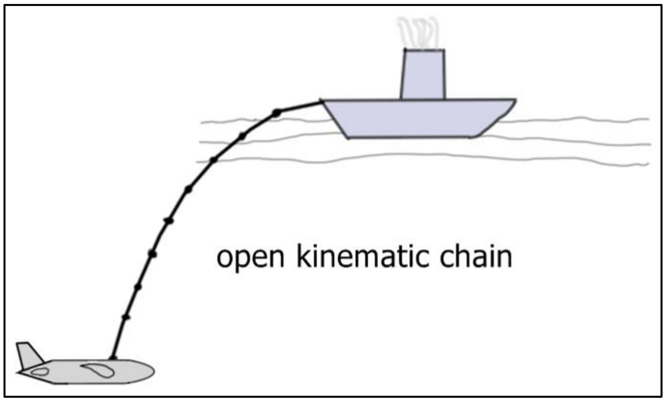
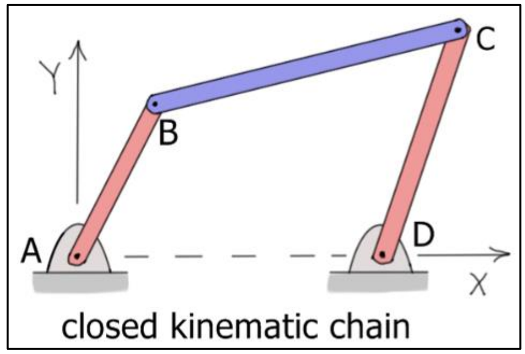
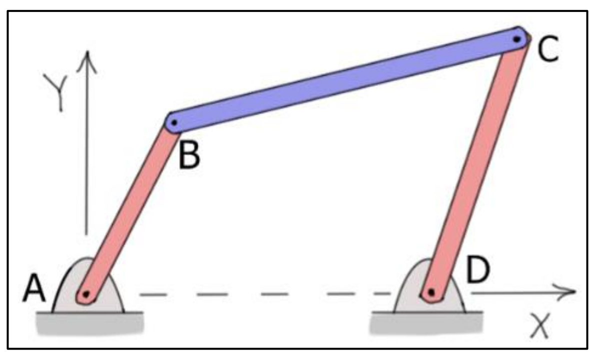
ME 5550 Intermediate Dynamics
Systems with Closed Kinematic Chains (Constraints)

The systems presented so far are "***open chain***" systems. The kinematic descriptions start at a point and advance into the system to ever more remote points. Many mechanical systems, however, have multiple points of known motion, e.g. a simple mechanism. These latter systems are said to possess "***closed kinematic chains***". Closed kinematic chains restrict (or constrain) the motion of the system.





Example: Consider, for example, the ***four-bar mechanism*** shown again in the diagram below. Using the kinematic formula for ***two points fixed*** on a rigid body, the velocity of point C can be found by starting either at point A or at point D. Both points have ***zero velocity*** and ***zero acceleration***. Starting at point A, write



$$\begin{aligned} \underset{\sim}{v}_C &= \underset{\sim}{v}_B + \underset{\sim}{v}_{C/B} \\ &= \underset{\sim}{v}_A + \underset{\sim}{v}_{B/A} + \underset{\sim}{v}_{C/B} \\ &= \underset{\sim}{v}_{B/A} + \underset{\sim}{v}_{C/B} \end{aligned}$$

Starting at point D, write

$$\underset{\sim}{v}_C = \underset{\sim}{v}_D + \underset{\sim}{v}_{C/D} = \underset{\sim}{v}_{C/D}$$

So, for the mechanism to remain ***connected***

$$\boxed{\underset{\sim}{v}_C = \underset{\sim}{v}_{C/D} = \underset{\sim}{v}_{B/A} + \underset{\sim}{v}_{C/B}}$$

The same result is true for the ***accelerations***.