Prince of Songkla University

Faculty of Engineering

Midterm Examination: Semester I — Academic Year 2009

Sunday, July 26, 2009 — Time 9:00-12:00

220-503 Dynamics of Structures — Room: Robot Conference

Name..... Student No. .....

Instructions.

1. There are 4 questions which equal marks as shown in the table below.
2. Attempt all questions using this question-answer book.
3. Books and notes are allowed.
4. Pencils are recommended to be used in answering the questions.

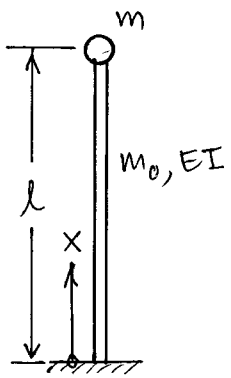
Question	Full Marks	Marks Obtained
1	25	
2	25	
3	25	
4	25	
Total	100	

Instructor : Fukit Nilrat

1. (25 marks) A cantilever tower is idealized as shown with a concentrated mass m at the top of the tower. To approximate the system to a single degree of freedom, a shape function $\phi(x) = (x/l)^2$ is assumed. The mass per unit length of the tower is assumed to be uniform and is equal to m_0. The stiffness EI of the tower is also uniform.

(a) Determine the generalized mass, the generalized stiffness, the generalized geometric stiffness and formulate the equation of motion of the undamped free vibration of the system in terms of given quantities.

(b) For m = 12500 kg, m_0 = 620 kg/m, E = 200 GPa, I = 1.6x10^6 cm^4, l = 20 m, determine the undamped natural frequency and the undamped natural period of the tower.



2. (25 marks) A roof plan of a one-story reinforced concrete building is as shown. The sizes of the reinforced concrete flat plate and the columns are as follows:

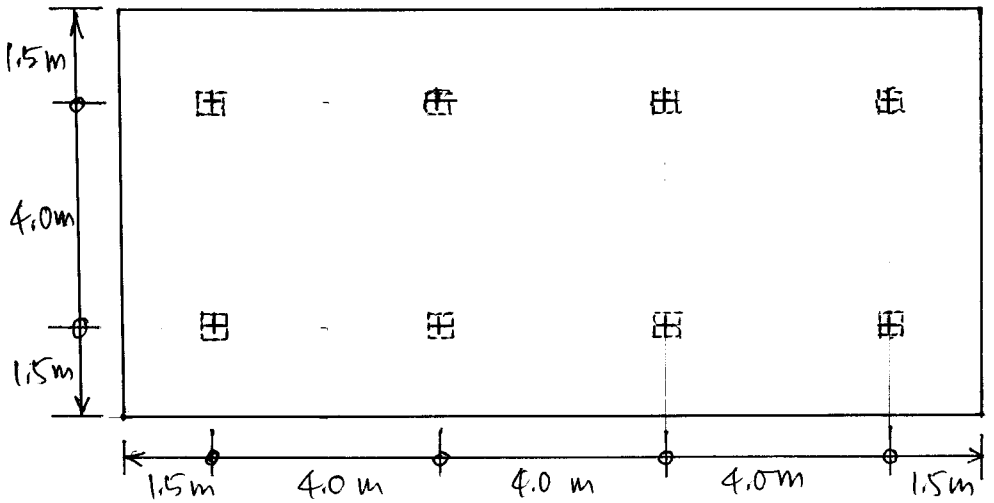
Flat Plate = 0.20 m thick

All columns = 0.30 x 0.30 m (cross section)

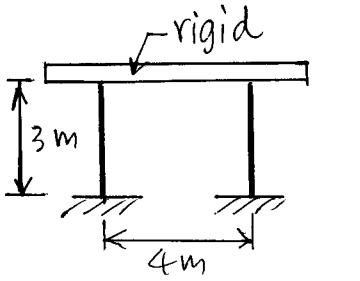
The one-story building is idealized as a rigid girder supported by massless columns as shown. The reinforcing steels, the mass of the columns and the geometric stiffness of the system are to be neglected. The modulus of elasticity of concrete is given as 20 GPa.

(a) Determine the natural period of the system.

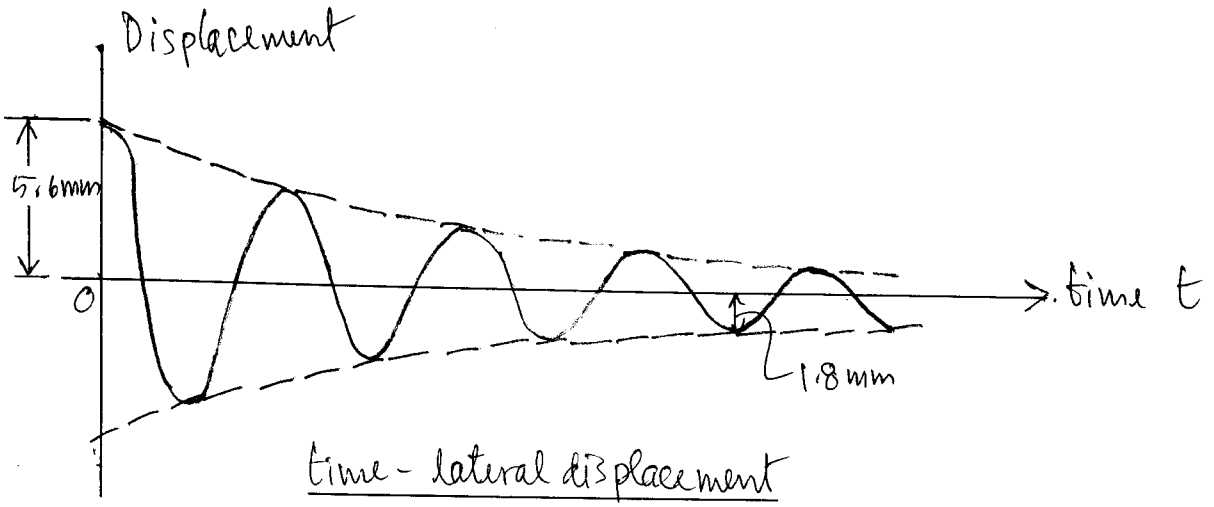
(b) When the roof is displaced laterally for 5.6 mm and then released, it is found that after the 3.5 periods the lateral displacement is 1.8 mm as shown in the graph of the time- displacement of the roof. Determine the damping ratio of the system.



Roof Plan



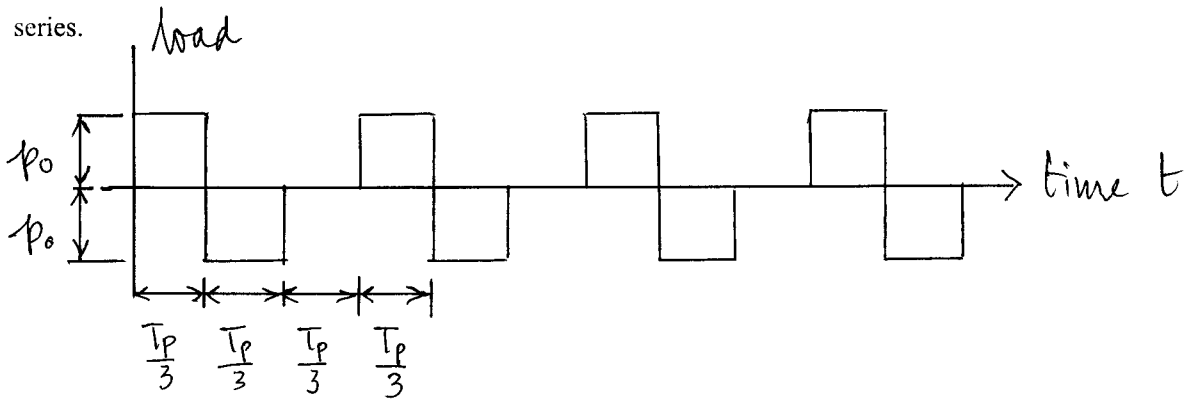
Idealized Structure



time - lateral displacement

 Student No.....

3. (25 marks) Express the periodic loading shown as a Fourier series by determining the coefficients of the series.



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4. (25 marks) A simple single degree of freedom system (SDOF) is subjected to an impulse as shown. Derive expressions of the displacement responses (that is when $t \leq t_1$ and when $t \geq t_1$) of the system to this impulse when the system is at rest in equilibrium at time t = 0.