Allowable Bearing Stress for Aluminum Alloys

$$\sigma_{bd} = \frac{\sigma_{by}}{2.48} \qquad \textbf{(3–25)}$$

The minimum values for bearing yield strength are listed in Reference 1. But many references, including the appendix tables in this book, do not include these data. An analysis of the data shows that for most aluminum alloys, the bearing yield strength is approximately 1.60 times larger than the tensile yield strength. Then Equation (3–25) can be restated as

Design Bearing Stress for Aluminum

$$\sigma_{bd} = \frac{1.60 s_y}{2.48} = 0.65 s_y \qquad \textbf{(3–26)}$$

We will use this form for design bearing stress for aluminum in this book.

Example Problem 3–21

A rectangular bar is used as a hanger, as shown in Figure 3–17. Compute the allowable load on the basis of bearing stress at the pin connection if the bar and the clevis members are made from 6061-T4 aluminum. The pin is to be made from a stronger material.

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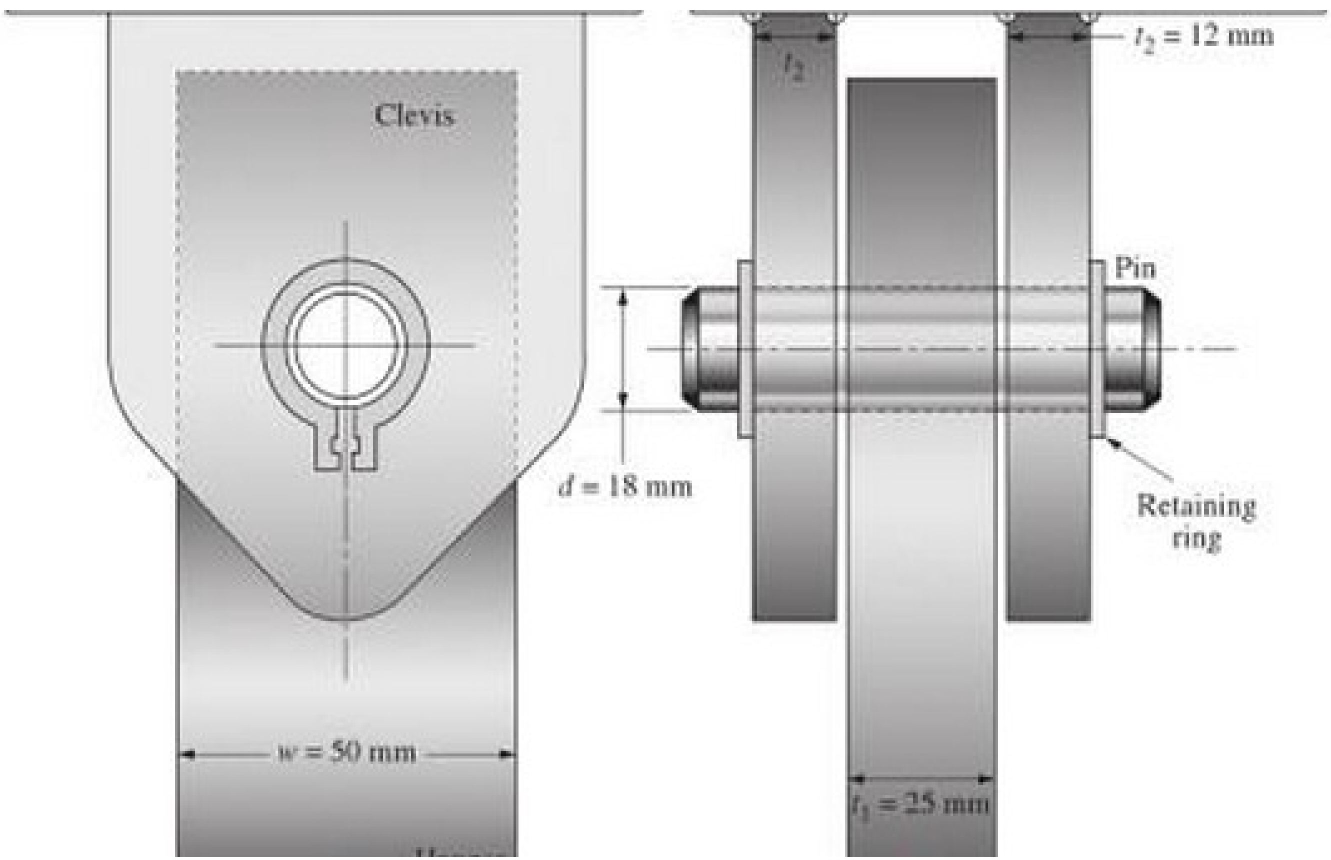
roblem 3–21.



ution — Objective: Compute the allowable load on the hanger.

Given: Loading in Figure 3–17. Pin diameter = d = 18 mm.
Thickness of the hanger = t_1 = 25 mm; width = w = 50 mm.
Thickness of each part of clevis = t_2 = 12 mm.
Hanger and clevis material: aluminum 6061-T4 (s_y = 145 MPa).
Pin is stronger than hanger or clevis.

Analysis: For cylindrical pins in close-fitting holes, the bearing stress is based on the *projected* area in bearing, found from the diameter of the pin times the length over which the load is distributed.

$$\sigma_b = \frac{F}{A_b} = \frac{F}{dL}$$

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Let $\sigma_b = \sigma_{bd} = 0.65\ s_y$ for aluminum 6061-T4.
Bearing area for hanger: $A_{b1} = t_1\,d = (25\text{ mm})(18\text{ mm}) = 450\text{ mm}^2$.
This area carries the full applied load, W.
For each side of clevis: $A_{b2} = t_2 d = (12\text{ mm})(18\text{ mm}) = 216\text{ mm}^2$.
This area carries 1/2 of the applied load, $W/2$.
Because A_{b2} is less than 1/2 of A_{b1}, bearing on the clevis governs.

lts $\sigma_{bd} = 0.65\ s_y = 0.65\ (145\text{ MPa}) = 94.3\text{ MPa} = 94.3\text{ N/mm}^2$
$\sigma_b = \sigma_{bd} = (W/2)/A_{b2}$
Then, $W = 2(A_{b2})(\sigma_{bd}) = 2(216\text{ mm}^2)(94.3\text{ N/mm}^2) = 40\,740\text{ N}$.

ent This is a very large force, and other failure modes for the hanger would have to be analyzed.
Failure could occur by shear of the pin or tensile failure of the hanger bar or the clevis.

TABLE 3–7 Allowable bearing stresses on masonry and soils for use in this book.

Material	Allowable bearing stress, σ_{bd} psi	MPa
Sandstone and limestone	400	2.76
Brick in cement mortar	250	1.72
Solid hard rock	350	2.41
Shale or medium rock	140	0.96
Soft rock	70	0.48
Hard clay or compact gravel	55	0.38
Soft clay or loose sand	15	0.10

Concrete: $\sigma_{bd} = Kf'_c = (0.34\sqrt{A_2/A_1})f'_c$ (But maximum $\sigma_{bd} = 0.68 f'_c$)

Where: f'_c = Rated strength of concrete

A_1 = Bearing area

A_2 = Full area of the support

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