**Bank of Questions**

 **Foundation Engineering**

 **Fourth Year /Civil Engineering**

 **Dr. Rizgar Ali Hummadi**

**Q.1:** **A pile group consists of 12 driven piles each 0.5m diameter is arranged in 3x4 matrix as shown in figure (1). The piles penetrate two silty clay soil layers. First has 5m thickness with average Cu=40kPa. and the second layer has Cu=80kPa. Calculate the required length (L) the pile group must penetrate the second layer to safely resist an applied load (P) of 2500kN. Take N\*c=9, factor of safety=3.**

**The mat foundation shown in figure (2). All the columns are (0.4x0.4)m, net allowable pressure =100kPa. The foundation geometry, column spacing, loads and moments are given in the figure.**

**Q.2:**  **show whether the area of the foundation is suitable to support the loads.**

**Q3 Draw shear diagram for the strips**

**Q4 Draw moment diagram for the strips**

**Q5 Calculate thickness of the foundation(punching shear)**

**Q6 Calculate the needed reinforcement in long direction**

 **Q7 Calculate the needed reinforcement in short direction**

 **The strap footing shown in figure (3)**

**Length of footing 1 is 2.2m**

**Fʹc=21MPa for both the column and footing concrete**

**Fy=420MPa for the reinforcement bars**

**The column size: col. 1(40x40cm), col. 2 (50x50cm)**

**The net allowable bearing pressure=120kPa**

**The unfactored loads and moments applied on the foundation by the columns:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **column** | **DL(kN)** | **LL(kN)** | **MD(kN.m)** | **ML(kN.m)** |
| **1** | **250** | **200** | **0** | **0** |
| **2** | **350** | **450** | **0** | **0** |

**Q8 Calculate the dimensions of the footing 1 and footing 2.**

 **Q9 Draw shear diagram**

**Q10 Draw moment diagram**

**Q11 Calculate thickness of the foundation1(punching shear)**

 **Q12 Calculate thickness of the foundation2(punching shear)**

**Q13 Calculate the needed reinforcement in long direction**

 **Q14 Calculate the needed reinforcement in short direction**

**Q15 Calculate the needed dowels**

**Q16 what is development length needed**

**Q.17** **The rectangular footing (2x3) m, supports a square column (0.5x0.5) m. The column applies a vertical load of 2000kN and a moment about X axis Mx=300kN.m as shown in figure (4). Show whether the dimensions of the foundation are adequate in order to safely resist shear failure of the soil. Use Hanson equation method. Assume c=50kPa, Ø=34°, g=18kN/m3 and gsat=20kN/m3.**

**The combined R.C footing shown in figure (5)**

**Fʹc=21MPa for both the column and footing concrete**

**Fy=420MPa for the reinforcement bars**

**The column size: col. 1(40x40cm), col. 2 (50x50cm)**

**The net allowable bearing pressure=120kPa**

**The unfactored loads and moments applied on the foundation by the columns:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **column** | **DL(kN)** | **LL(kN)** | **MD(kN.m)** | **ML(kN.m)** |
| **1** | **300** | **200** | **0** | **0** |
| **2** | **350** | **450** | **80** | **70** |

**Q18 Draw shear diagram**

**Q19 Draw moment diagram**

**Q20Calculate thickness of the foundation(punching shear)**

 **Q21Calculate thickness of the foundation(two way action shear)**

**Q22Calculate the needed reinforcement in long direction**

 **Q23 Calculate the needed reinforcement in short direction**

**Q24 Calculate the needed dowels**

**Q25 what is development length needed**

**Q.26** **A square concrete pile 0.50x0.50m in cross section is driven in a soil profile shown in figure(6). The pile is 12m long. The properties and variation of N55 with depth is given in the figure. Estimate the magnitude of ultimate carrying capacity of the pile.**

**Q27 The retaining wall shown in figure (7). Using Meyerhof Bearing capacity equation calculate bearing capacity of the soil foundation.**

**The combined R.C footing using shown in figure (8)**

**Fc=21MPa for both the column and footing**

**Fy=420MPa for the reinforcement bars**

**The column size: col. 1(40x40cm), col. 2 (50x50cm)**

**The net allowable bearing pressure=170kPa**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **column** | **DL** | **LL** | **MD** | **ML** |
| **1** | **220** | **200** | **0** | **0** |
| **2** | **240** | **250** | **20** | **30** |

**Q28 Draw shear diagram**

**Q29 Draw moment diagram**

**Q30 Calculate thickness of the foundation(punching shear)**

 **Q31 Calculate thickness of the foundation(two way action shear)**

**Q32 Calculate the needed reinforcement in long direction**

 **Q33 Calculate the needed reinforcement in short direction**

**Q34 Calculate the needed dowels**

**Q35 what is development length needed**

**Q.36** **A square precast concrete pile with 12m length and 0.5m diameter is driven in a soil profile as shown in figure (9). Calculate the allowable carrying capacity of the pile.**

**Q37 A rectangular footing 1.8mx2.5m is loaded with an axial total column load of 1500kN at center and Mx=200kN.m, My=150kN.m Figure (10). The column size is 0.5mx0.5m. Undrained triaxial test give Ø= 0 and C=40kPa. The foundation base is at 1.8m depth the soil has g= 16kN/m3 and the water table is at 2m depth with gsat=18kN/m3 of the soil under water table. What is the allowable bearing capacity qall if factor of safety =3 is required against shear failure use Hanson B.C**

**A foundation 3 m x 4 m, carrying a uniform load of 3000 kN, is located at a depth of 1.5m in a layer of sand 3.5 m thick Figure (11). The layer is underlain by a clay layer, 3 m thick. A hard stratum lies below the second layer. Ground water table is at depth of foundation. Calculate**

**Q38 the average immediate settlement under the foundation**

**Q39 the consolidation settlement in the clay layer.**

**The water tank shown in fig.(12) acts as a retaining wall with 8m height. It is filled with water to 6m from the bottom of the tank as shown:**

**Q40 Calculate factor of safety against sliding.**

**Q41 Calculate factor of safety against overturning**

**Q42 Is the retaining wall safe against bearing capacity. (assume allowable bearing capacity is 150kPa)**

**Q43 A pile group consists 12 concrete driven piles each 0.5m diameter is arranged in 3x4 matrix at a spacing 1m center to center Figure (13). The piles penetrate a clay soil 3m thickness with Cu=40kPa, g=18kN/m3 and unknown depth (L) m in another soil with Cu=80kPa g=20kN/m3. Calculate the required length L of the pile group to carry 5000kN.**

**A wall footing supports a 0.4m wide reinforced wall with dead load DL=150kN/m and live load LL=100kN/m the soil has allowable bearing pressure =150kPa, use fy=420MPa, fc=28MPa. Calculate and sketch**

**Q44 Required width of the foundation**

**Q45 The thickness of the foundation**

**Q46 The required reinforcement in short direction**

**Q47 The required reinforcement in long direction**

 **Show whether the following statements are correct or false. Explain with a suitable discussion for each case:**

**Q48 There are no constant criteria for determining directly the number and depth of bore holes.**

**Q49 The most suitable grouting method for clay is cement grouting.**

**Q50 Cement stabilization is used to reduce the swelling potential of fine grained soils.**

**Q51 The design of earth reinforced wall involves internal and external stability.**

 **Q52Two story building with 15mx20m area is required to be built on a soft cohesive soil. Discuss which method of drilling you prefer to perform site investigation.**

**Q53Two Shelby tubes one with area ratio=45% and the second with area ratio =40%. Explain which one you prefer to use to get samples.**

**Q54 Mention the subsurface exploration steps. Explain briefly what each step involves.**

**Q55What is drilling mud? For which purposes it can be used.**

**Q56What are the factors that govern the depth and number of boreholes for site investigation?**

**Q57 Two story building with 15mx20m area is required to be built on a soft cohesive soil. Discuss which method of drilling you prefer to perform site investigation.**

 **Q58The footing shown in figure (14). Calculate the bearing capacity.**

**The soil profile shown in figure (15) calculate:**

**Q59 The immediate settlement in clay layer.**

**Q60 The immediate settlement sand layer**

**Q61 The consolidation settlement in clay layer**

**Q62 The correction factor in clay layer**

**The combined footing shown in figure(16)**

**Q63Draw shear diagram**

**Q64 Draw moment diagram**

**Q65 Calculate thickness of the foundation(punching shear)**

 **Q66 Calculate thickness of the foundation(two way action shear)**

**Q67 Calculate the needed reinforcement in long direction**

 **Q68 Calculate the needed reinforcement in short direction**

**Q69 Calculate the needed dowels**

**Q70 what is development length needed**

**Q71 For the square concrete precast pile shown in figure(17). If the safe applied load is 1000kN calculate the length L required to resist the load safely.**

**For the retaining wall shown in figure(18). Determine**

**Q72 Factor of safety against sliding**

**Q73 The factor of safety against overturning.**

**Q74 The factor of safety against shear failure.**

**For the strap foundation shown in figure (19)**

**Q75Draw shear diagram**

**Q76 Draw moment diagram**

**Q77 Calculate thickness of the foundation(punching shear)**

 **Q78 Calculate thickness of the foundation(two way action shear)**

**Q79 Calculate the needed reinforcement in long direction**

 **Q80 Calculate the needed reinforcement in short direction**