MAH M Arch CET Building Technology Sample Paper – 1

Duration: 12 Minutes	**Questions:** 10	**Max Marks:** 20	**Mode:** CBT
Marking Scheme: +2 for each correct answer | No negative marking			

Instructions

1. This paper contains **10** multiple-choice questions (single correct answer each).
2. Each correct answer carries **+2 marks**. There is **no negative marking**.
3. Attempt all questions; allot approximately **72 seconds** per question.
4. All questions are from **Building Technology** as prescribed in the MAH M Arch CET syllabus.
5. Detailed solutions with the answer key are provided at the end of this paper.

Section A — Building Technology (Q1–Q10)

Q1. Which type of cement is specifically recommended for refractory applications such as furnace linings, foundry floors, and kiln structures, owing to its exceptional high-temperature resistance and rapid early strength development?

(A) OPC — Ordinary Portland Cement

(B) HAC — High Alumina Cement

(C) PPC — Portland Pozzolana Cement

(D) PSC — Portland Slag Cement

Q2. According to IS 1077:1992 for common burnt clay bricks, the **minimum compressive strength** required for a Class 1 (First Class) brick is:

(A) 3.5 N/mm^2

(B) 7.0 N/mm^2

(C) 10.5 N/mm^2

(D) 17.5 N/mm^2

Q3. Tempered (toughened) glass is preferred over ordinary float glass for frameless shower enclosures, glass doors, and balustrade panels primarily because:

(A) On fracture, it disintegrates into small, blunt-edged granules rather than sharp, blade-like shards

(B) Its surface is optically distortion-free, providing superior visual clarity compared with other glass types

(C) It provides significantly better thermal insulation than uncoated float glass of equivalent thickness

(D) A polyvinyl butyral (PVB) interlayer holds glass fragments in place after breakage, preventing injury

Q4. Which of the following is **NOT** a recognized structural advantage of an RCC framed construction system over a conventional load-bearing wall system?

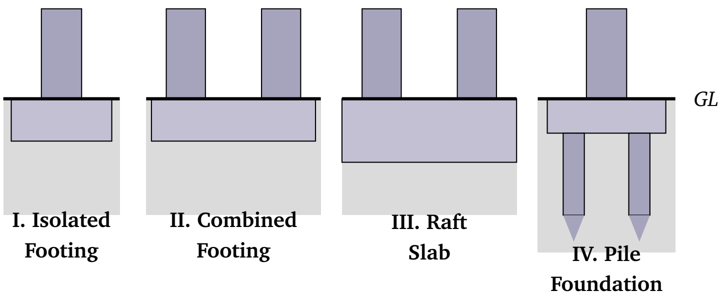
(A) Freedom to design open floor plans with large, uninterrupted interior spaces

(B) Better ductility and resistance to lateral loads such as seismic and wind forces

(C) Practicability of construction for buildings beyond four to five storeys

(D) Economy in use of construction materials for single- or double-storeyed residential buildings

Q5. The cross-section diagram below illustrates four common foundation types (I to IV). Foundation Type II (Combined Footing) is most appropriately selected when:



(A) The site has very high soil-bearing capacity, requiring only a small footing area beneath each column

(B) Two adjacent columns are so closely spaced that their individual isolated footings would overlap or nearly coincide

(C) Poor soil conditions over the entire site make it necessary to cover the full building footprint with a single continuous slab

(D) Hard bearing strata is available only at great depth, necessitating deep foundation elements

Q6. A reinforced concrete folded plate structure achieves its ability to span long distances with structural efficiency primarily because:

(A) It acts as a series of funicular arches that transmit imposed loads in pure compression along each fold

(B) High-tensile prestressed steel cables anchored within the folds provide the primary tensile force path

(C) The angular geometry of the folds creates an increased effective structural depth, imparting beam-like rigidity to the entire assembly

(D) Biaxial membrane compression forces develop across the doubly-curved surface, entirely eliminating bending

Q7. The GRIHA (Green Rating for Integrated Habitat Assessment) rating system in India is developed by:

(A) TERI (The Energy and Resources Institute) in association with the Ministry of New and Renewable Energy (MNRE)

(B) Bureau of Energy Efficiency (BEE) under the Ministry of Power

(C) Indian Green Building Council (IGBC) under the Confederation of Indian Industry (CII)

(D) Ministry of Housing and Urban Affairs (MoHUA) in partnership with UNDP

Q8. For a **south-facing** window in the Northern Hemisphere, which passive shading device is **most effective** at blocking high-altitude summer sun while simultaneously allowing low-altitude winter sunlight to penetrate into the building interior?

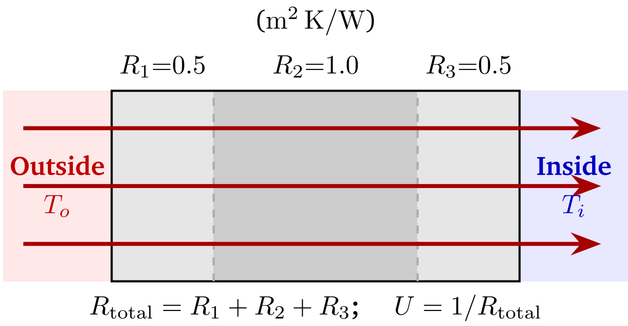
(A) Vertical fins positioned on the lateral sides of the window frame

(B) Fixed perforated metal louvres mounted on the outer face of the glazing

(C) Retractable internal roller blinds installed on the inner face of the window

(D) A horizontal projected chajja (overhang) placed directly above the window opening

Q9. The diagram below shows heat conduction through a wall assembly comprising three layers. If the thermal resistances of the layers are $R_1 = 0.5$, $R_2 = 1.0$, and $R_3 = 0.5\ \mathrm{m^2\,K/W}$ (including surface film resistances), the overall thermal transmittance (U-value) of the wall in $\mathrm{W/(m^2\,K)}$ is:



(A) $0.25\ \mathrm{W/(m^2\,K)}$

(B) $0.40\ \mathrm{W/(m^2\,K)}$

(C) $0.50\ \mathrm{W/(m^2\,K)}$

(D) $2.00\ \mathrm{W/(m^2\,K)}$

Q10. In the context of fire-compartmentalization design, the primary purpose of installing a self-closing, fire-rated door between two fire compartments is to:

(A) Completely and permanently prevent smoke from entering the escape corridor under all fire conditions

(B) Maintain fire-compartment integrity by resisting the spread of fire and hot gases for a specified rated period, while remaining operable for occupant evacuation

(C) Enable the automatic sprinkler system to operate independently in each fire zone without obstruction from the door

(D) Provide the primary structural fire protection for adjacent load-bearing columns and walls

Detailed Solutions

Sol. 1.

Solution

Difficulty: Intermediate • Chapter: Cement Types and Their Specific Uses

Quick Solution: Calcium aluminate composition gives HAC refractoriness to 1 000–1 300 °C; OPC/PPC/PSC lose strength above $\sim$300 °C. **Answer: (B).**

Concept — Cement Types and Their Specific Uses: Different Portland cement variants are formulated with distinct mineral compositions for specific construction environments. HAC (High Alumina Cement) contains a high proportion of calcium aluminates (CA and CA_2), which give it *refractoriness* — the ability to retain structural strength at sustained temperatures up to 1 000–1 300 °C, far exceeding the capability of ordinary cement.

Analysis of each option:

- **(A) OPC**: General-purpose cement; loses significant strength above $\sim$300 °C due to dehydration of calcium silicate hydrates. *Not suitable for refractory use.*
- **(B) HAC**: Specifically designed for furnace linings, kiln structures, and foundry floors. Also exhibits very high early strength (up to 80% of 28-day strength within 24 hours). *Correct.*
- **(C) PPC**: Contains fly ash or calcined pozzolana; improves sulfate resistance and reduces heat of hydration. Used for mass concrete and marine structures. *Not a refractory cement.*
- **(D) PSC**: Contains granulated blast-furnace slag; excellent durability in marine and sulfate-rich environments. *Not designed for high-temperature applications.*

Final Answer: HAC is the cement class recommended for high-temperature refractory applications. $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q1

Sol. 2.

Solution

Difficulty: Intermediate • Chapter: Brick Masonry — IS 1077:1992

Quick Solution: IS 1077:1992 Class 1 (First Class) threshold $= 10.5$ N/mm^2; Class 2 $= 7.0$ N/mm^2; Class 3 $= 3.5$ N/mm^2. **Answer: (C).**

Concept — IS 1077 Classification of Common Burnt Clay Bricks: IS 1077:1992 classifies bricks by minimum compressive strength (CS) measured as the average of five specimens tested on edge. Higher class bricks are denser, more uniform, and suitable for demanding structural and exposed applications.

IS 1077 Class-wise Minimum Compressive Strengths:

- **Class 1 (First Class):** ≥ 10.5 N/mm^2 — structural load-bearing walls, exposed brickwork, high-quality masonry construction.
- **Class 2 (Second Class):** ≥ 7.0 N/mm^2 — interior non-load-bearing partitions and moderate-quality work.
- **Class 3 (Third Class):** ≥ 3.5 N/mm^2 — temporary works or minor applications only.
- 17.5 N/mm^2 is not a standard IS 1077 class threshold.

Water absorption note: IS 1077 also limits water absorption; for Class 1 bricks, maximum permissible water absorption is 20% by weight after 24-hour immersion.

Final Answer: Minimum compressive strength for First Class (Class 1) bricks = 10.5 N/mm^2. $\Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q2**

Sol. 3.

Solution

Difficulty: Intermediate • Chapter: Glass Types — Tempered, Laminated, Float

Quick Solution: Tempered glass stores compressive surface pre-stress; on fracture it releases as blunt-edged granules, not sharp shards. Option (D) describes laminated glass (PVB interlayer). **Answer: (A).**

Concept — Safety Breakage Characteristics of Glass Types: The critical design property for safety glazing in doors, shower enclosures, and balustrades is how the glass behaves upon fracture.

Breakage characteristics by glass type:

- **Tempered (toughened) glass:** Heat-treated by rapid heating to ~620 °C followed by sudden air quenching, inducing compressive surface pre-stress. On fracture, the stored strain energy shatters the glass into small, roughly cuboid, blunt-edged granules — dramatically reducing laceration risk. Mandated for safety glazing in doors, shower screens, balustrades, and frameless assemblies. *This is option (A). Correct.*
- **Laminated glass:** A PVB or EVA polymer interlayer bonds two glass plies. Upon cracking, fragments adhere to the interlayer and do not scatter freely. This is the property described in option (D) — a common confusion with tempered glass.
- **Float glass:** Annealed; no treatment; breaks into large, sharp, irregular shards — hazardous.
- **Options (B) and (C):** Describe optical clarity and thermal performance respectively — unrelated to safety breakage behaviour.

Final Answer: The defining safety feature of tempered glass is granular, blunt-edged breakage. $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q3

Sol. 4.

Solution

Difficulty: Intermediate • Chapter: Structural Systems — RCC Frame vs. Load-Bearing

Quick Solution: Options (A), (B), (C) are genuine RCC advantages. Option (D) is reversed: economy for 1–2 storey buildings belongs to load-bearing masonry, not RCC framing. **Answer: (D).**

Concept — RCC Framed vs. Load-Bearing Wall Systems: In a *load-bearing wall system*, masonry walls carry all vertical loads. In an *RCC framed system*, a skeleton of columns and beams carries loads; the walls become non-structural infill.

Evaluation of each option:

- **(A) Open floor plans:** True advantage. Columns can be widely spaced; infill walls can be placed anywhere or removed. *IS an advantage of RCC framing.*
- **(B) Lateral load resistance:** True. The rigid beam-column frame provides

higher ductility and lateral stiffness, essential in seismic zones. *IS an advantage.*

- **(C) High-rise suitability:** True. Load-bearing walls require prohibitively thick walls beyond 4–5 storeys; RCC frames scale efficiently. *IS an advantage.*
- **(D) Economy for low-rise: NOT** an advantage of RCC framing. For 1–2 storey buildings, load-bearing brick masonry is simpler to construct, requires less steel, no complex formwork, less skilled labour, and is substantially less expensive than an RCC framed structure. The additional engineering of a frame is economically unjustified at this scale.

Final Answer: Option D describes an advantage of the *load-bearing* system, not the RCC framed system. $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q4

Sol. 5.

Solution

Difficulty: Intermediate • Chapter: Foundation Types — Isolated, Combined, Raft, Pile

Quick Solution: Diagram: (A) $\to$ Isolated; (B) $\to$ Combined; (C) $\to$ Raft; (D) $\to$ Pile. Combined footing is selected when two adjacent column footings would overlap or nearly coincide. **Answer: (B).**

Concept — Selection Criteria for Different Foundation Types: Foundation selection is governed by soil bearing capacity, column spacing, building load intensity, depth to competent strata, and risk of differential settlement. The diagram in the question illustrates the four types schematically.

Selection logic for each foundation type:

- **Type I — Isolated footing:** Best when columns are widely spaced and soil bearing capacity is sufficient for each column to have its own independent spread footing without overlap.
- **Type II — Combined footing:** Used when two (or more) adjacent columns are closely spaced such that their individual isolated footings would overlap or nearly coincide, or when an edge column cannot extend its footing beyond the property boundary eccentrically.
- **Type III — Raft slab:** Used when soil is weak and isolated footings would cover more than $\sim$50 % of the plan area, or when uniform load distribution is needed to control differential settlement.

- **Type IV — Pile foundation:** Used when soft or weak soil extends to a great depth and loads must be transferred to deeper, competent strata by friction or end bearing.

Matching options to types: (A)→Type I, (B)→Type II **[Correct]**, (C)→Type III, (D)→Type IV.

Final Answer: Combined footing is selected when adjacent column footings would overlap. $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q5

Sol. 6.

Solution

Difficulty: Advanced • Chapter: Structural Forms — Shells, Folded Plates, Arches

Quick Solution: Folded plate = flat slabs joined at angles; folding creates effective structural depth, making the assembly act as a deep beam. Arch/cable/biaxial-membrane mechanisms belong to other structural forms. **Answer: (C).**

Concept — Structural Behaviour of Folded Plate Structures: A *folded plate* (also called a prismatic shell) consists of flat planar slabs joined at angles to form a corrugated or polygonal-cross-section profile. Unlike true shells, it derives its efficiency not from surface curvature but from its folded geometry.

Structural mechanism: The folding creates **effective structural depth**. Each inclined flat plate acts as an inclined slab spanning transversely (between ridge and valley lines), while the folded assembly as a whole acts as a **deep beam** spanning longitudinally between end supports. The effective depth of the fold controls the longitudinal spanning efficiency. Load is resisted by a combination of transverse plate bending (local action) and global deep-beam bending.

Why other options are incorrect:

- **(A) Funicular arches:** Arches are curved elements that carry loads in pure compression along a funicular line. Folded plates are flat and span as beams in bending, not as arches. *Incorrect.*
- **(B) Prestressed steel cables:** Most folded plates are plain or ordinary reinforced concrete; prestressed cables are not inherent to the structural concept. *Incorrect.*
- **(D) Biaxial membrane compression:** This describes the load-carrying

mechanism of *doubly-curved shells* — barrel vaults, hyperbolic paraboloids, domes. These develop in-plane membrane forces through double curvature. Folded plates are composed of flat surfaces and do not develop biaxial membrane action in the same manner. *Incorrect.*

Final Answer: Folded plates gain structural efficiency through increased effective depth created by angular fold geometry. $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q6

Sol. 7.

Solution

Difficulty: Beginner • Chapter: Green Building Rating Systems — GRIHA, LEED, ECBC

Quick Solution: GRIHA is India's national green building rating tool, developed by TERI in association with MNRE. LEED India = IGBC/CII; ECBC = BEE. **Answer: (A).**

Concept — GRIHA Rating System: Origin, Criteria, and Structure: GRIHA is India's own nationally developed green building rating system, specifically tailored to Indian climate zones, construction practices, and regulatory frameworks — distinct from imported rating systems.

Key Facts about GRIHA:

- **Developed by:** TERI (The Energy and Resources Institute) jointly with MNRE (Ministry of New and Renewable Energy), Government of India.
- **Criteria:** Evaluates buildings on **34 criteria** covering site planning, construction management, water efficiency, energy efficiency, renewable energy integration, waste management, occupant health and comfort, and innovation.
- **Scoring:** Out of 100 points; rating from 1 star (50–59 pts) to 5 stars ($\geq$90 pts).
- Applicable to new construction — commercial, institutional, and large residential buildings.

Eliminating distractors:

- **(B) BEE:** Administers ECBC (Energy Conservation Building Code) and star-labelling for electrical appliances. *Not GRIHA.*
- **(C) IGBC/CII:** Administers **LEED India**, a localised version of USGBC's LEED system. *A separate, competing rating.*

- **(D) MoHUA/UNDP:** Involved in AMRUT, Smart Cities Mission, and urban development frameworks. *Not the originator of GRIHA.*

Final Answer: GRIHA is developed by TERI in association with MNRE. $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Sol. 8.

Solution

Difficulty: Intermediate • Chapter: Passive Solar Design — Shading Devices

Quick Solution: Horizontal chajja: blocks high-altitude summer sun, admits low-altitude winter sun via seasonal solar angle difference. Vertical fins suit east/west only; louvres and blinds cannot discriminate seasonally. **Answer: (D).**

Concept — Passive Solar Shading: Geometry and Seasonal Solar Angles: Effective passive shading design responds to the seasonal variation in solar altitude angle. In the Northern Hemisphere:

- **Summer sun**: high altitude angle ($\sim$70–80° at solar noon for tropical/subtropical latitudes).
- **Winter sun**: low altitude angle ($\sim$20–45° at solar noon, depending on latitude).

Why a horizontal chajja (overhang) works best for south-facing windows: A projecting horizontal slab (chajja) placed above a window casts a shadow whose depth is controlled by the overhang projection and the solar altitude angle. When correctly sized using the shadow angle protractor method:

- **Summer**: High-altitude sun is intercepted by the overhang $\Rightarrow$ window is shaded, solar heat gain is blocked.
- **Winter**: Low-altitude sun travels below the underside of the overhang $\Rightarrow$ winter solar gain is admitted, contributing to passive heating.

This selective seasonal discrimination is the hallmark of good passive solar design for south-facing facades.

Why other devices are less suitable for this specific purpose:

- **(A) Vertical fins:** Best suited for east- and west-facing windows where morning and evening sun arrives at low horizontal angles from the side. Ineffective against high-altitude midday/summer south sun.

- **(B) Fixed perforated louvres:** Reduce overall solar transmission uniformly across all seasons; cannot selectively admit low-angle winter sun while blocking high-angle summer sun.
- **(C) Internal roller blinds:** Block all daylight indiscriminately in both summer and winter; eliminate the desirable winter passive solar gain; not a passive climate-responsive strategy.

Final Answer: A horizontal projected chajja is the most effective passive shading device for south-facing windows. $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

Sol. 9.

Solution

Difficulty: Intermediate • Chapter: Thermal Comfort — U-value and R-value

Quick Solution: $R_{\text{total}} = 0.5 + 1.0 + 0.5 = 2.0\ \text{m}^2\,\text{K/W}$; $U = 1/R_{\text{total}} = 0.50\ \text{W/(m}^2\,\text{K)}$. Option (D) equals R_{total} itself, not U. **Answer: (C).**

Concept — Thermal Resistance (R-value) and Transmittance (U-value): For a multi-layer wall assembly, individual layer thermal resistances are **additive in series** (analogous to series resistors in an electrical circuit). The U-value is the reciprocal of the total thermal resistance and quantifies heat flux per unit area per unit temperature difference across the assembly.

Step 1 — Add layer resistances:

$$R_{\text{total}} = R_1 + R_2 + R_3 = 0.5 + 1.0 + 0.5 = 2.0\ \text{m}^2\,\text{K/W}$$

Step 2 — Calculate U-value:

$$U = \frac{1}{R_{\text{total}}} = \frac{1}{2.0} = \mathbf{0.50}\ \text{W/(m}^2\,\text{K)}$$

Why other options are incorrect:

- **(A) 0.25 W/(m^{2}K):** Would imply $R_{\text{total}} = 4.0\,\text{m}^2\text{K/W}$ — not the case here.
- **(B) 0.40 W/(m^{2}K):** Would imply $R_{\text{total}} = 2.5\,\text{m}^2\text{K/W}$ — arithmetic error.
- **(D) 2.00 W/(m^{2}K):** This equals R_{total}, not U. A common confusion: U and R are *reciprocals* of one another — never equal (except when $R = 1$).

Final Answer: $U = 1/2.0 = 0.50\ \text{W/(m}^2\,\text{K)}$. $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q9

Sol. 10.

Solution

Difficulty: Intermediate • Chapter: Fire Safety — Compartmentalization and Fire Doors

Quick Solution: Fire door dual function: (1) passive fire resistance for a rated period; (2) operable for occupant evacuation. Option (A) overstates; (C) and (D) assign wrong functions to the door. **Answer: (B).**

Concept — Fire Compartmentalization and the Dual Role of Fire Doors: Fire compartmentalization subdivides a building into discrete bounded zones to limit the spread of fire and smoke, thereby protecting occupants in other zones and preserving means of escape. Fire doors are the *dynamic* elements in compartment walls — they must satisfy two simultaneous and seemingly contradictory requirements.

Dual function of a fire-rated self-closing door:

(a) **Passive fire protection:** The door leaf, steel frame, and intumescent seals together resist the passage of flames, heat, and hot gases for a specified fire resistance rating (e.g., FD30 = 30 min, FD60 = 60 min). Intumescent strips expand on heating to seal the gap between door and frame.

(b) **Egress operability:** The door must be manually operable without special tools or knowledge, enabling occupants to pass through and escape. The self-closing mechanism automatically returns the door to the closed (protective) position after each use, preventing the door from being inadvertently left open.

Why other options are incorrect:

- **(A) "Completely prevent all smoke at all times":** Overstated. Smoke seals (intumescent and brush seals) resist smoke movement in a closed position, but the door is opened during evacuation, temporarily allowing some smoke movement. No passive door guarantees absolute smoke prevention under all conditions.
- **(C) Sprinkler system operation:** Sprinkler heads activate by heat independently of door position. Fire doors play no role in sprinkler flow or zone separation for the sprinkler system.
- **(D) Structural column fire protection:** Column and structural member fire protection is provided by applied systems (intumescent coatings, con-

crete encasement, board cladding) — not by fire doors, which protect openings in walls, not the structural members themselves.

Final Answer: Fire doors maintain compartment integrity for a rated period while remaining operable for evacuation. $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q10

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	A	4	D	5	B
6	C	7	A	8	D	9	C	10	B