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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.

KEY WORDS: Technical, Construction industry.

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.

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

2. METHODS & MATERIALS

Materials: The materials used in this project are Porotherm bricks, *Moringa oleifera,* Ground source heat pumps, Double glazed windows and Nano solar panel.

Specification:

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. 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.

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.

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.

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.

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.

Materials: Brick shall be porotherm brick of statement specification, 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.

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

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.

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

Windows: Windows of sizes0.9m * 1.2m and 1.5 m*1.5m are provided at places of building required.

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

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 25m^{2}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.

Footing design – limit state method:

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

Bending moment:

M_u =Load x Distance

D =370 – 150 = 220mm

M =Stress x Area

M = 62.5 KNm

Mu =62.5 KNm

M = Qbd^2

62.5 x 10^6 = 2.76 x 370 x d^2

d = 247.44 say 250 mm

Assume effective cover = 50mm

D =d + eff. Cover = 300

D =310mm

For safe against shear the overall depth= 2 x

D =600mm

D =600 - 50

D =550mm

To find MU limit:

Mu_{limit} = Qbd^2 = 2.76 x 370 x 550^2

Mu_{limit} = 0.308 x 10^9 N/mm

Mu_{limit} = 308.9 KNm

Mu < Mu_{limit}

So, it's under reinforced

Mu = 0.87 x fyAst

62.5 x 10^6 = 0.87 x 415 Ast

Ast = 173.1mm^2

Assume, 20mm

Ast = 314.159mm^2

No. of rods = 7.41 ≈ 8 nos

No. of rod = 8 nos of each direction

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.

Lateral ties:

Assume 6mm dia

¼ x d = ¼ x 20 = 5mm

So we take 6mm ϕ ties

Pitch:

LLD = 150mm

16xd = 16 x 20 = 320mm

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:

Load from bean = 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
Pu = 0.4 fck AC + 0.67 fyAsc
1300 x 10^3 = 0.4 x 20 x 0.98 Ag + (0.67 x 415 x 0.02 Ag)
Ag = 97.01 x 10^3 mm^2
a = 141.46mm ≈ 150mm
Ag = 150 x 150 = 22.5 x 10^3 mm^2
AC = 22.5 x 10^3 – Asc
Pu = 70 x 10^3 = 0.4 x 20 x (22.5 x 10^3-Asc) + 0.67 x 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% > 1.0.2%
So it's safe

Beam Design - Limit State Method:

Clear span = 3m
Wall thickness = 230mm
Fck = 20 N/mm^2
Fy = 415 /mm^2
Effective depth = span/20
d =150mm
D= 200mm
b=150mm
Effective span = clear span + effective depth = 3.15m

Table.1. Specifications

Lateral Ties	Pitch	Main Rod
Assume 6mm dia ¼ x d = ¼ 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 Total load = 7 KN/m Design Load =1.5 x 7 = 10.5 KN/m	Live load = 2 KN/m Design load= 3 KN/m

To find moment:-

Middle of end span

- $M1=0.87fyAst(d-fyAst/Fckbd^2)$
- M_1=87.24KNm

Near Of End Support

- $M_2=0.87fyAst(d-fyAst/Fckbd^{2)}$
- M2=-72.274KNm

Check For Depth:

- Mu_{limit} = $Qbd^2 = 2.76 \times bd^2$
- 87.24x10^6 = 62.1x10^6
- 87.24x10^6>62.1x10^6
- So, it's safe for depth
- **Ast:-**
- Mu = 0.87 fy Ast_1

IST Moment:

- Ast1=478.79mm^2

IIND Moment:

- Ast2=308.83mm^2
- Assume 20mm dia
- Ast=315.20mm^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

3. RESULT

Middle of end span

- M_1=87.24 KNm
- Ast_1=478.79mm^2
- Provide 8 nos of 20mm rods

ii) Near of next to end support

- M_2= (-) 65KNm
- Ast_2=308.78mm^2
- Provide 5 nos of 20mm rods.

Design of One Way Continuous Slab

Side radio:

- The side radio 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)
  - =100mm
- Provide a clear cover of 15mm and 10mm dia as main reinforcement.
- D= 100+15+ (10/2)
- =120mm
- d=100mm

Load:

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

Maximum B.M at support next to end support.

Mmax=-Wl^2/10-Wl^2 **/9**

= -10.69*3^2/10-10.69*3^2/9

=-9081+11.64

=-21.45kN.m

Depth required for strength

fck =m15 and fy = fe415

Effective depth required d=√21.45*10^6/2.07*1000 =101.8mm<105mm

Hence ok

Design bending moment

B.M. near middle of end span

M1=wl^2/12 + wl^2/10 = 17.30 KNm

B.M. at middle of end span

M2=wl^2/16 + wl^2/12 =14.98KNm

B.M. at support next to end support

M3= -21.45KNm

B.M. at interior support

M4=wl^2/12 + wl^2/9 =-19.98KNm

BM at end support with partially fixity

M5=-8.15KNm

Main Reinforcement – Area of Steel

Area of Steel Required At Section 1:

Mu=0.87fyAst (d-fyAst/Fckbd^2)

Ast1=530.61mm^2

Area Of Steel Required At Section 2:

Mu=0.87fyAst (d-fyAst/Fckbd^2)

Ast2=448mm^2

Area Of Steel Required At Section 3:

Mu=0.87fyAst (d-fyAst/Fckbd^2)

Ast3=692.2mm^2

Area Of Steel Required At Section 4:

Mu=0.87fyAst (d-fyAst/Fckbd^2)

Ast4=230mm^2

Spacing of main bars:

Spacing Of 10mm Dia Bars

S1=145mm

S2=175mm

S3=110mm

S4=120mm

S5=340mm

Distribution:

Area steel required = 150mm^2

Assume 8mm dia bars as distribution

Spacing = 50*1000/120 = 330mm

Maximum permitted spacing = least of 5d and 450mm=525 and 450mm

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

Check for shear:

Vu=39770N

Nominal shear stress = 0.678 N/mm^2

0.378<0.511 N/mm^2

Hence slab is safe.

Check for stiffness:

Area to be provided = 692.2mm^2

Area of steel required=714mm^2

Fs=233.35N/mm^2

MF=99.36mm

105>99.36mm

Hence Safe

Design of Two Way Slab

- Ly/Lx=1.28<2

Since it is two way slab

Depth of slab

- Depth = span /25 =140mm
- d=140mm
- D=165mm
- 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 (max) =0.138fckbd^2
- d=69.53mm<140mm

Hence sufficient.

Reinforcement:

- Mu=0.87fyAst (d-fyAst/Fckbd^2)
- Ast= 980mm^2
- Adopt 10mm dia bar at 250mm c/c
- Ast=213mm^2

Check for shear stress:

- τv=Vu/bd= 0.17N/mm^2
- Pt=100Ast/bd = 0.225
- Refer table from IS456
- kτc=0.39N/mm^2>τv

Check for deflection:

- **l/d=20**
- l/d(max)=32
- l/d(actual)=26<32

Deflection checked.

Reinforcement at edge stirrups:

- Ast= 0.12% = 198mm^2 / m
- Provide 10mm dia bars at 300mm c/c.
- Ast= 262mm^2

Design of staircase:

- R=160mm
- T=300mm
- 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=240mm

Load calculation:

- load on going:

- wn= 25x0.265=6.625KN/m
- ws = wn/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:

- RA+RB=91.06KN
- Vu=RA=RB=45.53KN
- Mu=63.16KNm
- d=√mu/Qb =151.2<240mm

Find Ast:

- Mu=0.87fyAst (d-fyAst/Fckbd^2)
- Ast=781.73mm^2
  S=350mm
- Ast(pro)=897.59mm^2
- Provide 20mm@350mmc/c

Distribution of steel:

- Ast=318mm^2
- S=230mm
- 10mmdia@230mmc/c

Check for shear:

- τv=0.19N/mm^2
- Pt=0.37
- τc=0.42N/mm^2
- $\tau v<\tau c$ normal shear

4. 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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