CARLETON UNIVERSITY

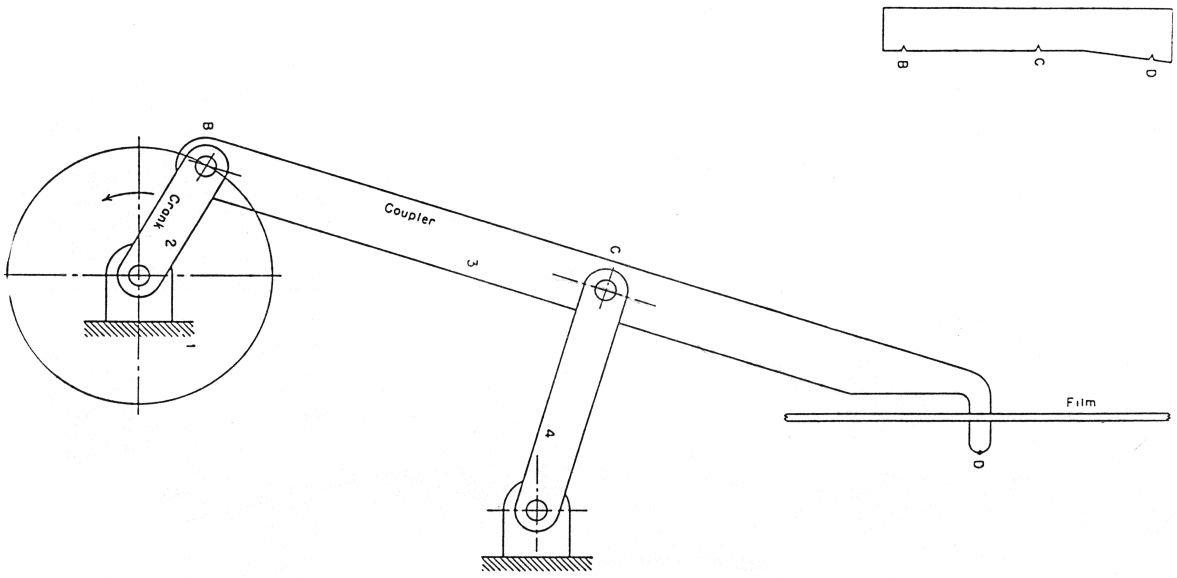
Department of Mechanical and Aerospace Engineering

MAAE 3004 - Dynamics of Machinery

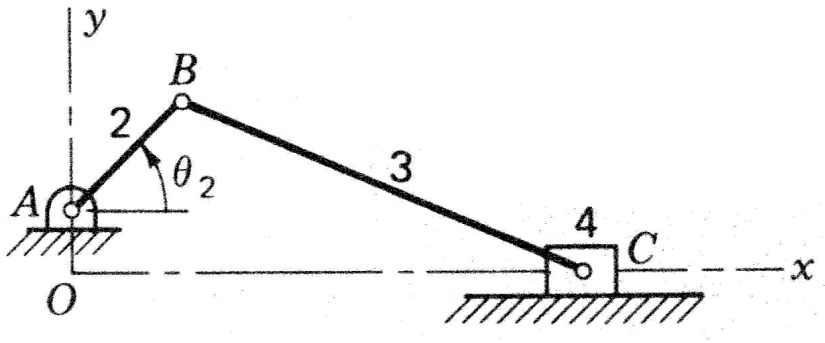
ASSIGNMENT 2

Displacement Analysis

1. A four-bar linkage that is used to produce intermittent motion of a film strip in a motion picture projector is shown. Rotation of crank 2 causes the coupler end, D, to move into a film slot, pull the film down one frame, then move out of the slot and up to be in position to engage another slot. (a) Plot the path of point D for 30 deg intervals of crank 2. Draw a smooth curve through these points. A strip of celluloid with holes, pierced with a compass point, that are laid out according to B, C, and D on the coupler, or a piece of heavy paper with small notches as shown in the upper right corner of the plate, can be useful in locating points C and D for assumed positions of B. The sketch of this template is for illustrative purposes and is not drawn to scale. (b) The speed of the crank is 1070 rpm. Determine the speed of the film in frames per second. Determine the approximate time in seconds that the film is moving during each cycle and the approximate time that it is stationary.

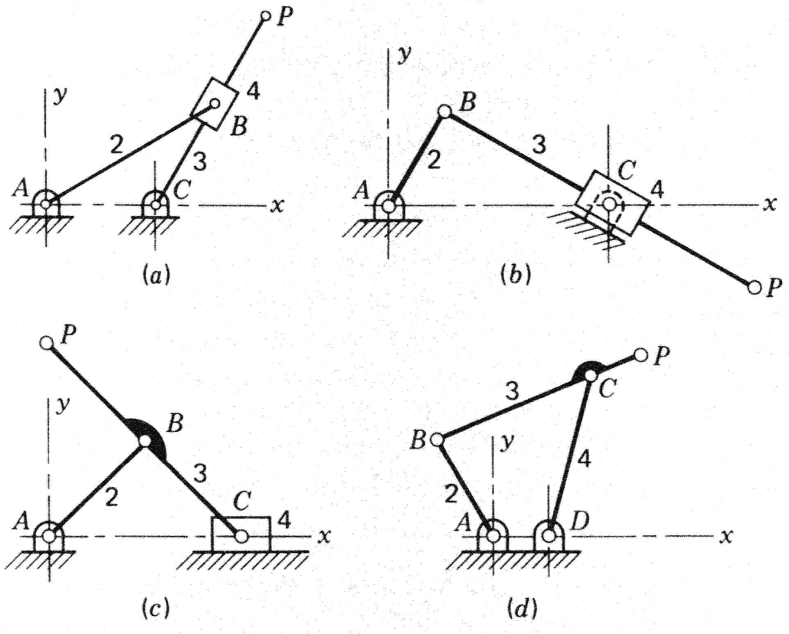


2. The offset slider-crank mechanism is driven by rotating crank 2. Write the loop-closure equation. Using graphical methods, solve for the position of the slider 4, when $\theta_2 = 30\,\text{deg}$. Lengths OA = 100 mm, BA = 250 mm, and CB = 700 mm.
Answer: $\vec{R}_{C/O} = 879.4$ mm



J.J. Uicker, G.R. Pennock, and J.E. Shigley. *Theory of Machines and Mechanisms.* Oxford Univ. Press Inc., New York, 4th edition, 2011.

3. For each linkage shown, find the path of point P using graphical methods.
   (a) Inverted slider mechanism: CA=50 mm, BA=87.5 mm, and PC=100 mm.
   (b) Second inversion of the slider-crank mechanism: CA=40 mm, BA=20 mm, and PB=65 mm.
   (c) Straight-line mechanism: BA=CB=PB=25 mm.
   (d) Drag-link mechanism: DA=25 mm, BA=50 mm, BC=DC=75 mm, and PB=100 mm.



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