

## DYNAMICS OF MECHANICAL SYSTEMS 462

Q1 2000

A children's playground is to be surfaced with a shock absorbent material to reduce the risk of head injury in the event of a child falling from a height. The material can be considered to act as a linear spring of stiffness  $3000/t$  N/m when impacted by a head.  $T$  is the thickness of the layer in metres. Serious injury is likely to occur when the head experiences a deceleration in excess of  $500 \text{ m/s}^2$ .

Calculate the minimum thickness of the layer when a child falls a height of 2 m.

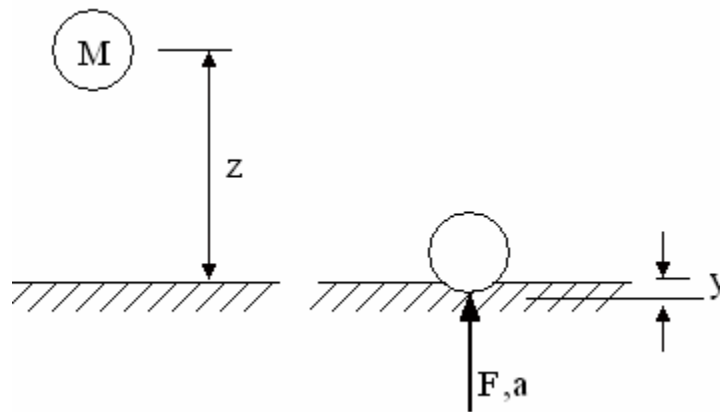
Data – Head Mass 5 kg

No energy loss in the impact.

No influence from the child's body.

Neglect the deflection of the layer in your calculations.

SOLUTION



$$\text{Potential Energy} = M g z = 5 \times 9.81 \times 2 = 98.1 \text{ Joules}$$

$$\text{Strain Energy when material is fully deflected } U = Fy/2 = ky^2/2$$

$$\text{Force } F = M a = 5 \times 500 = 2500 \text{ N}$$

$$\text{Substitute } U = 500y/2 = 250y$$

$$\text{Equate PE} = U \quad 98.1 = 250y \quad y = 0.3824 \text{ m}$$

$$F/y = k = 3000/t$$

$$2500/0.384 = 3000/t \quad t = 0.46 \text{ m}$$

This seems too simple ????