Chapter 1 HW Hints

Problem 1.3: I did this problem graphically (*i.e.* I drew it). The minimum and maximum transmission angles γ occur when the crank is at the horizontal positions. The toggle points are when the crank and coupler are collinear (they line up). One of the values I got was:

$$\gamma_{max} \approx 99^\circ$$

If we let the crank angle be denoted by θ, and measured from horizontal (positive ccw) then one of the toggle points and the associated transmission angle are:

$$\theta \approx 228^\circ$$
$$\gamma \approx 92^\circ$$

There will be another toggle point, of course, which you need to find.

Problem 1.5: The mobility m is simply the number of DOF of the mechanism. Use the *Kutzbach criterion* of text Equation (1.1). Note that a pin joint constrains 2 DOF, and a sliding pin joint constrains 1 DOF.

None of the mechanisms shown has more than 2 DOF (that is kind of a poor hint, BTW).

Problem 1.9: I did this problem two ways:

(a) I built a model of the Roberts' mechanism using cardboard and thumbtacks—my wife and kids thought it was great! I honestly think that's the easiest way to do this problem. I'll include a photograph in the final HW solution.

(b) I created an ADAMS model of the Roberts' mechanism. One advantage is that I was able to get a quantitative measure of the accuracy of the straight line. If you have had previous experience with ADAMS, give it a try!

However you do it, please apply *Grashof's law* (text Section 1.9) to check whether the mechanism has continuous rotation.

Problem 1.10: Refer to text Figure 1.8. Assuming right-hand threads for both threads, as the crank is turned clockwise (viewed from the right), the screw will move to the *left* relative to the frame, while the carriage will move to the *right* relative to the screw. The *overall* carriage displacement is the difference of the two.

Note that in the thread designation $\frac{3}{4}''\cdot$ 16NF there are 16 threads per inch. This information should be sufficient to calculate the carriage displacement. This problem is not really *difficult*, but may require some thought...

Although the problem asks for the distance moved in *ten* revolutions, the distance moved in *one* revolution is the pitch.