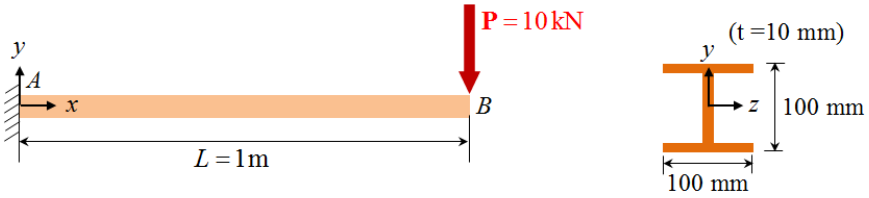
[File upload] ftp://cdl.hanyang.ac.kr → cdl/cdl → 차제구조 → 실습_midterm_exam

[analysis_result_file] (학번)_(문제번호)_(요소종류) ex) 2000100100_1_beam

[report_file] (학번) upload only one file for all problems.

[1-2] For the alloy steel beam and boundary condition shown, verify the following equations. Use 1-D beam element.

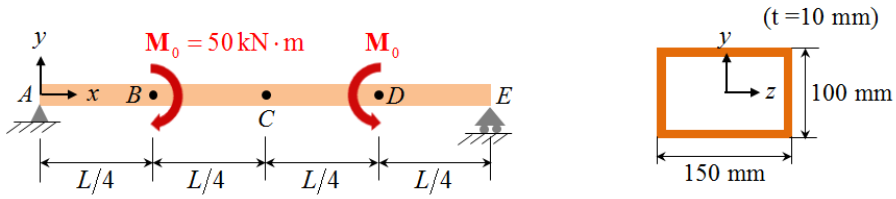
1. Cantilever beam (15 pts)



(a) the slope at the free end : $\phi_B = \dfrac{PL^2}{2EI}$

(b) the deflection at the free end : $d_B = \dfrac{PL^3}{3EI}$

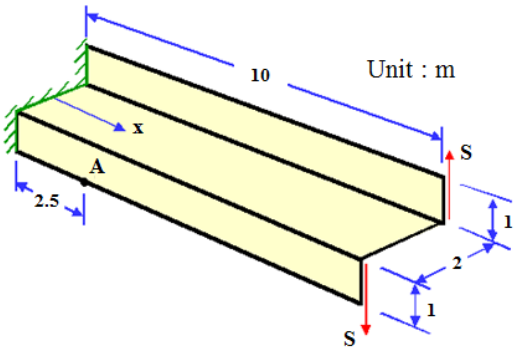
2. Simply supported beam (15 pts)

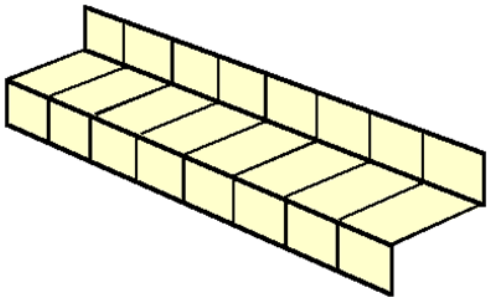


(a) the slope at end A : $\phi_A = \dfrac{M_0 L}{4EI}$

(b) the deflection at the center C : $d_C = \dfrac{3M_0 L^2}{32EI}$

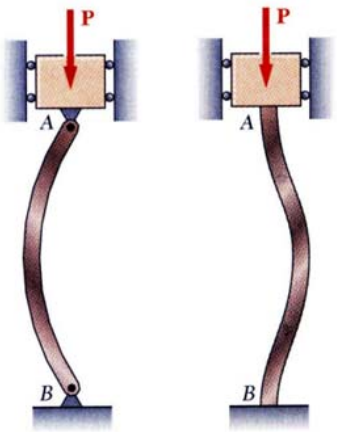
3. A z-angle beam under torsional load is illustrated in the figure below. By using the presented boundary conditions and the element shape, find the axial (x-x) stress at the mid-surface of point A. (35 pts)





Material properties	$E = 210\,\text{GPa}$, $\nu = 0.3$
Element type	24 shell element (thickness: 0.1 m)
Loading condition	Torque of 1.2 MNm applied at end x=10 by uniformly distributed edge shears, S=0.6 MN at each flange
Support conditions	Fixed conditions at edge x=0
Target value	-108 MPa (compression)

4. Each of the two struts consists of an alloy steel tube that has a 150-mm outer diameter and a 10-mm wall thickness. Determine the critical buckling load (P_{cr}) for each support condition shown (L=1m), and compare the results between 1-D and 3-D (solid) element. (35 pts)



$L_{eff} = L$ $\quad$ $L_{eff} = \frac{L}{2}$

Analytic solution : $P_{cr} = \frac{\pi^2 EI}{L_{eff}^{\ 2}}$