Module:2

TITLE:DRAWINGS RELATED TO DIFFERENT BUILDING ELEMENTS LEARNING OBJECTIVES:

- To draw the drawings of masonry wall footing and RCC column footing (isolated).
- To know the reinforcement details of RCC column footing (isolated).
- To study the detailing and drafting of stair cases.
- To study the reinforcement details of lintel and chhajja
- To know different types of slabs and beams.
- To know the detailing of slabs and beams.

AIM:

- To prepare the drawings of cross section of masonry wall and RCC column (isolated) foundation.
- Computer with AutoCAD software.

THEORY / HYPOTHESIS:

- Most of the structures built by us are made of reinforced concrete. Here, the part of the structure above ground level is called as the superstructure, where the part of the structure below the ground level is called as the substructure. Footings are located below the ground level and are also referred as foundations. Foundation is that part of the structure which is in direct contact with soil. The R.C. structures consist of various structural components which act together to resist the applied loads and transfer them safely to soil. In general the loads applied on slabs in buildings are transferred to soil through beams, columns and footings. Footings are that part of the structure which are generally located below ground Level. They are also referred as foundations. Footings transfer the vertical loads, Horizontal loads, Moments, and other forces to the soil.
- **Masonry wall foundation:** If you want a well built, sturdy brick wall, you must have a strong footing for proper support. Without a strong footing, the moisture from the ground will encourage your brick wall to crack. The footing should extend below the frost line. If your wall is a load bearing wall, your footing must be as deep as the wall is wide, and the width of the footing should be twice as wide as the wall.
- **RCC columns (Isolated):** Isolated column footings are the footings which are provided for each column. This type of footing is chosen when SBC is generally high, columns are far apart, and loads on footings are less. The isolated footings can have different shapes in plan. Generally it depends on the shape of column cross section. The isolated footings essentially consist of bottom slab. The bottom slab is reinforced with steel mesh to resist the two internal forces namely bending moment and shear force.

- Stairs consist of steps arranged in a series for purpose of giving access to different floors of a building. Since a stair is often the only means of communication between the various floors of a building, the location of the stair requires good and careful consideration. In a residential house, the staircase may be provided near the main entrance. In a public building, the stairs must be from the main entrance itself and located centrally, to provide quick accessibility to the principal apartments.
- **Types of stair cases**

Geometric classification;

1. Straight stairs (with or without intermediate landing).
2. Quarter turn stairs.
3. Dog legged stairs.
4. Open well stairs.
5. Spiral stairs.
6. Helicoidal stairs.
7. Slabless stair case.
8. Free standing stair case.

- **Lintel:** A lintel can be a load bearing building component, a decorative architectural element, or a combined ornamented structural item. It is often found over portals, doors, windows, and fireplaces. A lintel is defined as a structural horizontal block that spans the space or opening between two vertical supports.
- **Chhajja:** A chhajja is the projecting or overhanging **eaves** or cover of a roof, **usually** supported on large carved brackets.
- **Slab:** A slab is a flat two dimensional planar structural element having thickness small compared to its other two dimensions. It provides a working flat surface or a covering shelter in buildings. It primarily transfer the load by bending in one or two directions. Reinforced concrete slabs are used in floors, roofs and walls of buildings and as the decks of bridges.
- **Beam:** A structural member that support transverse (perpendicular to the axis of the member) load is called a beam. Beams are subjected to bending moment and shear force. Beams are also known as flexural or bending members. In a beam one of the dimensions is very large compared to the other two dimensions. Beams may be of the following types:
  a.Singly or doubly reinforced rectangular beams,
  b.Singly or doubly reinforced T beams,
  c.Singly or doubly reinforced L beams.

The drawings of different components of a building are to be prepared for the data given using AutoCAD software.

A. Cross section of masonry wall foundation, RCC columns with isolated and combined footings

Exercise 2.1

Draw a cross section of a S.S. Masonry foundation to be provided for a load bearing wall 300mm thick in Burnt Brick Masonry in superstructure of a residential building. Use following data:

i. Width of foundation = 1.20m
ii. Depth of foundation below GL = 1.20m
iii. Width of PCC = 1.20m
iv. Thickness of PCC in 1:3:6 = 75mm.
v. Width of first footing above PCC = 1.05m
vi. Depth of first footing above PCC = 0.375m
vii. Width of second footing = 0.90m
viii. Depth of second footing = 0.375m
ix. Width of third footing = 0.75m
x. Depth of third footing = 0.375m
xi. Width of plinth wall = 0.45m
xii. Depth of plinth wall = 0.60m
xiii. Thickness of DPC in 1:2:4 = 100mm.

Solution: Refer Fig. 2.1

Exercise 2.2

Draw a cross section of a S.S. Masonry foundation to be provided for a partition wall 150mm thick in Burnt Brick Masonry in superstructure of a residential building.

Solution: Refer Fig. 2.2

Exercise 2.3

Prepare a working drawing for an isolated column footing (RCC) for a column size 300mm x 300mm reinforced with #8 of 12mm HYSD- steel as main bars together with 2 legged 8ϕ stirrups at 200c/c.

Details of footing: Size of footing is 1.6m x 1.6m and the thickness of the footing at the face of the column is 450mm which reduces to 300mm at the edge of footing. The mat comprises of 10ϕ TOR- steel at 100 c/c both ways. The footing is provided with PCC bed in 1:3:6 of thickness 75mm.Depth of foundation is1.5m from natural ground level.

Solution: Refer Fig. 2.3

Exercise 2.4

Prepare a working drawing for an isolated rectangular RCC column and footing has the following details:

Column size: (400 x 600) mm.

Size of footing: 2m x 3m of uniform thickness 450mm.

Depth of foundation below GL = 1.5m

Height of column to be shown above GL = 1.0m

Thickness of PCC bed in 1:3:6 = 75mm

Details of reinforcement:

Column: #8 - 16ϕ as main bars with 2L - 8ϕ @ 150 c/c lateral ties

Footing: Longer direction steel - 12ϕ @ 130 c/c

Shorter direction steel - 12ϕ @ 220 c/c.

Solution: Refer Fig. 2.4

Exercise 2.5

Draw plan, sectional elevation and cross section of a slab type combined footing with the given details:

Size of columns = (400 x 400)mm

Size of footing =2m x 4m

Depth of footing = 600mm

Centre to centre distance between the columns =

2m Thickness of PCC bed in 1:3:6 = 100mm

Column reinforcement details – longitudinal steel of #8 - 20ϕ with lateral ties of 2L - 8ϕ @ 200 c/c

Footing reinforcement details – bottom reinforcement of 12ϕ @ 100 c/c both ways and top reinforcement of 12ϕ @ 150 c/c both ways

Solution: Refer Fig. 2.5

B. Different types of bonds in brick masonry

Exercise 2.6

Draw two consecutive courses for corner joints of the following walls in English bond.

(a) One brick thick wall i.e., 200 x 200

(b) One and half thick wall i.e., 300 x 300.

Solution: Refer Fig. 2.6a for one brick thick wall Refer Fig. 2.6b for one and half brick thick wall **Exercise 2.7**

Draw plan of two consecutive courses for corner joints of the following walls in Double

Flemish bond.
(a) One brick thick wall i.e., 200 x 200
(b) One and half thick wall i.e., 300 x 300.

Solution: Refer Fig. 2.7a for one brick thick wall Refer Fig. 2.7b for one and half brick thick wall **Exercise 2.8**

Draw plan and elevation of two alternate courses of a one brick thick wall in Header bond.

Solution: Refer Fig. 2.8

Exercise 2.9

Draw plan and elevation two alternate courses and elevation of a half brick thick wall in Stretcher bond.

Solution: Refer Fig. 2.9

C. Different types of staircases Exercise 2.10

Draw plan and sectional elevation of RCC dog legged staircase for an office building which measures 3m x 5.5m. The vertical distance between the floor is 3.3m (including landing). Thickness of the floor slab is 150mm. Provide steps with tread of 300mm and rise of 150mm. Thickness of waist slab and landing slab is 150mm. Width of stair is 1.5m. Reinforcement details: main steel: 10ϕ @125 c/c spacing and distribution: 8ϕ @ 250 c/c spacing.

Solution: Refer Fig. 2.10

Exercise 2.11

Draw plan and sectional elevation of an open newel stair with a rectangular well for an office building with the following data:
Inside dimensions of staircase = 4.5m x 5.4m.
Height between the floors is 3.6m.
Thickness of the floor slab and landing slab is 150mm. Width of landing=1.5m.
Width of stair = 1.5m.
Tread=300mm, riser=150mm.
Waist slab thickness = 150mm.
Reinforcement details: Main steel:12ϕ @150 c/c spacing and Distribution: 8ϕ @ 250 c/c spacing.

Solution: Refer Fig. 2.11

D. Lintel and chejja

Exercise 2.12

Draw the longitudinal section and cross section of RCC lintel monolithically cast with sunshade from following data:
Projection of the sunshade from the face of the wall = 600mm
Thickness at fixed end = 150mm
Thickness at free end = 75mm
Main tensile bars: 8ϕ @ 150 c/c
Distribution bars: 8ϕ @ 200 c/c
For RCC lintel (200 x 200)mm with #4 - 12ϕ at tension zone and stirrups of 2L - 8ϕ @ 150 c/c. The sunshade provided over a 3m wide window.

Solution: Refer Fig. 2.12

Exercise 2.13

Sketch the reinforcement details for the lintel beam with chejja for 3m wide opening. Size of lintel beam (300x300)mm. Lintel is provided with #5 of 12ϕ bars in tension zone

and 2 legged vertical stirrups of 8ϕ at 150 c/c.
Chejja details: projection- 1m; thickness at supports- 110mm and at end- 90mm; main steel provided is 12ϕ @ 150 c/c and distribution steel 10ϕ @ 150 c/c.

Solution: Refer Fig. 2.13

E. RCC slabs and beams

Exercise 2.14

Draw the longitudinal section and cross section of a rectangular RCC beam simply supported with the following data:
Clear span = 4.8m
Bearing at the supports = 300mm
Width of beam = 300mm
Overall depth of beam = 500mm
Main reinforcement consists of #5 - 20ϕ bars in two layers.
Provide #2 - 12ϕ as anchor bars.
Stirrups: 2L 8ϕ @ 180 c/c near the supports up to 1.20m and @ 220 c/c in the remaining portion.

Solution: Refer Fig. 2.14

Exercise 2.15

Draw a detailed longitudinal section, a cross section near the supports and a section at the middle of the span of a simply supported doubly reinforced beam for the following data:
Clear span = 5.4m
Bearing over the supports = 300mm
Size = 300 x 800 mm
Main reinforcement tensile: #7 - 25ϕ. 4 straight and 3 bent up @ 1400mm from support.
Compression reinforcement: #4 – 25ϕ.
Spacer bars=25 ϕ
Side face reinforcement=#2-12ϕ
Shear reinforcement: 2L - 12ϕ @ 150 c/c for a distance of 1.5m from the support and 2L - 12ϕ @ 300 c/c for remaining middle portion.

Solution: Refer Fig. 2.15

Exercise 2.16

Draw longitudinal section and cross section of a cantilever beam from the following data:
Clear projection from the face of RCC column = 2500mm Size of column = 300mm x 300mm
Size of beam at fixed end = 300mm x 300mm
Size of beam at free end = 300mm x 150mm
Reinforcement main bars: #5 - 20ϕ with 2 bars curtailed at 1500mm from the support and show the curtailment plan.
Compression bars: #3 - 16ϕ
Stirrups: 2L - 6ϕ @ 200 c/c up to 1000mm from support and @ 300 c/c in remaining length.

Solution: Refer Fig. 2.16

Exercise 2.17

Draw cross section and plan of one way roof slab showing the details of reinforcement for the following data:
Clear span = 4m
Length of slab = 10m

Thickness of slab = 130mm
Bearing wall = 200mm
Main reinforcement: 12ϕ @ 250 c/c with alternate bars bent up.
Distribution reinforcement: 8ϕ @ 200 c/c.
Solution: Refer Fig. 2.17

Exercise 2.18

One way continuous slab has been provided for a hall of clear dimensions 8mx14.25m.The slab is supported on RCC beams. The following details are given.
C/C distance of supporting beams=3.5m.
Column dimensions on which beam rest=250mmx500mm.
C/s of beams=250mmx600mm.
Slab thickness=150mm.
Beam depth is inclusive of slab depth.
Main positive reinforcement at the end and interior panels=10ϕ @120 c/c
Main negative reinforcement at all supports= 10ϕ @120 c/c.
Distribution steel =8ϕ @ 250 c/c.
Draw cross section and plan showing the details of reinforcement (Bottom & top).
Solution: Refer Fig. 2.18

Exercise 2.19

A simply supported two way slab is supported on all sides by using 230mm thick wall. The dimension of two-way slab is 3m x 4m (Clear). Following are the reinforcement details:
Along shorter span: 10ϕ @125 c/c.
Along longer span: 10ϕ @150 c/c.
Negative steel for shorter span: 10ϕ @250 c/c.
Negative steel for longer span: 10ϕ @300 c/c.
Alternative bars are cranked.
Corner mats are 8ϕ @150 c/c along shorter span and 8ϕ @200 c/c along long span.
Thickness of slab is 150mm.
Draw plan showing reinforcement and cross section along longer & shorter span. ***Solution: Refer Fig. 2.19***

F. Cross section of pavement

Exercise 2.20

Sketch the cross section of a flexible pavement having the following particulars:
Width of carriage way = 3.75m
Camber (@ 2%) = 38mm
Width of Shoulder = 1.5m
Granular sub-base (GSB)thickness = 300mm
Base course thickness = 225mm
Thickness of Binder course = 70mm
Thickness of Surface course = 40mm
Total thickness of the pavement = 635mm.
Solution: Refer Fig. 2.20

Exercise 2.21

Sketch the cross section of a rigid pavement in heavy rainfall area having the following particulars:
Width of carriage way = 3.75m
Camber (@ 2%) = 38mm
Width of Shoulder = 1.5m
Granular sub-base (GSB) = 250mm thick

Dry lean concrete sub-base = 150mm thick
Paving Quality Concrete layer = 240mm thick
Total thickness of the pavement = 640mm.

Solution: Refer Fig. 2.21

G. Septic tank and sedimentation tank

Exercise 2.22

Draw plan and cross section of the septic tank for 25 users. The details are given below:
Size (clear) of the septic tank (L x B) = (2m x 0.9m)
Depth of liquid = 1.4m
Free board = 0.3m
Thickness of PCC bed in 1:3:6 = 0.2m
Inlet and outlet pipe: 100mm diameter S. W. pipe
Thickness of brick wall up to 0.6m height is 300mm and for remaining height it is 200mm.
Thickness of RCC Baffle slab = 40mm
RCC slab of 75mm thick is provided with 50mm diameter C. I. ventilating pipe
Bed slope: 1 in 20

Solution: Refer Fig. 2.22

Exercise 2.23

Draw the cross section of the peripheral feed circular sedimentation tank mechanical sludge removal equipment for given data.
Diameter of the tank = 17.5m
Depth of the tank = 3.0m
RCC wall & slab thickness = 200mm
Diameter of influent pipe, effluent pipe and sludge pipe = 200mm.
Bed slope=8%.
Thickness of RCC Baffle slab = 40mm.

Solution: Refer Fig. 2.23

H. Layout plan of rain water recharging and harvesting system Exercise 2.24

Draw a layout plan of rainwater harvesting and recharging system for a (9 x 12)m area residential building leaving setback of 1.20m on all four sides as per bye laws. Show a cross section details for recharging pit.

Solution: Refer Fig. 2.24

I. Cross sectional details of a road for a residential area with provision for all services

Exercise 2.25

Draw the cross sectional details of a road for a residential area with provision for all services.

Solution: Refer Fig. 2.25

J. Steel truss (bolted connections)

Exercise 2.26

Draw the elevation of the given steel roof truss and show the connection details at joint A and E using the data given in figure.
i. 8mm thick gusset plate
ii. Use 2 numbers of 12ϕ HSFG bolts for each connection
iii. Truss is supported on a concrete column of size (500 x 500)mm
iv. Thickness of the base plate = 25mm
v. Anchor bolts of 450mm length and 25ϕ – 8 numbers at the connection of truss and column.

Solution: Refer Fig. 2.26

LEARNING OUTCOMES :

- Knowledge in drawing and calculating stair cases , slabs, footing and Combined footing.
- Also in gaining knowledge about cross section of pavement and Steel truss.

APPLICATION AREAS:

- Drafting , Modelling of the above said drawings.
- Detailing of Slabs, Beams Chejja and footings .

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