Fall Semester, 2024 **Instructor**: M.J. DeJong

CE 225 – Dynamics of Structures

Homework #1

Due: Friday, September 6

1) Starting from the basic definition of stiffness, determine the effective stiffness of the combined spring and write the equation of motion for the spring–mass systems shown in Fig 1.

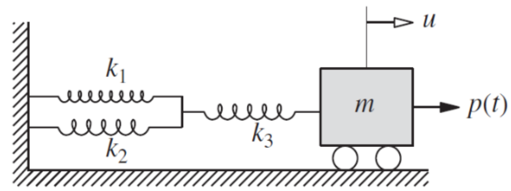

Figure 1

Main concept: stiffness of springs in series and in parallel.
Additional question: if you know "u", can you compute the deformations on the other three springs? How?

2) Write the equation governing the free vibration of the system shown in Fig. 3. Assuming the beam to be massless, the system has a single DOF defined as the vertical deflection under the weight w. The flexural rigidity of the beam is EI and the length is $2L$.

Hint: the system can be thought as two cantilever beams.
(*) Define explicitly what is "u" on your EOM
(Main concept: distinguish between total u and dynamic u as defined in lecture)

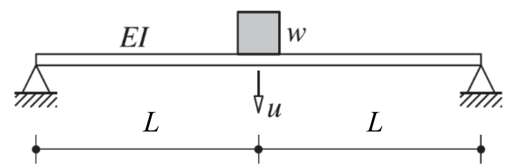

Figure 2

3) A heavy rigid platform of weight w is supported by four columns, hinged at the top and the bottom, and braced laterally in each side panel by two diagonal steel wires as shown in Fig. 4. Each diagonal wire is pretensioned to a high stress; its cross-sectional area is A and elastic modulus is E. Neglect the mass of the columns and wires. Derive the equation of motion governing the torsional vibration of the system of Fig. 4 about the vertical axis passing through the center of the platform. Assume the rotation is very small.

(Hint: Because of high pretension, all wires contribute to the structural stiffness.)

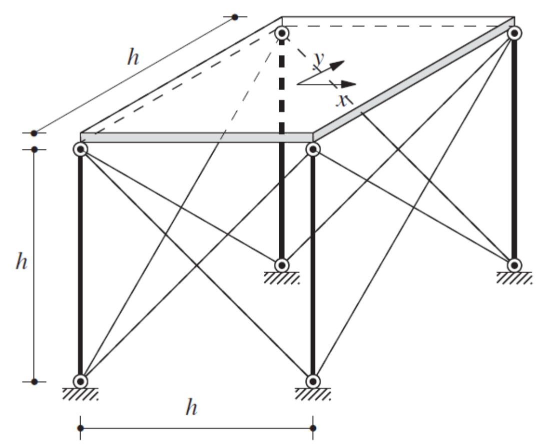

Figure 3

Hint: compute the stiffness contribution of a single wire to a lateral displacement in the plane of the wire.
Since the rotation is very small, we can ignore higher-order effects (e.g., out-of-plane stiffness contribution of the wires). This keeps our equations linear.
Main concept: proper interpretation of the stiffness in the equilibrium equations.