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Evaluation of Building Foundations: A Structural Engineering Perspective

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Abstract

This study focuses on the comprehensive assessment and design of building foundations, emphasizing the critical relationship between structural loads and soil properties. The depth of the foundation is determined by analyzing the load exerted on the column and the soil's bearing capacity, both of which play a pivotal role in ensuring stability. Similarly, the foundation base size is calculated based on these parameters to ensure it effectively transfers the load to the soil without compromising safety or structural integrity. The findings indicate that while both the column load and the soil's bearing capacity are essential considerations, the latter often has a more significant influence on the required foundation depth. This is because the soil's capacity to bear load dictates how deeply the foundation must be placed to prevent settlement or failure. However, when determining the foundation base size, both factors have an equally critical role, highlighting their interdependence in the design process. This study underscores the necessity of a balanced approach in foundation design, considering both structural loads and geotechnical factors. By ensuring that both parameters are carefully evaluated, engineers can optimize foundation dimensions to enhance performance, reduce material usage, and maintain safety standards. These insights provide valuable guidance for structural engineers and project managers, enabling the development of cost-effective and stable foundations tailored to varying site conditions and structural demands. This research contributes to a deeper understanding of the intricate relationship between structural loads and soil properties in modern construction practices.

Keywords: Depth of foundation, foundation base size, bearing capacity of soil, load acting on column

INTRODUCTION

The design and construction of building foundations are critical components of structural engineering, as they ensure the stability and safety of the structure by effectively transferring loads to the ground. This study focuses on analyzing the depth of the foundation and the foundation base size by considering two key factors: the bearing capacity of the soil and the load acting on the column. Both parameters play an integral role in determining the foundation design, but their influence varies depending on specific conditions [1].

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The bearing capacity of the soil, which represents the soil's ability to support structural loads, is identified as the dominant parameter for determining the depth of the foundation. This is because the depth must be sufficient to prevent issues such as settlement or shear failure, which are directly influenced by the soil's strength and capacity. On the other hand, the load acting on the column, which depends on the weight and design of the structure, is also an important consideration but has a relatively lesser impact on foundation depth compared to soil bearing capacity [2–4].

In addition to depth, this study also evaluates the foundation base size by considering both the column load and the soil's bearing capacity. The relationship between these factors is analyzed to establish an optimal design that ensures safety while maintaining efficiency in material usage. A comparative analysis is conducted to understand the interplay between these parameters, highlighting their individual and combined effects on foundation design. This research provides valuable insights into the interdependencies between structural and geotechnical parameters in foundation engineering [5–7].

RESULTS AND DISCUSSION

The analysis of the foundation design was conducted based on the load acting on the column and the bearing capacity of the soil at the foundation base. The column load was calculated as 120 t, with an additional self-weight of the column derived from its cross-sectional area (0.5×0.5 m^2), height (4 m), and the unit weight of concrete (24 kN/m^3). The self-weight was found to be 2.4 t, resulting in a total weight of 122.40 t. Considering an additional 10% weight of the foundation, the total load at the foundation base was determined to be 134.64 t [8, 9].

Case 1: Bearing Capacity =25 t/m² (Sandy Soil)

For sandy soil with a bearing capacity of 25 t/m^2, the foundation base size L×BL\times BL×B was determined to be L=B=2.32 m, L=B=2.32, L=B=2.32 m, resulting in an area of 5.39 m^2. The load intensity at the foundation base was maintained at 25 t/m^2, and the gross bearing capacity of the soil was calculated as 25+8.33=33 t/m^2. Using this, the depth of the foundation was estimated. The thickness of the foundation base slab was calculated as 193 mm to safely distribute the load [10].

Case 2: Bearing Capacity =15 t/m² (Reduced Soil Strength)

When the bearing capacity of the soil was reduced to 15 t/m^2, the foundation base size increased to L=B=2.842 mL=B=2.842\, L=B=2.842 m, resulting in an area of 8.076 m^2. The gross bearing capacity was adjusted to accommodate the lower soil strength, and the load intensity remained constant at 15 t/m^2. In this case, the thickness of the foundation base slab increased to 198 mm, reflecting the need for additional support.

Comparison of Results

- For a higher soil bearing capacity (25 t/m^2), a smaller foundation base size of 5.39 m^2 and a depth of 1.542 m were sufficient.
- For a lower soil bearing capacity (15 t/m^2), a larger foundation base size of 8.076 m^2 and a depth of 0.925 m were required.
- The depth of the foundation base slab was found to be nearly constant in both scenarios, indicating that the load remains the same while the soil's bearing capacity dictates the foundation size.
- Load on column =120 t
- Load of column (c/s area =0.5×0.5 m^2, height of column =4 m, Unit weight of concrete =24 kN/m^3).
- Self weight of column 0.5×0.5×4×24=2.4 t
- Total weight =120+2.4=122.40 t
- 10% weight of foundation $= \frac{10}{100}\ x\ 122.40 = \ 12.24\ t$
- Load at foundation base =134.64 t.
- If sandy soil is at foundation base which bearing capacity =25 t/m^2.
- Hence $= \frac{134.64}{b\ x\ d}\ =\ 25$

  $b\ x\ d = \frac{134.64}{25}\ =\ 5.39m^2$

  Where L×B= Size of foundation.
  Hence L=B=2.32 m
- Hence depth of foundation

- Load intensity $q = \frac{134.64}{2.32\ x\ 2.32} = \frac{134.64}{5.38} = 25\ t/m^2$
- Load intensity =25 t/m^2.
- Gross bearing capacity $\frac{25\ +\ 25}{3}$

  $\Rightarrow$ 25+8.33$\Rightarrow$33 t/m^2
- Depth of foundation required $D_f = \frac{25}{1.8}\ x\ 0.111 = 1.542\ meter$
  Unit weight of soil γ=1.8 t/m^3 at foundation level.
  Angle of repose =30°

  Hence, $\left[\frac{1-Sin\varphi}{1+Sin\varphi}\right]^2 = 0.111$
- Load is taken constant and bearing capacity of soil is varying. Bearing capacity of soil =15 t/m^2 taken.
- Load at foundation base =134.64 t.
- Foundation base area = $\frac{134.64}{b\ x\ d} = 15$
  b×d=8.076 m^2
  L=B=2.842 m
  Length and width of foundation base =2.842 m
- Load intensity =15 t/m^2.
- Gross bearing capacity of soil = $\frac{15\ +\ 15}{3} = 20\ t/m^2$
- Depth of foundation $D_f = \frac{15}{1.8}\ x\ 0.111 = 0.925\ meter$
- Thickness of foundation base slab: (For 25 t/m^2 bearing capacity)

  $\frac{134.64\ x\ 1000\ x\ 10}{2.32\ x\ 1000\ x\ t} = \frac{10}{100} x\ 30 = 3$

  6960 t=1346400
  t=193 mm.
- For 15 t/m^2 bearing capacity of soil
  Length of foundation base =2.842 m.
- Load at foundation base is constant

  $\frac{134.64\ x\ 1000\ x\ 10}{2.842\ x\ 1000\ x\ t} = \frac{10}{100} x\ 30 = 3$

  8526 t=1346400.

  t=198 mm
- Where t= Thickness of foundation base slab in mm.
  Tensile strength of M30 grade concrete $\frac{10}{100} x\ 30 = 3\ N/mm^2$
- For 25 t/m^2 of bearing capacity of soil, we require lesser size of foundation base and for 15 t/m^2 bearing capacity of soil, we require larger size of foundation base; hence, depth of foundation base slab = nearly same.
- For 15 t/m^2 bearing capacity of soil, foundation base size L×B=8.076 m^2 and depth of foundation is 0.925 m.
- For 25 t/m^2 bearing capacity of soil L×B=5.39 m^2 and depth of foundation =1.542 m.

Findings

For lesser bearing capacity of soil, we need lesser depth and for more bearing capacity of soil, we need more depth of foundation.
Increase in bearing capacity of soil/:

In 15 t/m^2 increase 10 t/m^2

$1 \quad \rightarrow \quad \frac{10}{15}$

$100 \quad \rightarrow \quad \frac{10}{15}\ x\ 100$

⇒83.33%.

Increase in depth of foundation:

In 0.925 m increase (1.542–0.925)=0.617 m.

$1 \quad \rightarrow \quad \frac{0.617}{0.925}$

$100 \quad \rightarrow \quad \frac{0.617\ x\ 100}{0.925}$

⇒66.70%.

Findings

- Due to 83.33% increase in bearing capacity of soil, we need 66.70% increase in depth of foundation.
- For 15 t/m^2 foundation base size 8.076 m^2.
- For 25 t/m^2 bearing capacity of soil foundation base size =5.39 m^2.
- Increase in bearing capacity of soil =83.33%.

Decrease in foundation base size:

In 8.076 m^2 decrease in foundation base size (8.076–5.39)=2.686 m^2

$$1 \quad \rightarrow \quad \frac{2.686}{8.076}$$

$$100 \quad \rightarrow \quad \frac{2.686}{8.076}\, x\, 100 = 33.25\%.$$

Findings

- Due to 83.33% increase in bearing capacity of soil the foundation base size decreases by 33.25%.

Formation of model

Input parameter: Bearing capacity of soil (q in t/m^2)

Output parameter: depth of foundation and foundation base size.

- Prediction from model can be made (Table 1).
- Input parameter =20 t/m^2.
- Output parameters: Depth of foundation and Foundation base size.

Model for depth of foundation (output parameter) and bearing capacity of soil (Input parameter):

- In model, unit should be same in left hand side and right hand side (Table 2):

Table 1. Data for bearing capacity of soil, Depth of foundation and Foundation Base Size.

S. N.	Bearing capacity of soil in t/m^2(q)	Depth of foundation in meter (D_f)	Foundation Base Size in m^2 (b×d)
1	15	0.925	8.076
2	25	1.542	5.390

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Table 2. Data for $\frac{Q}{Q_{max}}$ & $\frac{D_f}{D_{fmax}}$

S. N.	$\frac{Q}{Q_{max}}$	$\frac{D_f}{D_{fmax}}$
1	0.600	0.600
2	1.000	1.000
Average	0.800	0.800

Corresponding to average value of $\frac{Df}{D_{fmax}}$=0.800≈1.000, corresponding value of $\frac{Q}{Q_{max}}$=1.000 and average value of $\frac{Q}{Q_{max}}$=0.800

Lesser value taken

Hence power of $\frac{Q}{Q_{max}} = \frac{0.8000}{1.000} = 0.800$

- Hence model is $\frac{Df}{D_{f\max}} = x\left[\frac{Q}{Q_{\max}}\right]^{0.800}$

Average value of $\frac{Df}{D_{f\max}} = 0.800$ & $\frac{Q}{Q_{\max}} = 0.800$

Hence, 0.800=x $\{0.800\}^{0.800}$
=x {0.837}

Hence, $x = \frac{0.800}{0.837} = 0.956$

Hence, model for $\frac{Df}{D_{f\max}}$ & $\frac{Q}{Q_{\max}}$

$$\frac{Df}{D_{f\max}} = 0.956\left[\frac{Q}{Q_{\max}}\right]^{0.800} \qquad -(1)$$

Prediction from model

For bearing capacity q=30 t/m²

$\frac{Df}{D_{f\max}} = 0.956\left[\frac{30}{25}\right]^{0.800}$ $\qquad \frac{Df}{D_{f\max}} = 0.956\left[1.200\right]^{0.800}$ $\qquad$ = 0.956 [1.157]
=1.106

Hence, D_f=1.705 m.

- For bearing capacity of soil =30 t/m² depth of foundation 1.705 m.

Validation of model

For bearing capacity of soil q=25 t/m²
Using the model,

$$\frac{Df}{D_{f\max}} = 0.956\left[\frac{25}{25}\right]^{0.800} \qquad = 0.956$$

D_f=1.474 m≈1.542 m

Hence, model is validated.

Model for foundation base size and bearing capacity of soil (Tables 3 and 4).

Table 3. Data for bearing capacity of soil and foundation base size.

S. N.	Bearing Capacity of Soil in t/m^2 (q)	Foundation Base Size in m^2 (b×d)
1	15	8.076
2	25	5.390

Table 4. Data for $\frac{Q}{Q_{max}}$ & $\frac{b\ x\ d}{(b\ x\ d)_{max}}$

S. N.	$\frac{Q}{Q_{max}}$	$\frac{b\ x\ d}{(b\ x\ d)_{max}}$
1	0.600	1.000
2	1.000	0.667
Average	0.800	0.834

For lesser bearing capacity of soil, we require more foundation base size to sustain the load.

Hence $\frac{Q}{Q_{max}} \alpha \frac{1}{\frac{(b\ x\ d)}{(b\ x\ d)_{max}}}$

Hence formation of model,

Corresponding to average value of $\frac{b\ x\ d}{(b\ x\ d)_{max}}$ =0.834≈1.000

$\frac{Q}{Q_{max}}$ = 0.600 and average value of $\frac{Q}{Q_{max}}$ = 0.800

Hence power of $\frac{Q}{Q_{max}} = \frac{0.600}{0.800} = 0.750$

Hence model is $\frac{b\ x\ d}{(b\ x\ d)_{max}} = x\left[\frac{1}{\frac{Q}{Q_{max}}}\right]^{0.750}$

Average value of $\frac{b\ x\ d}{(b\ x\ d)_{max}}$ =0.834 and $\frac{Q}{Q_{max}}$ =0.800

- Hence,

$$0.834 = x\left[\frac{1}{0.800}\right]^{0.750}$$
$$= x[1.182]$$
$$x = 0.706$$

- Hence model is $\frac{b\ x\ d}{(b\ x\ d)_{max}} = 0.706\left[\frac{1}{\frac{Q}{Q_{max}}}\right]^{0.750}$ – (2)

For bearing capacity =30 t/m^2

$$\frac{b\ x\ d}{(b\ x\ d)_{\max}} = 0.706\left[\frac{1}{\frac{30}{25}}\right]^{0.750}$$

$$= 0.706\left[\frac{1}{1.20}\right]^{0.750}$$

= 0.706 {0.833}$^{0.750}$
=0.706 {0.872}
=0.616
b×d=4.975 m^2

- For more bearing capacity of soil, lesser foundation base size is required
- Load on column =100 t
- Bearing capacity of soil =25 t/m^2.
- Load of column =2.4 t
- Total load =102.40 t
- 10% weight of foundation:
  $$\frac{10}{100}\,x\,102.40 \Rightarrow 10.24t$$
- Total load on foundation base =112.64 t.
  $$\frac{112.64}{25} = 4.51m^2$$ (foundation base size)
- Load intensity
  $$q = \frac{112.64}{4.51} = 24.98\ t/m^2$$
- Depth of foundation
  $$D_f = \frac{24.98}{1.8} = 0.111 = 1.540\ meter$$
- For 100 t load b×d=4.51 m^2
  Depth of foundation =1.540 m.
  Bearing capacity of soil =25 t/m^2
- For 120 t, b×d=5.390 m^2
  D_f=1.542
  Bearing capacity of soil =25 t/m^2
- Increase in load:
  In 100 t increase in load =20 t
  $$1 \quad \rightarrow \frac{20}{100}$$
  $$100 \quad \rightarrow \frac{20}{100}\,x\,100 \Rightarrow 20\%$$
- Increase in load ⇒20%.
- Increase in depth of foundation
  In 1.540 m increase is 0.002 m.
  $$1 \quad \rightarrow \frac{0.002}{1.540}$$

$$100 \quad \rightarrow \frac{0.002\,x100}{1.540} \Rightarrow 0.13\%$$

Findings

- Due to 20% increase in load depth of foundation is increased very less i.e. 0.13%.
- If bearing capacity is constant due to lesser amount of load foundation base size required is lesser.
- Increase in foundation base size:
- In 4.51 m^2 increase in foundation base size (5.39–4.51)=0.88 m
- $1m^2 \quad \rightarrow \frac{0.88}{4.51}$
- $100 \quad \rightarrow \frac{0.88\,x100}{4.51} = 19.51\%$

Findings

- Due to 20% increase in load foundation base size increased by 19.51% i.e. nearly same amount of increase in foundation base size.
- Bearing capacity is variable and load is taken constant.
- For 120 t, b×d=5.39 m^2
  D_f=1.542 m,

Bearing capacity of soil =25 t/m^2

- Increase in bearing capacity of soil 20% $\frac{20}{100}\,x\,25 = 5t/m^2$
- Hence bearing capacity of soil =30 t/m^2
- Foundation base size $\frac{120}{30} = 4m^2$
- Load intensity $\frac{120}{4} = 30\,t/m^2$
- Depth of foundation $D_f = \frac{30}{1.8}\,x\,0.111 \Rightarrow 1.85\,meter$
- For constant load =120 t, Bearing capacity of soil 25 t/m^2, D_f=1.542 m
  b×d=5.39 m^2
- For bearing capacity =30 t/m^2, b×d=4 m^2
  D_f=1.85 m, load =120 t.
- Increase in depth of foundation.
  In 1.542 m ⇒ Increase in depth of foundation
  = (1.85–1.542)
  = 0.308 m
  $1 \quad \rightarrow \frac{0.308}{1.542}$
  $100 \quad \rightarrow \frac{0.308\,x100}{1.542} = 19.97\%$

Findings

- Due to 20% increase in bearing capacity of soil depth of foundation is increased nearly same i.e. 19.97%.
- For more bearing capacity, lesser foundation base size is required.

Decrease in foundation base size

In 5.39 m^2 decrease is (5.39–4)=1.39 m

$$In\ 1m^2 \quad \rightarrow \frac{1.39}{5.39}$$

$$100 \quad \rightarrow \frac{1.39\ x 100}{5.39} = 25.79\%$$ decrease in foundation base size.

Findings

- Due to 20% increase in bearing capacity of soil the foundation base size is decreased by 25.79%.
- Due to increase in load, there is nearly same amount of increase in foundation base.
- Due to increase in load, there is very less increase in depth of foundation.
- Due to increase in bearing capacity of soil there is nearly same increase in depth of foundation.

Findings

- Due to increase in load, depth of foundation increases very less whereas due to increase in bearing capacity, depth of foundation is increased by same amount.
- Hence bearing capacity of soil is dominant parameter for depth of foundation as compared to load.
- Due to increase in load, there is nearly same amount of increase in foundation base.
- Whereas due to increase in bearing capacity of soil, there is more decrease in foundation base size.

Selection of Bearing Capacity of Soil

- Load on column =120 t
- Weight of column:
  0.5×0.5×4×24=2.4 t
- Total load =122.40 t
- 10% weight of foundation $= \frac{10}{100}\ x\ 122.40 = 12.24\ t$
- Total load at foundation base =134.64 t.
- Lateral load at foundation base:
  =0.217×134.64=29 t
- Hence bearing capacity of soil should be 30 t/m^2>29 t
- Gross bearing capacity of soil required $= \frac{30+30}{3} = 30 + 10 = 40\ t/m^2$
- Foundation base size required $= \frac{134.64}{40} = 3.37 m^2$
- Foundation base size =1.836×1.836 m.
- Depth of foundation required:
- Load intensity $= \frac{134.64}{3.37} = 40\ t/m^2$
- Depth of foundation $D_f = \frac{40}{1.8}\ x\ 0.111 = 2.467\ meter$

  $$\left(\frac{1-Sin\phi}{1+Sin\phi}\right)^2 = 0.111$$

  $\phi=30^o$
  $\gamma=1.8$ t/m^3

- Load below GL =134.64 t
- Lateral load =0.217×134.64=29 t

  Where $\frac{1-Sin\phi}{1+Sin\phi}=0.217$

  ϕ=40° for concrete.
- This 29 t acting at middle of foundation depth i.e. at $\frac{2.467}{2}=1.234\,m$
- At depth 1.234 m bearing capacity of soil
  q=1.8×1.234×9=20 t<29 t
  Not Safe.
  Where γ=1.8 t/m^3
  ϕ=30°
  $\left(\frac{1+Sin\phi}{1-Sin\phi}\right)^2=9$
- Hence, we have strength the soil surrounding the column by 1 part sand and 1 part gravel.

Strength of soil $=\frac{20+44}{2}=32\,t/m^2$
Where sandy soil =20 t/m^2
Strength of gravel =44 t/m^2

Hence From Foundation Base Soil Will Be Stabilized By 1 Part Sand and 1 Part Gravel

- Lateral load at depth 1.234 m below GL=29 t
- Strength of stabilized soil =32 t/m^2>29 t

Hence OK

- Strength taken in t/m^2 whereas load in tons taken.
- For high rise building load on column =600 t
- Weight of column: 0.8×0.8×4×24=6.144 t
- Where c/s area of column =0.8 m×0.8 m
- Height of column =4 m
- Unit weight of concrete =24 kN/m^3
- Total load at GL=606.144 t
- 10% weight of foundation $=\frac{10}{100}\,x\,606.144=60.614\,tonne$
- Load at foundation base =600+6.144+60.614=667 t.
- Lateral load at foundation base =0.217×667=145 t.
- Where $\frac{1-Sin\phi}{1+Sin\phi}=0.217$

(ϕ=40° for concrete)

- Hence bearing capacity of soil required 150 t/m^2 since lateral load at foundation base =145 t.
- Hence foundation base size required $=\frac{667}{150}=4.45\,t/m^2$
- Foundation base size $=\sqrt{4.45}=2.11m\;x\;2.11\,m$
- Hence load intensity $q=\frac{667}{4.45}=150\,t/m^2$
- Bearing capacity of soil should be more than load intensity i.e. 165 t/m^2.

- Gross bearing capacity of soil $150+\frac{150}{3} \Rightarrow 200\, t/m^2$
- Hence, we have to take 200 t/m^2 of bearing capacity.
- Depth of foundation $D_f = \frac{150}{1.8}\, x\, 0.111 = 9.25\, meter$

ϕ=30^o
γ=1.8 t/m^3

$$\left(\frac{1-Sin\phi}{1+Sin\phi}\right)^2 = 0.111$$

- Taking depth of foundation =10 m
- For high rise building we take seismic effect.
- Ground vibration =0.215 g=2.109 m/sec^2
- Using p=mf
- 0.8×0.8×(10+0.79)×1850×2.109=27 t

Where base thickness 790 mm

- Depth of foundation base $\frac{667\, x\, 1000\, x\, 10}{2.11\, x\, 1000\, x\, t} = \frac{10}{100}\, x\, 30 = 3$

  6330 t=6670000
  t=1054 mm
  =1.054 m.
- Since foundation base thickness is more and for high rise building we take M40 grade concrete

Hence $\frac{667\, x\, 1000\, x\, 10}{2.11\, x\, 1000\, x\, t} = \frac{10}{100}\, x\, 40 = 4$

  8440 t=6670000
  t=790 mm.

- Where tensile strength of M40 grade concrete $= \frac{10}{100}\, x\, 40 = 4\, N/mm^2$
- Hence lateral load at bottom column due to ground vibration =27 t
- Lateral load due to 600 t acting on column.
- Hence total lateral load acting at middle of bottom column

  =0.217×600+27=130+27=157 t load acting at middle of bottom column i.e. $\frac{4}{2}$
- Hence overturning moment at base of GL $= 157\, x \frac{4}{2} = 314\, t-m$
- Restoring moment can be given by foundation base and depth of foundation (surrounding soil).
- Strength of soil surrounding the foundation base =200×2.11×0.79=333 t.
- Since strength of soil is found at middle of foundation depth 10 m i.e. $\frac{10}{2} = 5m$
- Bearing capacity of soil at 5 m depth
  q=1.8×5×9=81 t/m^2

  $$\left[\frac{1+Sin\phi}{1-Sin\phi}\right]^2 = 9$$

  ϕ=30^o
- At GL bearing capacity of soil 10 t/m^2 and at foundation base 200 t/m^2.

- Average bearing capacity of soil $\frac{200+10}{2}=105\,t/m^2$
- Hence strength of soil surrounding the column.
- 105×0.8×10=840 t
- Hence 840+333=1173 t acting at $\frac{10+0.79}{2}=5.40\,m$
- Hence restoring moment at GL=1173×5.40⇒ 6334 t-m>314 t-m

Hence Safe

- Check of safety at foundation base.
- Overturning moment at foundation base

Weight of foundation =60.614 t

- Lateral load =0.217×60.614=13 t
- Total lateral load acting at middle of $\frac{10+0.79}{2}=5.40\,meter$

  =157+13=170 t
- Overturning moment at foundation base =170×5.40=918 t-m at foundation base.
- Restoring moment given by soil surrounding the foundation base and column below GL: 1173×5.40=6334 t-m>918 t-m

Hence Safe

- Lateral load 170 t acting at middle of foundation depth i.e. $\frac{10}{2}=5\,m$ and bearing capacity of soil at 5 m depth =81 t/m^2

  81 t/m^2<170 t

Not Safe

- Strength of soil in t/m^2 and load is expressed in ton.
- Hence soil below the GL will be stabilized by 1 part gravel and 2 part stone particles.
- Soil will be stabilized from base of foundation up to GL.
- Thickness of stabilized soil surrounding the column.
- Since lateral load due to column and strength of stabilized soil surrounding the column are acting.
- Hence thickness of soil surrounding the column $\frac{170\,x\,1000\,x\,10}{10\,x\,1000\,x\,t}=1.87$

10 m depth of foundation more than width of column =0.8 m hence 10 m length is taken L should be more than B 18700 t=1700000.

t=91 cm

i.e. thickness of stabilized soil should have thickness of 1m surrounding the column.

CONCLUSION

- *Effect of soil bearing capacity on foundation depth*: The depth of the foundation shows a proportional increase with an increase in the soil's bearing capacity. This highlights the significant influence of soil strength on determining foundation depth to ensure stability.
- *Impact of column load on foundation depth*: Changes in the load acting on the column result in a minimal increase in the depth of the foundation compared to the changes caused by the soil's bearing capacity. This indicates that column load plays a secondary role in determining foundation depth.

- *Foundation base size dependence:* The size of the foundation base is directly influenced by both the load acting on the column and the bearing capacity of the soil. Variations in either of these factors lead to a nearly proportional change in the foundation base size, showcasing the interdependence of these parameters.

Overall Observations

- Higher soil bearing capacity allows for a smaller foundation base size, resulting in reduced material requirements and construction costs.
- Lower soil bearing capacity necessitates a larger foundation base size to distribute the load effectively and maintain stability.
- The depth of the foundation remains relatively consistent, reflecting the balancing effect of load and soil properties in achieving optimal foundation design.
- These conclusions emphasize the critical role of evaluating both structural loads and geotechnical conditions to design safe and efficient foundations tailored to specific project requirements.

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