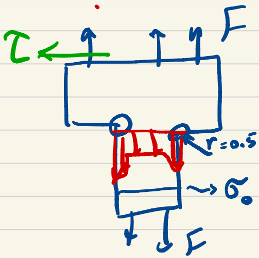
بسم الله الرحمن الرحیم

طراحی یک

جلسه ۱۳

تمرکز تنش :



$$\sigma_{max} = K_t \cdot \sigma_0$$

K_t ← ضریب تمرکز تنش

$$\tau_{max} = K_{ts} \cdot \tau_0$$

K_t با استفاده از جداول آخر کتاب قابل دستیابی است.

اما در بارگذاری نوسانی عامل دیگری نیز دخیل می‌شود.

$$\sigma_{max} = K_f \cdot \sigma_0$$ در بارگذاری نوسانی

K_f: ضریب تمرکز تنش در بارگذاری نوسانی

$$K_f = 1 + q(K_t - 1)$$

ضریب حساسیت ماده به رشد ترک $q = \dfrac{K_f - 1}{K_t - 1}$

$$q_{shear} = \frac{K_{fs} - 1}{K_{ts} - 1} \rightarrow K_{fs} = 1 + q_{shear}(K_{ts} - 1)$$

بارگذاری نوسانی $\tau_{max} = K_{fs}\,\tau_0$

q: ضریب حساسیت ماده به ترک (Table 6-20, 21)

$$q = \frac{1}{1 + \frac{\sqrt{a}}{\sqrt{r}}}$$

$\sqrt{a}$: Neuber constant

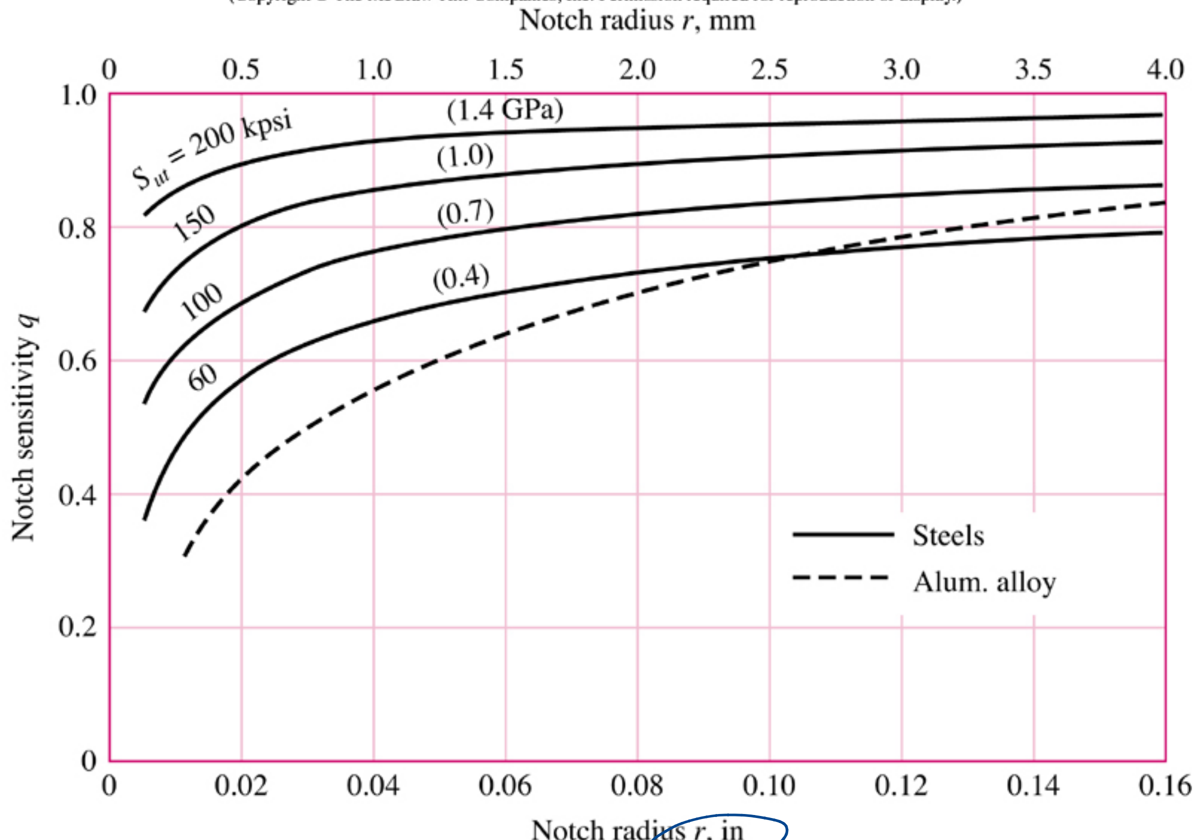
خواص ماده

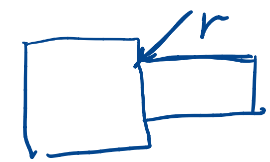
$$\sqrt{a} = 0.246 - 3.08(10^{-3})S_{ut} + 1.51(10^{-5})S_{ut}^2 - 2.67(10^{-8})S_{ut}^3$$

Bending or axial

$$\sqrt{a} = 0.190 - 2.51(10^{-3})S_{ut} + 1.35(10^{-5})S_{ut}^2 - 2.67(10^{-8})S_{ut}^3$$

Torsion





$$q = \frac{1}{1 + \frac{\sqrt{a}}{\sqrt{r}}}$$

$\sqrt{a}$: Neuber constant

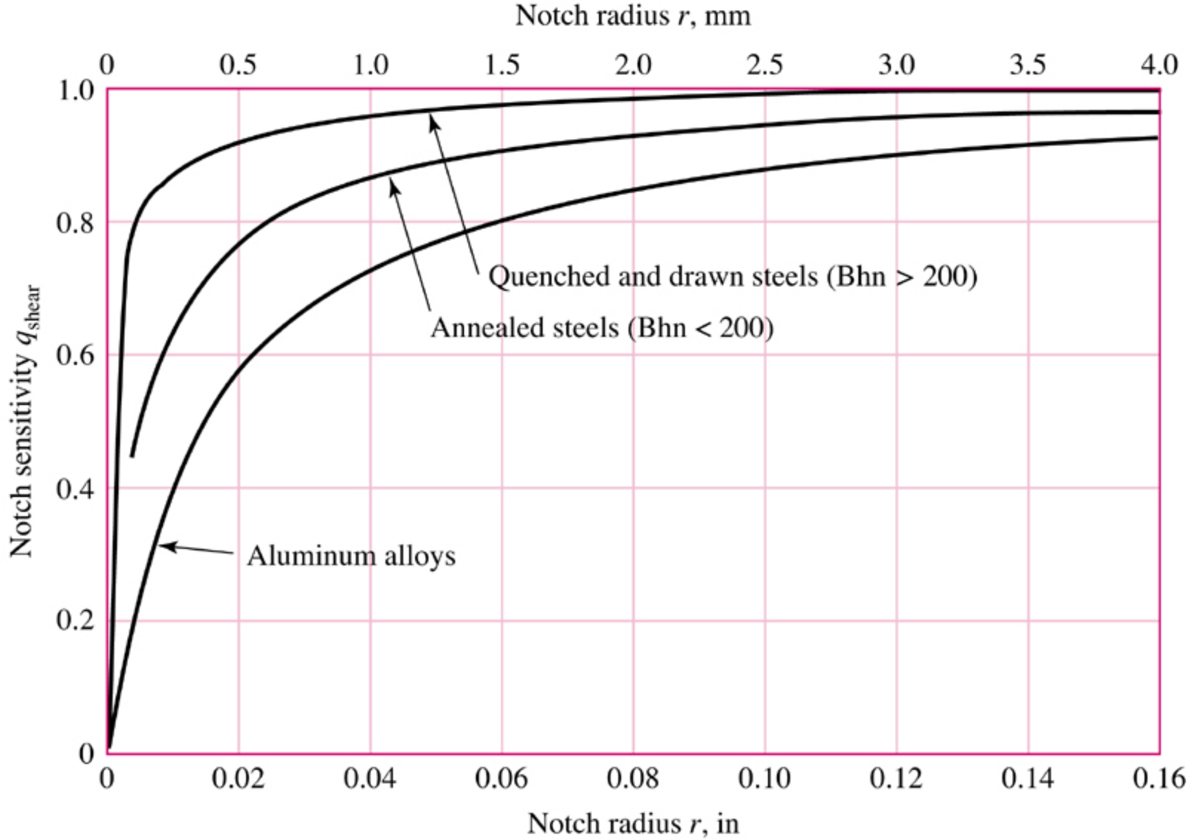
خواص ماده

Bending or axial

$$\sqrt{a} = 0.246 - 3.08(10^{-3})S_{ut} + 1.51(10^{-5})S_{ut}^2 - 2.67(10^{-8})S_{ut}^3$$

Torsion

$$\sqrt{a} = 0.190 - 2.51(10^{-3})S_{ut} + 1.35(10^{-5})S_{ut}^2 - 2.67(10^{-8})S_{ut}^3$$



Notch radius r, mm
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
1.0
0.8
0.6
0.4
0.2
0
Notch sensitivity q_shear
Quenched and drawn steels (Bhn > 200)
Annealed steels (Bhn < 200)
Aluminum alloys
0
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
Notch radius r, in

Table A–13

Charts of Theoretical Stress-Concentration Factors K_t^*

Figure A–13–1

Bar in tension or simple compression with a transverse hole. $\sigma_0 = F/A$, where $A = (w - d)t$ and t is the thickness.

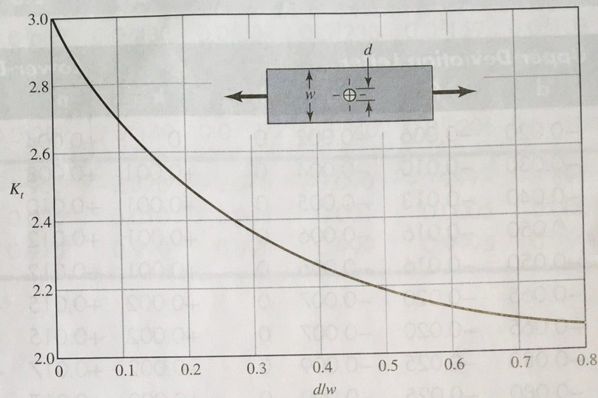


Figure A–13–2

Rectangular bar with a transverse hole in bending. $\sigma_0 = Mc/I$, where $I = (w - d)h^3/12$.

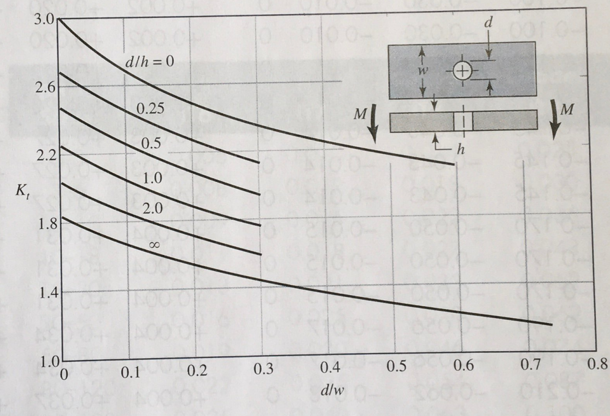
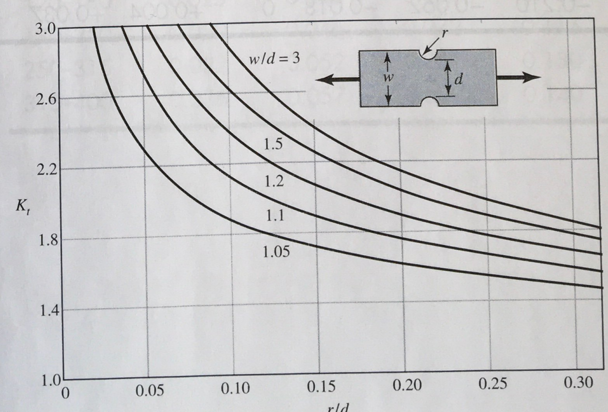


Figure A–13–3

Notched rectangular bar in tension or simple compression. $\sigma_0 = F/A$, where $A = dt$ and t is the thickness.



Charts of Theoretical Stress-Concentration Factors K_t^* (Continued)

Figure A–13–4

Notched rectangular bar in bending. $\sigma_0 = Mc/I$, where $c = d/2$, $I = td^3/12$, and t is the thickness.

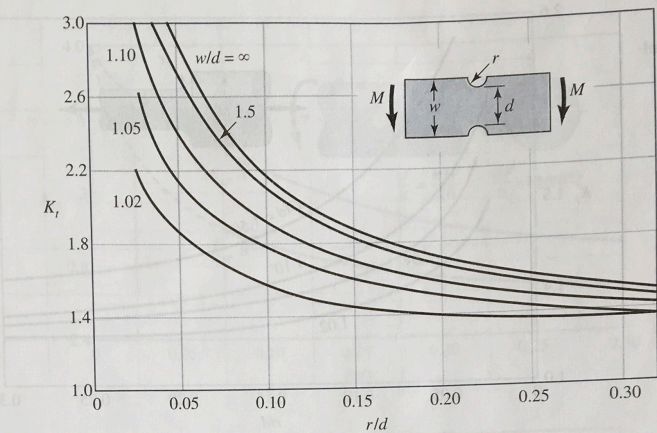


Figure A–13–5

Rectangular filleted bar in tension or simple compression. $\sigma_0 = F/A$, where $A = dt$ and t is the thickness.

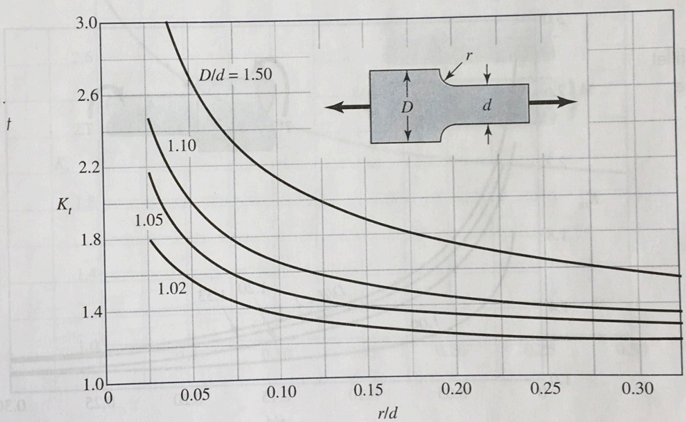
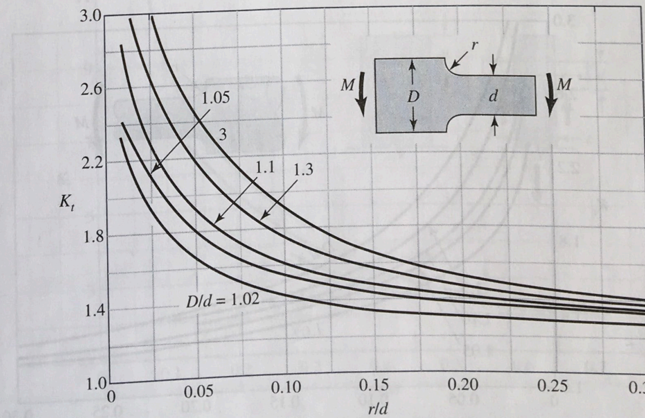


Figure A–13–6

Rectangular filleted bar in bending. $\sigma_0 = Mc/I$, where $c = d/2$, $I = td^3/12$, t is the thickness.



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*Factors from R. E. Peterson, "Design Factors for Stress Concentration," Machine Design, vol. 23, no. 2, February 1951, p. 169; no. 3, March 1951, p. 161, no. 5, May 1951, p. 159; n
1951, p. 173; no. 7, July 1951, p. 155. Reprinted with permission from Machine Design, a Penton Media Inc. publication.

Table A–13

Charts of Theoretical Stress-Concentration Factors K_t^* *(Continued)*

Figure A–13–7

Round shaft with shoulder fillet in tension. $\sigma_0 = F/A$, where $A = \pi d^2/4$.

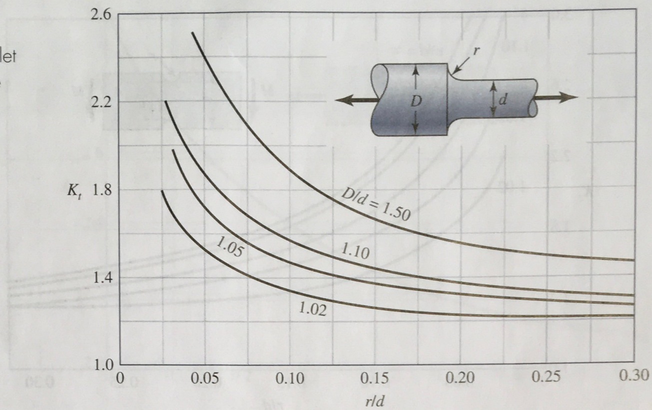


Figure A–13–8

Round shaft with shoulder fillet in torsion. $\tau_0 = Tc/J$, where $c = d/2$ and $J = \pi d^4/32$.

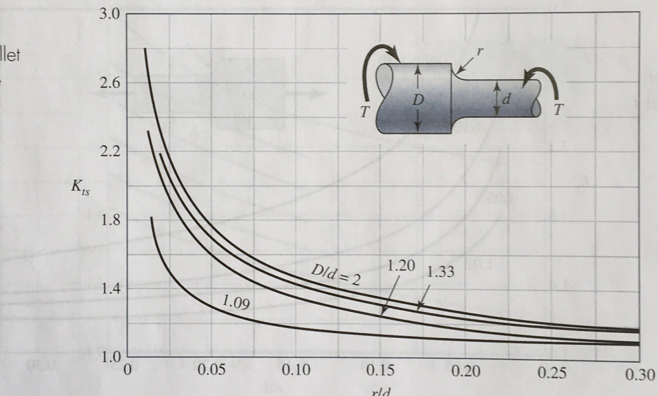


Figure A–13–9

Round shaft with shoulder fillet in bending. $\sigma_0 = Mc/I$, where $c = d/2$ and $I = \pi d^4/64$.

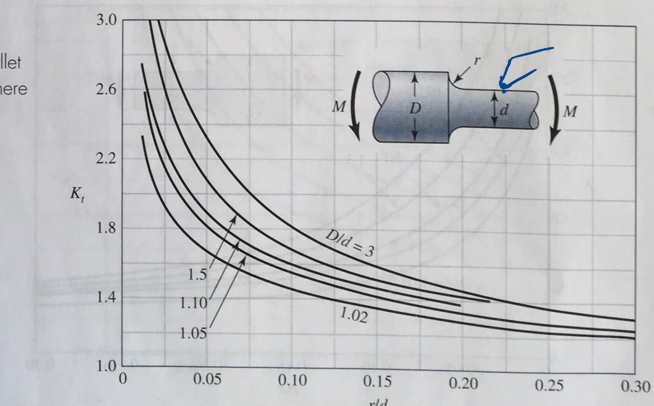


Figure A–13–10

Round shaft in torsion with transverse hole.

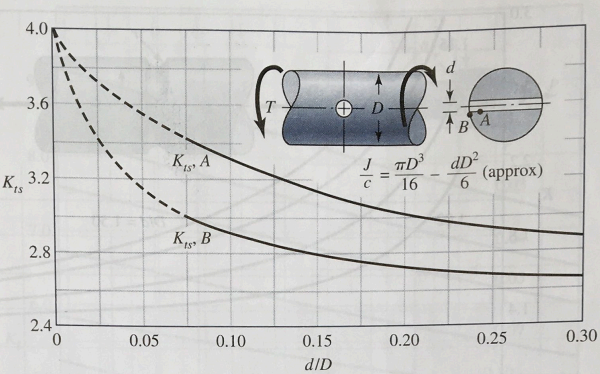


Figure A–13–11

Round shaft in bending with a transverse hole. $\sigma_0 = M/[(\pi D^3/32) - (dD^2/6)]$, approximately.

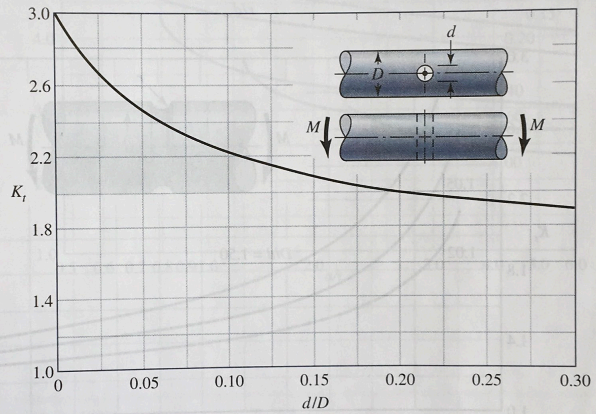
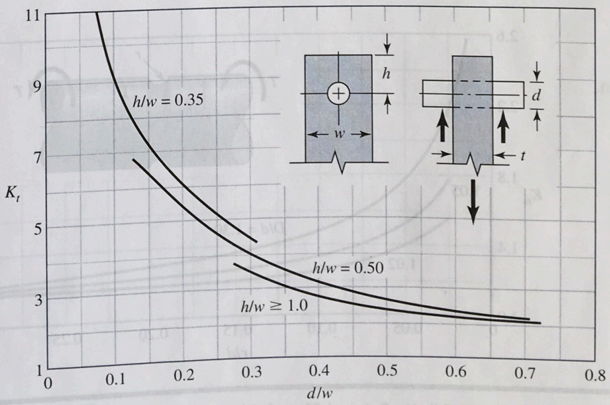


Figure A–13–12

Plate loaded in tension by a pin through a hole. $\sigma_0 = F/A$, where $A = (w - d)t$. When clearance exists, increase K_t 35 to 50 percent. (M. M. Frocht and H. N. Hill, "Stress Concentration Factors around a Central Circular Hole in a Plate Loaded through a Pin in Hole," J. Appl. Mechanics, vol. 7, no. 1, March 1940, p. A-5.)



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*Factors from R. E. Peterson, "Design Factors for Stress Concentration," Machine Design, vol. 23, no. 2, February 1951, p. 169; no. 3, March 1951, p. 161, no. 5, May 1951, p. 159; no. 6, Jun 1951, p. 173; no. 7, July 1951, p. 155. Reprinted with permission from Machine Design, a Penton Media Inc. publication.

Table A–13

Charts of Theoretical Stress-Concentration Factors K_t^* *(Continued)*

Figure A–13–13

Grooved round bar in tension. $\sigma_0 = F/A$, where $A = \pi d^2/4$.

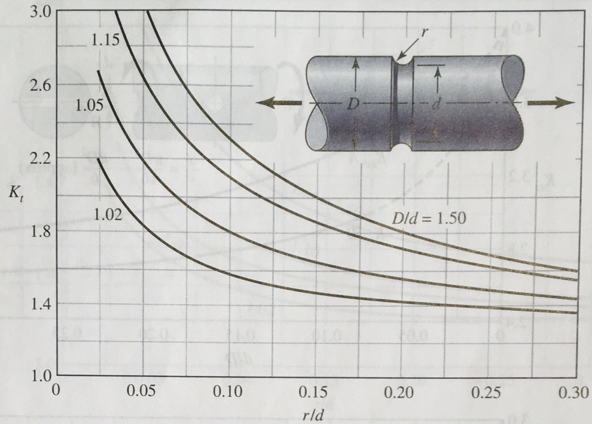


Figure A–13–14

Grooved round bar in bending. $\sigma_0 = Mc/I$, where $c = d/2$ and $I = \pi d^4/64$.

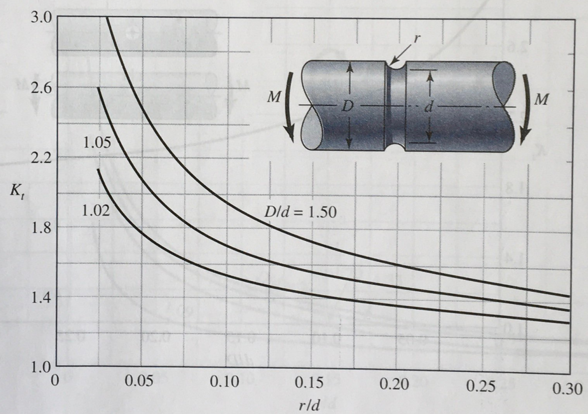
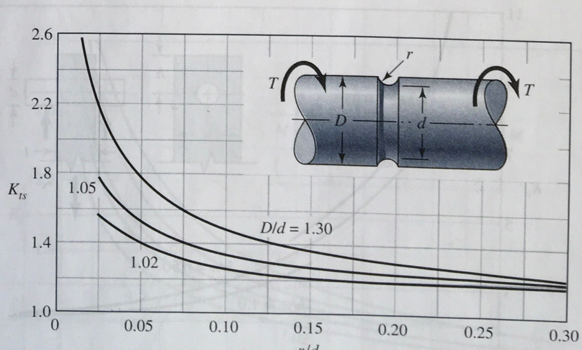


Figure A–13–15

Grooved round bar in torsion. $\tau_0 = Tc/J$, where $c = d/2$ and $J = \pi d^4/32$.



*Factors from R. E. Peterson, "Design Factors for Stress Concentration," Machine Design, vol. 23, no. 2, February 1951, p. 169; no. 3, March 1951, p. 161, no. 5, May 1951, p. 159; no. 6, June 1951, p. 173; no. 7, July 1951, p. 155. Reprinted with permission from Machine Design, a Penton Media Inc. publication.

Table A–13

Charts of Theoretical Stress-Concentration Factors K_t^* (Continued)

Figure A–13–16

Round shaft with flat-bottom groove in bending and/or tension.

$$\sigma_0 = \frac{4P}{\pi d^2} + \frac{32M}{\pi d^3}$$

Source: W. D. Pilkey, *Peterson's Stress Concentration Factors*, 2nd ed. John Wiley & Sons, New York, 1997, p. 115

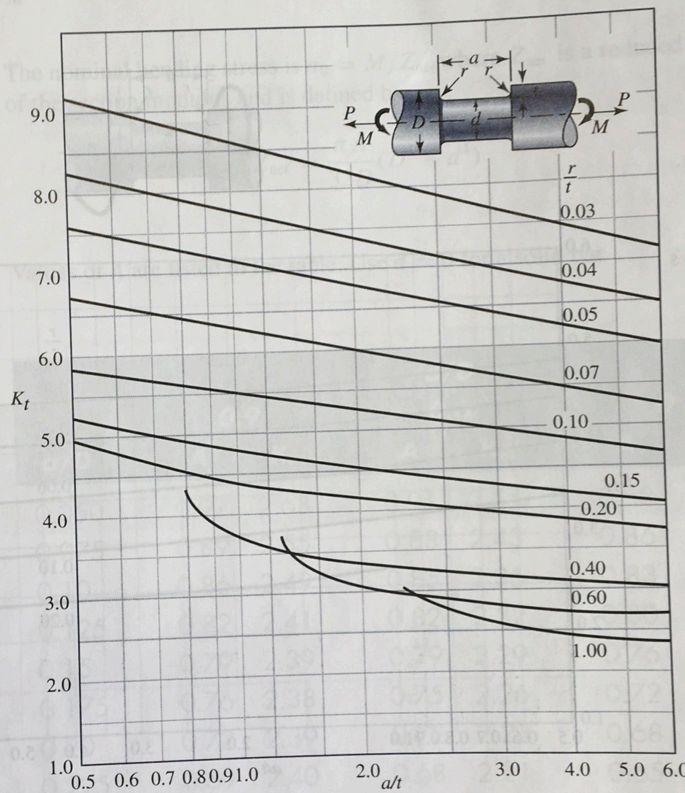


Table A–13

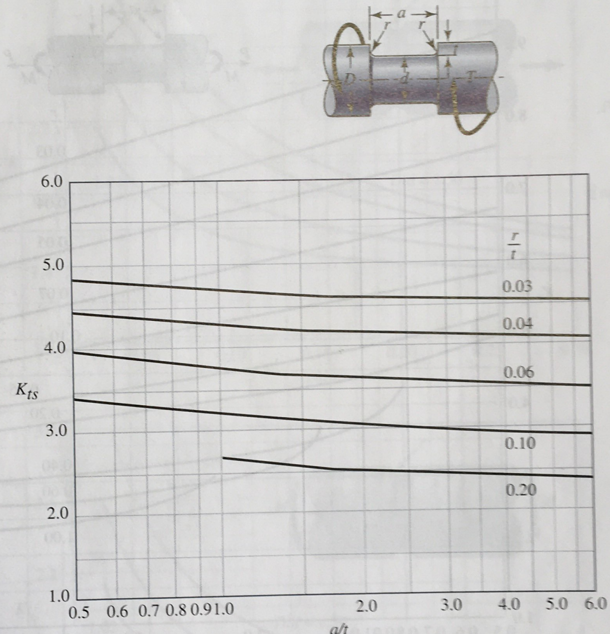
Charts of Theoretical Stress-Concentration Factors K_t^* *(Continued)*

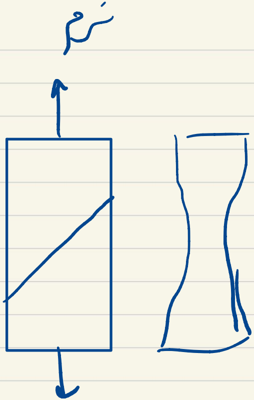
Figure A–13–17

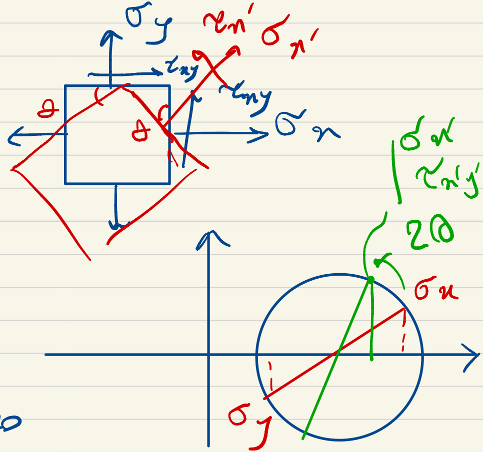
Round shaft with flat-bottom groove in torsion.

$$\tau_0 = \frac{16T}{\pi d^3}$$

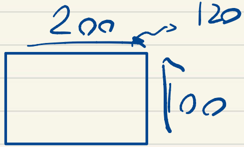
Source: W. D. Pilkey, *Peterson's Stress Concentration Factors,* 2nd ed. John Wiley & Sons, New York, 1997, p. 133







σy
τxy
σx
θ
σx'
τx'y'
2θ



200
120
100