

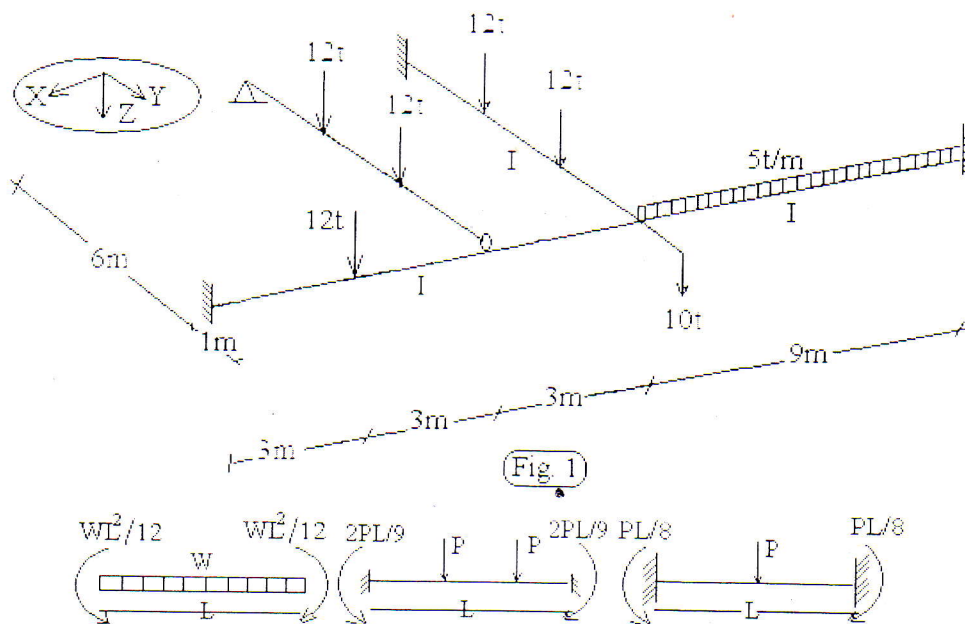
Allowed Tables and Charts: (None)

Read carefully the given data and solve all questions. (Total Marks: 70)

Question (1)

[30 marks]

For the shown structure in Fig. 1, draw the bending moment, shear force and torsion moment diagram ($EI=GJ$).



Question (2)

[25 marks]

a) Define the following:

- i. Lumped mass model.
- ii. Damping.
- iii. Shear building
- iv. Mode shape

b) A free vibration test is conducted to an empty water tank. A cable is attached to the tank applies a lateral force of 10t and pulls the tank horizontally by 5cm. The cable is suddenly cut and the resulting free vibration is recorded. At the end of five complete cycles, the time is 2 sec. and the amplitude is 2cm.

From this data compute:

- i. Damping ratio
- ii. Natural period of vibration
- iii. Effective stiffness
- iv. Effective weight

- v. Damping coefficient.
- vi. Equivalent earthquake force affecting the tank if it is exposed to the earthquake represented by the response spectrum shown in figure 2.
- vii. In your opinion, which case would be critical under the effect of the given earthquake; empty water tank or full water tank? Explain your answer.

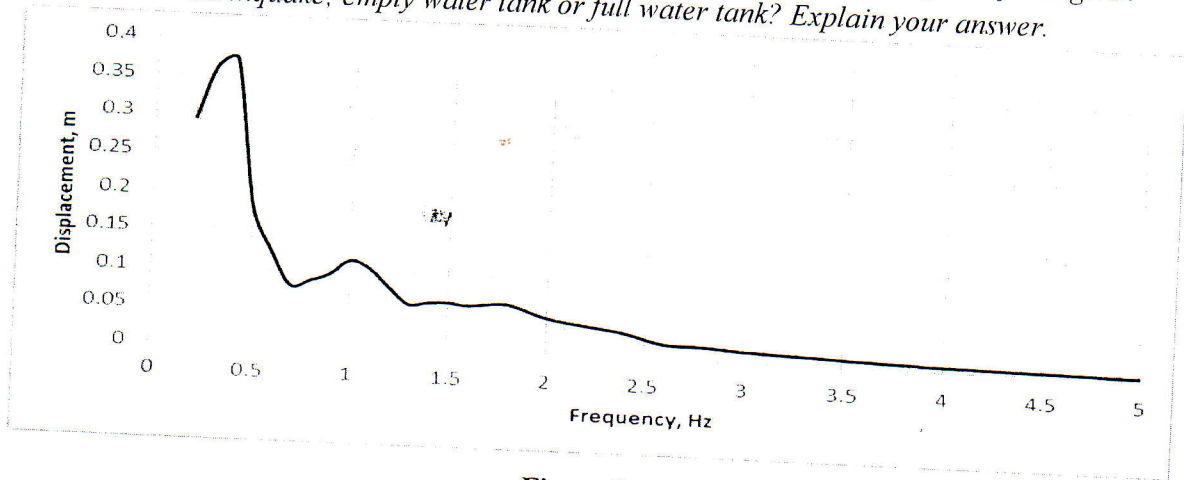


Figure 2

Question (3)

The shear building shown in figure 3 has the following properties:
 $EI = 3 \times 10^4 \text{ tm}^2$, $A_t = 30 \text{ cm}^2$, $E = 2 \times 10^6 \text{ t/m}^2$ and $g = 10 \text{ m/sec}^2$

[15 marks]

It is required to find:

- i. Mass and stiffness matrices.
- ii. The two natural frequencies and corresponding mode shapes.

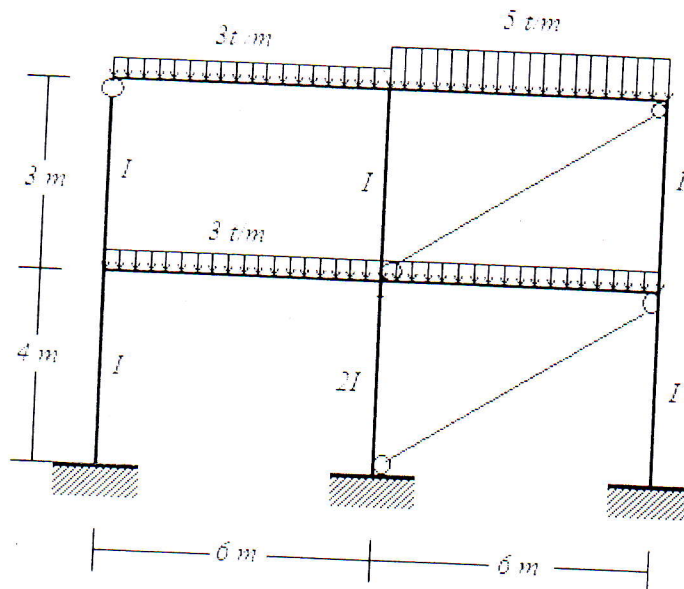


Figure 3

This exam measures the following ILOs												
Question Number	Q1	Q2-b	Q3	Q2-a	Q1	Q3				Q2-b	Q1	
Skills	I-a	I-f	I-e	I-c	II-a	II-c				III-b	IV-a	
	Knowledge & Understanding Skills				Intellectual Skills				Professional Skills			