24-261 Statics | October 23, 2001
Problem Set #9 | Due: October 30, 2001

1. Problem 2.4-9 (Gere, Mechanics of Materials)

2. Problem 2.4-14 (Gere, Mechanics of Materials)

3. Problem 2.6-13 (Gere, Mechanics of Materials). Rather than the question posed, (i) determine the normal force and shear force acting across the brazed face using equilibrium of the left portion of the bar; (ii) determine the area of the brazed face (it is elliptical in shape) assuming the bar diameter is 2”; (iii) determine the normal stress and shear stress acting across the brazed face.

4. In this problem you will consider the analysis of a four-bar linkage. This common mechanism is a part of the apparatus in Laboratory #5. The ground link L4 is stationary. The link L1 drives the mechanism and links L2 and L3 respond.

The following page shows the geometry and a simple analysis for relating the angle at one side ($?_2$) to the angle at the other side ($?_1$). This analysis has been implemented in a spreadsheet for the particular case of $L_1 = 6$, $L_2 = 3$, $L_3 =8$, and $L_4 = 12$. This spreadsheet is being emailed to you separately.

In the spreadsheet we have considered two values of the angle $?_1$ (48? and 50?). Using trial and error, we found approximately the associated values for $?_2$.

You are to begin with the same spreadsheet and do the following:

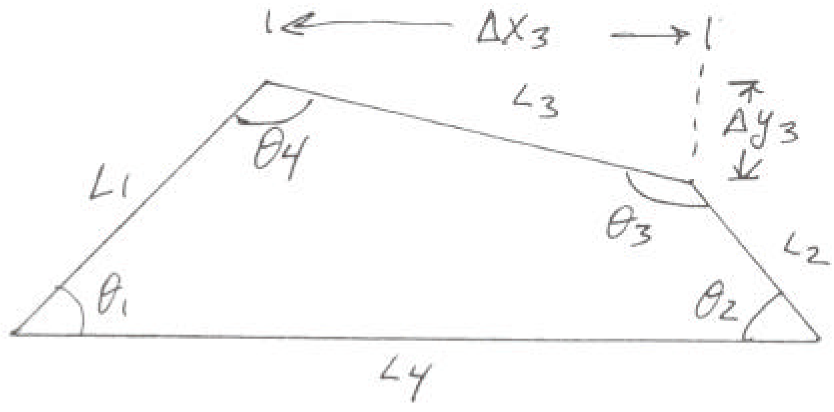
Consider the values for $?_1$ = 54? and 60?, and find, to a similar level of accuracy, the associated values for $?_2$.

Determine how to evaluate the angles $?_3$ and $?_4$, as defined on the following page. Derive the formulas for $?_3$ and $?_4$, and then determine those angles for all values $?_1$ = 48?, 50?, 54? and 60?. These should be additional columns in the spreadsheet.

Continuing Assignment to Evaluate Educational Software (Courseware)

Students with last names beginning with the letters A through K will complete the use of the axial module by solving the remaining problems. Log Files should again be sent to Jesse Olson, as described in Problem Set #8.

Four Bar Linkage Analysis



Horizontal components:

$$L_1 \cos\theta_1 + L_2 \cos\theta_2 + \Delta x_3 = L_4$$

Vertical components:

$$L_2 \sin\theta_2 + \Delta y_3 = L_1 \sin\theta_1$$

Solve for Δx_3, Δy_3 and insist that $\Delta x_3^2 + \Delta y_3^2 = L_3^2$

$$\left[L_4 - L_1\cos\theta_1 - L_2\cos\theta_2\right]^2 + \left[L_1\sin\theta_1 - L_2\sin\theta_2\right]^2 = L_3^2 \quad (A)$$

Consider angle θ_1 as having some value,
find value of θ_2 which satisfies last equation.

specific case: $L_1 = 6$, $L_2 = 3$, $L_3 = 8$, $L_4 = 12$

Here we considered $\theta_1 = 48^\circ$ (and then 50°)

For 48° we used trial and error to pick value of θ_2 which gives the calculated L_3 (Calc'd L_3 is the left side of equation (A)).

Can see that $\theta_2 = 87.7^\circ$ gave 7.9994 (which is close to 8).

Len1	Len2	Len3	Len4
6	3	8	12

Theta 1 (deg)	Theta 1 (rad)	Theta 2 (deg)	Theta 2 (rad)	Calc'd L3
48	0.837758041	88	1.535889742	8.014748662
48	0.837758041	87	1.518436449	7.963740309
48	0.837758041	89	1.553343034	8.065970875
48	0.837758041	87.5	1.527163095	7.989216521
48	0.837758041	87.6	1.528908425	7.994318554
48	0.837758041	87.7	1.530653754	7.999422805
50	0.872664626	82	1.431169987	7.894898296
50	0.872664626	83	1.448623279	7.944309317
50	0.872664626	84	1.466076572	7.994049882
50	0.872664626	85	1.483529864	8.044098868
50	0.872664626	84.3	1.471312559	8.009033147
50	0.872664626	84.1	1.467821901	7.999041247