110 學年度第一學期 機械設計原理(一) HW1

姓名：________________________________ 學號：______________________________

1. A ductile hot-rolled steel bar has a minimum yield strength in tension and compression of 350 MPa. Using the distortion-energy and maximum-shear-stress theories determine the factors of safety for the following plane stress states: (15%)
   (a) σ_x = 100 MPa, σ_y = 50 MPa
   (b) σ_x = 100 MPa, τ_{xy} = –75 MPa
   (c) σ_x = 100 MPa, σ_y = 20 MPa, τ_{xy} = –20 MPa

2. Repeat Problem 1 for a bar of AISI 1030 hot-rolled steel and: (table at last page) (15%)
   (a) σ_x = 175 MPa, σ_y = 105 MPa
   (b) σ_x = 140 MPa, τ_{xy} = 70 MPa
   (c) σ_x = –84 MPa, σ_y = 105 MPa, τ_{xy} = 63 MPa

3. An AISI 1018 steel has a yield strength, S_y = 295 MPa. Using the distortion-energy theory for the given state of plane stress, determine the factor of safety. (15%)

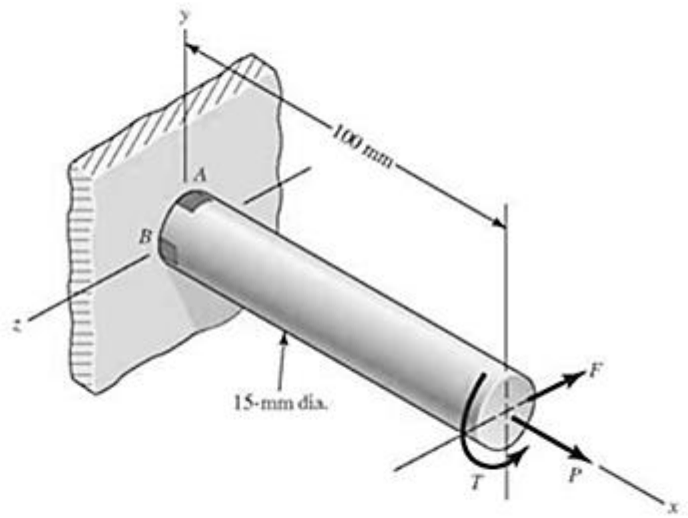
(a) σ_x = 100 MPa, τ_{xy} = -25 MPa

(b) σ_x = –30 MPa, σ_y = -65 MPa, τ_{xy} = 40 MPa

(c) σ_x = –80 MPa, σ_y = 30 MPa, τ_{xy} = -10 MPa

4. A ductile material has the properties S_{yt} = 413.700 MPa and S_{yc} = 517.125 MPa. Using the ductile Coulomb-Mohr theory, determine the factor of safety for the states of plane stress given in Problem 2. (15%)

5. This problem illustrates that the factor of safety for a machine element depends on the particular point selected for analysis. Here you are to compute factors of safety, based upon the distortion-energy theory, for stress elements at A and B of the member shown in the figure. This bar is made of AISI 1006 cold-drawn steel and is loaded by the forces $F = 0.55$ kN, $P = 4.0$ kN, and $T = 25$ N · m. (20%)



6. The figure shows a shaft mounted in bearings at A and D and having pulleys at B and C. The forces shown acting on the pulley surfaces represent the belt tensions. The shaft is to be made of AISI 1035 CD steel. Using a conservative failure theory with a design factor of 2, determine the minimum shaft diameter to avoid yielding. (20%)

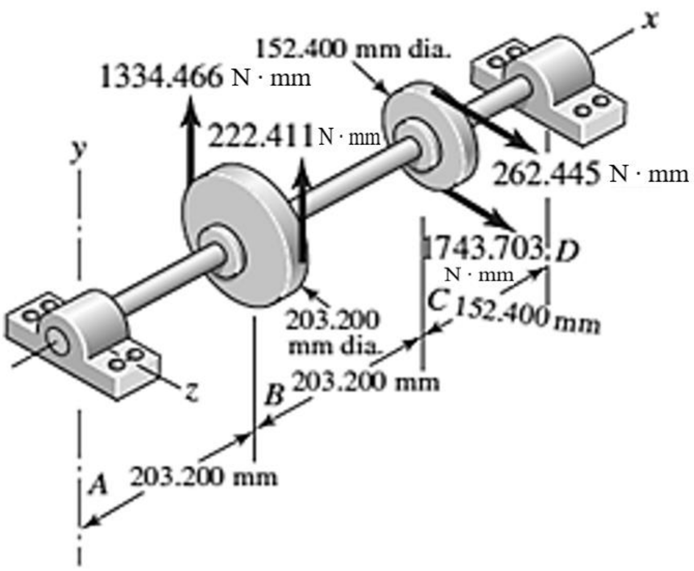


Table A–20 Deterministic ASTM Minimum Tensile and Yield Strengths for Some Hot-Rolled (HR) and Cold-Drawn (CD) Steels

[The strengths listed are estimated ASTM minimum values in the size range 18 to 32 mm ($\frac{3}{4}$ to $1\frac{1}{4}$ in). These strengths are suitable for use with the design factor defined in Sec. 1–10, provided the materials conform to ASTM A6 or A568 requirements or are required in the purchase specifications. Remember that a numbering system is not a specification.]

1 UNS No.	2 SAE and/or AISI No.	3 Processing	4 Tensile Strength, MPa (kpsi)	5 Yield Strength, MPa (kpsi)	6 Elongation in 2 in, %	7 Reduction in Area, %	8 Brinell Hardness
G10060	1006	HR	300 (43)	170 (24)	30	55	86
		CD	330 (48)	280 (41)	20	45	95
G10100	1010	HR	320 (47)	180 (26)	28	50	95
		CD	370 (53)	300 (44)	20	40	105
G10150	1015	HR	340 (50)	190 (27.5)	28	50	101
		CD	390 (56)	320 (47)	18	40	111
G10180	1018	HR	400 (58)	220 (32)	25	50	116
		CD	440 (64)	370 (54)	15	40	126
G10200	1020	HR	380 (55)	210 (30)	25	50	111
		CD	470 (68)	390 (57)	15	40	131
G10300	1030	HR	470 (68)	260 (37.5)	20	42	137
		CD	520 (76)	440 (64)	12	35	149
G10350	1035	HR	500 (72)	270 (39.5)	18	40	143
		CD	550 (80)	460 (67)	12	35	163
G10400	1040	HR	520 (76)	290 (42)	18	40	149
		CD	590 (85)	490 (71)	12	35	170