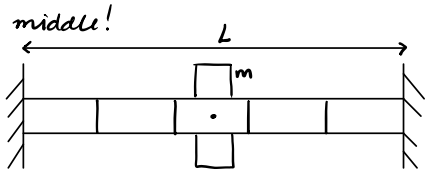
Assignment #8 posted, due in 1 week!

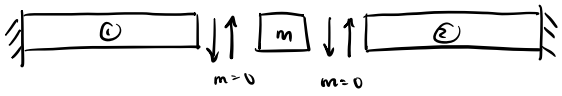
Vibrations-Lecture 24
Thur., 2021-04-22

Assignment #7 overview
- no zero nat. freq. because no rigid body movement
- went over solution
- MATLAB has findpeaks() ! → to find "valleys" do one over the function

Assignment #8 Notes:
- beam fixed at both ends
- mass in the middle!



l = length of 1 element

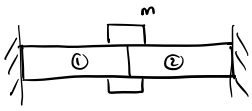


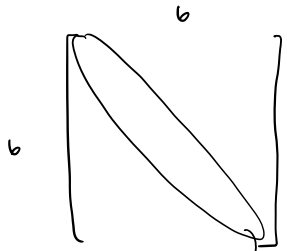
— non uniformity to can't use analytic approach... need FEM!

for a beam element, have 4 DOF:

simple 2-element system (don't do two on the assignment!)

6 x 6 matrix

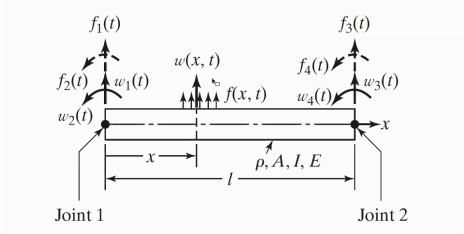




$= [m]$

mass will need to be added somewhere along diagonal?

MATLAB codes



← need to keep this numbering system in order to use the MATLAB codes: as in $w_1(t)$ is up @ point 1 and $w_2(t)$ is rotation at point 2

← why is mass matrix not diagonal?
- positive semi definite ($T = \frac{1}{2}\dot{\vec{x}}^T[m]\dot{\vec{x}} \geq 0$)
- positive semi definite for [k], too ($U = \frac{1}{2}\vec{x}^T[k]\vec{x} \geq 0$)

if all eigenvalues ≥ 0, then [k] and/or [m] are positive semi-definite

matlab scripts have matrices for M, K already typed in
→ p = # of elements
- each node has 2 DOF

⊛ beam_matrices.m
- next part blows up the scalars to vectors, such as rho
  ↳ I will be sent in as a vector
- loop over elements, fill in [m] and [k]
  ↳ then go through the connectivity
- M, K come out as if beam is free-free (in mid air)
  ↳ need to add the fixed-fixed in post processing
  ↳ also add the pin mass, whatever in post-processing

beam_matrices_test.m
- steel beam
- 200 elements, 1m long
- nodal locations, use x = linspace(0, L, Q) (Q = # of nodes)
- length of elements = diff(x)
- natural frequencies on diagonal of D, after square-rooting them, after [V, D] = eig( )
- Ch. 8:

  $\beta_1 l = 4.730041$

  $\beta_2 l = 7.853205$

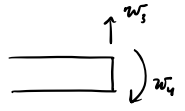
  $\beta_3 l = 10.995608$

  $\beta_4 l = 14.137165$
- higher # elements, longer it takes MATLAB to run

Q = # nodes = p + 1

N = # DOF = 2Q

$M(N-1, N-1) = m(N-1, N-1) + \Delta m$ if adding to

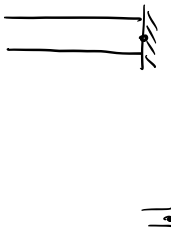


$$\begin{matrix} w \\ \theta \\ w \\ \theta \\ \vdots \\ w \\ \theta \end{matrix}$$

only add mass to xlational, not rotational DOF
↳ bc treating like a pt. mass

- the natural frequencies will need to be real, not imaginary

⊛ when make something stiffer, natural frequencies go up

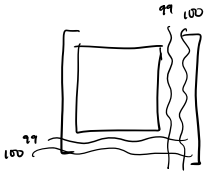


$$x = \begin{Bmatrix} \\ \\ \\ \\ \\ w \\ \theta \end{Bmatrix}$$

$w = 0$

$\frac{\partial w}{\partial x} = \theta = 0$

↳ the last node has these DOF



=> ZERO OUT ROW + COLUMN OF K + M FOR THAT DOF