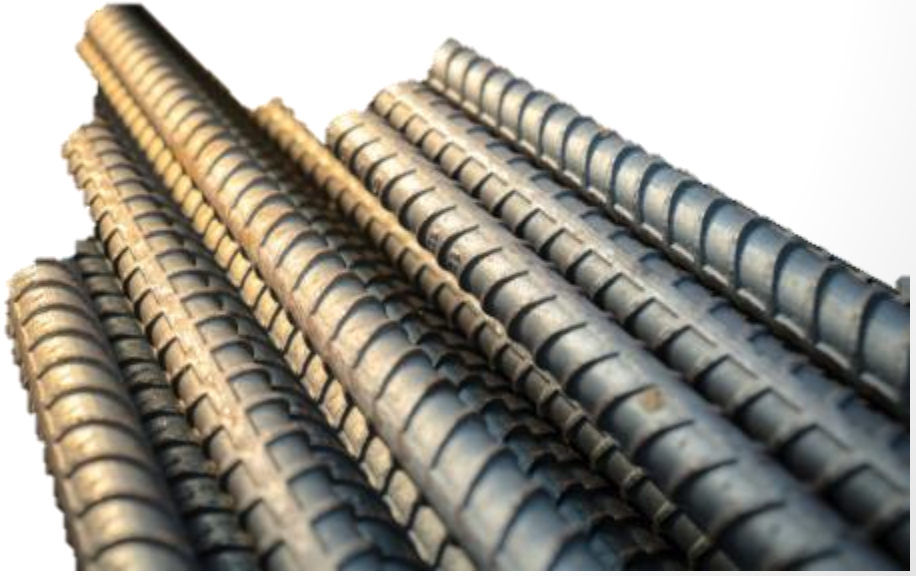
# CE 208
# Quantity Surveying

Reinforcement Estimation: RCC Slab



# Necessity for Reinforcement Estimation

- For procurement of material
- To submit or to check at site the consumption of the material
- For preparation of bill for payment

# Reinforcement used in RCC Work

- Plain round mild steel bar
- Deformed bar





# Properties of ASTM Standard Reinforcing Bars

| Bar No. | Diameter (in) | Nominal Area ($in^2$) |
|---|---|---|
| #3 | 3/8 | 0.11 |
| #4 | 4/8 | 0.20 |
| #5 | 5/8 | 0.31 |
| #6 | 6/8 | 0.44 |
| #7 | 7/8 | 0.60 |
| #8 | 8/8 | 0.79 |
| #9 | 9/8 | 1.00 |
| #10 | 10/8 | 1.27 |
| #11 | 11/8 | 1.56 |

Note: Nominal dimensions of deformed bar equivalent to plain bar; same weight per feet as plain bar

# Reinforcement Estimation

1. By percentage basis of concrete
2. By thumb rule &
3. Accurate estimation based on detailed drawings

(1 & 2 are crude methods)

Reinforcement estimated in units of weight in Kilogram, Pound and Quintal ( 1 Quintal = 100 Kilogram)

# Percentage Basis of Concrete

- Footing – 0.5% to 1%
- Column – 0.8% to 8%
- Beam – 1%
- Slab - 1%
- Lintel – 0.8%
- Sunshade – 0.5% to 0.8%



- Determine the amount of reinforcement in a RCC slab (20 ft x 15 ft x 5 inch) using percentage basis of concrete.

  (Unit weight of steel = 490 pcf)

# Thumb Rule

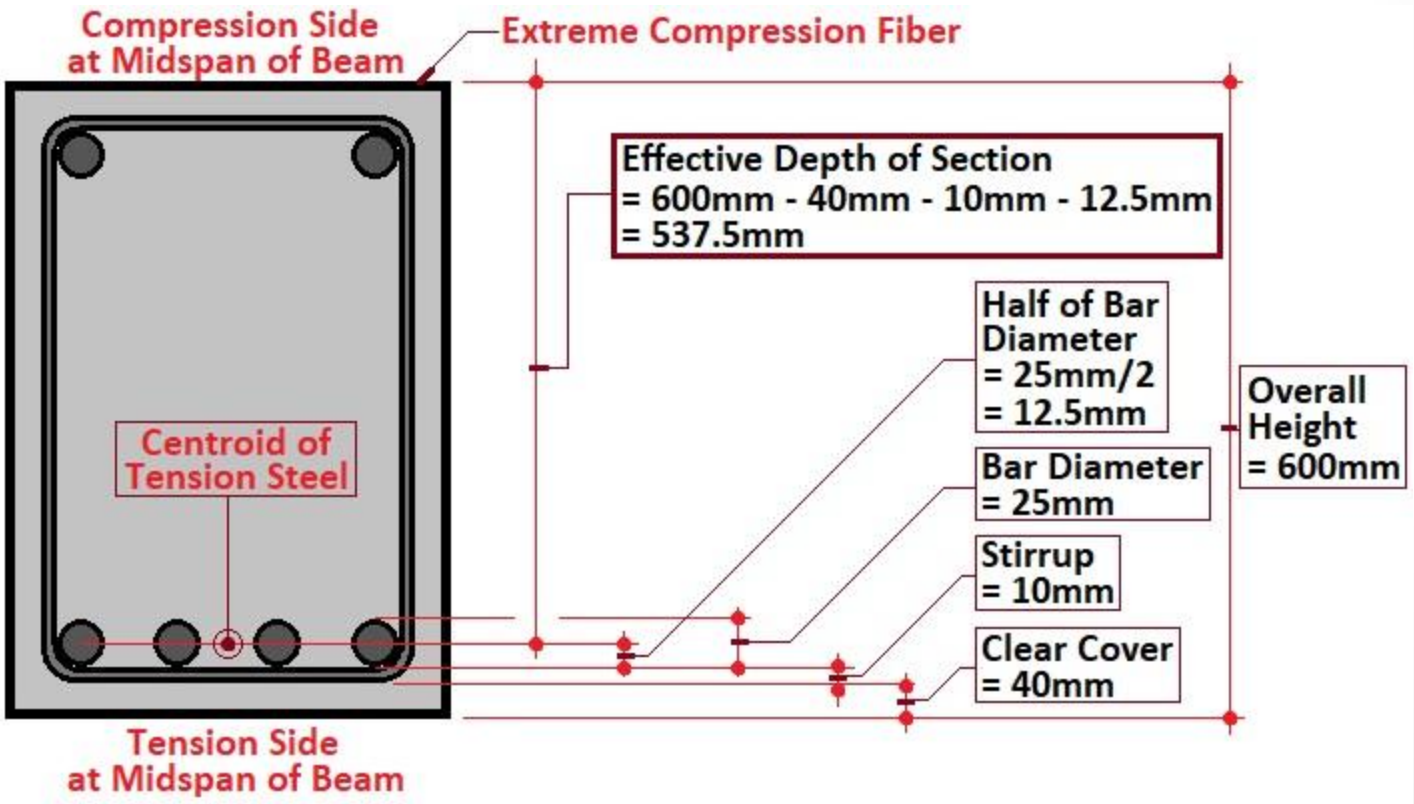
| Height of Building | Quantity of Reinforcement in Kg/sq. m. of Plinth Area | | | Remarks |
|---|---|---|---|---|
| | Foundation | Floor Beams per floor | Floor Slabs per floor | |
| 9 m to 13.5 m maximum | 22 to 33 | 18 to 20 | 10 to 12 | |
| 13.5 m to 21 m maximum | 50 to 65 | do | do | |
| 21 m to 36 m maximum | 95 to 110 | do | do | Foundation has to be raft slab. Piling will depend on soil condition. |
| Above 36 m | 130 to 150 | do | do | Concrete piling is generally required |

# Thumb Rule

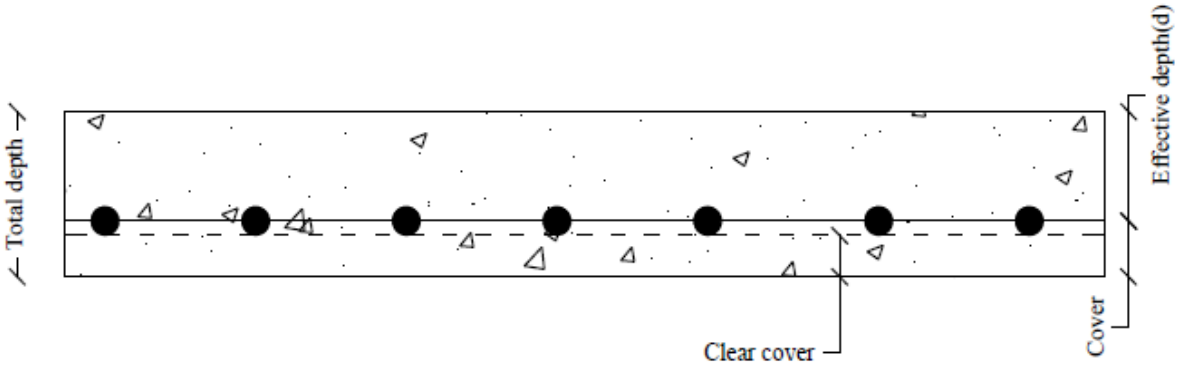
- A three storied building (each story being 10 feet) having a plinth area of 60 feet x 45 feet & height of 30 feet. Estimate the quantity of reinforcement in each floor & total reinforcement in the floors using thumb rule.

➢ Plinth Area, Quantity of Reinforcement in kg/sq. m. of plinth area, Number of floors

# Accurate Estimate Based on Detailed Drawings



# Accurate Estimate Based on Detailed Drawings




Total Depth (t) = Face to face distance
Effective Depth (d) = Distance from compression face of concrete to the center of gravity (C.G.) of steels
Cover = Distance of outer fiber from C.G. of steel
Clear Cover = Distance of outer fiber from face of steel
Total Depth (t) = Effective Depth (d) + Cover

# Reinforcement Covering

- To protect reinforcement/steel from weathering effect i.e. corrosion
- To protect from fire.
- The need for adequate adhesion between the steel and concrete.

For normal exposure of concrete according to ACI Code (American Concrete Institute)

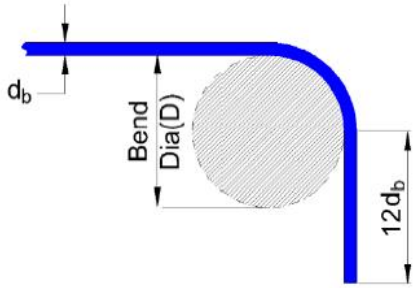
| | Beam/Column | Slab |
|---|---|---|
| Clear cover | 1.5 inch (minimum) | 0.75 inch (minimum) |
| Cover | 2.5 inch | 1 inch |

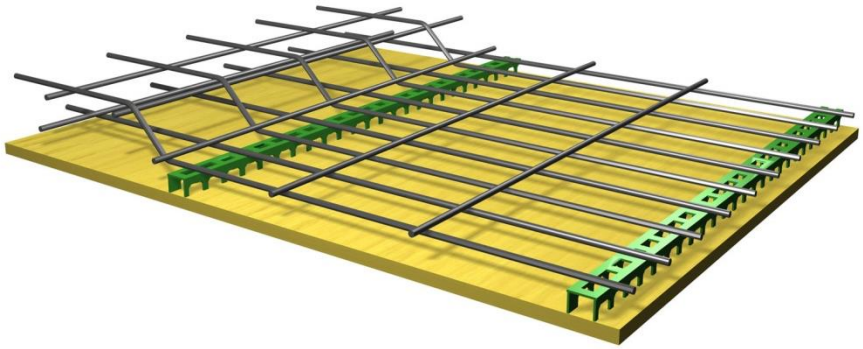
# Reinforcement in Slab

- Straight bar : lies at bottom
- Cranked bar: lies at top & at bottom (both location, depending upon cracking)
- Extra top: lies at top

These three types of reinforcement occurs in both direction (both long and short direction).

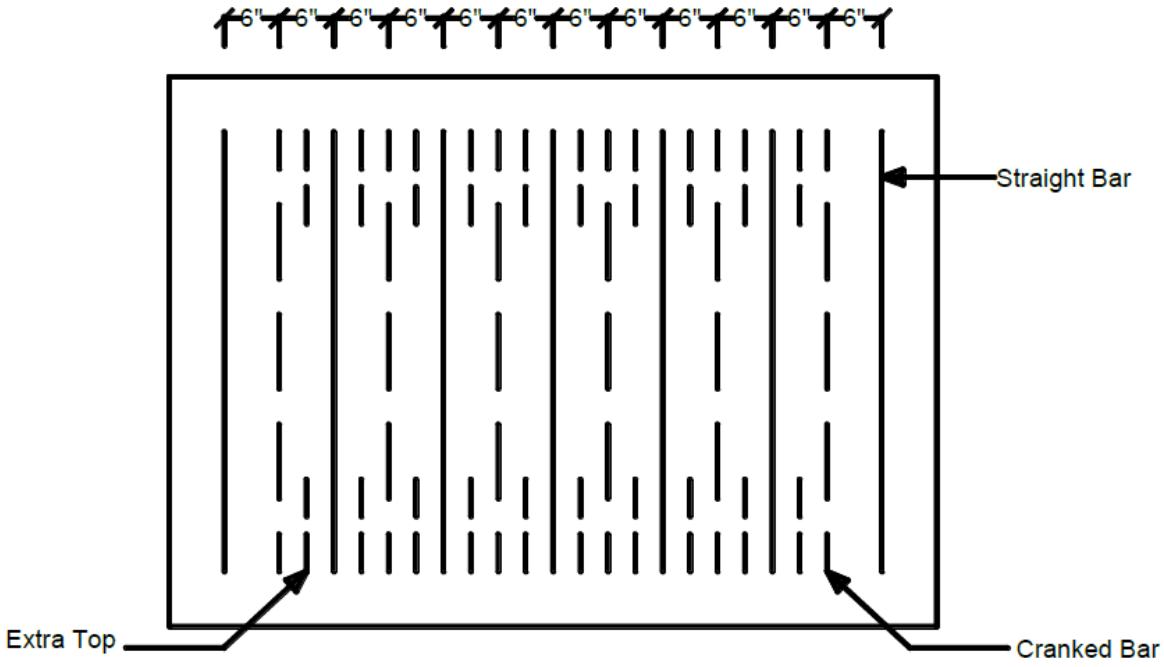
Each bar is hooked at each end if plain bar is used.



# Slab Reinforcement Distribution

- Start with a straight bar and end with a straight bar
- Cranked bars are in between straight bars.
- Extra tops are in between cranked bar.



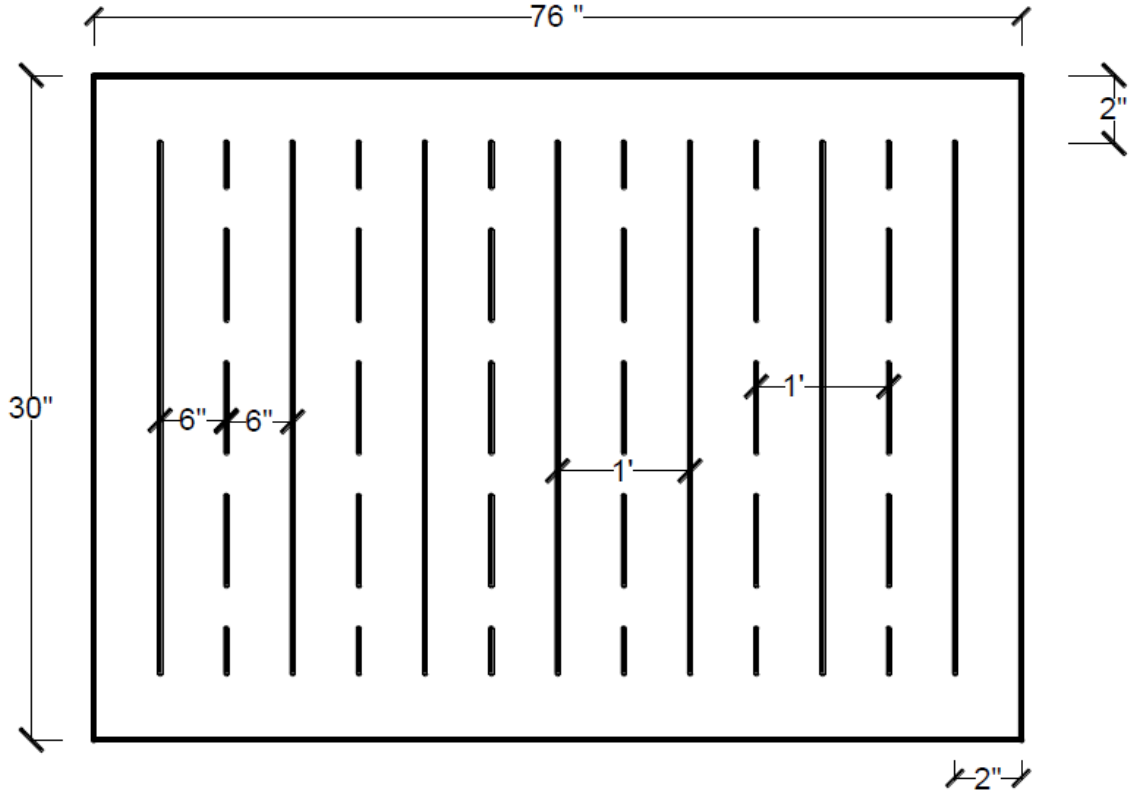
# Slab Reinforcement Distribution

- Number of straight bar $= \frac{Distance - 2" \ (from \ each \ side)}{spacing \ of \ straight \ bars} + 1$

  = Next higher integer

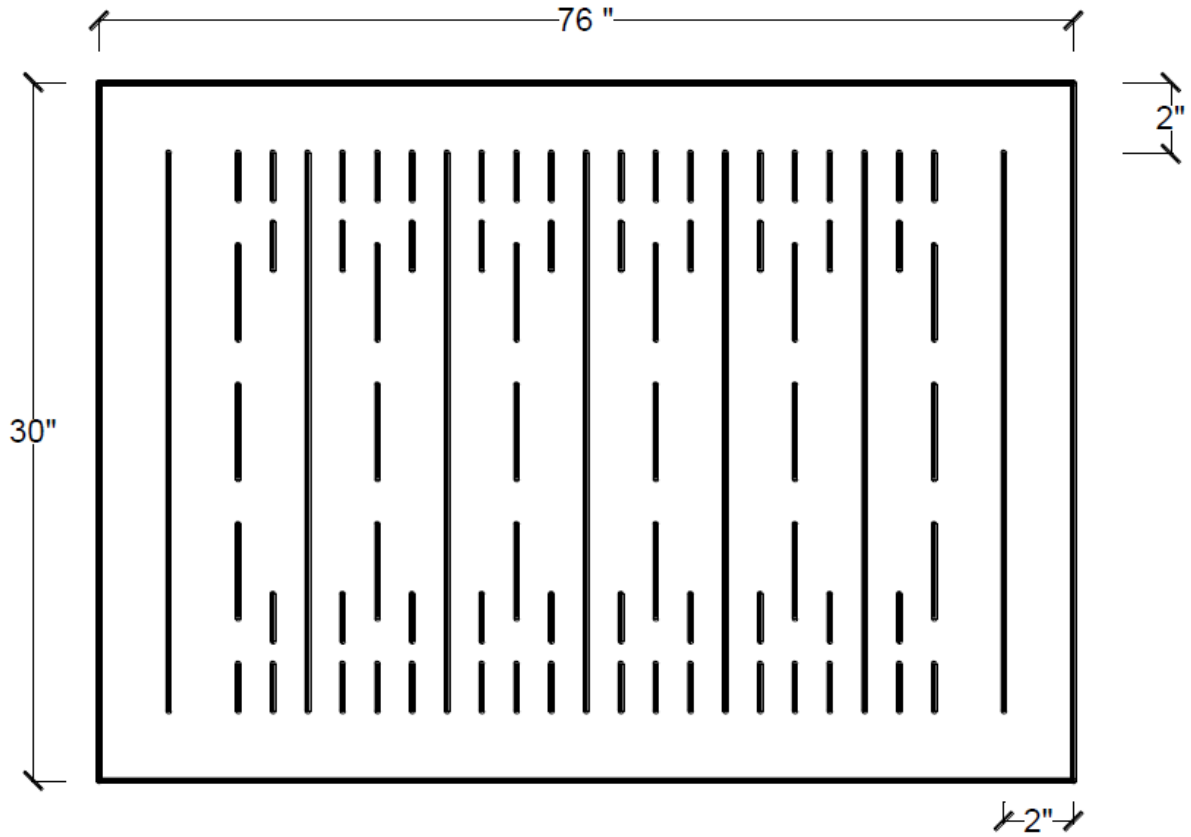
(distance is perpendicular to bar length)

- Between N number of straight bars, there will be (N-1) number of gaps. So, *No. of cranked bar = No. of straight bar -1*
- Between (N-1) number of cranked bars, there will be (N-2) number of gaps. So, *No. of extra top = No. of cranked bar – 1* (if one extra top in between cranked bars)
- No. of extra top = *n x (No. of cranked bar -1)* (if n extra tops in between cranked bars)




#3@6" c/c alt. ckd.

No. of straight bars = (76"- 2" - 2")/12 + 1 = 6.16 = 7 Nos.
No. of cranked bars = No. of straight bars - 1 = 7 – 1 = 6 Nos.




2#3 extra top in between cranked

No of extra top (one side) = (No. of cranked bar – 1) x 2

= (6 – 1) x 2

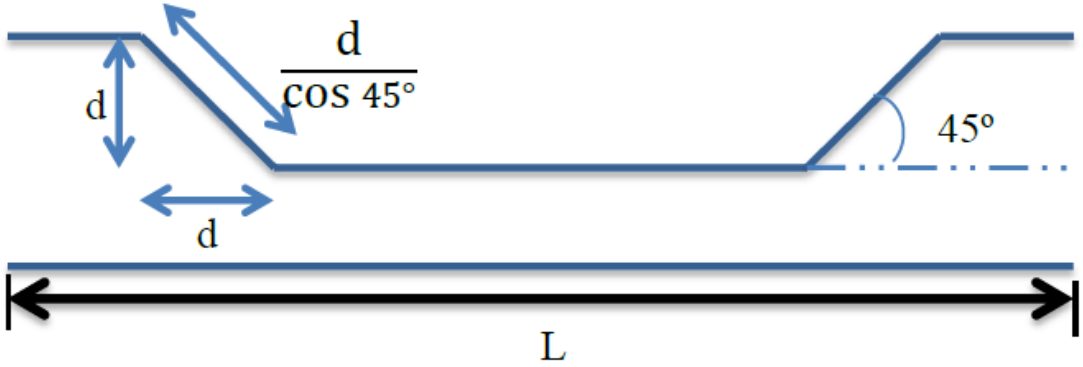
= 10

# Length of bar

- Length of straight bar = Length of slab (L) – 2 inch (from each side)
- Length of cranked bar $= (L - d - d) + \frac{d}{\cos 45} + \frac{d}{\cos 45}$

$= (L - d - d) + 1.42d + 1.42d$

$= L + 0.42d + 0.42d$




Length of cranked bar = Length of straight bar + n (0.42d)

Where n is number of bends, d is effective depth of slab

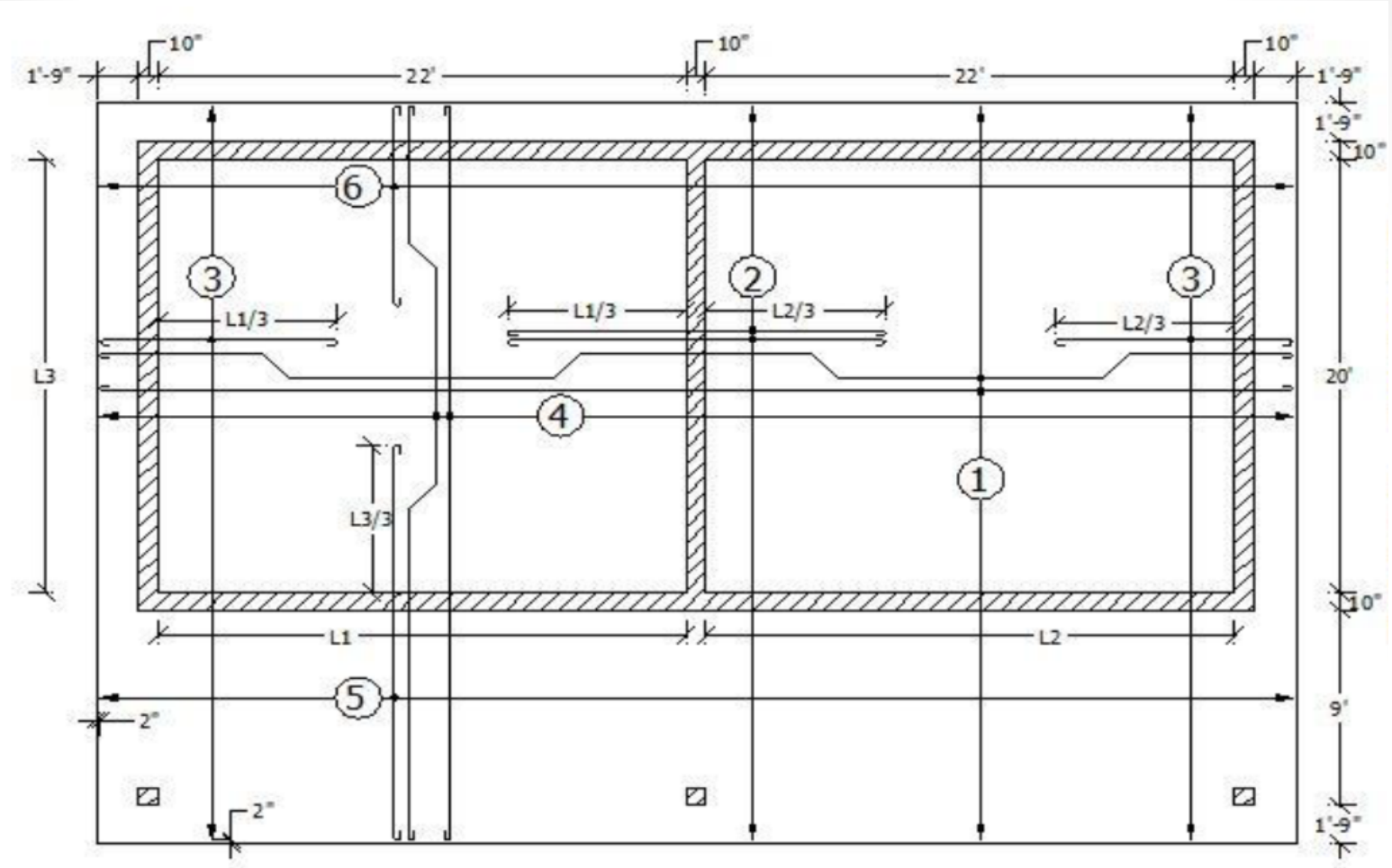
# Length of hook

- The standard hook length for each end of plain rods vary from 9 to 12.5 times diameter of the rods generally used

- If plain bar is used, each bar must be hooked at both ends.
- If deformed bar is used, no hooks required.

# Procedure for reinforcement estimation in slab

- Step 1: Determine the number of straight bars
- Step 2: Determine the number of cranked bar
- Step 3: Determine the number of extra top
- Step 4: Determine the number of hook
- Step 5: Determine the length of one straight bar
- Step 6: Determine the length of one cranked bar
- Step 7: Determine the length of extra top(s)
- Step 8: Determine the length of hook(s)
- Step 9: Determine the total length of straight bars
- Step 10: Determine the total length of cranked bars
- Step 11: Determine the total length of extra top(s)
- Step 12: Determine the total length of hook(s)
- Step 13: Repeat step 1 to step 12 for other direction
- Step 14: Volume of bar = Area of bar x Length of bar
- Step 15: Weight of bar = Unit weight of steel (490 pcf) x Volume




Legends:

(1) #4 @ 6" c/c alt. ckd

(2) 2#4 extra top in between ckd. bars

(3) 1#3 extra top in between ckd. Bars

(4) #3 @ 4" c/c alt. ckd

(5) 1#4 extra top in between ckd. bars

(6) 1#3 extra top in between ckd. bars