



FIGURE 3-30

Hoekens linkage geometry. Linkage shown with  $P$  at center of straight-line portion of path

The structural errors were computed separately for each of nine crank-angle ranges  $\Delta\beta$  from  $20^\circ$  to  $180^\circ$ . Table 3-1 shows the link ratios that give the smallest possible structural error in either position or velocity over values of  $\Delta\beta$  from  $20^\circ$  to  $180^\circ$ . Note that one cannot attain optimum straightness and minimum velocity error in the same linkage. However, reasonable compromises between the two criteria can be achieved, especially

**TABLE 3-1** Link Ratios for Smallest Attainable Errors in Straightness and Velocity for Various Crank-Angle Ranges of a Hoeken-Type Fourbar Approximate Straight-Line Linkage [19]

Range of Motion			Optimized for Straightness						Optimized for Constant Velocity					
$\Delta\beta$ (deg)	$\theta_{start}$ (deg)	% of cycle	Maximum $\Delta C_y$ %	$\Delta V$ %	$\frac{V_x}{(L_2 \omega_2)}$	Link Ratios			Maximum $\Delta V_x$ %	$\Delta C_y$ %	$\frac{V_x}{(L_2 \omega_2)}$	Link Ratios		
						$L_1 / L_2$	$L_3 / L_2$	$\Delta x / L_2$				$L_1 / L_2$	$L_3 / L_2$	$\Delta x / L_2$
20	170	5.6%	0.00001%	0.38%	1.725	2.975	3.963	0.601	0.006%	0.137%	1.374	2.075	2.613	0.480
40	160	11.1%	0.00004%	1.53%	1.717	2.950	3.925	1.193	0.038%	0.274%	1.361	2.050	2.575	0.950
60	150	16.7%	0.00027%	3.48%	1.702	2.900	3.850	1.763	0.106%	0.387%	1.347	2.025	2.538	1.411
80	140	22.2%	0.001%	6.27%	1.679	2.825	3.738	2.299	0.340%	0.503%	1.319	1.975	2.463	1.845
100	130	27.8%	0.004%	9.90%	1.646	2.725	3.588	2.790	0.910%	0.640%	1.275	1.900	2.350	2.237
120	120	33.3%	0.010%	14.68%	1.611	2.625	3.438	3.238	1.885%	0.752%	1.229	1.825	2.238	2.600
140	110	38.9%	0.023%	20.48%	1.565	2.500	3.250	3.623	3.327%	0.888%	1.178	1.750	2.125	2.932
160	100	44.4%	0.047%	27.15%	1.504	2.350	3.025	3.933	5.878%	1.067%	1.124	1.675	2.013	3.232
180	90	50.0%	0.096%	35.31%	1.436	2.200	2.800	4.181	9.299%	1.446%	1.045	1.575	1.863	3.456