BRUFACE
MA1 Civil Engineering

Dynamics of Structures
Academic year 2018-2019

Arnaud Deraemaeker (aderaema@ulb.ac.be)

Session 4 : Continuous systems

Exercise 1

Consider a simply supported beam of length L. Compute the coefficients ϑ and ϕ_M, used to find the equivalent stiffness and mass of the beam with a reference point in the middle, using the analytical expression of the first mode shape of the beam. (use the $integral$ function in Matlab). Compare with the values given in the tables from H. Bachman (Vibration Problems in Structures, see course slides).

Exercise 2

Consider the 5 storey building already used in Session 3, exercise 1.

- Using the single mode approximation for mode 1, compute the equivalent stiffness, mass and damping coefficients (K_{eq}, M_{eq} and C_{eq}).
- Compute the transfer function between a horizontal force applied on the top floor and the displacement of the top floor, for the equivalent 1 dof model and for the full model, and compare them. Discuss the differences between the two transfer functions.

Exercise 3

Consider a bar of length $L = 5m$, which is clamped at $x = L$ and free at $x = 0$. The bar is made of concrete ($E = 30GPa$, $\rho = 2200kg/m^3$) and has a square cross section of $0.1m$ x $0.1m$.

- Compute the transfer function between a horizontal force applied at $x = 0$ and the displacement at $x = L/2$ using a modal truncation approach with 5 modes.
- Compare with the transfer function using only the first mode and discuss the effects of truncation.
- Compute the time domain response for the horizontal displacement at $x = L/2$ for an impulse force applied at $x = 0$ with $\Delta t = 10\mu s$. Also compute the response in terms of longitudinal strain at $x = L/2$. What can you say about the velocity of the wave in the bar ?