Ref. No. : Ex/CE/PE/B/T/422C/2023(S)

B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER

SUPPLEMENTARY -2023

SUBJECT: DYNAMICS IN GEOTECHNICAL ENGINEERING

Time: 3 HOURS Full Marks : 100

(PART I – 50 MARKS)

Use separate Answerscript for each part

Assume reasonable values of data not supplied

C.O.1

1. What is the purpose of block vibration test? Discuss the test procedure with a neat sketch and how the dynamic soil parameters are determined from this test. 10

C.O.1

2. Derive the equations of motion of a block foundation subjected to simultaneous sliding and rocking vibrations (Give neat sketches). Solve these two equations to obtain expressions for natural frequencies. Also derive the expressions for amplitudes of coupled rocking and sliding if only horizontal exciting force is acting on the block foundation. 20

C.O.1

3. The moving component of an electric motor having a mass of 2.5 kg was running at a constant speed of 30 cps with an eccentricity of 160mm. The motor was mounted on an isolator with damping factor of 0.26. Determine the stiffness of the isolator spring such that 10% of the unbalanced force is transmitted to the foundation. Further, determine the magnitude of the transmitted force. 12

C.O.1

4. A reciprocating engine operating at 550rpm is mounted symmetrically on a concrete block foundation of size 10.0m x 5.0m x 2.0m resting on the ground. The unbalanced vertical force acting on the machine is 1.6 sin ωt kN. The weight of the engine is 20 kN The magnitude of elastic uniform compression is, Cu = 5.0 x 10^4 kN/m^3. Take unit weight of concrete = 24kN/m^3. Estimate the natural frequencies and amplitude of the block by linear elastic spring-mass approach. 8

[Turn over

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B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER SUPPLEMENTARY EXAM 2023

SUBJECT: DYNAMICS IN GEOTECHNICAL ENGINEERING
Part – II

Time: 3 hours

Full Marks: 100
[50 marks for this Part]

Use Separate Answer Scripts for Each Part

[Answer all the questions]
[Assume any data reasonably if necessary]
[Use code: IS 1893 (Part-I): 2016]

<table>
<tr><th>Sl. No.</th><th>Question</th><th>CO</th><th>Marks</th></tr>
<tr><td>1.(a)
(b)</td><td>Discuss different factors that affect liquefaction.

Measured penetration resistance values with depth for a site are given in the table (Table 1) below and the soil profile obtained from the bore-log data reveals mainly sandy soil up to a depth of 10m. The region is expected to experience an earthquake of magnitude 7. The project site is estimated to experience a_{max} of '0.250g' ground shaking under the expected earthquake. Estimate the liquefaction potential of the site at every 1.0m depth interval and also prepare a plot of depth vs CSR/CRR showing the liquefied zone.

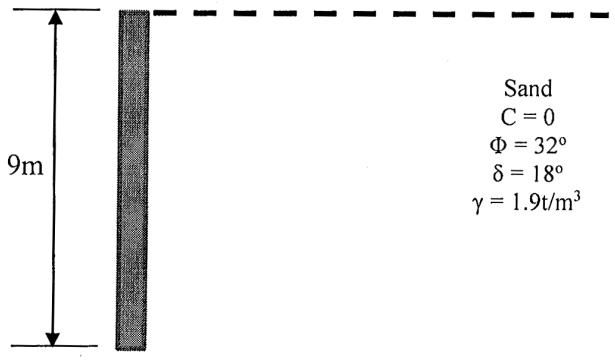
Table 1
<table><tr><td>Depth (m)</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>N-value</td><td>6</td><td>5</td><td>8</td><td>6</td><td>12</td><td>13</td><td>18</td><td>22</td></tr><tr><td>FC</td><td>10</td><td>4</td><td>15</td><td>30</td><td>6</td><td>0</td><td>0</td><td>0</td></tr></table>
Given:
[SPT conducted as per IS: 2131
Use unit weight of water, γ_w = 10 kN/m^3 in the calculations]
Assume Water Table at ground surface]</td><td>[CO3]</td><td>[5+20]</td></tr>
<tr><td>2.</td><td>Compute the static and dynamic active earth pressure for the wall shown below. Also calculate the location of total active thrust.
[Take k_h = 0.15 & k_v=50% of k_h]
 

Figure 2</td><td>[CO4]</td><td>[15]</td></tr>
</table>

	Given K_A = active earth pressure coefficient $$= \frac{\cos^2(\phi - \beta)}{\cos^2\beta\cos(\delta+\beta)\left[1+\left\{\frac{\sin(\delta+\phi)\sin(\phi - i)}{\cos(\delta+\beta)\cos(\beta - i)}\right\}^{1/2}\right]^2}$$ $$K_{AE} = \frac{\cos^2(\phi - \theta - \beta)}{\cos\theta\cos^2\beta\cos(\delta+\beta+\theta)\left[1+\sqrt{\frac{\sin(\phi+\delta)\sin(\phi - \theta - i)}{\cos(\delta+\beta+\theta)\cos(i - \beta)}}\right]^2}$$ where, φ = soil friction angle, β = slope of the back of the wall with vertical, $\theta = \tan^{-1}\left(\frac{k_h}{1-k_v}\right)$, δ = angle of friction between the wall and soil i = backfill inclination angle		
3.	Discuss the steps involve in geotechnical design of shallow foundation under earthquake loading using Pseudo-Static method.	[CO4]	[10]