



TECHNICAL DEVELOPMENT IN MODERN CONSTRUCTION INDUSTRY

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ABSTRACT

The technical development in modern construction industry refers to the uses of computer and information technology to control over the features like doors and interiors. The systems have developed through remote systems with various level of intelligence. Construction appliances are adopted for the reasons of easy and secured life.

Keyword: Development in Modern Construction

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1. INTRODUCTION

In modern construction industry have been increased its efficiency by its technical development in the case of interior design even in the wiring line to electrical power, telephones, TV cable, etc., when we discuss about the home appliances washing machine, refrigerators, bath tubs, water heaters, stove, these all reduce the level of labor consumption. Like this there are several development in the field of construction we will discuss about the technical based development in modern construction industry.

2. GREENHOUSE:

Green Buildings are high performance structures that also meet certain standards for reducing natural resource consumption.

CHARACTERIZED:

- Efficient management of energy and water resources
- Management of material resources and waste
- Restoration and protection of environmental quality
- Enhancement and protection of health and indoor environmental quality
- Reinforcement of natural systems
- Analysis of the life cycle costs and benefits of materials and methods
- Integration of the design decision-making process

3. MATERIALS:

The materials used in this project are Porotherm bricks, Moringaoleifera, Ground source heat pumps, double glazed windows and Nano solar panel.

4. SPECIFICATION

4.1. Earthwork excavation:

Before the earth work is started the whole area where the work is to be done .Shall be cleared of grass, roots of trees.[8] The excavation shall be carried out exactly as per drawing dimensions. No materials excavated from foundation trenches shall be placed nearer than one meter to the outer edges of the excavation. The water in trenches must be bailed or pumped out and where it is apprehended that the sides may fell down arrangement shall be made for adequate timber shoring.

4.2. Sand filling:

Sand is used for filling shall free from duet, organic and forge in matter. Sand shall be spread uniformly to a layer not exceeding 200mm to the entire filling area. The sand shall be thoroughly saturated in water.

4.3. Cement concrete:

The mix of the concrete is 1:1/2:3, it shall be laid to a depth of 150mm and should be vibrated by using vibrators and compaction will be done before initial setting time.

4.4. Reinforcement:

Mild steel bars shall conform to the IS specification, free from loose rust, dust loose mill scales, coats of paints, oil or other coatings which may destroy or reduce bond. It shall be stored in such a way so as to avoid distortion and to prevent corrosion.

4.5. Walls:

Provide sound shaping devices as required for proper acoustics in the Auditorium. In the Dressing Rooms, Control Booth and Lobby, extend all walls to the deck above.

4.6. Materials:

Brick shall be porotherm brick of statementspecification, regular in shape and size with sharp. Brick shall have an average compressive strength of not less than 100 kg per sq. cm and not more than 125 kg per sq.cm.

4.7. Mortar:

The brick work shall be done with the specified mortar mixing the ingredients in the specified proportion.

4.8. Damp proof course:

D.P.C of cement concrete should have a mix of 1:2:4 or 1:1½:3usual thickness
2.5 cm to 4cm

4.9. Lighting:

LED lighting where used which is connected to the window contact sensor and occupancy sensor.

4.10. Windows:

Windows of sizes 0.9m * 1.2m and 1.5 m*1.5m are provided at places of building required.

4.11. Doors:

Doors of composite materials where used of size 1.2m*2.1m.

5. PLANNING ASPECTS:

The building is planned to be constructed as normal residential building where greenhouse concept is introduced in it for the welfare of the future in terms of water resources, electricity, etc... by using availability of enough resources of our earth. The plan is of 25m² plot area where the nomenclature of our building norms in urban area was selected and according to it the plan was made. The entrance is of east facing and all the vastu was verified and plan was executed for the plot area.

MANUAL DESIGN

FOOTING DESIGN – LIMIT STATE METHOD	BENDING MOMENT
Load from column = 100 KN Column size = 150 x 150mm Safe bearing capacity = 220 KN Fck = 20 N/mm ² Fy = 415 N/mm ² Self-Weight = 10% of load = 10 KN Self-weight = 10 KN Total load = 100 + 10 = 110 KN Net upward pressure = 80 KN/m ²	$M_u = \text{Load} \times \text{Distance}$ $D = 370 - 150 = 220\text{mm}$ $M = \text{Stress} \times \text{Area}$ $M = 62.5 \text{ KNm}$ $M_u = 62.5 \text{ KNm}$ $M = Qbd^2$ $62.5 \times 10^6 = 2.76 \times 370 \times d^2$ $d = 247.44 \text{ say } 250 \text{ mm}$ Assume effective cover = 50mm $D = d + \text{eff. Cover} = 300$ $D = 310\text{mm}$ For safe against shear the overall depth = 2 x $D = 600\text{mm}$ $d = 600 - 50$ $d = 550\text{mm}$

TO FIND MU LIMIT	RESULT	PITCH
$Mu_{limit} = Qbd^2$ $= 2.76 \times 370 \times 550^2$ $Mu_{limit} = 0.308 \times 10^9 \text{ N/mm}$ $Mu_{limit} = 308.9 \text{ KNm}$ $Mu < Mu_{limit}$ So, it's under reinforced $Mu = 0.87 \times fy Ast$ $62.5 \times 10^6 = 0.87 \times 415 Ast$ $Ast = 173.1 \text{ mm}^2$ Assume, 20mm $Ast = 314.159 \text{ mm}^2$ No. of rods = 7.41 ≈ 8 nos No. of rod = 8 nos of each direction	Size of column = 150 x 150mm Size of footing = 2.5 x 2.5m To provide 8 nos of 20mm rod for each direction @ 300mm c/c. LATERAL TIES Assume 6mm dia $\frac{1}{4} \times d = \frac{1}{4} \times 20 = 5\text{mm}$ So we take 6mm φ ties	LLD = 150mm $16xd = 16 \times 20 = 320\text{mm}$ 300mm 6mm φ ties @ 300mm c/c. RESULT Size of column = 150 x 150mm Size of footing = 2.5 x 2.5m To provide 8 nos of 20mm rod for each direction @ 300mm c/c.

COLUMN DESIGN – LIMIT STATE METHOD		BEAM DESIGN - LIMIT STATE METHOD	
Load from beam	= 13 KN/m		
Clear length	= 3.4m		
Fck	= 20 N/mm ²		
Fy	= 415 N/mm ²		
Load	= 44.2KN ~ 45KN		
Load = 45 x 1.5	= 67.5 ~ 70		
Design load	= 70KN		
AC	= Ag – Asc		
Asc	= 0.2% of Ag		
AC	= Ag – 0.02 Ag = 0.98 Ag		
AC	= 0.98 Ag	Clear span	= 3m
Pu	= 0.4 fck AC + 0.67 fyAsc	Wall thickness	= 230mm
1300 x 10 ³	= 0.4 x 20 x 0.98 Ag +	Fck	= 20 N/mm ²
(0.67 x 415 x 0.02 Ag)		Fy	= 415 /mm ²
Ag	= 97.01 x 10 ³ mm ²	Effective depth	= span/20
a	= 141.46mm ≈ 150mm	d	= 150mm
Ag	= 150 x 150 = 22.5 x 10 ³ mm ²	D	= 200mm
AC	= 22.5 x 10 ³ – Asc	b	= 150mm
Pu	= 70 x 10 ³ = 0.4 x 20 x (22.5 x 10 ³ - Asc) + 0.67 x	Effective span	= clear span + effective depth = 3.15m
415 x Asc)			
Asc	= 236.97mm ²		
Assuming 20mm rod			
A	= 314.2mm ²		
No. of rods	= 3.74 ≈ 4 nos		
Asc (used)	= 4 x 314.2		
	= 1256.8mm ²		
% of steel	= 1.02%		
Min% of steel	= 0.8% < 1.02%		
Max % of steel	= 4% > 1.02%		
So it's safe			

LATERAL TIES	PITCH	MAIN ROD
Assume 6mm dia 1/4 x d = 1/4 x 20 = 5mm So we take 6mm φ ties	LLD = 150mm 16xd = 16 x 20 = 320mm 300mm 6mm φ ties @ 300mm c/c.	To provide 4 nos 20mm rod

LOADS:

DEAD LOAD	IMPOSED LOAD
Wall load = 3.75KN/m	
Self-weight of slab = 2.5 KN/m	
Self-weight of beam = 0.75 KN/m	Live load = 2 KN/m
Total load = 7 KN/m	Design load = 3 KN/m
Design Load = 1.5 x 7 = 10.5 KN/m	

TO FIND MOMENT:

MIDDLE OF END SPAN

- $M_1 = 0.87 f_y A_{st} (d - f_y A_{st} / F_{ck} b d^2)$
- $M_1 = 87.24 \text{ KNm}$

NEAR OF END SUPPORT

- $M_2 = 0.87 f_y A_{st} (d - f_y A_{st} / F_{ck} b d^2)$
- $M_2 = -72.274 \text{ KNm}$

CHECK FOR DEPTH:-

- $M_{u \text{ limit}} = Q b d^2 = 2.76 \times b d^2$
- $87.24 \times 10^6 = 62.1 \times 10^6$
- $87.24 \times 10^6 > 62.1 \times 10^6$
- So, it's safe for depth
- **Ast:-**
- $M_u = 0.87 f_y A_{st_1}$

IST MOMENT:-

- $A_{st_1} = 478.79 \text{ mm}^2$

IIND MOMENT:-

- $A_{st_2} = 308.83 \text{ mm}^2$
- Assume 20mm dia
- $A_{st} = 315.20 \text{ mm}^2$
- No. of rod = 7.49 ~ 8 nos
- Provide 8 nos of 20mm rod
- No. of rod = 4.9 ~ 5 nos
- Provide 5 nos of 20mm ϕ rods

6. RESULT:-

Middle of end span

- $M_1 = 87.24 \text{ KNm}$
- $A_{st_1} = 478.79 \text{ mm}^2$
- Provide 8 nos of 20mm rods

Near of next to end support

- $M_2 = (-) 65 \text{ KNm}$
- $A_{st_2} = 308.78 \text{ mm}^2$
- Provide 5 nos of 20mm rods.

6.1. DESIGN OF ONE WAY CONTINUOUS SLAB

Side Ratio:

- The side ratio of each panel= $42.88/8.4$
 $=5.17 > 2$
- The slab is designed as one way continuous slab.

Depth required for stiffness:

- C/c distances of support= 3m
- Basic value of l/d ratio =26
- Assume modification factor of 1.15
- Effective depth of required = $3000/(26*1.15)$
 $=100\text{mm}$
- Provide a clear cover of 15mm and 10mm dia as main reinforcement.
- $D= 100+15+ (10/2)$
 $=120\text{mm}$
- $d=100\text{mm}$

Load:

- Consider 1m width of slab
- Live load = $1*1*3$ =3kN/m
- Dead load = $1*1*0.12*25=3\text{KN/m}$
- Weight of floor finish =1KN/m
- Total load =7KN/m
- Design load=10.5KN/m

6.2. Maximum B.M at support next to end support

$$\begin{aligned}M_{\max} &= -Wl^2/10 - Wl^2/9 \\ &= -10.69*3^2/10 - 10.69*3^2/9 \\ &= -9081 + 11.64 \\ &= -21.45\text{kN.m}\end{aligned}$$

Depth required for strength

$$\begin{aligned}f_{ck} &= m15 \text{ and } f_y = f_{e415} \\ \text{Effective depth required } d &= \sqrt{21.45*10^6/2.07*1000} \\ &= 101.8\text{mm} < 105\text{mm} \\ &\text{Hence ok}\end{aligned}$$

Design bending moment

B.M. near middle of end span

$$\begin{aligned}M_1 &= wl^2/12 + wl^2/10 \\ &= 17.30 \text{ KNm}\end{aligned}$$

B.M. at middle of end span

$$M2 = w l^2 / 16 + w l^2 / 12 \\ = 14.98 \text{KNm}$$

B.M. at support next to end support

$$M3 = -21.45 \text{KNm}$$

B.M. at interior support

$$M4 = w l^2 / 12 + w l^2 / 9 \\ = -19.98 \text{KNm}$$

BM at end support with partially fixity

$$M5 = -8.15 \text{KNm}$$

6.3. MAIN REINFORCEMENT – AREA OF STEEL

AREA OF STEEL REQUIRED AT SECTION 1:

$$M_u = 0.87 f_y A_{st} (d - f_y A_{st} / F_{ck} b d^2) \\ A_{st1} = 530.61 \text{mm}^2$$

AREA OF STEEL REQUIRED AT SECTION 2:

$$M_u = 0.87 f_y A_{st} (d - f_y A_{st} / F_{ck} b d^2) \\ A_{st2} = 448 \text{mm}^2$$

AREA OF STEEL REQUIRED AT SECTION 3:

$$M_u = 0.87 f_y A_{st} (d - f_y A_{st} / F_{ck} b d^2) \\ A_{st3} = 692.2 \text{mm}^2$$

AREA OF STEEL REQUIRED AT SECTION 4:

$$M_u = 0.87 f_y A_{st} (d - f_y A_{st} / F_{ck} b d^2) \\ A_{st4} = 230 \text{mm}^2$$

6.4. SPACING OF MAIN BARS:

Spacing Of 10mm Dia Bars

$$S1 = 145 \text{mm}$$

$$S2 = 175 \text{mm}$$

$$S3 = 110 \text{mm}$$

$$S4 = 120 \text{mm}$$

$$S5 = 340 \text{mm}$$

Distribution:

$$\text{Area steel required} = 150 \text{mm}^2$$

Assume 8mm dia bars as distribution

$$\text{Spacing} = 50 * 1000 / 120 \\ = 330 \text{mm}$$

Maximum permitted spacing = least of 5d and 450mm

$$=525 \text{ and } 450\text{mm}$$

Provide 8mm dia Fe415 distributors at 330 mm c/c

Check for shear:

$$V_u=39770\text{N}$$

$$\text{Nominal shear stress} = 0.678 \text{ N/mm}^2$$

$$0.378 < 0.511 \text{ N/mm}^2$$

Hence slab is safe.

Check for stiffness:

$$\text{Area to be provided} = 692.2\text{mm}^2$$

$$\text{Area of steel required} = 714\text{mm}^2$$

$$F_s = 233.35\text{N/mm}^2$$

$$MF = 99.36\text{mm}$$

$$105 > 99.36\text{mm}$$

Hence safe

6.5. DESIGN OF TWO WAY SLAB

- $L_y/L_x = 1.28 < 2$

Since it is two way slab

Depth of slab

- Depth = span / 25 = 140mm
- $d = 140\text{mm}$
- $D = 165\text{mm}$
- Effective span:
- Effective span = clear span + effective depth
= 3.64mm

Load:

- Self-weight = 4.125KN/m^2
- Live load = 4KN/m^2
- Floor finish = 0.6 KN.m^2
- Total = 8.725 KN/m^2
- Ultimate load = 13.08KN/m^2
- Check for depth:
- $\mu (\text{max}) = 0.138f_c k b d^2$
- $d = 69.53\text{mm} < 140\text{mm}$

Hence sufficient.

Reinforcement:

- $\mu = 0.87 f_y A_{st} / (d F_{ck} b d^2)$
- $A_{st} = 980 \text{ mm}^2$
- Adopt 10mm dia bar at 250mm c/c
- $A_{st} = 213 \text{ mm}^2$

Check for shear stress:

- $\tau_v = V_u / b d = 0.17 \text{ N/mm}^2$
- $P_t = 100 A_{st} / b d = 0.225$
- Refer table 19 from IS456
- $k \tau_c = 0.39 \text{ N/mm}^2 > \tau_v$

Check for deflection:

- $l/d = 20$
 - $l/d(\text{max}) = 32$
 - $l/d(\text{actual}) = 26 < 32$
- Deflection checked.

Reinforcement at edge stirrups:

- $A_{st} = 0.12\% = 198 \text{ mm}^2 / \text{m}$
- Provide 10mm dia bars at 300mm c/c.
- $A_{st} = 262 \text{ mm}^2$

6.6 DESIGN OF STAIRCASE

- $R = 160 \text{ mm}$
- $T = 300 \text{ mm}$
- Floor height = 3.2
- No. of rise = 20
- No of each flight = 10
- No of treats = 9
- Going length = 2700
- Width of landing slab = 1150mm
- Width of flight = 1150mm

Effective span:

- Overall length = 5200mm
- Provide (D) = 265mm
- $D = 240 \text{ mm}$

Load calculation:

- load on going:
- $w_n = 25 \times 0.265 = 6.625 \text{ KN/m}$

- $w_s = w_n/t/\sqrt{t^2+R^2}$
- =7.5KN/m
- Dead load on steps=2KN/m
- Finishes =0.5KN/m
- Live load =3KN/m
- Total load =13kN/m

Load on landing slab:

- Dead load of landing=6.625KN/m
- Floor finish load =0.5KN/m
- Live load =3KN/m
- Total load =10.125KN/m
- Finish load =15018KN/m

Bending moment & shear forces:

- $R_A+R_B=91.06\text{KN}$
- $V_u=R_A=R_B=45.53\text{KN}$
- $M_u=63.16\text{KNm}$
- $d=\sqrt{m_u/Q_b}=151.2<240\text{mm}$

Find Ast:

- $M_u=0.87f_yA_{st}(d-f_yA_{st}/F_{ck}bd^2)$
- $A_{st}=781.73\text{mm}^2$
 $S=350\text{mm}$
- $A_{st}(\text{pro})=897.59\text{mm}^2$
- Provide 20mm@350mmc/c

Distribution of steel:

- $A_{st}=318\text{mm}^2$
- $S=230\text{mm}$
- 10mmdia@230mmc/c

Check for shear:

- $\tau_v=0.19\text{N/mm}^2$
- $P_t=0.37$
- $\tau_c=0.42\text{N/mm}^2$
- $\tau_v<\tau_c$ normal shear

7. CONCLUSION

Usage of porotherm bricks made the construction so easy and strength and stability will be maintained. With the help of sensors there will be much security to the house. Waste water with low turbidity can recycle and used effectively with the use of natural coagulants. Dead load of the building will be low. Capital cost of the building will be the same as normal

residential building but maintenance cost will be much low as compared to the normal residential building. After 5 years there will be about 85% in the maintenance cost of the building. Thus the plan of building is made using AutoCAD , analyzed using STAAD.pro and designed manually for green building concept and home automation system with varying cross-sectional depths.

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