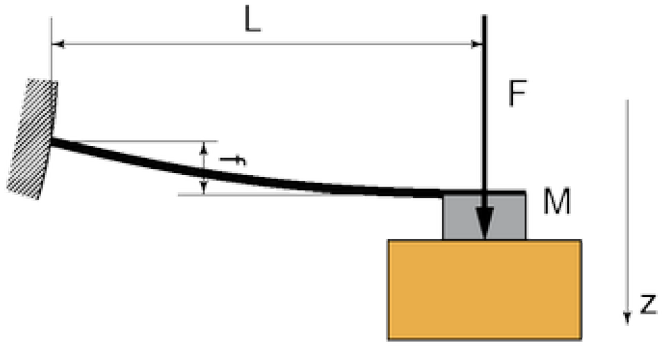
EE-580 Space Mechanisms

Exercise 4.2 - Stiffness and stresses

v.01

Problem Statement

An elastic beam keep a mass M in contact with a surface according to the following scheme



The beam has the following dimensions:

- Thickness t = 0.5 mm
- Width w = 5 mm
- Material: CuBe (E = 113 GPa)
- Length of the beam L = 35 mm
- Deflection f = 2 mm

Mass being pushed against the surface M = 2 g (grams)

Questions

1. What is the stiffness of the beam?
2. What is the force F of the mass on the surface?
3. Calculate the maximum stress in the beam.
4. Where is the maximum stress in the beam located?
5. Which acceleration shall be applied to the system in the z direction in order to remove the contact between the mass and the surface?

6. Taking into account a maximum allowable stress for CuBe of 400 MPa, what is the margin of safety (MOS) for this system, with the applied deflection f (FOS = 1)?

Definition

The Margin of Safety (MOS) for a stress σ compared to a reference stress $\sigma 0$ with a Factor of Safety FOS is:

$$\text{MOS} = \frac{\sigma 0}{\sigma \cdot \text{FOS}} - 1$$

Solution