

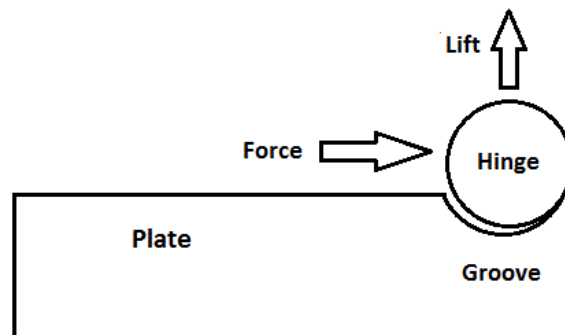
Sine Plate Engineering Problem
FRC Team 1640
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When in use, the sine plate will encounter significant sideways or twisting forces on the upper plate. The lower plate will be fixed to the mill table and can not move. This leaves the hinge to resist these sideways forces. It does this in two ways. One, being mated into a groove that matches the radius of the hinge. Two, being held down into the groove tightly with bolts to prevent the hinge from rocking, rolling or camming up out of the groove.

How deep to make this groove is a critical decision that affects the strength, durability, and utility of our sine plate device.

If the groove is made too shallow, high enough camming forces on the hinge could break the bolts. Lesser camming forces may not break the bolts, but stretch them enough to allow the hinge to move and wear or distort both the hinge and the groove, reducing the accuracy of the device prematurely.

If the groove is made too deep, the hinge will be very resistant to twisting forces, maintaining its strength and accuracy for a long time. However, it will reduce the maximum angle that the sine plate can be opened, and reduce the how useful the device is.

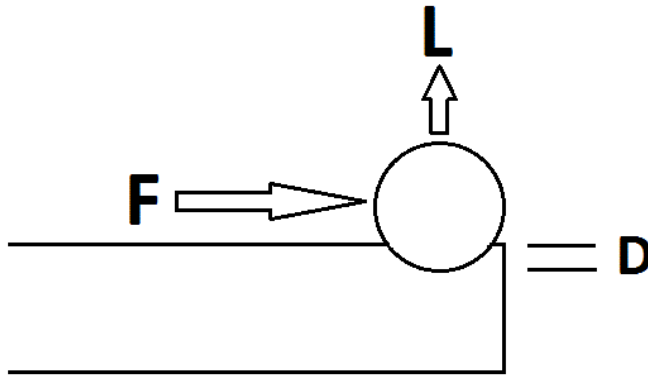


Example 1

So to help us determine how deep to make the groove, and achieve our design goals, we need to analyze the problem on page 2.

Problem

As the groove depth D changes from 0.000" to 0.500", what is the resulting upward force L , given a constant side force F ?



Notes:

- Solutions can be in the form of a formula: $f(D) = L$
- Spreadsheet or graph relating D to L would be of interest.
- Use English units of measure.
- The hinge is 1 inch in diameter.
- Friction between hinge and groove is assumed to be zero.
- A groove depth of exactly 0 or greater than 0.5 need not be considered.