**THE UNITED REPUBLIC OF TANZANIA**

**NATIONAL EXAMINATIONS COUNCIL OF TANZANIA**

**CERTIFICATE OF SECONDARY EDUCATION EXAMINATION**

**071 BUILDING CONSTRUCTION**

(For Private Candidates Only)

**Time: 3 Hours** **ANSWERS** **Year: 2015**

**Instructions**

1. This paper consists of sections A, B and C with total of fifteen questions

2. Answer all questions in section A and B, and two questions in section C.

I. A person engaged by the building owner as an agent of designing, advising, and ensuring that the project is kept within cost and completes the design is called

A Architect
B Surveyor
C Estimator
D Quantity surveyor
E Contractor's manager

The correct answer is D Quantity surveyor because a quantity surveyor is responsible for cost estimation, budgeting, and ensuring financial efficiency in construction projects.

II. One of the following is a property which helps to ensure the purpose of the foundation on the building.

A Combined footings
B Safety against undermining
C Determining ground water level
D Site reconnaissance
E Uplift pressure

The correct answer is B Safety against undermining because foundations should be designed to prevent soil erosion and loss of support beneath the structure.

III. Load-bearing walls are generally provided with

A Thick foundation
B Large thickness
C Partition walls
D Hollow concrete blocks
E Extra not load-bearing wall

The correct answer is B Large thickness because load-bearing walls must have sufficient thickness to support vertical loads and resist structural stresses.

IV. One of the following provides a level surface capable of supporting the occupants of a building, furniture, equipment and sometimes internal partitions.

A Hard core
B Compactation of hard core
C Oversite concrete
D Floor

The correct answer is D Floor because a floor is the horizontal surface designed to carry occupants, furniture, and loads within a building.

V. The roof members that run from the ridge to the eaves wall and support the battens underneath the roof covering are known as

A Hip rafters
B Common rafters
C Valley rafters
D Jack rafters
E Barge boards

The correct answer is B Common rafters because these rafters extend from the ridge to the eaves, providing main support for the roofing material.

VI. The vertical member running through the middle of the framework of a shutter is called
A Transom
B Sill
C Mullion
D Jamb
E Ledge

The correct answer is C Mullion because a mullion is a vertical dividing element in window or door frames, supporting the structure.

VII. The wooden block fixed on the back side of a door or window frame to prevent damage of the plastering of jambs is called
A Brace
B Stop
C Batten
D Ledge
E Mullion

The correct answer is B Stop because a stop is a molding or block attached to the frame to limit the movement of the door or window and protect the adjacent plaster.

VIII. The upper horizontal portion of a step upon which the foot is placed while ascending or descending the stair is called
A Landing
B Going
C Tread
D Riser
E Flight

The correct answer is C Tread because a tread is the flat surface on which the foot rests while using stairs.

IX. A bidet can be connected to a waste-pipe system by using a pipe with a diameter of
A 100mm
B 50mm

C 45mm
D 75mm
E 32mm

The correct answer is B 50mm because a bidet typically requires a small waste pipe for efficient drainage.

X. To prevent an overflow of a cold water storage cistern every supplying pipe must be fitted with
A Gate valve
B Stop valve
C Float valve
D Stop cock
E Non-return valve

The correct answer is C Float valve because a float valve controls the water level in storage tanks by stopping water inflow when the desired level is reached.

2. Matching items

List A

i. Load-bearing members spanning from the ridge to the valley.
ii. Beams used to give support to ceiling joists and counteract excessive deflections.
iii. Fixing media for roof members and distribute the roof load evenly all around the building.
iv. Main load-bearing members of a roof spanning between the wall and the ridge.
v. Acts as beams reducing the span of the main load-bearing members from the ridge.
vi. Compression member which transfers loads to a suitable load-bearing support.
vii. Tie rafters that give additional strength to tie truss.
viii. Members running from the ridge forming the spine of an external angle.
ix. Vertical timbers used to give support to beams carrying the ceiling joists.
x. Members running from the ridge forming an internal angle.

List B

A Dragon ties
B Collars
C Hangers
D Binders
E Purlins
F Struts
G Soffits
H Common rafters
I Jack rafters

J Hip rafters
K Valley rafters
L Wall plates
M Wall boards
N Wall battens
O Fascia boards

i - K Valley rafters
ii - D Binders
iii - L Wall plates
iv - H Common rafters
v - I Jack rafters
vi - F Struts
vii - B Collars
viii - J Hip rafters
ix - C Hangers
x - A Dragon ties

3. Enumerate eight chemical ingredients of Portland cement.

Portland cement consists of various chemical compounds that contribute to its setting and strength properties. The key ingredients include:

- Lime (CaO) – Provides strength and helps in the formation of calcium silicates.
- Silica ($SiO_2$) – Contributes to the formation of dicalcium and tricalcium silicates, which enhance durability.
- Alumina ($Al_2O_3$) – Improves resistance to heat and speeds up setting time.
- Iron oxide ($Fe_2O_3$) – Gives cement its color and helps in clinker formation.
- Gypsum ($CaSO_4 \cdot 2H_2O$) – Regulates the setting time of cement.
- Magnesia (MgO) – Enhances strength but must be limited to prevent expansion issues.
- Sulfur trioxide ($SO_3$) – Controls the formation of aluminate compounds.
- Alkalies ($Na_2O$ & $K_2O$) – Affect setting time and may cause efflorescence.

4. (a) What is the need of sub-surface investigation?

Sub-surface investigation is necessary to assess the soil and ground conditions before construction. Its purposes include:

- Determining the load-bearing capacity of the soil.
- Identifying underground water levels that may affect stability.
- Detecting weak soil layers or rocks that could lead to foundation failure.
- Ensuring proper foundation selection to prevent structural defects.

(b) Name four methods applicable in boring method of sub-surface investigation.

- Auger boring – Uses a helical auger to drill into the soil and extract samples.
- Percussion boring – Involves a heavy weight repeatedly dropped to break soil for sampling.
- Rotary drilling – Uses a rotating drill bit to penetrate the ground for deep soil analysis.
- Wash boring – Involves injecting water to loosen the soil while samples are collected.

5. (a) Explain workability of concrete.

Workability refers to the ease with which concrete can be mixed, transported, placed, and compacted without segregation or excessive bleeding. It determines how well concrete flows and fills molds or formwork.

(b) How is workability of concrete measured at site?

Workability is measured using different tests, including:

- Slump test – Determines the consistency and flowability of fresh concrete.
- Compaction factor test – Measures the effort needed to compact concrete.
- Vee-Bee test – Evaluates the time required for concrete to change shape under vibration.

6. Sketch the conventional symbols for the following sanitary items:

(a) Urinal wall hung
(b) Urinal stall
(c) Shower head
(d) Urinal corner hinge

7. (a) When is a revolving door preferred to a hinged door?

A revolving door is used when:

- Continuous pedestrian movement is required without obstruction.
- There is a need to reduce heat loss or air exchange between indoor and outdoor environments.
- Space-saving is a priority in commercial buildings.
- Security and controlled access are necessary.

(b) Define shutter and sill in a door opening.

- Shutter – The movable part of a door or window that opens and closes to allow or restrict entry.
- Sill – The horizontal base of a window or door frame that provides structural support and protection against water penetration.

8. With the aid of sketches, define the following terms:

(a) Open cave

An open cave is a roof overhang that extends beyond the exterior wall of a building without being enclosed underneath. It is designed to provide shade and protection from rain and sun. Open caves allow for better air circulation and reduce heat gain on walls.

(b) Closed cave

A closed cave is an overhanging roof structure that is enclosed or covered underneath with soffits or boarding. It is commonly used in modern buildings to create a more finished appearance and prevent pests from entering the roof space.

9. Describe four effects of dampness in a structure.

Dampness in buildings is caused by water penetration due to poor drainage, leaking pipes, or capillary action. The effects of dampness include:

- Structural weakening – Continuous exposure to moisture weakens building materials, leading to cracks and deterioration of walls and floors.
- Mold and mildew growth – Damp conditions promote the growth of fungi, which causes health issues such as respiratory problems and allergies.
- Corrosion of reinforcement – Moisture exposure causes steel reinforcements in concrete to rust, reducing the structural strength of the building.
- Damage to finishes – Damp walls cause peeling of paint, blistering of plaster, and rotting of wooden elements, leading to high maintenance costs.

10. Describe the following terms as applied to the floors:

(a) Base course

The base course is the first layer of material placed on the ground to support the flooring system. It provides stability and distributes loads evenly across the foundation. It is usually made of compacted gravel, sand, or crushed stones.

(b) Underlayer

The underlayer is a secondary layer placed between the base course and the final flooring material. It helps in leveling the surface, improving insulation, and reducing noise transmission. It can be made of plywood, foam, or cement-based screed.

(c) Topping

Topping is a thin, high-strength layer applied over the underlayer to create a smooth and durable surface. It enhances the aesthetic appeal of the floor and protects the underlying layers from wear and tear. It is usually made of polished concrete, epoxy, or terrazzo.

(d) Floor finish

Floor finish refers to the final treatment applied to the surface of a floor to improve its appearance, durability, and functionality. Common floor finishes include tiles, vinyl, carpet, hardwood, and polished concrete.

11. Give four disadvantages of timber flat roofs.

- Prone to decay – Timber is susceptible to rot and termite infestation, requiring regular treatment and maintenance.
- High maintenance – Timber flat roofs need frequent sealing and protective coatings to prevent water damage.
- Fire hazard – Timber is highly flammable and poses a higher fire risk compared to materials like concrete or metal.
- Limited load capacity – Timber flat roofs cannot support heavy loads, requiring additional reinforcement for durability.

12. Differentiate cornices from the architraves.

- Cornices – Decorative moldings that project outward at the junction of walls and ceilings. They are used to enhance aesthetics and conceal joints between the wall and roof.
- Architraves – Horizontal moldings that frame the top of a door or window opening. They provide a smooth transition between the wall and the door/window frame.

13. (a) Differentiate lime sand mortar from cement sand mortar.

- Lime sand mortar – Uses lime as the binding agent, making it more flexible and breathable. It is suitable for historic buildings where movement and breathability are important.
- Cement sand mortar – Uses cement as the binder, making it stronger and more resistant to moisture. It is commonly used in modern construction for brickwork and plastering.

(b) Give two classifications of aggregates and describe their technical requirements.

- Fine aggregates – Include sand and crushed stone dust that pass through a 4.75mm sieve. They provide cohesion in concrete and improve workability.
- Coarse aggregates – Include gravel and crushed stones larger than 4.75mm. They add strength and reduce shrinkage in concrete.

(c) Explain the preparation of plastered surface before painting.

- The surface should be cleaned to remove dust, grease, and loose particles.
- Any cracks or holes should be filled with putty or filler.
- A primer should be applied to ensure uniform absorption of paint.
- The surface should be allowed to dry completely before painting.

14. (a) Why is it not advised to introduce winders in stairs?

- Winders create uneven steps that increase the risk of tripping and falling.
- They make staircases uncomfortable to use, especially for elderly people and children.
- Winders complicate stair construction, requiring more precise measurements and cutting.

(b) Explain the requirements of a good stair by considering the following:

(i) Pitch of the stair

The pitch of a stair refers to the angle of the stairway in relation to the horizontal plane. It should be between 30-45 degrees for comfortable ascent and descent. A steep pitch makes climbing difficult, while a low pitch requires more space.

(ii) Headroom

Headroom is the vertical clearance between a step and the ceiling or any overhead obstruction. It should be at least 2 meters to prevent head injuries.

(iii) Handrail

A handrail provides support and stability when using stairs. It should be installed at a height of 900-1000mm from the stair tread and should be continuous along the stairway.

(c) With the aid of plan sketches, distinguish between Straight Stairs and Quarter-turn Stairs.

15. (a) Explain the following parameters in relation to the principles of good drainage.

(i) Quality

The quality of a drainage system depends on the durability and strength of the materials used. High-quality drainage pipes and fittings should be resistant to corrosion, pressure, and environmental factors such as chemicals and temperature variations. Poor-quality materials can result in cracks, leaks, and blockages, leading to structural and environmental issues. The pipes should also be able to withstand high flow rates without deforming or collapsing under pressure. Using durable materials such as PVC, cast iron, and reinforced concrete helps ensure a long-lasting and efficient drainage system.

(ii) Water tightness

A drainage system must be watertight to prevent leakage, infiltration, and contamination of the surrounding soil and water sources. If a drainage system is not watertight, wastewater may seep into the ground, leading to structural weakening of nearby buildings, soil erosion, and pollution of drinking water supplies. Water tightness is achieved through the use of properly fitted pipe joints, rubber seals, and adhesives. In underground drainage systems, special techniques such as trenchless pipe installation and pressure testing are used to ensure that no leaks occur. Regular inspections and maintenance are necessary to detect and repair leaks before they cause serious damage.

(iii) Straightness

The straightness of a drainage system is crucial to ensure the smooth flow of wastewater without obstructions. A properly aligned drainage system allows gravity to move waste efficiently, reducing the risk of blockages and backflow. Poorly aligned pipes can lead to slow drainage, accumulation of solid waste, and increased maintenance costs. To maintain straightness, pipes should be installed with a proper gradient, usually a slope of 1% to 2%, to facilitate water flow. During installation, engineers use laser levels, string lines, and plumb bobs to ensure correct alignment. Deviations from straight alignment should be avoided unless necessary, such as in curved piping systems where smooth bends are designed to prevent resistance to flow.

(b) Describe the straightness test method and its procedure of testing the drainage pipe.

The straightness test is conducted to ensure that drainage pipes are correctly aligned and free from unintended bends or obstructions. A properly installed drainage system improves efficiency by allowing waste to flow smoothly. The procedure for conducting a straightness test involves the following steps:

i. Preparation of the pipe – The pipe is installed in its intended position, ensuring that joints are properly fitted and sealed. Any dirt or debris inside the pipe is removed to prevent blockages during the test.

ii. Insertion of a plumb line or laser beam – A plumb line (a weighted string) or a laser beam is inserted through the pipe to check for misalignment. If a plumb line is used, it should pass smoothly through the entire length of the pipe without obstruction. A laser beam provides a more precise check by highlighting any deviation from a straight line.

iii. Observation and measurement – The pipe is visually inspected from both ends to check for any displacement. If the plumb line or laser beam does not pass straight through, the misalignment is measured to determine the extent of the problem.

iv. Correction of alignment – If the test reveals any bends or misalignment, adjustments are made by repositioning the pipe or re-excavating the trench to achieve the correct slope and straightness.

v. Final verification – After adjustments, the test is repeated to confirm that the pipe is properly aligned. The drainage system is then secured in place using backfill materials, ensuring that the pipes remain straight and stable over time.

(c) (i) List down four types of waste water fittings.

Wastewater fittings are components used in plumbing systems to facilitate the flow of sewage and greywater. They help connect pipes, direct the flow of waste, and prevent backflow or leaks. The main types of wastewater fittings include:

i. Floor drains – These are used to remove wastewater from indoor spaces such as bathrooms, kitchens, and basements. They are usually covered with grates to prevent debris from entering the drainage system.

ii. Water closets – These are toilet fixtures designed for flushing human waste into the sewage system. They are connected to the main drainage system via a trap that prevents sewer gases from escaping into living spaces.

iii. Gully traps – These are installed at the junction between indoor and outdoor drainage to prevent foul smells and insects from entering buildings. They collect wastewater from sinks and washbasins before directing it to the sewer.

iv. Sinks and basins – These are fitted with traps and pipes that drain wastewater from kitchens, bathrooms, and laundry areas. The traps retain a small amount of water to block sewer gases from coming back into the building.

(ii) Name two types of urinals.

Urinals are sanitary fixtures used for urination, commonly found in public restrooms, offices, and commercial buildings. They are designed to conserve water and reduce maintenance costs. The two main types of urinals are:

i. Wall-hung urinals – These are mounted on a wall and connected to a drainage system with a flushing mechanism. They are space-saving and easy to clean.

ii. Stall urinals – These are floor-mounted urinals with partitions for privacy. They are commonly used in high-traffic public restrooms where multiple users may need access at the same time.