

# Problem Set #3 1.050 Solid Mechanics Fall 2004

(Due Friday, 1 October)

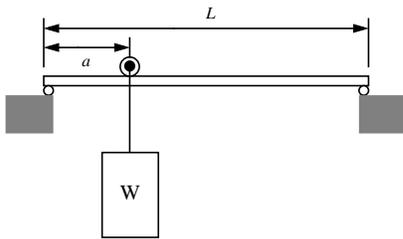
### Problem 3.1

Construct an expression for the bending moment at the root of the lower limbs of a mature maple tree in terms of the girth, length, number of offshoots, etc... whatever you judge important. How does the bending moment vary as you go up the tree and the limbs and shoots decrease in size and number (?). (Prob. 3.7, Text).

### Problem 3.2

Estimate the force Ramelli's laborer (or is it Ramelli himself?) must push with in order to just lift a full bucket of water from the well shown in the figure. (Prob. 3.9, Text).

### Problem 3.3



A simply supported beam (indicated by the rollers at the ends) carries a trolley used to lift and transport heavy weights around within the shop. The trolley is motor powered and can move between the ends of the beam. For some arbitrary location of the trolley along the beam,  $a$ ,

- i) What are the reactions at the ends of the beam?
- ii) Sketch the shear force and bending moment distributions.
- iii) How does the *maximum* bending moment vary with  $a$ ; i.e., change as the trolley moves from one end to the other? (Prob. 3.17, Text).

### Problem 3.4

A simply supported beam of length  $L$  carries a uniform load per unit length,  $w_0$ , over a portion of the length,  $\beta L < x < L$

- i) Determine the reactions at the supports.
- ii) Draw two free body diagrams, isolating portions of the beam to the right of the origin. Note: include all relevant dimensions as well as known and unknown force and moment components.
- iii) Apply force equilibrium and find the shear force  $V$  as a function of  $x$ . Plot.
- iv) Apply moment equilibrium and find how the bending moment  $M_b$  varies with  $x$ . Plot.
- v) Verify that  $dM_b/dx = -V$  within each region.

