Massachusetts Institute of Technology
Department of Mechanical Engineering

2.003J/1.053J Dynamics & Control I
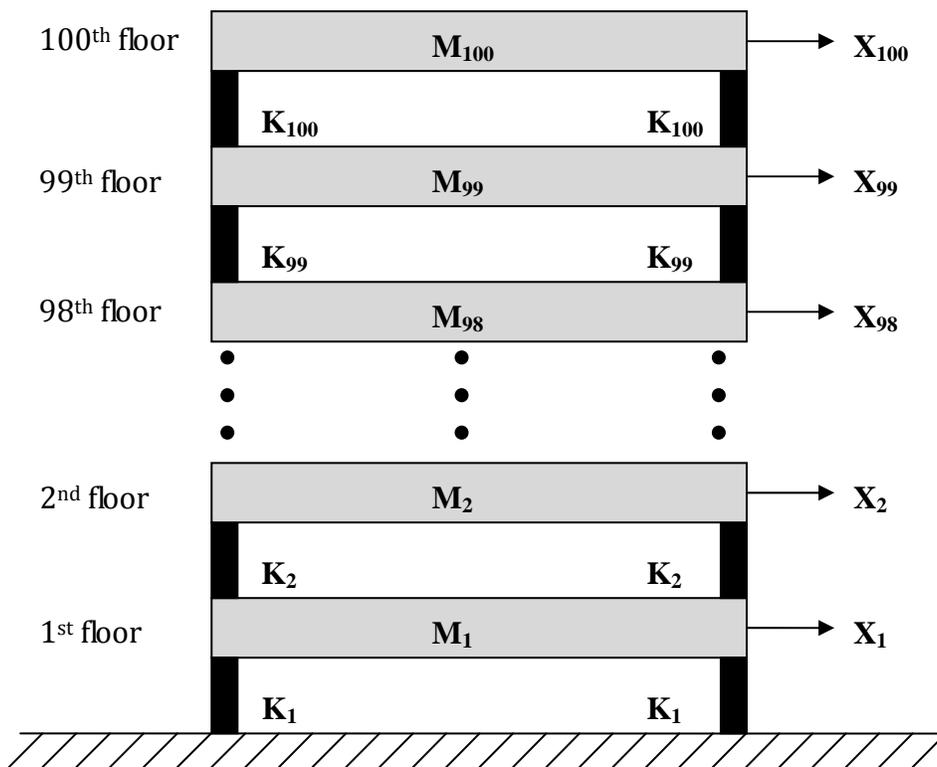
Fall 2007

Homework 9 (OPTIONAL)

Issued: Dec.5. 2007   **Due:** Dec.12. 2007

Problem 9.1 :   Equation of the lateral vibration of a 100 story building.

Consider the lateral vibration of a 100 story building. The mass are assumed to be concentrated at the floors. The walls constitutes springs. This can be models as a 1-D system. (See figure)

i)   Derive the equation of motion of 1st floor.

ii) Derive the equation of motion of 100th floor.

iii) Derive the generalized equation of motion of nth floor ($2 \le n \le 99$)

Problem 9.2 :   Generating code to calculate vibration modes of a 100 story building

In this problem, your task is to generate MATLAB code to calculate vibration mode of a 100 story building. In order to simplify the problem, it is assumed that $M_1 = M_2 = \cdots = M_{99} = M_{100} = 3kg$

and $k_1 = k_2 = \cdots = k_{99} = k_{100} = 8N/m$ are given. **'Building_*your_kerberos_name*'**

should be function name (as well as m-file name) and upload it to 2.003 MIT Server site. You also submit the hardcopy of your code with appropriate comments. Function has following structure.

```
function v= Building_your_kerberos_name(nvm)
nvm: vibration mode number you want to generate
v: eigen vector for nvm-th vibration mode
```

(Hint: Define the mass and the stiffness matrices first, and then solve eigenvalue problem.)

Problem 9.3 :   Plotting some vibration modes of a 100 story building

With m-code you generated in problem 9.2, print a single figure for each sub-question where x axis represents the eigenvector value, and y axis represents the building floor. Use different line types for different vibration modes. Legend for the vibration modes should be provided.

   i)   The first four vibration modes
   ii) The 25th, 50th, 75th, and 100th vibration modes