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: 2010**

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 client is
A the person engaged to prepare bills of quantities
B an agent engaged to design advice and ensure quality
C the person or a committee that commissions the work
D the person who carries out the constructional works
E the person or committee that orders building materials

The correct answer is C. A client is the person or entity that commissions the construction work, meaning they initiate and oversee the project, ensuring it meets their needs.

II. The method of applying timber preservative that attains the deepest penetration is
A Spraying
B Dipping
C Pressure impregnation
D Natural
E Brushing

The correct answer is C. Pressure impregnation forces preservatives deep into the timber under pressure, making it highly resistant to decay, insects, and fungi.

III. The suitable recommended size of board for making a profile board is
A 25 mm x 150 mm
B 38 mm x 150 mm
C 50 mm x 150 mm
D 38 mm x 175 mm
E 50 mm x 175 mm
The correct answer is B. A profile board needs to be stable and durable, and 38 mm x 150 mm is a standard size that provides enough strength for this purpose.

IV. A scaffold whose some members bear on a wall for support is called
A trestle scaffold
B independent scaffold
C dependent scaffold
D tubular scaffold
E ladder

The correct answer is C. A dependent scaffold relies on a wall for support, while an independent scaffold stands freely without requiring external structural assistance.

V. The suitable type of pitched roof for spans of 6 m to 9 m is
A couple roof
B collar tie roof

C couple close roof
D king-post truss roof
E collar roof

The correct answer is D. A king-post truss roof is structurally efficient for medium spans like 6 m to 9 m, providing stability and load distribution.

VI. For a comfortable ascent of stairway, the number of steps in a flight should be restricted to a maximum of
A 16 steps
B 15 steps
C 14 steps
D 13 steps
E 12 steps

The correct answer is E. A maximum of 12 steps ensures ease of climbing, reduces fatigue, and aligns with ergonomic stair design principles.

VII. Coach screws are used mainly for
A shaped screw driver
B fittings of materials which are too thin to be counter sunk
C good quality fixtures
D a flush finish
E heavy carpentry work

The correct answer is E. Coach screws are large, strong screws designed for securing heavy carpentry components, providing durability and structural integrity.

VIII. A water pipe which is directly subjected to pressure from a main pipe is called
A service pipe
B communication pipe
C distribution pipe
D cistern pipe
E main pipe
The correct answer is E. A main pipe carries water under high pressure and distributes it to other pipes in the system.

IX. The space behind a fireback should be filled with
A a clay soil
B normal soil
C loose bricks or non-combustible materials

D a lightweight concrete
E a dense concrete

The correct answer is C. Loose bricks or non-combustible materials provide heat insulation, preventing excessive heat damage and improving fireback efficiency.

X. The shores which provide a clear working space under the shoring are known as
A raking shores
B dead shores
C putlog shores
D flying shores
E trestle shores

The correct answer is D. Flying shores provide lateral support to walls while leaving space underneath for work to continue unobstructed.

2. Matching items
list a
i) The structural engineer's representative on site for large contracts.
ii) The composition of water, sand, stones and cement.
iii) Building term used to express the operations of leveling the sloping site before commencing the actual building works.
iv) Pad foundations.
v) The roof slope or inclination to the horizontal.
vi) The purpose for construction of windows.
vii) One of the applications of shoring.
viii) A fixed reference point for all levels in the building.
ix) Two methods of which concrete can be mixed or batched during construction on site.
x) English garden wall bond.

list b
a) Clerk of works
b) Site agent
c) Gravel
d) Concrete
e) Reducing level
f) Datum level
g) Deep foundations
h) Shallow foundations
i) Hip
j) Pitch

k) Light and accessibility into the building
l) Ventilation and light in the structure
m) Contractor
n) Provides temporary support to walls which show signs of failure
o) A “beacon”
p) A “datum”
q) By volume and by mass
r) By volume and by weight
s) Used on a one and half brick (1 ½) walls for added strength, suitable for retaining walls.
t) Consists of three courses of stretchers to one course of headers.

answers
i) a
ii) d
iii) f
iv) g
v) j
vi) l
vii) n
viii) o
ix) r
x) t

3. Mention four (4) duties of a quantity surveyor.

i. Preparing bills of quantities for construction projects. A quantity surveyor is responsible for compiling a detailed document listing all materials, labor, and costs associated with a project. This document helps in budgeting, cost estimation, and tendering processes.

ii. Estimating and controlling costs throughout a project. The quantity surveyor monitors expenditures from project initiation to completion, ensuring that costs remain within the allocated budget and avoiding unnecessary expenses.

iii. Preparing and assessing tender documents and contracts. Quantity surveyors draft and evaluate contract documents to ensure fairness and compliance with construction regulations. They assess bids from contractors and recommend the best option based on cost-effectiveness and capability.

iv. Valuing completed work and arranging payments to contractors. Quantity surveyors measure completed works at various project stages, prepare payment certificates, and ensure contractors receive payments according to work progress and agreements.

4. List four (4) basic requirements of a mortar suitable for brick and stone works.

i. Adequate strength to bond bricks or stones. Mortar must possess enough compressive strength to hold masonry units firmly together and resist external loads or pressure.

ii. Workability for easy application. Good mortar should be easy to mix, spread, and manipulate during masonry work. Proper workability ensures strong adhesion and uniform bonding of bricks or stones.

iii. Durability to withstand environmental conditions. Mortar must resist weathering effects such as rain, heat, and frost. Durable mortar ensures the longevity of brick or stone structures.

iv. Water retention to prevent premature drying. The mortar should retain sufficient moisture to allow proper setting and hydration. This prevents cracking and weak bonding due to rapid moisture loss.

5. Elaborate four (4) methods which are generally adopted to improve the bearing capacity of soils.

i. Compaction. This involves compressing soil using rollers, rammers, or vibratory compactors to increase its density. Compacted soil has reduced air voids, which enhances its strength and load-bearing capacity.

ii. Soil stabilization. Soil properties can be improved by mixing it with stabilizing agents such as cement, lime, or bitumen. This enhances cohesion, reduces permeability, and strengthens weak soils for better foundation support.

iii. Grouting. This technique involves injecting cementitious or chemical grout into weak or loose soil to fill voids and solidify the ground. Grouting is often used in areas with sandy or gravelly soils to prevent settlement.

iv. Pile foundations. In cases where the upper soil layers are weak, deep foundation methods like pile driving are used. Piles transfer structural loads to deeper, stronger soil layers, preventing excessive settlement or failure.

6. Mention four (4) types of pointing finishes on brick walls.

i. Flush pointing. The mortar is pressed and finished level with the brick surface, giving a smooth and uniform appearance.

ii. Recessed pointing. The mortar joint is slightly pushed back from the face of the brickwork, creating a shadow effect and enhancing aesthetics.

iii. Beaded pointing. A rounded bead shape is created using a special tool, providing a decorative and durable finish.

iv. Struck pointing. The upper edge of the mortar joint is slightly recessed while the lower edge is projected, helping to drain rainwater efficiently.

7. Outline eight (8) principles to be observed during the construction of brick masonry work.

i. Use good quality bricks with proper dimensions. High-quality bricks ensure strong, durable masonry structures. They should be uniform in size, shape, and free from cracks or defects.

ii. Ensure bricks are soaked in water before use to prevent excessive absorption. Dry bricks absorb moisture from the mortar, leading to weak bonds and improper curing. Soaking prevents this issue.

iii. Apply uniform mortar thickness for even bonding. Proper mortar thickness, usually around 10 mm, ensures consistent adhesion and structural stability.

iv. Follow proper curing methods to strengthen the masonry. Curing involves keeping brickwork moist for several days to ensure complete hydration of the mortar, leading to stronger masonry.

v. Use correct bonding patterns such as English or Flemish bonds. Proper bonding arrangements enhance strength, stability, and appearance. English bond is commonly used for load-bearing walls.

vi. Provide expansion joints where necessary to prevent cracks. Expansion joints accommodate thermal expansion and contraction, reducing the risk of cracks due to temperature changes.

vii. Ensure vertical alignment and level correctness throughout construction. Regular checking with a plumb bob and level ensures straight, stable walls.

viii. Keep the worksite clean to avoid contamination of mortar. Dirt and debris can weaken mortar adhesion, reducing the structural integrity of the masonry.

8. Name four (4) suitable materials for damp-proof membrane.

i. Bitumen felt. A flexible, water-resistant material commonly used to prevent moisture penetration in walls and floors.

ii. Polythene sheets. Plastic sheeting that acts as a barrier to prevent dampness from rising through concrete slabs.

iii. Mastic asphalt. A waterproof, durable material that seals surfaces against moisture infiltration.

iv. Metal sheets. Corrosion-resistant metal sheets such as lead or copper provide long-lasting damp-proofing in foundations and walls.

9. State four (4) functional requirements of a roof.

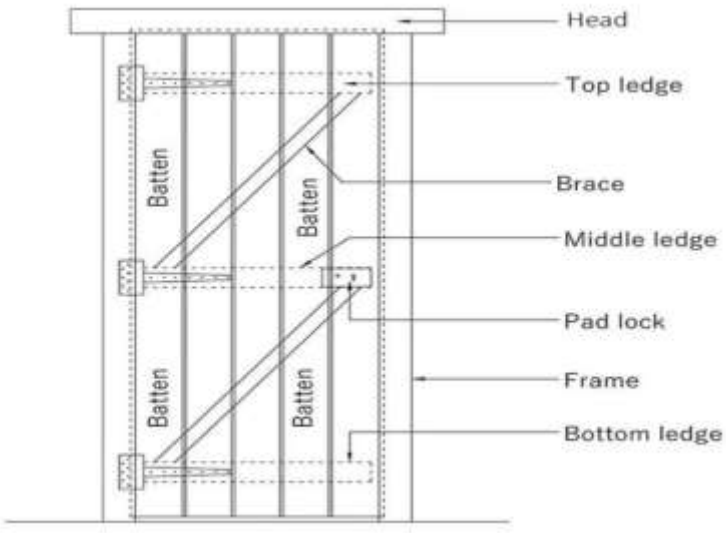
i. Protection against weather conditions. A roof must shield the building from rain, sun, wind, and snow to ensure indoor comfort.

ii. Structural stability. The roof should support its own weight, imposed loads such as snow, and external forces like wind without collapsing.

iii. Thermal insulation. A well-designed roof helps regulate indoor temperatures by preventing excessive heat loss or gain, improving energy efficiency.

iv. Proper drainage. The roof should facilitate water runoff to prevent accumulation, which can lead to leaks or structural damage.

10. Sketch a framed, ledged, braced, and battened door and label four (4) basic members.
A framed, ledged, braced, and battened door is a traditional wooden door design known for its strength and simplicity. It consists of vertical boards (battens) held together by horizontal members (ledges) and reinforced with diagonal braces, all enclosed within a sturdy frame.
Key Components:
1. Frame: The outer structure that encompasses the door, providing overall support and a mounting point for hinges.
2. Battens: Vertical wooden boards that form the main body of the door. They are placed side by side to cover the entire door area.
3. Ledges: Horizontal members fixed across the battens to hold them together. Typically, there are three ledges: top, middle, and bottom.
4. Braces: Diagonal supports running between ledges to prevent the door from sagging and to maintain its shape.



11. State two (2) basic requirements of openings for ventilation in the room.

i. Proper positioning to ensure cross-ventilation. Openings should be strategically placed to allow fresh air to enter and stale air to exit, improving indoor air quality.

ii. Adequate size to allow sufficient airflow. Ventilation openings should be large enough to facilitate continuous air circulation, preventing stuffiness and moisture buildup.

12. Explain briefly the location of stairs in the following structures:

a) Public buildings. Stairs are centrally located for easy accessibility, often near entrances, corridors, or emergency exits. They are designed to accommodate large numbers of users and comply with safety regulations, ensuring smooth movement within the building.

b) Residential buildings. Stairs are usually positioned in hallways, living areas, or along sidewalls to connect different floors efficiently. In smaller houses, they may be placed near the entrance or at the back for space optimization and convenience.

13.

a) What are the three (3) operations for preparing site works and setting out the building?

i. Site clearance involves the removal of vegetation, trees, old structures, debris, and any obstructions on the construction site. This step ensures that the ground is free from obstacles that may interfere with foundation excavation and other construction processes. Proper clearance also prevents future structural issues caused by weak soil or underground obstructions.

ii. Marking and leveling is the process of establishing reference points and ensuring that the site is properly leveled before construction begins. The use of instruments such as theodolites, spirit levels, and leveling staffs helps in achieving accurate ground elevations. Proper leveling prevents differential settlement of the structure and ensures a stable foundation.

iii. Setting out the building involves marking the exact positions of walls, foundations, and structural components on the ground. This is done using wooden pegs, strings, and chalk lines to guide construction workers. Accurate setting out is crucial as any misalignment can lead to structural defects, misplacement of doors and windows, and inefficient use of materials.

b) Find the moisture content of a timber 25 mm thick × 3000 mm long weighing 120 g before being seasoned and 90 g after it has been dried.

Moisture content is the percentage of water present in the timber before and after drying. It is calculated using the formula:

Moisture content (%) = ((Initial weight - Final weight) / Final weight) × 100

Substituting the given values:

Moisture content (%) = ((120 - 90) / 90) × 100
= (30 / 90) × 100
= 33.33%

This means that before drying, the timber contained 33.33% of its dry weight as moisture. Proper seasoning reduces moisture to prevent shrinkage, warping, and fungal attack.

Final answer: 33.33%

c) Mention six (6) main constituents of an oil paint.

i. Pigment is the coloring agent in paint, responsible for providing opacity and aesthetic appeal. It is derived from natural or synthetic sources and must be finely ground to ensure uniform mixing with other ingredients.

ii. Binder is the adhesive component that holds pigment particles together and enables the paint to form a protective film when dried. It ensures the durability of the paint layer and contributes to adhesion to surfaces.

iii. Solvent is a liquid used to dissolve or dilute the binder and pigment for ease of application. Once the paint is applied, the solvent evaporates, leaving behind a solid film. Common solvents include turpentine and mineral spirits.

iv. Drier accelerates the oxidation and hardening of the paint film. It promotes quicker drying by facilitating the polymerization of the binder, which is essential for ensuring the longevity of the painted surface.

v. Filler is an additive used to improve the consistency and durability of paint. It enhances thickness, provides better coverage, and contributes to a smooth finish. Common fillers include chalk and silica.

vi. Additives are special chemicals included to enhance paint properties such as UV resistance, mildew resistance, and adhesion. They improve performance in specific environmental conditions and increase the lifespan of the paint.

d) State briefly the data required to determine the total load of a building.

i. Dead load consists of the weight of permanent structural components such as walls, beams, columns, roofs, and flooring materials. It remains constant throughout the life of the building and must be accurately calculated during design.

ii. Live load includes variable loads due to occupancy, furniture, equipment, and movable objects. This load changes over time and varies depending on the function of the building.

iii. Wind load refers to the force exerted by wind on the structure. Buildings in open areas, coastal regions, or high-altitude locations experience higher wind pressures, which must be considered during design.

iv. Snow load is a critical factor in areas that receive snowfall. The weight of accumulated snow on roofs and structural components can cause excessive stress, requiring reinforcement in building design.

v. Seismic load is the force generated by ground movements during an earthquake. It affects the stability of the building and necessitates special structural reinforcements, especially in earthquake-prone regions.

vi. Impact load occurs when sudden forces are applied to the structure, such as moving vehicles, heavy machinery, or accidental collisions. Buildings with industrial applications must account for such loads to prevent damage.

14.

a) Outline the forces that a boundary wall is required to withstand.

i. Wind pressure acts laterally on the boundary wall, potentially causing it to tilt or collapse if not properly reinforced. Walls in open fields or coastal areas are more susceptible to strong winds.

ii. Soil pressure applies force against boundary walls that act as retaining structures. Poorly designed walls may crack or buckle under the weight of retained soil.

iii. Impact load results from accidental forces such as vehicle collisions, falling objects, or human activities near the wall. Proper reinforcement can minimize damage from such impacts.

iv. Seismic forces occur due to ground movements during earthquakes, which can cause boundary walls to crack or collapse if they lack flexibility and strength.

v. Thermal expansion and contraction lead to material movement due to temperature changes. Continuous expansion and contraction can create stress cracks in boundary walls.

vi. Vibration loads come from nearby traffic, heavy machinery, or construction activities. Prolonged exposure to vibrations weakens boundary walls, making them susceptible to cracks and structural failure.

b) State four (4) basic requirements of any material specified for use as reinforcement to concrete.

i. High tensile strength ensures the material can withstand stretching forces without breaking, increasing the durability of reinforced concrete structures.

ii. Good bond with concrete allows reinforcement to integrate seamlessly with the concrete mix, ensuring load transfer and structural stability.

iii. Corrosion resistance is necessary for reinforcement materials, especially in damp or chemically aggressive environments, to prevent deterioration over time.

iv. Ductility enables the reinforcement material to undergo deformation without sudden failure, allowing the structure to absorb energy during loads or seismic activity.

c) Define the following terms:

i. Common joist is a horizontal structural member that supports floors or ceilings by distributing loads evenly across a framework. It plays a key role in maintaining the integrity of multi-story buildings.

ii. Trimming joist is a specially reinforced joist that supports the cut ends of other joists around openings such as stairwells, chimneys, or large windows. It helps in load redistribution and ensures structural continuity.

iii. Trimmer joist is used to strengthen the edges of openings in floors or ceilings. It is placed perpendicular to common joists to prevent structural weakening caused by large cutouts.

15.

a) Mention two (2) functions of roofing felts.

i. Roofing felts provide waterproofing, preventing water infiltration through the roof and protecting the underlying structure from leaks and moisture damage.

ii. They act as thermal insulators, reducing heat loss or gain and helping to regulate indoor temperatures. This improves the energy efficiency of buildings.

b) Describe "firring pieces" as applied to flat roofs construction.

Firring pieces are thin, tapered strips of timber or other materials that are fixed to flat roof structures to create a gentle slope for drainage. Without firring pieces, water may pool on a flat roof, leading to structural damage and leaks. By facilitating water runoff towards drains or gutters, firring pieces help prolong the lifespan of the roof.

c) List two (2) functions of a door sill.

i. A door sill prevents water ingress by acting as a barrier that stops rainwater from seeping under the door and into the building. This is essential for maintaining interior dryness.

ii. It enhances durability by providing a strong base that protects the bottom of the door from wear and tear caused by foot traffic, impacts, and environmental exposure.

d) Draw a neat sketch of a timber stair and show the following parts:

- Newel Post: This is the sturdy vertical post located at the beginning, end, or at turns of a staircase. It provides essential support for the handrail and helps anchor the balustrade system.
-Balusters: Also known as spindles, these are the vertical posts that support the handrail. They are spaced evenly along the staircase and serve both a structural and decorative purpose, preventing falls and adding to the staircase's design.
- Handrail: The angled member that runs parallel to the slope of the staircase, providing a handhold for safety and support. It is affixed atop the balusters and is essential for guiding individuals as they ascend or descend the stairs.
Outer String: Also referred to as the "open" string, this is the inclined board running along the side of the staircase that is visible. It supports the ends of the treads and risers, and often has a decorative profile.
Nosing: The front edge of the tread that protrudes beyond the face of the riser beneath. It provides additional space for users' feet and often has a rounded edge to reduce sharpness, enhancing both safety and comfort.