6.4 Frames

Preparatory Problems

6.4.1 In what way(s) is/are trusses different from more general frames?

6.4.2 Consider a frame made of 3 pieces connected together. Assume that no free-body diagram cut is within a part.

a) How many different free-body diagrams can you draw?

b) For each free-body diagram how many independent scalar equations can be extracted from the equilibrium relations?

c) In total, from all the free-body diagrams, how many independent scalar equations can be extracted from the various equilibrium conditions?

6.4.3 Consider the two-bar frame shown. Choose appropriate coordinate axes. Find

a) The reaction at D.

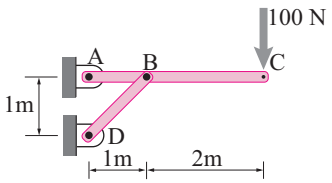
b) The tension in bar DB.

c) The reaction at A.

d) The force of DB on ABC.

e) The moment in ABC

- just (an infinitesimal distance) to the right of A
- just to the left of B
- just to the right of B
- just to the left of C



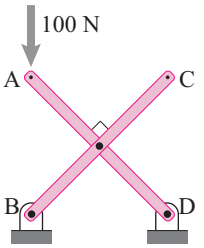
Problem 6.4.3

6.4.4 Two 1m bars are pinned together, at their middles, at right angles. Find

a) the reactions at B and D,

b) the force of BC on AD, &

c) the moment in AD just above the hinge,



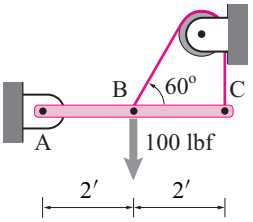
Problem 6.4.4

6.4.5 For the structure shown find

a) the tension in the string

b) the reaction at A

c) the moment in ABC just to the right of B



Problem 6.4.5

More-Involved Problems

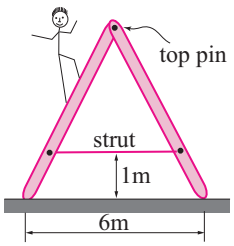
6.4.6 An A-frame aluminum ladder consists of two uniform 5 m, 150 N sections that are pinned at the top and held from splitting by a massless strut $1m$ above the slippery floor. An 800 N person has climbed halfway up the left side.

a) Find the reactions (the forces of the ground on the two ladder sections).

b) Find the force of the left section on the right at the top pin.

c) Find the tension in the connection strut.

d) Find the moment in the right leg of the ladder just above the tension strut.



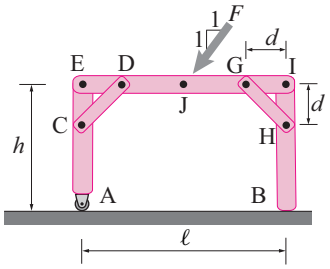
Problem 6.4.6

6.4.7 To make a model of a table statically determinate, we assume that leg EA slides easily on the floor. Assume the other leg does not slip. A force $F = 200$ N acts at 45° at the center of the table. Use $h = 1$ m, $\ell = 2$ m, and $d = .25$ m. Find

a) the reactions at A and B,

b) the tension in GH,

c) the moment in IHB just below H.



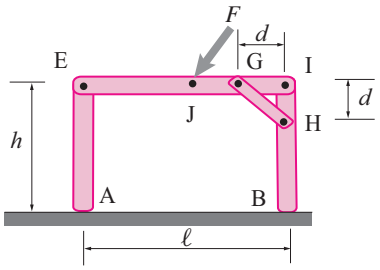
Problem 6.4.7

6.4.8 Another way to make a model of a table statically determinate (see problem 6.4.7) is to assume that one leg is not braced. Now, neither leg can slip. A force $F = 200$ N acts at 45° at the center of the table. Use $F = 200$ N, $h = 1$ m, $\ell = 2$ m, and $d = .25$ m. Find

a) the reactions at A and B

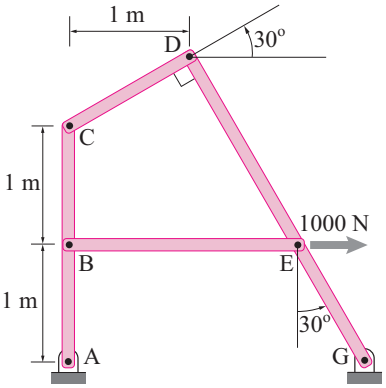
b) the tension in GH

c) the moment in IHB just below H



Problem 6.4.8

6.4.9 For the structure shown find the reaction at A.



Problem 6.4.9

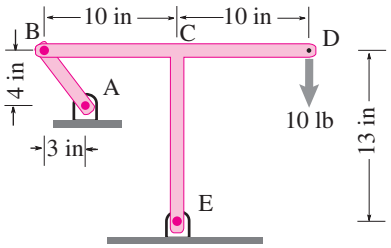
6.4.10 The structure consists of two pieces: bar AB and 'T' EBCD. They are connected to each other with a hinge at B. They are connected to the ground with hinges at A and E. The force of gravity is negligible. Find

a) The reaction at A.

b) The reaction at E.

c) The moment in BCED just to the left of C.

d) Why are these forces so big or small? (Your answer should be in words).



Problem 6.4.10