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Design of Partial Magnetic Repulsion Foundation Building by Using U-Boots and Autoclaved Aerated Concrete Bricks

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Abstract

Civil Engineering demands for more and more structures with the present rate of growth of population. This increase in structures, is becoming a reason which increases the stresses and burden on the earth. So, for decreasing this over-pressure, it is a need for lightweight buildings. I am going to see the design of slabs using this U-Boot technology and conventional brickwork with AAC blocks. U-Boot Baton is recycled polypropylene formwork which was manufactured to create light weighted slabs and rafts. Because of its exceptional characteristic features, AAC stands for Autoclaved Aerated Concrete and the density of this block is considerably less than that of conventional brick. Hence it would reduce the self weight of structure. I have also used magnetic repulsion technique in the foundation of the structure so as to resist any possible deflections and other additional loads.

1. Introduction

There are plenty of reasons for the growth of structures in this world growing rapidly and knowingly or unknowingly, the pressure on earth due to all these structures is increasing on a fast note. The so-called pressure is due to increase in weight of this rapidly increasing infrastructure. Therefore there is a fast need to counter this heavy weight and pressure coming onto this planet. And from this, there arose a unique concept of Lightweight Buildings.

The reason why I kept the name **'magnetic repulsion building'** is that I felt like this building with unique features could well replace the conventional buildings in all aspects and could be ideal in the constructions field for the next genres to come.

2. Need for Lightweight Buildings

The first need is reducing the weight, pressure and stresses coming onto the surface of the earth. For this concept, it is necessary to realise what actually these heavy weights, over pressure and higher stresses do to the earth.

The surface of earth is made of tectonic plates placed in a particular arrangement. So these stresses induced by the structures on the earth, at some stage, would disturb the arrangement of the tectonic plates. This internal disturbance would affect externally onto the earth's surface producing natural disasters in the form of earthquakes, landslides, etc.

Hence in order to forecast and prevent such problems in future, I am coming with a solution of constructing these lightweight buildings. Therefore I am trying my project using some modifications in conventional buildings to obtain the lightweight buildings.

3. Objectives

The main purpose of my work is to give a design for lightweight buildings. In 'Ideal Building – I', I am going to rectify the load of structure by using U-boot technology in slabs and foundations. The other objectives which follow due to my project are listed.

→ To study and implement a new technology related to slabs and foundations, i.e., u-boot technology.
→ To study the loads of different components of structure separately and finally to calculate the entire weight of the structure.
→ To study the properties and behaviour of various materials utilised in construction.
→ To compare the corresponding elements of lightweight and conventional buildings separately.
→

4. Materials Used

U-boot batons

Autoclaved Aerated Concrete blocks

M-25 grade concrete

Mild steel

5. Advantages of Polypropylene

✓ It is available readily and is cheap in price.
✓ It has more tensile strength and is because of semi crystalline.
✓ It has a relatively glossy surface.
✓ It absorbs zero moisture.
✓ It has good resistance against chemicals (bases and acids)
✓ It imparts good fatigue resistance.
✓ It has good impact ness and act as a good insulator against electricity.

5.1 Properties of Polypropylene

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Following are some major properties of polypropylene:

Chemical Resistivity**:** polypropylene will not allow any chemical to react with it because of its special characteristics, which allow it as a better choice for manufacturing containers in which chemicals have to be stored like acids, bases, and first aid products.

Elastic and tough**:** it possesses elastic property up to certain limit and after that it acts as a tough material.

Fatigue Resistance**:** it has more fatigue resistance

Electricity Insulator**:** it is a plastic material so it will having electric insulation which helps in the manufacture of electric insulators.

Transmissivity**:** it is having another crucial property that is transmissivity, and is used as a curtain walls and other roof slabs where lighting is necessary.

6. Sample Dimensions of a Single U-Boot Baton TABLE-1

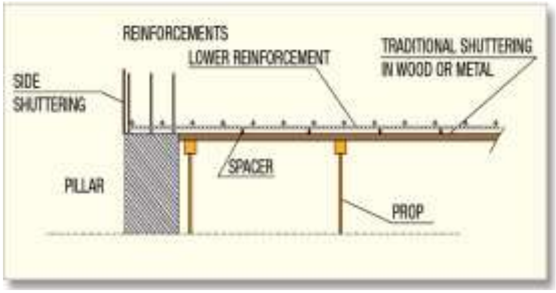
Working dimensions	52cm ×52cm
Height (H)	10 cm
Foot height	0-5-6-7-8-9-10 cm
Spacer height	0.8 cm
Weight per piece	1.150 kg
Piece volume	0.0213 m^3
Pallet dimensions	110 × 110 × 240 cm
Pallet piece	720 pcs/pal
Pallet weight	840 kg/pal

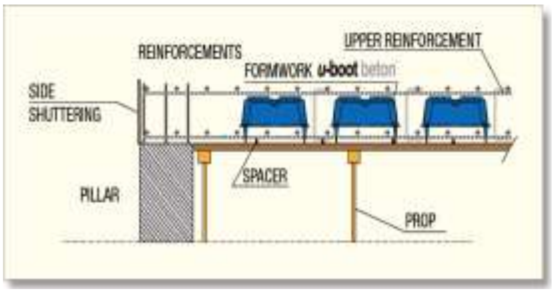
6.1 U-BOOT baton advantages in slabs

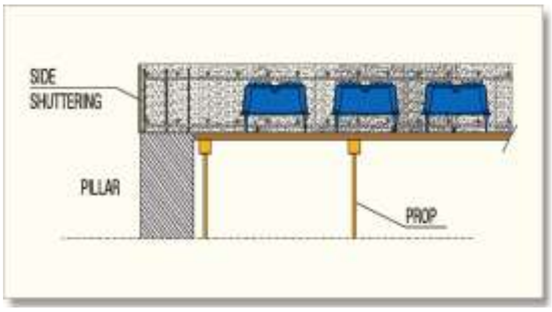
Construction of a big span floor with less deformations and avoiding combined beams with non-standard thicknesses.
Creation of very rigid rafts, minimising the quantity of concrete and the foundation weight in the case of inconsistent ground surfaces.

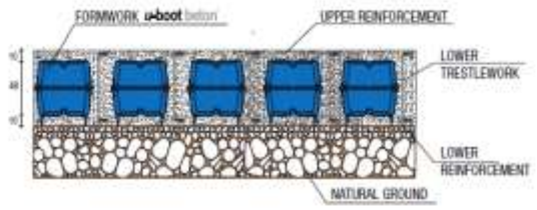
- reduces the structure weight up to 35% of actual existing structure
- it consumes less concrete because boot gaps contain air and are covered with sheets
- No lowered structures (beams), because the boots act as the beams with reinforcement
- Bi-directional structure
- Structure stiffness
- Decrease on stress on the ground
- Elimination of foundation piles, not much importance of deep foundations
- Acts as sound insulator from floor to floor
- We can increase the number of maximum floors instead of limited numbers.
- More flexible

6.2 installation in slabs and foundation rafts









7. About Autoclaved aerated concrete blocks

Autoclaved aerated concrete (AAC) is a less weight, pre manufacture, foam concrete constructing material coined in the midle-1920 that simultaneously enrich structure, insulation, and fire and mould-resistance. AAC products include blocks, wall panels, floors and roof panels cladding panels and lintels. AAC is concrete and has been manufacturing which have more air gaps in fact, this type of concrete contains 75% of voids. And is made up of OPC, aerated lime, fine sand, gypsum, aluminium fine powder and autoclave

7.1 Advantages of AAC blocks

- Contains 75% of air so super structure weight is reduced compared to normal bricks
- Blocks typically have strengths ranging from 3-9 Nmm^{-2} (when tested in accordance with BS EN 771-1:2000)
- Densities range from about 460 to 750 kg m^{-3}

8. Design using U-boot batons

8.1 top slab design

For the sake of geometry, I have considered a square slab of size 32” × 32” i.e., 9.76 m × 9.76 m and have planned all the rooms inside that span.

Size of slab: 9.76 m × 9.76 m

Mixed Design: M25 and Fe415

Density Calculations:-

Density of Reinforced Concrete = 25 KN / m^3

Volume of 1 u-boot beton = 0.021 m^3

1 $m^3 \rightarrow$ 25 kN

0.021 $m^3 \rightarrow$?

$\Rightarrow 25 \times 0.021 = 0.525$ kN

2 u-boot betons can be placed in 1 m^3 of volume

Therefore, density for 2 u-boot betons = 2 × 0.525 = 1.05 kN/m^3

So, after placing the u-boot betons in 1 m^3, the density would become,

25 – 1.05 = 23.95 kN/m^3

Now, adding the density of u-boot beton material for the above density,

The density of u-boot beton material is 35 kg/m^3 = 0.343 kN/m^3

Hence, the final density to be used would become,

23.95 + 0.343 = **24.29 kN/m^3**

Load Calculations:-

Assuming depth of slab to be 150 mm for the load calculations,

For unit width of slab,

Dead Load = 1 × 0.15 × 24.29 = 3.64 kN/m3

Live Load = 0.8 kN/m3

Total Load, w = 3.64 + 0.8 = 4.44 kN/m3

Total Factored Load, w_u = 4.44 × 1.5 = 6.66 kN/m = **7 kN/m3**

Moments Calculations:-

$l_x = l_y = 9.76$ m $\Rightarrow l_y/l_x = 1$

Hence, it is a two-way slab

$M_{ux} = \alpha_x w_u l_x^2 = 0.062 \times 7 \times 9.76^2 = 41.34$ kN-m

Similarly, $M_{uy} = 41.34$ kN-m

Depth of slab, $d = \sqrt{(M_u/0.138 f_{ck} b)} = \sqrt{[(41.34 \times 10^6)/0.138 \times 25 \times 1000)]}$

= 109.46 mm < 150 mm

Hence provide the depth of slab of **150 mm**

Reinforcement Details:-

$A_{st} = (0.36\ f_{ck}\ b\ x_u) / (0.87\ f_y)$

$= (0.36 \times 25 \times 1000 \times 0.48 \times 150) / (0.87 \times 415)$

= 1794.76 mm^2 (for both directions)

Therefore, $A_{stx} = A_{sty} = 1794.76/2 = 897.38\ mm^2$

Use 12 mm bars for the calculation of spacing,

$S = B\ a_{st} / A_{st}$

$= (1000 \times \pi/4 \times 12^2) / (897.38) = 126.03$ mm

Number of bars = 9.76/0.126 = 77.38 = 78 bars in one direction

Hence, provide **78 bars** of **12 mm dia** with a spacing of **126 mm c/c**

Check for Shear:-

$V_u = ½ \times w_u \times l_x$

$= ½ \times 7 \times 9.76 = 34.16$ kN

$\tau_v = V_u/bd$

$= (34.16 \times 1000) / (1000 \times 150) = 0.23\ N/mm^2$

$\tau_c' = \tau_c \times k$

$P_t = (100 A_{st})/bd$

$= (100 \times 897.38) / (1000 \times 150) = 0.59$ %

Now, calculating the τ_c value from the P_t value,

0.50 % → 0.49

0.59 % → ?

0.75 % → 0.57

By using interpolation,

I get 0.49 + (0.57 – 0.49) (0.59 – 0.5) / (0.75 – 0.5)

$\Rightarrow \tau_c = 0.5188$

$\tau_c' = 1.20 \times 0.5188 = 0.622\ N/mm^2$

From IS 456:2000, $\tau_{c\ max} = 2.80\ N/mm^2$

Now 0.23 < 0.622 < 2.80, i.e., $\boldsymbol{\tau_v < \tau_c' < \tau_{c\ max}}$

Hence it is safe in shear

Check for deflection:-

Checking for deflection, especially at the cantilever projections made from the column strips,

For Cantilevers, span/l_{eff} = 7

The modification factor for given mixed design is found out to be around 1.2

Therefore, 7 × 1.2 = 8.4

Now, span/l_{eff} = 1.22/0.15 = 8.13 < 8.4

Hence deflection is controlled in the span

Weight of Top Slab

U-boot betons

A total of 225 u-boot betons can be placed in our slab

Weight of u-boot beton is given as 1.15 kg/piece

For 225 u-boot betons, we get

225 × 1.15 = **258.75 kg**

Steel:-

Volume of steel = $[156 \times \pi/4 \times 0.012^2 \times 9.76] \times 2$

$= 0.17 \times 2 = 0.34\ m^3$

Weight of steel = volume × density

= 0.34 × 7850 = **2669 kg**

Concrete:-

Volume of concrete = total volume – volume of steel – volume of u-boot betons

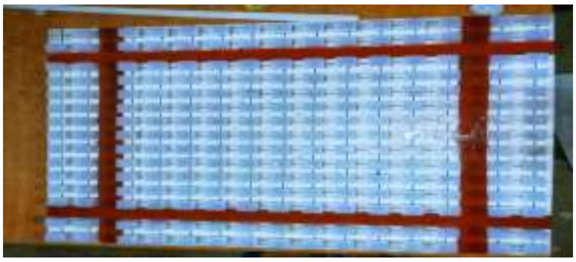
= (9.76 × 9.76 × 0.15) – 0.34 – (225 × 0.021)

= 14.28 – 0.34 – 4.725 = 9.215 m^3

Weight of concrete = 9.215 × 2400 = **22116 kg**

Total weight of slab = 258.75 + 2669 + 22116 = 25045 kg

= 245.53 kN = **250kN**



8.2 Intermediate Slab Design

For the design of intermediate slab, we have to take into consideration, the weight of top slab, the weight of columns present in that floor and the weight of brickwork obtained in that floor. The weight of columns taken here is the same which is obtained in chapter 4. The weight of brickwork considered here is obtained from the calculations of 'Ideal Building – II'.

Size of slab: 9.76 m × 9.76 m

Mixed Design: M25 and Fe415

Density Calculations

Density of Reinforced Concrete = 25 KN / m^3

The reduced density in our slab as taken above is = **24.29 kN/m³**

Load Calculations

Assuming depth of slab to be 150 mm for the load calculations,

For unit width of slab,

Dead Load = 1 × 0.18 × 24.29 = 4.37=5 kN/m

Live Load = 0.8 kN/m

Assume Floor Finish Load =1 kN/m

Total Load = 5 + 0.8 + 1 = 6.8 kN/m

Factored Load = 6.8 × 1.5 = 10.2 kN/m

Loads from top floor,

Brickwork = 375 kN (from 'Ideal Building – II')

Top slab = 250 kN

Columns load = 15 kN (from Chapter 4)

Total load from above floor = 375 + 250 + 15 = 640 kN

But the load of 640 kN is for the whole slab, hence calculating the load for 1 m^2 area, we get

9.76 × 9.76 $m^2 \rightarrow$ 640 kN

1 $m^2 \rightarrow$?

640 / (9.76 × 9.76) = 6.71 kN/m^2 = 7 kN/m^2

For unit width of slab, the load becomes 1 × 7 = 7 kN/m

Now, the total factored load = 10.2 + 7

= **17.2 kN**

Moments Calculations

$l_x = l_y = 9.76$ m $\Rightarrow l_y/l_x = 1$

Hence, it is a two-way slab

$M_{ux} = \alpha_x w_u l_x^2 = 0.062 \times 17.2 \times 9.76^2 = 101.58$ kN-m

Similarly, M_{uy} = 101.58 kN-m

Depth of slab, d = $\sqrt{(M_u/0.138 f_{ck} b)}$ = $\sqrt{[(101.58 \times 10^6)/0.138 \times 25 \times 1000)]}$

= 171.59 mm < 180 mm

Hence provide the depth of slab of **180 mm**

Reinforcement Details

$A_{st} = (0.36\ f_{ck}\ b\ x_u) / (0.87\ f_y)$

= (0.36 × 25 × 1000 × 0.48 × 180) / (0.87 × 415)

= 2153 mm^2 (for both directions)

Therefore, $A_{stx} = A_{sty}$ = 2153/2 = 1076.85 mm^2

Use 16 mm bars for the calculation of spacing,

$S = B\ a_{st} / A_{st}$

$= (1000 \times \pi/4 \times 16^2) / (897.38) = 186.7$ mm = 190 mm

Number of bars = 9.76 / 0.190 = 51.36 = 52 bars in one direction

Hence, provide **52 bars** of **16 mm dia** with a spacing of **190 mm c/c**

Check for Shear

$V_u = ½ \times w_u \times l_x$

$= ½ \times 17.2 \times 9.76 = 83.936$ kN

$\tau_v = V_u / bd$

$= (83.936 \times 1000) / (1000 \times 180) = 0.46$ N/mm^2

$\tau_c' = \tau_c \times k$

$P_t = (100A_{st}) / bd$

$= (100 \times 1074.85) / (1000 \times 180) = 0.59$ %

Now, calculating the τ_c value from the P_t value,

0.50 % → 0.49

0.59 % → ?

0.75 % → 0.57

By using interpolation,

We get 0.49 + (0.57 – 0.49) (0.59 – 0.5)/ (0.75 – 0.5)

$\Rightarrow \tau_c = 0.5188$

$\tau_c' = 1.20 \times 0.5188 = 0.622$ N/mm^2

From IS 456:2000, $\tau_{c\ max} = 2.80$ N/mm^2

Now 0.46 < 0.622 < 2.80, i.e., $\boldsymbol{\tau_v < \tau_c' < \tau_{c\ max}}$

Hence it is safe in shear

Check for deflection

Checking for deflection, especially at the cantilever projections made from the column strips,

For Cantilevers, span/l_{eff} = 7

The modification factor for given mixed design is found out to be around 1.2

Therefore, 7 × 1.2 = 8.4

Now, span/l_{eff} = 1.22/0.15 = 6.77 < 8.4

Hence deflection is controlled in the span

Weight of Intermediate Top Slab

U-boot betons

A total of 225 u-boot betons can be placed in our slab

Weight of u-boot beton is given as 1.15 kg/piece

For 225 u-boot betons, we get

225 × 1.15 = **258.75 kg**

Steel

Volume of steel = $[104 \times \pi/4 \times 0.016^2 \times 9.76] \times 2$

$= 0.204 \times 2 = 0.408$ m^3

Weight of steel = volume × density

= 0.408 × 7850 = **3204.15 = 3205 kg**

Concrete

Volume of concrete = total volume – volume of steel – volume of u-boot betons

= (9.76 × 9.76 × 0.18) – 0.408 – (225 × 0.021)

= 17.14 – 0.408 – 4.725 = 12.01 m^3

Weight of concrete = 12.01 × 2400 = **28824 kg**

Total weight of slab = 258.75 + 3205 + 28824 = 32287.75=**32288** kg

= 316.54 kN = **320 kN**

8.3 design of Bottom Slab

Size of slab: 9.76 m × 9.76 m

Mixed Design: M25 and Fe415

Density Calculations

Density of Reinforced Concrete = 25 KN / m^3

The reduced density in our slab as taken above is = **24.29 kN/m^3**

Load Calculations:-

Assuming depth of slab to be 280 mm for the load calculations,

For unit width of slab,

Dead Load = 1 × 0.28 × 24.29 = 6.8kN/m

Live Load = 0.8 kN/m

Assume Floor Finish Load =1 kN/m

Total Load = 6.8 + 0.8 + 1 = 8.6 kN/m

Factored Load = 8.6 × 1.5 = 12.9 kN/m = **13 kN/m**

Loads from top floor,

Brickwork = 375 + 375 = 750 kN

Top slabs = 250 + 320 = 570 kN

Columns load = 15 + 15 = 30 kN

Total load from above floor = 750 + 570 + 30 = 1350 kN

But the load of 640 kN is for the whole slab, hence calculating the load for 1 m^2 area, we get

$9.76 \times 9.76\ m^2 \rightarrow 1350$ kN

$1\ m^2 \rightarrow$?

$1350 / (9.76 \times 9.76) = 14.17\ kN/m^2$

For unit width of slab, the load becomes 1 × 14.17 = 14.17 kN/m

Now, the total factored load = 12.9 + 14.17

= **27.07 kN**

Moments Calculations

$l_x = l_y = 9.76$ m $\Rightarrow l_y/l_x = 1$

Hence, it is a two-way slab

$M_{ux} = \alpha_x w_u l_x^2 = 0.062 \times 27.07 \times 9.76^2 = 159.87$ kN-m

Similarly, $M_{uy} = 159.87$ kN-m

Depth of slab, $d = \sqrt{(M_u/0.138 f_{ck} b)} = \sqrt{[(159.87 \times 10^6)/0.138 \times 25 \times 1000)]}$

= 215.26 mm < 280 mm

Hence provide the depth of slab of **280 mm**

Reinforcement Details

$A_{st} = (0.36\ f_{ck}\ b\ x_u) / (0.87\ f_y)$

$= (0.36 \times 25 \times 1000 \times 0.48 \times 280) / (0.87 \times 415)$

$= 3350.22\ mm^2$ (for both directions)

Therefore, $A_{stx} = A_{sty} = 3350.22/2 = 1675.11\ mm^2$

Use 16 mm bars for the calculation of spacing,

$S = B\ a_{st} / A_{st}$

$= (1000 \times \pi/4 \times 16^2) / (1675.11) = 120.02$ mm = 120 mm

Number of bars = 9.76 / 0.120 = 81.33 = 82 bars in one direction

Hence, provide **82 bars** of **16 mm dia** with a spacing of **120 mm c/c**

Check for Shear

$V_u = ½ \times w_u \times l_x$

$= ½ \times 27.07 \times 9.76 = 132.10$ kN

$\tau_v = V_u / bd$

$= (132.10 \times 1000) / (1000 \times 280) = 0.47\ N/mm^2$

$\tau_c' = \tau_c \times k$

$P_t = (100 A_{st}) / bd$

$= (100 \times 1675.11) / (1000 \times 280) = 0.59$ %

Now, calculating the τ_c value from the P_t value,

0.50 % $\rightarrow$ 0.49

0.59 % $\rightarrow$?

0.75 % $\rightarrow$ 0.57

By using interpolation,

We get 0.49 + (0.57 – 0.49) (0.59 – 0.5)/ (0.75 – 0.5)

$\Rightarrow \tau_c = 0.5188$

$\tau_c' = 1.20 \times 0.5188 = 0.622\ N/mm^2$

From IS 456:2000, $\tau_{c\ max} = 2.80\ N/mm^2$

Now 0.47 < 0.622 < 2.80, i.e., $\boldsymbol{\tau_v < \tau_c' < \tau_{c\ max}}$

Hence it is safe in shear

Check for deflection:-

Checking for deflection, especially at the cantilever projections made from the column strips,

For Cantilevers, span/l_{eff} = 7

The modification factor for given mixed design is found out to be around 1.2

Therefore, 7 × 1.2 = 8.4

Now, span/l_{eff} = 1.22/0.15 = 6.77 < 8.4

Hence deflection is controlled in the span

Weight of Bottom Slab

U-boot betons

A total of 225 u-boot betons can be placed in our slab

Weight of u-boot beton is given as 1.15 kg/piece

For 225 u-boot betons, we get

225 × 1.15 = **258.75 kg**

Steel

Volume of steel = [164 × π/4 × 0.016^2 × 9.76] × 2

= 0.32 ×2 = 0.64 m^3

Weight of steel = volume × density

= 0.64 × 7850 **= 5024 kg**

Concrete

Volume of concrete = total volume – volume of steel – volume of u-boot betons

= (9.76 × 9.76 × 0.28) – 0.64 – (225 × 0.021)

= 26.67 – 0.64 – 4.725 = 21.305 m^3

Weight of concrete = 21.305 × 2400 = **51132 kg**

Total weight of slab = 258.75 + 5024 + 51132 = 32287.75=**56414.75** kg

= 553.08 kN = **560kN**

8.4 design of Raft Foundation

Size of slab: 9.76 m × 9.76 m

Mixed Design: M25 and Fe415

Density Calculations

Density of Reinforced Concrete = 25 KN / m^3

The reduced density in our slab as taken above is = **24.29 kN/m³**

Load Calculations

Assuming depth of slab to be 320 mm for the load calculations,

For unit width of slab,

Dead Load = 1 × 0.320 × 24.29 = 7.77kN/m

Live Load = 0.8 kN/m

Assume Floor Finish Load =1 kN/m

Total Load = 7.77 + 0.8 + 1 = 9.5 kN/m

Factored Load = 9.5 × 1.5 = 14.25 kN/m = **14.25 kN/m**

Loads from top floor,

Brickwork = 375 + 375 = 750 kN

Top slabs = 250 + 320 = 570 kN

Columns load = 15 + 15 = 30 kN

Bottom Slab Weight = 560 kN

Central Column Weight = 30 kN

Total load from above floor = 750 + 570 + 30 + 560 + 30 = 1940 kN = **2000**kN

But the load of 2000 kN is for the whole slab, hence calculating the load for 1 m^2 area, we get

9.76 × 9.76 m^2→ 2000 kN

1 m^2→ ?

2000 / (9.76 × 9.76) = 20.19 kN/m^2 = 21 kN/m^2

For unit width of slab, the load becomes 1 × 21 = 21 kN/m

Now, the total factored load = 14.25 + 21

= **35.25 kN**

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Moments Calculations

$l_x = l_y = 9.76$ m $\Rightarrow l_y/l_x = 1$

Hence, it is a two-way slab

$M_{ux} = \alpha_x w_u l_x^2 = 0.062 \times 35.25 \times 9.76^2 = 208.18$ kN-m

Similarly, $M_{uy} = 201.18$ kN-m

Depth of slab, d = $\sqrt{(M_u/0.138 f_{ck} b)} = \sqrt{[(201.18 \times 10^6)/0.138 \times 25 \times 1000)]}$

= 245.64 mm < 320 mm

Hence provide the depth of slab of **320 mm**

Reinforcement

$A_{st} = (0.36\ f_{ck}\ b\ x_u) / (0.87\ f_y)$

$= (0.36 \times 25 \times 1000 \times 0.48 \times 320) / (0.87 \times 415)$

= 3828.83 mm^2 (for both directions)

Therefore, $A_{stx} = A_{sty} = 3828.83/2 = 1914.41$ mm^2

Use 16 mm bars for the calculation of spacing,

$S = B\ a_{st} / A_{st}$

$= (1000 \times \pi/4 \times 16^2) / (1914.41) = 105.02$ mm = 106 mm

Number of bars = 9.76 / 0.106 = 92.07 = 92 bars in one direction

Hence, provide **92 bars** of **16 mm dia** with a spacing of **106 mm c/c**

Check for Shear

$V_u = ½ \times w_u \times l_x$

$= ½ \times 35.25 \times 9.76 = 172.02$ kN

$\tau_v = V_u / bd$

$= (172.02 \times 1000) / (1000 \times 320) = 0.54$ N/mm^2

$\tau_c' = \tau_c \times k$

$P_t = (100 A_{st}) / bd$

$= (100 \times 1914.41) / (1000 \times 320) = 0.59$ %

Now, calculating the τ_c value from the P_t value,

0.50 % $\rightarrow$ 0.49

0.59 % $\rightarrow$?

0.75 % $\rightarrow$ 0.57

By using interpolation,

We get 0.49 + (0.57 – 0.49) (0.59 – 0.5)/ (0.75 – 0.5)

$\Rightarrow \tau_c = 0.5188$

$\tau_c' = 1.20 \times 0.5188 = 0.622$ N/mm^2

From IS 456:2000, $\tau_{c\ max} = 2.80$ N/mm^2

Now 0.54 < 0.622 < 2.80, i.e., $\boldsymbol{\tau_v < \tau_c' < \tau_{c\ max}}$

Hence it is safe in shear

Check for deflection

Checking for deflection, especially at the cantilever projections made from the column strips,

For Cantilevers, span/l_{eff} = 7

The modification factor for given mixed design is found out to be around 1.2

Therefore, 7 × 1.2 = 8.4

Now, span/l_{eff} = 1.22/0.15 = 6.77 < 8.4

Hence deflection is controlled in the span

Weight of Raft Foundation

U-boot batons

A total of 225 u-boot batons can be placed in our slab

Weight of u-boot baton is given as 1.15 kg/piece

For 225 u-boot batons, we get

225 × 1.88 = **423 kg**

Steel

Volume of steel = $[184 \times \pi/4 \times 0.016^2 \times 9.76] \times 2$

= 0.361×2 = 0.72 m^3

Weight of steel = volume × density

= 0.72 × 7850 = **5652 kg**

Concrete

Volume of concrete = total volume – volume of steel – volume of u-boot betons

= (9.76 × 9.76 × 0.32) – 0.72 – (225 × 0.044)

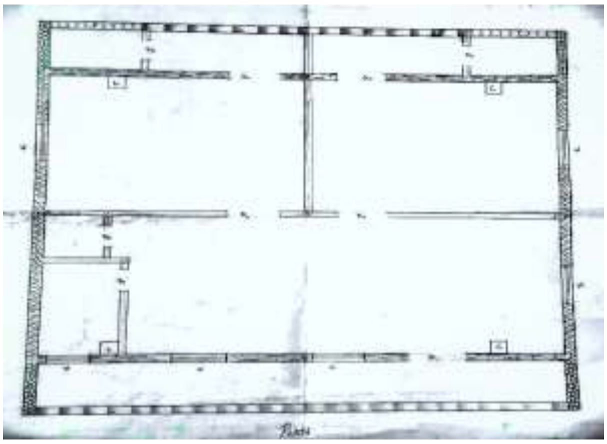
= 26.67 – 0.72 – 9.9 = 19.86 m^3

Weight of concrete = 19.86 × 2400 = **47664 kg**

Total weight of slab = 423 + 5652 + 47664 = 53739 kg

= 526.85 kN = **530kN**

9. PLAN OF 3 FLOORS



10. Brick work for u boot building

Description	Volume (m^3)	No. of bricks
Full bricks	27.4312	974
Half bricks	5.6315	382
Lintel	0.9911	-
Mortar	0.0894	-

10.1 Brick work for conventional

Description	Volume (m^3)	No. of bricks
Bricks	59.3040	29652
Lintel	1.8003	-
Mortar	0.0019	-

11. Magnetic repulsion technique

Repulsion is the opposite force of attraction which is obtained when two like poles of two magnets are tried to bring together. Magnets along with a central based together combined work for balancing the structure and transferring the loads from above safely to the raft foundation

I am choosing Neodymium magnets in my design and for prototype because these are very powerful. The lifetime of Neodymium is about 100 years, If we go for electromagnets, it is easier because the more is the supply of electricity, more will be the magnetic strength and lifetime. Care should be taken while noticing the north and south poles in the electromagnets.

The magnets shall be so placed that other than the repulsion chamber, the whole remaining area must be covered with a magnetic resistant material like rubber so that the magnetic lines does not affect the reinforcement and other magnetic materials in that area. The whole foundation must also be a closed chamber with the magnetic resistant materials.

12. OBSERVATIONS AND RESULTS

OBSERVATIONS

S No	Parameter	AAC Block	Brick
1	size (L x H x B)	0.6m x 0.2m x 0.15m	0.23m x0.075m x0.115m
2	compressive strength	3.72 n/mm2 (As per IS.:21851)	2.45 n/mm2
3	density wet	6.07 kn/m3	19.11 Kn/m3
4	density dry	7.84 Kn/m3	23.03 Kn/m3

5	fire Resistance	2 to 6 Hours depends on thickness	2 Hours
6	sound reduction in dB	45 per 200 mm thick wall	50 per 230 mm thick wall
7	Thermal Conductivity (Kw-m/C)	0.16	0.81
8	Mortar Consume per m^3 for 1:6	25 kg of Cement	75 kg of Cement
9	Chemical Composition	60 % fly-ash which mill with Lime to form AAC	Soil contain in-organics like sulphates result in Efflorescence

U-boot baton

height	dimensions	Piece wt	Piece volume	Pallet dimension
10 cm	52 X 52 cm	1.15 kg	0.0212 m3	110X110X240

- Number of columns = 4 each floor
- Dead load = 3.64 KN/m3
- Live load = 0.5 KN/m3
- Number of boots used per m3 = 2

U-BOOT SLABS DESIGN DETAILS

Details	Top slab	Intermediate slab	Bottom slab	Foundation raft
Density (Kn/m3)	24.29	24.29	24.29	24.29
Total factored load	7	17.2	27.07	35.25
Depth of slab	150 mm	180 mm	280 mm	320 mm
Area of steel for two way	1794.76 mm2	2153 mm2	3350.22 mm2	3828.83 mm2
Number of bars Dia of bar c/c distance	78 12 126	52 16 190	82 16 120	92 16 106
Check for shear Check for deflection	OK OK	OK OK	OK OK	OK OK
Weight of u-boot	258.75 kg	258.75 kg	258.75 kg	423 kg
Steel	2669 kg	3205 kg	5024 kg	5652 kg
Concrete	22116 kg	28824 kg	51132 kg	47664 kg

BRICK WORK DETAILS BY AAC BLOCKS

DESCRIPTION	DESITY Kg/m3	VOLUME M3	NUMBER OF BRICKS	WEIGHT KG
Full brick	625	27.4312	974	17144.5
Half brick	625	5.6315	382	3519.68

Lintel	2400	0.991 1	-	2378. 64
mortar	2200	0.089 4	-	196.6 8
			TOT AL	23239 .505 KG

227.83 KN

Taking 250 KN

Total factored weight = 250 x 1.5

= 375 KN

BRICK WORK DETAILS BY NORMAL BRICKS

DESCRI PTION	DES ITY Kg/ m3	VOL UME M3	NUM BER OF BRIC KS	WEI GHT KG
Brick work	1800	59.30 4	29652	10674 7.2
Lintel	2400	1.800	-	4320
mortar	2200	0.001 9	-	7.92
			TOT AL	11107 5.12 KG

1088.97Kn

Taking 1100 KN

Total factored weight = 1100 x 1.5

= 1650 KN

RESULTS

	MATERIAL		CONVENTI ONAL	Ideal by batons and AAC blocks
densi ty	RC C	1st floor	357.22 KN	245.42 KN
		2nd floor	428.65 KN	316.41 KN
		3rd floor	666.80 KN	552.86 KN
		Raft founda tion	762.06 KN	526.64 KN
weig ht	Total Brick work		1650 KN/structure	375 KN/stru cture
quan tity	Ste el	1st floor	26.15 KN	26.15 KN
		2nd floor	31.40 KN	31.40 KN
		3rd floor	49.23 KN	49.23 KN
		Raft founda tion	55.38 KN	55.38 KN

The amount of steel is same in two cases bot the pattern of arrangement should be changed

13. CONCLUSION

From the design criteria, properties of the materials used, and prototype structure I can conclude that the construction of lightweight building can be made possible and there is surely a hope for the future generations to apply this ‘Ideal Building’ concept

- I am concluding that there is an enormous decline in the weight of the structure.
- U-boot baton structure takes excess care when compared to that of a conventional one.

- The whole magnet system on the mat foundation will act as columns poles reflection
- Comparing the weights of conventional brickwork and AAC brickwork system, we see a rate of almost 4.4 times of heavy weight using conventional. Hence by using AAC Blocks, we can reduce the weight from 1650 kN to 375 kN, i.e., decrease of about 4.4 times.
- U-boot and AAC building structures with mat foundations are suitable in such soil conditions where the bearing capacity of soil is poor.

REFERENCE

Code Books:

- IS: 456-2000, code of practice for Plain and Reinforced Concrete, Bureau of India Standards.
- IS: 10262-1982, Recommended Guidelines for Concrete Mix Design, Bureau of India Standards.

Certifications:

- Fire Resistant Certificate REI 180 for U-Boot Baton issued by the CSI institute in Bollate
- Certification of a Load Test on a sample with U-Boot Baton issued by the University of Darmstadt.
- Acoustic test according to the standard UNI EN ISO 140-6 - Measurement of acoustic insulation
  In buildings and building elements; Laboratory measurements of the insulation footstep noise
  Issued by the Institute Giordano di Gatteo
- Acoustic test according to the standard UNI EN ISO 140-3 - Measurement of acoustic insulation
  In buildings; Laboratory measurements of the insulation of air-borne noise from building elements
  Issued by the Institute Giordano di Gatteo
- Loading and breaking test certified by the University of Padua.
- Environmental Compatibility Certification
- Member of the Green Building Council Italia.
- System certification pursuant to ISO 9001-ISO 14001 - SA Standard 8000.

Text Books:

ESTIMATION AND COSTING, by B. N. DUTTA

CONCRETE TECHNOLOGY, by M. S. SHETTY

DESIGN OF REINFORCED CONCRETE STRUCTUTES, by ASHOK K. JAIN

DESIGN OF STRUCTURAL ELEMENTS, by DHEERENDRA BABU

MAGNETISM IN PHYSICS, by H. C. VERMA