THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

071 BUILDING CONSTRUCTION

(For Both School and Private Candidates)

Time: 3 Hours **ANSWERS** **Year: 2017**

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. The tube fixed diagonally in a scaffold to prevent any movement is called
A brace, B transom, C bridle, D tie, E standard.
The correct answer is A brace because a brace is a diagonal structural member used to prevent movement and provide stability in scaffolding.

ii. Fine aggregate is that which passes a
A 3mm sieve, B 5mm sieve, C 7mm sieve, D 10mm sieve, E 15mm sieve.
The correct answer is B 5mm sieve since fine aggregate typically passes through a sieve of 4.75mm to 5mm as per construction standards.

iii. Which of the following is used to cut blocks by hand?
A Claw hammer, B Brick trowel, C Sledge hammer, D Piece of round bar, E Mallet and chisel.
The correct answer is E Mallet and chisel since these tools are commonly used for manually shaping and cutting bricks.

iv. The highest point of an arch at which the key brick is placed is called
A span, B haunch, C crown, D springer, E extrados.
The correct answer is C crown because the crown is the highest central part of an arch where the keystone is placed.

v. The part of the building which transfers the entire load of the building to the subsoil is called
A beam, B wall, C plinth, D foundation, E floor.
The correct answer is D foundation because it supports the entire structure and distributes loads to the ground.

vi. A ratio of the mass of water to the mass of solids found in the soil is known as
A soil capacity, B air content, C soil strength, D density of soil, E moisture content.
The correct answer is E moisture content because it refers to the amount of water present in soil compared to the solid particles.

vii. Which of the following tools is used to measure accurately the amount of building materials to be used?
A Gauge box, B Mortar pan, C Bucket, D Wheelbarrow, E Spade.
The correct answer is A Gauge box because it is used to measure precise proportions of materials like sand and cement.

viii. A container of water in which the stored water is under atmospheric pressure is called
A bucket, B open drum, C cistern, D tank, E cylinder.
The correct answer is C cistern because a cistern is a tank designed for storing water under atmospheric pressure.

ix. The recommended ratio of cement to sand for plaster is
A 1:3, B 1:1.5, C 1:8, D 1:6, E 1:4.
The correct answer is E 1:4 as the standard plastering mix ratio for most applications.

x. The brickwork structure that carries the flue above the roof is known as
A back, B chimney, C breast, D fireback.
The correct answer is B chimney because a chimney is designed to carry smoke and gases out of a building.

2. Matching Items

List A

i. A temporary support to the unsafe structure.
ii. The diagonal members fixed on the vertical member of the scaffold.
iii. The horizontal platform which supports workmen and materials.
iv. The vertical poles that carry the weight of the scaffolding to the ground.
v. A component used to secure firmly a vertical member placed vertically along the face of the wall.
vi. The cross pieces that have one end built into the wall of the building.
vii. The square metal plates that fit into the bottom of scaffold tubes to spread the load.
viii. The components embedding the inclined members into the ground.
ix. An inclined member used to give lateral support to the wall.
x. A member nailed directly on the wall plate or base plate for strengthening purposes.

List B

A. Boarding
B. Transoms
C. Base plate
D. Wedges
E. Ledger
F. Fin wheel
G. Hoop
H. Toe board
I. Rakers
J. Braces
K. Straining piece
L. Standards
M. Shoring
N. Iron dog
O. Putlogs
P. Post
Q. Needle
R. Cleat

i - A Boarding
ii - J Braces

iii - H Toe board
iv - E Ledger
v - C Base plate
vi - I Rakers
vii - F Fin wheel
viii - M Shoring
ix - N Iron dog
x - Q Needle

3. Give four reasons of stripping-off vegetable soil before commencing construction of a building.

Vegetable soil is the uppermost layer of soil that contains decomposed plant matter, roots, and organic nutrients. Although it is useful for plant growth, it is not suitable for construction purposes. The reasons for stripping it off before commencing construction are:

i. Weak bearing capacity – Vegetable soil is loose and lacks the necessary strength to support heavy loads. It contains organic matter that decomposes over time, making it unstable for foundation laying. If this layer is not removed, the structure built upon it may experience settlement and cracks.

ii. Prevention of settlement – The decomposition of organic material in vegetable soil leads to volume changes, causing the ground to settle unevenly. This can create structural weaknesses in the foundation and lead to long-term instability of the building.

iii. Elimination of moisture retention – Vegetable soil has high water-holding capacity due to its organic content. This can cause excessive moisture retention around the foundation, leading to dampness, mold growth, and deterioration of building materials such as concrete and steel reinforcement.

iv. Enhancing foundation stability – Removing vegetable soil ensures that the foundation is laid on compact, firm, and stable subsoil. This improves load-bearing capacity, reduces risks of differential settlement, and enhances the overall durability of the structure.

4. List four factors that may cause failure of the foundation.

The foundation of a building plays a crucial role in providing stability and strength. However, several factors can contribute to its failure, leading to structural defects and collapse. These factors include:

i. Poor soil conditions – Some types of soil, such as loose sand, expansive clay, and silt, are not suitable for supporting foundations. Weak or compressible soil can cause uneven settlement, leading to cracks and structural instability.

ii. Overloading – Every foundation is designed to support a specific load. If additional weight is applied beyond the designed capacity, such as constructing extra floors without proper reinforcement, the foundation may fail due to excessive stress.

iii. Poor drainage system – Accumulation of water around the foundation weakens the soil structure, causing erosion and reducing its load-bearing capacity. Poor drainage can also lead to hydrostatic pressure against foundation walls, resulting in cracks and instability.

iv. Use of substandard materials – The strength of a foundation depends on the quality of materials used in its construction. Poor-quality concrete, low-grade reinforcement bars, and improper mixing ratios can lead to weak foundations that deteriorate over time.

5. (a) Briefly explain the meaning of reinforced concrete.

Reinforced concrete is a type of construction material that combines concrete with embedded steel reinforcement bars (rebars) to improve its structural strength. Concrete alone has high compressive strength but is weak in tension, meaning it can withstand heavy loads but cracks under bending forces. By embedding steel rebars, which have high tensile strength, the material gains the ability to resist bending, shear forces, and cracking. This makes reinforced concrete an essential material for constructing beams, columns, slabs, and foundations in modern buildings.

(b) List four factors which influence the strength of a concrete.

The strength of concrete depends on various factors that affect its composition, curing, and structural integrity. These include:

i. Water-cement ratio – The amount of water added to the cement mixture significantly affects the concrete's strength. A lower water-cement ratio improves strength, while an excessive amount weakens the bond between particles and leads to lower durability.

ii. Quality of cement – The grade and type of cement used determine the final strength of concrete. High-quality cement with proper chemical composition enhances the setting and hardening process, resulting in better performance.

iii. Curing process – Proper curing is essential for the hydration process, where cement reacts with water to form strong bonds. Inadequate curing leads to incomplete hydration, causing weak and brittle concrete.

iv. Aggregate properties – The size, shape, and grading of aggregates (sand, gravel, crushed stones) play a vital role in concrete strength. Well-graded aggregates with proper binding improve compactness and overall durability.

6. List four causes of cracks in walls.

Cracks in walls are a common structural problem that can result from various factors. The primary causes include:

i. Foundation movement – If the foundation of a building settles unevenly due to soil conditions or structural defects, it creates stress on the walls, leading to cracks.

ii. Thermal expansion and contraction – Changes in temperature cause construction materials to expand and contract. Repeated cycles of expansion and contraction create stress that results in cracks over time.

iii. Poor construction practices – Inadequate mixing of concrete, improper curing, and lack of reinforcement in walls can lead to the formation of cracks due to weak structural integrity.

iv. Excessive loading – If a wall is subjected to loads beyond its design capacity, such as heavy furniture, additional structures, or vibrations, it may develop cracks due to stress and pressure.

7. What are the structural requirements for chimneys in the construction of fireplaces?

A well-designed chimney ensures proper ventilation, heat resistance, and safety in buildings. The structural requirements for a chimney include:

i. Proper height – The chimney should extend at least 3 feet above the highest point of the roof to ensure efficient smoke dispersion and prevent backflow of gases into the house.

ii. Adequate flue lining – The flue, which is the passage inside the chimney, should be lined with heat-resistant materials such as clay tiles or stainless steel to withstand high temperatures and prevent corrosion.

iii. Thermal insulation – Chimney walls should have insulation to prevent heat transfer to surrounding structures, reducing the risk of fire hazards and heat damage.

iv. Stable foundation – The base of the chimney should be strong enough to support its weight and prevent tilting or collapse over time. A solid foundation ensures durability and structural stability.

8. List down four advantages of flat roof construction.

Flat roofs are commonly used in modern architecture due to their practical and economic benefits. The advantages of flat roof construction include:

i. Cost-effective – Flat roofs require fewer materials and less labor compared to pitched roofs, making them more affordable for construction and maintenance.

ii. Additional usable space – The flat surface can be utilized for various purposes such as rooftop gardens, solar panel installation, water storage, or recreational areas.

iii. Ease of maintenance – Unlike sloped roofs, which are difficult to access, flat roofs provide easier access for maintenance, repairs, and cleaning.

iv. Modern aesthetic appeal – Flat roofs complement contemporary architectural designs, providing a sleek and minimalistic appearance suitable for commercial and residential buildings.

9. Outline four advantages of steel windows over wooden windows.

Steel windows are widely used in construction due to their durability and strength compared to traditional wooden windows. Their advantages include:

i. Durability – Steel windows are resistant to termites, rot, and warping, making them more long-lasting than wooden windows that deteriorate over time.

ii. Fire resistance – Steel is non-combustible and does not contribute to the spread of fire, making it a safer choice compared to wooden frames.

iii. Slimmer frame design – Steel has higher strength, allowing for thinner frames while maintaining structural integrity. This enables larger glass areas, improving natural lighting and aesthetics.

iv. Low maintenance – Steel windows require minimal upkeep since they do not need frequent painting or sealing like wooden windows, which are more susceptible to weathering and decay.

10. Differentiate 'back flap hinge' from 'parliamentary hinge' in fixing doors and windows.

A back flap hinge is a type of hinge with extended leaves that provide additional support when fixing heavy wooden doors and furniture. It is commonly used where a strong attachment is required.

A parliamentary hinge, on the other hand, allows doors to open to a full 180-degree angle, making it ideal for outward-opening doors and windows that require maximum clearance. It is commonly used in modern and space-saving designs.

11. What is the difference between separate drainage system and combined drainage system in building construction?

A separate drainage system is a drainage setup where wastewater (sewage) and stormwater (rainwater) are carried in different drainage pipes. In this system, one set of pipes is dedicated to carrying household sewage from sinks, toilets, and bathrooms, while another set of pipes carries rainwater from roofs and surface runoff to stormwater drains. This system reduces the risk of sewage overflow during heavy rains and helps in proper water treatment before disposal.

A combined drainage system, on the other hand, carries both wastewater and stormwater through the same pipeline. While this system is cost-effective since it requires fewer pipes and infrastructure, it has the disadvantage of overloading during heavy rainfall, leading to flooding and contamination of natural water bodies due to the mixing of untreated sewage with stormwater.

12. Give four advantages of using stones instead of bricks in wall construction.

i. High durability – Stones have a natural strength and last longer compared to bricks, making them ideal for permanent structures that require minimal maintenance.

ii. Better resistance to weather – Stone walls are more resistant to moisture, temperature variations, and erosion, making them suitable for both dry and wet environments.

iii. Lower maintenance – Unlike bricks, which require regular plastering and painting to prevent wear, stones do not need frequent repairs, reducing long-term maintenance costs.

iv. Aesthetic appeal – Natural stones provide a unique and elegant appearance, enhancing the overall beauty of buildings. Stone walls can also be used for decorative purposes without requiring additional finishes.

13. (a) (i) How is site clearance operation conducted?

Site clearance is the process of preparing land for construction by removing all unwanted materials that may obstruct building activities. The process involves several steps:

- The site is first inspected to identify obstacles such as trees, shrubs, rocks, and existing structures that need removal.
- The vegetation is cleared using manual tools or machinery such as bulldozers and excavators.
- Any underground utilities such as pipes or electrical cables are marked and relocated if necessary.
- Large debris and topsoil with organic materials are removed to expose stable ground suitable for foundation work.
- The cleared site is leveled and compacted to create a firm base for further construction activities.

(ii) What are the precautions to be observed during site clearance operation?

- Proper safety measures must be followed to protect workers from injuries caused by falling debris, operating machinery, and unstable ground.
- Environmental protection measures should be observed, including proper disposal of waste materials and conservation of nearby natural resources.
- Underground utilities such as water pipes, gas lines, and electrical cables should be identified before excavation to prevent accidental damage.
- Machinery used for clearing must be operated by trained personnel to ensure efficiency and safety.

(b) (i) Why is it necessary to conduct site exploration before commencing construction works?

Site exploration is conducted to assess the physical and geological properties of the soil before starting construction. It is necessary for the following reasons:

- It helps determine the type of soil and its load-bearing capacity, ensuring the selection of a suitable foundation.
- It identifies groundwater levels, which is crucial for planning drainage and waterproofing solutions.
- It detects the presence of underground obstacles such as rocks and voids that may affect excavation and foundation laying.
- It helps in estimating construction costs by providing insights into the type of foundation and construction techniques required.

(ii) Give three advantages of site exploration.

- It reduces the risk of foundation failure by ensuring the soil conditions are properly assessed before construction begins.
- It helps in selecting the most appropriate construction materials and techniques based on the soil and environmental conditions.
- It minimizes unforeseen costs by identifying potential ground issues that could lead to structural problems in the future.

(c) With the help of sketches, briefly explain 'auger boring' as applied in site exploration.

Auger boring is a method used for drilling into the ground to collect soil samples for analysis. It involves rotating a spiral-shaped auger into the soil, which lifts the soil to the surface. This method is useful for investigating soil composition and determining the depth at which a firm foundation can be established.

(d) Why larger sites should be fenced before commencement of construction works?

- Fencing prevents unauthorized access to the construction site, reducing the risk of theft and vandalism.
- It enhances safety by keeping out pedestrians and animals, preventing accidents from open excavations and construction equipment.
- It helps in defining property boundaries, avoiding disputes with neighboring landowners.
- Fencing helps in controlling dust, debris, and noise from affecting surrounding areas, ensuring minimal disruption to the community.

14. (a) With the aid of a sketch, outline the procedures followed for setting out the building by using Builder's Square Method.

The Builder's Square Method is used to establish accurate right angles for the foundation layout. The procedure involves:

- Marking the position of the main reference points on the ground.
- Using pegs and a builder's square to measure and create perpendicular angles.
- Checking diagonals to ensure the layout is symmetrical and accurately aligned.
- Adjusting any misalignments before excavation begins.

(b) Briefly explain how the bearing capacity of soil can be improved by using the following methods:

(i) Increasing depth of foundation – Deeper foundations transfer the building load to more stable soil layers, reducing settlement and improving structural stability. This method is commonly used when the topsoil is weak but stronger soil exists at greater depths.

(ii) Grouting – This technique involves injecting a mixture of cement, water, and chemicals into the ground to fill voids and stabilize weak soils. Grouting helps in increasing soil density and reducing water infiltration, making the foundation more secure.

(c) With the help of a sketch, describe the timbering of trenches in extremely loose and soft ground by using a runner system.

Timbering of trenches is the process of providing temporary support to trench walls to prevent collapse. In a runner system, horizontal planks (runners) are placed against the trench walls and secured using vertical posts and struts. This method is effective in preventing soil from caving in while excavation work is carried out.

15. (a) Briefly describe dead shore as applied in construction works.

Dead shoring is a temporary support system used to hold up the weight of an existing structure while alterations or repairs are being made. It is commonly used when removing walls, replacing columns, or constructing basements beneath existing buildings. The system consists of vertical posts (shores) and horizontal beams that transfer the load safely until permanent supports are installed.

(b) Enumerate the necessary operations for a successful dead shoring arrangement.

- A structural assessment is conducted to determine the weight and points that need support.
- Vertical shores are placed at calculated positions to carry the load.
- Horizontal beams are fixed across the vertical shores to distribute the weight evenly.
- The arrangement is tested for stability before proceeding with the construction work.
- Shores are gradually removed only after permanent structural elements have been secured.

(c) Draw a typical well-labeled sketch of single frame cantilever or needle scaffolds.

A single-frame cantilever scaffold consists of vertical posts anchored to the building structure, with horizontal planks extending outward to provide a working platform. Needle scaffolds, on the other hand, use horizontal beams (needles) inserted into the walls to support the scaffold structure without resting on the ground. These types of scaffolds are used for working on upper levels of buildings without requiring ground support.