Code No: NR420106 **Set No.1**

IV B.Tech. II Semester Supplementary Examinations, July -2005
SOIL DYNAMICS &MACHINE FOUNDATION
(Civil Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) The resonant frequency of a block is observed as 18Hz. The amplitude at resonance is 1.25mm. The dynamic force exerted at 18Hz is 4.5KN. If the weight of the block is 18KN. What is the damping factor.
   (b) Explain
      i. Simple harmonic motion
      ii. Logarithmic Decrement
      iii. Damped natural frequency
      iv. Magnification factor.

2. (a) Explain free vibration with damping, giving, the meaning of over damped, under damped and critical damping. Also derive an expression for the above case using mass-spring-dash pot model.
   (b) Determine the natural frequency of a machine foundation which has a base area of 2.20m × 2.20m and a weight of 155KN including the weight of the machine. Take $C_u = 4.4 \times 10^4$ KN/m^3.

3. (a) Explain the various types of vibration Isolation in detail.
   (b) The following data is given to a single-cylinder reciprocating machine.
      Crank radius = 100 mm
      Length of connecting rod = 300 mm
      Operating speed = 1500 rpm
      Weight of reciprocating parts = 45N
      and weight of rotating parts = 9N
      Calculate the maximum unbalanced force generated by the machine.

4. (a) Explain the design criteria for the foundation of an impact machine.
   (b) The exciting force in a constant force amplitude excitation is 90KN. The natural frequency of the machine foundation is 3Hz. The damping factor is 0.30. Determine the magnification factor and the transmitted force at an operating frequency of 6Hz.

5. A machine weighing 1.0t is provided with foundation block with base area of $2m^2$ and a weight of 2.0t; The coefficient of elastic uniform compression of the subsoil and the damping ratio are respectively 2.5 kg/cm^3 and 0.15.
   Determine

(a) The response Curve

(b) The natural frequency of the system

(c) The maximum amplitude of the system

(d) The maximum force transmitted in the soil.
if the force of excitation is vertical and given by F = 0.06 w^2 sin(wt) kg.

6. Explain Pauw's analogy for the analysis of foundation soil system in detail.

7. (a) How do we experimentally determine shear modulus from wave theory? Explain it.

   (b) Discuss Barkan's theory for the determination of natural frequency in detail.

8. Write short notes on the following:-

   (a) Elastic waves and their characteristics

   (b) Apparent soil mass - bulb of pressure concept

   (c) Isolating materials and their properties.

   (d) Coefficients of elastic uniform compression and elastic uniform sheer.

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1. (a) What are the various types of machine foundations used for different kinds of machinery? Give neat sketches.
   (b) A Foundation weights 800 kN. The foundation and the soil can be approximated as a mass-spring-dashpot system. Given spring constant = 20 $\times 10^4$ kN/m, Dashpot coefficient = 2340 kN-sec/m. Determine
      i. Critical damping coefficient
      ii. Damping ratio
      iii. Logarithmic decrement
      iv. Damped natural frequency.

2. (a) Analyse a system undergoing free vibrations with damping using a mass-spring-dashpot model, stating clearly the various possible cases.
   (b) Determine the natural frequency of a machine foundation of base area 2m $\times$ 2m and weight 150 kN, assuming that the soil-mass participating in the vibration is 20% of the weight of the foundation.
   Take Cu= 36,000 kN/m^3.

3. (a) Explain different types of waves that propagate through the soil with their characteristics in detail.
   (b) Resonance occurs at a frequency of 24 Hz in vertical vibrations of a test of block 1m $\times$ 1m $\times$ 1m. Determine the Coefficient of elastic uniform compression? The weight of the oscillator is 620N, and the force produced by it at 12Hz is 1000N. Also compute the amplitude in the vertical directions at 12Hz.

4. (a) Explain the salient features of the elastic half space theory for the design of machine foundations.
   (b) What is bulb of pressure concept? Explain it in detail.

5. The following particulars are given to the foundation for an impact machine.
   Weight of ram = 12 kN
   Height of fall = 100mm
   Weight of anvil = 300 kN
   Efficiency of fall of ram = 90%
   Coefficient of restitution = 0.5
   Steam pressure = 600 kN/m^2

Area of piston = 0.12 m^2
Limiting frequency of anvil = 240 rad/sec. Natural frequencies of the combined system = 270 rad/sec and 45 rad/sec..
Design the foundation.

6. (a) Explain the design criteria for the design of foundation for the reciprocating type machines.
   (b) Describe different methods of active isolation and of passive isolation.

7. In a block test according to IS standards, a resonant frequency of 18 Hz was observed in the vertical direction. The base size of the concrete test block is 1.50m × 0.75m. The thickness of the test block is 0.75m. The unit weight of the concrete can be taken as 24KN/m^3. Determine the Coefficient of elastic uniform compression. If a machine weighing 100KN is to be supported an a rigid block of 6m × 8m × 2.5m, what is the natural frequency in vertical vibrations?

8. (a) Explain Barkan's theory for the determination of natural frequency of foundation-soil system.
   (b) Explain
      i. Resonance
      ii. Frequency ratio
      iii. Magnification factor
      iv. Degrees of freedom.

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Code No: NR420106 **Set No.3**

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Time: 3 hours **Max Marks: 80**

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1. (a) Explain the general criteria for the design of machine foundations.
   (b) Explain the following:
      i. Damping Ratio
      ii. Resonance and Damping
      iii. Free vibrations and Forced vibrations
      iv. Logarithmic Decrement.

2. (a) A machine weighing 1kN is supported directly on springs having a stiffness of 2000 kN/m. The unbalanced rotating mags results in a disturbing force of 200N at a speed of 3000rpm. The damping factor is 0.10. Determine the amplitude of vibration and the force transmitted to the foundation.
   (b) What is natural frequency of foundation-soil system? Explain Barkan's method to determine it.

3. (a) Describe the "Standard Block vibration Test" for the determination of insitu dynamic properties of soil.
   (b) Determine the Coefficient of elastic uniform compression if a vibration test on a concrete block of $1m^3$ gave a resonant frequency of 36 Hz in vertical vibration. The weight of the oscillator used was 500N. Take unit weight of concrete as $24kN/m^3$.

4. (a) Explain apparent Soil-mass-bulb of pressure concept in detail.
   (b) Describe I.S method for the determination of natural frequency of foundation soil system.

5. (a) What are the special considerations for the design of Impact machines? Explain them.
   (b) Calculate the unbalanced inertial forces for a two-cylinder vertical compressor with the following data.

      Operating speed = 600rpm

      Radius of crank = 400mm

      Equivalent weight concentrated at crank-pin of each cylinder of compressor=40N

      Equivalent weight concentrated at cross-head of compressor = 200N

      Crane angles

i. $\alpha_1 = 0; \alpha_2 = \pi$ / 2
ii. $\alpha_1 = 0; \alpha_2 = \pi$

6. The following particulars are gives for the design of a foundation for an impact machine.

   Weight of ram = 15.50kN

   Height of fall = 900mm

   Weight of anvil and frame = 342kN

   Efficiency of drop = 0.9

   Coefficient of restituation = 0.5

   Steam pressure = 700kN/m^2

   Area of piston = 0.129m^2

   Limiting frequency of anvil = 253 rad/sec

   Natural frequencies of the combined system = 272 rad/sec and 54.3 rad/sec. Design the foundation.

7. Explain Pauw's analogy for the analysis of foundation-soil system in detail.

8. Write short notes on the following:

   (a) Types of machine foundations
   (b) Elastic half space theory
   (c) Types and methods of Isolation
   (d) Tachehotarioffs reduced natural frequency.

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1. (a) Explain various types of machine foundations with their salient features.
   (b) A foundation block weights 1000kN. The foundation and soil can be treated as a mass- spring system.
   Given spring constant = 200,000kN/m.
   Dash pot coefficient = 2400 kN-sec/m.
   Determine the natural frequency and Damping ratio?

2. A block vibration test was preformed on an M 150 concrete block of size 1m × 1m × 1 m using vertical exitation. The unit weight of concrete is 24kN/m^3. The results of the test are as follows.

Frequency(rpm)	600	700	800	900	950	1100	1125
Amplitude(mm)	0.12	0.32	0.64	2.40	2.08	1.68	1.36

   Determine the magnitude of coefficient of elastic uniform compression and internal damping.

3. (a) Describe the "Repeated plate bearing test" used for the determination of the coefficient of elastic uniform compression.
   (b) The coefficient of elastic uniform compression of a soil is found to be 24,000 kN/m^3 using a plate of diameter 4m. What will be the percentage variation in its value if the diameter of the plate is halved?

4. (a) Explain Barkan's theory for the determination of natural frequency of foundation soil-system.
   (b) Using Barkan's expressions for natural frequency and amptitude of vibrations, calculate the change in the percentage amptitude in terms of "r" (frequency ratio) if the soil mass participating in the vibrations is 24% of "m" (Mass of machine plus foundation) Also calculate this change for r = 0.4 and r = 3.

5. Discuss the following:
   (a) Relsher's solution and its limitations.
   (b) Hsiegh's equations for vertical vibration.

6. Design the foundation for a gas engine with a vertical cylinder and vertically oscillating parts, for the following data:
   (a) Total weight of the engine = 4600Kg

(b) Speed of rotation = 250rpm.

(c) Unbalanced vertical force = 1tonne

(d) Base dimension of the engine = 1.2m × 2.8m

(e) Elevation of machine base above the ground = 1m.
Weak silty sand exists upto a depth of 0.5m followed by a dense sand to a depth of 5m. The unit weigth of moist sand is $1.8t/m^3$.

7. (a) Explain various principles of design of foundations for the impact type of machines.

   (b) What are the basic kinds of vibration isolation? Explain different isolating materials with their properties.

8. Write short notes on the followings:

   (a) Bulb of pressure concept

   (b) Elastic waves and their characteristics

   (c) Design criteria for machine foundations

   (d) Dynamic soil parameters.

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