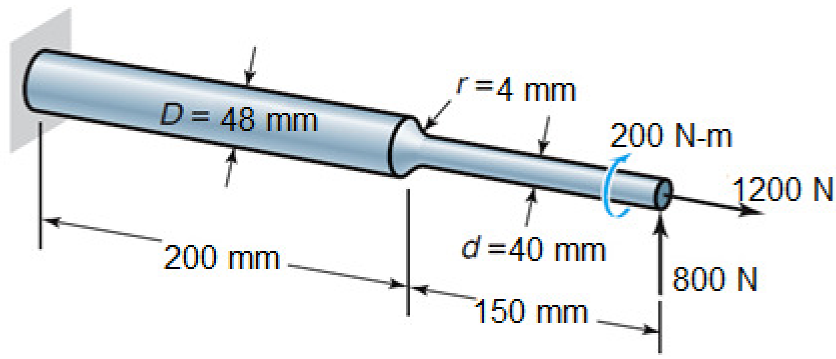
HW4.1

BigD	48	mm	
LittleD	40	mm	
LLeft	200	mm	
LRight	150	mm	
RFillet	4	mm	
Axial	1200	N	
Radial	800	N	
Torque	200	N-m	



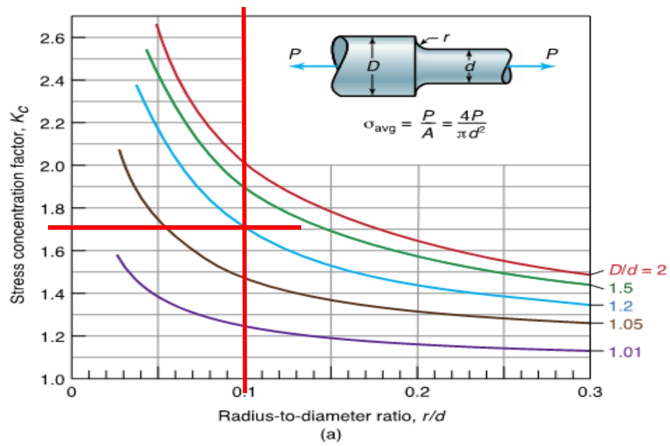
LittleR	20	mm	=LittleD/2		
Area	1256.63706	mm^2	=PI()*LittleR^2		
MomOfInertia	125,663.71	mm^4	=PI()*LittleR^4/4		
PolarMoment	251,327.41	mm^4	=MomOfInertia*2		
Average Stresses					
SigmaAxial	0.955	MPa	=Axial/Area		
SigmaBend	19.099	MPa	=Radial*LRight*LittleR/MomOfInertia		
TauTors	15.915	MPa	=Torque*LittleR*1000/PolarMoment		
R/d	0.10		=RFillet/LittleD		
D/d	1.20		=BigD/LittleD		
Kaxial	1.7		Fig. 6.5a	1.7	
Kbend	1.6		Fig. 6.5b	1.6	
Ktors	1.32		Fig. 6.5c	1.32	
Max Stresses					
StressAxial	1.623	MPa	=Kaxial*SigmaAxial		
StressBend	30.558	MPa	=Kbend*SigmaBend		
Tensile	32.181	MPa	=StressAxial+StressBend	This is Sigma X	Sigma Y = 0
Shear	21.008	MPa	=Ktors*TauTors	This is Tau XY	
MohrRadius	26.462	MPa	=SQRT(Shear^2+(Tensile/2)^2)		
MohrCenter	16.091	MPa	=Tensile/2		
MaxPrincipal	42.553	MPa	=MohrCenter+MohrRadius		
MinPrincipal	-10.372	MPa	=MohrCenter-MohrRadius		

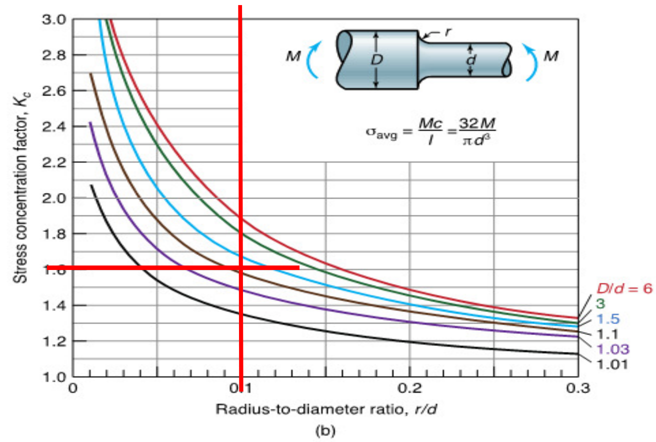
See Charts next page.

Just to be sure, check the bending stress at the wall:

FarMomOfI	260,576.26	mm^4	=PI()*(BigD/2)^4/4
SigmaFarBend	25.79	MPa	=Radial*(LRight+LLeft)*BigD/2/FarMomOfI

Smaller than the bending stress at the neckdown.





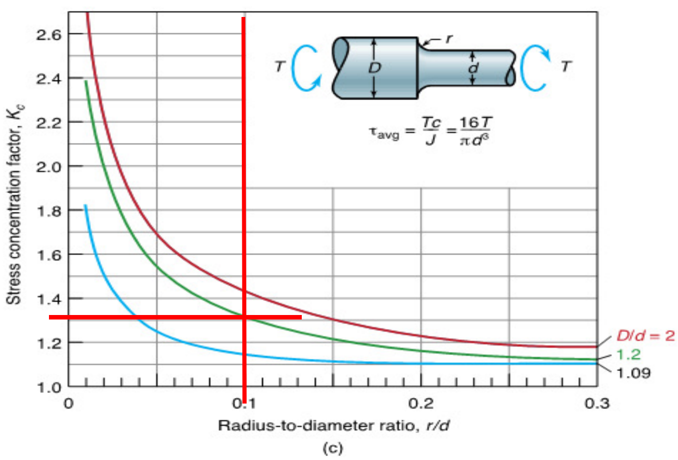


Figure 6.5: Stress concentration factors for round bar with fillet. (a) Axial load; (b) bending; (c) torsion.

HW4.2

Tensile	75	ksi	Sigma X			
Shear	60	ksi	Tau XY			
Yield	134	ksi	Ti-6Al-4V Annealed		924	MPa
					0.14504	ksi/Mpa
					134.02	ksi
MohrRadius	70.755	ksi	=SQRT(Shear^2+(Tensile/2)^2)			
MohrCenter	37.500	ksi	=Tensile/2			
MaxPrincipal	108.255	ksi	=MohrCenter+MohrRadius			
MinPrincipal	-33.255	ksi	=MohrCenter-MohrRadius			
Diameter	141.510	ksi	=MaxPrincipal-MinPrincipal			
MSST						
Nmsst	0.947		=Yield/(MaxPrincipal-MinPrincipal)			
DET						
SigmaE	128.160	ksi	=SQRT(Tensile^2+3*Shear^2)			
NvonMises	1.046		=Yield/SigmaE			

$$\sigma_e = \sqrt{\sigma_x^2 + 3\tau_{xy}^2}$$

HW4.3A

SigmaX	15	MPa	Sigma X
SigmaY	-75	MPa	Sigma Y
Shear	0	MPa	Tau XY
Yield	325	MPa	Al 2024-T351
MohrRadius	45.000	MPa	=SQRT(Shear^2+((SigmaX-SigmaY)/2)^2)
MohrCenter	-30.000	MPa	=(SigmaX+SigmaY)/2
MaxPrincipal	15.000	MPa	=MohrCenter+MohrRadius
MinPrincipal	-75.000	MPa	=MohrCenter-MohrRadius
Diameter	90.00	ksi	=MaxPrincipal-MinPrincipal
MSST			
Nmsst	3.611		=Yield/(MaxPrincipal-MinPrincipal)
DET			
SigmaE	83.516		=SQRT(SigmaX^2+SigmaY^2-SigmaX*SigmaY+3*Shear^2)
NvonMises	3.891		=Yield/SigmaE

$$\sigma_e = \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x\sigma_y + 3\tau_{xy}^2}$$

HW4.3B

SigmaX	-35	MPa	Sigma X
SigmaY	-35	MPa	Sigma Y
Shear	-35	MPa	Tau XY
Yield	325	MPa	Al 2024-T351
MohrRadius	35.000	MPa	=SQRT(Shear^2+((SigmaX-SigmaY)/2)^2)
MohrCenter	-35.000	MPa	=(SigmaX+SigmaY)/2
MaxPrincipal	0.000	MPa	=MohrCenter+MohrRadius
MinPrincipal	-70.000	MPa	=MohrCenter-MohrRadius
Diameter	70.00	ksi	=MaxPrincipal-MinPrincipal
MSST			
Nmsst	4.643		=Yield/(MaxPrincipal-MinPrincipal)
DET			
SigmaE	70.000		=SQRT(SigmaX^2+SigmaY^2-SigmaX*SigmaY+3*Shear^2)
NvonMises	4.643		=Yield/SigmaE

$$\sigma_e = \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x \sigma_y + 3\tau_{xy}^2}$$

HW4.3C

SigmaX	40	MPa	Sigma X
SigmaY	-40	MPa	Sigma Y
Shear	60	MPa	Tau XY
Yield	325	MPa	Al 2024-T351
MohrRadius	72.111	MPa	=SQRT(Shear^2+((SigmaX-SigmaY)/2)^2)
MohrCenter	0.000	MPa	=(SigmaX+SigmaY)/2
MaxPrincipal	72.111	MPa	=MohrCenter+MohrRadius
MinPrincipal	-72.111	MPa	=MohrCenter-MohrRadius
Diameter	144.222	ksi	=MaxPrincipal-MinPrincipal
MSST			
Nmsst	2.253		=Yield/(MaxPrincipal-MinPrincipal)
DET			
SigmaE	124.900		=SQRT(SigmaX^2+SigmaY^2-SigmaX*SigmaY+3*Shear^2)
NvonMises	2.602		=Yield/SigmaE

$$\sigma_e = \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x \sigma_y + 3\tau_{xy}^2}$$

HW4.3D

SigmaX	-110	MPa	Sigma X
SigmaY	-55	MPa	Sigma Y
Shear	30	MPa	Tau XY
Yield	325	MPa	Al 2024-T351
MohrRadius	40.697	MPa	=SQRT(Shear^2+((SigmaX-SigmaY)/2)^2)
MohrCenter	-82.500	MPa	=(SigmaX+SigmaY)/2
MaxPrincipal	-41.803	MPa	=MohrCenter+MohrRadius
MinPrincipal	-123.197	MPa	=MohrCenter-MohrRadius
Diameter	81.394	ksi	=MaxPrincipal-MinPrincipal
MSST			
Nmsst	2.638		=Yield/(MaxPrincipal-MinPrincipal)
DET			
SigmaE	108.513		=SQRT(SigmaX^2+SigmaY^2-SigmaX*SigmaY+3*Shear^2)
NvonMises	2.995		=Yield/SigmaE

Must substitute Zero for MaxPrincipal here.

$$\sigma_e = \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x \sigma_y + 3\tau_{xy}^2}$$