Prince of Songkla University

Faculty of Engineering

Final Examination: Semester II   Academic Year 2005

Saturday, February 25, 2006   Time 13:30-16:30

220-503 Dynamics of Structures   Room R300

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

## Instructions.

1. There are 3 questions which marks 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 Scored
1	30	
2	30	
3	30	
Total	90	

Instructor : Fukit Nilrat

1. (30 marks)   A single degree of freedom (SDOF) structure is subjected to a triangular impulse as shown,

   (a) Derive an expression for the response of the structure to this impulse when the structure is **at rest** at the

        time t = 0.

   (b) Determine the dynamic magnification factor $D = v_{max}/(p_0/k)$ when $t_1 = 3\pi/\omega$.
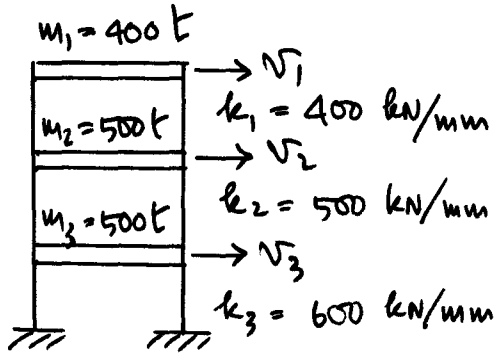

rigid girder

triangular impulse
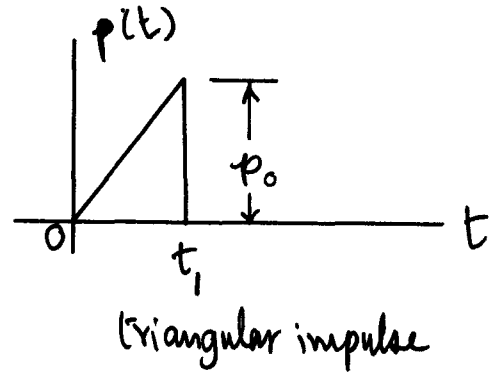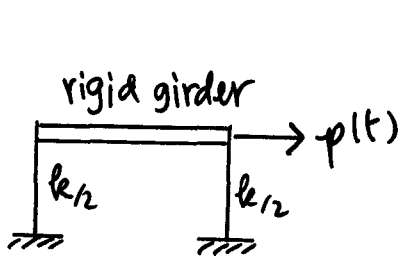
2. (30 marks) A one-story building is idealized as a uniform girder supported by uniform massless columns with the properties of the girder and the columns as shown.

(a) Assemble the stiffness and the **lumped-mass** matrices for the three degrees of freedom as shown.

(b) Using static condensation, eliminate the two rotational degrees of freedom from the stiffness matrix.

(c) Using the condensed stiffness matrix, write the SDOF equation of motion for the undamped free vibration.
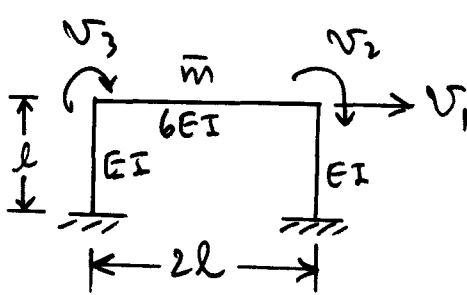
$\bar{m}$ = mass per unit length

3. (30 marks)   A three-story building is idealized by assuming that the entire mass is lumped in the rigid

girders and the properties of the building are as shown.

(a)   Evaluate the stiffness and mass matrices of the structure.

(b)   Formulate the frequency equation of the structure.

(c)   By solving the frequency equation, it is given that the three frequencies of the system are 15.457, 39.72

and 56.42 rad/s, determine the three mode shapes of the structure by letting the largest element of the

displacement vector be unity.

$m_1 = 400 t$

$m_2 = 500 t$

$m_3 = 500 t$

$\rightarrow v_1$

$k_1 = 400 \ kN/mm$

$\rightarrow v_2$

$k_2 = 500 \ kN/mm$

$\rightarrow v_3$

$k_3 = 600 \ kN/mm$

k_1, k_2, k_3 are total latiral stiffnesses of the two columns of the storeys as shown.