Position Analysis

Ryan Brown – Mechanism 9, Index 1

Due 9/1/2015

Mechanism Details

AB [m]	AC [m]	CD [m]	DE [m]	Φ [°]	n [RPM]
0.22	0.08	0.20	0.60	240°	500
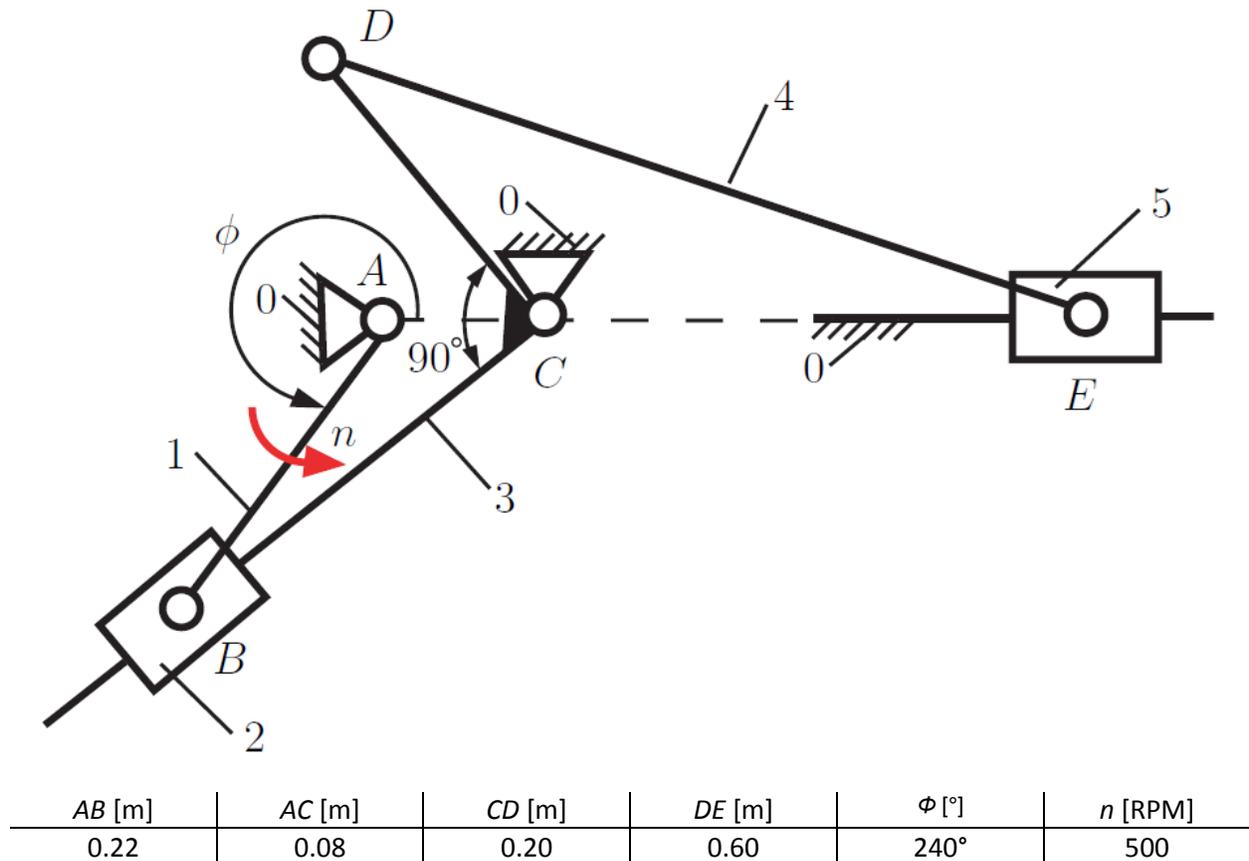
1. Find the positions of the joints and the angles of the links with the horizontal axis when the angle of the driver link 1 with the horizontal axis is ϕ.

    1. The position of A is considered the origin, so the position of joint A, A=[0,0].

    2. The position of B is found using the following equation:

$$B = AB * \cos(\phi) * \bar{\imath} + AB * \sin(\phi) * \bar{\jmath}$$
$$B = AB * \cos(240°) * \bar{\imath} + AB * \sin(240°) * \bar{\jmath} \tag{1}$$
$$B = -.11 * \bar{\imath} - .1905 * \bar{\jmath}$$

    3. C is located on the horizontal axis, so the y component of C is 0, and the position of C is C=[.08,0].

4. The angle of the link between B and C is found using the following equation:

$$\angle BC = \arctan\left(\frac{y_C - y_B}{x_C - x_B}\right)$$

$$\angle BC = \arctan\left(\frac{0 - (-.1905)}{.0800 - (-.1100)}\right) \tag{2}$$

$$\angle BC = 45$$

$$\angle BC = 45.075 + 180 = 225.075°$$

5. $\angle BC$ can be used to calculate $\angle CD$ based off the fixed relationship

$$\angle CD = \angle CD - 90°$$

$$\angle CD = 225.075° - 90° \tag{3}$$

$$\angle CD = 135.075°$$

6. The position of joint D can be calculated using the following equation

$$\boldsymbol{D} = CD * \cos(\angle CD) * \bar{\imath} + CD * \sin(\angle CD) * \bar{\jmath} + \boldsymbol{C}$$

$$\boldsymbol{D} = .20 * \cos(135.075°) * \bar{\imath} + .20 * \sin(135.075°) * \bar{\jmath} + .08 * \bar{\imath} \tag{4}$$

$$\boldsymbol{D} = -.0616 * \bar{\imath} + .1412 * \bar{\jmath}$$

7. The position of joint E can then be calculated using the Pythagorean Theorem:

$$(y_E - y_D)^2 + (x_E - x_D)^2 = DE$$

$$(0 - .1412)^2 + (x_E + .0616)^2 = DE \tag{5}$$

$$\boldsymbol{E} = .5215 * \bar{\imath}$$

8. Using the positions, along with equation 2, the rest of the angles with respect to the horizontal can be calculated.

The results of the above calculations give:

Positions		
Joint	X	Y
A	0	0
B	-.1100	-.1905
C	.0800	0
D	-.0616	.1412
E	.5215	0

Angles With Respect to (+) X-axis	
$\angle AB$	240°
$\angle BC$	225.075°
$\angle CD$	135.075°
$\angle DE$	166.388°