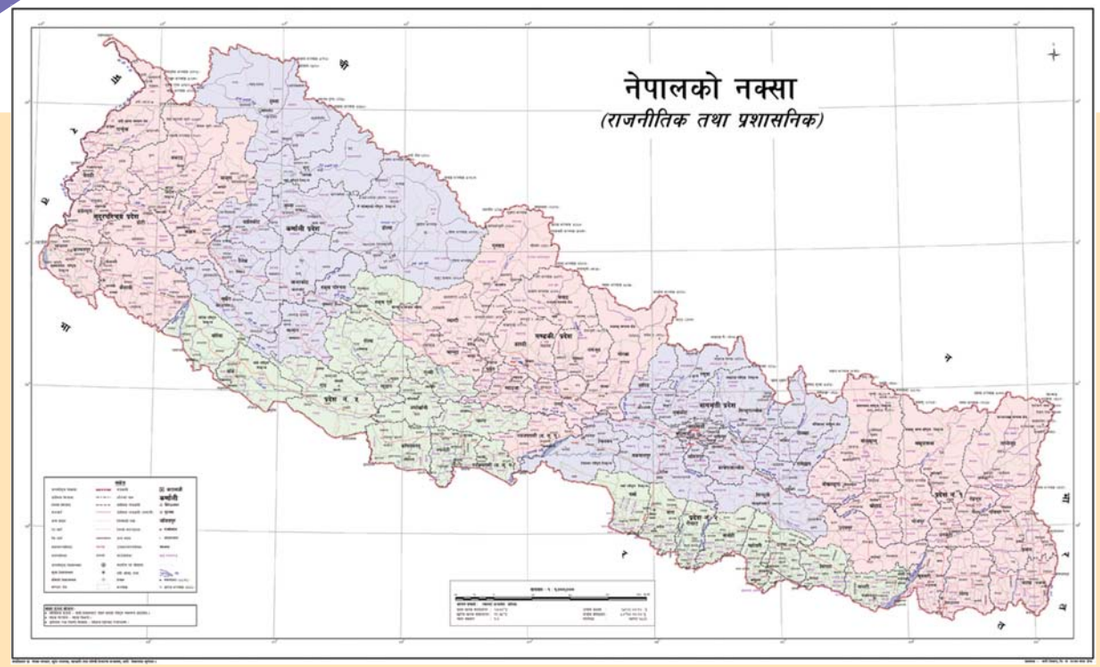
Civil Engineering



Building Construction

Government of Nepal
Ministry of Education, Science and Technology
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Technical and Vocational Stream
Learning Resource Material

Building Construction
(Grade 10)

Secondary Level
Civil Engineering

Government of Nepal
Ministry of Education, Science and Technology
Curriculum Development Centre
Sanothimi, Bhaktapur

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Preface

The curriculum and curricular materials have been developed and revised on a regular basis with the aim of making education objective-oriented, practical, relevant and job oriented. It is necessary to instill the feelings of nationalism, national integrity and democratic spirit in students and equip them with morality, discipline and self-reliance, creativity and thoughtfulness. It is essential to develop in them the linguistic and mathematical skills, knowledge of science, information and communication technology, environment, health and population and life skills. it is also necessary to bring in them the feeling of preserving and promoting arts and aesthetics, humanistic norms, values and ideals. It has become the need of the present time to make them aware of respect for ethnicity, gender, disabilities, languages, religions, cultures, regional diversity, human rights and social values so as to make them capable of playing the role of responsible citizens with applied technical and vocational knowledge and skills. This Learning Resource Material for Civil Engineering has been developed in line with the Secondary Level Civil Engineering Curriculum with an aim to facilitate the students in their study and learning on the subject by incorporating the recommendations and feedback obtained from various schools, workshops and seminars, interaction programs attended by teachers, students and parents.

In bringing out the learning resource material in this form, the contribution of the Director General of CDC Dr. Lekhnath Poudel, Dr. Jagatkumar Shrestha, Dr. Kamal Thapa, Dr. Bharat Mandal, Kedar Dahal, Subash Gurung, Achyut Neupane is highly acknowledged. The book is written by Jagadishchandra Karki and the subject matter of the book was edited by Badrinath Timalsina and Khilanath Dhamala. CDC extends sincere thanks to all those who have contributed in developing this book in this form.

This book is a supplimentary learning resource material for students and teachrs. In addition they have to make use of other relevnt materials to ensure all the learning outcomes set in the curriculum. The teachers, students and all other stakeholders are expected to make constructive comments and suggestions to make it a more useful learning resource material.

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Table of Contents

Unit 1

BUILDINGCONSTRUCTION

COMPONENTS OF BUILDING

1. Objective

- To familiar with component of building.
- To compare the types of building.
- To list out the different component of super and sub structure.
- To familiar about the consideration of building design.

2. Content

Types of building

a. Residential Bldg.

They are used residence purpose. Residential buildingis in small scale in shape and size. These building are used for human beings and have small scale of different room like living room, bathroom, bedrooms, kitchen, etc.

b. Institutional and Educational Bldg.

These building are type of Buildingin which school, college, university, are open. It main purpose is to give public plat from for the different education like commerce, arts, science, etc.

c. Business Bldg.

In these type f Building the commercial thing like market, shop will be open and give service to public. Business building is used in large scale so that large number of business and get more service from it.

d. Storage Bldg.

They type of building in which different types of material or things can be for the long time.

e. Industrial Bldg.

These types of building are built for the production purpose in large scale so that it can manufacture different types of daily usable things and other useful

things required for future.

Loads on Building

1. **Live loads:** This is the movable load on the floor and hence it is variable. It is also called super imposed load. It includes the load of a person standing on the floor weights of the material temporarily stored on the floor, weight of the snow on roof and also furniture. It unit is kilo Newton per m^2
2. **Dead loads:** This is the lad of the materials used for various component of Bldg such as wall, roof, floor, pillar and other all permanent structure are also included in dead load. Partition wall, terrace garden are also considered are as a dead load. Its unit is kilo Newton lm^2.
3. **Wind load:** In case of tall building the effect due to the wind should be considered that the exposed sides and roof of such building are subjected to wind pressure so, which designing the building wind pressure (p) = KV^2
   k= coefficient of wind speed, temperature of air shape of structure]

Components part of building

Sub-structure

It is the lower portion of the building usually located below the ground level which transmit the load of the super structure to the supporting soil. Its basic function is to transmit the dead load, live load and other load to the sub-soil or sub grade soil. In the sub-structure it consists of mainly footing. This is the lowest part of the building or any construction work in which different part like wall, PCC, RCC, soling and natural ground sub soil or sub grade soil. This all components are design or constructions per specification and required.

Super structure

It is part of a building which is above the ground level and it serves the purpose of use. The super structure has masonry work, beam, pillar, roof structure, floor structure, door, window, staircase or finished work.

i. Masonry Work

It is defined as the construction of the building. It is the boundary of the building. It make the partition of the building or divide the room in the different part if the

area. Its main purpose is to separate the area for the different purposed inside the building. It is the essential part or component of the building and its primary function is to enclosed and to make function able useful.

ii. Column/Pillar

It is an essential part of the building. It is on isolated vertical load bearing member and having length, breadth and height as per design or required. It is the vertical component so that it takes all the load of the sub-structure. So, generally column or pillars are more stronger than other structure.

iii. Beam

It is an also calculated horizontal tensile load bearing member having length, breadth and span as per required or as per design. It is horizontal component so that its main purpose is to support the wall, slab or other any component of building on slab and it transferred its own weight or load and other all load above it to the pillar.

iv. Floor structure

Floors are the horizontal element which divides the building into different level. Its main purpose is to create the open surface or accumulation for the different use on it. It has length breadth and thickness as per required or design. In the building floor works is of any material or any types.

v. Roof structure

A roof is the uppermost part of the building. It is covering provided on the top of building with a view to keep out rain, snow, sunlight, wind etc and to protect the building from their adverse affect. The roof are of different design such slope, flat and of different material.

vi. Door

A door is a framework of wood, steel, aluminum etc. Fixed in the wall opening for the purpose of providing access to user of the building.

vii. Window

It is also an opening made in the wall and fixed on it for the purpose of providing day light, wind or ventilation and for vision purpose.

viii. Stair case

It is defined as a series of step which are suitably arranged for the purposed to connect different floor of the building. It provide and easy safe and quick access to the user in the different floor to floor.

ix. Building finish

They are used to give protective coveting to various building component at a same time. They provide decorative effect

Consideration of building design

- Types of building
- Geographical location
- Decorative purpose
- Find performance
- Impact Resistance
- Environmental performance
- Detailing and interface
- Cost

1. Learning process and support materials.

Following are the learning process of this unit:

- Group discussion
- Drawing presentation
- Site visit nearby school.

2. Assessment

A. Very short questions answer

1. Define building
2. Write any two components of building

B. Short questions answer

1. What are the types of building? Explain any one.
2. Explain about superstructure

C. Long questions answer

1. Differentiate between super structure and substructure.

2. Explain about the design considerations of building

3. Glossary

Beam: Beams are the horizontal member to bear load of slab.

Column: columns are the vertical member to bear load of superstructure and to transport load to the foundation.

Floor: platform for furniture and human

4. Reference materials

Suggested texts and reference

Punmia B.C. Dr.,Building Construction(Latest Edition).

Sharma S.K. &Kaul B.K.,Building Construction(Latest Edition).

Kumar SushilBuilding Construction(Latest Edition).

Singh Gurucharan, Building Planning & Design (Latest Edition)

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चौधरी; महेश कुमार, गाह्रो लगाउने प्रविधि

FOUNDATION

1. Objective

- To familiar with foundation and its function.
- To gather information for requirement of good foundation.
- To list the type of foundation.
- To familiar with footing at different level.

2. Content

Definition of foundation (the lowest weight bearing part of a building)

Every building has two basic components one is super structure and sub structure.

A foundation is therefore that part of structure which is in direct contact with ground to which the load is transmitted. The lowest land in which all the building load is rest on it and it totally below the ground level and in some cases the lowest part of building wall or masonry are partially or wholly below the surface of ground. The foundation will resist the all load i.e. dead load, live load, wind load will transmit the sub grade soil and it won't provide any settlement on the foundation. A foundation should be sufficiently strong to prevent excessive settlement as well as unequal settlement. Foundation also preserve the building from ground movement, shrinkage of land, uplift pressure and other unexpected impact.

Function of foundation

a. Reduction of load intensity

Foundation distributes the load of the super structure to the large area so that the intensity of load at its base doesn't exceed safe soil bearing capacity of the sub- soil.

b. Even distribution of load

Foundation distributes the non-uniform load of super structure evenly to a large are of sub-soil for eg. Two columns carrying unequal load can have a combine footing which may transmit the load to sub-soil evenly with uniform soil pressure. Due to this unequal or differential settlement are minimized.

c. Provision of level surface

Foundation provides level and hard surface over which the super structure can be built.

d. Lateral stability

Due to the different load like wind load impact load and the load created by soil mass movement inside the ground. The foundation will give to the stability for the super structure of the building. It gives stability on sliding and over turning.

e. Safe Against under mining

In some cases under the beneath of the foundation the soil can be scoring. In the result the foundation may get unequal settlement, foundation give safety against it.

f. Protection against soil movement

Foundation will measure preventive method to minimize the crack on the super structure or other structure due to the movement of soil or expansion or contrition and due to the moisture movement.

Essential requirement of good foundation

Foundation should be contract safely by the following requirement.

- Foundation should be constructed to resist bear on the imposed load and to transmit to the sub grade soil in such a way that all pressure.
- Won't give any settlement on the foundation.
- The foundation base should be rigid so that all the differential settlement can be minimized when the super structure load or other are distributed unevenly.
- Foundation should be taken sufficiently deep to resist the building laterally when the soil-mass get movement under foundation.
- Foundation should be perfumed stable when it is affected by unexpected load or impact.

Types of foundation

a) Shallow foundation
b) Deep foundation

Shallow foundation

a) Spread footing

b) Combine footing

c) Mat footing

3. Learning process and support materials.

Following are the learning process of this unit:

- Group discussion
- Drawing presentation
- Site visit nearby school.

4. Assessment

A. Very short questions answer

1. Define footing.
2. Enlist the type of foundation.
3. Define footing at different level.

B. Short questions answer

1. What is the important of foundation?
2. Write the function of foundation.
3. Explain the essential requirement of good foundation.

C. Long questions answer

1. What are the types of foundation? Explain
2. Explain about the shallow foundation.
3. Enlist the type of shallow foundation and explain it.
4. Explain briefly about the footing at different level.

5. Glossary

Foundation: foundation is the element of a building structure which connects it to the ground and transfers loads from the structure to the ground.

Settlement: gradual distortions created in a structure.

Stability: stable

Bearing Capacity: is the capacity of soil to support the load applied to the ground.

6. Reference materials

Suggested texts and reference

Punmia B.C. Dr.,*Building Construction*(Latest Edition).

Sharma S.K. &Kaul B.K.,*Building Construction*(Latest Edition).

Kumar Sushil*Building Construction*(Latest Edition).

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STAIRCASE

1. Objective:

- To familiar with staircase.
- To compare the different type of staircase
- To gather the idea about the design criteria.

2. Content

Definition of Stair

A staircase is defined as a sequence step and is providing to afford the means of ascent and descent between the floor to floor and with landing. Staircase is generally located at the middle of the building through it can be any corner. The opening or space occupied by the stair is called stairway. The other means of transportation between the floors are lifts, ramps, moving stairs, etc.

Technical Terminology

1. Baluster
2. flight
3. going
4. handrail
5. Headroom
6. landing
7. Newel post
8. Nosing
9. Riser
10. Tread
11. Pitch/slope
12. waist
13. Scotia
14. Soffit

1. Baluster

This is the vertical member which is fixed between the handrail and on steps to give support the hand rail.

2. High

This is defined as the unbroken series of steps between the landing.

3. Going

This is the horizontal distance between the face of two consecutive riser.

4. Handrail

It is the inclined rail over the Balster. It is provided at convenient height of different material so as to give graps to the hands during ascent and descent.

5. Headroom

This is the vertical distance between the nosing of one flight and the bottom of flight immediately above.

6. Landing(a raised level area in which people or things stand)

The horizontal platform between two flight of stair. It changes the direction and provide the opportunity of taking rest during the use of stair.

7. Newel Post

This is the vertical member which is placed at the end of the flight to connect the end of string and handrail.

8. Nosing (at or to the further side of)

The projection part of the trade beyond the face of riser.

Requirement of good stair

1. Location
2. Width of stair
3. Length of light
4. Pitch of stair
5. Material
6. Landing
7. Different components (handrail, Newel post Headroom, riser, Tread)

A well plan and design of staircase should provide and easy, quick and safe mode of communication between the floor. The requirement of good stair are

1. Location

It should be located at the middle point of building or sufficient light and ventilation.

2. Width of stair

It is the width (breadth) part of staircase so that the breadth of staircase varies with the purpose and uses. In the public, Residential etc. It has different width of stair respectively and for the good staircase, it should be sufficient for the two way movement in each case.

3. Length of flight

For the comfortable ascent and descent in the stair, it varies the length of flight. In the flight there are many number of steps should be provided for the movement and its number depend on length of the flight.

4. Pitch of staircase (compliment insincerely)

The pitch of stair should be flatter as far as possible to make the easy movement on it. Its inclination slopes depend on the types of stair and height of building. Theslope shouldn't be exceed 45^{o} and flatter less than 25^{o} .

5. Material

The material used in the staircase should be of good qualities so as to resist all type of damage and certain impact load while using it and also should be posses fire resistance quality while finishing the staircase its not depend on the material it good when the workmanship is good.

6. Landing

The width of landing should be greater than or equal to the width it good when the workmanship is good.

7. Different component

a. Handrail Newel post Tread and Riser must be of good material and should be provide with great finish work so that while using it, it doesn't harm user. The height of the handrails should be rise above more than 0.8m and Trader and riser should be provide with as per design and

tread should be horizontal and riser must be vertical.

Classification of staircase

1. Straight
2. Turning Quarter
   Halfdog legged
   Three quarter turn open well

3. Circular or helical or spiral

1. Straight

   In thestraight stair case all the steps laid in one direction. In this type of staircase the only flight and they are used when space is enough and width is narrow.

2a. Quarter Turning

A stair turning through one right angle is called quarter turning stair. If the quarter turn stair is branch into two flights then the landing must be provide and it is as middle.

a. Half turning

i. Dog legged

In the case of Dog legged stair, the flight run in opposite direction and there is some inches of space between them. This is good for less space available in the building.

ii. Open well

In the case of open well there is a well or hole or space between two flight and the steps are added in between that open space.

a. Three quarter turn

A stair turning through three Right angles is called three quarter turn.

3. Circular or helical or spiral In this of stair the steps are made from the center of the main post and they behave like circular or helical or spiral.

3.5 Design criteria (except structural design)

1. Width of flight=width of landing
2. Riser=(6-8)"

   6"=6x2.54=15.24cm

   =150mm

   8"=210mm
3. Tread =(9-13)"

   9"=9x2.54x10 13"=13x2.54x10

   = 220mm =330mm
4. 2R+T=600
5. T=R-1
6. Slope

Q.1. For two storied building is to have an RCC stair from ground to first floor. The size of staircase is (5mx3m)
Height of floor = 3.3m (in residential Building, masonry thickness= 9" gap =6")
solution
Let;
width of flight = 1190
we have,
width of flight = width of landing
Now, Height of half floor = $\frac{3.3}{2}$ =1.65cm
Let us assum height of Riser =160mm
in m = $\frac{160}{100}$ = 0.16
Now, No of Riser = $\frac{165}{0.16}$ = 10nos
No of Tread = R-1
= 10-1
= 9 nos

Let us, assume = 260mm

length of tread = 9x260mm

= 2340mm

Then, length covered by tread and landing = 3530mm and Reaming 5000-3530mm = 1470mm which is greater then 1000 (ढोका अगाडीकम्तीमा 3ft ठाउँ खाली हुनुपर्छ, अनि 3ft भनेको 1000mm हो) त्यसैले भऱ्याङ्गबनाउँदा अगाडी 1000mm or 3.28ft ठाउँ छोड्नुपर्छ) ।

4. Learning process and support materials.

Following are the learning process of this unit:

- Group discussion
- Drawing presentation
- Site visit nearby school.

5. Assessment

a. Very short questions answer

b. Short questions answer

c. Long questions answer

6. Glossary

Riser: The vertical or the front members of steps which connects to the trade.

Tread: The horizontal upper portion of steps is known as Tread.

Pitch/slope: The angle of inclination of stair with the floor is pitch.

Waist: The thickness of structural slabs in case of an RCC stair.

Scotia: This is an additional finish to provide to the nosing or trade at once.

Soffit: It is the inclined part of staircase which is just below trade at once.

7. Reference materials

Suggested texts and reference

Punmia B.C. Dr.,*Building Construction*(Latest Edition).

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DOORS WINDOWS

1. Objective

- Tofamiliar withdoor and window
- To well known about the parts of door and window.
- To compare the types of doors and window.
- To list the types of door and window.

2. Content

Door is a movable barrier seared in a wall opening which is used for the movement from the outside to inside and to ventilate the light and other physical atmospheric control. Door is also is taken as noise barrier and it gives the complete form of room.

Door should be as far as possible at the corner of the room. In the room if the double door is to be provided. The door should be in opposite wall if possible. The door should be kept minimum.

WINDOW

A window is a ventilated open part of the room to admit the light are and other atmospheric control inside room. It also provided view to outside the room. IT also attached a noise barrier.

Location of door

The door should be kept in the corner of room as far as possible.

- It should be about 20-25cm far from the corner of the room.
- It two doors should be kept in one room, it must be in opposite direction if possible.
- The location of the door must be in the room such that it gives the easily movements of the user form one room to another room without any conflict.

a. **Panel:** It is the area of the shutter enclosed between adjacent near or next to rail.

b. **Mullion:** It is the vertical member of a frame which sub divide the door vertically.

c. **Transon:** It is the horizontal member of the door which subdivide the door horizontally.

d. **Hold fast:** This is the steel bent in Z shaped to fixed or hold frame on the wall vertically.

Size of the door

Main: Door for residential building, main door (1m to 1.5m) (width) and height (2m to 2.5m)

Main: (0.85-0.95m) width and height (2 to 2.5m)

(kitchen bathroom, store room Barandah door) : (0.6-0.85) width and height (2 to 2.5m)

Ventilator and sky lights

Ventilators are the small window fixed at the great height which is generally at the lintel a horizontal support across the top of a door level of the window. Its main function is to ventilate air outside to inside which is made up of frame and shutter with one panel and upwards openable. (a section of a door, vehicle, garment, etc)

Sky light is provided on the slope of the room to admit the light and it is water proof.

Location of Window

The window must be on the middle part of the wall as far as possible and in the case of more than one window need the gap between the two window must be greater than 1m window are used for ventilation view outside the room and for atmospheric control so at least one window and one door should be required in one room windows should be kept at the height of greater than 0.6m from the floor level and must not be greater than 2.5m.

Types of window

- fixed window
- Pivoted window
- sliding window
- Gazed window

Fixed window: These window are provided for the purpose to admit the light and providing vision in the room in the room, it cannot be open.

Pivoted window: These window are allowed to swing round pivoted fixed to the window frame. The frame of the window is similar to fixed window. The shutter of the pivoted window rotates either horizontally or vertically.

Sliding window: The shutter moves either horizontally a structure of a piece of glass on which object is placed or vertically on the frame to make opening when it is slide. It is mostly used in buses, shops, bank, party palace and where the space is not sufficiently available for the opening.

Glazed window: They are provided for the additional light is required to the room. Glazed are usually used in all window in the replace of panel but in the case of glazed window is covered by glazed which is fixed at the frame and shutter.

3. Learning process and support materials.

Following are the learning process of this unit:

- Group discussion
- Drawing presentation
- Site visit nearby school.

4. Assessment

A. Very short questions answer

1. Define door and window
2. Write any two components of door.
3. Write any two components of window.

B. Short questions answer

1. What are the types of door? explain.
2. What are the types of window? Explain.

C. Long questions answer

1. Differentiate between door and window.
2. Explain about the location of door and window.

4. Glossary

Frame: It is an assembly of horizontal and vertical member forming and in closer to which shutter are fixed.

Shutter: These are the operable part of door Assembling of style rail and panel.

Head: It is the uppermost part of the frame.

Horn: It is the horizontal projection of head on both sides. It helps to get fixed in wall. The length of horn should be 10-15cm.

Sill: It is the bower horizontal part of frame.

Style: It is the vertical member of the shutter.

Top rail: It is the most horizontal member of shutter.

Lock rail: It is the middle horizontal member of shutter which is used to fix the locking arrangement.

Bottom rail: It is the lowermost horizontal member of the shutter.

5. Reference materials

Suggested texts and reference

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Stone /Brick Piers/ Arches

1. Objective

- To familiar with piers and arches.
- To compare with stone and brick piers and arches
- To list out the different type of piers and arches.
- To well know of uses of piers and arches.
- To familiar with roof.
- To gather the idea about the ceiling.

2. Content

Arch

An arch is a structure contracted of wedge shape units, jointed together with mortar and spanning on opening to support the weight of the wall above it along with other super imposed lads.

Piers

A pier is a structure constructed of brick, stone in a rectangular pillar shape joining together with mortar at the tangent shape of the every span of arches end to support the entire load above it. It is just under the end of arches.

Types of arch

1. **Segmental Arch:** In this types, the shape of arch is just a segment of the oracular and the center of circle lies below the springing line. The lad transferred to the abutment in inclined direction.
2. **Semicircular Arch:** This is modified form of segmental arch in which center of circular arch lies on the springing line and shape of Arch is in semicircular shape and all load on it transferred to the abutment and piers very perfectly.

BRICK PIERS

Piers are the support for the beams, trusses or other structural member which is mainly made for to give the support for beams walls and other heavy structure to resist and bear the entire load. It is also called column or pillar.

Types of Pies

1. Isolated piers

Isolated pies can be constructed in any types of bond, generally English and Flemish bond is adopted and the shape and size may be or square, rectangular or circular as per specified design.

2. Attached piers

As isolated piers attached piers also can be constructed in any types of bond but in this case the pier is attached at central part of it with T-joint shape so that it can resist heavy load from the superstructure and roof and to provide the more strength to the wall.

Roof/Roof covering works

As we know roof is defined a cover providing over the top of the building with a view to keep out rain, snow, sunlight and wind away and to protect the building from the adverse effect of these element. It is important to make self-functional for a building and is equally important to provide good appearance on the building.

Requirement of Roof

- It should be good enough to resist the super imposed loads (dead and live) and enough stability.
- It should be all function able so that it will make building protect from rain water, sunlight and others. Wind and snow effect on it.
- Its essential required that totally thermal (heat) insulation and sound insulation.
- It should be as far as possible to resist the fire.
- It should provide good slope to drain out for water leakage proof.

Ceiling works

A ceiling is an overhead interior surface that cover the upper limit of the room. It is not consider as a structure element. It is only the finished work of the room of floor just below it.

1. Purpose

It man purpose that it give complete finished work inside the room.

- Though it is ceiling but it also provide as a floor for upper part of bldg.
- In case of one stroked building, it protects from the dust. Water lockage from roof.
- It also protects the roof from kitchen smoke.
- It other purpose to fix ceiling fans and lights.

2. Material used

- Cement and sand for plaster
- Plywood, timber in the case of local house.
- Metals
- Plastic, paper etc.

3. Advantages and disadvantages

Advantage

- It give an decorative purpose inside the room.
- It protect from the dust water lockage from roof.
- It prevents the roof material by kitchen smoke.
- It helps to installed light and fans inside the room.

Disadvantage

- It is costly or expensive in case of RCC, timber for.
- It's renovation is tedious

4. Learning process and support materials.

Following are the learning process of this unit:

- Group discussion
- Drawing presentation
- Site visit nearby school.

5. Assessment

A. Very short questions answer

1. Define Pier and arch
2. Write any two components of roof.
3. Write any two components of ceiling.

B. Short questions answer

1. What are the types of pier? Explain any one.
2. Explain about Arches and its types.

C. Long questions answer

1. Differentiate between Brick and stone piers.
2. Explain about the roof and its covering material.

6. Glossary

Arch: An arch is a structure contracted of wedge shape units, jointed together with mortar

Piers: A pier is a structure constructed of brick, stone in a rectangular pillar shape joining together with mortar at the tangent shape of the every span of arches end.

Ceiling: upper part of the room and the lower part of the floor.

7. Reference materials

Suggested texts and reference

Punmia B.C. Dr.,*Building Construction*(Latest Edition).

Sharma S.K. &Kaul B.K.,*Building Construction*(Latest Edition).

Kumar Sushil*Building Construction*(Latest Edition).

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UNIT 2
TEMPORARY CONSTRUCTIONS

1. Objective

- To familiar with shoring
- To well know about the scaffolding
- Tofamiliar with underpinning.
- To familiar with formwork.
- To list out the types of shoring, underpinning, scaffolding.

2. Content

SHORING

Definition

In normal activity of building construction become necessarily to some times of temporary structure so, as to proceed meet the work and to complete in the different types of temporary construction required. They are

Shoring: Shoring is the contraction of temporary structure to support like building wall, shoring is done under following conditions

a) When a wall show the sign of tilt out and not in plumbob and outside the vertical line due to the bad workmanship and due to old age of the structure.
b) When the wall crack due to the unequal settlement of foundation.
c) When adjust adjacent structure is demolished.
d) When the opening are to be made.

Types

1. Racking shoring (inclined shoring)

A racking shoring is defined as the inclined support give to the external wall from the ground. It consists of rocker wall, plate, needle, cleat, sole plate, bracing.

The following point should be considered during shoring:

a) It should be inclined to the ground by 45^0 Top rocker should not inclined steeper by 75^0

b) Rocker should be properly braced at interval.
c) Factor of safety should be adopted while designing shoring.

2. Horizontal shoring (flying shoring)

In thus arrangement the horizontal support are given two parallel wall which have became unsafe due. To removal or collapse or intermediate building. In this shoring the bracing are fixed from one wall to another wall in cross shaped which looks like flying and the horizontal snore are kept at the middle of the cross to support all parts of shoring cleat, plate needle, sole plate.

3. Dead or vertical shoring

In this arrangement the horizontal member known as needle is support by vertical member known as dead shore dead shore is done for following cases:

a) When the lower part of the foundation wall are become defective.
b) When the foundation are to be extend deeper.
c) When the large opening are to be made in the existing wall.

UNDERPINNING

The placing of new foundation below an existing foundation or the process of strengthen the existing foundation is known as under pinning. The following point should be considered for under pinning.

a) A building with deep foundation is to be constructed adjoining to an existing building to on existing building.
b) When the basement is to be provided improve to an existing bldg.
c) When the settlement of the existing building has taken place then the underpinning is required.

Shoring and shuttering should be provided and the examination of the building should be conduct so that it can find out the present condition of the building and it can provide under pinning when repair is require.

Types of under pinning (Method)

a) Pit method

In this method the existing wall is divided into suitable section of width about 1.2m-1.5m. Jack is provided both side of the shutter to take the load on it and distribute both side with the help of Jack shore.

b) Pile method

In this method, the pile is driven along with the both side of the existing foundation wall and then, pile caps are provided to take the load on it and distribute on the both side the pile. This method is useful in the clay soil, water logged area. While driving the pile it must be in the equal interval and along the both side of the wall. The piles are connected by a steel leader or concrete slab penetrating wall.

SCAFFOLDING

1. Definition

When the height above floor level exceed about 1.5m at the construction of masonry or other work or temporary structure needed for the placement of the material and workmanship. Usually of timber or steel erected close to the work parallel to wall and it given or provides safe platform for all these workers and materials.

2. Types

2.1 Single Scaffolding

This consist of single framework of standard, ledger put log, boarding etc constructed parallel to the wall at a distance of about 1.2m. The standards are placed at distance (2-2.5) m maternal ledgers are connected to the standards and provided at a vertical. Putlogs are placed at one end on ledger and continuously putlog are provided at interval as standard are paced and the boarding are rest on the putlog which will provide as a required platform for workers and materials. It also called putlog scaffolding.

2.2 Double scaffolding

This consists of the double framework of standards and ledgers and other all as single scaffolding. This method is adopted when the stone masonry should be construct and in other case the platform need more space, more strength which is generally done on the high rise building and it also make the wall without any holes which is needed on the single scaffolding. Rockers and Braces are to be provided in the cross shape to make the double scaffolding strong and stable.

3. Component parts

a) Standards

These are the vertical member running parallel to the wall

b) Ledger

These are the horizontal member running parallel to the wall and perpendicular to the standards.

c) Braces

These are the diagonal member fixed at the standard

d) Putlogs

These are the transverse members' right angle to the wall with one end support on ledger and other end on the wall in the case of single scaffolding.

e) Boarding

These are horizontal platform to support workman and material. These boars are provided on the putlog.

f) Guard Rail

These rails are provided like a ledger to give protection at the level of working height.

Uses

Uses of scaffolding are

a) It is used to provide a platform for the material and working ship safely.
b) It is also used for plastering, painting at the high level.

4. Formwork for slab/ beam/column

Introduction

Formwork is a temporary const provided for laying reinforcement andconcrete to required shape and size. It also provided platform of the workmanship and for equipments formwork are of different material like plywood, steel, plastic, etc.

Requirement of good formwork

a) Strength
b) Low cost
c) Formwork true to design
d) Proper material
e) Finish

5. Formwork for slab/ beam/ column

Column

Formwork for column is probably the simplest formwork. It consists of sheet or

plank all around the column. Site plank and ends plank are consisting of two members each side along the height of column.

Beam

Formwork for beam is continuously horizontal member or horizontal part throughout the entire beam which is rest on the pillar and support by apps. The horizontal members of beam are of plants on three sides of rectangle.

Slab

Formwork for slab is continuous over a member of beams which is plywood, timber, plank, shuttered tightly throughout the area over the beam at its required thickness.

6. Learning process and support materials.

Following are the learning process of this unit:

- Group discussion
- Drawing presentation
- Site visit nearby school.

7. Assessment

A. Very short questions answer

1. Define shoring
2. What is underpinning.
3. Define scaffolding.
4. Define Formwork.

B. Short questions answer

1. What are the types of Shoring? Explain any one.
2. Explain about Underpinning.
3. What are the components of scaffolding?

C. Long questions answer

1. Differentiate between pit and pile underpinning.
2. Explain about the types of shoring.
3. Explain the different type of scaffolding.

4. Write about the Requirement of good formwork.

7. Glossary

Shor: support for the week structure.

Standards: These are the vertical member running parallel to the wall

Ledger: These are the horizontal member running parallel to the wall and perpendicular to the standards.

Braces: These are the diagonal member fixed at the standard

Putlogs: These are the transverse member's right angle to the wall with one end support on ledger and other end on the wall in the case of single scaffolding.

Boarding: These are horizontal platform to support workman and material. These boars are provided on the putlog.

Guard Rail: These rails are provided like a ledger to give protection at the level of working height.

8. Reference materials

Suggested texts and reference

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Unit 3

STRUCTURE AND SUPER STRUCTURE

1. Objective

- To familiar with structure and super structure.
- To list out type of brick.
- To well know about the masonry.
- To familiar damp proofing.

2. Content

Types of wall and their function

a) Load bearing wall

b) Non Load bearing wall.

c) Partition wall.

a) Load bearing wall

In the general building a load bearing wall which takes all the load of the building of super structure, (wall, door, window, slab, roof and finishes) etc. On it load bearing wall consists of brick with mortar or block combined of these three or other material also. In the building if there is no any frame structure then all the load of the building taken by the wall so it called load beating wall.

Function

- Its main function is to resist the entire load which comes over the building and give the bounded structure for the building.
- The load of the roof and other load of floor, slab on it and it transfer to the foundation.
- It's another function is to installed doors and windows on it.
- Due to the load bearing wall its thickness become larger than other wall so, it has more load to the foundation.
- It is also used as partition wall on the building.

b) Non- load bearing wall

When the building is constructed with frame structure. in this type of bldg the wall is known as non- load bearing wall which only takes it self-weight and transfer to

the beam, pillar and at last on foundation on due to the frame structure which take load of roof, slab and other material in which the wall is constructed of frame structure.

Functions ofnon-load bearing wall

- Its main function is only to bound the boundary of building doesn't take any load except own load.
- Its function is less in compared to load bearing due to frame structure.
- In the non load bearing wall its wall thickness is thinner than load bearing wall so, it has less load on the building.
- In the partition of building non lad bearing wall is also.

Partition wall

A partition wall is a wall made by brick stone or other material which main purpose is to divide or separate the room. It is also taken as a non-lad bearing wall because all the lad of the building is taken by main building wall and the partition wall is only constructed inside the building.

Function of partition wall

- Its main function is to divide or separate the room inside building it is also used as to install the door for the room.
- Partition wall is used for the insulation purpose.
- Due to the wall thickness is thin its load is also less than main building wall.

Types of Brick masonry

1. **Stretcher:** A stretcher is the longer face of Brick. It is laid on an stretcher on facing is known as stretcher.
2. **Header:** A header is the shorter face of the Brick.

Types of stone masonry rubble, coursed hammer dressed

a) Rubble masonry

In the rubble masonry the block of stone that are used either undressed or comparatively roughly dressed. The masonry has wide joints, since stone of irregular size are used its types are

i) Random Rubble

ii) Square Rubble
iii) Miscellaneous types
iv) Dry Rubble

a) Ashlarmasonry

Ashlar is finally dressed masonry either an individual stone that has been worked until square or the masonry built of such stone. It is the finest stone masonry unit, generally cuboid or less frequently trapezoidal. It consists of block of an accurately dressed. Stone with extremely fine bed and end point. The blocks may be either square or rectangular shape. The height of block in each course is kept equal or rectangular shape. The height of block in each course is kept equal but it is not necessary to keep all the course of same height. It is sub divided into.

1. Ashlar fine tooled
2. Ashlar rough tooled
3. Ashlar rock, rustic or quarry faced.
4. Ashlar chamfered
5. Ashlar block in course.
6. Ashlar facing

General principle to be observedin stone masonry construction

- The stone used should be strong, tough, hard and should conform with specification of the work.
- The stone used should be free form defect like cracks, flaws (flake) cavities veins, etc.
- Proper Bond should be maintained formation of vertical joint should be avoided.
- Through stone should be used for facing and backing of wall to well bond.
- Double scaffolding should be adopted to carry out the stone masonry construction at higher level (at least at 1.5)
- After the construction is over the whole work should be cured at least for 2-3 weeks.

Damp Proofing

Dampness is the presence of moisture due to hydroscopic or gravitational moisture

on the bldg or any structure. The term damp proofing is treatment given to keep the wall, floor, roof and basement dry and free from any kind of moisture. Dampness gives rise to unhygienic condition and may effect of the different finishes.

b) Source of Dampness

- Ground water (Rising up)
- Air water or Condensation
- Rain water travel from wall top
- Defective junction from wall top
- Defective roof covering
- Faulty design of roof and valley gutter
- Improper rain water collection
- Inadequate roof slope
- Splashing rain water

c) Cause of dampness

i) Moisture rising up on the wall from the ground

Every structure are founded on soil and soil get moisture from the ground water gradually due to capillary action in building or wall get moisture which cause dampness.

ii) Rain travel; from wall top

Rain travel from wall top if wall top are not properly made and protected then the rain water get penetrate inside the wall.

iii) Rain biting against external wall

Due to splashing rain the wall get direct hit by the rain water and may get moisture which may enter inside the wall.

iv) Condensation

Condensation may also get wall dampness due to the condensation water deposited on wall, floor and ceiling cause dampness.

v) Miscellaneous poor drainage

- Imperfect roof slope.
- Poor drainage
- Imperfect orientation
- Defective construction.

Defect of dampness

- Dampness creates unhealthy living condition.
- Wall and ceiling may cause unsightly patches.
- Softening and crumbling of plaster (especially lime, plaster)
- The wall decoration may damage.
- Moisture in the wall may causes efflorescence of brick, stone tiles and may also reduction in strength.
- Flooring material may damaged
- Timber fitting such as door, window etc. Coming in contact with moisture and get deteriorated.
- Electrical fitting may damaged and get short circuit
- Growth of termites.
- Spread the germs and cause a dangerous disease such as TB and also effect for asthma problem.
- Moisture caused rusting, corrosion at metal fitting.

Remedial measures to prevent dampness

1. Use of DPC (DAMP Proof COURSE)

This is the membrane damp roofing consists of course between the source of dampness and the part of building adjacent to it. DPC may consists of flexible material such as bitumen, bituminous felts, plastic or polythene sheet, metal sheet, cement, concrete, etc. It is done throughout the wall and both way of building on the ground level also.

2. Integral Damp proofing

This consists of adding certain water proofing component compound of material to the concrete mixed so that it became impermeable.

3. Surface treatment

It consists of application of layer of water in trapping agent or compound. On these surface through which moisture enter. Pointing and plastering of exposed surface must be done carefully.

4. Cavity wall construction

This is an effective method of damp prevention, in which the main wall is shielded by outer skin wall, leaving cavity between them.

5. Grunting

This consists of depositing under pressure and impervious layer of rich cement mortar over the exposed surface. Cement mortar consist of 1:3 cement and sand mixed which is shot on the clean surface with the help of cement gun under a pressure.

6. Pressure grouting

This consists of facing cement grout under pressure into crack, voids, etc. This method is quite effective in checking the seepage of raise ground water through the foundation and also in super structure.

Materials used for damp proofing

a. Plastic Sheet

Plastic Sheet is used below the ground level to prevent from moisture inside the foundation. Plastic sheet is an impervious material from which moisture cannot transfer from it.

b. Hot Bitumen (Bituminous felt)

Bitumen are the solid material which character is hard in day, soft in hot and no soluble with water so, hot bitumen is spread out through the espoused wall or in between the wallmasonry which is not more than 3-5mm thickness.

c. Metal sheet

Metal sheet are the iron sheet which is also used for preventing seepage of water from ground to the structure wall.

d. Stone Slab

Stone slab are also laid on the masonry at exposed area where can easily raise or penetrate to the wall.

e. Cement concrete (Mortar)

Cement concrete is widely used for the damp proofing in which cement and sand is used.

f. Other material

- Combination of sheet and fest.
- Bituminous felt.
- Brick

3. Learning process and support materials.

Following are the learning process of this unit:

- Group discussion
- Drawing presentation
- Site visit nearby school.

4. Assessment

A. Very short questions answer

1. Define brick
2. What is dampness?
3. Define masonry.

B. Short questions answer

1. What are the types of wall?
2. Explain about function of wall.
3. What are the types of masonry? Explain.

C. Long questions answer

1. Differentiate traditional and modular brick.
2. Explain about the general principal to be observed in stone masonry.
3. What are the defects of dampness? Explain.
4. What makes dampness the structure? Explain.
5. Explain about the source of dampness.
6. What are the remedial measures to prevent dampness? Explain.

5. Glossary

Lap: A lap is horizontal distance between the vertical joint of successive brick work.

Perpend: A perpends is an imaginary vertical line which induces the vertical joint separating two adjoining bricks.

Bed: It is a portion lower surface of the brick which laid flat.

Closer: It is a portion of a brick with the cut made longitudinally and is often used to close of bond at the end of course. It helps in preventing the joints of successive course to come in a vertical line.

Queen closer: It is a portion of a brick with the cut made longitudinally and it has half queen closer and quarter queen closer.

Bat: It is a portion of a brick cut across the width.

Anis: It is an edge of a brick

Bull nose: It is the special molded brick with one edge.

Splay: It is special molded brick which are often used in form plinth. It is special molded brick.

Toothing: Is the termination of a wall in a stepped fashion. It is the termination of wall in such a fashion that each course at the end project.

Damp: Moisture present on any structure.

5. Reference materials

Suggested texts and reference

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Unit 4
CEMENT AND CONCRETE CONSTRUCTION

1. Objective

- To list out the different type of concrete.
- To familiar about the grading of concrete.
- To well know about the mixing of concrete.
- To gather idea about the Batching.
- To familiar with reinforced concrete.

2. Content

Workability of concrete and water cement ratio

The strength of concrete at given edge and cured at a prescribe temperature is assumed to depend primary on two factor water cement Ratio and degree of compaction.

Water cement Ratio

Water cement Ratio is the ratio of cement and is express as the ratio of the weight or volume of water in the concrete mixer. The curve plotted between water cement Ratio and compressive strength indicates that strength of concrete decreases as the water cement Ratio increases.

Note

E.g.: - water cement Ratio

SN	Grade of concrete	Ratio	water cement Ratio
1	m_{10}	1:3:6	0.6-0.65
2	m_{15}	1:2:4	0.55-0.6
3	m_{20}	1:15:3	0.5-0.55
4	m_{25}	1:1:2	0.25-0.5

Workability of concrete

The strength of concrete of given mix proportion is very seriously affected by degree of its compaction. Therefore that the consistence of mixed be such that

concrete can be transported, placed and finished sufficiently, easily and without segregation. It can also be defined as amount of internal work required to fully compacted that the concrete to be optimum density.

Factor affecting work ability

a) W/C

Water cement Ratio is directly proportional to the

b) Size of aggregate

Bigger the size lowers the work ability

c) Shape of aggregate

More rounder more work ability

d) Surface texture of aggregate

Smoother more work ability

e) Grading of aggregate

Well grading improve workability

f) Time

Faster the placement or quicker the time using mixer more the strength of work ability.

Measurement of work ability

a) Slump test

The test is conducted to determine the workability of concrete. It needs simple cone for test. Slump cone is a vessel in the shape of trustum of a cone with diameter at bottom 200mm and 100mm at top and 300mm height. And this test most be done on the impervious platform.

Process

a) It is placed in smooth surface with smaller opening at the top and fills with the concrete in four layers.

b) Each layer is tamped 25 times with the standard bull nose diameter steel rod and top surface is struck with trowel.

c) Immediately after feeling the cone is slowly lifted and the unsupported concrete will now stump the decrease in theheight of the highest.

d) Then keep the mould just side of the sample and measure the height with tape.

Methodsof Mixing of concrete

a) Hand mixing

b) Machine mixing

a) Hand Mixing

Hand missing is the process of mixing the ingredient of concrete by manual, labor. The concrete thus produce is known as hand mixed concrete. The ingredient of mortar are batch by volume or weight and spread on an impervious platform then the dry mix is done properly to make homogenous mixture then, necessary water is sprinkled over the dry mix. The mixture is again turn over two or three times for throughout and even mixing of material prepared mixed should be consumed in 30 minutes after adding water. This method is allowed in case of small work and 10% more cement must be added as specified.

b) Machine mixing

It is the process of mixing the ingredient of concrete by a machine The concrete thus produce is known as machine mixed concrete. Firstly the Batching is done by the volume or weight and out it inside the mixing drum of miser. Then the drum is rotate for 1-2 minutes for each Batch for the homogenous mix and the water is poured inside it and the same Process is done for homogenous mix.

1. Add the water is poured inside it and the same process is done.
2. Generally 4.5 liter of fresh water is required for $0.03m^3$of concrete.
3. Then the concrete mix is poured on the impervious surface and it is transferred to the required side within the 30min of water added to the mixer.
4. Then the mixer should washed and dean after uses.
5. This method is superior than had mix because it doesn't need any additional cement and make the concrete mix homogenous and also a help to increase the strength concrete.
6. It is used where continuous supply of concrete is required for big or important

engineering project.

Bulking of sand

The increase of volume of sand due to presence of surface moisture up to some extent is called bulking of sand while bulking doesn't affect the proportioning of material by weight. The extent of bulking depend on the percentage of moisture present in sand and on its fineness.

Method of determining bulking of sand

- Take a measuring cylinder of about 250 cubic centimeter (C.C)of cup.
- Take sand sample then make the sand damp with water and for both case poured it into the cylinder and note a level as $h_1 h_1$respectively.
- Then add sufficient quantity of water into the cylinder to saturated the sand completely and stir the sample and note level h_2 which is equal to h.
- Then calculate the bulking of sand by (%) bulking sand = $\frac{h_1 - h_1}{h_2} \times 100$

Preparation of concrete

1. Storing of concrete material
2. Batching
3. Mixing
4. Transporting and placing
5. Compaction
6. Curing

1. Storing of concrete material

The course aggregate and fine aggregate should be store in a bin water tight store. The bin may be open or close but it should be construct in such a way that and loading and unloading take minimum amount of time and work.

Now in the case of cement it should be store inside a room where there is no possibility of any moisture contain and direct sunlight.

2. Batching

The measurement of material for making concrete is know as Batching. The following two method of Batching is practiced

a) Volume Batching
b) weight Batching

a) Volume Batching

In this method cement sand and Aggregate are batched by volume. A gauge box is made with wooden plate. Its volume being equal to that of 1 bag cement which is 35 $l$or$\frac{35}{1000}m^3$. The required amountof and aggregate is added by measuring on the boxed as it require.

b) Weight Batching

This is the recommended method of batching A weighting platform is used in thefield to pick up proportion of sand we Batching ismore accurate then volume Batching due to its accurate weight.

1. Mixing

- Hand mixing
- Machine mixing

4. Transporting and placing

After mixing the concrete should be transported to final position in a small work it is transported in a iron pan from hand of a set of workers wheelbarrow and handcraft also may be used in large scale concreting. Belt conveyor or pipe with pump are used in transporting a care should be taken to see that segregation of aggregate and of cement don't take place.

While placing, at first the formwork should be cleaned and smooth if the concrete is to be placed for foundation. The soil bed should be compacted well concrete should be placed or dropped on its final position in the height of not more than 1m. if it is dropped from a height, the course aggregate may segregate. This segregation result concrete weak.

5. Compaction

In the process of placing of concrete, Air is entrapped. This entrapped air reduce the strength of concrete up to 30% Hence, it s necessary to remove this entrapped air. Compaction can be carried out either by hand or with the help vibrator.

a) Hand compaction

In this method, concrete is compacted by ramming. Tamping spading with tools. A pointed wooden rod, steel rod, iron rod of 16 mm diameter which is long in length for compaction concrete in column/pillar.

b) Compaction by vibrator

Concrete can be compacted by using high frequency vibrator vibration reduce the friction between particles and seethe motion of particle. As a result, entrappedair is removed the concrete is compacted. The use of vibrator the compaction time and also help to improve strength of concrete due to its compaction with homogenous vibration should be stopped as soon as cement paste is on the surface of concrete.

6. Curing

Curing may be defined as the process of maintaining enough moisture and temperate condition or freshly placed concrete for some specified time proper hardening of concrete and also for gaining proper strength of concrete curing must be done for 2 weeks which is better to gain good strength. It curing isn't done properly the strength of concrete decreases, crack developed due to shrinkage.

The methods of curing are

a) Sprinkling (of water)
b) wet covering the surface
c) Ponding
d) Application of curing component
e) Sprinkling (of water)
   Wall, column, plaster surface are cured by sprinkling of water with the help of any process as possible.
f) Wet covering the surface
   Column and other vertical surface may be cured by covered the surface with wet bags or sacks or straw.
g) Ponding
   The horizontal surface like slab, floor re cured by ponding the water to a

height of 25-50 mm by providing temporary small hands at the boundary surface so that it can pond the water on it.

h) Application of curing component

The component like calcium chloride may be applied on curing surface. It shows the affinity to the moisture and retain on the surface. It keep the concrete surface wet for a long time.

4.5 Mix design

a. Control mix

b. Nominal mix

It is the methodf selection the amount of suitable ingredient of concrete with the objective of getting economical concrete of certain minimum strength, durability, workability. The main purpose of is design is economize the cost of concrete and gain the desired strength. Types of mix are:

a. Control mix

When the proportion of cement, sand, aggregate and e water established standard relationship then the mix is called control mix and the concrete is called control mix concrete. The basic assumption in the control mix concrete is that compressive strength of concrete is depend almost entirely on the water cement Ratio.

b) Nominal mix

When the proportion of cement (sand, aggregate and the water are adopted by using arbitrary standards then the mix is known as Nominal mix. This method is applied in such work where the quality control requires for control mix is difficult to implement.

INTRODUCTION TO REINFORCED CONCRETE

Concrete is good in resisting compression but very weak in the concrete wherever tensile stress is expected. The best Reinforcement is steal since tensile strength of steal is quite high and bonded between steel and concrete is good. As the force resistance by steal is high for the same extent the force resistance by steal is high compared to concrete. However in the tensile zone hair crack in concrete are unavoidable. Reinforcement are usually in the form of mild steal, Tor steal and TMT steel and steel bars are of 6mm to 32 mm diameter. Now in the concrete Reinforcement is prepared as per design requirement and is kept in a formwork and then wet concrete is removed. The composite materials hardens, the formwork is removed. The composite materials of steel and concrete now called RCC act as a structural member and can resist tensile as well as compressive stresses very well.

1. Properties of RCC

- It should be capable of resisting expected tensile compressive bending and shear forces.
- It should be not show excessive deflection and spoil serviceability requirement.
- When it is fresh, it can be molded to any desired shape and size.
- The hair cracks developed should be within the permission limit.
- It should be fire resistance.
- RCC structure can be designed to take any load.

2. Advantage/use of RCC

It is widely used in bldg material some of the advantage is listed below.

1. Its main advantages is to contract structural element in a building where RCC is used are.
    a) Footing
    b) Column
    c) Beam
    d) Lintel and sill band
    e) Roof and slab

f) Staircase, etc

2. RCC is used for constructing storage structure like
   a) Water tank
   b) Dams
   c) Weir and Barrage
   d) Hydropower Reservoir
   e) Bunker
3. RCC are used for the construction of big structure like
   a) Bridge
   b) Retaining wall (shear wall)
   c) Under water structure
4. it's another advantage which is widely used for pre-casting are electric pole, concrete pipe (hump pipe)
5. RCC is used in cost of tall structure.
   a) Multi storied building
   b) Chimney
   c) Tower/light house
6. It is also used as paving
   a) Road b) Airport

3. Properties of concrete

Concrete has completely different properties when it is in plastic stage and when in harden stage. Concrete in plastic stage is known as green concrete. Properties of wet concrete are:

a) Workability
b) Segregation
c) Bleeding
d) Harshness

1. Workability

This is defined as the case with which concrete can be compacted completely without any segregation and bleeding. It can also be defined as the amount of internal work required to fully compacted to obtain optimum density. It depend the

quantity of water, grading of aggregate. Workability is measured by

a) Slump test which is observed as a slump height.
b) The compaction factor determined after allowing the concrete to fall through the compaction testing machine.

2. Segregation

Separation of course particle from the concrete due to improper placement and proportion of aggregate and vibration. Because of the segregation the cohesiveness of concrete is lost and honeycombing results. Ultimately, it result in the loss of strength of harden concrete. Hence most care is to be taken to avoid segregation.

a) Bleeding

These referrers to the appearance of water along with cement particle on the surface of freshly lay concrete. This happen when there is excessive quantity of water in mix compaction. Bleeding causes the formation of porous and also makes the insufficient cement paste which makes concrete weak. Bleeding can be avoided by controlling the quantity of water and in compaction.

4. Harshness

Harshness is the resistance offered by concrete to its surface fineness. Harshness is due to the presence of less quantity of fine aggregate in sufficient cement and due to use of poor grading of sand and aggregate and also due to the insufficient smooth surface finish so while concreting proportion of cement, aggregate sand and water must be careful.

Properties off dry concrete

- Strength
- Resistance to wear
- Dimensional change
- Durability
- Durability
- Impermeability

1. Strength

The characteristics of strength of concrete is defined as compressive strength

of 150mm size cube after 28 days of curing below which not more than 5% of the test result are expected to fail. The unit of stress is N/mm^2. It 456 grade the concrete based on its characteristics. The strength is shown it table.

Grade	M_{10}	M_{15}	M_{20}	M_{25}	M_{30}	M_{35}	M_{45}
Characteristics	10	15	20	25	30	35	45

2. Resistance to wear

The characteristics of concrete is to resist any kind of physical were and chemical were on the surface of it. However, concrete gain strength after 28 days then only it shows the resistance to wear. After mixing, placing and compaction its surface become smooth and plane as per desire and the curing is conducted for 7 days. Up to this it gain strength 60-65% which may not capable to resistance to wear by physical or chemical.

3. Dimensional Change

Concrete shrinkage with age.The total shrinkage upon the component of concrete, size of member and the environmental condition. The total shrinkage is approximately 0.003 of original dimension. The permanent dimension change due to loading over a long period.Its value depends on the stress in the concrete age of concrete and duration of loading. The size of concrete may also change due to thermal expansion. The coefficient of thermal expansion depends upon the nature of cement types of aggregate water contain and its humidity and the size of section of structure.

3. Durability

Environmental force such as weathering environment condition, freezing, excessive heat may destroy the concrete. The period of exiting of concrete without getting adversely affect. By these force is known as durability. Generally crossing strength of the concrete guide says it durability concrete should have adequate cement contain and should have perfect w/c.

4. Impermeability

This is the resistance of concrete to the flow of water through it pores excessive water during concerting leaves a large number of continuous pores

leading to the permeability. Since the permeability reduce the durability of concrete. It should be kept very low by using perfect w/c, dense and well-graded aggregate, good compaction and continuous curing at low temperature.

5. Learning process and support materials.

Following are the learning process of this unit:

- Group discussion
- Drawing presentation
- Site visit nearby school.

6. Assessment

A. Very short questions answer

1. Define concrete.
2. What is grading of aggregate.
3. Define batching.
4. What is water cement ratio?

B. Short questions answer

1. What are the nominal mix and controlled mix.
2. Explain about the workability of concrete.
3. Explain about the bulking of sand.

C. Long questions answer

1. Differentiate between hand mixing and machine mixing.
2. What are the types of batching? Explain.
3. Explain about the advantage of RCC
4. Explain about the slump test and its uses.

6. Glossary

Air-entraining: Air entrained concrete contain minute air bubble that are distributed uniformly throughout the cement paste.

Aggregate: a mixture of sand, rock crushed stone, expanded materials.

Admixture: an ingredient in concrete other than water, Portland cement and

aggregate used to modify the properties of concrete.

Concrete: Concrete is a combination of cement as a binding agent, chemical additives, water and mineral.

Water cement ratio: the ratio of the weight or volume of water in the concrete mixer

RCC: Reinforcement cement concrete

Mixing: mix together of any two or more ingredient.

Bulking: Increase in volume.

Compaction: making compact and release out the all air entrap.

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ब्यन्जनकार मोहनमान, गाह्रो लगाउने प्रविधि

चौधरी महेश कुमार, गाह्रो लगाउने प्रविधि

EARTHQUAKE

1. Objective

- To familiar about the earthquake.
- To well know about the effect of earthquake.
- To familiar with causes of earthquake.
- To list out the different form of earthquake resistance building.
- To familiar with foundation.

2. Content

Earthquake Introduction

An earthquake is a sudden rapid shaking of the earth surface caused by braking and shifting of rock plate beneath the earth surface. During earthquake ground motion occur in a random manner in all direction radiating from a point within an earth crust called epicenters. It causes vibration of structure and induces inertia force on them. as a result structure may collapse resulting in a loss of property and lives. Earthquake do not kill people, structure do so hence, there is needed of designing of earthquake resistance building structure min a highly seismic zone.

Types of Earthquake

1. Natural earthquake
2. Earthquake due to induce activities

1. National earthquake

a) Natural earthquake may be due to active fault
b) Movement of tectonic plate.
c) Due to volcanic eruption.

a) Active fault

The displacement of rock fault cause earthquake when the earth mass move due to the earth pressure or any natural pressure then it creates displacement of rock and whole plate start to move and cause motion on the surface.

b) Movement of tectonic plate

Moving plate of earth surface provide an expansion for a new settlement. A

relatively simple theory the tectonic plate move towards or upward to each tectonic plate which create seismic activities on the earth. The basic idea is that the earth curst consists of several large and fairly stable slab called plates. These plates are further compared as smaller sub plate which moves throughout the area of such tectonic plate. The plate move against each other with average speed ranging from 1 to 6 cm/years.

c) Due to volcanic eruption

Volcano is a mountain or hill having lava, rock fragmented, hot vapors and gas. Have been erupted from the earth crust occasionally the volcano become active and create earthquake near the mountain.

Seismograph

Seismograph is an instrument for measuring oscillation of earth during earthquake.

It has three major components

1. The sensor
2. The recorder
3. Time

The pendulum mass, string, magnet together constitutes the sensor. The drum pen and chart paper consist the recorder. The motor that rotate the forms at a constant speed forms the timer.

The pen attached to the tip of an oscillating simple pendulum make on the chart paper. The magnet around the string provide the require damping to control the amplitude of the oscillation.

Earthquake magnitude

It is the quantity to measure the size of an earthquake and is independent of the place of the observation. It is a quantitative measure of strength of earthquake would be the same from any seismographic station recording that earthquake. The magnitude of most earthquake is measured on Richter scale the pitcher magnitude is calculate from the completed of the largest seismic waves recorded for the earthquake, on matter what types of wave was the strongest. The magnitude are based on logarithm, scale which means that for each whole number goes up on the

rector scale with logarithm scale base 10 ($\log_{10}$)

Magnitude and effect

Richter	Description	Earthquake effect
<2 (less than 2)	Micro	Micro earthquake not felt
2-2.9	Minor	General not felt but recorded
		Often felt, but rarely cause damages
3.3.9	Minor	General not felt but recorded
		Often felt, but rarelycause damages
4- 4.9	Light	noticeable shaking of indoor
		Items, rattling noises, significant
5-5.9	Moderate	can cause measure damage to
		Poorly constructed building
		Over small building slide damage to
		Well design building at most
6-6.9	Strong	cause destructive in area up to 160 km
7-7.9	Major	can cause seriously damage over
		Large area greater than 160 km
8-8.9	Great	can cause serious damage in area
		100 mile across.Several damage
		in mile across
9-9.9	Epic	never recorded

Earthquake intensity

It is a measure of the effect of an earthquake at a particular place on human and or structure on the earth surface. It is a qualitative assessment of the kind of damage. Intensity is a qualitative measure of the actual shaking at a location during an earthquake. Hence for the same earthquake it has different value at different places;

highest value being at the intensity at a point depends not only upon the strength of earthquake to the epicenter and the local geology at that point. The damage reduces with increase distance from the epicenter for the same earthquake. Earthquake intensity is the violence of an earthquake felt in a particular locality. Intensity is assessed in the term of associated effect and is depend on.

1. Distance from the epicenter
2. Local geological condition
3. Type and quality of bldg
4. Human observation influence by panic and state of after major shock (earthquake)

Effect of Earthquake

The effect of earthquake are as follows

1. Ground shaking
2. Liquefaction
3. Landslide
4. Retaining structure fail
5. Life line hazard
6. Tsunami
7. Fire
8. Ground subsidence
9. Sand blow
10. Surface faulting

1. Ground Shaking

Earthquake shakes ground as well as structure above it and cause them to collapse. Must earthquake relate death are caused by the collapse of structure and construction like as temples, towers, compound wall and other heavy structure (water tank). The following occurrence happens during earthquake on ground.

- The whole building including all component and life be in hazard after ground shaking.
- The earthquake motion result into vibration of building along its all three axis.

- The movement is reversible in direction and the numbers of cycle per second depend on the characteristics of earthquake.
- Inertia forces are created on the masses due to the ground acceleration.

2. Liquefaction

Liquefaction is more likely to occur in loose or moderate or saturated soil with poor drainage such assilt sand or sand and gravel containing impermeable sediment.

During loading usually cyclic on drain loading e.g.: loose sand tends to decreases in volume which produce an increase in their pore water pressure. It depositmost susceptible to liquefaction on young sands silt. Such deposits are often found along river Bed Ocean and area where sand has deposited. It is caused damage to structure in several ways.

1. Building whose foundation on sand which liquefies will be experience as sudden loss of support and irregular settlement of building.
2. **Pipe line and other underground structure may float up.**
3. **Landslide**

   It is a geological phenomenon which includes a wide range of ground mass movement. Including rock falls typically the primary force for a landslide to occur. Though in this case there was another contributing factor earthquake magnitude: often on stable range of hill side and mountain allure. It also causes non- lethal slides on highway and blocks transportation and cause emergency rescue operation.

4. Retaining structure failure

Earthquake cause significant damage to masonry in fill types retaining wall. It was observed that some walls which is not in proportion has major crack and also wall sank into the earth due to insufficient pressure support at its toe (lowermost part of retaining wall)

5. Life line hazard

The great effect on the life line due to earthquake in several conditions. It may blockage the mode of transportation rail road. Pipe line of gas water communication can be disconnected and other basic hazard. It also losses in

economic status and cannot maintain hazard in health. Often thousands of hundreds of residential building can damage and other all daily supply and life style change.

6. Tsunami

Dramatic bi-product of certain type of earthquake is Tsunami. It is termed means harbor wave. Tsunamis are frequently confused with tidal wave but they have nothing to do with tides they are the result of sudden nothing vertical effect in the ocean floor caused by earthquake.

7. Fire

Fire is the indirect result of earthquake caused by broken gas and power line. This induces fire in addition to the damage of building due to earthquake.

8. Ground subsidence

During earthquake, due to ground shaking compaction of soil and rearranged and take of less space. When the volume of soil is reduce in this manner the land is settle down forming a depression. This result falling of land crack formation damage to building, road, bridge, pipe line, etc.

9. Sand blow

In the same case, when the surface is on drain by a saturated san riches layer of soil shaking can cause the expulsion of fluid from the sand layer resulting in large sand blows.

10. Surface faulting

During earthquake there is sometime a discontinuity of movement on the two sides of boundary line consisting of a narrow belt of land. This belt is called fault. Normal fault occur due to tension of over lying block moving.

IMPROVING EARTHQUAKE RESISTANCE OF BUILDING

a) Building configuration
b) Height and no of storey
c) Distribution of load bearing element
d) Location and size of door and window openings.

a) Building configuration

The main consideration to make the building earthquake resistance on building configuration (setting). It explains about its shape, uniformity, simplicity and several blocks they are:

- symmetry
- Regularity
- separation of block
- Simplicity
- Enclosed area

The building as a whole or its variation block should be kept symmetrical about its axis for this a square shaped bldg is most suitable whereas rectangular shape building is also good as long as its length doesn't exceed three time the width likewise regularity also considered in bldg construction.

This irregular shape and many projectionsoccur tensional effect on ground motion and the large bldg must be separated in several block which may be required so as to obtain symmetric and regularity of each block. Ornamentation involving large cornice vertical or horizontal cantilever, face stone like are dangerous and a desirable from a seismic view point. a small building in closer with properly interconnected wall act like rigid box and wall thickness cross wall determine strong and durable and collar beam, column and foundation in a rigid state make bldg seismically strong.

b) Height and no of storey

The height of building in an earthquake is directly considerable to its horizontal force on ground motion. The height of building should not exceed. Three times its width. It is self evident that increasing height increases the earthquake resisting problem. While earthquake motion it vibrate the building and higher the building longer. Its period limiting the height width ratio to 3 or 4 keeps the overturning problems.

a. Distribution of load bearing elements.

Distribution of load in a building plays the vital role to resist the building from earthquake. The load from roof, slab, and wall to the foundation should maintain symmetric and transferred of load must be vertically down wards to beneath of the foundation. The thickness of wall floor/roof slab or truss should have a sufficient bearing to wall and tied properly to prevent from tall and transferred land vertically. In load bearing masonry wall are the main lateral load resistance cement in brick masonry in cement mortar the minimum thickness of wall min ground first and second are 350 mm, 230 mm and 230mm respectively.

And for the foundation it should be design in such a way that the all load coming from the superstructure must resist on it and its width should not be less than 900mm. And the load of wall and the load of wall and after cement must be transferred symmetrically to foundation.

b. Conation and size of door and window opening

Openings are functional necessities in building. However, location and size of opening in wall assume significances in deciding the performance of masonry building. During earthquake shaking inertia force act in the strong direction and in the weak direction it act perpendicular to wall where the opening get most probability to damage. So opening get most probability to damage so opening of window and door from the corner of wall must be of at least 600mm from corner of the gap between the window and door must be of greater than the 0.25 height of door.

Door and window

In load berating wall wall are the main lateral load resistance element, Door and windows are the voids in wall that makes walls weaker. Therefore their size and location need to be carefully decided and constructed. Opening from close to wall corner hamper the flow of forces from one wall to another further, large opening weaken walls from carrying the inertia force in their own plane. Thus it is best to keep all openings as small as possible. Requirement for openings in wall as provisioned under NBC.

1. Any opening in the wall should be small in size and centrally located and

away from inside corner by a clear distance equal to at lest $\frac{1}{4}$ of the height of the opening but not less than 600mm.

2. The total length of opening in a wall is not to exceed 50% of the length of the wall between consecutive cress wall in single storey 42% in two storey and 33% in three storeys.
3. The horizontal distant between two openings is to be not less than one half of the height of the shorter openings but not less than 600m.
4. The vertical distance from one opening to another opening directly above it shall not be less than 600mm.
5. It the vertical opening of the wall is more than 50% of the wall height vertical bars shall be provided in the jams
6. Door window opening attached to wall junction also increase weakness of the building. Opening shall be provided either at a distance such that,
   P_1> 0.25h
   P_2> $0.25h_2$
   P_3> $0.25h_2$ or at least 600mm from the wall junction.

Band

It is the RCC band which is constructing throughout the wall length and width of minimum thickness is 75mm and at least two bars of 8mm diameter and they should be tied with steel limbs of 6mm diameter at 150mm center to center spacing if the wall size is large and vertical band also may be provided.

Types of band

There are four types of bands in a typical masonry building which are named after location in the building they are:

1. Gable band

The gable band is employed only in buildings with pitched or sloped roofs.

2. Roof band

In bldg with flat reinforced concrete or reinforced bricks roofs, the roofs band is not required because the roof slab also plays the role of a band, however, in building with flat timber or CGI sheet roof band need to be provided.

3. Lintel band and sill band

The lintel band and sill band is the horizontal band constructed throughout the wall just above and below the level of window. It is the important of all and need to be provided in almost all bldg. The lintel and sill band ties the wall together and creates a support for walls loaded along weak direction from walls loaded in strong direction. These bands also reduce the unsupported height of the walls and hereby improve their stability in the weak direction.

4. Plinth Band

Plinth band are primarily used there is concern about uneven settlement of foundation soil. And it is also constructed throughout the area of the wall both length and width. And it is connected to the column also so that it can transfer the load equally throughout all the foundation equally.

1. What do you mean by seismic zone? In which seismic zone Nepal lies?

Bar Bending

When the length of the bar is insufficient as per design in the beam and slabs the bar bended is provided. It is also called anchored bar which is kept in bent of angle $90^0, 270^0$ and $30^0 to\ 60^0$as per required. There is several reasons for bending bars

a) Where anchorage cannot be provided to straight length with on the available concrete shape.

b) When continuity of strength is required between two intersections on concrete. The member bar will be blended.

c) When tie like stirrups enclose longitudinal bar in a beam or column, the bend is provided at angle 30^0or not more than 45^0

Types of foundation

- Shallow foundation
- Deep foundation

Shallow foundation

The features of shall foundation are as follows

1. The depth of foundation is less than or equal to its width.
2. It is placed immediately beneath the lowest part of super structure.

3. It is spread more horizontal than vertical.
4. It transfers the load to sub soil at a shallow depth close.

Types of shallow foundation

1. Spread footing
2. Strip footing
3. Mat footing
4. Grillage footing

1. Spread footing

In this type of foundation, the base is made wider than the top so as to distribute the load from the superstructure over a large area. This type of foundation is commonly used for wall and masonry column. These foundations are built after opening the trench to required depth. These foundations are in suitable depth and they are grouped under shallow depth. Before starting the masonry PCC is provided.

Types of spread footing

a) Isolated footing

If separate footings are provided for each column, it is called isolated footing. The size of footing is based on the distribution of load and soil type and the thickness may be uniform or varying.

b) Combine footing

In combine footing, two or more column are supported by a single base. This type of footing is necessary when a column is much closed to each other and near to the boundary hence, there is no scope to project footing. The two columns may or may not be connected by a strap beam.

Grade of Aggregate

M_{25} =1:1:2 (It is used in bridge)

M_{20} =1:1.5:3 (It is used for high grade project like hospital, Apartment)

M_{15} =1:2:4

M_{10} =1:3:6 (It is used for normal Residential building)

Types of cement

OPC (Ordinary Portland cement)

PPC (PozzalanaPortland cement)

RCC (Reinforcement Cement Concrete)

PCC (Plain Cement Concrete)

Constitute of cement

a. lime

Material used for $1m^3$ Aggregate (1:3:6)

Solution

Unit=$1m^3$

Dry mixed (increase 50 to 60%) = $\frac{55}{100} \times 1 + 1$

$= 1.55m^3$

Total Proportion = 1+3+6=10

Required quantity of cement =$\frac{1.55}{10} = 0.155m^3 \times 28.8$

$= 4.464m^3$

Required quantity of sand = 0.155×3

$= 0.465$

Required quantity of sand aggregate = 0.155×6

$= 0.93$

W/C = 0.6

$W = 0.6 \times 4.464 \times 50$

$= 133.92l$

1. No of Bricks and other materials in $1m^3$ Brick masonry

Unit = $1m^3$

Nominal size of brick = $(230 \times 110 \times 55)\ mm$

Add 10% for mortar = $(240 \times 120 \times 65)\ mm$

No of Brick = $\frac{1}{0.24 \times 0.12 \times 0.065}$

= 534 nos

Add 5% for wastage then no of brick = $534 + \frac{5}{100} \times 534$

= 561nos

Volume of mortar = 1-(561× $0.23 \times 0.11 \times 0.055$)

= $0.22m^3$

Mortar proportion = 1+4=5

Cement required = $\frac{0.29}{5}$ = $0.058m^3 \times 28.8\ bags$

= 1.65 bags

Sand required = 0.085× 4

= 0.232

W/C = 0.8

Water = $0.8 \times 1.65 \times 50$

= $66l$

If proportion is 1:3

Mortar proportion = 1+3=4

Cement required =$\frac{0.29}{4} = 0.0725 \times 28 = 2.03\ bag$

Sand required = 0.0725 X 3= $0.217m^3$

W/C = 0.8

Water = $0.8 \times 2.03 \times 50$

= $81.2l$

d. Continuous footing

If a footing is common to more than two column in a row is called continuous footing. This type of footing is necessary if the columns in a row are close of if bearing capacity of soil is low.

2. Strip Footing

Strip footing is in depended footing of two columns connected by a beam to each other where the bearing capacity of soli is very poor. In this case strip footing is provided the load of the structures is through walls then also such footing is provided. In the case of boundary construction of footing the eccentrically loaded column footing with the help of beam.

3. Mat footing

If the load on the column is quiet high or when the bearing capacity of soil is

very low and the size of isolated column may work out to be to such extent that they overlapped each other and the load of such building can't resist by isolated footing in such case mat and raft foundation is provided. In this footing the whole footing area is made one isolated footing of mat in its desired thickness. The advantage of such footing is settlement is uniform and hence, unnecessary stresses are not produced.

4. Grillage foundation

High rise buildings are built with steel column in case of concrete such columns carry very heavy load and hence they need very special foundation to spread out load to the large area of soil. Sp, Grillage foundation is one such special foundation which is used where, the load of the structure is excessive and the bearing capacity of soil is very poor and the deep foundation is not possible. It consist of I section steel beam and Chanel section or I section are used for beam. All the floor load, beam load are transferred to the base plate which is constructed at the base of the foundation. To rest all the base plate, column it is constructed of a isolated footing inside the foundation and all other beam Chanel section are rest one it.

Deep foundation

Deep foundation is those for which depth of the foundation is more than the width of foundation. The foundation is driven deep into the ground till it reaches ma hard strata or compacted soil. This is preferred where the soil strata at the surface are not good for the bearing capacity of heavy structure of building and the bearing capacity of soil is very low and the soil contained more sand.

Necessity of deep foundation

a) Deep foundation when strata having more sandy and the bearing capacity of soil is unsuitable so the foundation of structure has to take deep with the purpose of attending or suitable bearing capacity of strata.

b) To ensure stability of structure eg. The foundation a bridge must be placed very deep. Although suitable bearing strata may exist at a higher level.

Type of Deep foundation

Pile is the pile like structure driven deep into the ground to increase the strength of soil when the pile is driven it make soil compacted inside the ground and make soil strata well compacted and strong. It act as support to the spread footing piles are driven along the ground throughout the area of foundation or individually a one foundation. Piles are made precast or formed insitu by excavating a hole and then filling it with concrete. A group of pile is driven to the required depth and isolated foundation, mat or raft foundation is constructed over it and superstructure is constructed. In this way pile foundation transferred the heavy load to the very depth of the foundation and also this foundation is used where the water logged soil is presence.

1. Caissons or well foundation

It is the water tight box structure of concrete. This foundation is mostly used in the bridge. It is constructed inside the ground level. In the shape of box inserted open the caissons. It is made of concrete which is used for the water logged area which provides resist to flow of water inside the foundation. If it occurs water movement inside the foundation. Water may flow clay particle of the soil which makes soil strata weak in the deep foundation well foundation is constructed throughout the area of the foundation and also it make the soil more compacted and increase bearing capacity. Above the well foundation other all structure like instated footing, super structures is built over it.

Cause of foundation failure

The foundation with fail or collapse due to the following reasons

- Unequal settlement of soil beneath the area of building.
- Unequal settlement of masonry work inside the building.
- Due to the unequal load distribution to the footing level.
- Shrinkage and cracks are formed in the soil particle which causes due to the movement of water in different weather.
- Lateral escape of soil below the foundation due to the lateral movement of water.
- The foundation may also fail due to the natural disasters like landslide earthquake.
- It also fails due to the collapse of retaining wall and cause soil erosion on the

foundation level.

Precaution against failure/ (Remedial measures)

- To prevent the unequal settlement of soil, choose the right place and soil test before construction of structure.
- To prevent the unequal settlement of foundation the foundation selection as per its soil type and proper material should be used.
- The unequal settlement of masonry can be prevented by using stiff mortar and avoiding construction the wall greater than 1.5m in height per day.
- In some soil condition the sub soil moisture may dried up during not weather and cause shrinkage in such case driven the pile up to hard strata.
- The lateral pressure on the sub structure can cause tilting overturning of foundation. This can be prevented by providing sufficient area below the wall and column.
- The lateral scope of support in material like soil. Retaining wall can be prevented by confining the soil by driving sheet pile around the foundation.

6. Learning process and support materials

Following are the learning process of this unit

- Group discussion
- Drawing presentation
- Site visit nearby school

7. Assessment

A. Very short questions answer

1. Define earthquake.
2. What is earthquake magnitude?
3. Define earthquake intensity.
4. What is band?
5. Define foundation.

B. Short questions answer

1. What are the causes of earthquake?
2. Explain about seismicity of Nepal.
3. What are the Ground effects of earthquake?

C. Long questions answer

1. What are the effects of earthquake? Explain.
2. Explain about the seismic hazard of Nepal.
3. What are the causes of failure of Building?
4. Explain about the building Configuration for earthquake resistance.
5. Explain about the types of foundation.

8. Glossary

Focus– The point on the fault where slip start is the fours. It is also known as Hypocenter.

Epicenter- The point vertically above the focused on the surface of the earth is called epicenter.

Focal depth- The depth of focus from the epicenter is called focal depth.

Epicenter distance – Distance from epicenter to any point of interest on the surface of the earth is called epicenter distance.

Body wave- A seismic wave that travels through the interior of the earth and is not related to a boundary surface is called body wave.

Elastic wave – A wave that is propagated by some kind of elastic deformation that is a deformation that disappears when the force are removed.

Foreshock- A small shocks that commonly precede a large earthquake or main shock and that originate near the focus of the large earthquake foreshock are important for earthquake called predication.

Aftershock- An earthquake that follows a large magnitude called main shock and originates in around the rupture zone of main shock. Generally major shock mare followed by a number of aftershock which shows a decreasing trend in magnitude and frequency with time.

7. Reference materials

Suggested texts and reference

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ब्यन्जनकार मोहनमान, गाह्रो लगाउने प्रविधि

चौधरी महेश कुमार, गाह्रो लगाउने प्रविधि