# CE 316
# CONCRETE STRUCTURES DESIGN SESSIONAL-1

## Session: January 2020
## Section: C2

**COURSE TEACHERS**

1. Dr. Shohel Rana,
   Associate Professor

2. Ahmed Farhan Ahnaf Siddique,
   Lecturer

**COURSE OUTLINE**

**1.50 credits, 3 hrs/week**

Analysis and design of low-rise masonry buildings; problems based on CE 315; design of slab bridge; design of balanced cantilever bridge.

**DEPARTMENT OF CIVIL ENGINEERING**

**BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)**

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   Lecturer

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# COURSE OVERVIEW

## Topics

1. Low-rise Masonry Building for Gravity Loading
2. Slab Bridge
3. Balanced Cantilever Bridge

## Activities

- Lecture
- Lab report
  a. Design calculations
  b. Drawings
- Class assessment
- Site visit
- Poster Presentation
- Viva
- Quiz

## Marks Distribution (Tentative)

| | | |
|---|---|---|
| 1. | Attendance: | 10% |
| 2. | File and Class Assessment: | 30% |
| 3. | Site Visit (plus report): | 05% |
| 4. | Poster: | 05% |
| 5. | Viva 1 and Viva 2: | 5+5 = 10% |
| 6. | Mid and Final Quiz: | 20+20 = 40 % |

**Total = 100 %**

**Course Outcomes (COs):**

At the end of the course a student should be able to:

| | | |
|---|---|---|
| CO1 | **identify** the structural elements of a low-rise masonry building, slab bridge and balanced cantilever bridge. | C1 |
| CO2 | **analysis** and **design** of various structural components of low-rise building, slab bridge and balance cantilever bridge for gravity loading. | C4,C6 |
| CO3 | **generate** the detailing of various structural components of low-rise building and bridges. | C6 |

# DESIGN OF A MASONRY BUILDING FOR GRAVITY LOADING

## Tentative Lecture Plan

| Lecture | Topic |
|---|---|
| 1 | Course Overview<br>Introduction to Masonry Building, Building Details |
| 2 | Analysis and Design of Slab |
| 3 | Analysis and Design of Beam |
| 4 | Design of Lintel, Sunshade and Stair |
| 5 | Analysis and Design of Brick Wall<br>Analysis and Design of Brick Wall Footing |

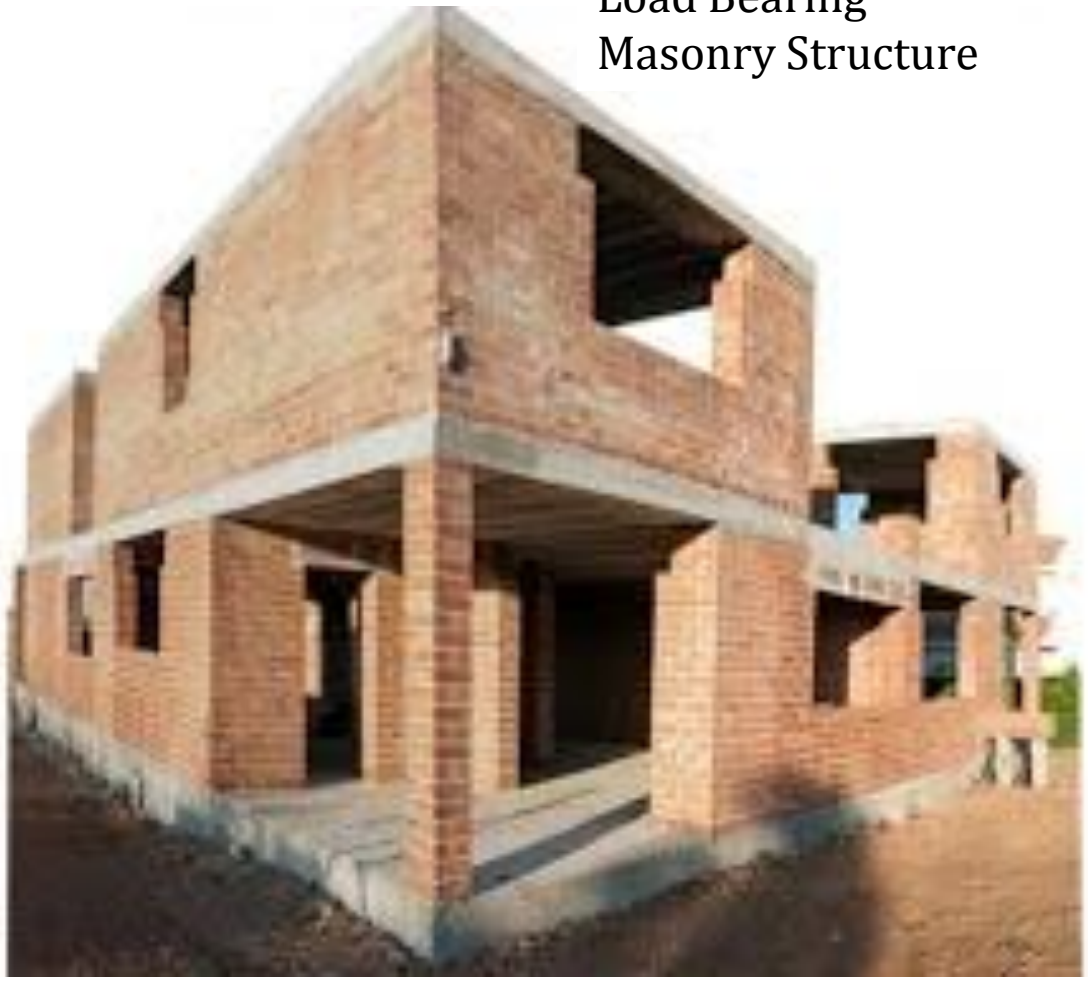
# DESIGN OF A MASONRY BUILDING FOR GRAVITY LOADING

## Outline of the lecture

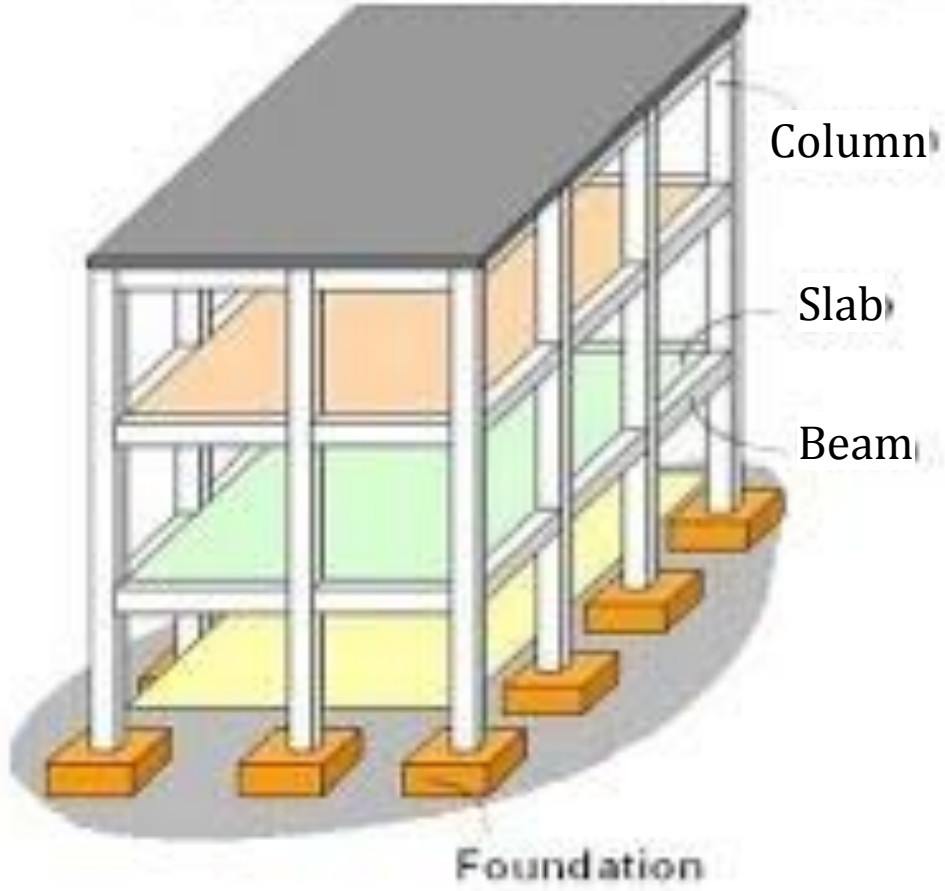
1. Introduction to Load Bearing Masonry Building and its Structural Components
2. Details of the Building to be Designed
3. Design and Drawing Items

# Load Bearing Masonry Structure and RC structure

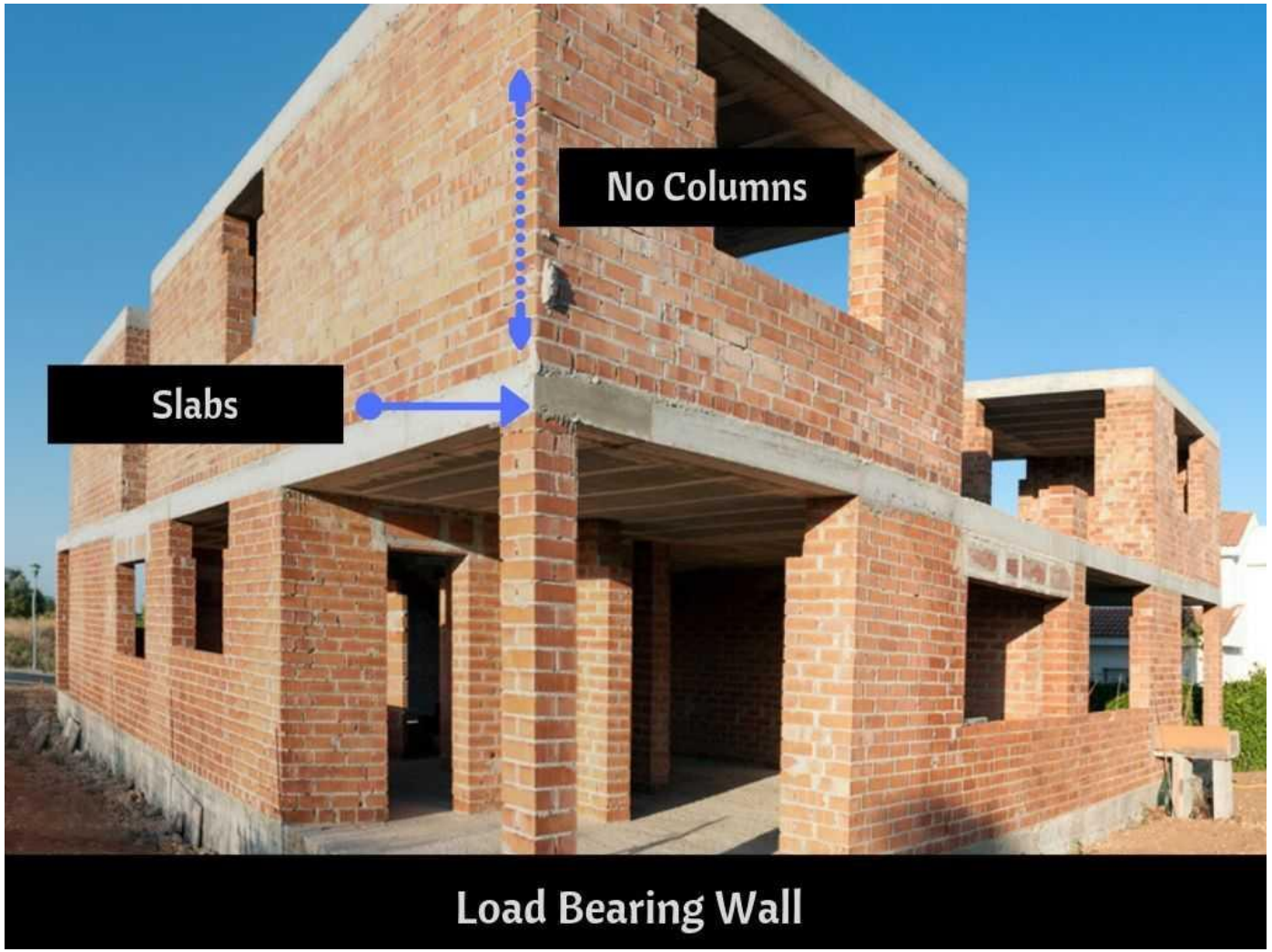
Load Bearing
Masonry Structure

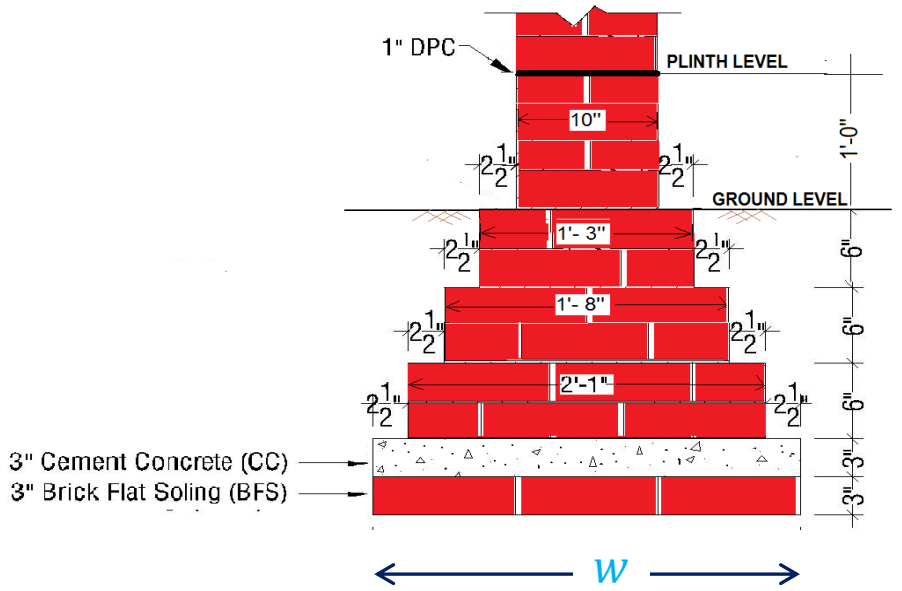


RC Structure



# Load Bearing Masonry Structure

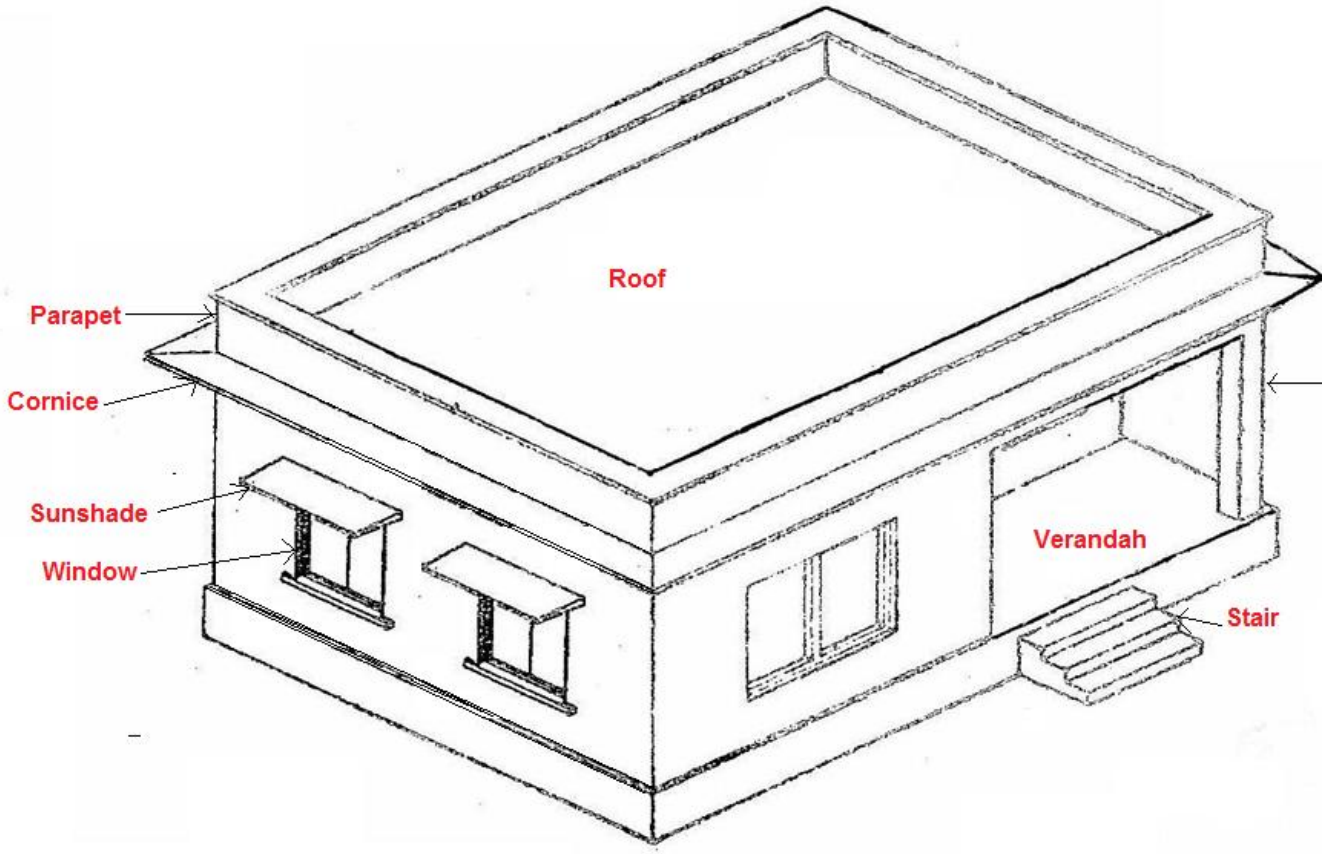


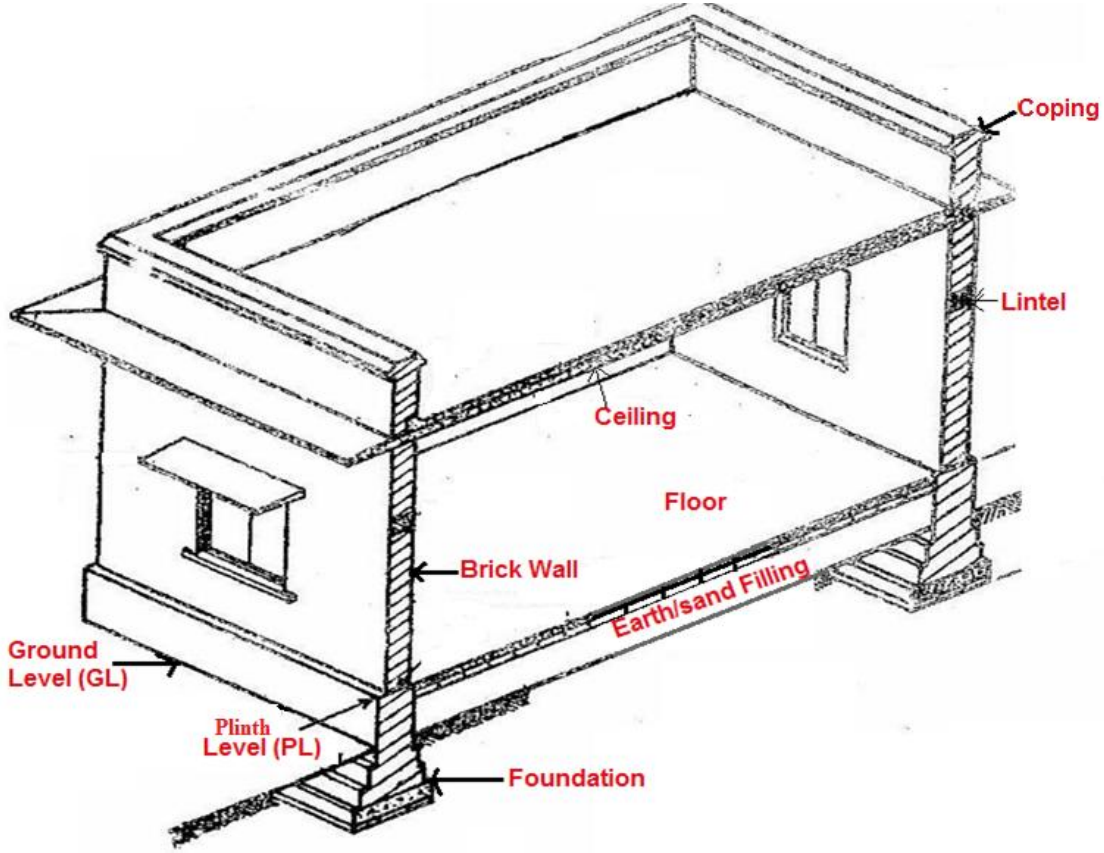




Foundation: Continuous Wall Footing

# Load Bearing Masonry Structure

## Components of a Building (From CE 100)



## Building Details:

- No. of Story: 3
- Type: Masonry
- Material of the wall: brick
- Brick wall carries load from slab, beam etc.
- Foundation: Continuous wall footing

→ See details of plan and sections from the lecture materials

## Loads:

- Gravity Loads: DL and LL
- Lateral Loads: Wind and EQ

→ ❖ Only gravity load will be considered

# Sructural Elements and design

**Design Code:** BNBC-2006, ACI 318-08

**Design Items:**

a. Stair –
   i. Stair flights with landing - reinforcement design
   ii. Stair beam – size ($h > 3t$) and reinforcement design

b. Floor slab
   i. Thickness determination
   ii. Reinforcement design

c. Beam
   i. Beam depth determination ($h > 3t$)
   ii. Flexural and shear deformation.

d. Lintel and sunshade (window and door lintels)
   i. Sunshade reinforcement
   ii. Lintel load calculation
   iii. Lintel reinforcement (flexure and shear).

e. Brick wall
   i. Calculation of load on wall from slab and beams
   ii. Wall slenderness check
   iii. Compressive stress check.

f. Brick foundation – determination of foundation width.

**Drawing items:**

a. Stair: vertical section of first and 2nd flight including landings and stair beam.
b. Floor slab: Reinforcement layout in plan – may draw one plan for bottom steel and one plan for top layer steel.
c. Beam: One long section and two cross sections.
d. Lintel: One long section and one cross section.
e. Brick foundation: Three cross sections.

All design calculations shall be accompanied by appropriate hand-sketched design drawings.

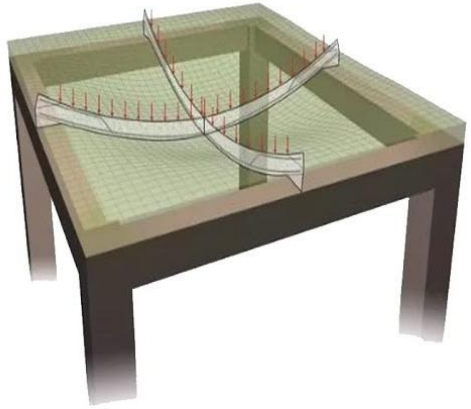
**All drawings shall include:**

a. all the required dimensions e.g. length, thickness etc.,
b. reinforcement details – rebar size, spacing or quantity, cutoff points etc.

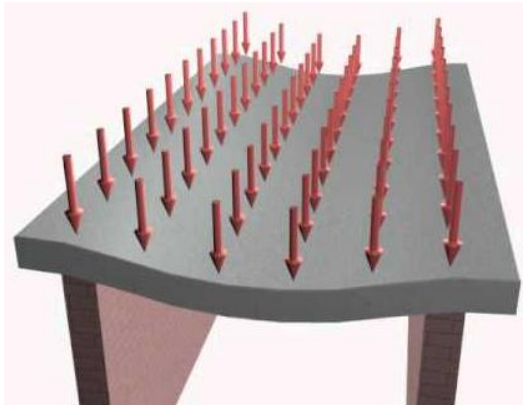
# Slabs: (Edge supported)

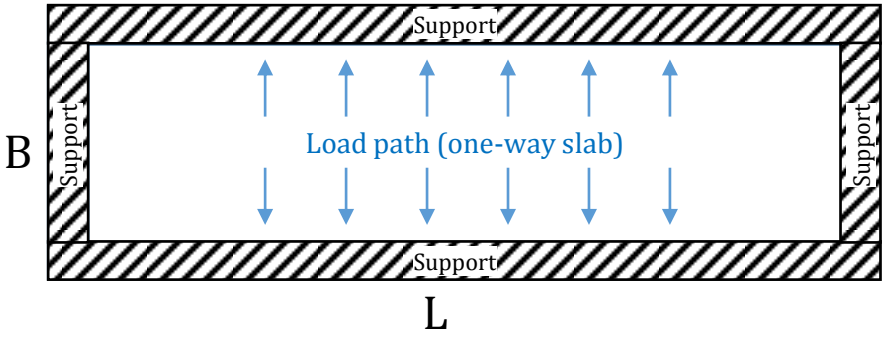


One-way



Two-way






For slabs supported on all four edges

- If $L/B \geq 2$: One way (Majority of the loads travel in one direction)
- If $L/B < 2$: Two way

## Slab Design:

1. Determine Thickness
2. Design Reinforcement

### 1. Thickness

- Determine thickness as per code (Table 6.6.3)
- Rounding
  - Upper rounding to nearest 0.25” for t<6”
  - Upper rounding to nearest 0.5” for t>6”

BNBC 2006

**Table 6.6.3**
**Minimum Thickness of RC Beams or One-way Slabs Unless Deflections are Computed**

| Member | Minimum Thickness, h | | | |
|---|---|---|---|---|
| | Simply Supported | One end Continuous | Both Ends Continuous | Cantilever |
| Solid one-way slabs | $\ell/20$ | $\ell/24$ | $\ell/28$ | $\ell/10$ |
| Beams or ribbed one-way slabs | $\ell/16$ | $\ell/18.5$ | $\ell/21$ | $\ell/8$ |

Note: Values given shall be used for reinforcement with $f_y = 410\ N/mm^2$.
For $f_y$ other than $410\ N/mm^2$, the values shall be multiplied by $(0.4+f_y/685)$.

## Slab Design:

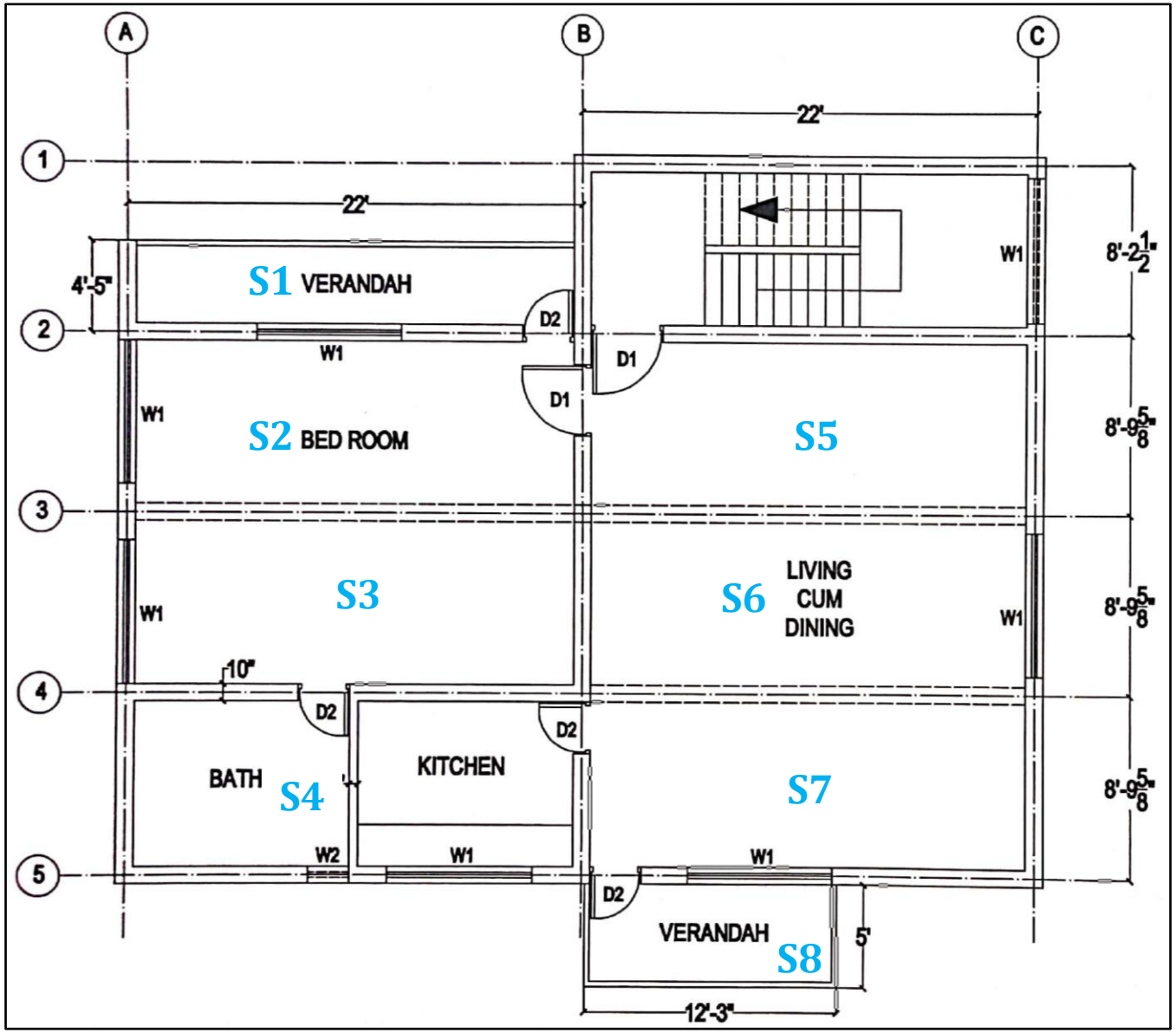
**Determination of Minimum slab thickness for $f_y$ =500 Mpa:**

- S1:

$$t_{min} = \frac{l}{10} \times \left(0.4 + \frac{f_y}{685}\right)$$

$$t_{min} = \frac{4 \times 12 + 5}{10} \times \left(0.4 + \frac{500}{685}\right) = 5.98\ in. \approx 6\ in.$$

- S2: $t_{min} = 4.26 \approx 4.5\ in$
- S5: $t_{min} = 4.97 \approx 5\ in$



# THANK YOU!