Prince of Songkla University

Faculty of Engineering

Midterm Examination: Semester I   Academic Year 2007

Sunday, July 29, 2007   Time 9:00-12:00

220-503 Dynamics of Structures   Room: A201

Name.. Student No. ....

Instructions.

1. There are 4 questions which 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	30	
2	30	
3	20	
4	20	
Total	100	

Instructor : Fukit Nilrat

1. (30 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 $\phi(x) = 1 - \cos(\pi x/2l)$ 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 $m = 12000$ kg, $m_0 = 600$ kg/m, $E = 200$ GPa, $I = 1.5 \times 10^6$ cm^4, $l = 20$ m, determine the undamped natural frequency and the undamped natural period of the tower.
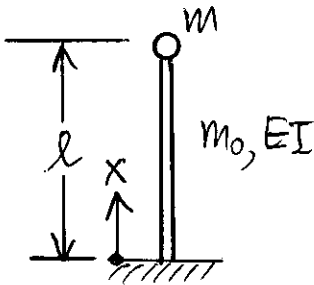
2. (30 marks) A roof plan of a one-story reinforced concrete building is as shown. The sizes of the flat slab (or plate) and of the columns are as follows:

Slab = 0.15 m thick

All columns = 0.30 x 0.30 m

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.

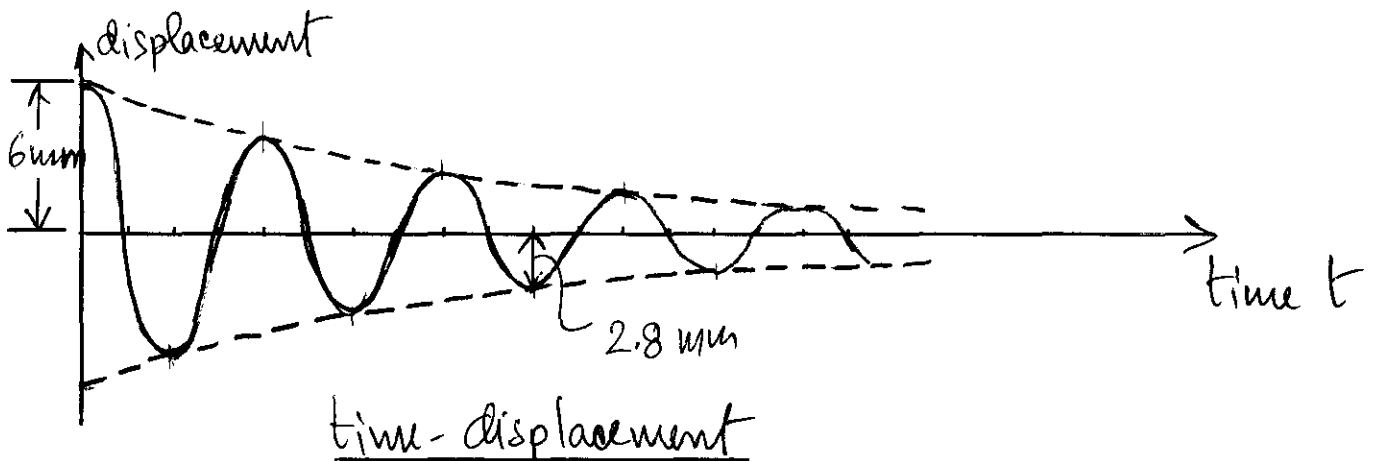(a) Determine the natural period of the system.

(b) When the roof or the rigid girder is displaced laterally for 6 mm and then released and it is found that after the 2.5 periods the lateral displacement is 2.8 mm as shown in the graph of the time- displacement of the roof. Determine the damping ratio of the system.
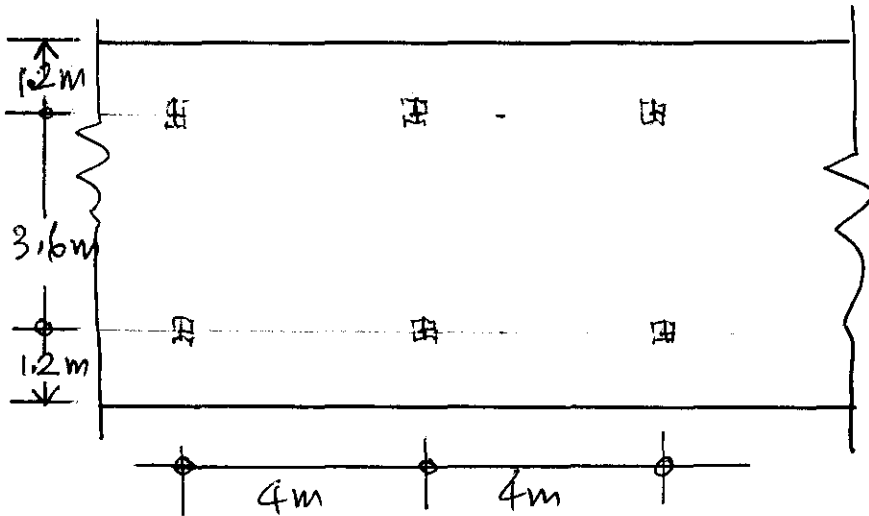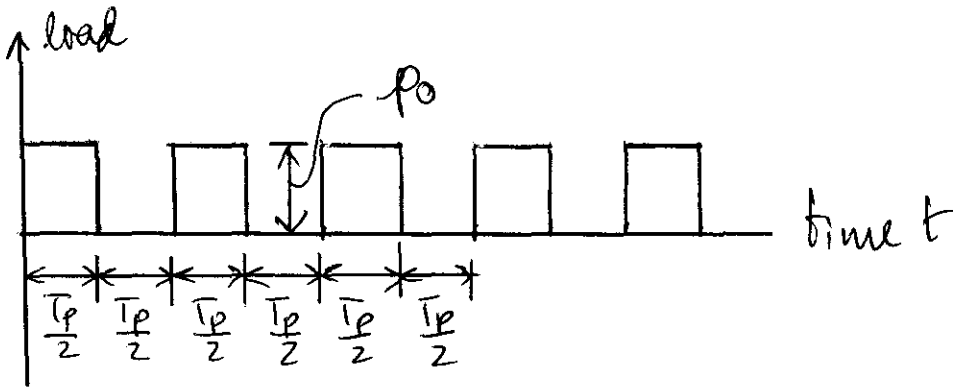

Roof Plan
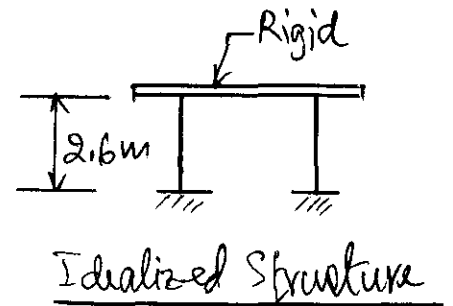
Idealized Structure

time - displacement

3. (20 marks)   Express the periodic loading shown as a Fourier series by determining the coefficients of the series.

4. (20 marks)   A simple single degree of freedom system (SDOF) is subjected to a triangular 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 $t = 0$.

load

P_o

time t

t_1