

Date 07/01/2023

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(iv) Occupant Safety :-

In spaces where harmful gases or fumes might be present (e.g. → kitchen, laboratories), air patterns can help direct air away from people and ensure that hazardous substances are vented out of the building.

* Importance of ventilation :-

- Indoor Air Quality.
- Energy Efficient.
- Moisture content control.

* segmental Arch : (keywords) :-

- a radius less than semicircle - bridges.

Date 07/08/22

cul097/22

Saath

3) Explain briefly the following :-

1. Lift and its components :-

↳ Lift :-

A lift (also known as an elevator) is a platform or compartment used for transporting people or goods between floor of a building. It moves vertically and is a crucial part of modern architecture at in multi-story buildings.

↳ Components of a lift :-

(i) Cabin (car) :-

The cab or car is the enclosed platform where passengers or goods are carried. It is typically equipped with doors and interior controls.

(ii) Shaft :-

The shaft is the vertical enclosure through which the lift travels. It houses the lift car, counter weights, and various mechanical parts.

iii) Doors :

- Landing doors are installed on each floor and open to allow passenger to enter and exit the lift.
- car doors are part of the lift cabin and open and close to provide access to the passengers inside lift.

iv) Hoistway :

- (i.) The hoistway is the entire vertical space in the building where the lift moves. It encompasses that shaft and is typically used for the housing of lift components.

* Types of lift :(i.) Hydraulic lifts :

These lift use hydraulic fluid to power the lift car. They are commonly used for low-rise buildings and typically do not require a counterweight.

(iii) Electric Lifts :

These use a counter weight system and are powered by an electric motor. They are more energy - efficient for taller buildings.

(iv) Machine Room - Less (MRL) Lift :

These lifts eliminate the need for a separate machine room and integrate the motor and controls directly into the lift shaft.

(v) Ramp and Escalators :

Ramp and escalators are both types of transportation system designed to move people and goods between different levels but they operate differently and serve specific purposes.

↳ Ramp :

A ramp is a sloped surface that allows for the gradual transition between different elevations. It is often used where stairs are not feasible or accessible such as for people with disabilities loading goods or in areas with heavy foot traffic. Ramps can be constructed from

Date 07/01/25

CU/097/0093

Saathi

various materials such as concrete, wood, metal or even rubber.

↳ Key features of Ramps :

i) Incline :

Ramps have a sloped surface typically at an angle between 1:12 and 1:20 depending on the purpose.

eg: wheel chair, access the incline should not exceed.

ii) Accessibility :

They are designed to be used by people with mobility challenges.

eg :

Wheelchair users, people with strollers.

iii) Non - Powered :

Ramps rely on the user's ability to walk or push a wheelchair manually and do not use any mechanical system to assist movement.

Date 07/05/25

07/05/25

Saathi

(iv) Applications :

Commonly used in public building parking garages, airports or places with large variations in floor height.

(v) Load-bearing :

Rams can be used for loading heavy objects or carts such as in loading docks.

* Escalator :

An escalator is a moving staircase designed to transport people between different levels in a building or structure. It consists of a continuous loop of steps that move up/down, powered by an electric motor. Escalators are generally used in places with high foot traffic such as shopping malls, train stations, airports and large office buildings.

* Key Features of Escalators :

1. Powered Movement :

Escalators are electrically powered using motors to drive the steps along a continuous track, allowing for automated movement of people.

Date 07/01/25

cu/097/2002

Saathi

2) Step Design :

The steps are connected to a chain that moves them in a loop. They are typically made of metal with rubber treads to provide grip.

3) Direction :

Escalator can be bidirectional (moving in either direction) though usually one set of escalator is dedicated to moving people up and another set moves people down.

4) Capacity :

Escalators can move large number of people quickly, especially if an escalator typically ranges between 0.2 to 0.6 meters per second.

5) Safety features :

Escalators are equipped with handrails that move with the steps as well as safety sensors that stop the movement if there is any obstruction.

Date 07/01/25

CU/097/23

Saathi

* Comparison : Ramp Vs Escalator (IS - 4963)

Feature	Ramp	Escalators
i. Movement	Non - Powered require	Powered moves, automatically.
ii. Capacity	Limited to manual movement (one person at a time)	Can carry many people simultaneously
iii. Accessibility	Easy for wheelchairs, strollers and carts.	Accessible for those who can walk or stand.
iv. Speed	Dependent on the user.	Constant speed
v. Application	used for accessibility loading goods, gentle inclines.	Used for high-traffic busy location
vi. Energy Source	Non power source Needed	Electrically powered.

- Elevators
- Lift, Lift Pit
- foundation for life

- Isolated foundation
- Combined foundation

* Foundation concrete or Block work :

- ↳ Lift Pit walls (200 - 300 mm)
- ↳ Lift shaft walls (150 - 200 mm)
- ↳ Lift headroom

• Lift headroom

- ↳ Min^m headroom 3.5 - 4 m
- ↳ clearance 150 - 200 mm

* Intermediate column - Beam structure :

- ↳ column spacing (3 - 4 m)
- ↳ Beam design (200 - 400 mm) deep and (300 - 600 mm) wide
- ↳ Column size (200 - 600 mm) square or 400 - 800 mm thick dia.
- ↳ Sunshade : horizontal or sloping protection.

Q. Define scaffolding write its components parts types and materials.

• Scaffolding :-

Scaffolding refers to temporary structure or support system used to assist in construction, repair, or maintenance tasks.

It provides a platform for workers to reach high or difficult-to-access areas safely. In educational contexts, scaffolding is a teaching method where teachers provide temporary support to students, helping them achieve a higher level of understanding or skill before gradually removing the support as the student becomes more capable.

• Component parts :-

(i) Standards :-

These are vertical members of the framework, support on ground or drums, or embedded into the ground.

(ii) Braces :-

These are diagonal members fixed on standards.

(ii) Ledgers :-

These are horizontal members, running parallel to the wall.

(iv) Putlogs :-

These are transverse members, placed at right angles to the wall with one end supported on ledgers and other end on the wall.

(v) Transoms :- These are those Put logs whose both ends are supported on ledgers.

(vi) Briddle :- This is a member used to bridge a wall opening supports one end of putlog at the opening.

(vii) Boarding :- These are horizontal platform to support workmen and material; these are supported on the putlogs.

(viii) Guard rail :- This is rail, provided like a ledger, at the working level.

(ix) Toe board :-

These are boards, placed parallel to ledgers, and supported on putlogs, to give protection at the level of working platform.

• Types of scaffolding :

(i) Single scaffolding : (Brick-layer's scaffolding) :-

Single scaffolding is a type of scaffolding commonly used in construction, particularly for brickwork. It consists of a single row of vertical support poles, which are placed parallel to the structure being worked on. Horizontal beams (called ledgers) are fixed to these vertical poles and the work platform is supported by the ledgers. Single scaffolding is typically used when working on one side of a building, providing access for workers without enclosing the entire structure and is also called outlog scaffolding.

(ii) Double or Mason's scaffolding :-

Double scaffolding, also known as masonry scaffolding, is a type of scaffolding used primarily for masonry work. It consists of two parallel rows of vertical support poles (standards) that are placed on either side of the wall being constructed by ledgers to provide stability and support for the work platform. The platform is then constructed on the ledgers, allowing workers to access higher areas of the wall.

Double Scaffolding is typically used for working on thick walls, where a single row of poles might not provide support. Such a scaffolding is also called independent scaffolding.

(iii) Cantilever or needle scaffolding :

Cantilever scaffolding is used under the following circumstances :

- Ground is weak to support standards.
- Construction of upper part of the wall is to be carried out.
- It's required to keep the ground, near wall, free for traffic etc.

(iv) Suspended scaffolding :

This is a light weight scaffolding used for repair works such as pointing, painting etc. The working platform is suspended from roof by means of wire ropes or chain etc. The platform can be raised or lowered at any desired level.

(v) Trestle scaffolding :

Such type of scaffolding is used for painting and repair work inside the room, up to a height of 5m.

Date ____/____/____

The working Platform is supported on the top of movable contrivances such as tripods, ladders etc, mounted on wheels.

(vi) steel scaffolding :

A steel scaffolding is partially similar to timber scaffolding except that wooden members are replaced by steel tubes and rope lashings are replaced by steel couplers or fittings. Such a scaffolding is replaced by steel tubes and rope lashing are replaced by steel couplers or fittings. Such a scaffolding can be erected and dismantled rapidly. It has greater strength, greater durability and higher fire resistance. Though its initial cost is more but its salvage value is higher. It is extensively used these days.

(vii) Patented scaffolding :

Many Patented scaffolding, made of steel, are available in the market. These scaffolding are equipped with special couplings, frames etc. The working platform is supported on brackets which can be adjusted at any suitable height.

• Material used in scaffolding :

i.) Steel :

commonly used its strong, durable and widely used due to its ability to support heavy loads and resistance to corrosion.

ii.) Aluminum :

Lightweight and resistant to corrosion, making it ideal for areas where mobility and ease of transport are important.

iii.) Wood :

Used in traditional scaffolding, especially in low-rise construction, offering flexibility and ease of handling, though it is less durable than metal.

iv.) Plastic / Composites :

Some modern scaffolding systems use composite material that are strong, lightweight, and resistant to weathering.

v.) Fiberglass :

Non-conductive and durable, it is used in situation where electrical hazards are present.

Date ____/____/____

Q 2) Define formwork write its necessity and types of formwork based on material.

↳ Formwork :-

The formwork or shuttering is a temporary ancillary construction used as a mould for the structure, in which concrete is placed and in which it hardens and matures. The construction of form work involves considerable expenditure of time and material. The cost of form work may be up to 10 to 25% of the cost of structure in building work, and even higher in bridges. In order to reduce this expenditure, it is necessary to design economical types of form work and order to reduce this expenditure, it is necessary to design economical types of form work and to mechanize its construction. When the concrete has reached a certain required strength, the form is no longer needed and is removed. Forms are classified as wooden, plywood, steel combined wood-steel reinforced concrete and plain concrete. Timber is the most common material used for formwork. The disadvantage of wooden formed is the possibility of warping, swelling and shrinkage of the timber. However those defects can be

Date ____/____/____

overcome by applying to the shuttering water impermeable coatings. This coating also prevent the shuttering from adhering to concrete and hence make steel formwork has many advantages such as follow :

- (i) It can be put to high number of uses.
- (ii) It provides ease of stripping.
- (iii) It ensures even and smooth concrete surface.
- (iv) It possible greater rigidity.
- (v) It is not liable to shrinkage or distortion.

However, steel formwork is comparatively more costly.

↳ Necessity of formwork :

(i) Shaping concrete :-

Formwork is essential for creating the specific shape and design of concrete structure like beams, columns, wall and slabs.

(ii) Support during curing :

Formwork can help achieve smooth and precise finishes on the surface of the concrete.

Date ____/____/____

(iii) Structural Integrity :

Proper formwork ensures that the concrete is evenly distributed and solidified, contributing to the strength and stability of the structure.

(iv) Cost and Time Efficiency :

Using formwork allows for the efficient production of large volumes of concrete structure and reduces error during construction.

↳ Types of Formwork Based on material :

(i) Timber Formwork :

Timber formwork is the most traditional and widely used framework material. It is easy to cut and shape, making it versatile for various designs.

• **Advantages :** Economical, easy to handle and flexible for different shapes and sizes.

• **Disadvantages :**

Less durable, can be affected by weather conditions and is not suitable for high-strength requirements.

(ii) Steel formwork :-

Steel formwork is made from steel sheets or pannels. It is used for large scale projects requiring more durability and ensure.

• Advantages :-

Strong, durable and reusable for multiple projects. It provides high precision and smooth finishes.

• Disadvantages :- Higher initial cost, heavy and requires more labour to handle.

(iii) Aluminum formwork :-

Aluminum formwork is made from lightweight, high-strength aluminum alloy, often used for repetitive construction project like multi-story building.

• Advantages :- Lightweight, durable and offers fast construction and ease of handling.

• Disadvantages :-

Expensive limited in ensure for large projects compared to steel.

(iv) Plastic (Polyurethane) Formwork :

Made from Plastic or Polyurethane this type of framework is lightweight and is used primarily for small-scale projects or residential buildings.

- **Advantages :** Lightweight easy to transport and less maintenance compared to timber or steel.
- **Disadvantages :** Not as strong or durable for large-scale, heavy-duty construction.

(v) Plywood Formwork :

Plywood is often used in combination with timber or metal frames. It is a common material in residential and low-rise commercial construction.

- **Advantages :** Readily available relatively inexpensive and easy to use for complex shapes.
- **Disadvantages :** Not as durable or reusable as steel or aluminum formwork.

Date ____/____/____

Saathi

(vi) Glass Fiber Reinforced Polymer (GFRP) Formwork :-

is made of reinforce plastic, providing excellent strength and lightweight properties.

• Advantages :-

Highly durable, corrosion-resistant and capable of withstanding extreme temperature.

• Disadvantages :-

Expensive and may not be suitable for all construction types.

Date ____ / ____ / ____

Q 3) Explain briefly shuttering and centring :

→ shuttering :

shuttering is the process of constructing a temporary mold on formwork used to shape and support freshly poured concrete until it hardens and gains sufficient strength to support itself. It provides the necessary structure to shape concrete elements like beams, walls, slab and column during the curing process. Shuttering ensures that the concrete takes the desired form, maintains its stability and achieves the required surface finish.

→ Method of shuttering :

(i) Planning and Design :

The first step in the shuttering process is the planning phase, where the formwork is designed based on the type of concrete structure (slab, beam, column, etc) and its dimension. The material for the formwork (timber, steel etc), also selected based on the project needs and budget.

Date ____/____/____

(ii) Preparation of site :-

The construction site should be cleared and leveled. If required a base plate is placed on the ground to provide a stable foundation for the formwork.

(iii) Erection of formwork (shuttering) :

(a) Assembly :

The formwork panels (timber, steel or other material) are assembled based on the design specifications. For vertical structure (like walls or column) the shuttering is built vertically while for horizontal structure (like slabs) the shuttering is installed horizontally.

(b) Alignment and support :

The formwork is then aligned and braced to ensure it remains in the correct position and does not shift during concrete pouring. Supports and props are used to maintain the structure stability.

Date ____ / ____ / ____

(iii) Sealing and Bracing :

The formwork panels are secured and tightly sealed to avoid any leakage of the concrete. Braces and tie-rods are installed to prevent the formwork from bulging or collapsing under the weight of the wet concrete.

(iv) Pouring concrete :

Once the shuttering is set up ready the concrete is poured into the formwork. It's essential to pour the concrete carefully and evenly to prevent any dislocation or distortion of the formwork. In some cases vibrates are used to eliminate air pockets and ensure proper compaction of the concrete.

→ Failures in shuttering (Formwork) :

Failures can lead to delays, accidents and structural defects in concrete construction project. Below are common types of formwork failures - their causes and their impact :

(i) Formwork Collapse :

• Cause :-

Formwork collapse occurs when the temporary mold is unable to withstand the weight and pressure of the wet concrete. This could be due to insufficient design, weak materials, poor bracing or improper support.

• Impact :-

This is the most dangerous failure, leading to potential accidents, concrete spillage and significant delays in construction.

• Preventive measures :-

Ensure proper load calculation, strong bracing and adequate supports. Use materials that are appropriate for the size and weight of the concrete pour.

(ii) Concrete Leakage :

• Cause :-

Concrete can leak through gaps, joints or poorly sealed formwork. This typically occurs with old or damaged material.

- Impact :-

Leakage can lead to a poor surface finish, irregular shape or waste of concrete which affects both the appearance and structural integrity of the finished concrete.

- Preventive Measures :-

Seal joints properly use, high-quality formwork materials and apply release agents to reduce leakage.

(iii) Bulging or Deformation of the formwork :-

- Cause :-

Formwork can bulge or deform under the pressure of wet concrete if it is not properly supported, if there is excessive pressure from the previously poured concrete or if the material used is not strong enough.

- Impact :-

Deformation of formwork can lead to irregular shapes in the concrete and weak structure and costly repairs.

Date ____/____/____

4 Remedies for Shuttering :

Shuttering failures can lead to significant delays, safety hazards and cost overruns. However, implementing certain remedies can help mitigate or prevent these failures. Below are some key remedies for the common causes of shuttering failures.

(i) Formwork collapse

4. Remedy :

• Proper Design :

Ensure that formwork is designed based on accurate load-bearing calculation. The formwork must be able to withstand the weight of the concrete, live loads, and external forces like wind.

• Reinforce supports :

Use strong durable materials for formwork components and install additional supports or braces especially for large concrete pours.

B. Concrete Leakage :

- Seal Joints Properly :

Ensure that all formwork joints and edges are tightly sealed using appropriate sealing materials (eg :- form tape or rubber gaskets) to prevent leakage.

- Use Suitable Release Agents :-

Apply a release agent to the formwork to reduce the risk of leakage while allowing for easy formwork removal later.

- Inspect formwork for Gaps :

Inspect the formwork before and after installation to ensure that there are no gaps through which concrete could escape.

C. Building or Deformation of the formwork :

- Proper Bracing and Tie Rods :-

Use adequate to ensure that the formwork does not deform or bulge under the weight.

centering :-

In the context of civil engineering and construction centring refers to the temporary formwork or support structure used during the construction of arches, beam, slab or other structural elements. It is typically used to support these elements until they are strong enough to support themselves after the concrete or material sets and hardens.

↳ Key Point about centring in civil engineering :

- It is a temporary support system.
- Used in the construction of arches, beams and slab.
- Made of materials like wood, steel or other strong supports.
- Removed once the structure is self-sustaining.

Method of Centring :

↳ Centring in regression analysis :-

A process that reference value for each involves selecting a reference value for each predictor, coding data and ensuring that regression coefficients are relevant to the research question.

(ii) Within - individual centring :-

A method in ecology that helps distinguish between within and among individual process.

(iii) centring in construction :-

A technique that involves using temporary structure to support concrete during construction. Centring is important for ensuring the stability and accuracy of concrete structures.

• Failure of centring :-

Centring of failure refers to the process of identifying and analyzing the root causes of failure in construction, engineering or other fields. The goal of centring of failure is to determine the underlying reasons for a failure rather than just addressing its symptoms.

(i) Data collection :-

Gather information about the failure, including its consequences, timing and any relevant contextual factors.

(ii) Root Cause Analysis :-

Use techniques such as the "5-Whys" or fishbone diagram to drill down to the underlying root causes of the failure.

(iii) Causal mapping :-

Create a visual representation of the causal relationship between the root causes and the failure.

* Centring of Remedies :-

Centring of remedies may refer to the idea of putting right holders at the center of remedy and accountability efforts. This involves acknowledging that right holders have knowledge and lived experience that can help provide a fuller picture of how harms are experienced.

(i) Right holders :-

People who have experienced harm and can provide valuable input on how to remedy it.

(ii) Remedy :- Action taken to address harm or injustice.

(iii) Accountability :- The responsibility to address harm or injustice.

(iv) Epistemic diversity :- The value of including a variety of perspectives in the discourse around remedy and accountability.

Q 4. Write the safety precaution using scaffolding and explain briefly its types.

→ Safety Precaution :- Safety precaution for scaffolding are essential to prevent accidents and ensure the well-being of workers at construction sites.

→ Key safety measures to follow :-

(i) Proper Training :- Ensure all workers involved in scaffolding construction or use are adequately trained and knowledgeable about safety procedures scaffold types and proper usage.

(ii) Inspection :-

Scaffolds must be inspected before use and regularly checked throughout their use. Inspection should be conducted by a qualified person to ensure structural stability and compliance with safety standards.

(iii) Stable Foundation :-

Scaffolding should be erected on a solid level foundation. It should not be placed on unstable ground or on temporary structures that could shift or collapse.

(iv) Correct Assembly :-

Follow manufacture guidelines for the proper assembly and disassembly of scaffolding. All parts (braces, platforms, guardrails and supports) should be securely fastened.

(v) Weight Limits :-

Adhere to the specified weight limit for the scaffold. Overloading can cause instability and collapse.

(vi) Safe Access :-

Provide proper access to scaffold through ladders, stairways or ramps. Ensure these are secured stable and free from obstruction.

(vii) Personal Protective Equipment (PPE) :-

Worker should wear appropriate PPE such as helmets harnesses, non-slip footwear and other safety gear as required for the work being performed.

→ Types of scaffolding :-

→ Shoring :-

Shoring is the construction of temporary structure to support temporarily an unsafe structure. These render lateral support to walls and are used under the following circumstances :-

- (i) When a wall show signs of building out due to bad workmanship.
- (ii) When a wall cracks due to unequal settlement of foundation and the cracked wall needs repairs.

Date ___/___/___

- (iii) When an adjacent structure is to be dismantled.
- (iv) When openings are to be made or enlarged in the wall.

• Shores may be of the following types :

- (a) Raking Shores
- (b) Flying Shores
- (c) Dead shores

a) Raking Shores :-

In this method inclined members called rakers are used to give lateral support to the wall. A raking shore consist of the following components :

- a) rakers or inclined members..
- b) wall plate
- c) needles.
- d) cleats.
- e) bracing
- f) sole plate.

The wall plate about 20 to 25 cm wide and is 40 to 7.5 cm thick is placed vertically along the face of the wall and is secured by means of needles of 10 cm x 7.5 cm section. These needles penetrate of 10 cm the wall

by about 10 cm. In other that the needle do not get sheared off due to the thrust of the raker the needles are further strength end by means of cleats which are nailed directly of the wall plate.

(i) For tall building the length of raker can be reduced by introducing rider raker.

(ii) Raker should be properly braced at intervals.

(iii) The size of the raker should be decided on the basis of anticipated thrust from the wall.

(iv) The centre line of a raker and the wall should meet at floor level.

(v) Wedges should not be used on sole plates since they are likely to give way under vibrations which are likely to occur.

b. Flying or Horizontal Shores :-

Such as Shores are used to give horizontal support to two adjacent parallel party walls which have becomes unsafe due to removal or collapse of the intermediate building. All types of arrangements of supporting the unsafe structure in which the shores do not reach the ground fall under this category. If the

walls are quite near to each other (distance of 40 cm) Single flying shore can be constructed. It consists of wall plates, needles, cleats, struts, horizontal shore straining pieces and folding wedges.

(i) Flying shores are inserted the old building is being removed and should be kept in position till the new unit is constructed.

(ii) Large factor of safety should be used for determining sections of various members of the shoring since it is difficult to assess the actual loads.

(iii) The struts should preferably be inclination 45° exceed 60° . In no case should be this inclination exceed 60° .

(iv) The flying floor shores should be spaced at 3 to 4.5 m centres along the two walls and horizontal braces should be introduced between adjacent shores.

Date ____/____/____

c) Dead or Vertical Shores :-

Such type of Shoring consists of dead vertical members known as dead shores supporting horizontal members known as needles.

The needles transfer the load of the wall etc. to the dead shores. Such shoring is provided to serve the following purpose:

- (i) To rebuild the defective lower part of the wall.
- (ii) To rebuild or deepen the existing foundation.
- (iii) To make large opening in the existing wall of lower level.

Holes are made in the wall at suitable height. Needles, which are made of thick wooden section or of steel, are inserted in the holes. Each needle is supported at its two ends by vertical posts or dead shores.

- (i) The needles should be suitably braced.
- (ii) The floors should be suitably supported from ^{inside}.
- (iii) If the external wall is weak raking shores may be provided in addition to the dead shores.
- (iv) If the opening is made in an external wall the length of the outer dead shore will be greater than the inner one.

Q.5) Define roof while its types and materials and differentiate between pitched roof and flat roof.

↳ Roof :

A roof may be defined as the uppermost part of the building, provided as a structural covering to protect the building from weather (i.e. from rain, sun, wind etc). Structurally a roof is constructed in the same way as an upper floor, though the shape of its upper surface may be different. Basically a roof consists of structural elements which support roof coverings. The structural element may be trusses, portals, beams, slabs, shells or domes. The roof covering may be A.C. Sheet, G.I. sheets, wooden shingles, tiles, slate or slab, itself.

↳ Requirement of a roof :

The requirement of a good roof are summarised below :

(i) It should have adequate strength and stability to carry the superimposed dead and live loads.

(ii) It should provide adequate thermal insulation.

- (iii) It should be water proof and should have efficient drainage arrangements.
- (iv) It should be fire resistant.
- (v) It should be effectively protect the building against rain, sun, wind etc and it should be durable against the adverse effect of these agencies.

→ Types of Roofs :

Roofs may be divided into three categories :-

- (i) Pitched or sloping roofs
- (ii) Flat roofs or terraced roofs
- (iii) curved roofs

(i) Pitched roofs :-

The selection of the type of roofs depends upon the shape or plan of the building, climatic conditions of the area and type of constructional material available. Pitched roofs have sloping top surface. These are suitable in those areas where rainfall is very heavy. Broadly building with limited width and simple shape can generally be covered satisfactorily by pitched roof. Building irregular in plan, or with long

spans, present awkward problems in the design of a pitched roof, involving numbers valleys gutters and hips.

(ii) Flat Roofs :

Flat roofs are considered suitable for buildings in plains or in hot regions where rainfall is moderate and where snowfall is not there. Flat roofs are equally applicable to building of any shape and size.

(iii) Curved roofs :

Curved roofs have their top surface curved such roofs are provided to give architectural effects. Such roofs include cylindrical and parabolic shells and shell domes, doubly curved shells such as hyperbolic paraboloids and hyperboloids of revolution and folded slab and prismatic shells such roofs are more suitable for public building like libraries theatres, recreation centres etc.

Date ____/____/____

Q. Materials of Roofs :-
Roofs can be made from a variety of materials each with its own advantages depending on the climate, aesthetic preference and budget. Here are some common roofing materials :-

(i) Asphalt Shingle :-
Popular due to their affordability and ease of installation. They are available in a variety of colors and are suitable for most climates.

(ii) Metal Roofing :-
Includes material like aluminum, steel and copper. It is durable, lightweight, fire-resistant and can be energy-efficient due to its reflective properties.

(iii) Wood Shingles :-
Made from cedar, pine or redwood. These provide a natural look but require maintenance to prevent rot and pests.

(iv) Concrete Tiles :-
These are durable, fire-resistant and provide excellent insulation. Often used in mediterranean or Spanish-style homes.