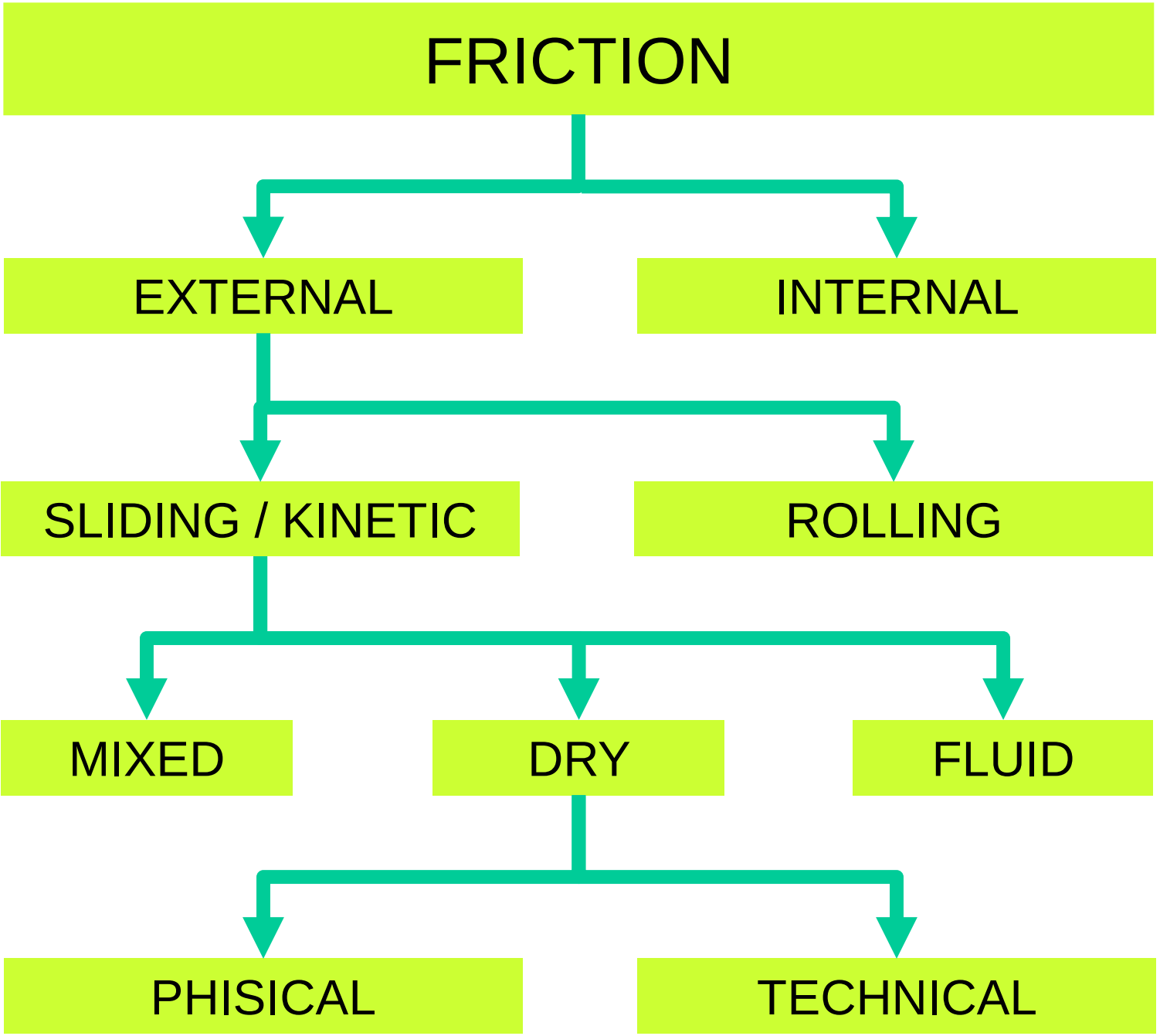
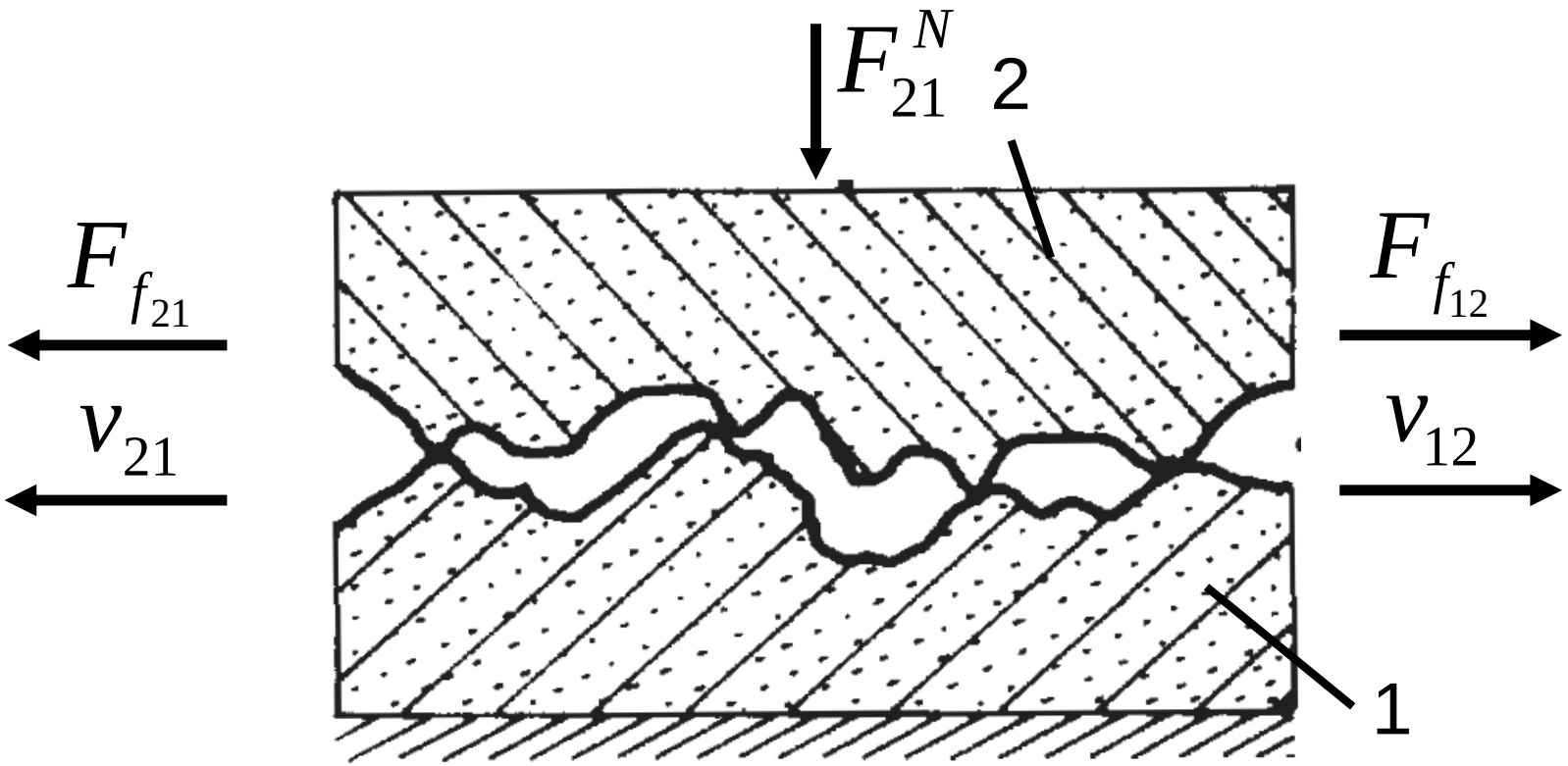

FRICTION
EXTERNAL
INTERNAL
SLIDING / KINETIC
ROLLING
MIXED
DRY
FLUID
PHISICAL
TECHNICAL

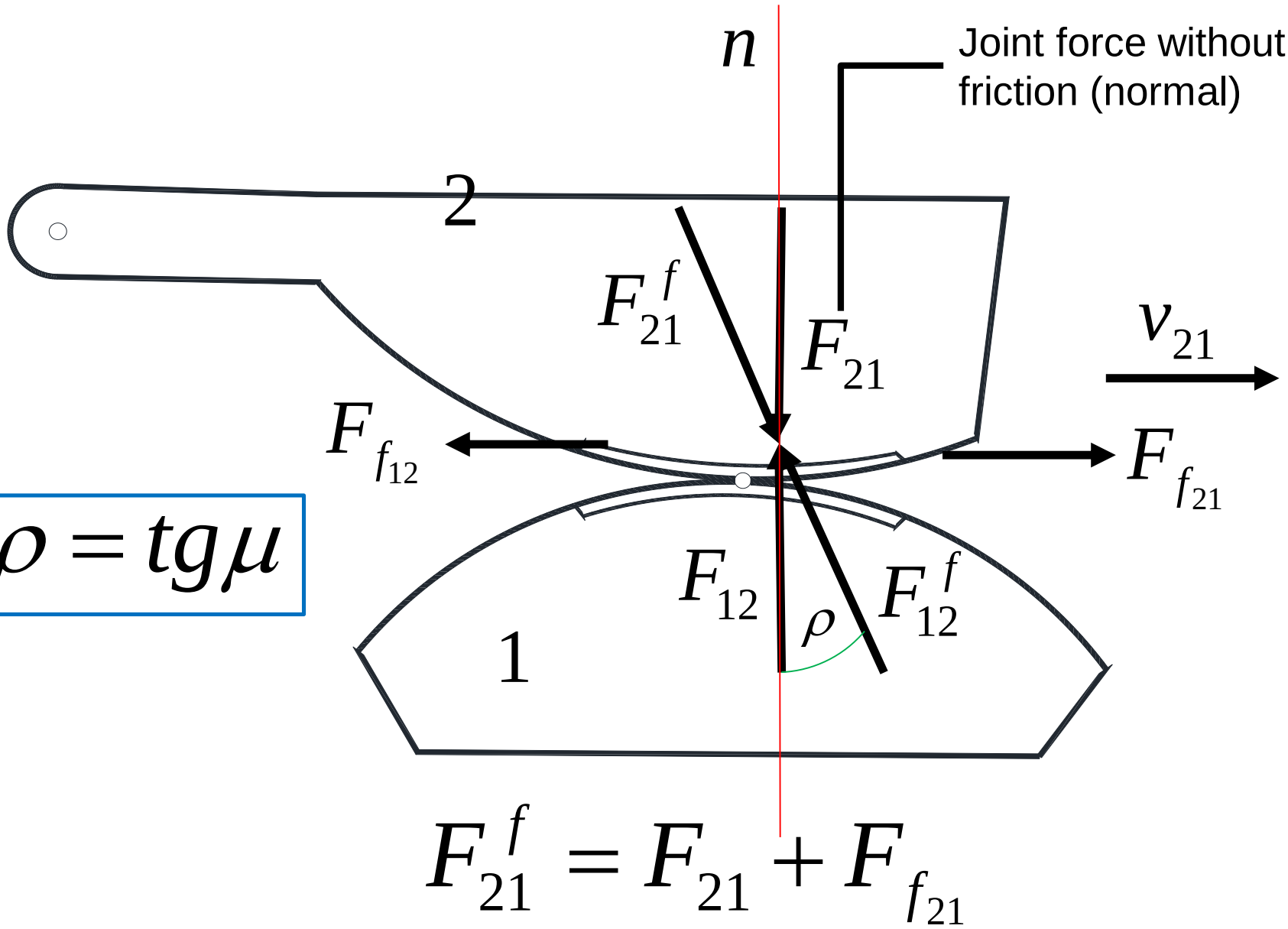
Friction force phenomenon

$$F_f \le \mu \cdot F_N$$

coefficient of friction $\in (0 \div 1)$



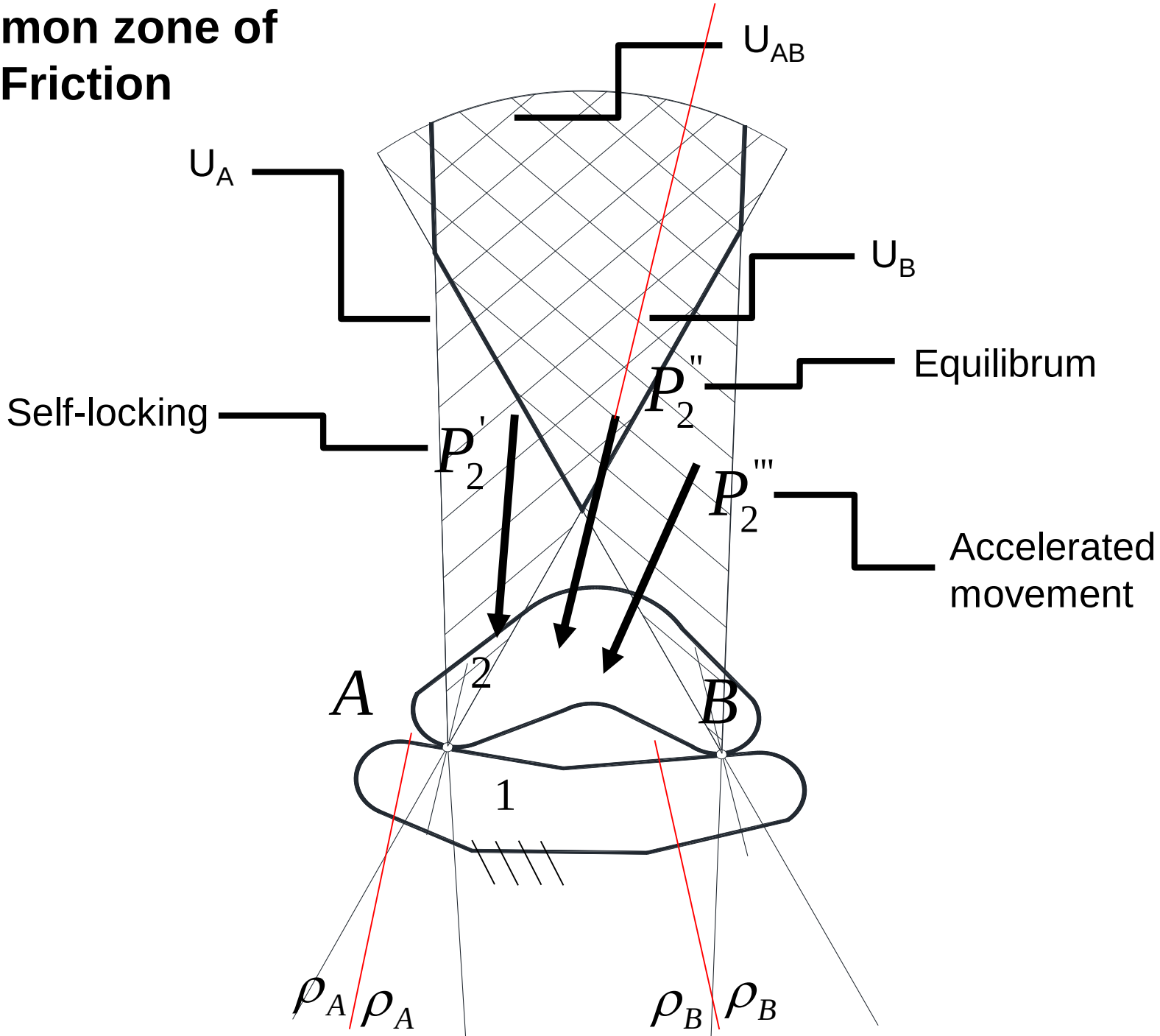
Angle of Friction



$$\rho = tg\mu$$

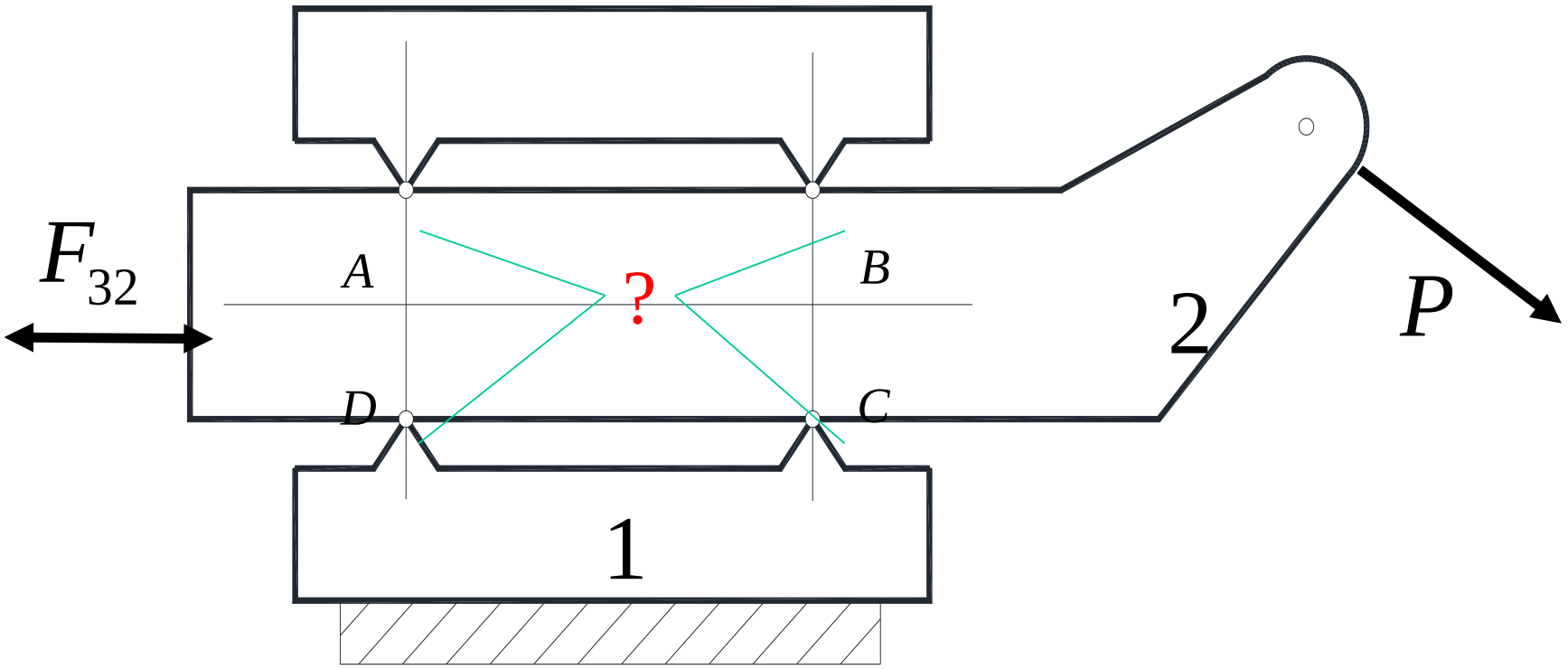
$$F_{21}^{f} = F_{21} + F_{f_{21}}$$

Common zone of Friction

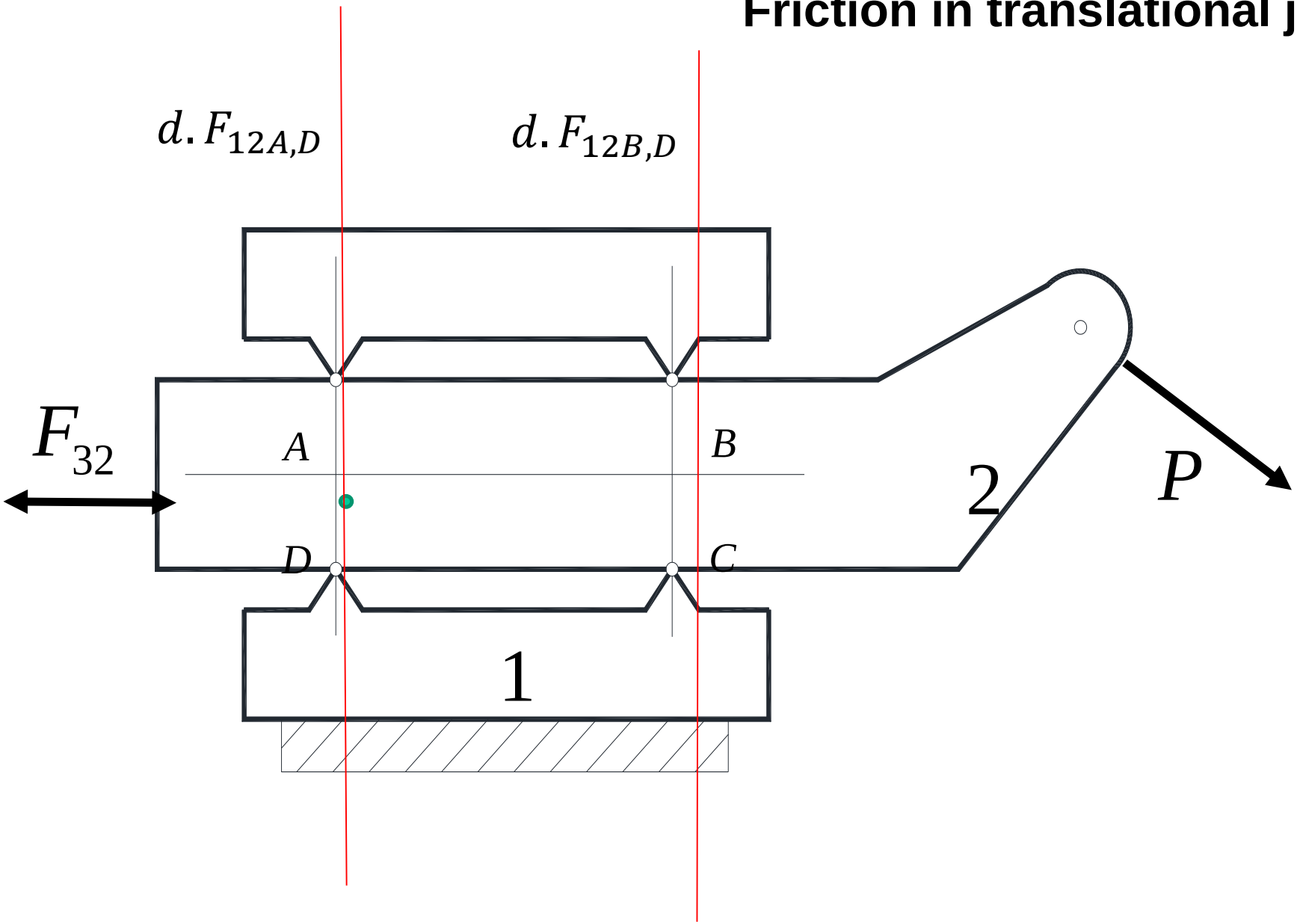


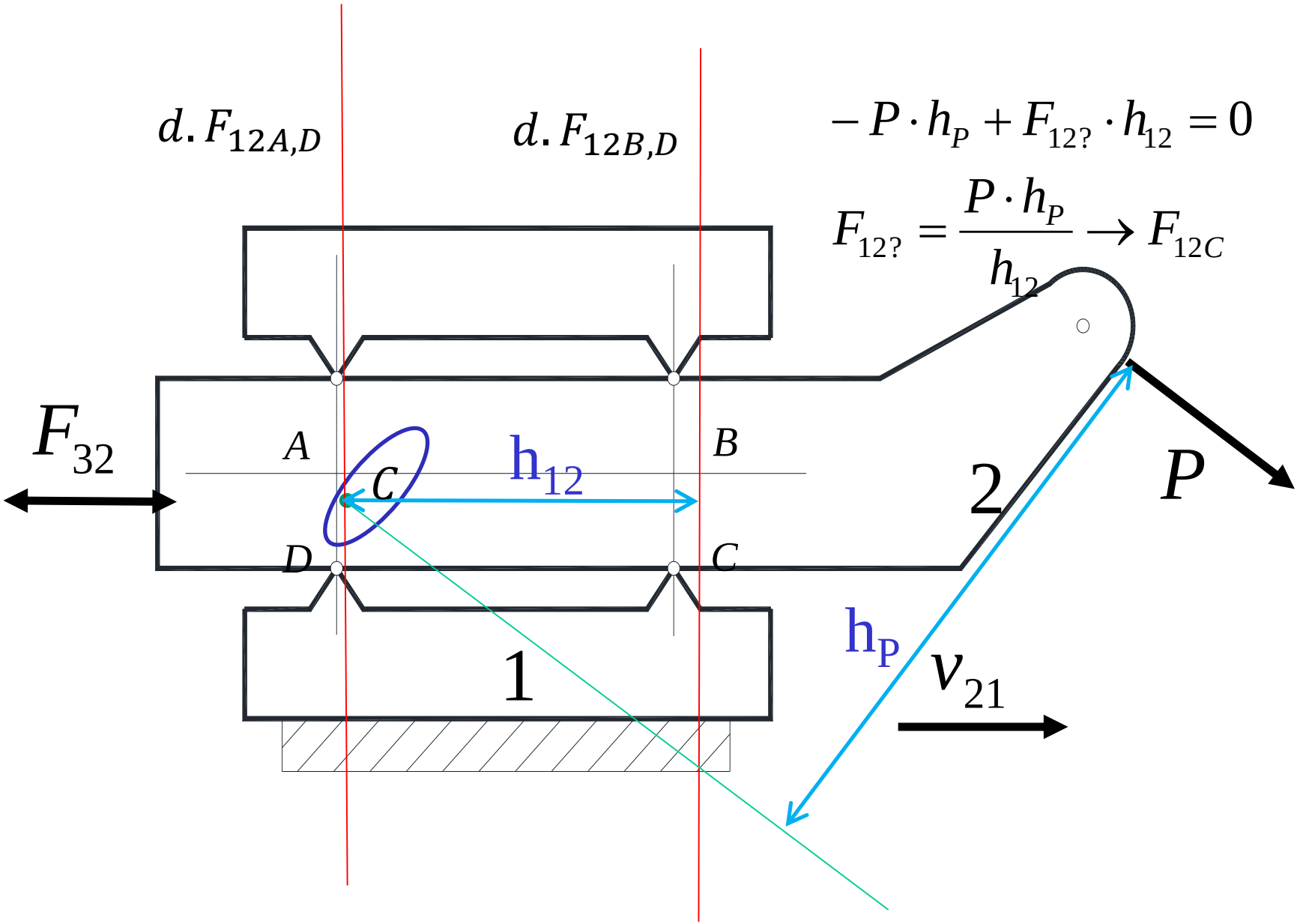
Friction in translational joint

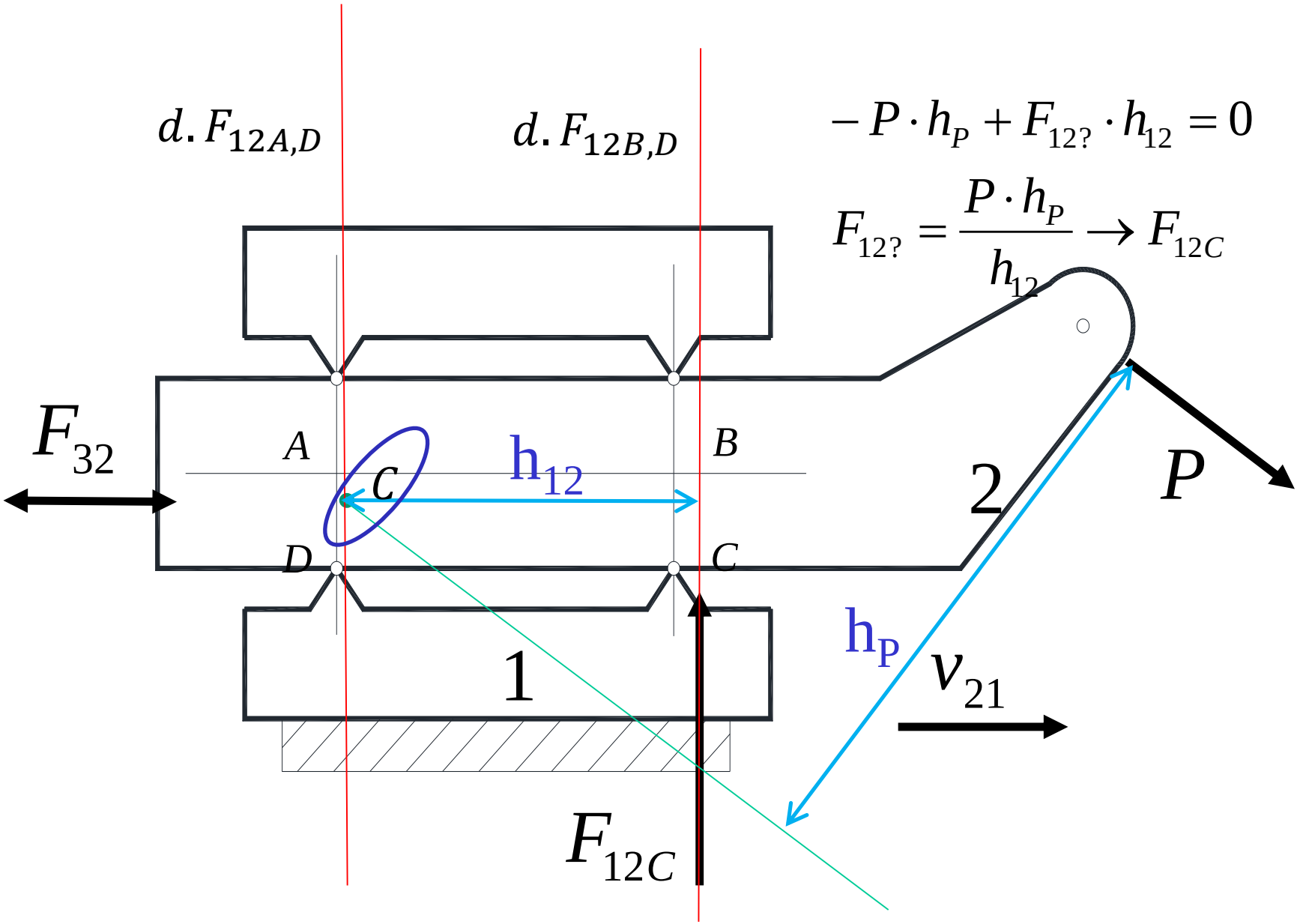
Two reaction points (which two?)

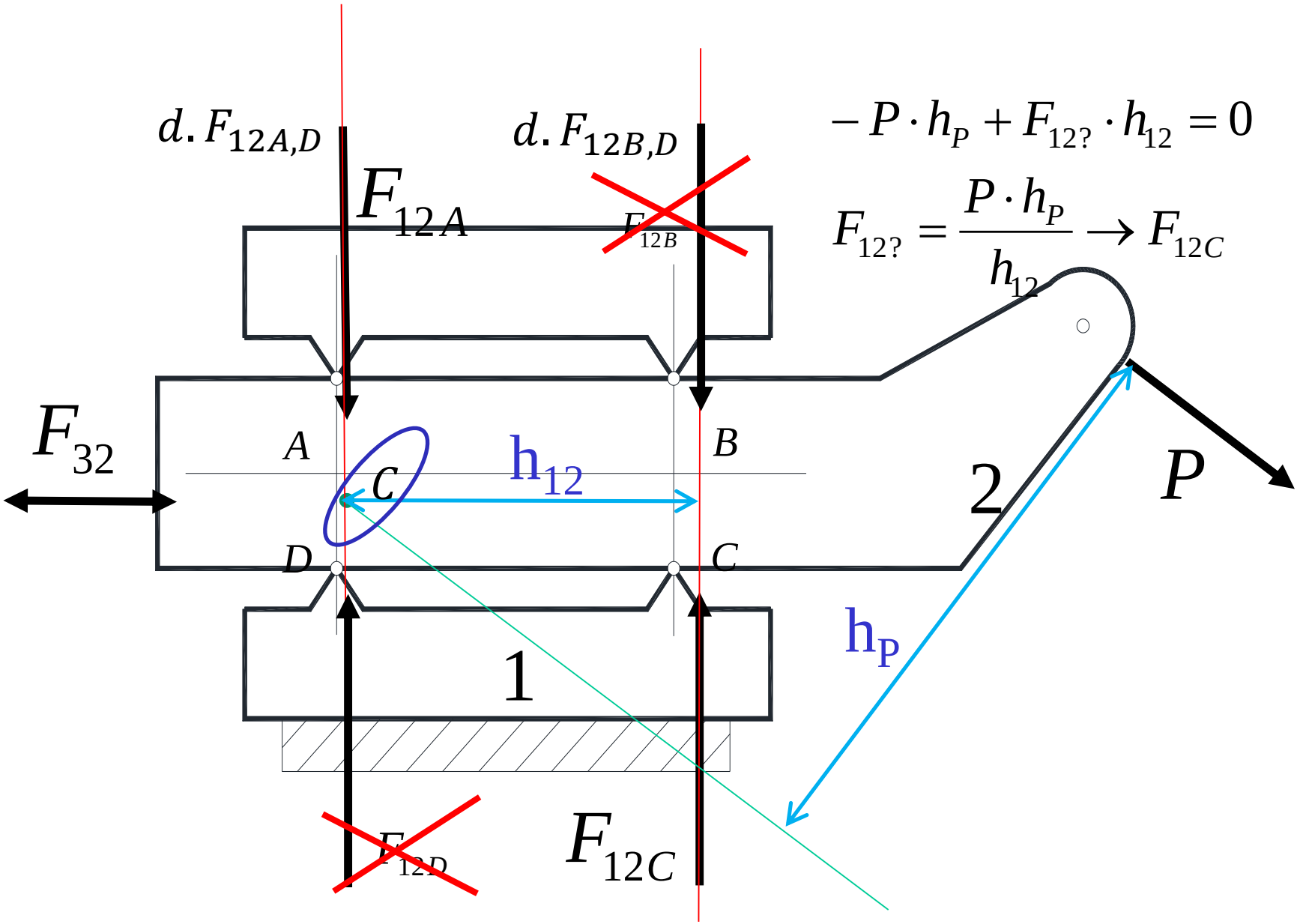


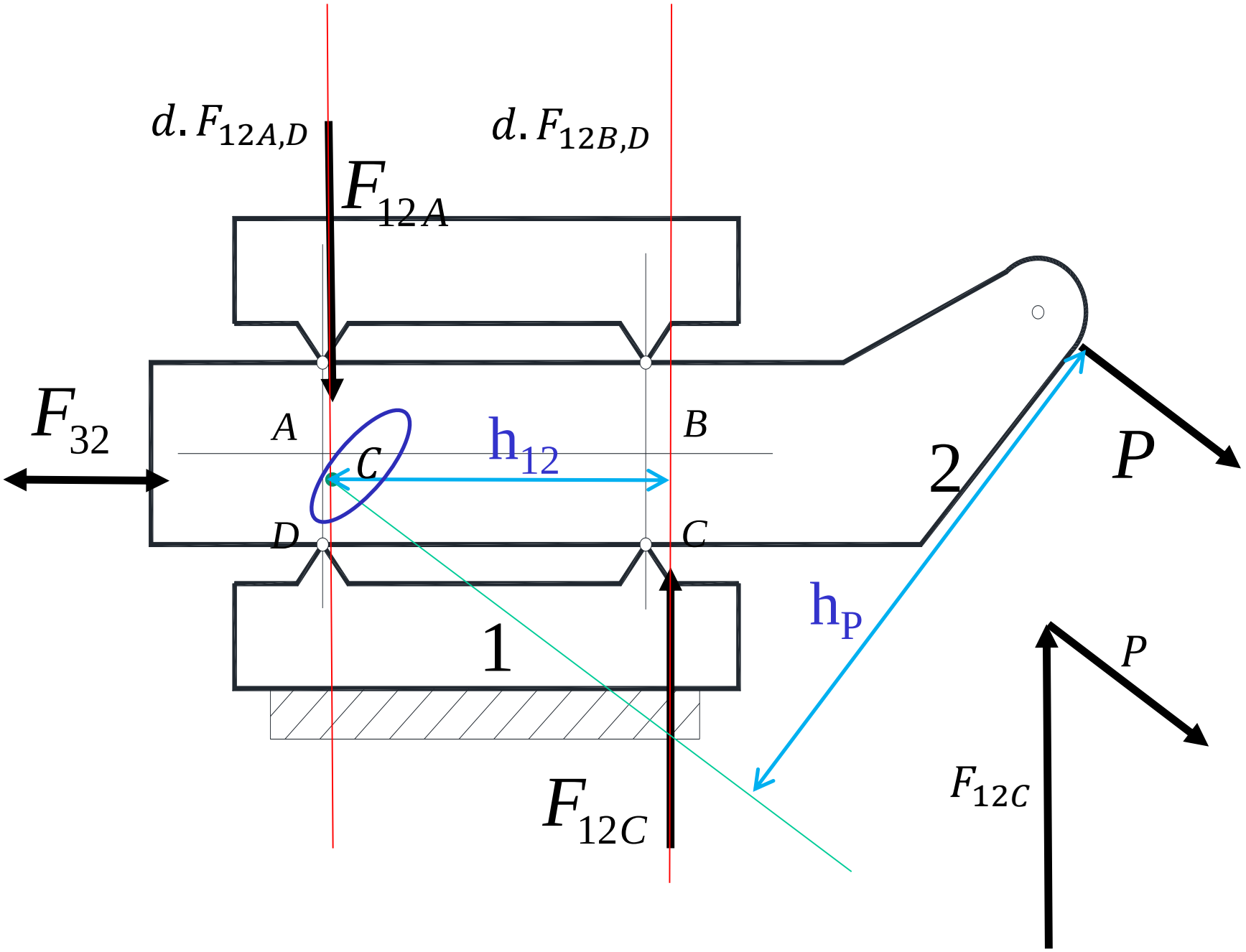
Friction in translational joint

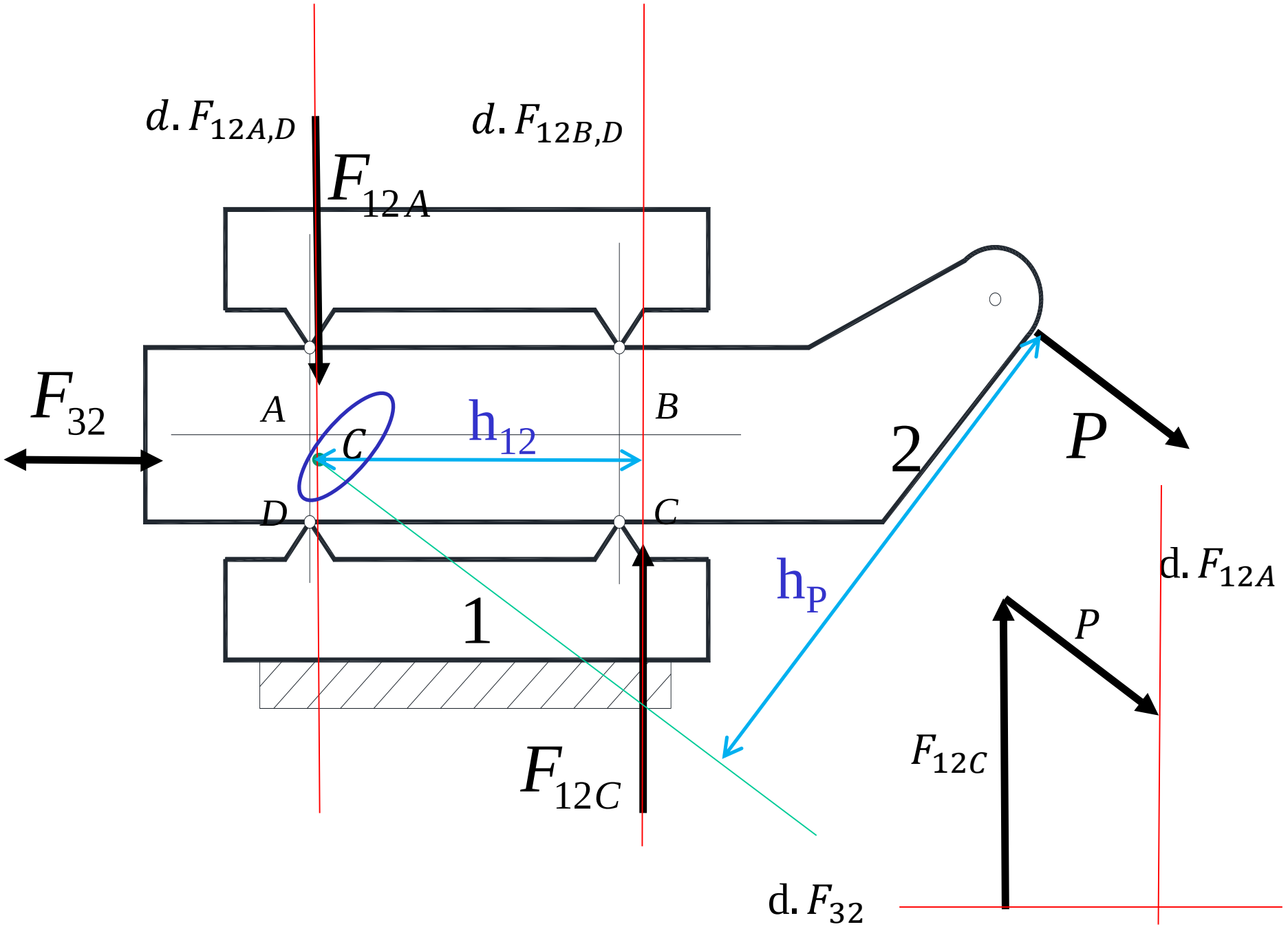


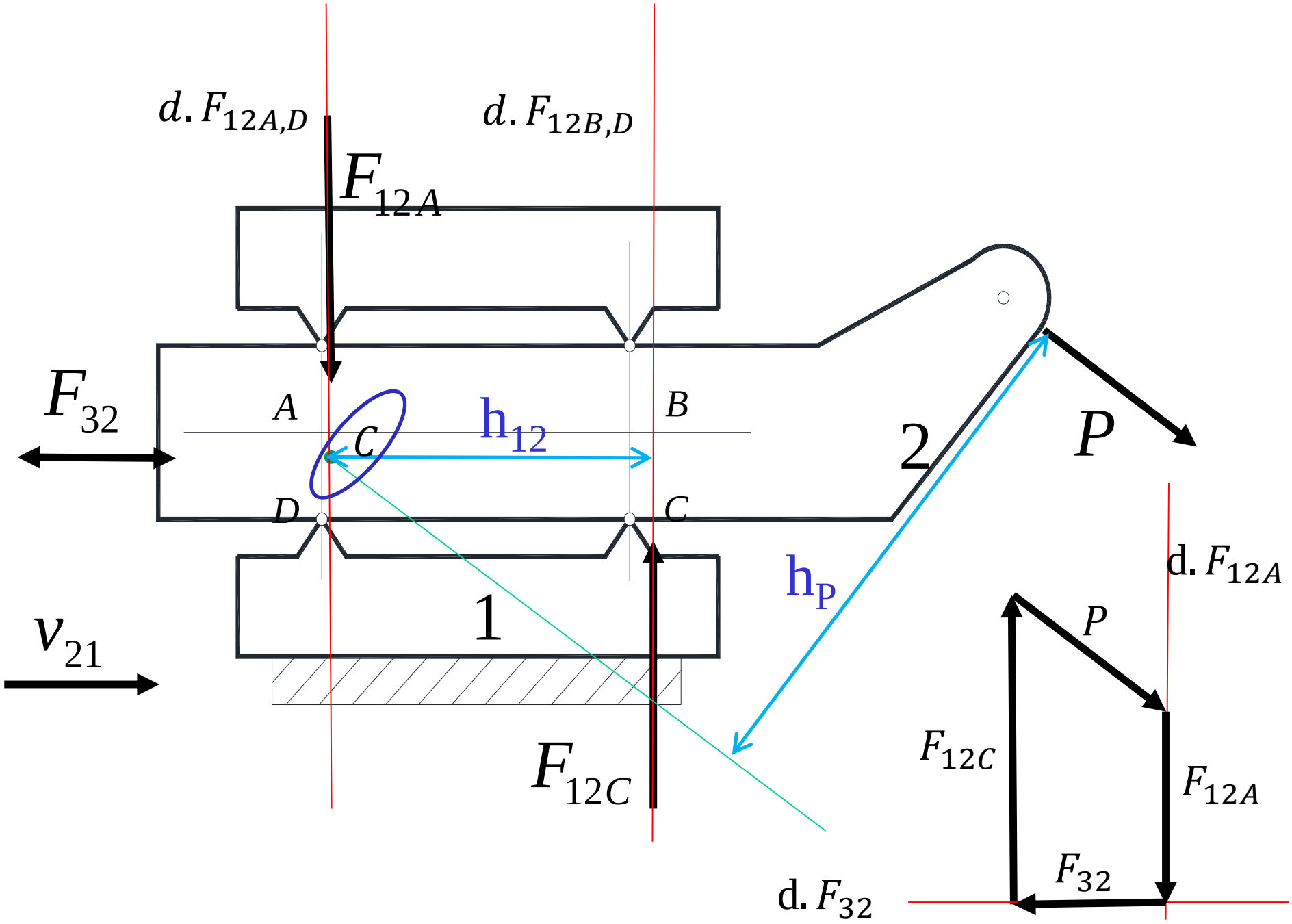

$d.F_{12A,D}$
$d.F_{12B,D}$
$-P \cdot h_P + F_{12?} \cdot h_{12} = 0$
$F_{12?} = \frac{P \cdot h_P}{h_{12}} \rightarrow F_{12C}$
F_{32}
A
B
C
D
h_{12}
2
P
h_P
v_{21}
1

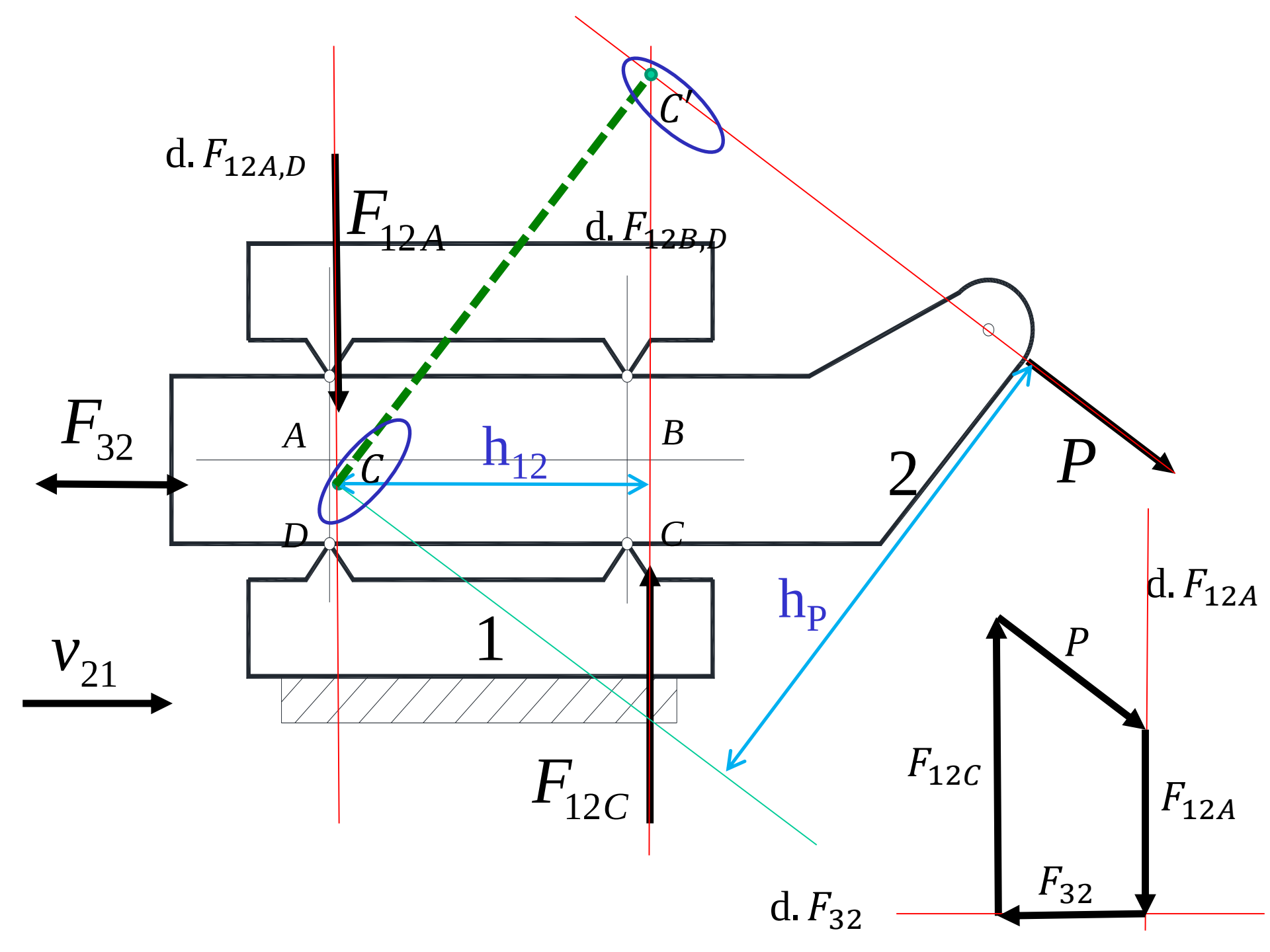

$d.F_{12A,D}$
$d.F_{12B,D}$
$-P \cdot h_P + F_{12?} \cdot h_{12} = 0$
$F_{12?} = \frac{P \cdot h_P}{h_{12}} \rightarrow F_{12C}$
F_{32}
A
B
C
D
h_{12}
2
P
h_P
v_{21}
1
F_{12C}

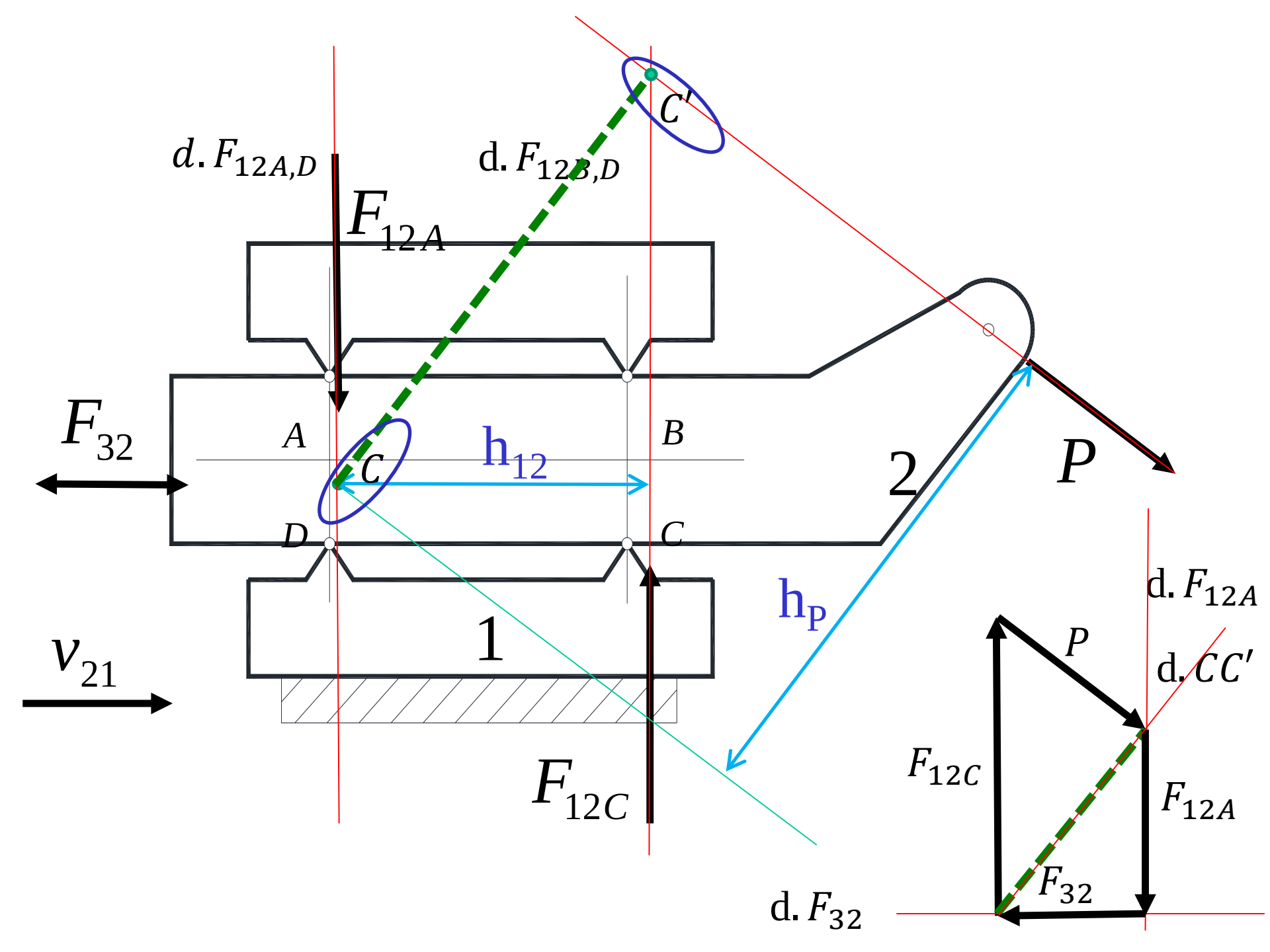

$d.F_{12A,D}$
$d.F_{12B,D}$
F_{12A}
F_{12B}
$-P \cdot h_P + F_{12?} \cdot h_{12} = 0$
$F_{12?} = \frac{P \cdot h_P}{h_{12}} \rightarrow F_{12C}$
F_{32}
A
B
C
D
h_{12}
2
P
h_P
1
F_{12D}
F_{12C}

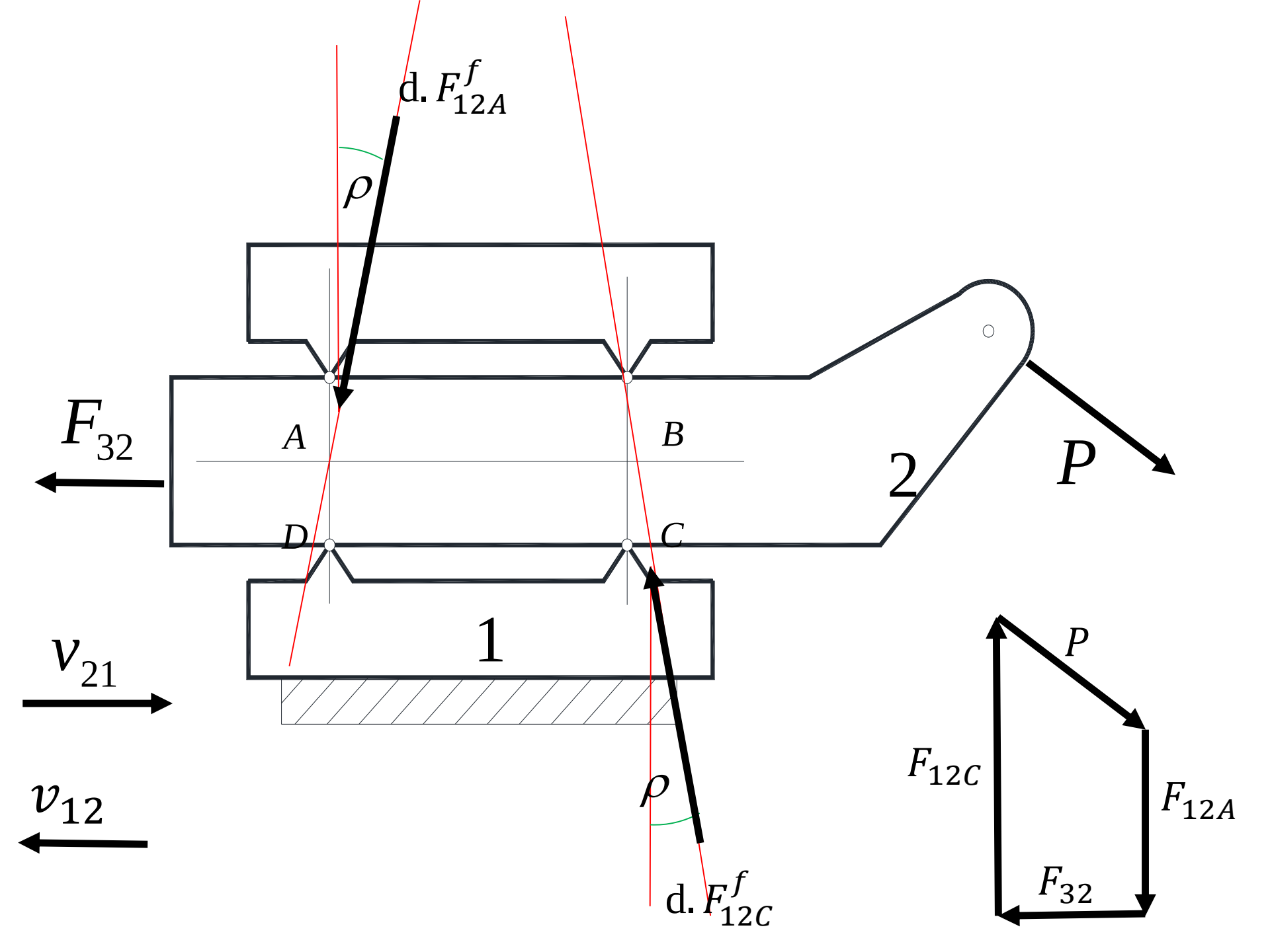

$d.F_{12A,D}$
$d.F_{12B,D}$
F_{12A}
F_{32}
A
B
C
D
h_{12}
2
P
h_P
1
F_{12C}
P
F_{12C}

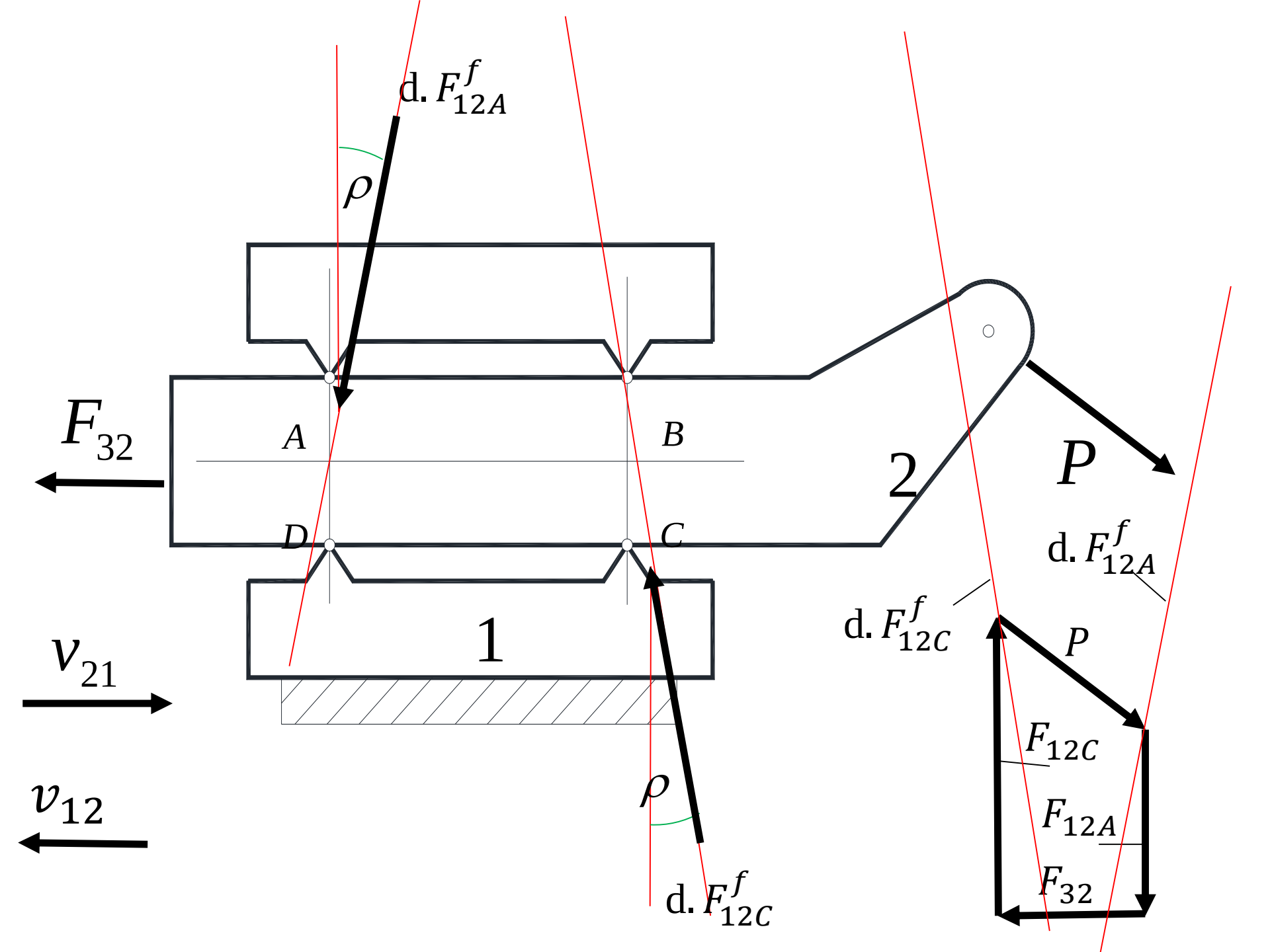

$d.F_{12A,D}$
$d.F_{12B,D}$
F_{12A}
F_{32}
A
B
C
D
h_{12}
2
P
h_P
1
F_{12C}
d. F_{12A}
P
F_{12C}
d. F_{32}

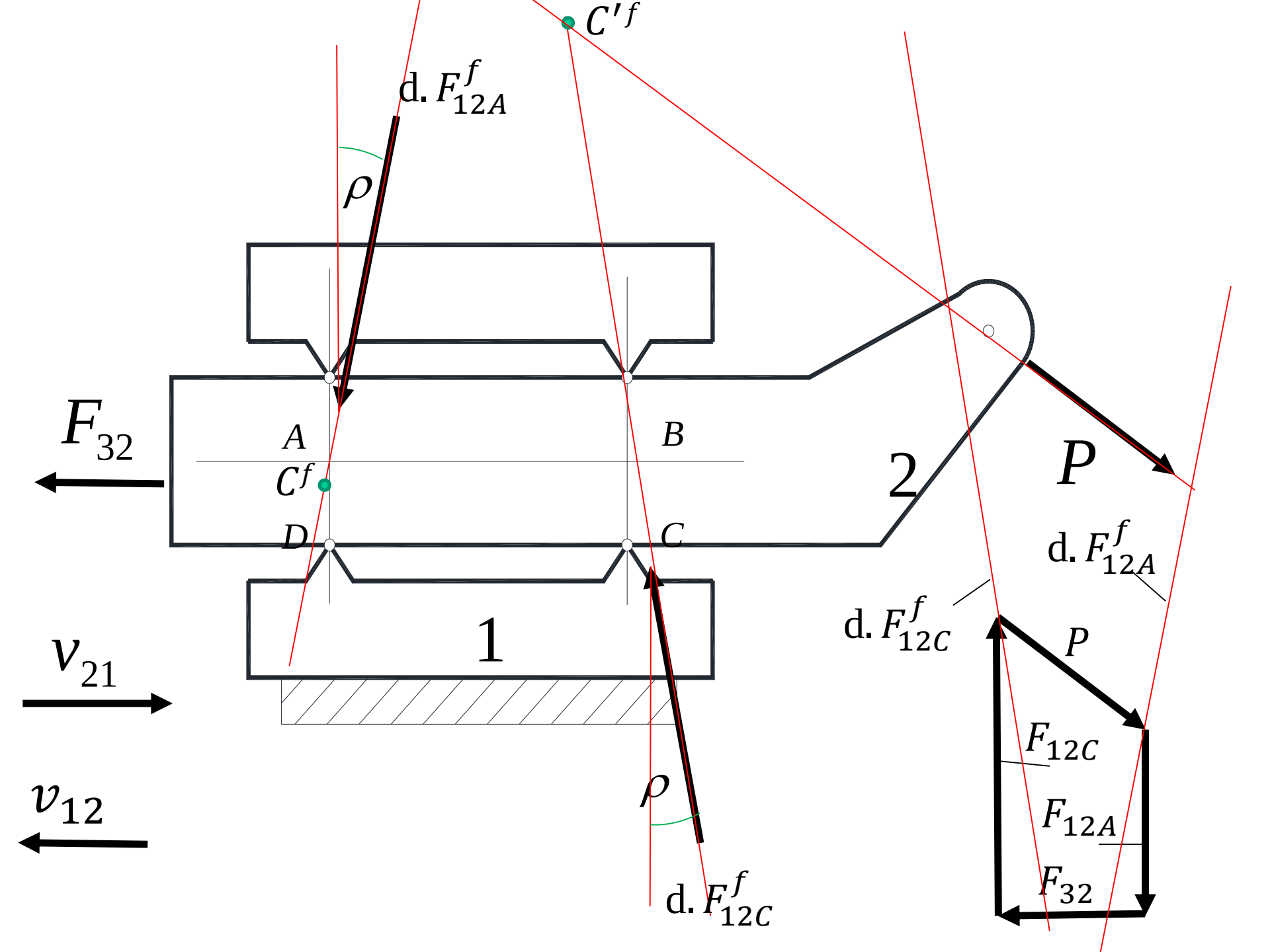

$d.F_{12A,D}$
$d.F_{12B,D}$
F_{12A}
F_{32}
A
B
C
D
h_{12}
2
P
h_P
1
v_{21}
F_{12C}
d. F_{12A}
P
F_{12C}
F_{12A}
F_{32}
d. F_{32}

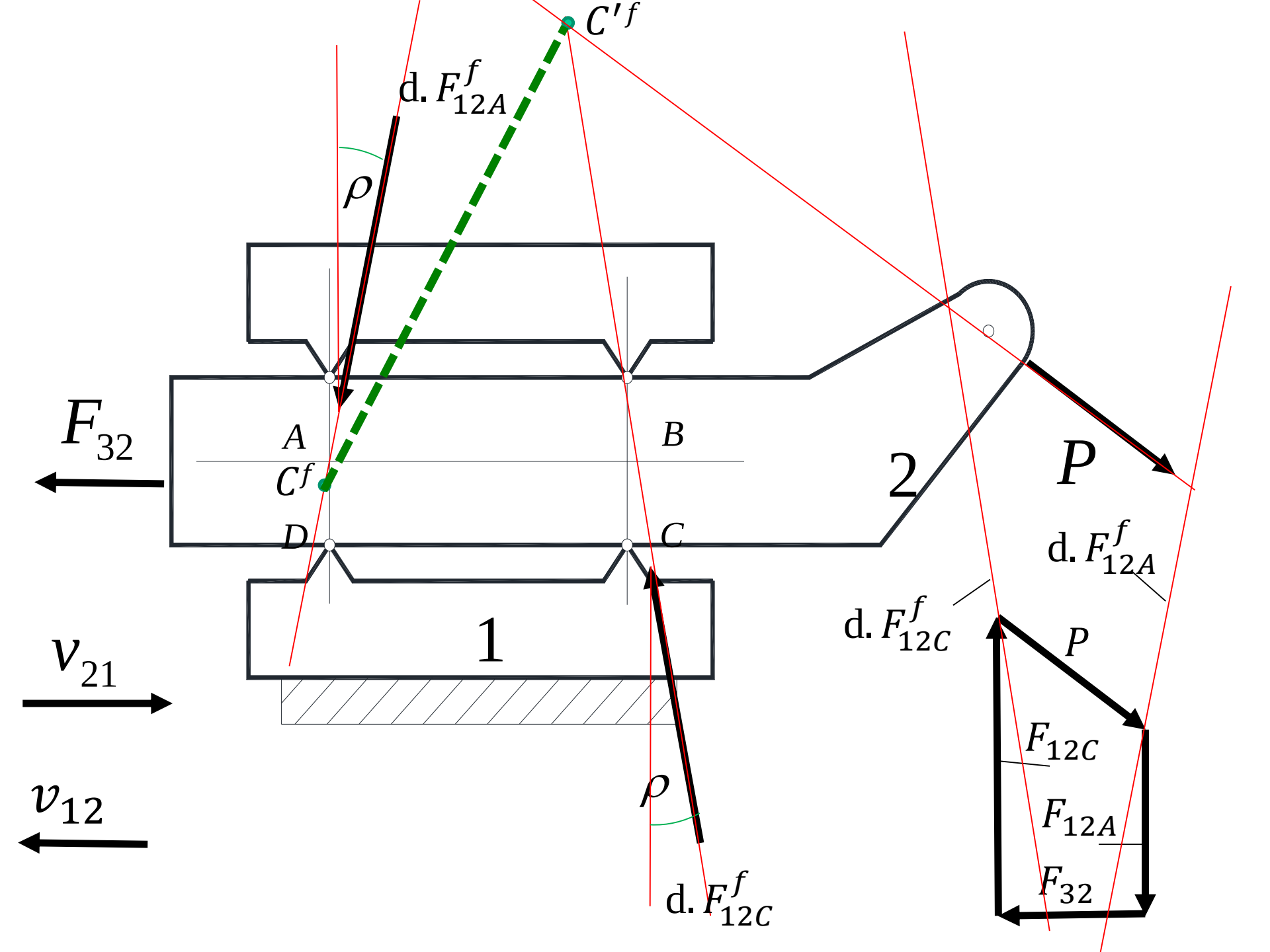

d. $F_{12A,D}$
F_{12A}
d. $F_{12B,D}$
C'
F_{32}
A
B
C
D
h_{12}
2
P
h_P
1
v_{21}
F_{12C}
d. F_{12A}
P
F_{12C}
F_{12A}
F_{32}
d. F_{32}

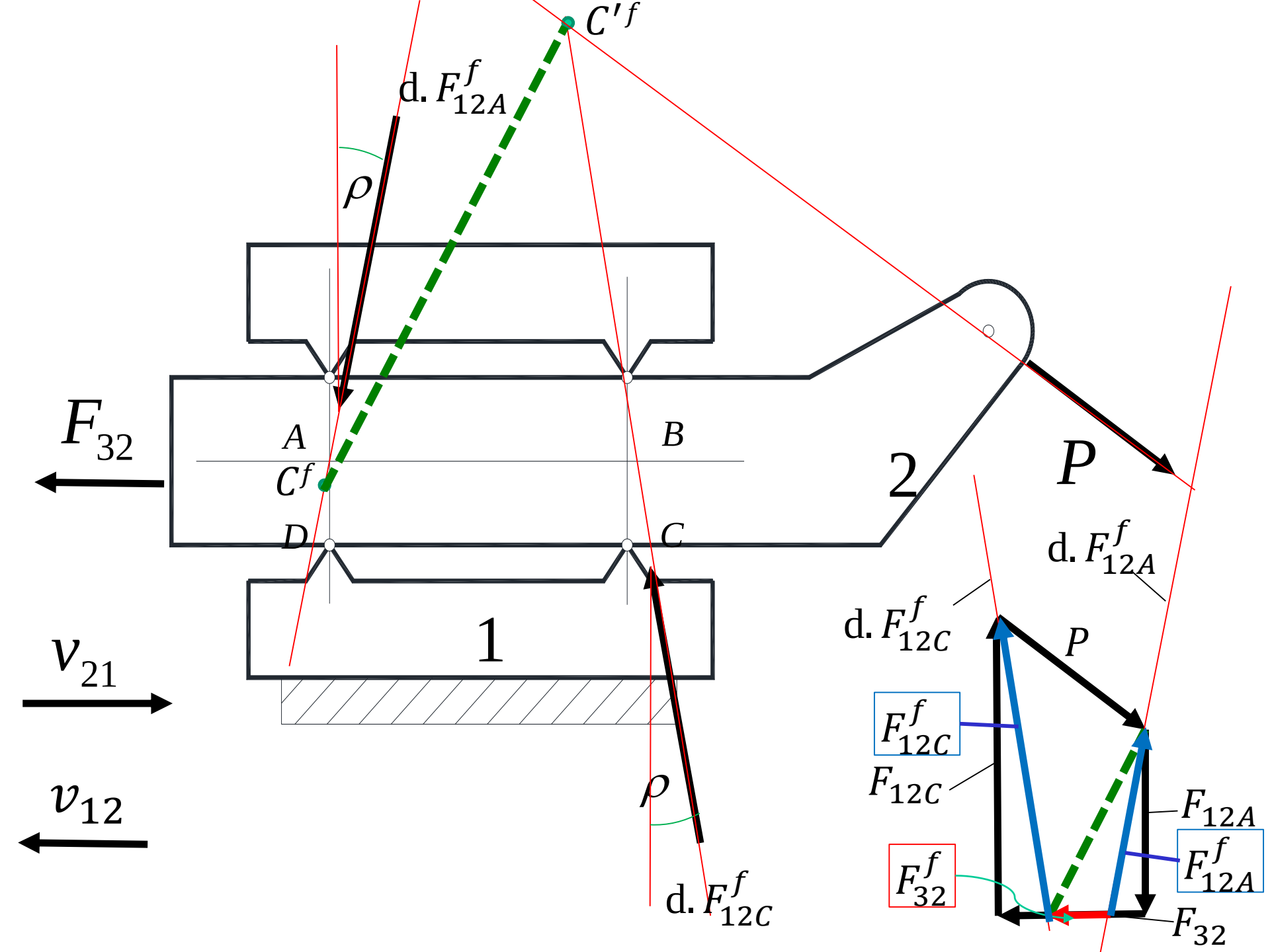

$d.F_{12A,D}$
F_{12A}
d. $F_{12B,D}$
C'
F_{32}
A
B
C
D
h_{12}
2
P
1
h_P
v_{21}
F_{12C}
d. F_{12A}
P
d. CC'
F_{12C}
F_{12A}
F_{32}
d. F_{32}

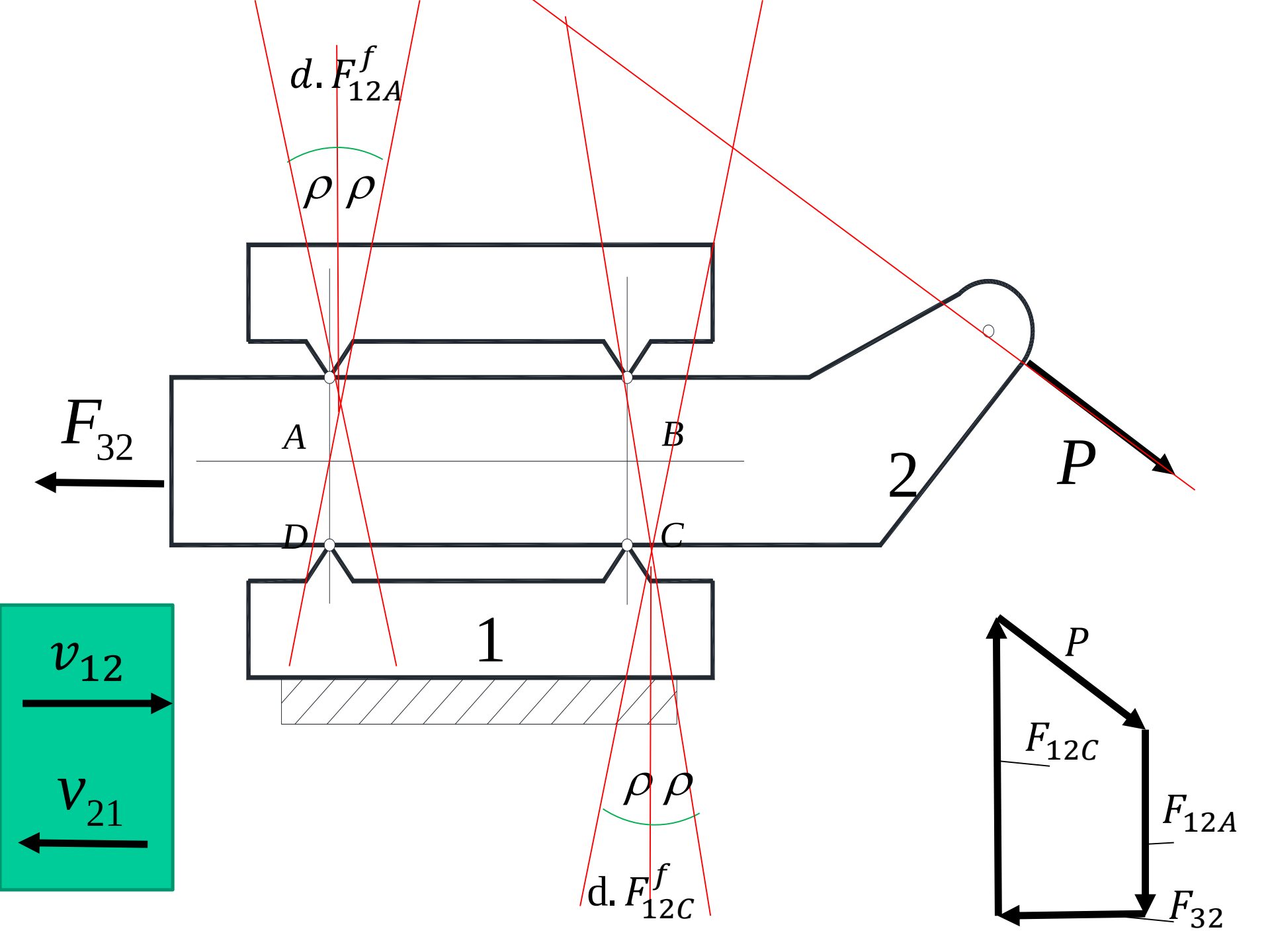

d. F_{12A}^{f}
ρ
F_{32}
A
B
D
C
2
P
1
v_{21}
v_{12}
ρ
d. F_{12C}^{f}
P
F_{12C}
F_{12A}
F_{32}

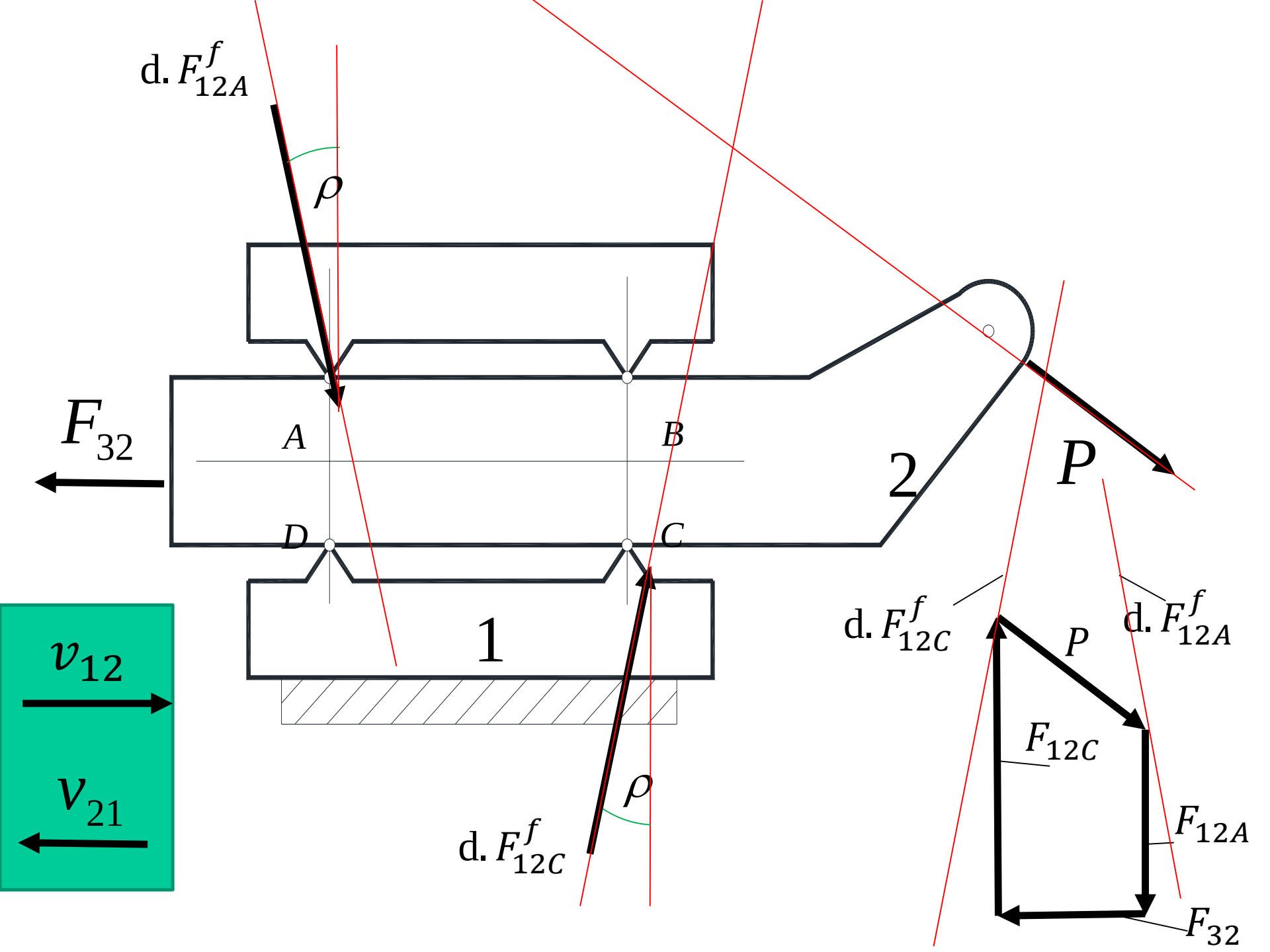

d. F_{12A}^{f}
ρ
F_{32}
A
B
D
C
2
P
1
v_{21}
v_{12}
d. F_{12A}^{f}
d. F_{12C}^{f}
P
F_{12C}
F_{12A}
F_{32}
ρ
d. F_{12C}^{f}

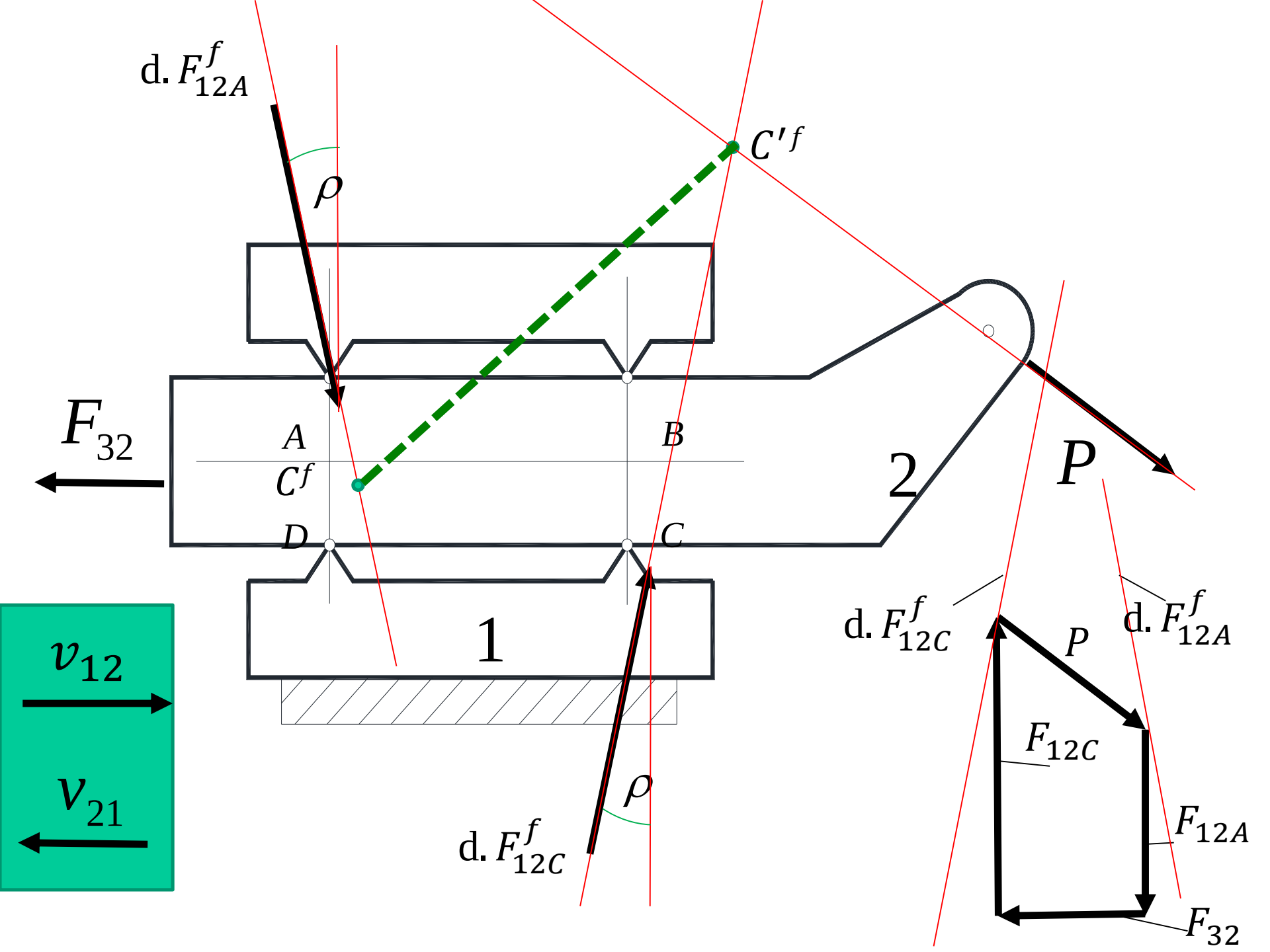

C'^f
d. F_{12A}^f
ρ
F_{32}
A
B
C^f
D
C
2
P
1
v_{21}
v_{12}
d. F_{12A}^f
d. F_{12C}^f
P
F_{12C}
F_{12A}
F_{32}
ρ
d. F_{12C}^f

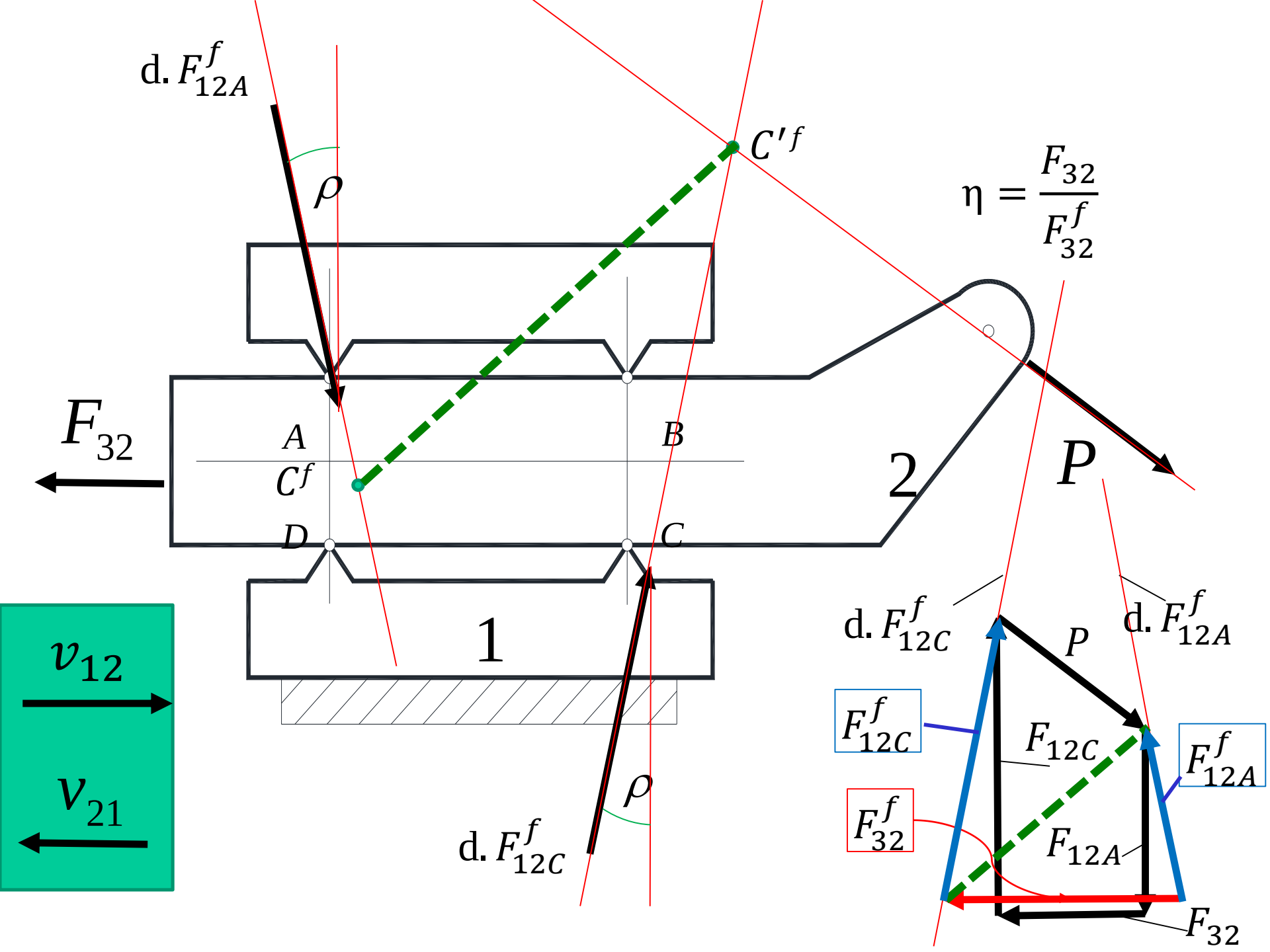

C'^f
d. F_{12A}^f
ρ
F_{32}
A
B
C^f
D
C
2
P
1
v_{21}
v_{12}
ρ
d. F_{12C}^f
d. F_{12A}^f
d. F_{12C}^f
P
F_{12C}
F_{12A}
F_{32}

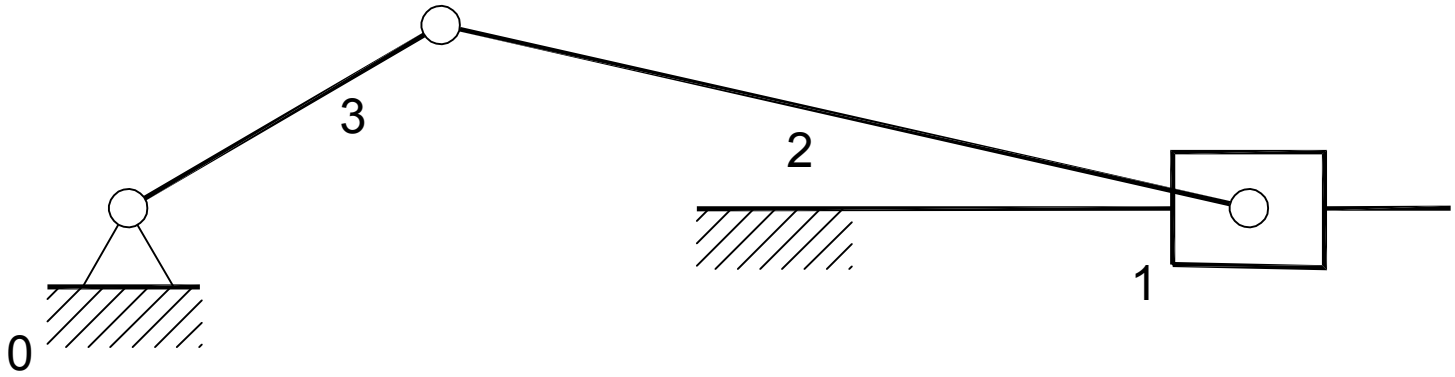

C'^f
d. F^f_{12A}
ρ
F_{32}
A
B
C^f
D
C
2
P
1
v_{21}
v_{12}
ρ
d. F^f_{12C}
d. F^f_{12A}
d. F^f_{12C}
P
F^f_{12C}
F_{12C}
F_{12A}
F^f_{12A}
F^f_{32}
F_{32}

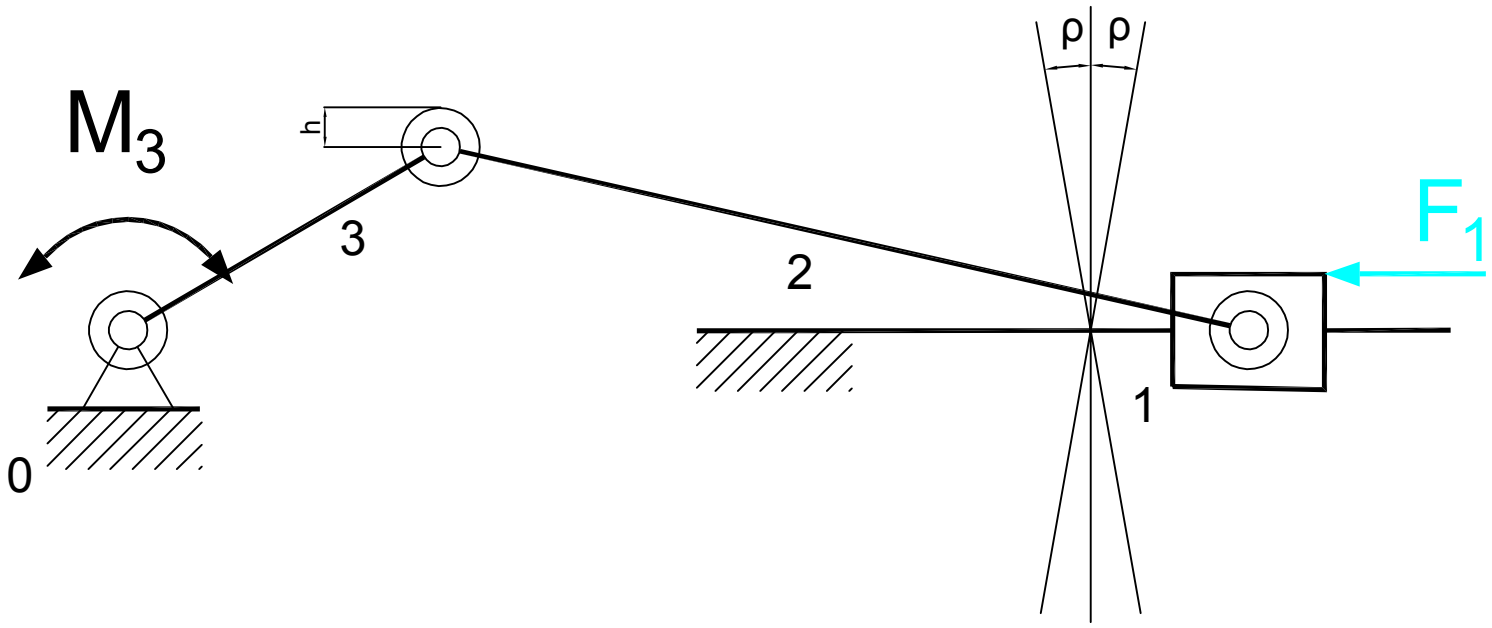

$d.F_{12A}^{f}$
ρ ρ
F_{32}
A
B
D
C
2
P
1
v_{12}
v_{21}
ρ ρ
d. F_{12C}^{f}
P
F_{12C}
F_{12A}
F_{32}

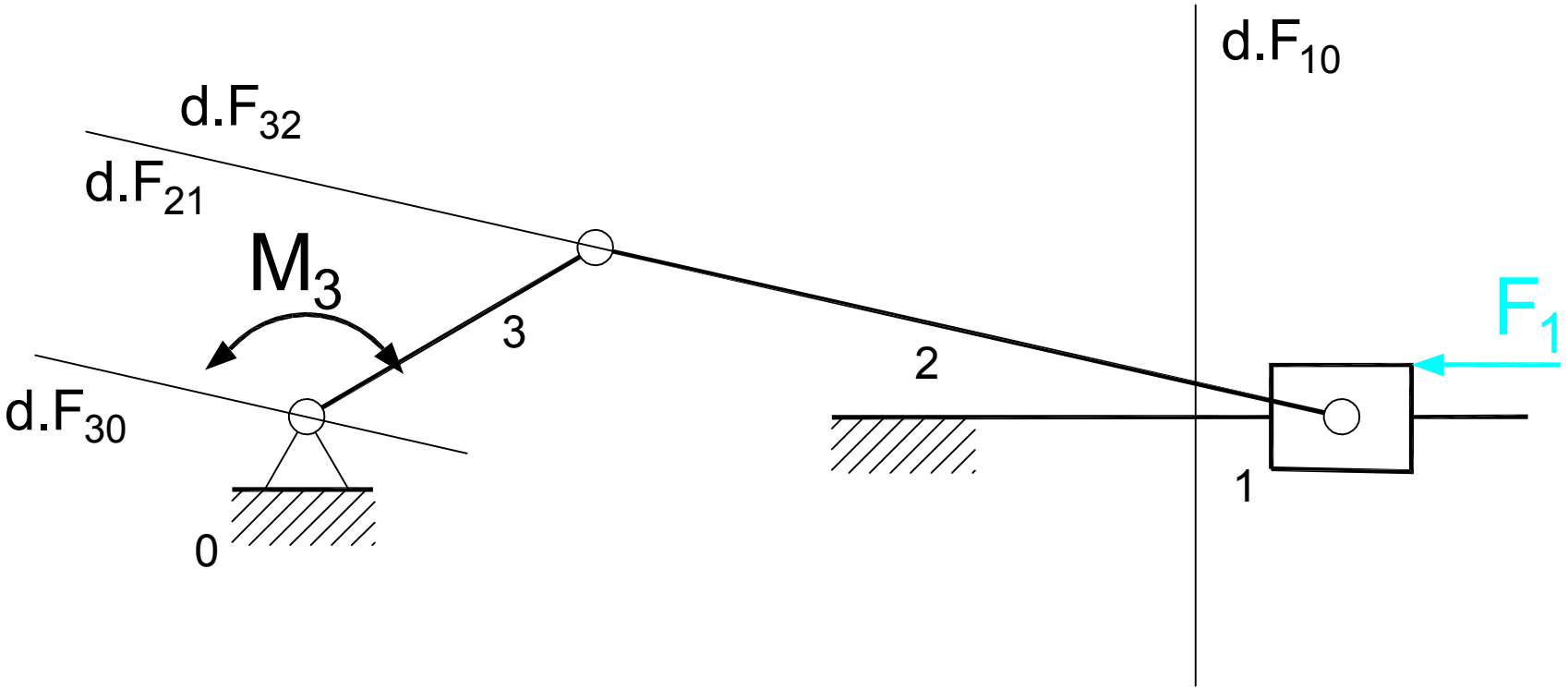

d. F_{12A}^{f}
ρ
F_{32}
A
B
D
C
2
1
P
v_{12}
v_{21}
d. F_{12C}^{f}
d. F_{12A}^{f}
P
F_{12C}
F_{12A}
F_{32}
ρ
d. F_{12C}^{f}

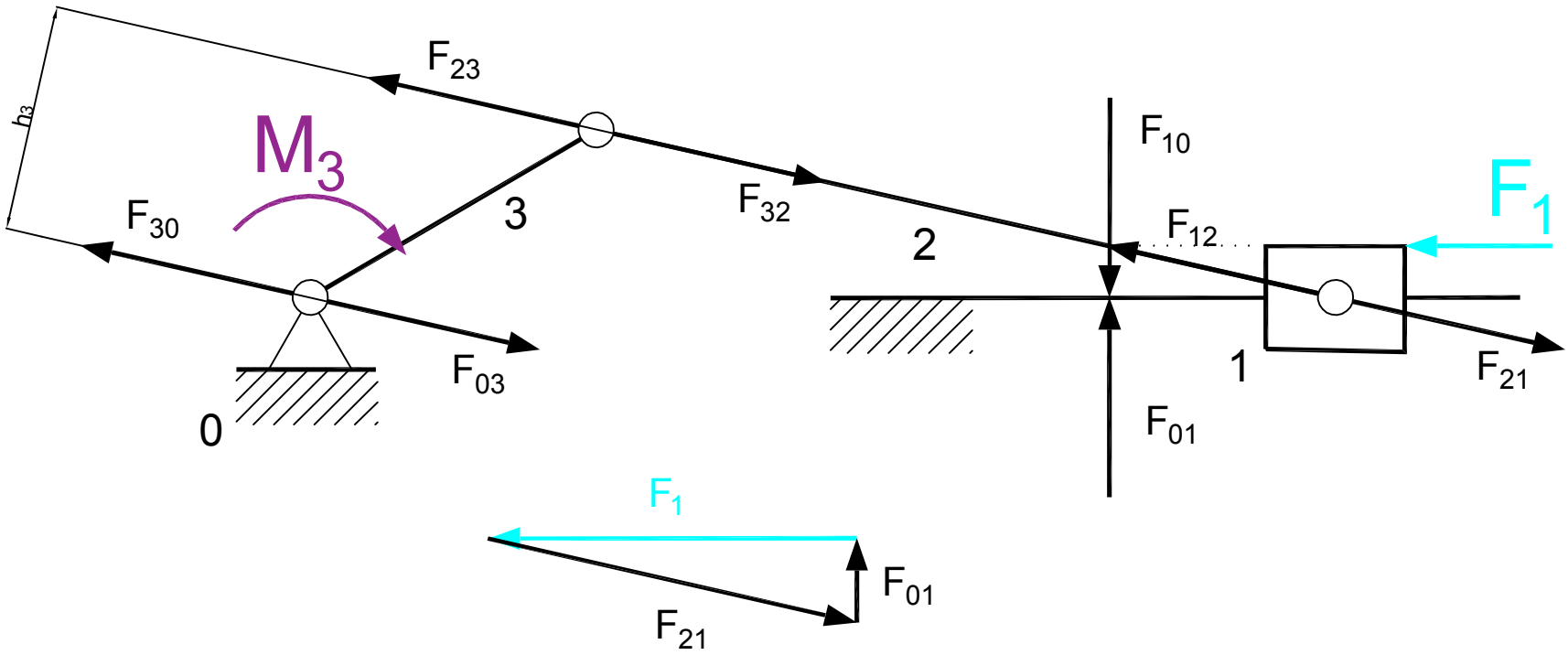

d. F_{12A}^{f}
ρ
C'^{f}
F_{32}
A
B
C^{f}
D
C
2
P
1
v_{12}
v_{21}
d. F_{12C}^{f}
ρ
d. F_{12C}^{f}
P
d. F_{12A}^{f}
F_{12C}
F_{12A}
F_{32}

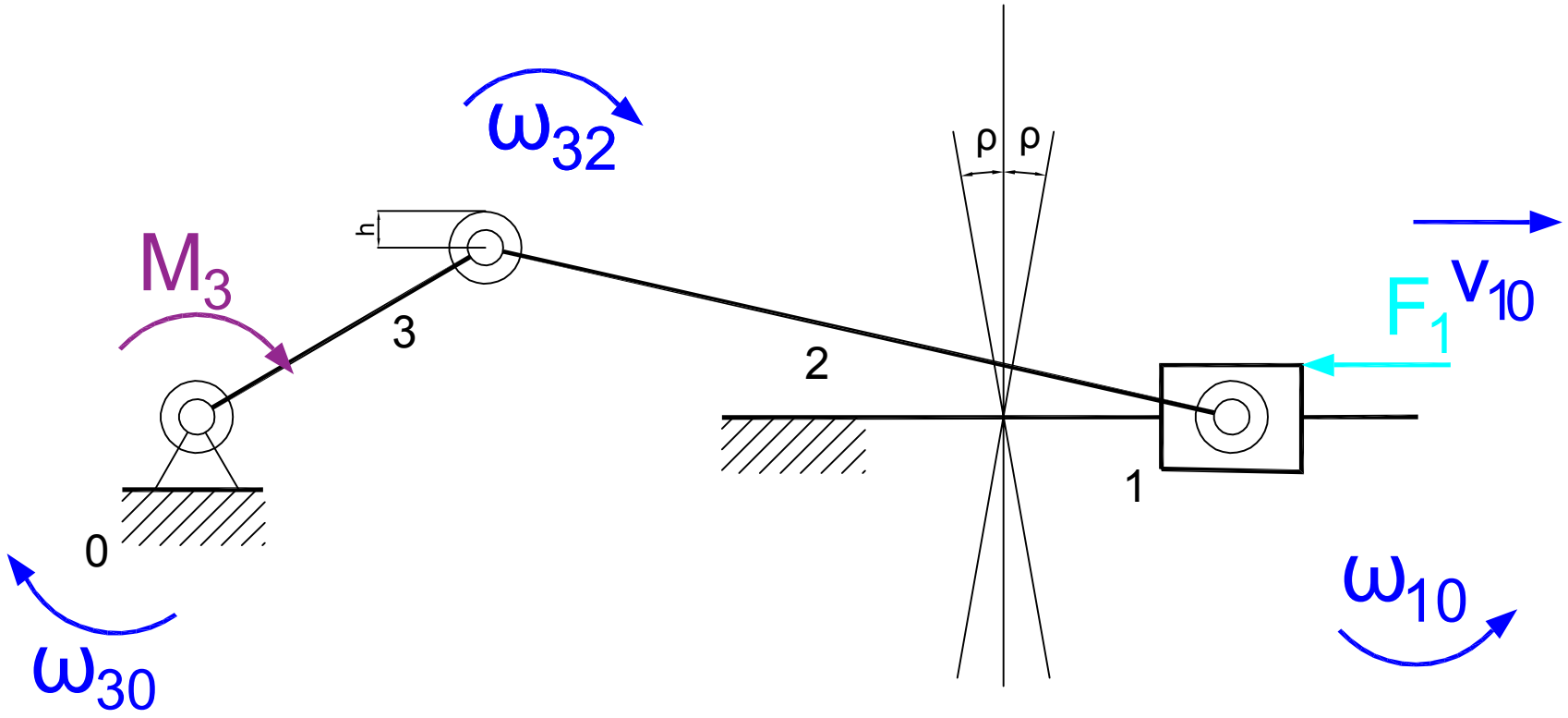

d. F_{12A}^{f}
ρ
C'^{f}
$\eta = \frac{F_{32}}{F_{32}^{f}}$
F_{32}
A
B
C^{f}
D
C
2
P
1
v_{12}
v_{21}
d. F_{12C}^{f}
ρ
d. F_{12C}^{f}
P
d. F_{12A}^{f}
F_{12C}^{f}
F_{12C}
F_{12A}^{f}
F_{32}^{f}
F_{12A}
F_{32}

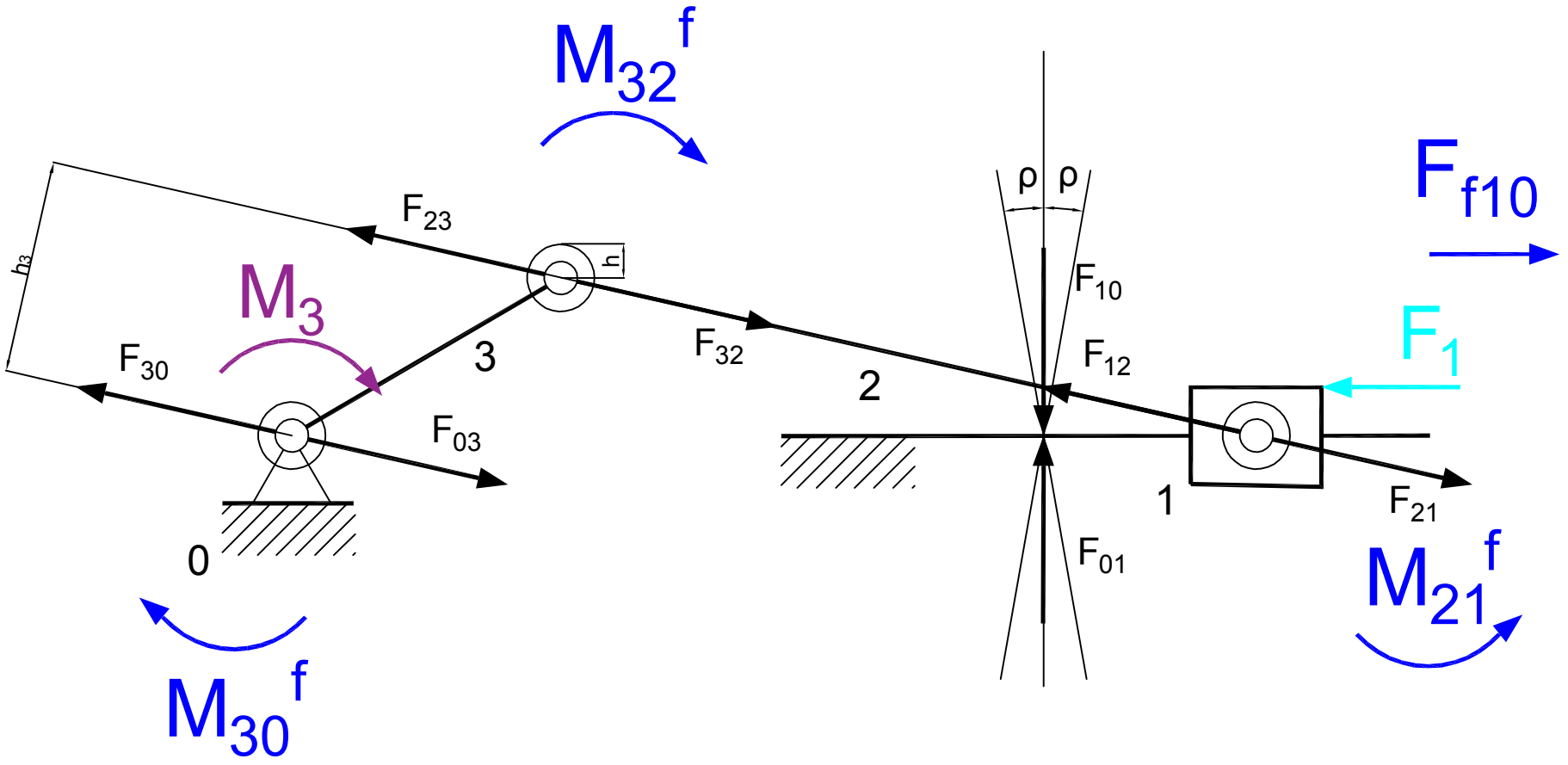

3
2
1
0


M3
h
3
2
ρ
ρ
F1
1
0

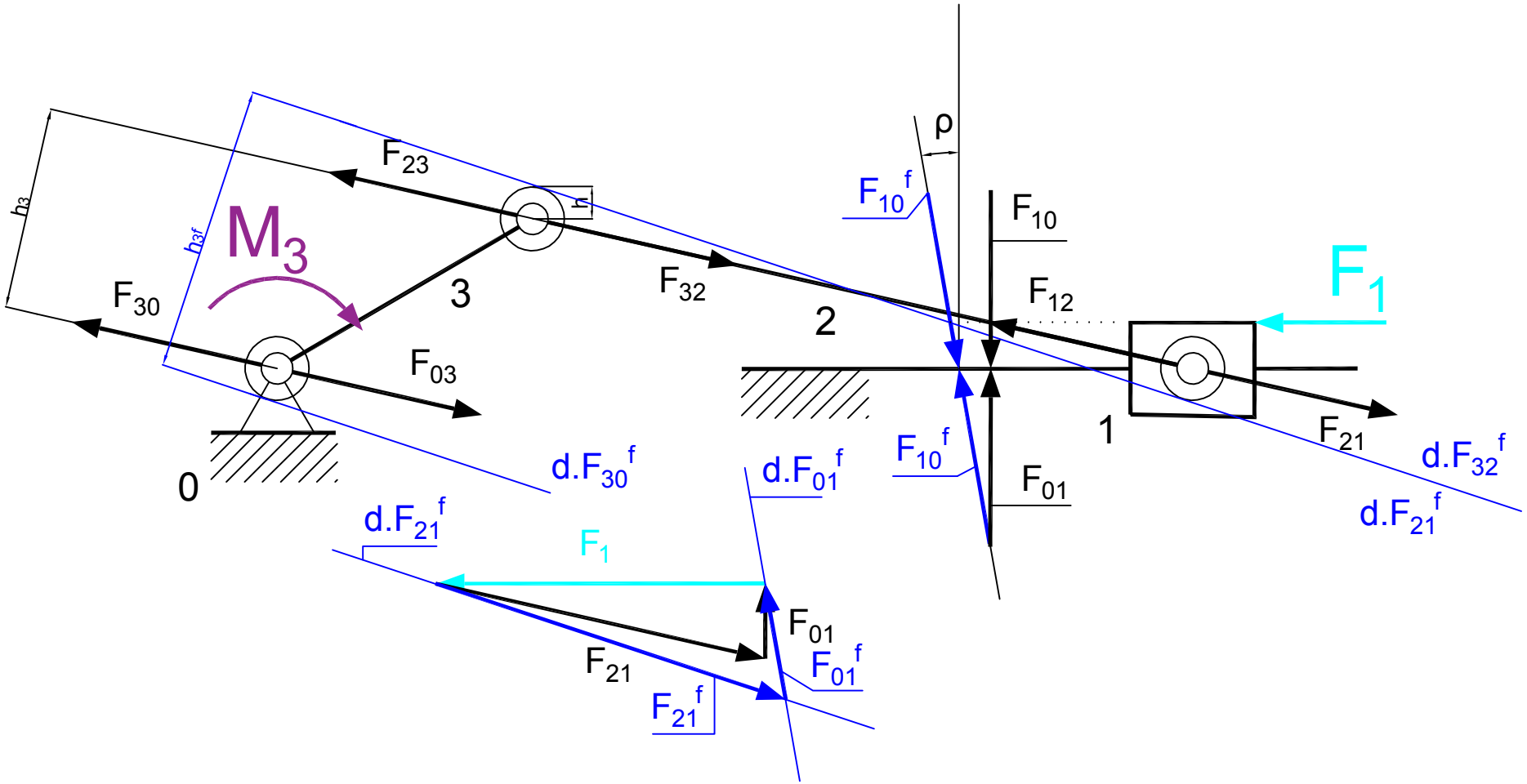

d.F32
d.F21
M3
3
d.F30
0
2
d.F10
F1
1

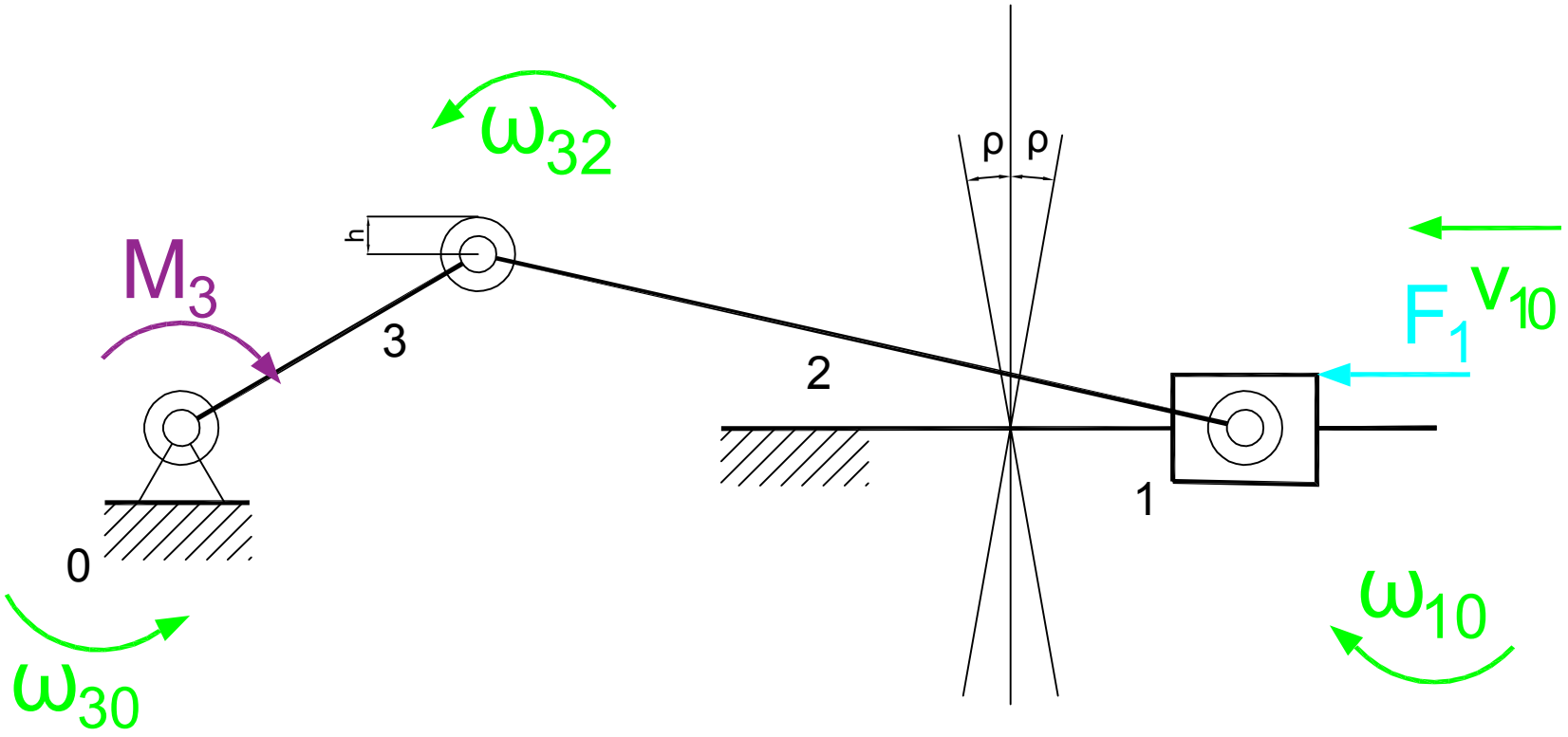

h_3
M_3
F_{23}
F_{30}
3
F_{32}
F_{10}
F_{12}
2
F_1
F_{03}
0
1
F_{21}
F_{01}
F_1
F_{01}
F_{21}

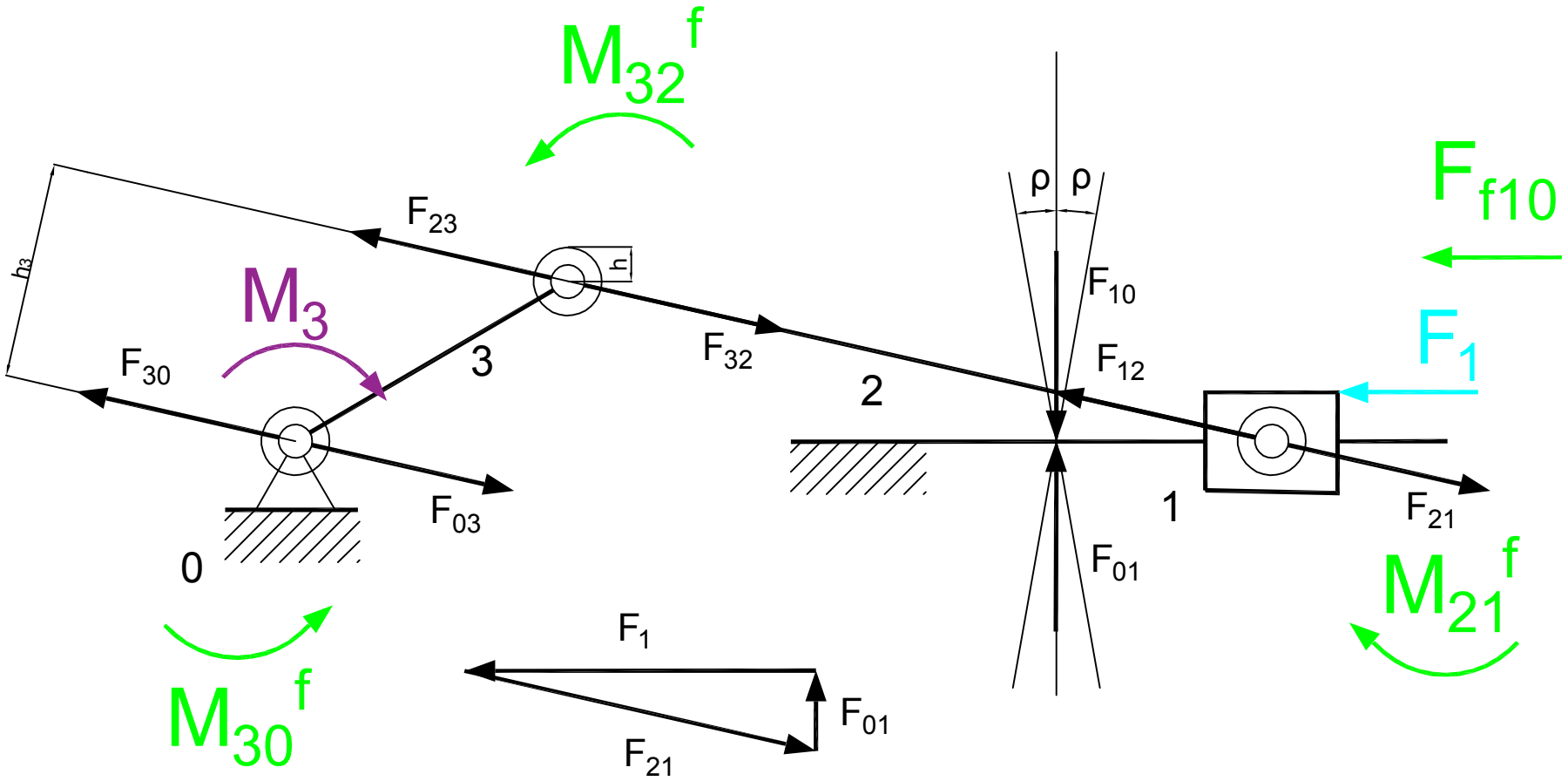

ω32
ρ ρ
M3
3
2
F1
v10
0
1
ω30
ω10



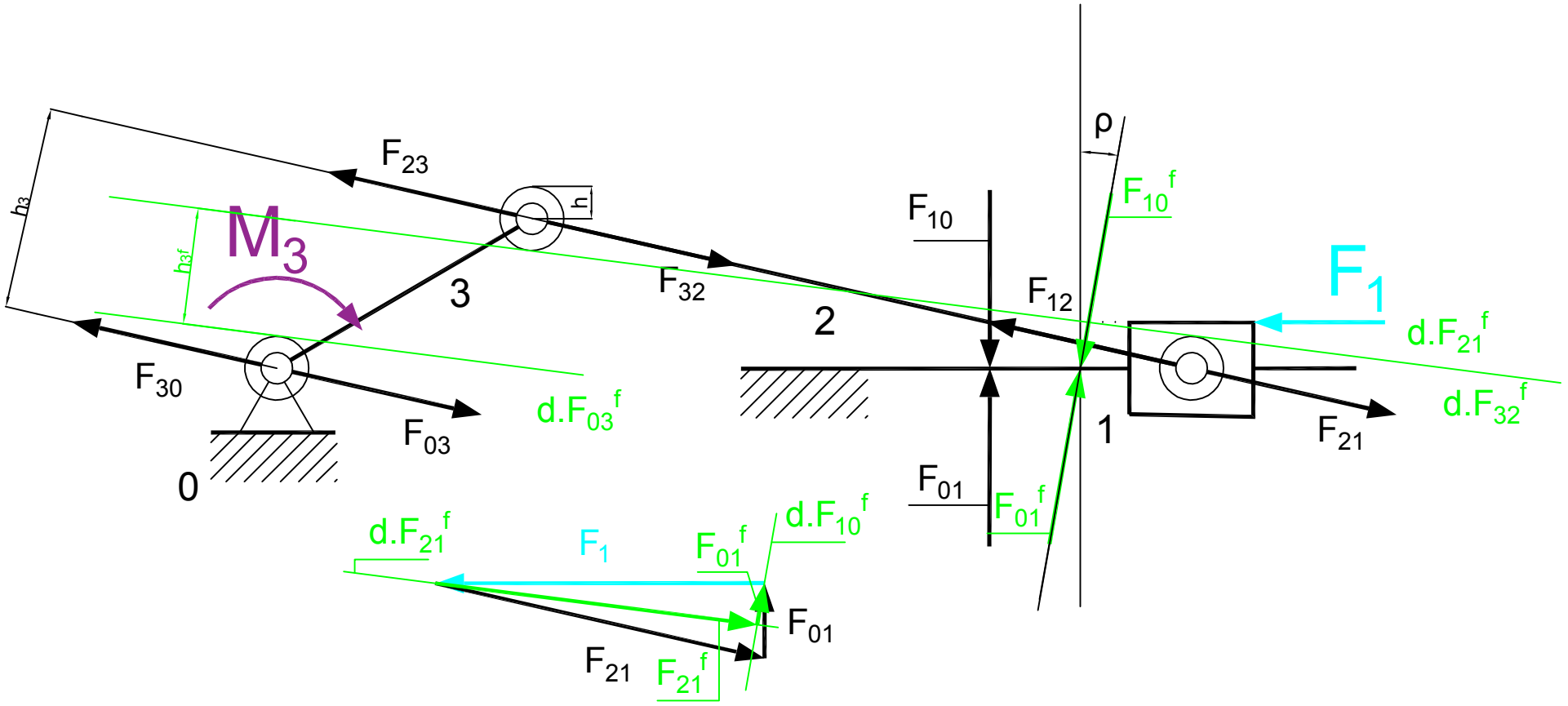
M32f
Ff10
F23
h3
h
M3
F30
3
F32
2
ρ
ρ
F10
F12
F1
F03
1
F21
0
F01
M21f
M30f


h_3
h_{3f}
M_3
F_{23}
F_{30}
F_{03}
F_{32}
3
2
1
0
h_f
ρ
F_{10}^f
F_{10}
F_{12}
F_1
F_{21}
F_{01}
F_{10}^f
$d.F_{30}^f$
$d.F_{01}^f$
$d.F_{32}^f$
$d.F_{21}^f$
F_1
F_{01}
F_{01}^f
F_{21}
F_{21}^f


ω32
M3
h
3
2
ρ
ρ
F1
v10
0
1
ω30
ω10



M32f
F23
h3
h
M3
F30
3
F32
2
ρ ρ
F10
F12
Ff10
F1
1
F21
F03
0
F01
M21f
M30f
F1
F01
F21



F23
h3
h3f
M3
h
3
F32
2
F10
F12
ρ
F10f
F1
d.F21f
d.F32f
F30
F03
d.F03f
0
1
F21
F01
F01f
d.F21f
F1
F01f
d.F10f
F01
F21
F21f