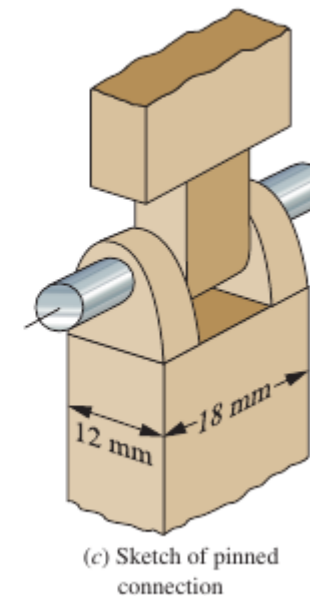
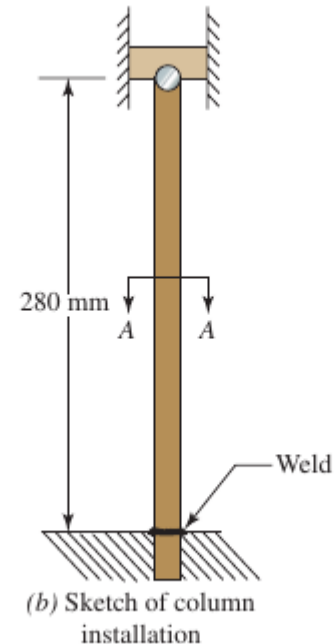
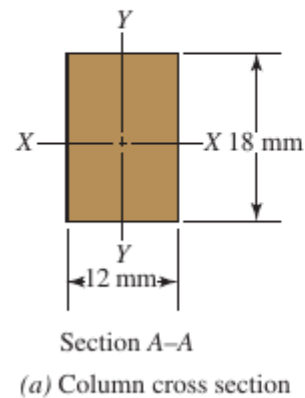


Design exercise 1

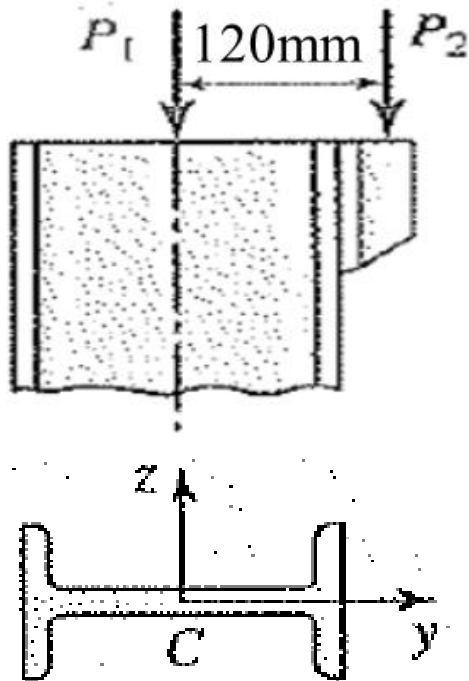
Determine the critical load on a steel column having a rectangular cross section, 12 mm by 18 mm, and a length of 280 mm. It is proposed to use SAE 1040 hot-rolled steel. The lower end of the column is inserted into a close-fitting socket and is welded securely. The upper end is pinned

For the SAE 1040 hot-rolled steel,
 $E = 207\text{GPa}$ and $S_y = 290\text{MPa}$.

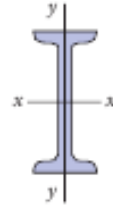


Design exercise 2

A 6m long pin-ended steel column of S200×34 section (with $E = 200\text{GPa}$ and $S_y = 250\text{MPa}$) carries a centric load $P_1 = 400\text{kN}$ and an eccentrically applied load $P_2 = 80\text{kN}$. Determine the stress in the column and the factor of safety



Design exercise 2



Properties of Rolled-Steel (S) Shapes, American Standard I Beams

SI Units										
Designation ^a	Area (10 ³ mm ²)	Depth (mm)	Flange		Web Thickness (mm)	Axis x-x			Axis y-y	
			Width (mm)	Thickness (mm)		<i>I</i> (10 ⁸ mm ⁴)	<i>r</i> (mm)	<i>S</i> (10 ³ mm ³)	<i>I</i> (10 ⁸ mm ⁴)	<i>r</i> (mm)
S 610 × 149	19.0	610	184	22.1	19.0	995	229	3260	19.9	32.3
× 119	15.2	610	178	22.1	12.7	878	241	2880	17.6	34.0
S 510 × 141	18.0	508	183	23.3	20.3	670	193	2640	20.7	33.8
× 112	14.3	508	162	20.1	16.3	533	193	2100	12.3	29.5
S 460 × 104	13.3	457	159	17.6	18.1	385	170	1685	10.0	27.4
× 81	10.4	457	152	17.6	11.7	335	180	1466	8.66	29.0
S 380 × 74	9.5	381	143	15.8	14.0	202	146	1060	6.53	26.2
× 64	8.13	381	140	15.8	10.4	186	151	977	5.99	27.2
S 310 × 74	9.48	305	139	16.8	17.4	127	116	833	6.53	256.2
× 52	6.64	305	129	13.8	10.9	95.3	120	625	4.11	24.9
S 250 × 52	6.64	254	126	12.5	15.1	61.2	96	482	3.48	22.9
× 38	4.81	254	118	12.5	7.9	51.6	103	406	2.83	24.2
S 200 × 34	4.37	203	106	10.8	11.2	27	78.7	266	1.79	20.3
× 27	3.5	203	102	10.8	6.9	24	82.8	236	1.55	21.1
S 150 × 26	3.27	152	90	9.1	11.8	11.0	57.9	144	0.96	17.2
× 19	2.36	152	84	9.1	5.8	9.20	62.2	121	0.76	17.9
S 100 × 14	1.80	102	70	7.4	8.3	2.83	39.6	55.5	0.38	14.5
× 11	1.45	102	67	7.4	4.8	2.53	41.6	49.6	0.32	14.8

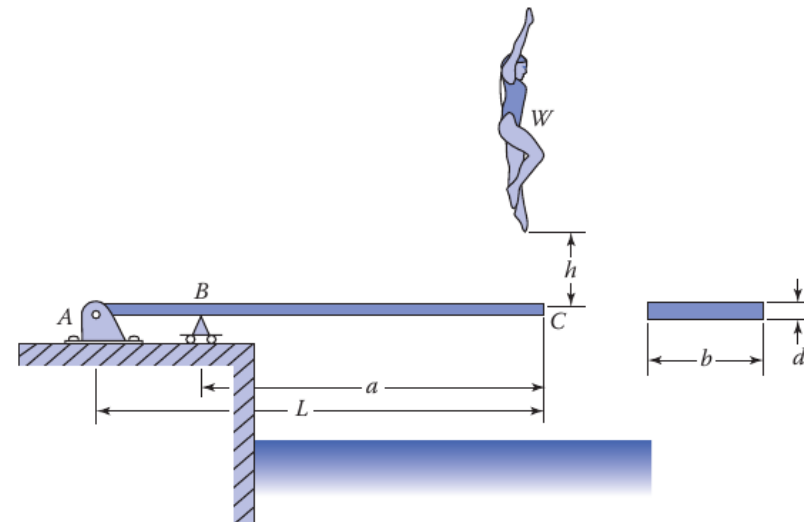
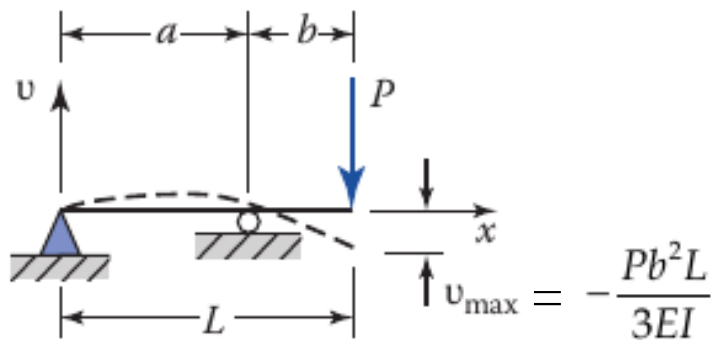
^a An American standard beam is designated by letter S followed by the nominal depth in millimeters and the mass in kilograms per meter.

Design exercise 3

A diver of weight W is springing on a rectangular cross-sectional diving board ABC . On the average bounce, the diver reaches a height h above the end C of the board. Determine

- a) The maximum static deflection and stress in the board
- b) The maximum dynamic deflection at end C
- c) The maximum dynamic stress in the board

Given: $a = 3\text{m}$, $L = 4\text{m}$, $b = 400\text{mm}$, $d = 65\text{mm}$, $h = 500\text{mm}$, $E = 12.6\text{GPa}$, and $W = 600\text{N}$



Announcement

You need to perform buckling analysis in project 1

Ancient Chinese mechanisms

Jie Gao (桔槔) for water lifting

How would you analyse the 2 supporting bamboo columns?

