TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2083 Baishakh**

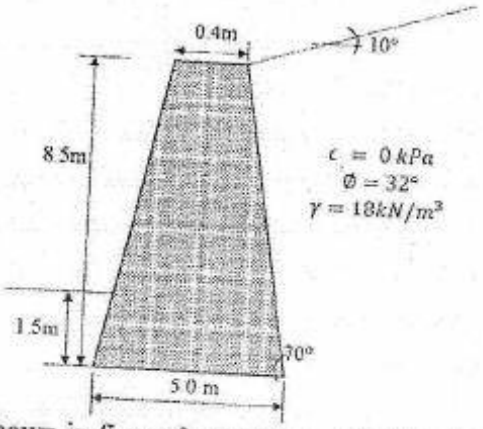
| Exam. | Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / I | Time | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE 602)*

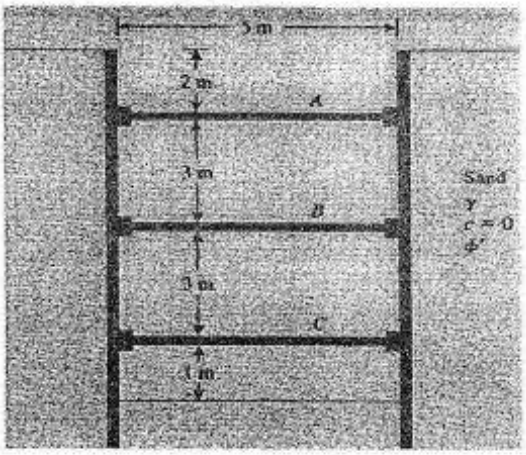
- ✓ *Candidates are required to give their answers in their own words as far as practicable.*
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*



1. What are the basic criteria that needs to be satisfied by foundations for its satisfactory performance? [2]
2. a) Explain stages of site exploration. [4]
   b) A SPT was performed at a depth of 20 m in a dense sand deposit with a unit weight of $20\ kN/m^3$. If the number of blows were found to be 20, 22 and 24 for each 150 mm penetration, what is the corrected N-Value? If the sampling tube is pushed into the soil at the bottom of borehole to a distance of 550 mm and the length of sample recovered is 510 mm, what is the recovery ratio? What is your conclusion on recovery ratio?
   c) What are the things you will consider while preparing the site investigation report? [4]
3. a) What are the assumptions and limitations of Rankine's earth pressure theory? [4]
   b) A retaining wall is 8 m high and the supported soil consists of 4.0 m sand ($\phi = 40^\circ$ and $\gamma = 18\ kN/m^3$) overlying saturated sandy clay with (C= 17 $kN/m^2$, $\phi = 30^\circ$ and $\gamma = 19\ kN/m^3$). The ground water table is at the upper surface of the sandy clay. Make a sketch of the distribution of the active pressure on the wall stating the principal values. Calculate the total earth thrust per metre of the wall and its point of application. Assume that the backfill is horizontal at the surface. [6]
   c) Check different stability conditions for the given retaining wall. Assume appropriate value where necessary. [8]




4. Refer the braced cut as shown in figure for which $\gamma = 17\ kN/m^3$, $\phi = 35°$, and $c = 0$. The struts are located 4 m on center in the plan. Draw the earth pressure envelope and determine the strut loads at levels A, B and C. [4]




5. Find depth of embedment for the anchored sheet pile supporting 8 m deep excavation in cohesionless soil. Take $\gamma\ of\ soil\ = 18\ kN/m^3$, $\phi = 30^\circ$ and position of anchor is 1m from ground surface. [4]

6. a) Critically differentiate between general shear failure and local shear failure. What are the factors affecting bearing capacity of soil? [4]
   b) A circular footing of 2.5m diameter carries a gross load of 2000 kN. The supporting soil is claycy sand ($\phi = 30°$, $\gamma = 19kN/m^3$). Determine the depth at which the footing should be located to provide the factor of safety 3. Use Terzaghi's theory. Take $N_c = 37.2$, $N_q = 22.5$, $N_\gamma = 19.7$ for $\phi = 30^0$. [8]

7. A raft foundation is 20 m x 30 m. The raft is constructed over a soft clay stratum having $C_u$=10kN/m$^2$ and $\gamma$=19 kN/m$^3$. If the live load and dead load on the raft are 100 MN, find the depth of foundation if [6]
   a) The foundation is fully compensated.
   b) Determine the depth of foundation for a factor of safety of 3.

8. a) Classify pile based on material, method of installation load transfer mechanism and use. [4]
   b) A 30 cm square concrete pile, 15 m long is driven in a deposit of medium dense sand ($\phi = 36^\circ, N_\gamma = 40$ and $Nq = 42$). The unit weight of sand is $18kN/m^3$. What is the allowable load carrying capacity of pile. Take FOS= 3. [4]
   c) What are the effects and remedial measures of negative skin friction in pile. [4]

9. a) Define the components of well foundation with diagram. [3]
   b) A circular well of 8m external diameter and 6m internal diameter is embedded to a depth of 20 m subjected to a horizontal force of 600 kN acting at a height of 10 m above scour level. Determine the allowable equivalent resisting force due to earth pressure assuming tilt is at point above base. Take $\gamma_{sat} = 22\ kN/m^3$ and $\phi = 30^\circ$ and FoS for passive resistance = 2. [5]

10. List out the types of dynamic compaction methods for deeper layers of soil. What do you understand by vibro flotation? Explain. [4]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2082 Bhadra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III/1 | Time | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE 602)*

- ✓ *Candidates are required to give their answers in their own words as far as practicable.*
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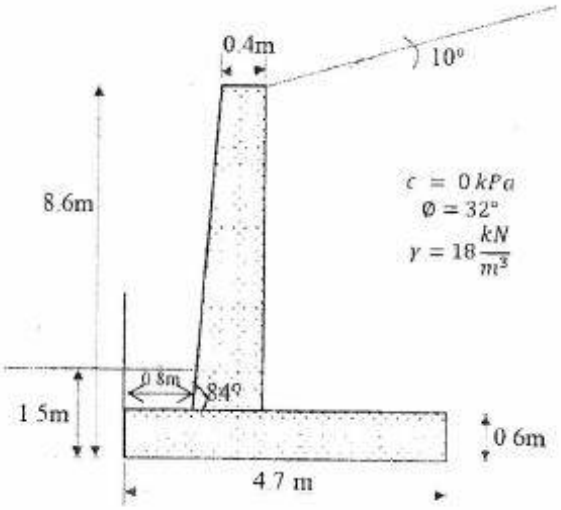
1. Differentiate between shallow foundation and deep foundation. Also, name their types. [2]
2. a) What do you understand by site investigation? How would you decide the depth of exploration and lateral extent of investigations? [4]
   b) A soil sampler is used to extract a soil sample. The sampler has an inner diameter of 68 mm at the cutting edge and 70 mm at the sampling tube, while the outer diameter is 74 mm at the cutting edge and 72 mm at the sampling tube. Calculate the Inside clearance, Outside clearance, Area ratio.Based on the calculated values, classify the type of soil sampleobtained (disturbed or undisturbed). [4]
   c) Describe plate load test and its limitations. [4]
3. a) What are the differences between Rankine's and Coulomb's theory? [2]
   b) A retaining wall of 6 m high has two layers of backfill. The soil supported consists of 3m sand ($\gamma$=17.5 kN/m$^3$, $\phi$=30$^0$) overlaying saturated sandy clay ($\gamma$=19 kN/m$^3$, $\phi$=30$^0$, c=10 kN/m$^2$). The ground water table is at the upper surface of the sandy clay. Draw the distribution of active pressure on the wall and calculate the total thrust per meter of the wall and its pointof application. [6]
   c) Check different stability conditions for the given retaining wall. Assumeappropriate value where necessary. [8]



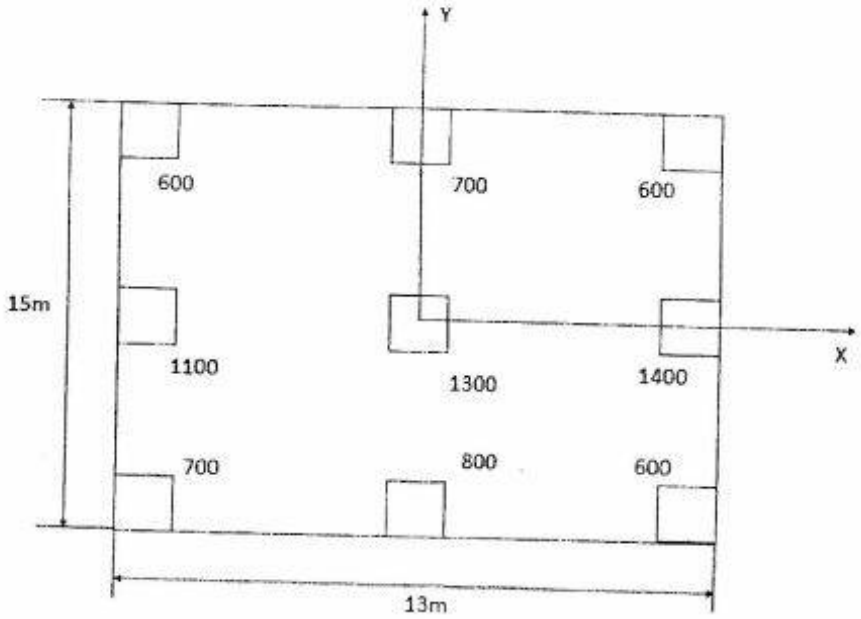
4. What is arching in soil? What are the essential requirements for aching effect to come into play? [4]

5. Find the depth of embedmentfor the cantilever sheet pile supporting 8m deep excavation in cohesionless soil. Take $\gamma_{sat} = 20\ kN/m^3, \gamma = 20\ kN/m^3$ , $\phi = 33^\circ$ and water table at 6.5m from the ground surface. [4]

6. a) Discuss Terzaghi's bearing capacity theory. Also state the assumptions. [4]

   b) A strip footing of 1.5m width its base at a depth of 1.2m is resting on dry sand. Find the change in ultimate bearing capacity of footing if the water rises up to the depth 0.5m below the ground level. Take $N_c$= 95.7, $N_q$ = 81.3, $N_\gamma$ = 100.4, G = 2.70 and dry unit weight of sand as 16kN/m$^3$. [8]

7. The plan of Mat foundation with columns (Loads in kN) is shown in figure. Assuming that the mat is rigid, determine the soil pressure distribution at points A, B, C and D; All the columns are of size 0.6 m by 0.6 m. [6]




8. a) What are the types of pile based on use? Where are tension piles used? [2]

   b) Explain the procedure for constructing bored and cast-in-situ pile. [2]

   c) A 0.8 m dia. 10m long group of piles (4x4) driven into a clay deposit in a spacing of 2.4 m. The average untrained shear strength along the upper 5 m length of the pile is 40 kN/m$^2$ and the average undrained shear strength along the lower 5 m length of the pile is 60 kN/m$^2$.If adhesion factor is 0.6 for both layers, determine the ultimate load capacity of the pile group. [8]

9. a) Draw a well foundation showing its different components and describe well foundation. [4]

   b) Discuss the remedial measures to overcome tilt and shift of well foundation. [4]

10. What are the different soil improvement techniques? Explain any two of them. [4]

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TRIBHUVAN UNIVERSITY
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**Examination Control Division**
**2081 Bhadra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / I | Time | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE 602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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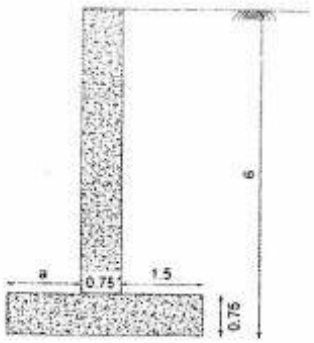
1. Define foundation. Enlist the major criteria to be satisfied in the design of Foundation. [2]
2. a) A SPT was performed at a depth of 20 m in a dense sand deposit with a unit weight of $17kN/m^3$. If the number of blows were found to be 18, 21 and 22 for each 150mm penetration, what is the N-Value corrected for Overburden and Dilatancy? [4]
   b) List out the contents of a site investigation report. [4]
   c) Describe different requirements of a sampler used for undisturbed sampling. [4]
3. a) The retaining wall shown in figure is to be designed to retain a granular backfill. Determine the width of base in front of wall, i.e. dimension 'a' in order to provide factor of safety 2 against overturning alone for the case that the drainage system of backfill gets clogged and backfill gets submerged for the depth of 1m from the surface and soil is fully saturated above it. The property of retaining wall and backfill is, G = 2.65, void ratio, e = 0.594, angle of internal friction $\phi = 30°$ and unit weight of concrete = $23kN/m^3$. [8]






   b) Explain with neat sketch the step by step procedure for Cullman's graphical method of active earth pressure without surcharge load for cohesionless soil. [4]
   c) Derive a relation form the maximum height of unsupported excavation in clayey soil. [4]
4. Draw the complete diagram for Terzaghi's trap door experiment and explain why arching in soil is important to be studied in Geotechnical Engineering. [4]
5. What is coffer dam? Describe with neat sketch of the different types of coffer dam. What are the relative merits and demerits of them? [4]
6. a) How does size, shape and water table affect Bearing Capacity of foundation? [4]
   b) A RCC Column footing rectangular in shape (L/B=1.5/1) rests 1.5 m below the ground surface. The total load to be transmitted including the weight of column and footing is 6000kN. If the saturated density of sand be 2.0 g/cc for $\phi = 34°$, $N_q = 41.4$, $N_\gamma = 42.4$, find the suitable size of Foundation considering the rise of water table to the ground surface. Use FoS = 3. [6]

c) How do you calculate Bearing capacity from load settlement curve obtained from Plate Load Test for sandy soil? [2]

7. Explain conventional method of design of Mat Foundation. [6]

8. a) A group of 16 piles with 4 piles in a row was driven into soft clay. The diameter and length of piles were 0.40 m and 12 m, respectively. The undrained cohesion is 35 kPa. The piles were placed 80 cm centre to centre. Calculate the allowable load carrying capacity of foundation. Take Adhesion factor = 0.8 and FoS = 2.5. [8]

   b) Define negative skin friction in pile its effects and remedial measures. [4]

9. a) A circular well of 4.5m external diameter and 0.75m steining thickness is embedded upon a depth of 12m in a uniform sand deposit. The angle of shearing resistance of sand and submerged unit weight are $30^0$ and 1 $t/m^3$, respectively. The well is subjected to resultant horizontal force of 50 tons and a total moment of 400 t-m at the scour level. Assume the well to be light, compute allowable equivalent resisting force due to earth force. A factor of safety of 2 may be adopted for soil resistance. [5]

   b) List out the precautionary measures that should be taken to prevent tilt and shift of well foundation. [3]

10. a) What are sand compaction piles and stone columns? [2]

    b) Briefly explain Soil stabilization by use of Admixture. [2]

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***Subject:*** - Foundation Engineering *(CE 602)*

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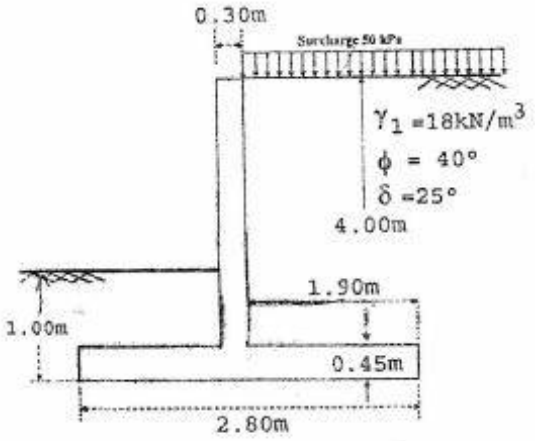
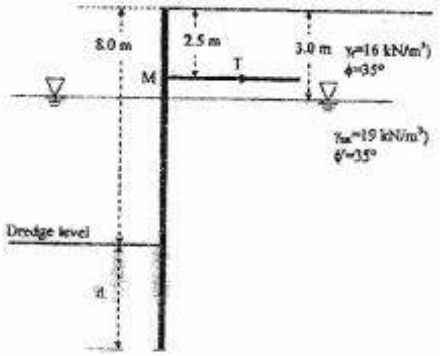
1. Explain the major criteria to be satisfied in the design of foundation. [2]
2. a) Discuss the features of good site investigation report. [4]
   b) A sampler has the following dimension: inside diameter of Cutting edge = 59 mm; Outside diameter of Cutting edge = 63mm; Inside diameter of sampling tube = 60 mm and outside diameter of sampling tube = 62 mm. Calculate (i) Area ratio (ii) Inside clearance (iii) Outside clearance. [3]
   c) List the field tests commonly used in subsurface exploration. What are the corrections that must be applied to the SPT –values for sand before they are used in design charts and empirical correlations? [5]
3. a) Explain earth pressure coefficient and its types. [2]
   b) Draw an earth pressure diagram for a purely cohesive soil ($\gamma_t$, $\phi = 0$, c) supported by rigid retaining wall of height, H at active condition. Find magnitude and line of action of this active earth pressure force per unit length of the wall from the base of the retaining wall. [6]
   c) Check the overall stability of the cantilever retaining wall shown in figure below. Take the allowable soil pressure as 600 kN/m$^2$. [8]




4. List out essential requirements of soil arching. Draw apparent pressure diagrams for deep cuts in sand and clay. [2+2]
5. a) Determine the depth of embedment of the free earth support anchored sheet pile shown in figure below. [3]




b) Also, find the tensile force (T) per meter acting on the anchor. Assume necessary conditions. [1]

6. a) Differentiate between general shear failure local shear failure and punching shear failure with neat sketch. [4]

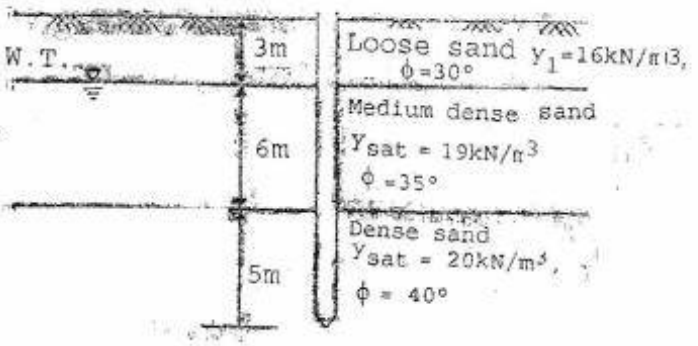
b) A strip footing 2m wide carries a safe load intensity of 400 kN/m$^2$ at a depth of 1.2 m in cohesion less soil. Saturated unit weight and bulk unit weight are 19.5 kN/m$^3$ and 16.8kN/m$^3$ respectively. Determine the value of FOS with respect to shear failure for following conditions of water table. Use Nc = 58, Nq = 41 and Nr = 42. [8]

(i) WT at 4m below GL (ii) WT at 2.5m below GL. (iii) WT at 0.5m below GL.

7. A mat 18m×22m in plane has its base 3m below the surface of the deposit of clay with unit weight of 20kN/m$^3$. The unconfined compressive strength of clay is 75kN/m$^2$. The factor of safety against bearing capacity failure must be 3. Determine total weight of building plus the foundation the raft can safety support. [6]

8. a) Define pile foundation. How do you classify pile foundation based on (i) materials (ii) methods of installation and (iii) load transfer? [1+3]

b) Determine the allowable pile load capacity of 4×4 group of 40cm diameter driven concrete pile shown in figure. Use FOS = 2.5, spacing= 2.5B and $\frac{Dcr}{B}$ =12 [8]




9. Explain with clear sketches the various components of well foundations. Discuss the remedies for tilt and shift of well foundation. What are the different forces acting on well foundation? [4+2+2]

10. a) What is preloading? [1]

b) Briefly explain different methods of soil stabilization. [3]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
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**2080 Bhadra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / I | Time | 3 hrs. |

***Subject:*** -Foundation Engineering *(CE 602)*

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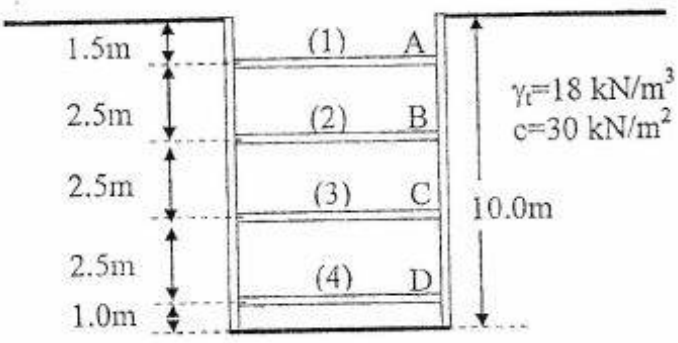
1. a) Explain Foundation. [1]
   b) Mention two important things which are considered during foundation design. [1]
2. a) What are different sampler design parameters? Explain physical significance of each parameter to obtain an undisturbed sample. [2+4]
   b) What types of boring is best suited for sub grade investigation of roads and why? [2]
   c) Calculate the corrected N-value, if a standard penetration test was conducted 6m below the ground level in a deposit of fully submerged fine sand. Numbers of blows were found to be 18, 23 and 17 for each 150mm penetration. The average saturated unit weight of the soil is 19kN/m$^3$. [4]
3. a) Explain with neat sketch the step by step procedure for Culmann's graphical method of passive earth pressure. [6]
   b) A trapezoidal masonry retaining wall 1 m wide at top and 3 m wide at its bottom is 4m high. The vertical face is retaining soil ($\phi = 30°$) at a surcharge angle of 20° with the horizontal . Determine the maximum and minimum intensities of pressure at the base of the retaining wall using coulumb's Earth pressure Theory. Unit weights of soil and masory are 20kN/m$^3$ and 24kN/m$^3$ respectively. Take $\delta = 24°$ on the base wall, determine the factor of safety against sliding and overturning. [10]
4. Determine the forces in the struts for the bracing system shown in figure below. Assume hinges at the levels B and C. Take the spacing of the struts in each strut level as 2.0m. [4]




5. Assume suitable condition to prove that Use of anchor can reduce the depth of embedment of cantilever sheet pile wall. [4]
6. a) Explain the development of different classical bearing capacity theories. [6]
   b) A strip and punching shear failure footing of 1.5 m width with its base at a depth of 1.2 *m* is resting on dry sand. The water table is 1 m below the base of footing. Find the change inn the ultimate bearing capacity of footing if the water table rises up to the depth 0.5m below the ground level. Take Nc = 95.7, Nq=81.3, N$\gamma$ = 100.4, G =2.70 and dry unit weight of sand as 16 KN/m$^3$. [6]

7. Explain the concept of floating foundation. Why we should design a mat foundation? What is the basic difference between bearing capacity calculation of a mat foundation in cohesive soil and in cohesion less soil? [2+2+2]

8. a) Classify the pile foundations according to their material, load transfer and method of forming and method of installation. [4]
   b) A group of 16 piles arranged in a square pattern is to be proportioned in a deposit of soft saturated clay. Assuming the piles to be square with side 30 cm and 12 cm long, determine the centre to centre spacing of piles for 100% efficiency of the pile group. Take adhesion factor = 0.8 for Cu = kPa and consider both point bearing and skin friction. [8]

9. List out the remedial measures to rectify tilt and shift while sinking of well foundation. Derive an expression for lateral stability analysis of light weight well using Terazaghi's simplified approach. [5+3]

10. Write down the different methods of soil improvement techniques. Explain any two of them. [4]

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**2080 Baishakh**

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***Subject:*** - Foundation Engineering *(CE 602)*

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1. Write down the basic requirements of foundation. [2]
2. a) What types of information are obtained in preliminary subsurface exploration? What are the merits and demerits of percussion drilling?Describe briefly about the borehole log format with a suitable example. [2+2+4]
   b) Differentiate between disturbed and undisturbed sample. What are the factors affecting the disturbance of sample? [2+2]
3. a) Why are retaining walls designed for active earth pressure? [2]
   b) A concrete gravity retaining wall of height 6 m retains two layers of horizontal backfill soil. The upper layers is 3 m deep cohesionless soil of unit weight 20 $kN/m^3$ and angle of internal friction 32° and the bottom layer is C-$\phi$ soil of unit weight 22 $kN/m^3$, cohesion 30 $kN/m^2$ and angle of internal friction 27°. There is water table at the depth of 2 m from the ground surface. The back of the retaining wall is smooth and vertical with the top width 1.2m and bottom width 5 m. Check the stability of retaining wall. Take unit weight of concrete as 25 $kN/m^3$. [12]
   c) How is Columb's theory step ahead of Rankine's theory for calculating earth pressure? Justify your answer in reference to the limitations of Rankine's theory. [2]
4. What is soil arching? Explain with clear sketches about the components of braced excavation. [1+3]
5. What is a sheet pile? Draw the clear deflected shapes for the following: (i)cantilever sheet pile, (ii) anchored bulkhead driven to shallow depth and (iii)anchored bulkhead driven to deeper depth. [1+3]
6. a) What are the factors affecting the bearing capacity of foundation? Explain how fluctuation of water table affects the bearning capacity of foundation when water table lies above and below the base of the footing. [2+2]
   b) A 4 m × 4 m square footing in plan is founded in a soil having angle of internal friction $\phi = 32°$, cohesion c = 35 $kN/m^2$ and unit weight = 18 $kN/m^3$. The load of 2000kN from the superstructure acts at an eccentricity of 0.3 m at one direction from the geometrical centre of the footing. What should be the minimum depth of the footing to avoid shear failure in soil at the factor of safety of 2.5?Take $N_c = 55$, $N_q = 40$, $N_\gamma = 45$. [8]
7. Mention the common types of mat foundations with their clear sketches and suitability. What are the basic assumptions in conventional method of analysis of mat foundation? [4+2]

8. a) What are the reasons behind the dynamic method of determination of ultimate load carrying capacity of pile being inaccurate? [3]

   b) Design a pile group driven in a 16 m deep consolidated clay having unit cohesion of 30 $kN/m^2$ and unit weight of $22kN/m^3$ to carry the superstructure load of 2000kN. Take adhesion factor as 0.6 and factor af safety of 3. [6]

   c) Describe briefly the laterally loaded piles with suitable examples. [3]

9. a) What are the situations where a well foundation is more suitable than the other types of foundations? [2]

   b) What do you understand by grip length? What is its importance in well foundation? [2]

   c) Draw a clear sketch showing the different components of a well foundation and also write the functions of each component. [4]

10. What is dynamic compaction? Describe the soil stabilization by injection of suitable grouts with its advantages for the following soil improvement. [1+3]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2079 Bhadra**

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|---|---|---|---|
| **Exam.** | **Regular** | | |
| **Level** | BE | **Full Marks** | 80 |
| **Programme** | BCE | **Pass Marks** | 32 |
| **Year / Part** | III / I | **Time** | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE 602)*

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1. What are the factors that influence the selection of a foundation? Under what circumstances strap footings and combined footings are adopted? [1+1]
2. a) Differentiate between accessible and inaccessible method of exploration. How do you determine the depth of exploration? Explain with the help of suitable example. [2+3]
   b) Explain the various precautions to be taken during the sampling, transportation and storage of the sample. [3]
   c) What is the physical meaning of area ratio, inside clearance, outside clearance and recovery ratio? (No need to write formula) [4]
3. a) Justify with suitable reasons for not considering the passive earth pressure during the design of rigid retaining structures. [2]
   b) Describe step by step procedure of Culmann's method of determining active thrust behind the retaining wall carrying inclined backfill with line load with the help of sketch. [5]
   c) A 6 m high retaining wall having vertical back has horizontal cohesion-less backfill having $\gamma$ = 17 kN/m$^3$, $\phi$= 30° and carrying uniform surcharge of 25 kN/m$^2$ has a water table at a depth of 3.5 m from the base of the retaining wall. Determine the magnitude and direction of total active thrust. Take $\gamma_{sat}$ = 21 kN/m$^3$. [9]
4. Define strut load, braced cut and explain the Terzaghi's trap door experiment. [1+1+2]
5. Why sheet pile wall considered as a flexible retaining structure? Explain the function of coffer dams with relative merits and demerits. [2+2]
6. a) Explain the various limitations of the plate load test. [3]
   b) A concrete column has a square footing to carry a column load of 750 kN, founded in a clay deposit below the ground surface. The unit weight and unit cohesion of clay are 17 kN/m$^3$, 35 kN/m$^2$ respectively. Determine the dimension of the footing taking factor safety of 3 and assuming the foundation to be backfilled. [6]
   c) Describe the procedure for the proportionating of footings for uniform settlement. [3]
7. Write down the procedure of analysis of mat foundation by conventional method with neat sketch. [6]
8. a) Compare among the large displacement piles, small displacement piles and non-displacement piles with the suitable examples. [2]
   b) Explain the factors affecting selection of pile foundation types. [2]
   c) 12 circular piles are arranged in a rectangular pattern with spacing to diameter ratio equal to 3.0 in a purely cohesive soil having unconfined compressive strength of $q_u$ = 80 kN/m$^2$. The length of the pile is 15 m and taking adhesion factor as 0.85, determine the spacing and diameter of the pile considering the 100% efficiency of pile group. [8]
9. How do you determine the depth of the well? Describe the sinking process of the well in the site having water table above the ground level. [4+4]
10. Explain the following: [2+2]
    a) Preloading  b) Bituminous stabilization of soil

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2078 Kartik**

| Exam. | Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / I | Time | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE 602)*

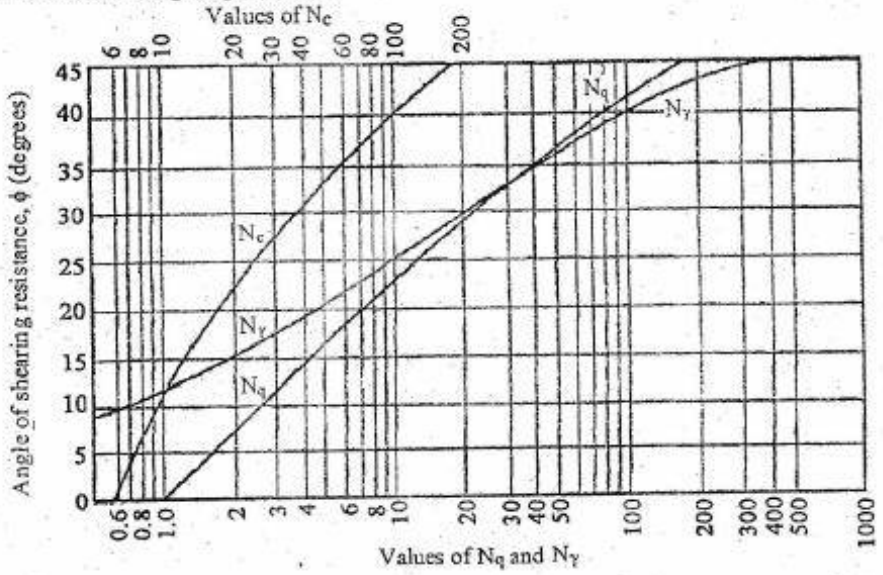
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*



1. Identify the factors that influence the choice of foundation. What are the things that you will consider while preparing the site investigation report? [2+4]
2. In a site investigation for the design of bridge foundation, what kind of detail information do you set out to obtain? Describe briefly the limitations of plate load test. [5+3]
3. a) What general guidelines are adopted before checking the stability of different types of retaining walls? Explain the different design considerations for retaining walls. [5+3]

   b) A retaining wall of 7.5 m high has two layers of backfill. The soil supported consists of 4.5 m sand ($\gamma$ = 18 kN/m$^3$, $\phi$ = 35°) overlaying saturated clayey soil ($\gamma$ = 19.5 kN/m$^3$, $\phi$ = 30°, C = 16 kN/m$^2$). The ground water table is at the upper surface of the clay. Make a sketch of the distribution of the active pressure on the wall stating the principal values. Calculate the total earth thrust per meter of the wall and its point of application. Assume that the backfill is horizontal at the surface. [8]
4. Explain the phenomenon of arching in soils. In what respects does the design of flexible retaining walls vary from that of a rigid retaining wall? [1+3]
5. Enlist the uses of sheet pile. Write down the step by step procedure of analysis of anchored sheet pile by free earth support method in granular soil. [1+3]
6. a) Discuss on the findings of Skempton on clayey soil regarding net safe bearing capacity. Why is more differential settlement allowed in clay than in sand? [2+2]

   b) A footing 2 m × 3 m in plan which is to be laid at a depth of 1.5 m below ground surface to carry a column load having one way eccentricity of 0.26 m along the width. Determine the safe bearing capacity if the water table is 0.5 m below the ground level. Use Terzaghi's theory. Take c = 20 kN/m$^2$, $\phi$ = 35° to interpolate the bearing capacity factors from the figure presented. [8



7. a) Define fully compensated raft foundation. Also derive the relation to calculate its depth. [1+1]

   b) Determine the allowable bearing pressure of a raft foundation 3 m × 12 m in plan, resting at depth of 2 m on cohesionless soil. The corrected N value over a depth of 12 m was 22. It is specified that the differential settlement is not to exceed 20 mm. Water table is at depth of 4 m below the ground level. [4]

8. a) What are the conditions where a pile foundation is more suitable than a shallow foundation? How negative skin friction is calculated for a single pile and group of piles in clay? [2+3]

   b) A friction pile 350 mm diameter is proposed to be driven in a layer of uniform cohesive soil with unconfined compressive strength of 80 kPa. Considering the pile end carry only 30% of the total load, determine the length of the pile required for the ultimate load of 1200 kN. Assume adhesion factor = 0.80. [7]

9. What is a well foundation? Show all components in a neat sketch. Discuss the remedies for tilt and shift of well foundation. [1+4+3]

10. Describe mechanical and chemical method of soil stabilization. [2+2]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2078 Bhadra**

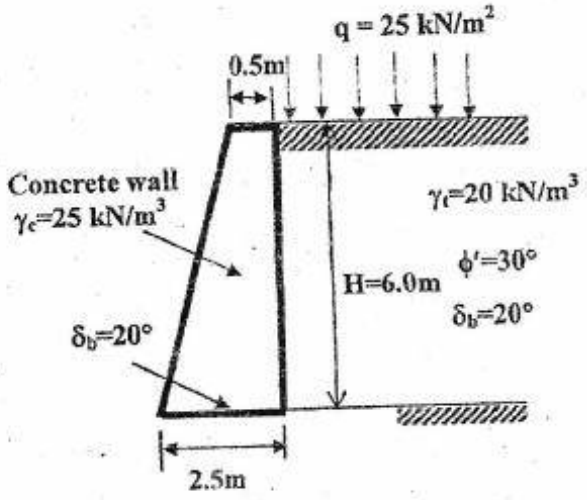
| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / I | Time | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE 602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*



1. Why foundations are used? Describe different types of foundation. [2]
2. a) Describe in detail the importance of site investigation and stages of site investigation. How the depth of borehole is decided in various projects. [4+3]
   b) Differentiate disturbed and undisturbed soil samples. What are the factors affecting quality of a sample. [2+1]
   c) The internal diameter of a sampler is 40 mm and the external diameter is 42 mm. Will you consider the sample obtained from the sampler as disturbed or undisturbed? [2]
3. a) Draw the plot showing the relationship between lateral earth pressure force per unit length of the wall vs. movement of retaining wall. [2]
   b) Different assumptions are made while considering Rankine's theory and Coulomb's theory for finding lateral earth pressure force per unit length of the wall. Point out four basic differences made during assumption. [4]
   c) Check the stability of the retaining wall shown in figure below. Assume necessary conditions and take ultimate bearing capacity of the foundation soil as 250 kN/m$^2$. [10]



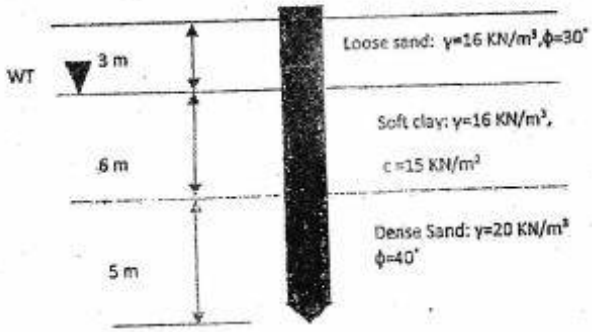

4. Describe the following: [2×2]
   a) Criteria of selecting the pressure diagram for soil having sand and clay layer in braced cut
   b) Arching of soil and its basic requirements
5. a) Write down the differences between free earth and fixed earth support anchored pile. [2]
   b) Define cofferdam and explain the cellular cofferdam with the help of neat sketch. [2]

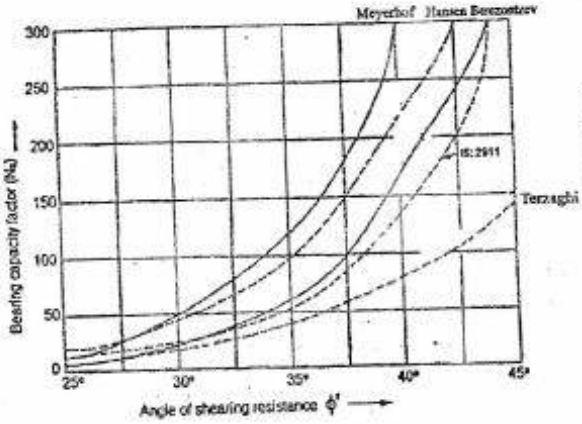
6. a) State the different modes of shear failure. In what way the local shear failure differs from general shear failure? [4]

   b) A footing of 2m × 3 m in plan is founded 2m below the ground level in clay having angle of repose $\phi = 35°$, c = 25kPa, what will be the allowable load which can be carried by the footing if the load is eccentrically applied with eccentricity along X and Y direction as 0.2m and 0.3m respectively. The center of footing in plan is taken as origin. The water table is located 0.8 m below the ground level. Assume soil above water table is as dry. Take dry and saturated unit weight of clay as 16.5 kN/m$^3$ and 19.6 kN/m$^3$ respectively. Take $N_c = 57.8$, $N_q = 41.4$ and $N_\gamma = 42.4$. Take FOS as 3.

7. Write down the concept of compensated foundation. Describe with sketches the various types of mat foundations. [6]

8. Explain the inclined pile. Determine the allowable pile load capacity of the 400 mm diameter driven concrete pile shown in the following figure. [2+10]




| Pile material | δ | Values of K | |
|---|---|---|---|
| Steel | 20° | 0.5 | 1 |
| Concrete | 0.75ϕ | 1 | 2 |
| Timber | 0.67ϕ | 1.5 | 4 |

9. a) Explain with clear sketches the various components of well foundations. [4]

   b) How do you rectify the tilt and shift in the construction of well foundations? [4]

10. a) Write down names of different types of mechanical and dynamic compaction used in regard with foundation soil improvements. [1]

    b) In order to increase the engineering properties of soils, soil stabilization is done. Briefly explain the preloading and stone columns for foundation soil improvements. [3]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2076 Chaitra**

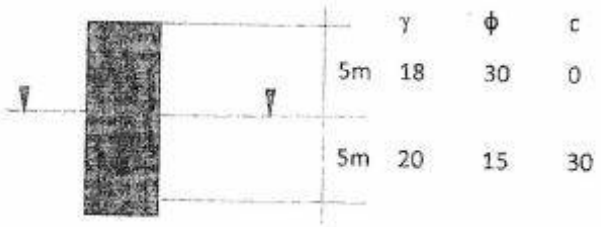
| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / I | Time | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE 602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*



1. Classify the shallow and deep foundations according to their soil conditions. [2]
2. a) What is standard penetration test? What are the corrections that must be applied to the SPT-values for sand before they are used in design charts and empirical correlations? [1+4]
   b) What is meant by inside and outside clearance? What are the circumstances which make the plate load test data misleading when used for extrapolation of prototype behaviour? [2+5]
3. a) Explain the various reasons for neglecting the passive pressure during the stability analysis of retaining wall. Describe the Culmann's method for determining active thrust for the inclined backfill carrying the surcharge load. [3+5]
   b) Calculate the total passive thrust and its point of application coming on the back of the following retaining wall. [8]




4. What is arching in soil? What are the essential requirements for aching effect to come into play? [1+3]
5. In what respects does the design of bracings in cuts vary from that of a retaining walls? Enlist the types of cofferdam with neat sketches. [2+2]
6. a) Describe the different modes of failure due to the settlement with neat sketches. [5]
   b) Determine the size of the footing resting over sand to carry a column load of 150 tons. The bottom of the footing is 1.5 m below the ground level and water table is located at 3 m below the footing. Take unit weight of sand is 20 KN/m$^3$. Assume $N_c$ = 55.2, $N_q$ = 39.51 and $N_\gamma$ = 40.13. [7]
7. A raft foundation is 20m × 10m exerts a gross pressure of 200KN/m$^2$ at the foundation level. The depth of foundation is 2.5m. If the soil is clay $C_u$ = 80KN/m$^2$ and $\gamma$ = 19 KN/m$^3$. Determine the Factor of Safety, Use Skemption's equations. [6]
8. a) Describe the various method of determining the settlement of pile group in sand. Describe about the piles subjected to uplift loads. [3+2]
   b) A friction pile 300 mm in diameter is proposed to be driven in a layer of uniform soil having unit skin friction between pile surface and soil as 60 KN/m$^2$. Determine the length of the pile required to carry allowable load of 250 KN assuming the pile tip carries 20% of the total load. [7]
9. Define grip length and tilt and shift of well. Describe the various components of well foundation. [2+6]
10. Write down the different methods of soil improvement techniques. Explain about preloading method for improvement of foundation soil. [2+2]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
2076 Ashwin

| Exam. | Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / I | Time | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE 602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*



1. Explain the major criteria to be satisfied in the design of a foundation. [2]
2. a) What makes pressure meter testing quite distinctive as compared to other field tests? [2]
   b) List the factors that will consider for deciding the depth of soil exploration. If you are in-charge of subsoil exploration of important structures, how do you decide the depth and lateral extent of soil exploration? [2+5]
   c) A soil sampler has the following dimensions: inside diameter of the cutting edge=69 mm; outside diameter of cutting edge=73 mm; inside diameter of the sampling tube = 70mm and outside diameter of the sampling tube = 72 mm. Calculate: (i) inside clearance (ii) outside clearance and (iii) area ratio of the sampler. [3]
3. a) What do you understand by "General State of Plastic Equilibrium"? How the retaining walls can be proportioned? [3+5]
   b) A 6 m high vertical wall supports a saturated cohesive backfill with horizontal surface. The top 3 m of backfill weighs 18 kN/m$^3$ and cohesion of 18 kN/m$^2$. The bulk unit weight and cohesion of bottom 3 m of the wall are 20 kN/m$^3$ and 25 kN/m$^2$ respectively. What is the likely depth of tension crack? If the tension crack develops what will be the active earth pressure? Draw the pressure distribution diagram and determine the point of application of the restaurant pressure. [8]
4. What is arching in soil? What are the essential requirements for arching effect to come into play? Describe Terzaghi's arching theory. [1+1+2]
5. What is cofferdam? An excavation of 5 m deep is to be carried out in sandy soil deposit having unit weight = 22 kN/m$^3$ and angle of shearing resistance = 33°. To support the soil, cantilever sheet pile walls are driven into the ground prior to excavation. Determine the depth of embedment needed for the sheet pile to retain the backfill. The water table is located below the base of the sheet pile. [1+3]
6. a) How do you ascertain whether a foundation soil is likely to fail in local shear or in general shear? Explain the limitations of different classical bearing capacity theories. [2+3]
   b) A circular footing of 2.5 m diameter carries a gross load of 2000 KN. The supporting soil is clayey sand ($\phi$=30°, $\gamma$=19KN/m$^3$). Determine the depth at which the footing should be located to provide the factor of safety 3. Use Terzaghi's theory. $N_c$=37.2, $N_q$=22.5, $N_\gamma$=19.7 for $\phi$=30°. [7]
7. Explain about compensated foundation. Describe with neat sketches the various types of mat foundations. [2+4]
8. a) What are the different circumstances under which a pile foundation is used? How is negative skin friction calculated for a single pile and a group of piles in clay? [1+3]

b) A 15 m long closed end steel pipe pile group (3×4) consists of 12 piles of a 300 mm diameter and evenly spaced at 900 mm, center-to-center, is driven into layered undrained clay. The top 6 m consists of clay with undrained cohesion of 50 kPa and adhesion factor of 0.74, followed by 6 m of clay with undrained cohesion of 65 kPa and adhesion factor of 0.62, which was underlain by stiff clay with undrained cohesion of 90 kPa and adhesion factor of 0.50. Estimate the allowable load carrying capacity of pile group. Take factor of safety=2.5. [8]

9. What is a well foundation? Show all components in a neat sketch. Discuss the remedies for tilt and shift of well foundation. [1+4+3]

10. What is stone column? Explain the soil stabilization by use of admixture. [1+3]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2075 Chaitra**

| Exam. | Regular / Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / I | Time | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE 602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*



1. What are the various factors that influence the choice of a foundation? [2]
2. a) Define the physical meaning of terms with reference to the sampling tube, with a neat sketch i) Inside clearance ratio ii) Outside clearance ratio iii) Area ratio iv) Recovery ratio. Also indicate the recommended values to get least disturbed samples. [6+2]
   b) A multistoried commercial complex building is to be constructed in a core of a Kathmandu Valley, for this a Geotechnical investigation is to be carried out. As an engineer recommend the number of boreholes, depth of boreholes and spacing of the borehole for subsoil explorations. [4]
3. a) How the different retaining walls can be proportioned? Describe the methods of stability check of retaining wall. [5+3]
   b) A retaining wall of 7.5m high has two layers of backfill. The soil supported consists of 3m sand ($\gamma$=18KN/m$^3$, $\phi$=35°) overlaying saturated clayey soil ($\gamma$=19.5 KN/m$^3$, $\phi$=35°, C=16KN/m$^3$). The ground water table is at the upper surface of the clay. Make a sketch of the distribution of the active pressure on the wall. Calculate the total earth trust per meter of the wall and its point of application. Assume that the backfill is horizontal at the surface. [8]
4. What is cofferdams? Describe the types of cofferdams with their uses. [1+3]
5. In what respects does the design of bracings in cuts vary from that of a rigid retaining wall? Describe Terzaghi's arching theory. [2+2]
6. a) Critically differentiate between general shear failure and local shear failure. What are the factors affecting bearing capacity of soil? [2+2]
   b) A rectangular footing (3m x 4m) is placed at 1.5m depth in sandy soil having angle of shearing resistance of 34° and unit weight of 20 kN/m$^3$ above water table and saturated unit weight of 21.5 kN/m$^3$ below water table. Determine the safe load that can be carried by the footing for a safety factor of 3.0 if the excavation is backfilled for the following cases: (i) the water table is at 1m below the ground level and (ii) the water table is at 1m below the base of the footing. The bearing capacity factors for strip footing for $\phi$=34° are $N_q$=29 and $Ny$=41. [8]
7. A raft foundation is 20m x 30m. The raft is constructed over a soft clay stratum having $C_u$=10KN/m$^2$ and $\gamma$=19KN/m$^3$. If the live load and dead load on the raft are 100MN, find the depth of Foundation if
   a) The foundation is fully compensated.
   b) Determine the depth of foundation for a factor of safety of 3. [3+3]

8. a) Describe Negative skin friction with its causes, effect, preventive measures. [4]

   b) The 20 numbers of concrete pile of 0.3m diameter and 20 meter depth are designed to construct 4 x 5 layout pattern. The site consist of clay with unconfined compressive strength 80KN/$m^2$. Design center to center spacing of piles so that group pile has some possibility of individual pile failure an block failure. Take adhesion factor ($\alpha$) =0.5 [8]

9. What considerations govern the fixing of the depth of a well foundation? Name the different methods to analyze the lateral stability of well foundation. A circular well of 4m internal diameter and 0.75m steining thickness is embedded upto a depth of 12m in a uniform sandy deposit. The well is subjected to a resultant horizontal force of 500kN and a total moment of 4000kN-m at the scour level. Calculate the allowable total equivalent resisting force due to earth pressure for the both light well and heavy well conditions using Terzaghi's analysis. Take saturated unit weight of soil of 20kN/$m^3$,$\phi$=30° and factor of safety for passive resistance of 2. [1+1+6]

10. What are the different methods of improving the foundation soils? [4]

01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2075 Ashwin**

| Exam. | Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / I | Time | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Normal graph paper should be provided.*
- ✓ *Assume suitable data if necessary.*

1. a) How would you select the suitable type of foundation according to soil conditions? [2]
   b) Why undisturbed samples are required? [2]
2. a) In a core of a Kathmandu valley a Geotechnical investigation is to be carried out. As an engineer recommend the type of drilling and the suitable field tests such that the test data can be used as much as possible. [5]
   b) Prepare an example of borehole log format. [3]
3. a) What mathematical procedures are used in checking the stability of retaining wall? Why are retaining walls usually designed for active earth pressure? [2+6]
   b) A trapezoidal masonry retaining wall 1 m wide at top and 3 m wide at its bottom is 4 m high. The vertical face is retaining soil ($\phi = 30°$) at a surcharge angle of 20° with the horizontal. Determine the maximum and minimum intensities of pressure at the base of the retaining wall. Unit weights of soil and masonry are 20kN/m$^3$ and 24kN/m$^3$ respectively. Assuming the coefficient of friction at the base of the wall as 0.45, determine the factor of safety against overturning. [8]
4. Explain arching in soils. Explain heave of the bottom of cut in soft clays. [4]
5. Differentiate between rigid retaining structural and flexible retaining structures in terms of stability and deformation analysis. [4]
6. a) Explain how the bearing capacity of soil is affected by the fluctuation of the water table with neat sketch. [6]
   b) Below figure shows the load-settlement curve obtained from a plate load test conducted on a sandy soil. The size of the plate used was 30cm × 30cm. Determine the size of a square column footing to carry a net load of 3200KN with a maximum settlement of 25mm. [8]

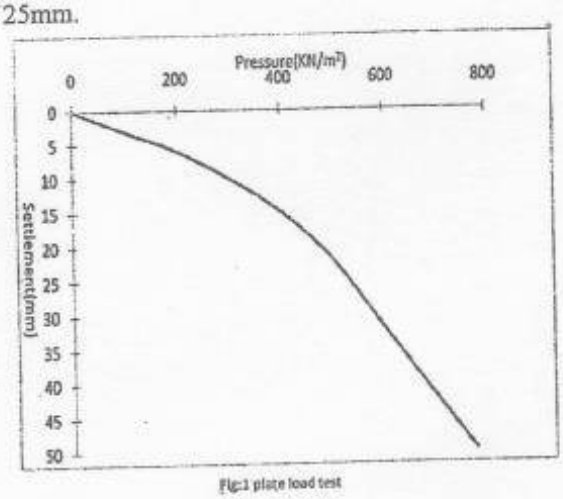

Fig:1 plate load test

7. The 10m × 15m size mat is constructed at 2.5m depth having basement for underground parking. The site consists of highly compressible saturated clay having cohesion of 30 KN/m$^2$. If the mat carries the total load of 4000 KN. Calculate the factor of safety. [6]

8. a) Elaborate the behavior of single pile differing in its group actions. [4]

   b) A circular pile group of 16 piles penetrates through a unconsolidated soil of 3.5m depth. The diameter of circular pile is 60 cm and pile spacing of 800cm. The average unconfined compressive strength of material is 60 KN/m$^2$ and the unit weight of soil is 16 KN/m$^3$. Compute the negative skin friction on the group. Take adhesion factor = 1. [8]

9. Discuss the remedies for tilt and shift of well foundation. Describe with clear sketches the components of well foundations. [3+5]

10. What are the purposes of foundation soil improvement? Explain, in brief, vibroflotation techniques. [2+2]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2074 Chaitra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / I | Time | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Classify the shallow and deep foundations according to soil conditions. [2]
2. a) Determine the area ratio of a sampler having external radius of 30 mm and wall thickness of 2.25 mm. Do you recommend this sampler for obtaining undisturbed soil samples and why? [2+1]
   b) List the field tests commonly used in subsurface exploration. What are the corrections that must be applied to the SPT-values for sand before they are used in design charts and empirical correlations? [1+4]
   c) What are the things that you will consider while preparing the site investigation repot? [4]
3. a) Explain the relative wall movements and lateral earth pressure coefficients. How do tension cracks influence the distribution of active earth pressure in purely cohesive soils? Distinguish critically between Rankine's and Coulomb's theories of lateral earth pressure. [2+2+2]
   b) A retaining wall of 7.5 m high has two layers of backfill. The soil supported consists of 5m sand ($\gamma = 18KN/m^3$, $\phi = 35°$) overlaying saturated clayey soil ($\gamma = 19.5\ KN/m^3$, $\phi = 35°$, $C = 16KN/m^2$). The ground water table is at the upper surface of the clay. Make a sketch of the distribution of the active pressure on the wall stating the principal values. Calculate the total earth thrust per meter of the wall and its point of application. Assume that the backfill is horizontal at the surface. [10]
4. What is arching effect in soils? A long 5 m wide and 10 m high vertical trench has to be constructed in a deep deposit of cohesive soil with $c = 35\ kN/m^2$ and $\gamma = 18\ kN/m^3$. The safety of the bottom of trench against heave is to be checked before protecting the trench walls using sheet piles. If the excavation to be completed rapidly, determine the factor of safety against bottom heave. What will be the factor of safety if a hard rock is present at 2.5 m from the bottom of the trench? [1+3]
5. What is coffer dam? Describe with neat sketch of the different types of coffer dam. What are the relative merits and demerits of them? [4]
6. a) What are the implications of settlement on structures? Write down the steps of proportioning footings for uniform settlement. [2+4]
   b) A building is to be supported on a reinforced concrete raft covering an area of 14 m × 21 m. The subsoil is clay with an unconfined compressive strength of $14\ kN/m^2$. The pressure on the soil due to weight of the building and loads it will carry will be $135\ kN/m^2$, at the base of the raft. If the unit weight of excavated soil is $19\ kN/m^3$, at what depth should the bottom of the raft be placed to provide a factor of safety of 3? Use Skempton's bearing capacity formula. [6]

7. Write down the concept of compensated foundation. Describe with sketches the various types of mat foundations. [1+5]

8. a) What are the various approaches used to estimate the vertical load bearing capacity of a pile? Write causes and effects of negative skin friction in a pile foundation. [1+4]

   b) A group of 16 piles arranged in a square pattern is to be proportioned in a deposit of soft saturated clay. Assuming the piles to be square with side 30 cm and 12 m long, determine the centre to centre spacing of piles for 100% efficiency of the pile group. Take adhesion factor = 0.8 and consider both point bearing and skin friction. [7]

9. What are the advantages of well foundations over the other types of deep foundations? Explain about the methods use to rectify tilt and shift of the well foundation with clear sketches. [2+6]

10. Write down the different methods of soil improvement techniques. Explain sand compaction piles and stone column. [2+2]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2074 Ashwin**

| Exam. | Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / I | Time | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Classify the foundations according to their soil condition. [2]

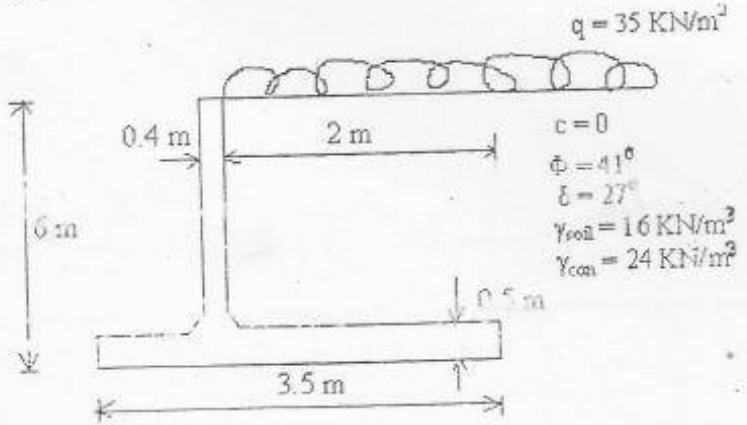
   b) Explain how standard penetration test is carried out in the field. What various corrections are made on the tested value? Describe the nature of sample obtained from the test. [8]

   c) Describe briefly the limitations of plate load test. [4]

   d) Write down the different methods of improving the bearing capacity of weak soils. [4]

2. a) Explain with neat sketch the step by step procedure for Culmann's graphical method of passive earth pressure. [6]

   b) Determine the maximum and minimum pressure under the base of the cantilever retaining wall as shown in figure below and also the factor of safety against sliding and overturning. The approximate shear strength parameters for the soil are c = 0, $\Phi = 41°$. The unit weight of soil and concrete are 16 KN/m$^3$ and 24 KN/m$^3$ respectively. The water table is below the base of the wall. Take $\delta = 27°$ on the base of the wall. [10]




3. a) What is the effect of water table on bearing capacity of soil? A footing was designed based on ultimate bearing capacity arrived for the condition of water table at the ground surface. If there is a chance for raise in water level much above the ground level do you expect any change in the bearing capacity, why? [4]

   b) A circular footing is resting on stiff clay with unconfined compression strength of 250 KN/m$^2$. Determine the diameter of the footing when the depth of foundation is 2 m and the column load is 700 KN assuming a factor of safety as 2.5, the bulk unit weight of sol is 20KN/m$^3$. What will be the change in ultimate, net ultimate and safe bearing capacity if the water table is at ground level? [8]

4. a) In what respects does the design of flexible retaining structure vary from rigid retaining structure. [3]

   b) A cantilever sheet pile wall is driven into sand deposit having friction angle 35° and bulk unit weight of 22kN/m$^3$. One side of the sheet pile was backfilled to 3 m height. The backfill material is cohesion less sand having $\Phi = 32°$ and bulk unit weight of 18kN/m$^3$. Using the simplified method determine the depth if penetration needed for the sheet pile to retain the backfill. Provide a safety factor of 2 for the passive resistance. The water table is below the base of the sheet pile. [5]

5. a) What are the conditions where a pile foundation is more suitable than a shallow foundation? What is a negative skin friction? [3+2]

   b) A group of nine piles, 12 m long and 300 mm in diameter is to be arranged in a square pattern in clay with an average unconfined compressive strength of 75 KN/m$^2$. Determine the centre to centre spacing of the piles for the efficiency of 1. Neglect the point bearing. [7]

6. a) How do you determine the depth of the well foundation? Describe the process of sinking of well. [4+4]

   b) Describe the procedure of determining the bearing capacity of cohesive cohesion-less soil in case of mat foundation. What is compensated foundations. [4+2]

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06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2073 Shrawan**

| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / I | Time | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What is standard penetration test? Write down its procedure. For what purpose can the result of this test be used? How can the standard penetration values be corrected for dilatancy and over burden pressure? [8]

   b) Explain Terzaghi's trap door experiment with neat sketch. A 8 m deep cut in sand with a cut width of 5 m is braced at equal distance of 2 m from the surface at three locations. In the plan the struts are placed at a spacing of 4 m center to center. Using empirical pressure diagram, calculate the design strut loads if the properties of sand is, angle of shearing resistance of 30° and unit weight of 16 $kN/m^3$. [8]

2. a) High steel sheet pipe wall with smooth vertical back supports a dry cohesionless soil that weighs 18 $kN/m^3$. The backfill rises from the crest of the wall at an angle of 20° with the horizontal. If the angle of internal friction of backfill materials is 30°, determine the magnitude and point of application of active earth pressure per meter length of the wall. What will be the change in its magnitude and point of application, if water tables rises to an elevation of 2 m below the top of the wall? Take the submerged unit weight of the backfill material as $12kN/m^3$. [8]

   b) Describe Culmann's graphical method of finding earth pressure for active state and explain how surcharge will affect earth pressure in active states. [8]

3. a) How do you differentiate whether there will be general or local shear failure at your site? An engineer wants to construct a circular footing of 1 m diameter to transfer the load of 1000 kN with the safety factor of 2.5 to a soil strata with an angle of shearing resistance 30°, cohesion $10kN/m^2$ and unit weight of 18 $kN/m^3$. Suggest the engineer what should be the depth of the footing. Take Terzaghi's bearing capacity factors Nc, Nq and Nγ as 37.2, 22.5 and 19.7 respectively. [4+8]

   b) A mat 18m×22m in plan has its base 3 m below the surface of the deposit of clay with a unit weight of 20 $KN/m^3$. The unconfined compressive strength of clay is 75 $KN/m^2$. The factor of safety against bearing capacity failure must be 3. Determine total weight of building plus the foundation the raft can safety support. [4]

4. a) Give a method to determine the bearing capacity of a pile in sandy soil. What is group effect and how will you estimate the capacity of a pile group in sand with neat sketch? Explain the application and limitations of pile load test. [10]

   b) A group of 16 piles of 50 cm diameter is arranged with a center to center spacing of 1.0 m. The piles are 90 m long and are embedded in soft clay with cohesion of 30 $kN/m^2$. Bearing resistance may be negelected for the piles. Adhesion factor is 0.6. Determine the ultimate load capacity of the pile group. Also check the efficiency of the group of pile. [6]

5. a) What are the conditions that demand the improvement of the soil? Write down the different methods of soil improvement techniques. Write down the measures to be taken for sinking the wells and correcting the tilts and shifts occurred during sinking of caissons. [2+2+4]

   b) Determine the depth of embedment and force in tie rod of an anchored sheet pile wall retaining soil bank of height 5 m. The tie rod is located 1 m below the top of the wall.

03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2072 Chaitra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / I | Time | 3 hrs. |

***Subject:*** - Foundation Engineering *(CE602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What are the major criteria to be satisfied in the design of a foundation? [2]
2. a) Differentiate between representative and non-representative soil samples. What are the different sampler design parameters? Explain with their physical meaning (No need to write the formulas) [2+5]
   b) How do you prepare the good site investigation reports? [5]
3. a) What is the earthquake effect on earth pressure? What is the order of horizontal strain required to produce active state in (i) coarse grained soil and (ii) Fine grained soil? What are the tentative dimensions of cantilever retaining walls? [1+2+5]
   b) A retaining wall with a smooth vertical back is 8 m high and retains a 2-layered soil having properties as follows: [8]

| Depth (m) | C ($KN/m^2$) | Φ (degrees) | γ ($KN/m^3$) |
|---|---|---|---|
| 0-4 | 10 | 30 | 18 |
| 4-8 | 0 | 34 | 20 |

   Show the active earth pressure distribution on the back of the retaining wall and its resultant.
4. What are the essential requirements for arching effects? Draw the apparent earth pressure design diagrams recommended by Pecketal (1974) for cuts in sands, firm clay and soft to medium clay. [1+3]
5. What are the different types of cofferdams? What are their relative merits and demerits? [2+2]
6. a) What is the difference among immediate settlements, primary consolidation settlement and secondary compression settlement? Explain the limitations of plate load test. [3+3]
   b) A mat foundation of size 8 m×10 m is resting at a depth of 5 m. The foundation is resting on saturated cohesive soil having undrained cohesion of 50 kPa. The soil has unit weight of 19 $KN/m^3$. Find the net safe bearing capacity using Skemton's method. [6]
7. What is compensated foundation? Describe the procedure for the conventional design of raft foundations. [2+4]
8. a) Define negative skin friction in pile. Explain a typical situation where negative skin friction may occur. How does negative skin friction affect load carrying capacity of pile? [4]
   b) A pile group consists of 16 piles is driven into a clay deposit. The piles are arranged in square configuration, i.e 4 piles in each direction. The center to center distances between the piles in both directions are 2.4 m. The length of the pile is 10 m and diameter is 0.8 m. The average undrained shear strength along the upper 5 m length of the pile is 40 $KN/m^2$ and the average undrained shear strength along the lower 5 m length of the pile is 60 $KN/m^2$. If adhesion factor is 0.6 for both layers, determine the ultimate load capacity of the pile group. [8]
9. Explain with clear sketches the various components of well foundations. What are the different methods to analyze the lateral stability of well foundation? What are the different forces acting on well foundation? [4+2+2]