

### 3 Homework Position Analysis

#### 3.1 Problems

##### Problem 3.2

Figure P3.2 shows a quick-return shaper mechanism. Given the lengths  $AB=0.20$  m,  $AD=0.40$  m,  $CD=0.70$  m,  $CE=0.30$  m, and the input angle  $\phi=\phi_1=45^\circ$ , obtain the positions of all the joints. The distance from the slider 5 to the horizontal axis  $Ax$  is  $y_E=0.35$  m.

Results

$$x_B = y_B = 0.141 \text{ m}, \quad x_C = 0.17 \text{ m}, \quad y_C = 0.27 \text{ m}, \quad x_E = -0.114 \text{ m}, \quad \phi_3 = 75.36^\circ, \quad \phi_4 = 165.9^\circ.$$

##### Problem 3.3: R-RTR-RRT mechanism

The planar R-RTR-RRT mechanism is considered in Fig. P3.3. The driver is the rigid link 1 (the element  $AB$ ) and makes an angle  $\phi=\phi_1=\pi/6$  with the horizontal. The length of the links are  $AB=0.02$  m,  $BC=0.03$  m, and  $CD=0.06$  m. The following dimensions are given:  $AE=0.05$  m and  $L_a=0.02$  m. Find the positions of the joints and the angles of the links with the horizontal axis.

Results

$$x_B = 0.017 \text{ m}, \quad y_B = 0.010 \text{ m}, \quad x_C = 0.046 \text{ m}, \quad y_C = 0.014 \text{ m}, \quad x_D = 0.02 \text{ m}, \quad y_D = -0.039 \text{ m}, \quad \phi_2 = \phi_3 = 0.147 \text{ rad} = 8.449^\circ, \quad \phi_4 = 1.104 \text{ rad} = 63.261^\circ.$$

##### Problem 3.4: R-TRR-RRT mechanism

The mechanism is shown in Fig. P3.4. The following data are given:  $AC=0.100$  m,  $BC=0.300$  m,  $BD=0.900$  m, and  $L_a=0.100$  m. If the angle of link 1 with the horizontal axis is  $\phi=45^\circ$ , find the position of joint  $D$ .

Results

$$x_C = 0.100 \text{ m}, \quad y_C = 0, \quad x_B = 0.256 \text{ m}, \quad y_B = 0.256 \text{ m}, \quad x_D = 1.142 \text{ m}, \quad y_D = 0.100 \text{ m}.$$

**Problem 3.5:** R-RRR-RTT mechanism

The R-RRR-RTT mechanism is shown in Fig. P3.5. The following data are given:  $AB=0.080$  m,  $BC=0.350$  m,  $CE=0.200$  m,  $CD=0.150$  m,  $L_a=0.200$  m,  $L_b=0.350$  m, and  $L_c=0.040$  m. The angle of the driver link with the horizontal axis is  $\phi=155^\circ$ . Find the positions of the joints and the angles of the links with the horizontal axis.

Results

$x_B=-0.0725046$  m,  $y_B=0.0338095$  m,  $x_C=0.254847$  m,  $y_C=0.157668$  m,  
 $x_D=0.295983$  m,  $y_D=0.0134181$  m,  $x_F=0.295983$  m,  $y_F=-0.04$  m,  
 $\phi_2=0.361716$  rad= $20.7248^\circ$ ,  $\phi_3=-1.293$  rad= $-74.0835^\circ$ .

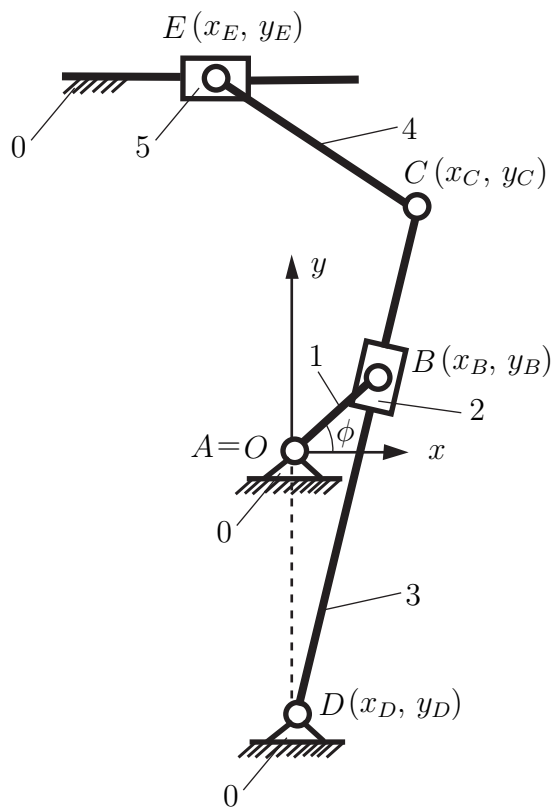


Figure P3.2

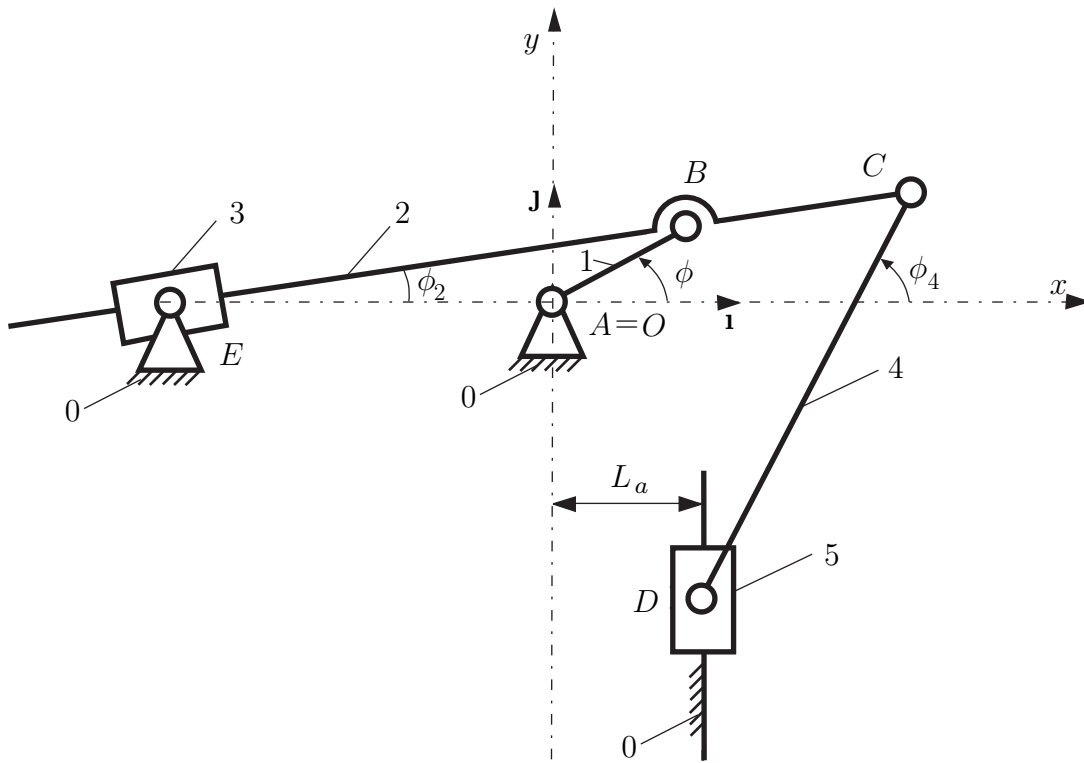


Figure P3.3

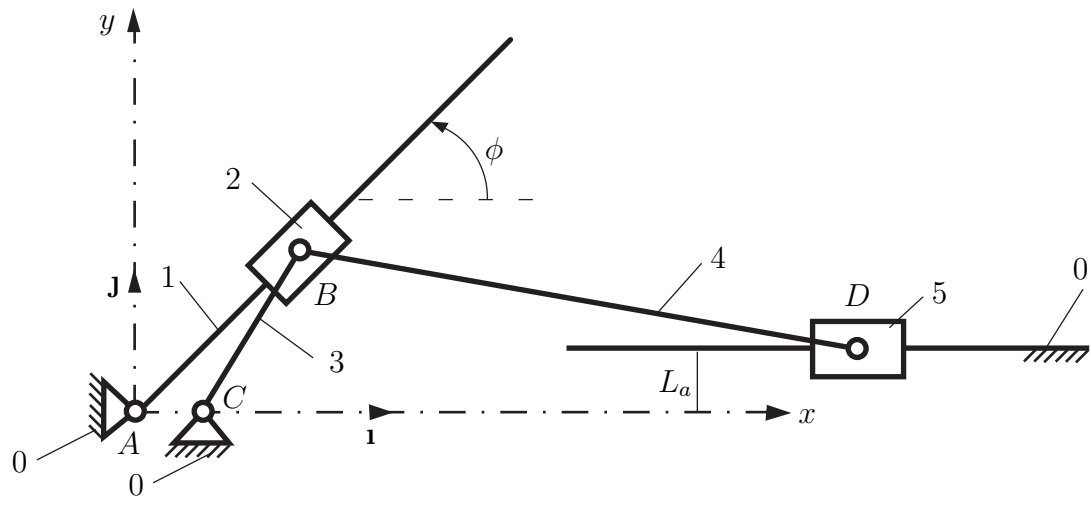


Figure P3.4

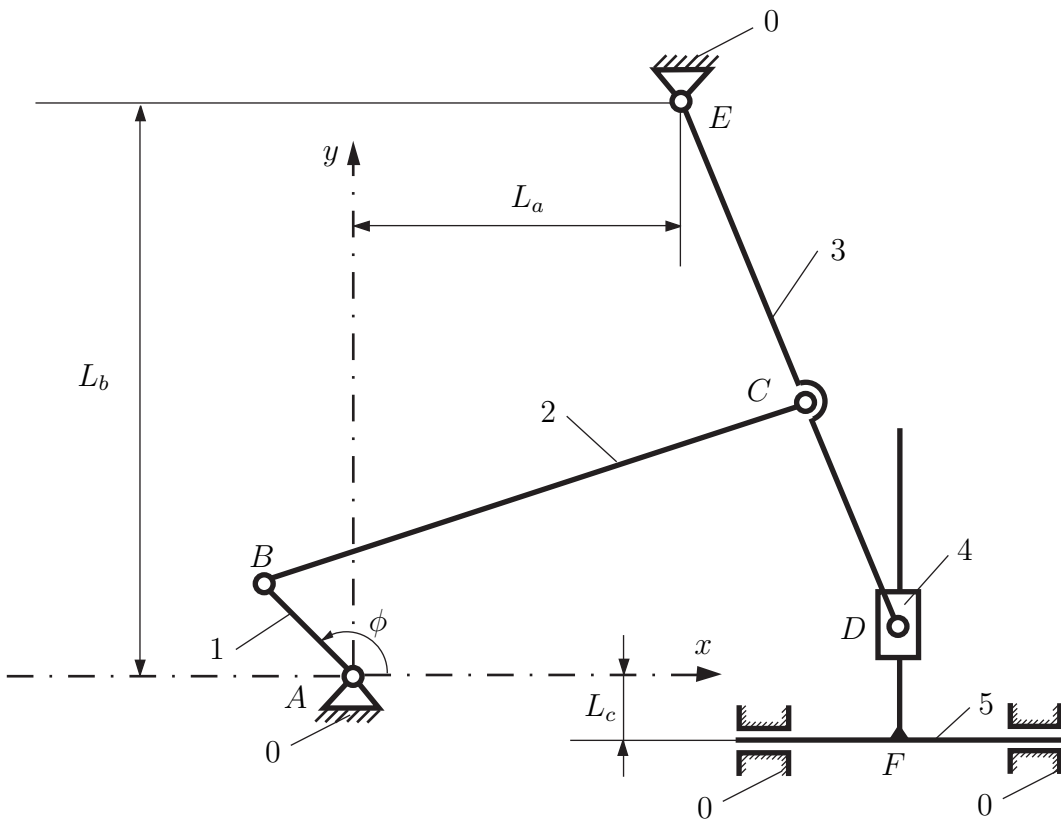


Figure P3.5