concrete debris should be hauled away before the excavation to prevent their use as backfill material.
- When the ground is unstable trench wall must be stepped or sloped
- The trench bottom must be uniform
- Water must be kept out of the trench during constructions
- The depth of the trench should be sufficient to allow pipe diameter bedding

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(17) Differentiate separate system from combined system of drainage

Separate system	Combined system
<ul style="list-style-type: none">• Rain water is kept separate from sewage• The storm/natural water is not polluted• Storm water can be discharged into river without treatment• Sewer are small in size• The cleaning sewer is hard• The maintenance cost is high• Loads on treatment unit become less• Self-cleaning velocity is not easily achieved• High installation cost• etc	<p>Rain and sewage passes from a single set of pipe</p> <p>Storm water get polluted Storm water must be treated before mixing to the river</p> <p>Sewer are large in size Cleaning sewer it is easy due to large diameters</p> <p>The maintenance cost is reasonable Loads on treatment unit become high</p> <p>Self-cleaning velocity is easily achieved Less installation cost etc</p>

(18) a) Explain rainwater movement on earth surface

Saturation flow

Unsaturated flow

Water vapour

b) State 5 factors affecting the movement of water

5 factors affecting the movement of water are:

- Feature of soil
- Structure of soil
- Amount of organic mater
- Depth of soil to hard pan
- Temperature
- Pressure of water
- Vegetation cover
- etc.