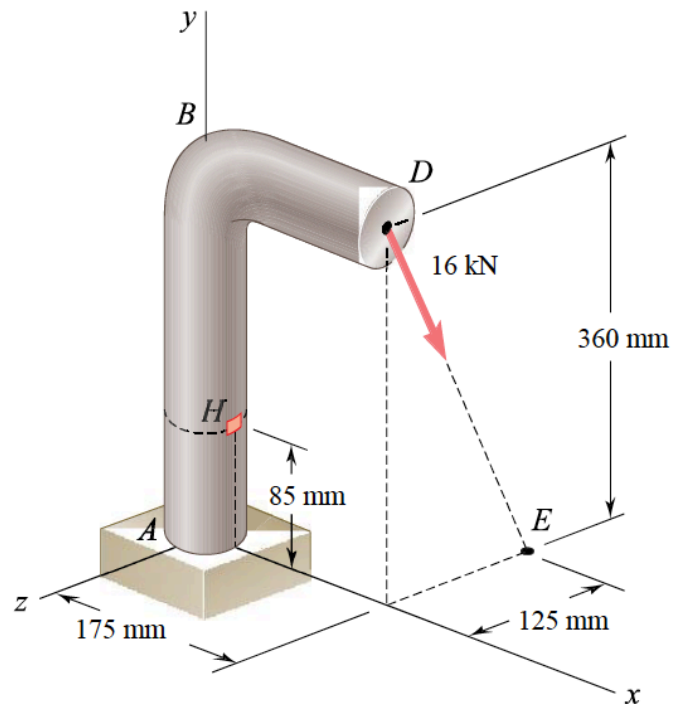

Machine Design -1

A 16 kN force is applied to a 66 mm diameter clamped post ABD, as shown in the figure.



- (a) Calculate all the force and moment components at the centroid of a horizontal cross section containing point H **(25 Points)**.
- (b) Find all the non-zero normal and shear stress components in point H. Hint: The transverse shear stress is NOT negligible, and Q for a semicircle is $\frac{2}{3}c^3$, where c is the radius **(25 Points)**.
- (c) Calculate the principal stresses and the maximum shear stress in point H **(20 Points)**.
- (d) The bar is made of a ductile material, and it is preferred to be more conservative for designing the post against static failure. What failure theory do you suggest for designing this post **(5 Points)**?
- (e) You are asked to select a material for this post, in a way that the factor of safety for the static failure at point H is at least 4. Use the failure theory that you suggested in part (d) and by considering the attached table select a material that satisfies this condition **(20 Points)**. Remember that you are using a failure theory which is valid for ductile materials. Using the properties in the attached table, how can you justify that the material you have selected is ductile not brittle **(5 Points)**?

Material properties:

1	2	3	4	5	6	7	8
UNS No.	SAE and/or AISI No.	Process- ing	Tensile Strength, MPa (kpsi)	Yield Strength, MPa (kpsi)	Elongation in 2 in, %	Reduction in Area, %	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
G10450	1045	HR	570 (82)	310 (45)	16	40	163
		CD	630 (91)	530 (77)	12	35	179
G10500	1050	HR	620 (90)	340 (49.5)	15	35	179
		CD	690 (100)	580 (84)	10	30	197
G10600	1060	HR	680 (98)	370 (54)	12	30	201
G10800	1080	HR	770 (112)	420 (61.5)	10	25	229
G10950	1095	HR	830 (120)	460 (66)	10	25	248