

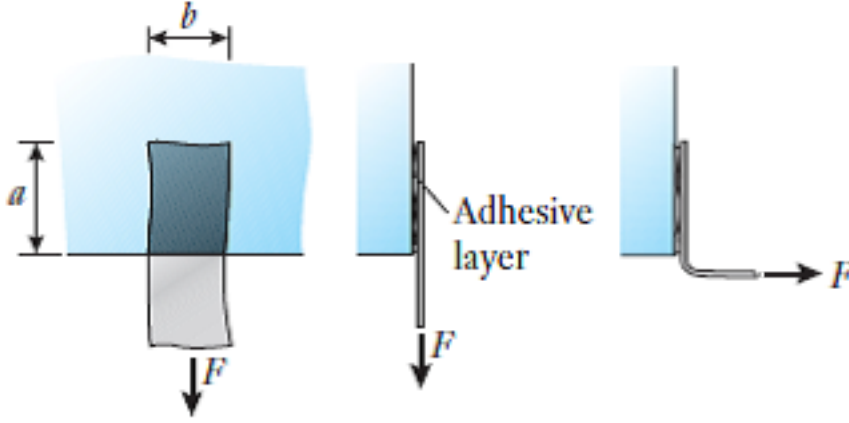
An Introduction to Mechanical Engineering | (4th Edition)

Problem

Adhesive tape is capable of supporting relatively large shear stress, but it is not able to support significant tensile stress. In this problem, you will measure the shear strength of a piece of tape. Refer to Figure P5.19.

- (a) Cut about a dozen segments of tape having identical length L and width b . The exact length isn't important, but the segments should be easily handled.
- (b) Develop a means to apply and measure the pull force F on the tape. Use, for instance, dead weights (cans of soda or exercise weights) or a small fishing scale.
- (c) Attach a segment of tape to the edge of a table, with only a portion of tape adhering to the surface. In your tests, consider attachment lengths ranging between a fraction of an inch and several inches.
- (d) Being careful to apply the pull force straight along the tape, measure the value F necessary to cause the adhesive layer to slide or shear off the table. Tabulate pull-force data for a half dozen different lengths a .
- (e) Make graphs of pull force and shear stress versus a . From the data, estimate the value of the shear stress above which the tape will slide and come loose from the table.
- (f) At what length a did the tape break before it sheared off the table?
- (g) Repeat the tests for the orientation in which F is applied perpendicular to the surface, tending to peel the tape instead of shearing it. Compare the tape's strengths for shear and peeling.

Figure P5.19



Step-by-step solution

Step 1 of 5

The length and width of adhesive tape segments taken for test of shear strength are 5 inches and 1 inch respectively. The force F necessary to cause the adhesive layer to slide off the table for different lengths ' a ' attached to the are listed in the below table.

S.No	Length, a (inches)	Force, F (lb)
1	0.5	0.2
2	1	0.4
3	1.5	0.6
4	2	0.75
5	2.25	0.82
6	2.5	0.875

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Step 2 of 5

The shear stress acting on the tape for a particular length of adhesiveness to the table is

$$\tau = \frac{\text{pull force}}{\text{area of adhesiveness attached to the table}}$$
$$= \frac{F}{a \times b}$$

Substitute 0.02 lb for F , 0.5 in for a and 1 in for b ,

$$\tau = \frac{0.2 \text{ lb}}{0.5 \text{ in} \times 1 \text{ in}}$$
$$= 0.4 \frac{\text{lb}}{\text{in}^2} \times \frac{1 \text{ psi}}{1 \frac{\text{lb}}{\text{in}^2}}$$
$$= 0.4 \text{ psi}$$

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Step 3 of 5

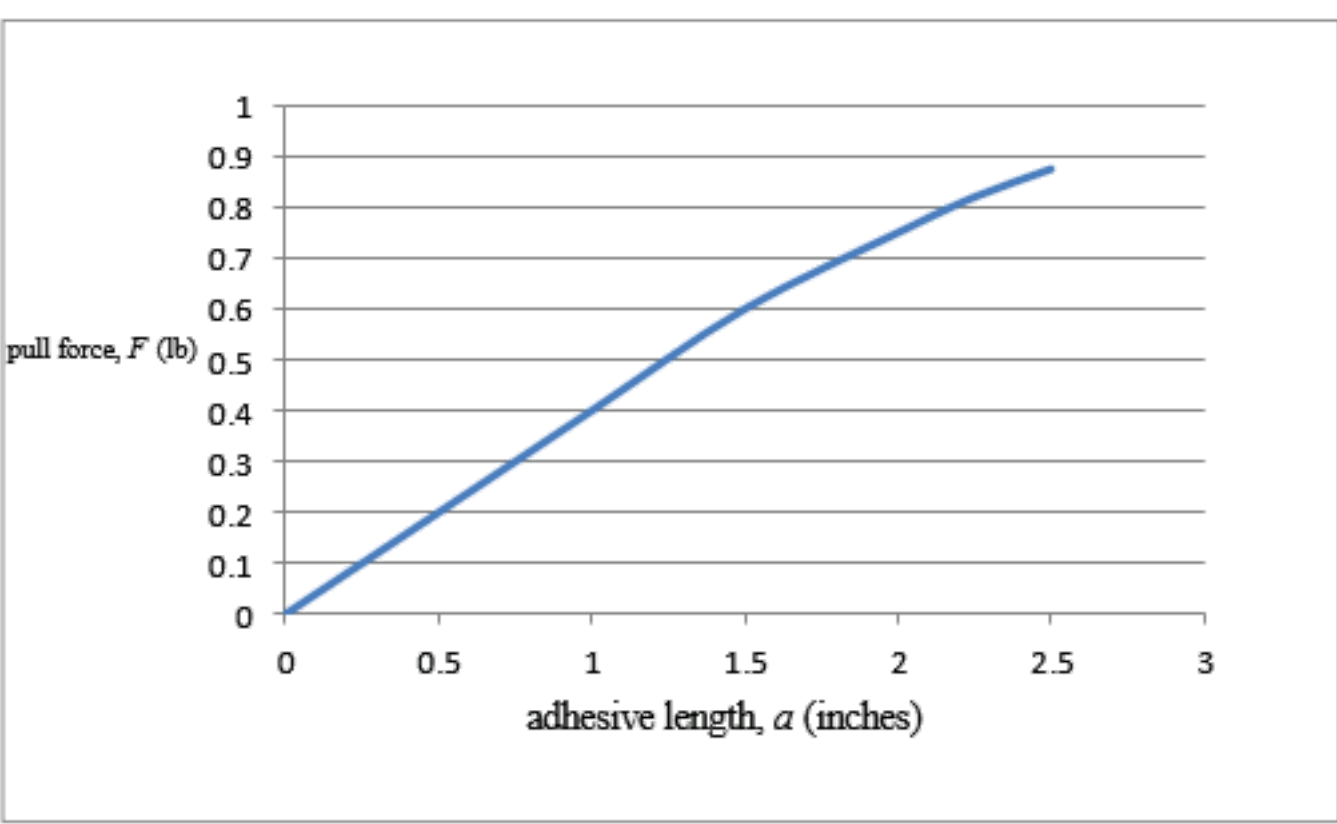
The shear stress in tape for different lengths is listed in the below table.

S.No	Length, a (inches)	Shear stress, τ (psi)
1	0.5	0.4
2	1	0.4
3	1.5	0.4
4	2	0.375
5	2.25	0.364
6	2.5	0.35

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Step 4 of 5

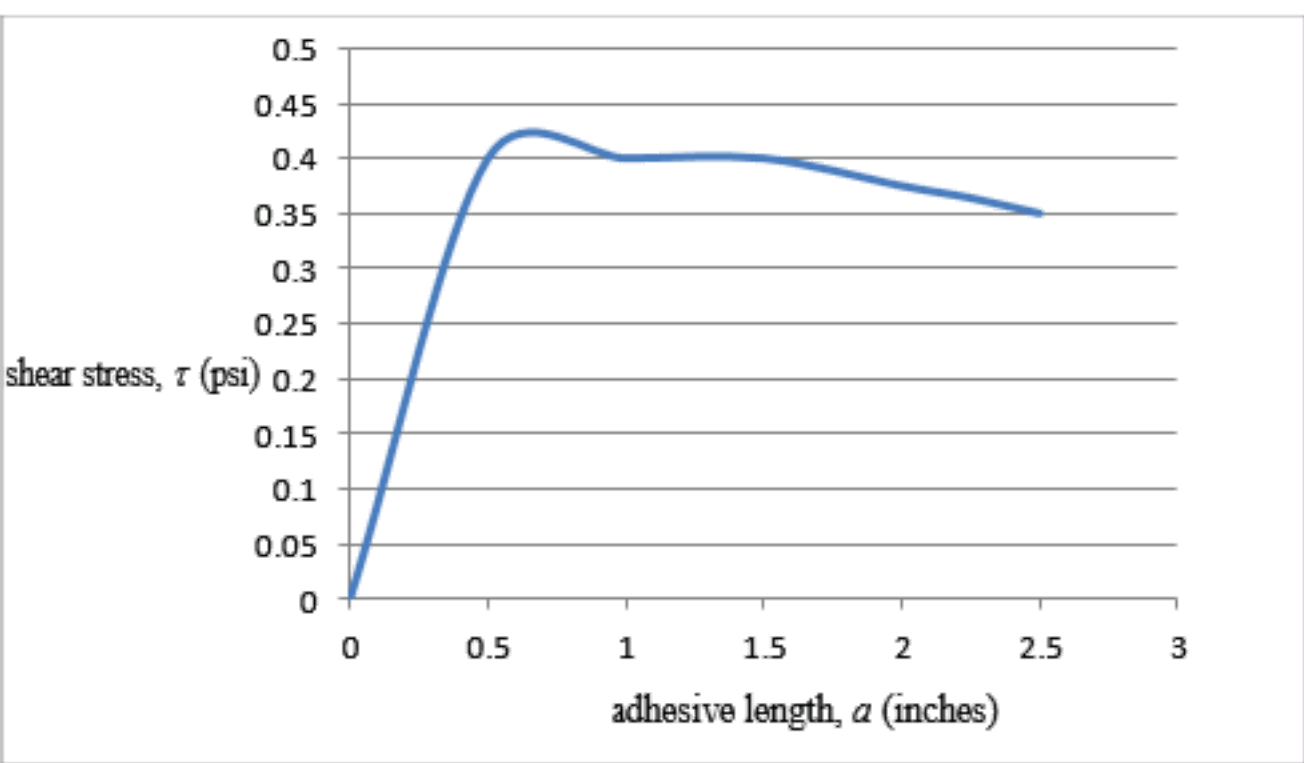
The graphs of pull force versus adhesive length a is shown in the below table



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Step 5 of 5

The graph of shear stress versus adhesive length a is shown in the below table



The adhesive tape brakes at a length of 2.8 inches adhesive length on the table before it sheared off the table.

The force required for peeling of tape from table for different adhesive lengths of tapes is observed as 0.1 lb. That is, the peeling strength of tape remains same for different adhesive lengths are 0.1 lb only.

From the above data, it is observed that the shear strength of tape increases with increase in adhesive tape length with table, but peeling strength of tape remains same beyond what ever be the adhesive tape length with table

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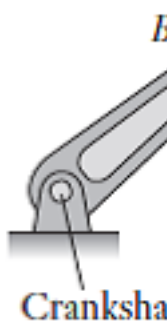
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Figure P4.3



Chapter 2, Problem 4SSR

To what extent should detailed decisions be made early in the design process regarding dimensions, materials, and other factors?

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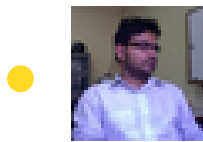
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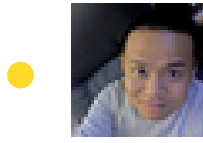
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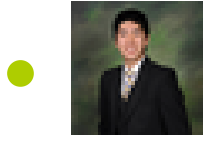
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