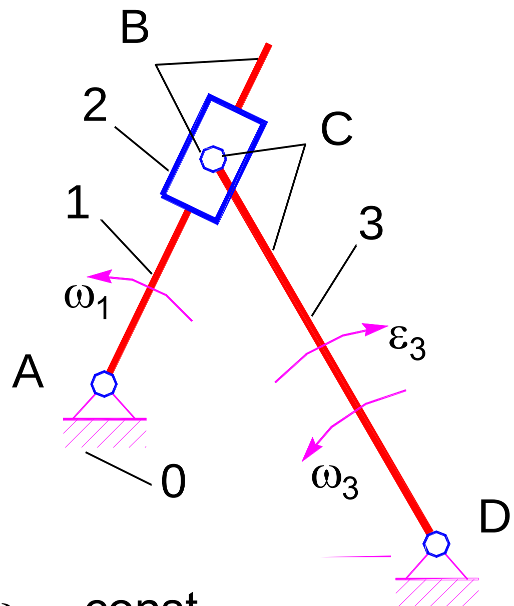
Example –mechanism with point to curve constrain

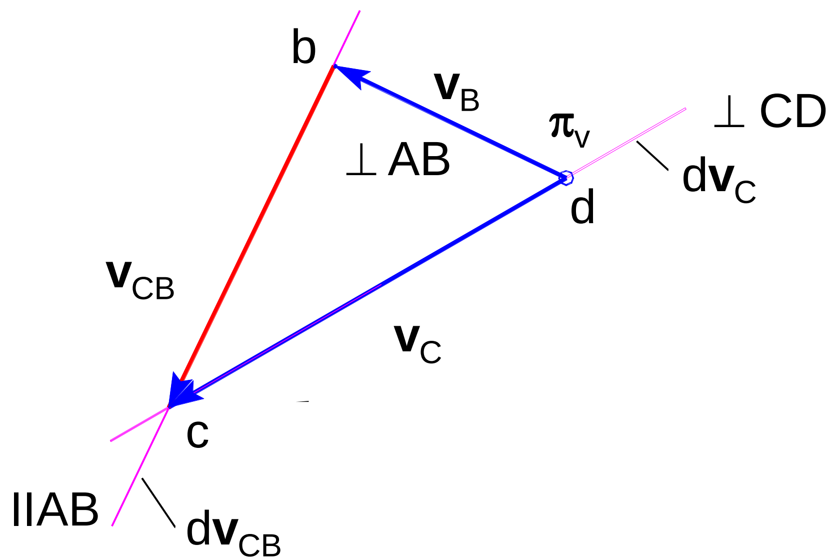


$\omega_1 = \omega_2 = \text{const.}$

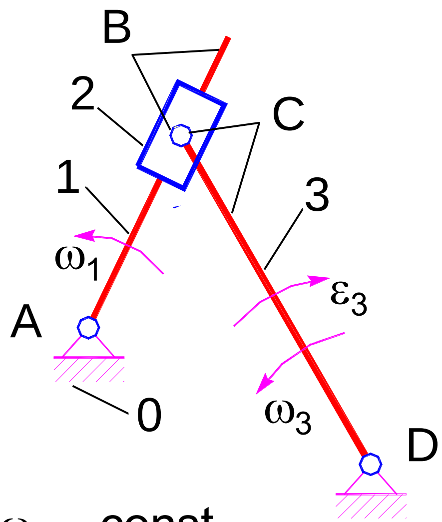
$$\underline{\mathbf{v}_C} = \underline{\underline{\mathbf{v}_B}} + \underline{\mathbf{v}_{CB}}$$

$$\mathbf{v}_B = \boldsymbol{\omega}_1 \times \mathbf{AB}$$

$$v_B = \omega_1 \cdot AB$$



$$\omega_3 = \frac{v_C}{CD}$$



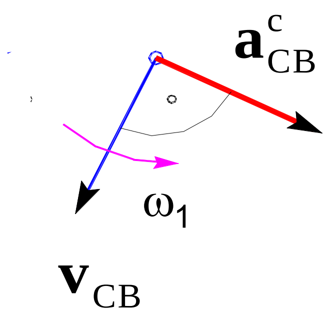
$\omega_1 = \omega_2 = \text{const.}$

$$\mathbf{a}_C = \mathbf{a}_B + \mathbf{a}_{CB}$$

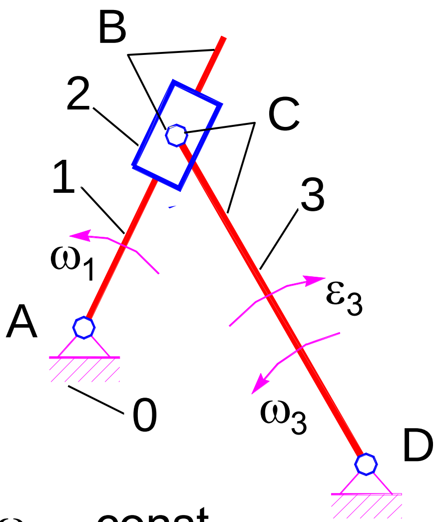
$$\underline{\underline{\mathbf{a}_C^n}} + \underline{\mathbf{a}_C^t} = \underline{\underline{\mathbf{a}_B^n}} + \underline{\mathbf{a}_B^t} + \underline{\underline{\mathbf{a}_{CB}^n}} + \underline{\mathbf{a}_{CB}^t} + \underline{\underline{\mathbf{a}_{CB}^C}}$$

$$a_B^n = \frac{v_B^2}{AB}, \qquad a_B^t = \varepsilon_1 \cdot AB = 0, \quad \text{since} \quad \varepsilon_1 = 0$$

$$a_C^n = \frac{v_C^2}{CD}, \qquad a_{CB}^n = \frac{v_{CB}^2}{\rho} = 0, \quad \text{since} \quad \rho = \infty$$

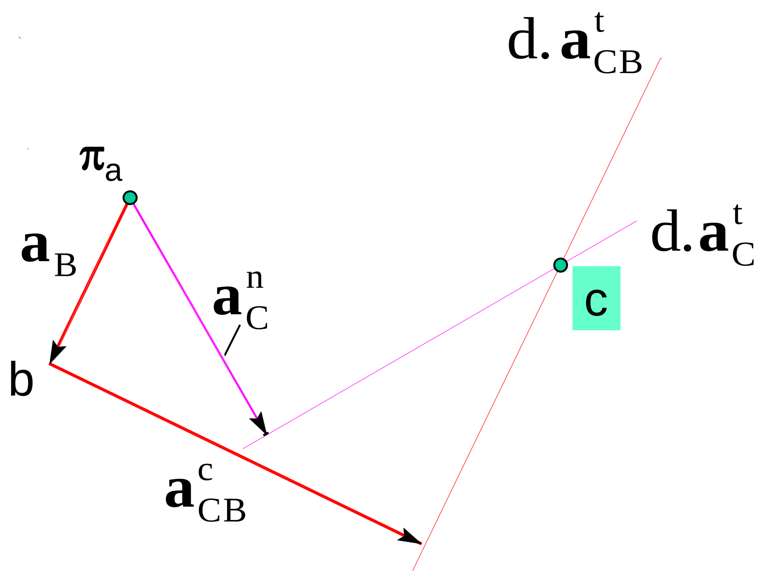


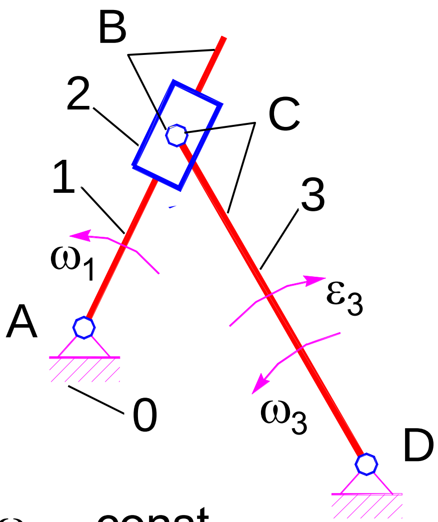
$$\mathbf{a}_{CB}^C = 2\boldsymbol{\omega}_1 \times \mathbf{v}_{CB} \quad \Rightarrow \quad a_{CB}^C = 2\omega_1 \cdot v_{CB}$$



$\omega_1 = \omega_2 = \text{const.}$

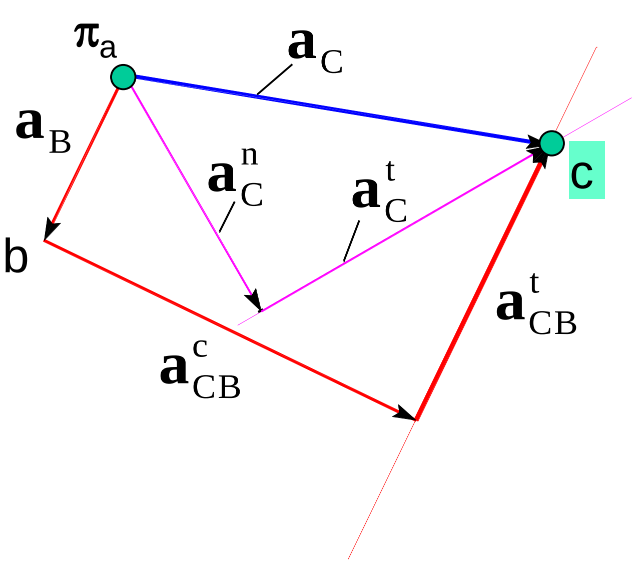
$$\underline{\underline{\mathbf{a}_C^n}} + \underline{\mathbf{a}_C^t} = \underline{\underline{\mathbf{a}_B^n}} + \underline{\underline{\mathbf{a}_{CB}^C}} + \underline{\mathbf{a}_{CB}^t}$$





$\omega_1 = \omega_2 = \text{const.}$

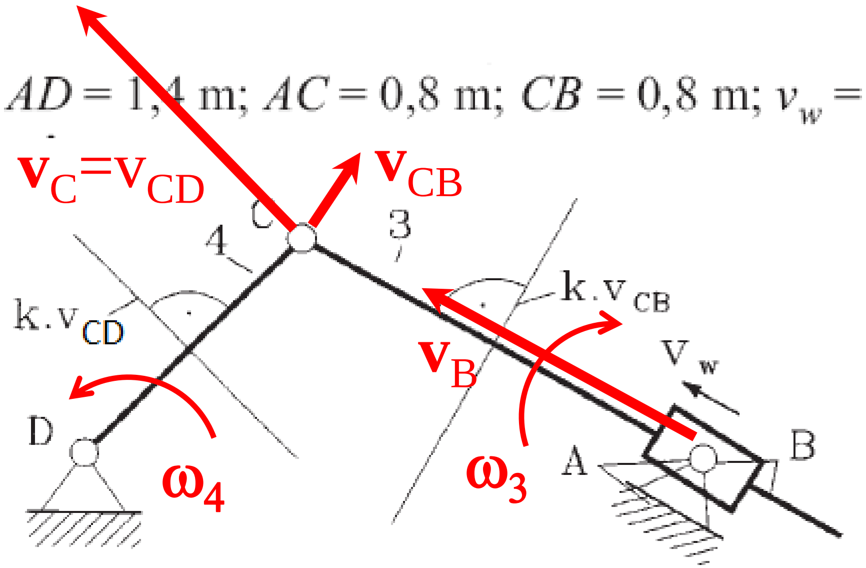
$$\underline{\underline{\mathbf{a}_C^n}} + \underline{\mathbf{a}_C^t} = \underline{\underline{\mathbf{a}_B^n}} + \underline{\underline{\mathbf{a}_{CB}^C}} + \underline{\mathbf{a}_{CB}^t}$$

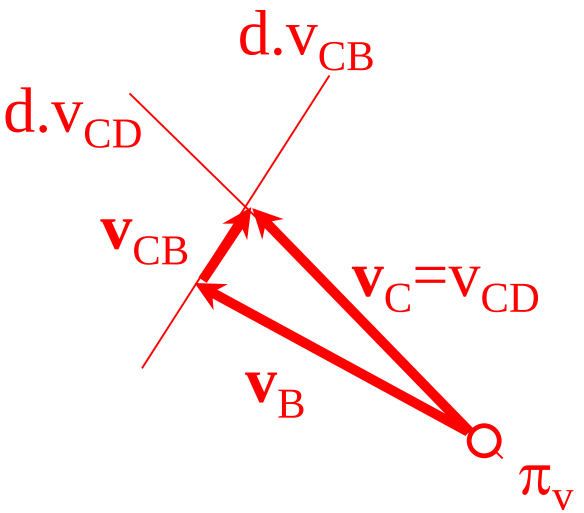


$$\varepsilon_3 = \frac{\mathbf{a}_C^t}{CD}$$

Example 2

$AD = 1{,}4$ m; $AC = 0{,}8$ m; $CB = 0{,}8$ m; $v_w = 0{,}1$ m/s.





$\mathbf{v}_B = \mathbf{v}_A + \mathbf{v}_{BA}$

$\mathbf{v}_A = 0$

$\mathbf{v}_B = \mathbf{v}_{BA} = \mathbf{v}_w$

$\mathbf{v}_C = \mathbf{v}_B + \mathbf{v}_{CB}$

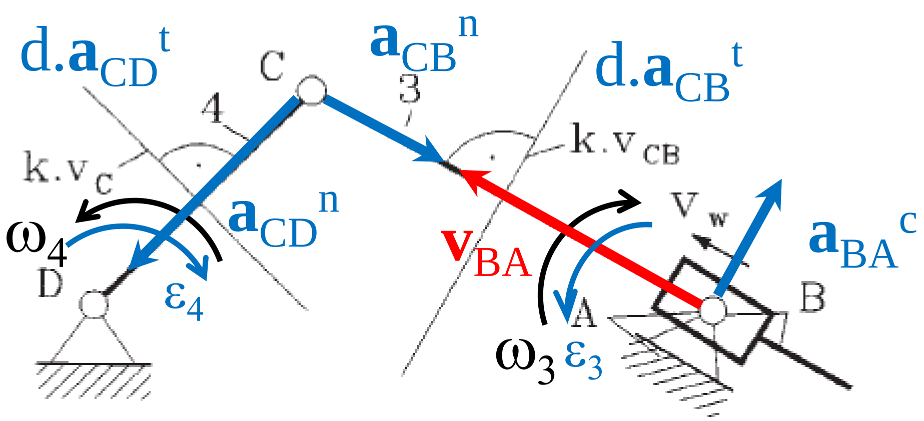
$\mathbf{v}_C = \mathbf{v}_D + \mathbf{v}_{CD}$

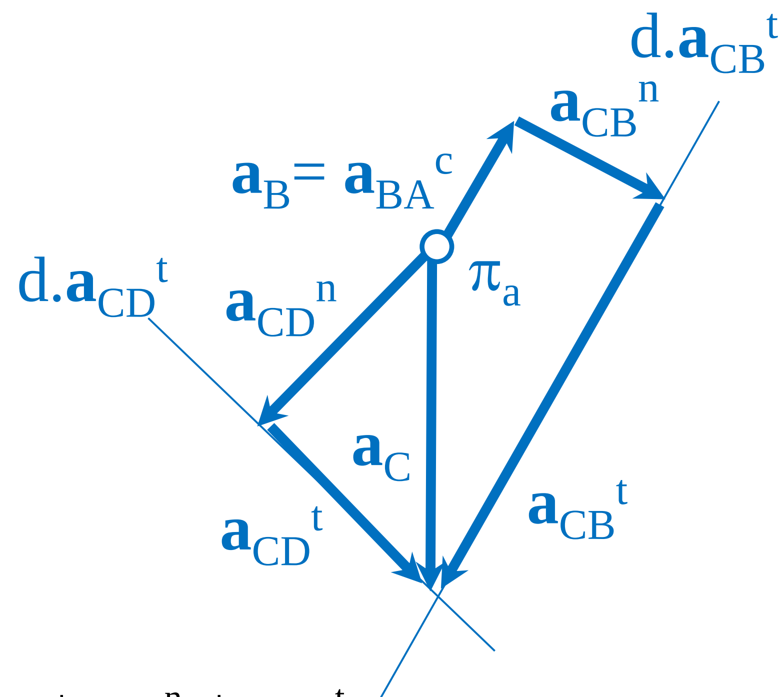
$\mathbf{v}_D = 0$

$\boldsymbol{\omega}_3 = \mathbf{v}_{CB} / CB$

$\boldsymbol{\omega}_4 = \mathbf{v}_{CD} / CD$

Example 2





$\mathbf{a}_B = \mathbf{a}_A + \mathbf{a}_{BA}^{n} + \mathbf{a}_{BA}^{t} + \mathbf{a}_{BA}^{C}$

$\mathbf{a}_A = 0$

$\mathbf{a}_{BA}^{t} = d\mathbf{v}_{BA}/dt=0$, bo $v_{BA}=v_w=\text{const.}$

$a_{BA}^{n} = v_{BA}^{2}/\rho = 0$, bo $\rho \rightarrow\infty$

$\mathbf{a}_{BA}^{C} = 2\boldsymbol{\omega}_3 \times \mathbf{v}_{BA}$

$\mathbf{a}_B = \mathbf{a}_{BA}^{C}$

$\mathbf{a}_C = \mathbf{a}_B + \mathbf{a}_{CB}^{n} + \mathbf{a}_{CB}^{t}$

$a_{CB}^{n} = \omega_3^{2}\ CB$

$\mathbf{a}_C = \mathbf{a}_D + \mathbf{a}_{CD}^{n} + \mathbf{a}_{CD}^{t}$

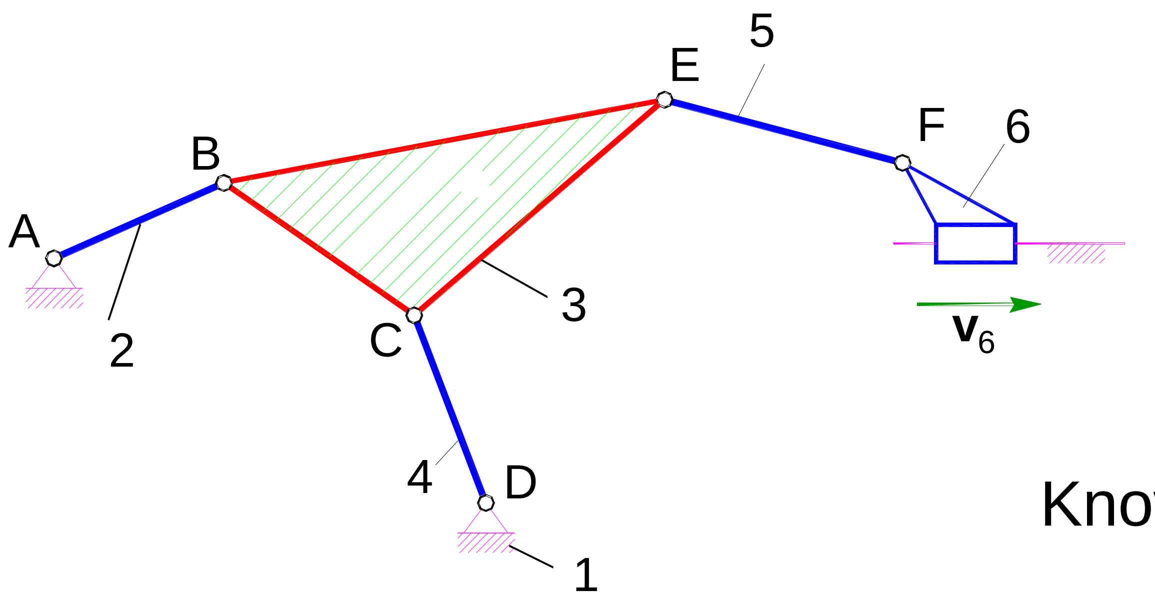
$\mathbf{a}_D = 0$

$a_{CD}^{n} = \omega_4^{2}\ CD$

$\varepsilon_3 = a_{CB}^{t}/CB$

$\varepsilon_4 = a_{CD}^{t}/CD$

Complex planar mechanism



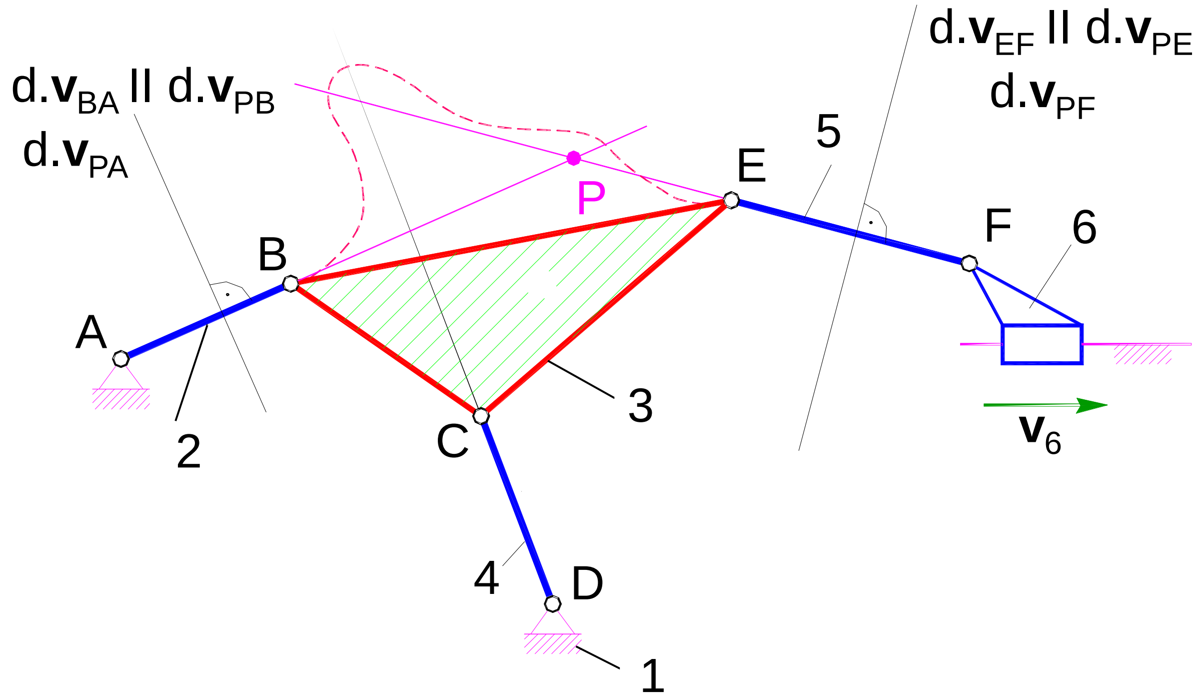
Known: $v_6 = v_F$

We have equation:

$$\mathbf{v}_E = \underline{\underline{\mathbf{v}_F}} + \underline{\mathbf{v}_{EF}}$$

Direction of v_E ???

Instant center ? Trajectory ?



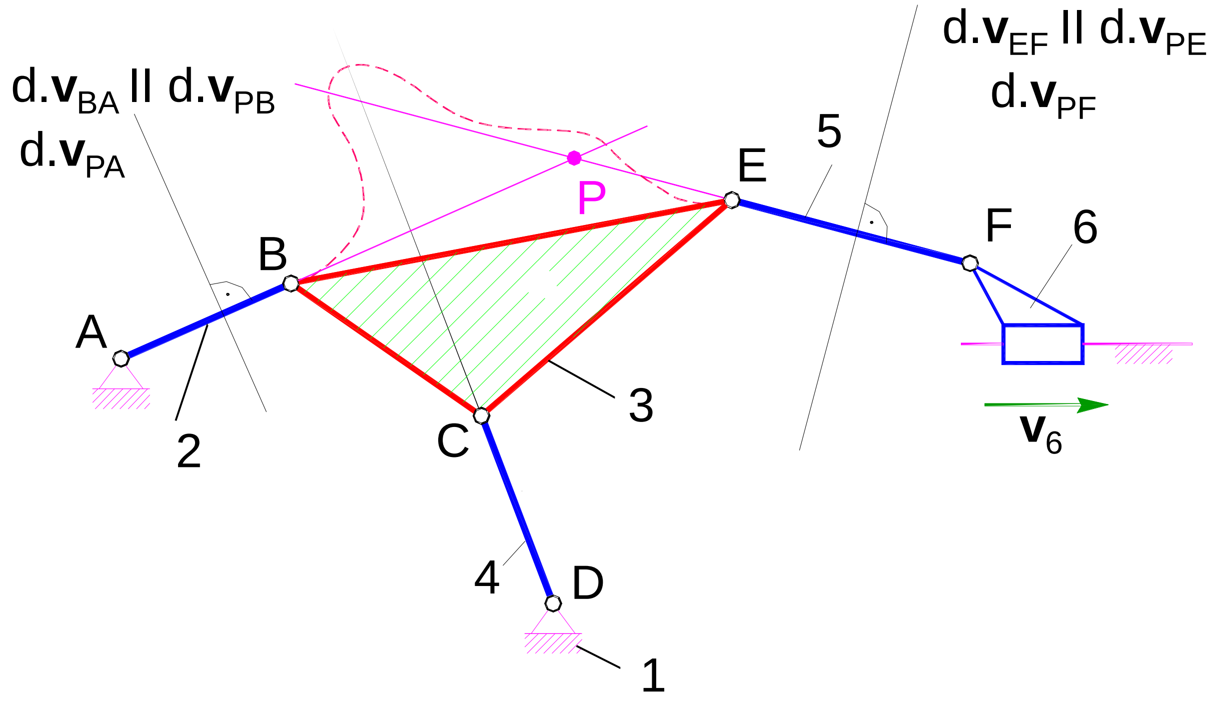
$$\mathbf{v}_E = \mathbf{v}_F + \mathbf{v}_{EF}$$

$$\mathbf{v}_P = \mathbf{v}_E + \mathbf{v}_{PE}$$

$$\mathbf{v}_P = \mathbf{v}_F + \underline{\mathbf{v}_{EF}} + \underline{\mathbf{v}_{PE}} = \mathbf{v}_F + \underline{(\mathbf{v}_{EF} + \mathbf{v}_{PE})}$$

Common direction

$$\mathbf{v}_P = \mathbf{v}_F + \underline{\mathbf{v}_{PF}}$$



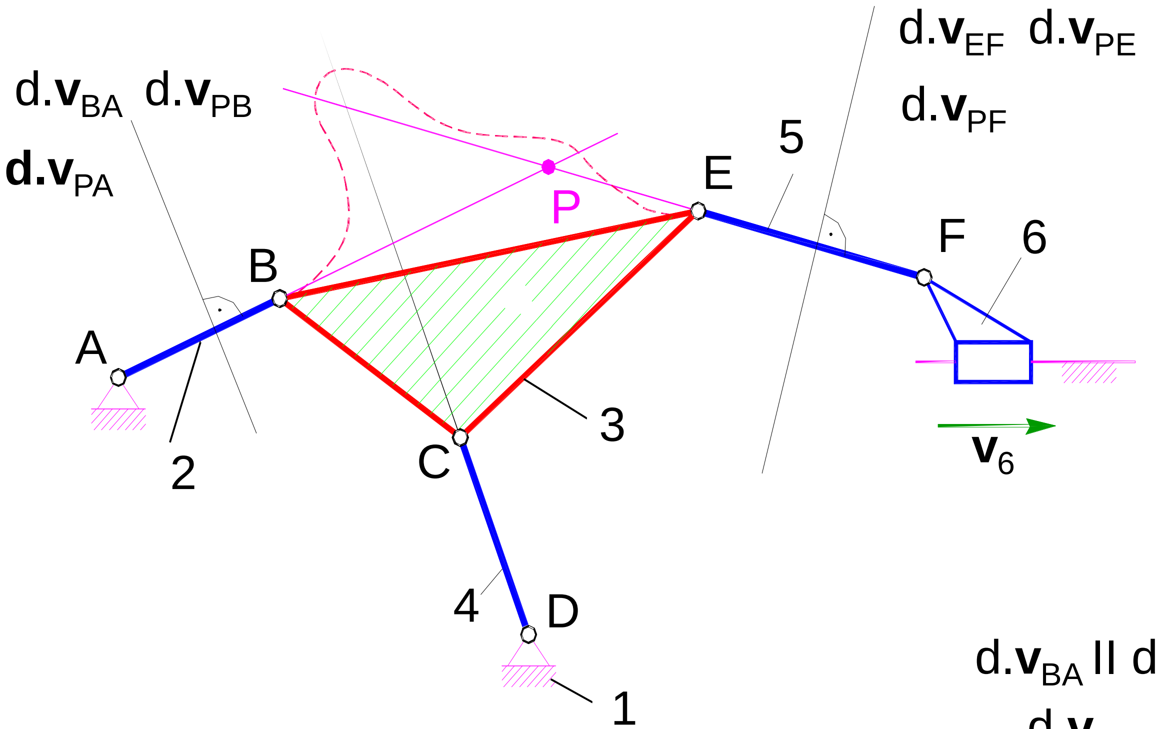
$$\mathbf{v}_{B} = \mathbf{v}_{A} + \mathbf{v}_{BA}$$

$$\mathbf{v}_{P} = \mathbf{v}_{B} + \mathbf{v}_{PB}$$

$$\mathbf{v}_{P} = \mathbf{v}_{A} + \underline{\mathbf{v}_{BA}} + \underline{\mathbf{v}_{PB}} = \mathbf{v}_{A} + \left(\underline{\mathbf{v}_{BA} + \mathbf{v}_{PB}}\right)$$

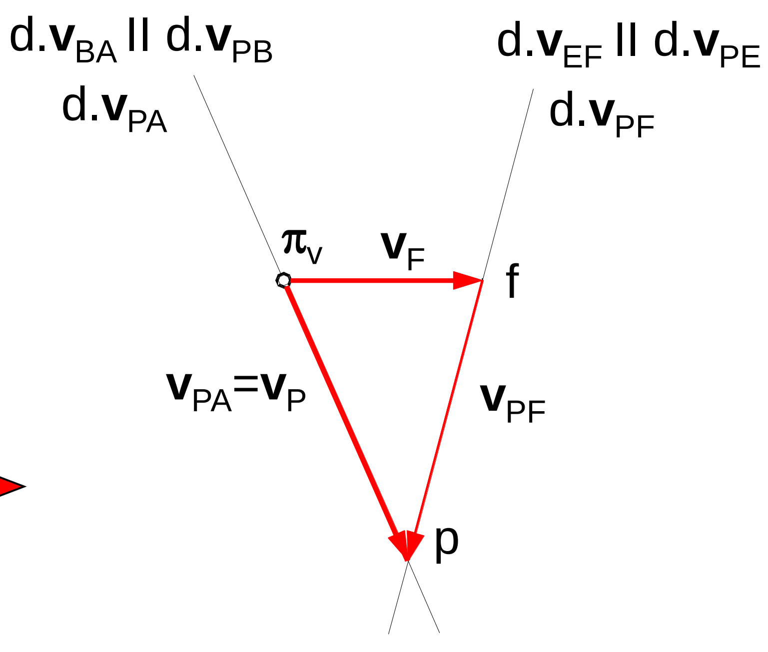
Common direction

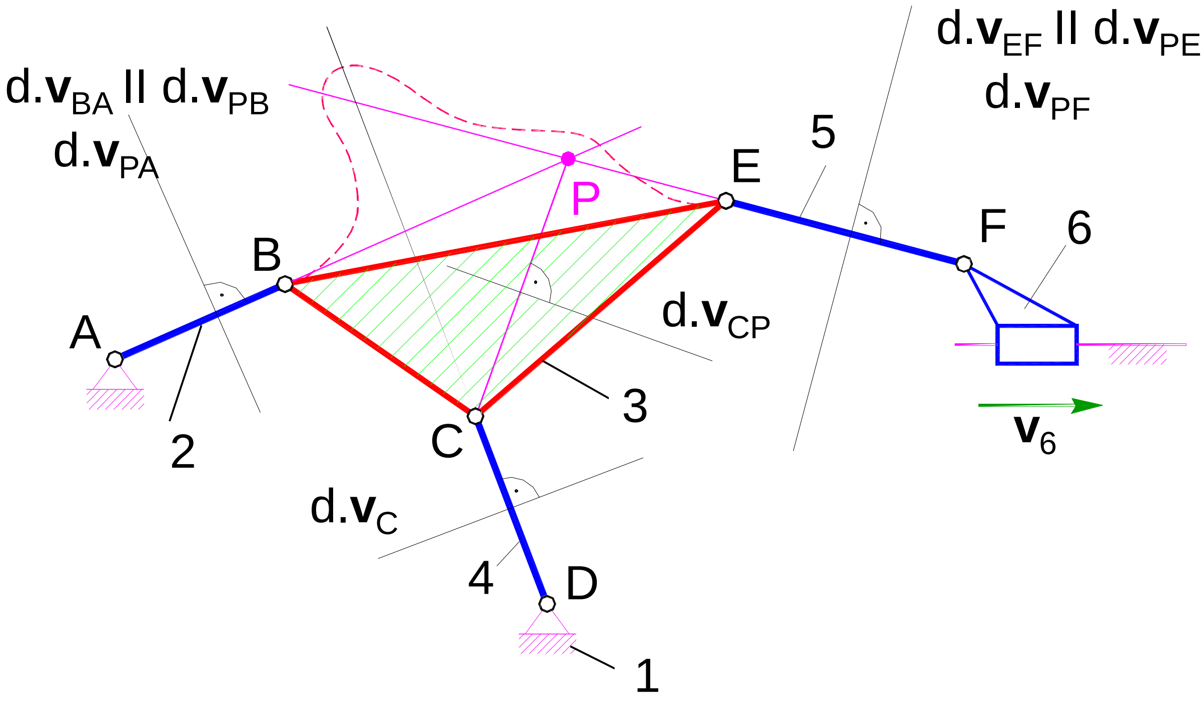
$$\mathbf{v}_{P} = \mathbf{v}_{A} + \underline{\mathbf{v}_{PA}}$$



$$\begin{cases} \mathbf{v}_P = \mathbf{v}_A + \mathbf{v}_{PA} = \mathbf{v}_{PA} \\ \mathbf{v}_P = \mathbf{v}_F + \mathbf{v}_{PF} \end{cases}$$

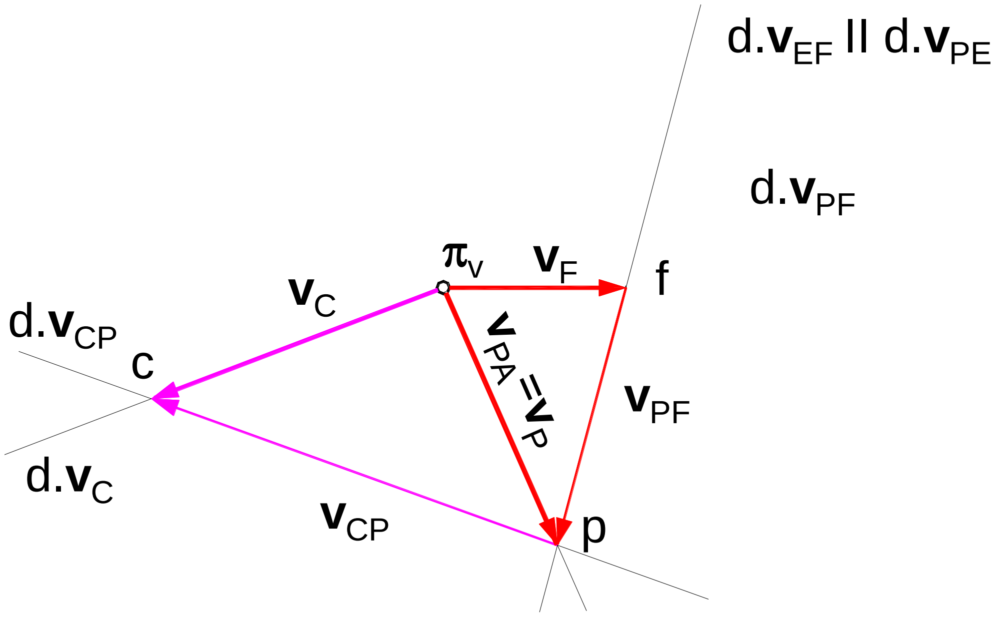
$$\underline{\mathbf{v}_{PA}} = \underline{\underline{\mathbf{v}_F}} + \underline{\mathbf{v}_{PF}}$$

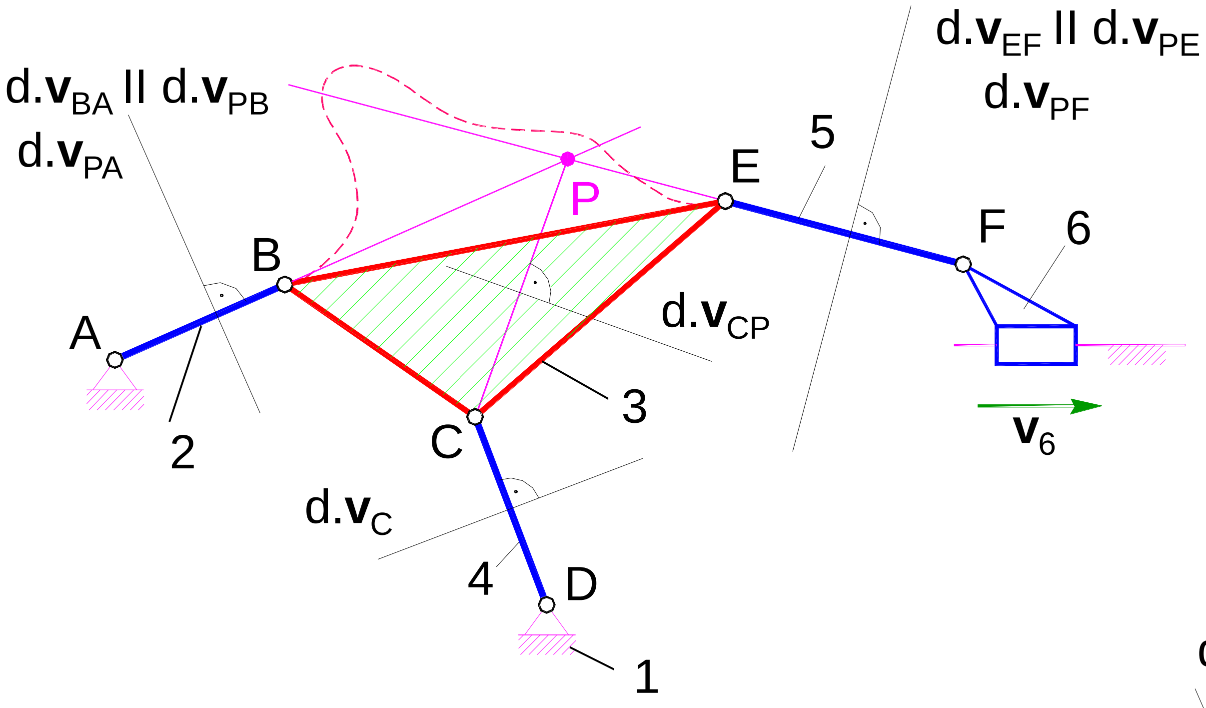




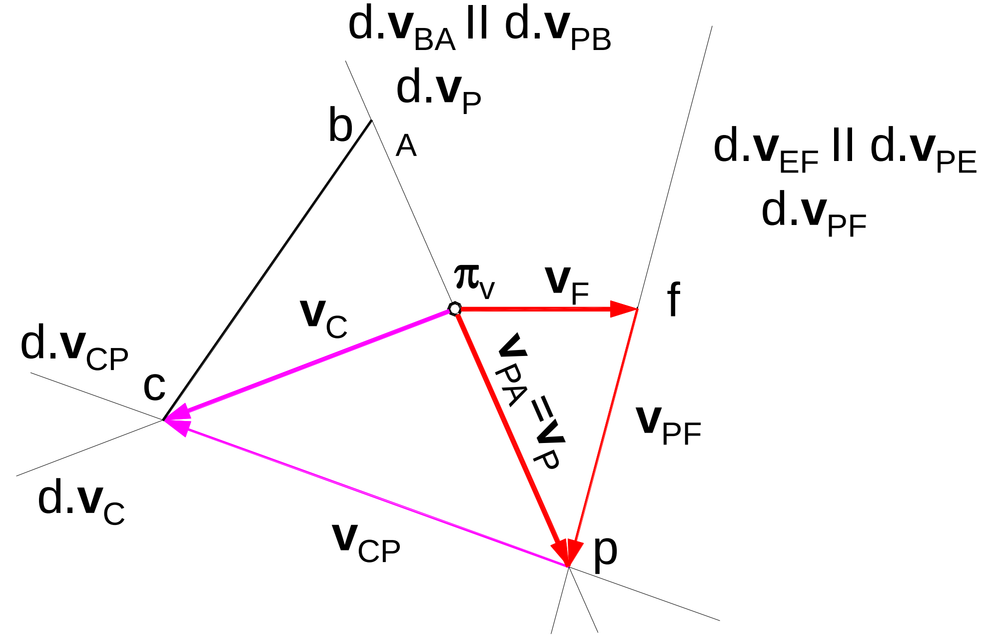
$$\begin{cases} \mathbf{v}_C = \mathbf{v}_P + \mathbf{v}_{CP} \\ \mathbf{v}_C = \mathbf{v}_D + \mathbf{v}_{CD} = \mathbf{v}_{CD} \end{cases}$$

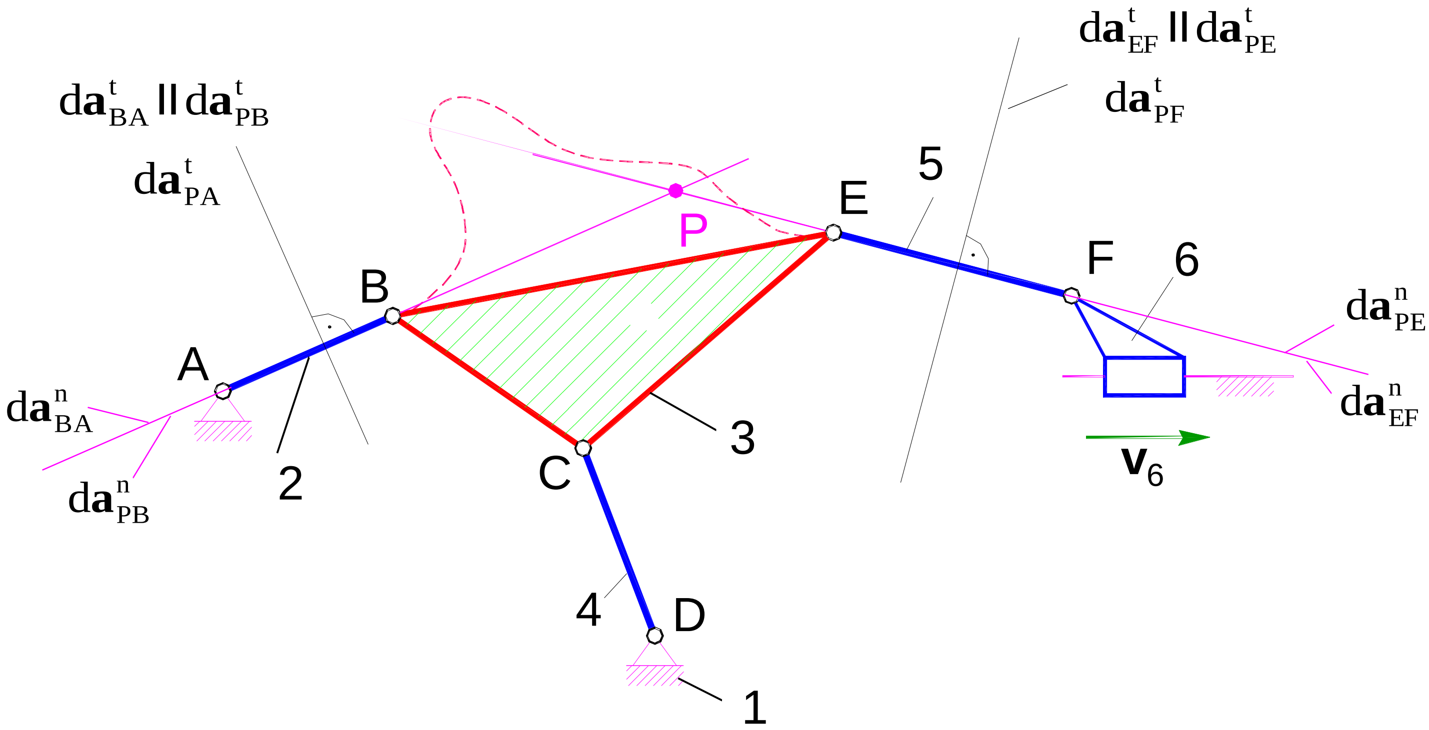
$$\underline{\underline{\mathbf{v}_P}} + \underline{\mathbf{v}_{CP}} = \underline{\mathbf{v}_{CD}}$$





$$\Delta BCP \sim \Delta bcp$$





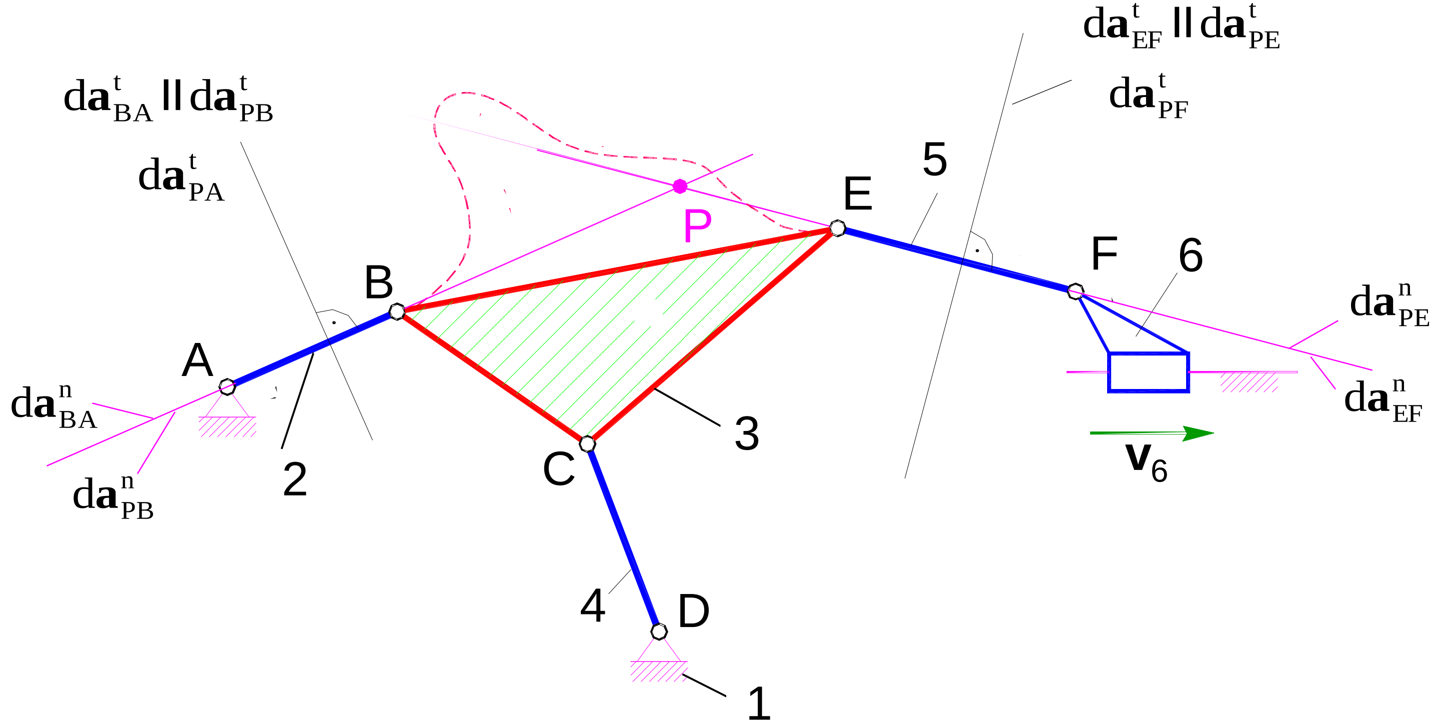
$$\mathbf{a}_E = \mathbf{a}_F + \mathbf{a}_{EF} = \mathbf{a}_F + \mathbf{a}^n_{EF} + \mathbf{a}^t_{EF}$$

$$\mathbf{a}_P = \mathbf{a}_E + \mathbf{a}_{PE} = \mathbf{a}_F + \mathbf{a}^n_{EF} + \mathbf{a}^t_{EF} + \mathbf{a}^n_{PE} + \mathbf{a}^t_{PE}$$

$$\mathbf{a}_P = \mathbf{a}_F + \mathbf{a}^n_{EF} + \mathbf{a}^n_{PE} + (\underline{\mathbf{a}^t_{EF} + \mathbf{a}^t_{PE}})$$

$$\mathbf{a}_P = \mathbf{a}_F + \mathbf{a}^n_{EF} + \mathbf{a}^n_{PE} + \underline{\mathbf{a}^t_{PF}}$$

Common direction



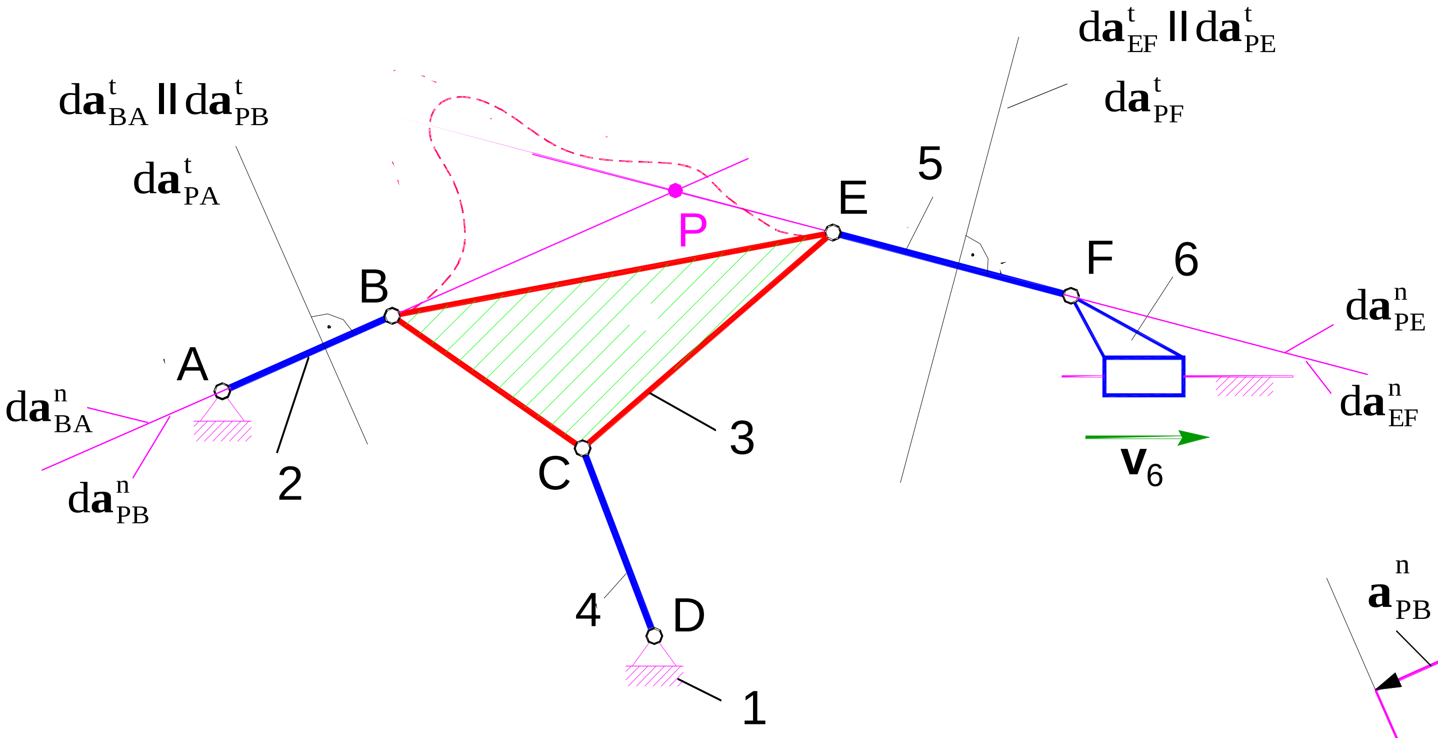
$$\mathbf{a}_B = \mathbf{a}_A + \mathbf{a}_{BA} = \mathbf{a}_A + \mathbf{a}^n_{BA} + \mathbf{a}^t_{BA}$$

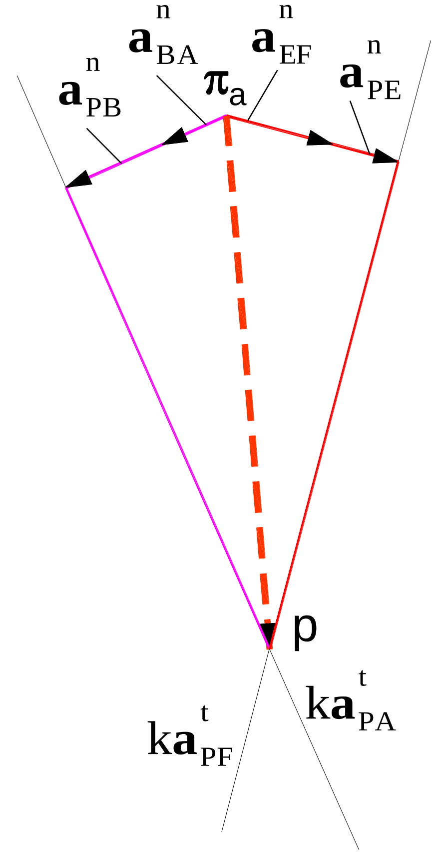
$$\mathbf{a}_P = \mathbf{a}_B + \mathbf{a}_{PB} = \mathbf{a}_A + \mathbf{a}^n_{BA} + \mathbf{a}^t_{BA} + \mathbf{a}^n_{PB} + \mathbf{a}^t_{PB}$$

$$\mathbf{a}_P = \mathbf{a}_A + \mathbf{a}^n_{BA} + \mathbf{a}^n_{PB} + (\underline{\mathbf{a}^t_{BA} + \mathbf{a}^t_{PB}})$$

$$\mathbf{a}_P = \mathbf{a}_A + \mathbf{a}^n_{BA} + \mathbf{a}^n_{PB} + \underline{\mathbf{a}^t_{PA}}$$

Common direction



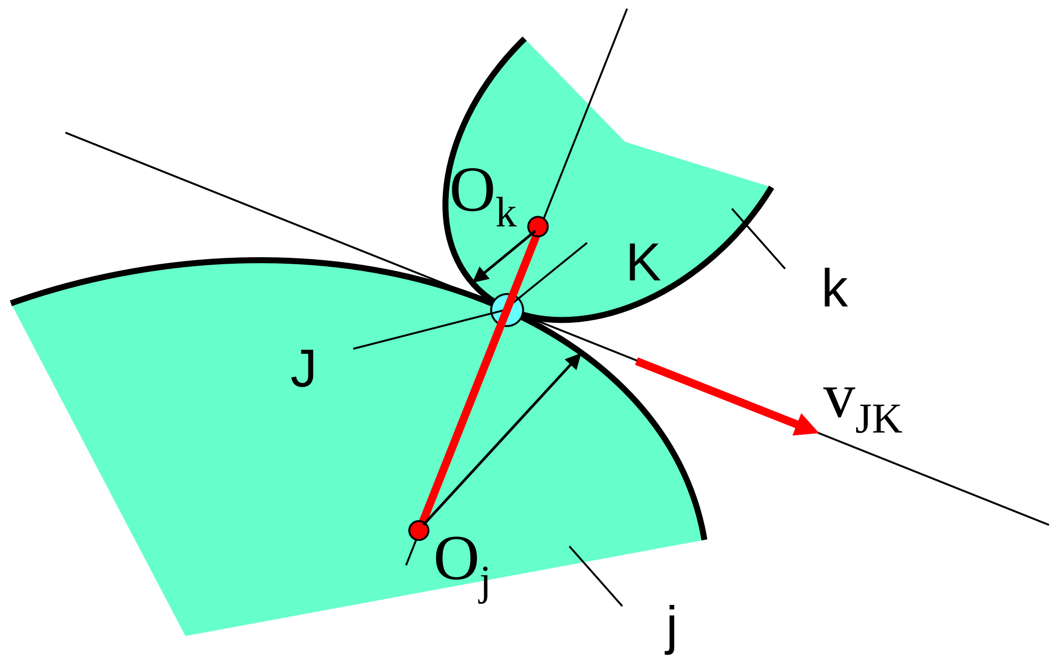


$$\mathbf{a}_P = \mathbf{a}_F + \mathbf{a}^n_{EF} + \mathbf{a}^n_{PE} + \underline{\mathbf{a}^t_{PF}}$$

$$\mathbf{a}_P = \mathbf{a}_A + \mathbf{a}^n_{BA} + \mathbf{a}^n_{PB} + \underline{\mathbf{a}^t_{PA}}$$

$$\mathbf{a}_F = \mathbf{a}_A = 0;\quad a^n_{EF} = \frac{v^2_{EF}}{EF};\quad a^n_{PE} =;\quad a^n_{BA} =;\quad a^n_{PB} =;$$

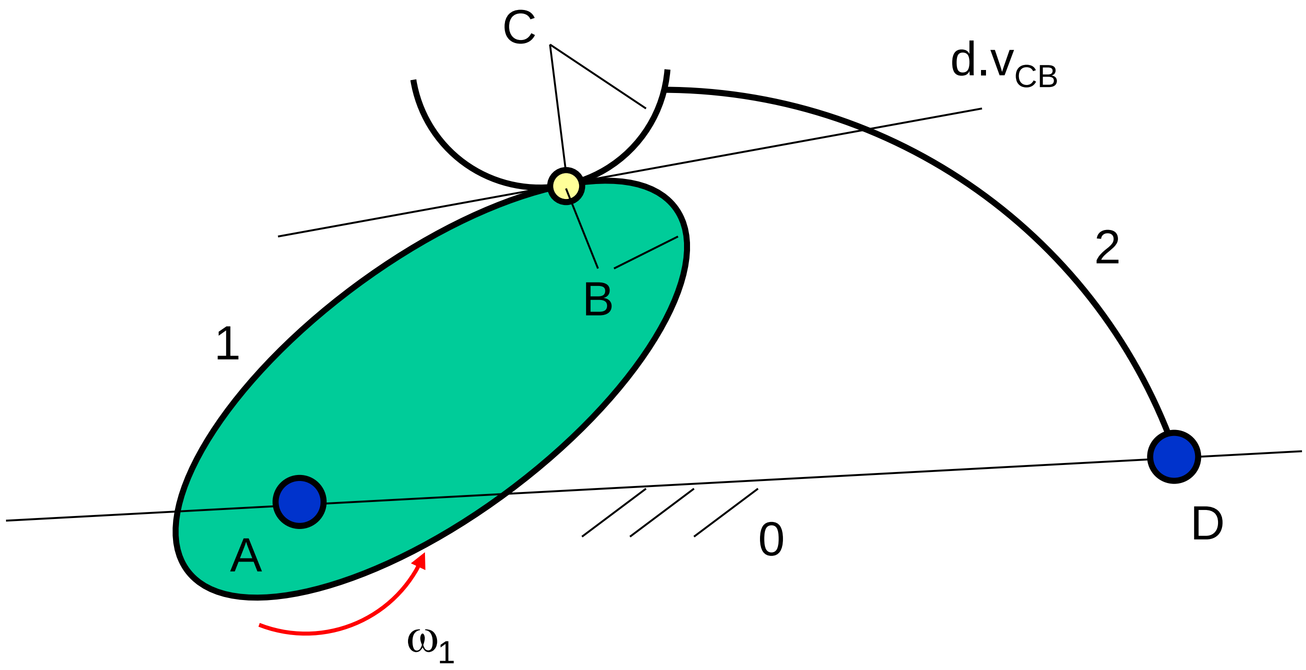
Cam pair (joint)

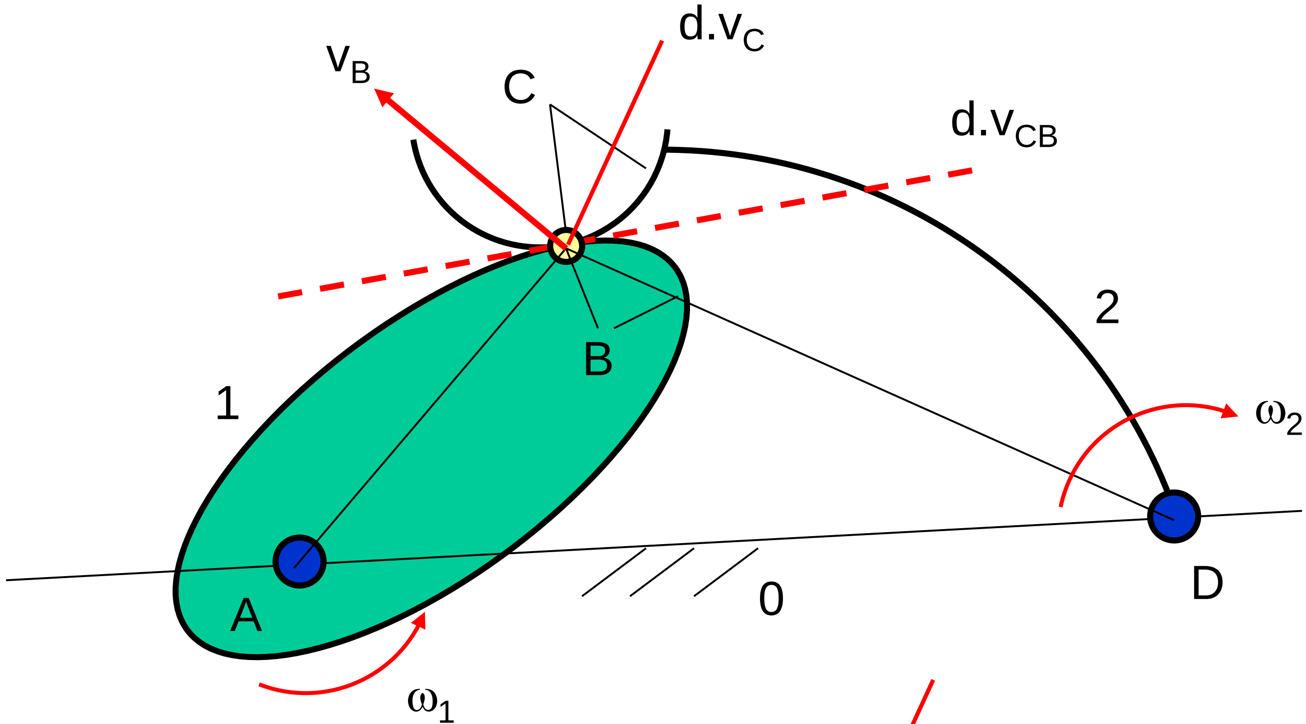


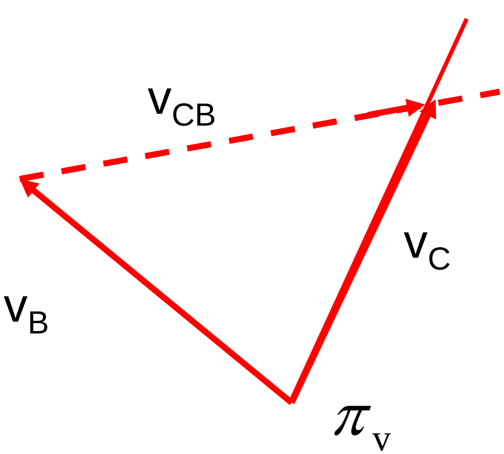
Velocity: $v_J = v_K + v_{JK}$

Acceleration – equivalent mechanism

Cam mechanism - velocity







$$\underline{\mathbf{v}_{\mathrm{C}}} = \underline{\underline{\mathbf{v}_{\mathrm{B}}}} + \underline{\mathbf{v}_{\mathrm{CB}}}$$

$$\omega_2 = \frac{\mathbf{v}_{\mathrm{C}}}{CD}$$

Cam mechanism – equivalent mechanism (4 bar linkage)