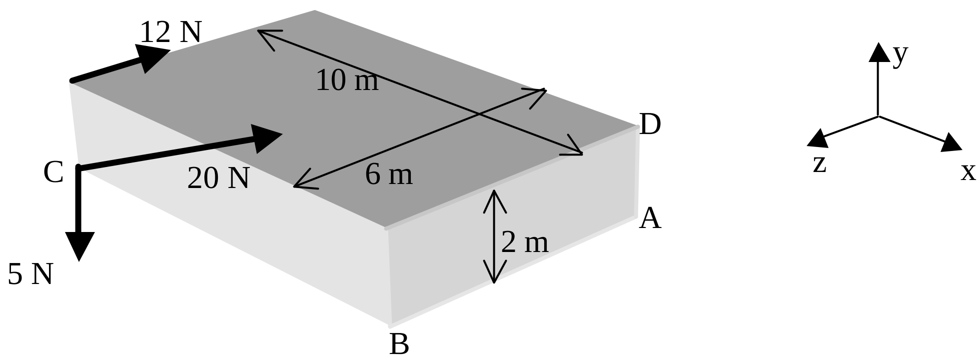
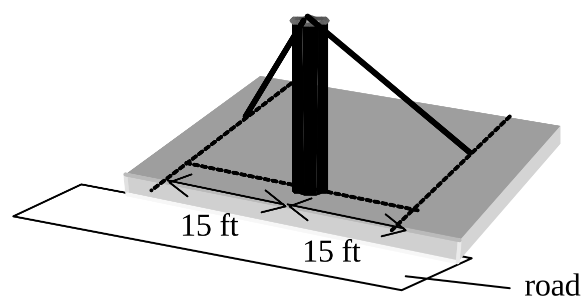
24-261 Statics September 4, 2001
Problem Set #2 Due: September 11, 2001

1. Consider the three forces separately. For the 5 N force, determine the moment about each of the coordinate axes through point D. Indicate the magnitude and sign of each moment component, for example, $M|_{Dx}$.= +100 N-m. For the 12 N force, determine the moment about each of the coordinate axes through point A. For the 20 N force, which runs from point C to point D, determine the moment about each of the coordinate axes through point A. You must first convert the 20 N force to components, using a unit vector, find the moment due to each component and then add those to get the total moment due to the 20 N force.



2. Telephone poles are often subjected to forces due to line tensions that tend to topple them over. If these forces are expected to be too severe, counterbalancing stabilizing cables are often used. A trade-off is involved in the placement of the stabilizing cables. The further from the base of the pole they are anchored (further from the road in figure), the more effective is their stabilizing effect for a given tension, but the greater is the area that is obstructed by the cables.



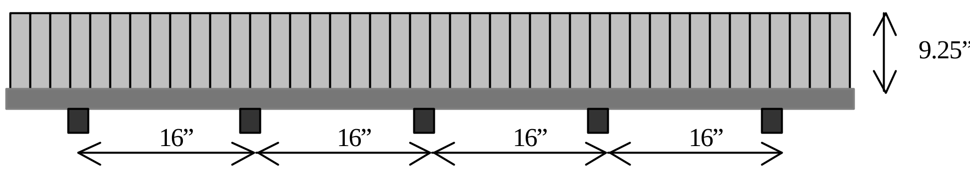
Consider a pair of stabilizing cables, each of which carries a tension of 200 lb. Take the height of the pole above the ground to be 40’. Say the anchor points are 15’ to each side of the pole parallel to the road, but a range of distances away from the road is being considered (from 5’ to 25’ behind the pole in 1 ft increments). For each of these anchor positions, determine:

- ? the net force acting perpendicular to the pole due to the combined effect of the pair of cables

- ? the moment about the base of the pole due to the pair of cables

Derive the formulas needed to do this. Then set up an Excel spreadsheet having three columns: the position (5’, 6’,…, 24’, 25’) , the force and the moment. Let the spreadsheet do the calculations from your formulas. Indicate the units and directions of this force and moment (these are the same regardless of the position).

3. A shelving system is designed to support books which have dimensions 9.5” x 8.25” x 1.6” and weigh 4 lb each. The books, which are stood up side by side with no gap in between, rest on a wood plank that is 0.75” thick and has depth identical to the books. The wood plank weighs 40 lb/ft^3. The plank rests in turn on brackets which are 0.125” thick and are as long as the plank depth. (The brackets are 16” apart and are attached to the wall). A portion of the shelf is shown in the Figure (it continues in both directions). To answer some of the questions below, consider a repeating segment of the shelf containing one bracket.



What is the force due to the weight of the books per unit area acting on the surface of the plank (lb/in^2)?

What is the force per unit length of plank due to the books (lb/in)?

Including the weight of the books and of the plank itself, what is the force carried by each bracket (lb)?

What is the force per unit area acting on the top surface of a bracket (lb/in^2)?

What is the force per unit length of bracket (lb/in)?

Note each of the forces and force intensities calculated above would be usable for various analyses.