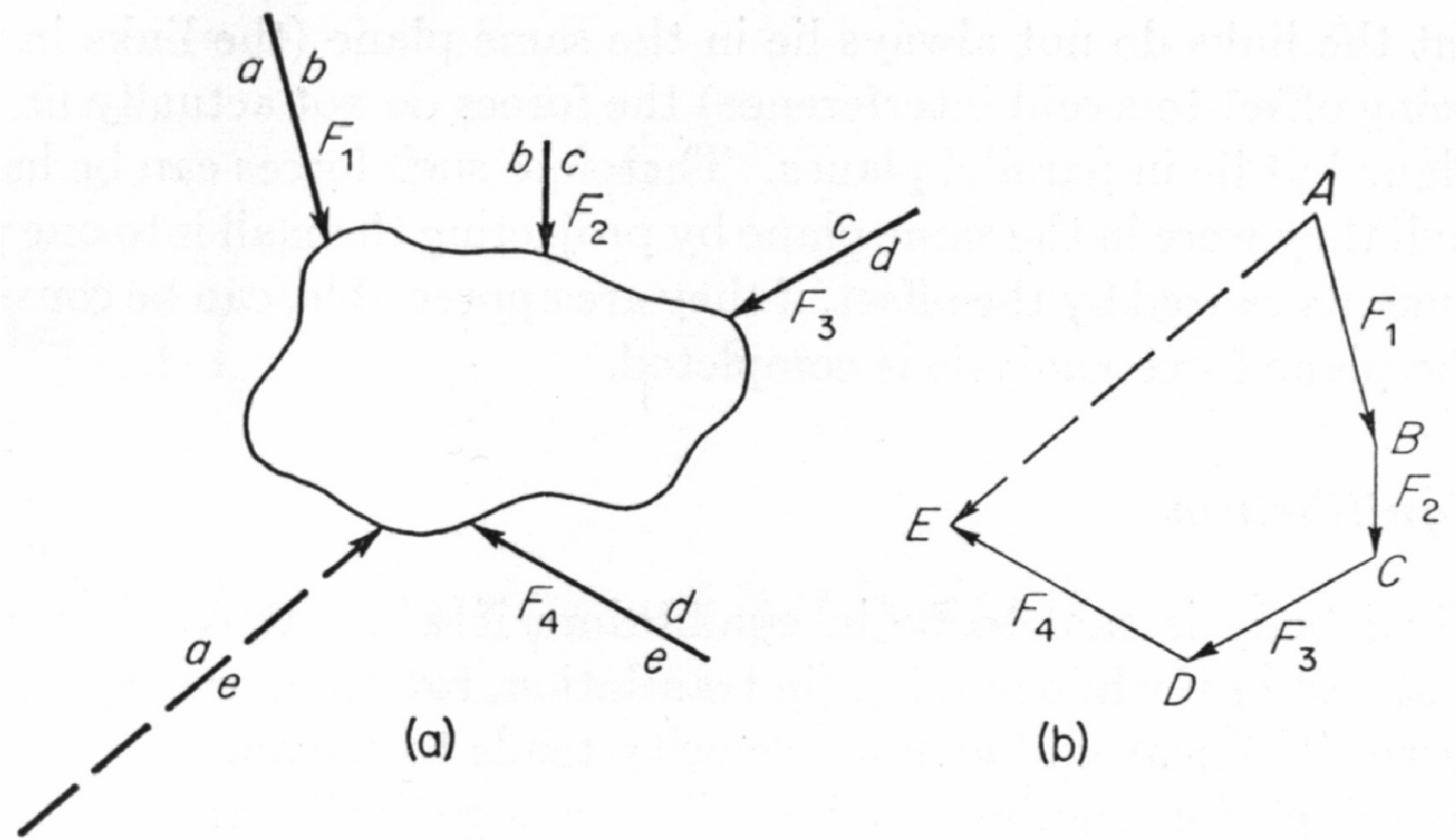
Mekanizmalarda Kuvvet Analizi

Kuvvet Analizi

- Statik denge gereği mekanizmanın herhangi bir konumunda herhangi bir yönde $\Sigma F = 0$ ve herhangi bir nokta için $\Sigma M = 0$ olmalıdır.
- Mekanizmanın herhangi bir konumunda uzuvlarına etki eden dış kuvvetlerin yönleri ve büyüklükleri bilinmelidir. Bu dış kuvvetler hızdan bağımsız olmalıdır.

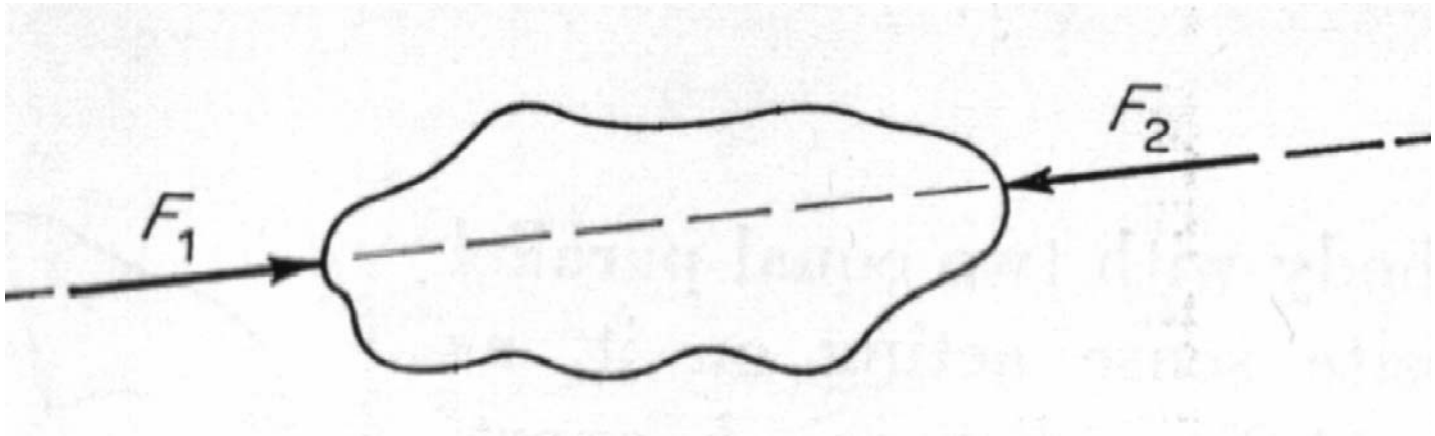
Kuvvet Analizi



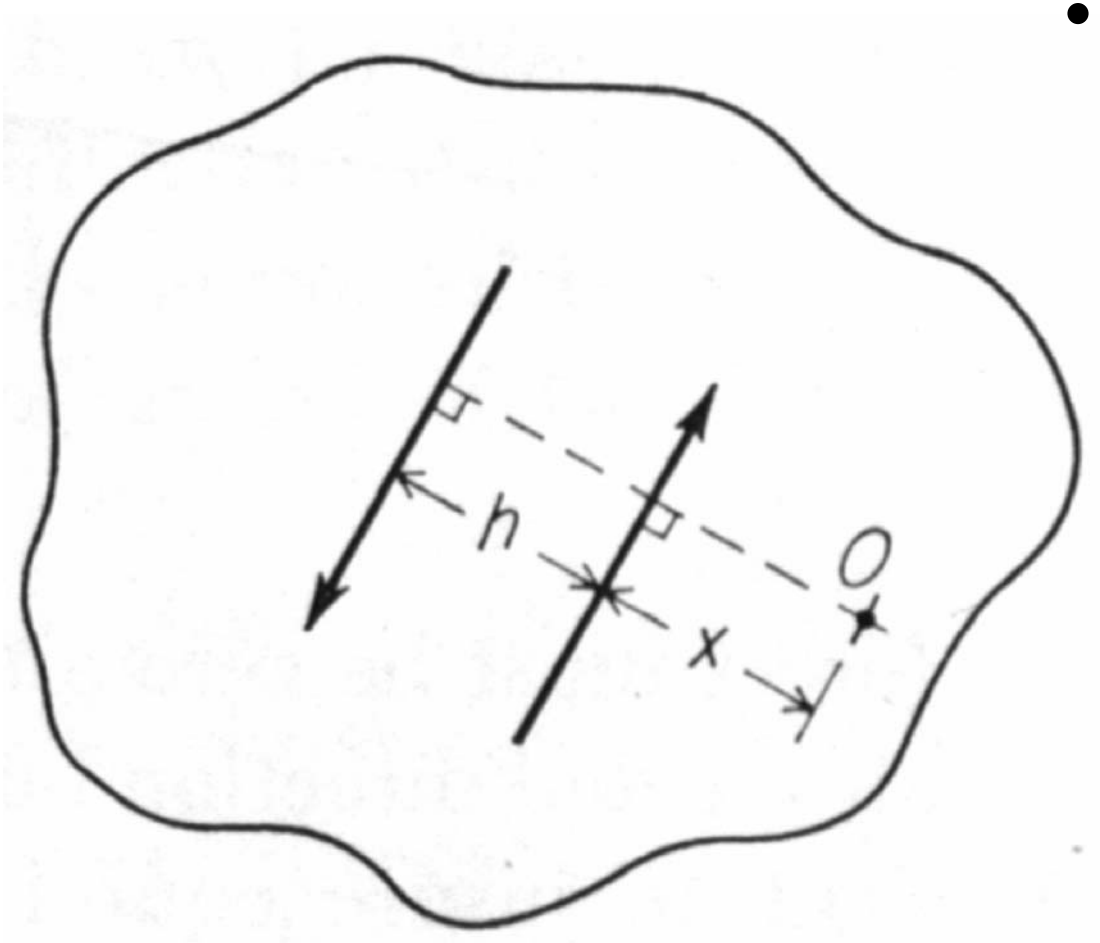
İki Kuvvet Etkisindeki Uzuv

Kuvvetlerin,

- Büyüklükleri eşit
- Yönleri ters
- Doğrultuları çakışık olmalıdır.
- Doğrultular çakışık olmazsa ne olur?

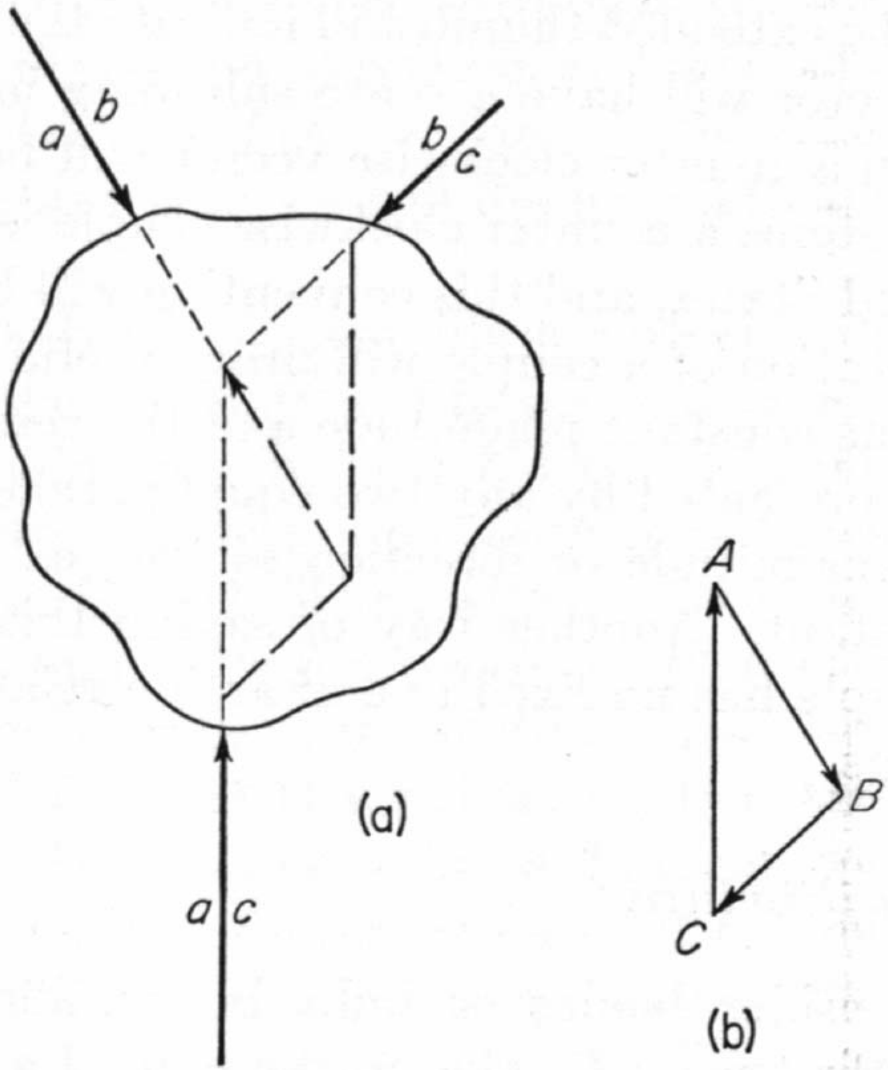


İki Kuvvet Etkisindeki Uzuv



- İki kuvvetin doğrultuları çakışık değilse ortaya bir tork çıkar.

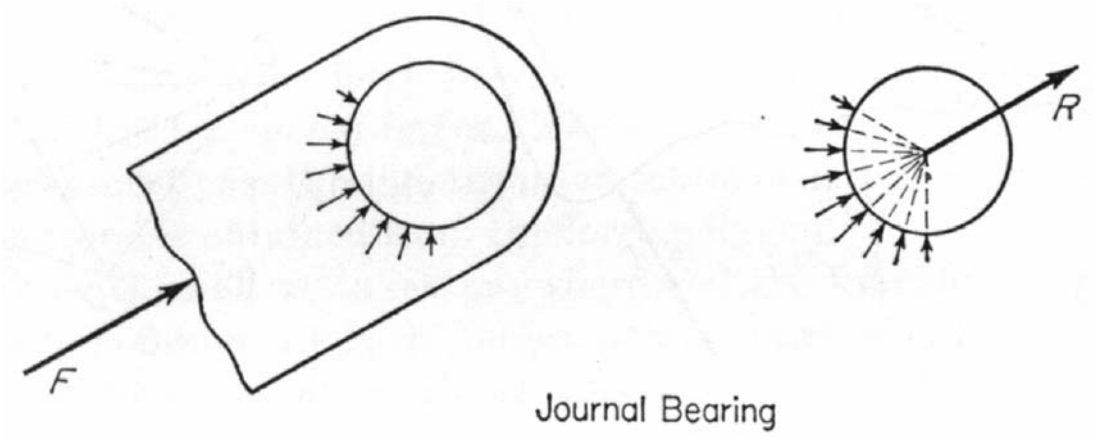
Üç Kuvvet Etkisindeki Uzuv



- Kuvvetler paralel olabilir,
- Kuvvetlerin doğrultuları farklı ise şekildeki gibi doğrultuları herhangi bir noktada kesişmelidir.
- İkisinin doğrultusu bilinirse üçüncü bulunur.

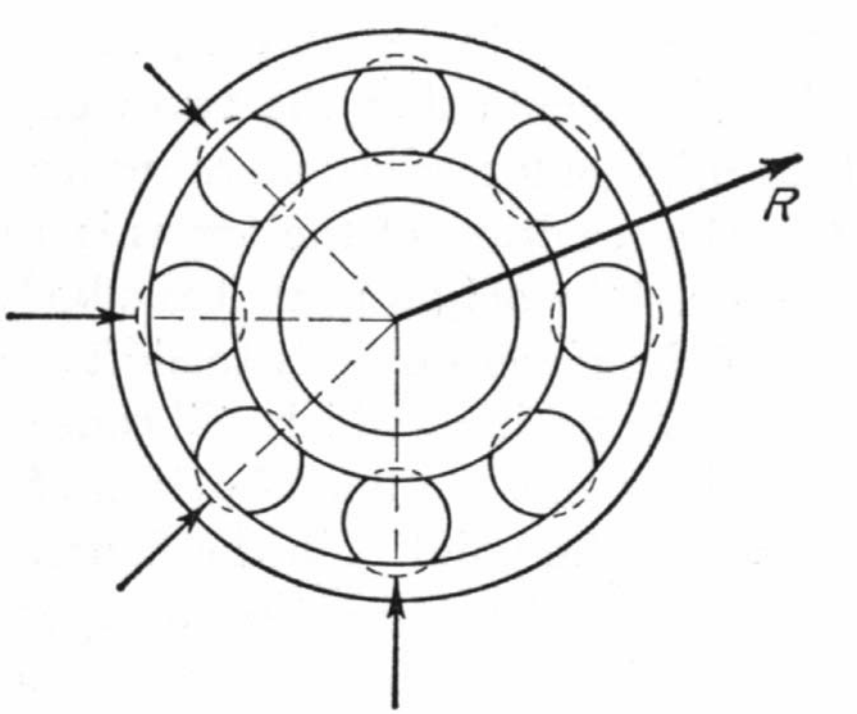
Kuvvet Analizi

Adi eleman çiftlerinde sürtünme kuvvetleri ihmal edilirse bağlantı noktası etrafındaki kuvvetlerin bileşkesi bağlantısının orta noktasında bulunur ve dişer uzuva hareket buradan iletilir.



Journal Bearing

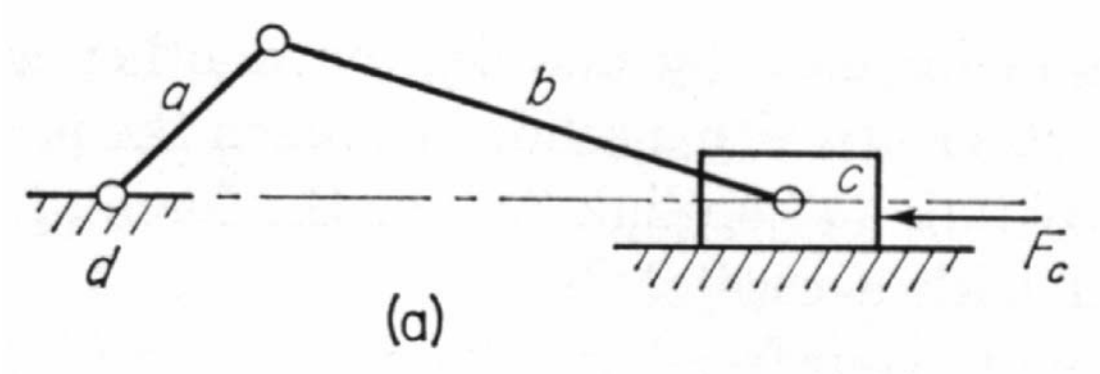
Kuvvet Analizi



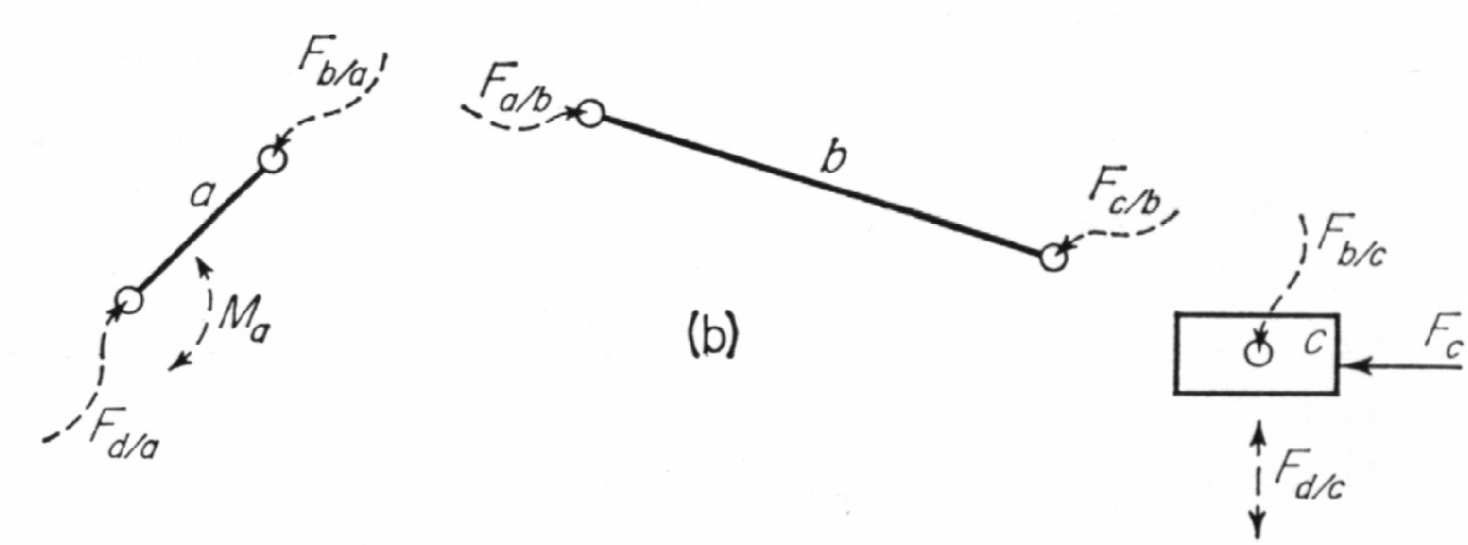
Ball or Roller Bearing

Şekildeki gibi bilyalı bir yatakta da (yüksek eleman çifti) benzer durum vardır.

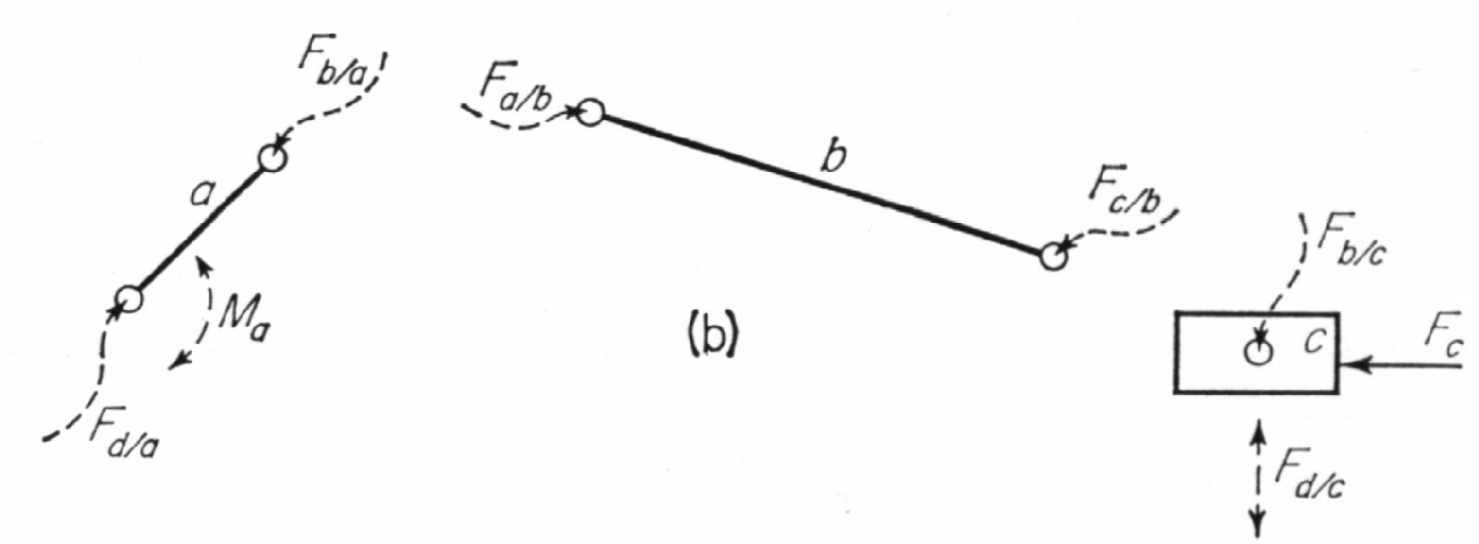
Kuvvet Analizi



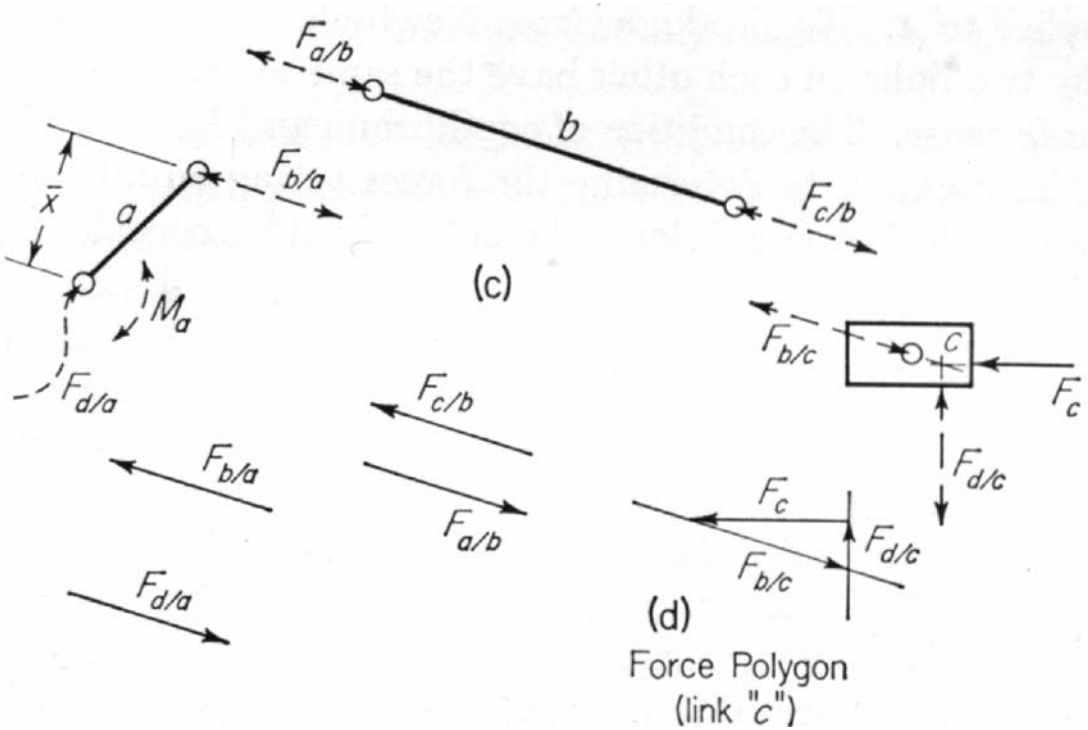
Kuvvet Analizi



Kuvvet Analizi



Kuvvet Analizi

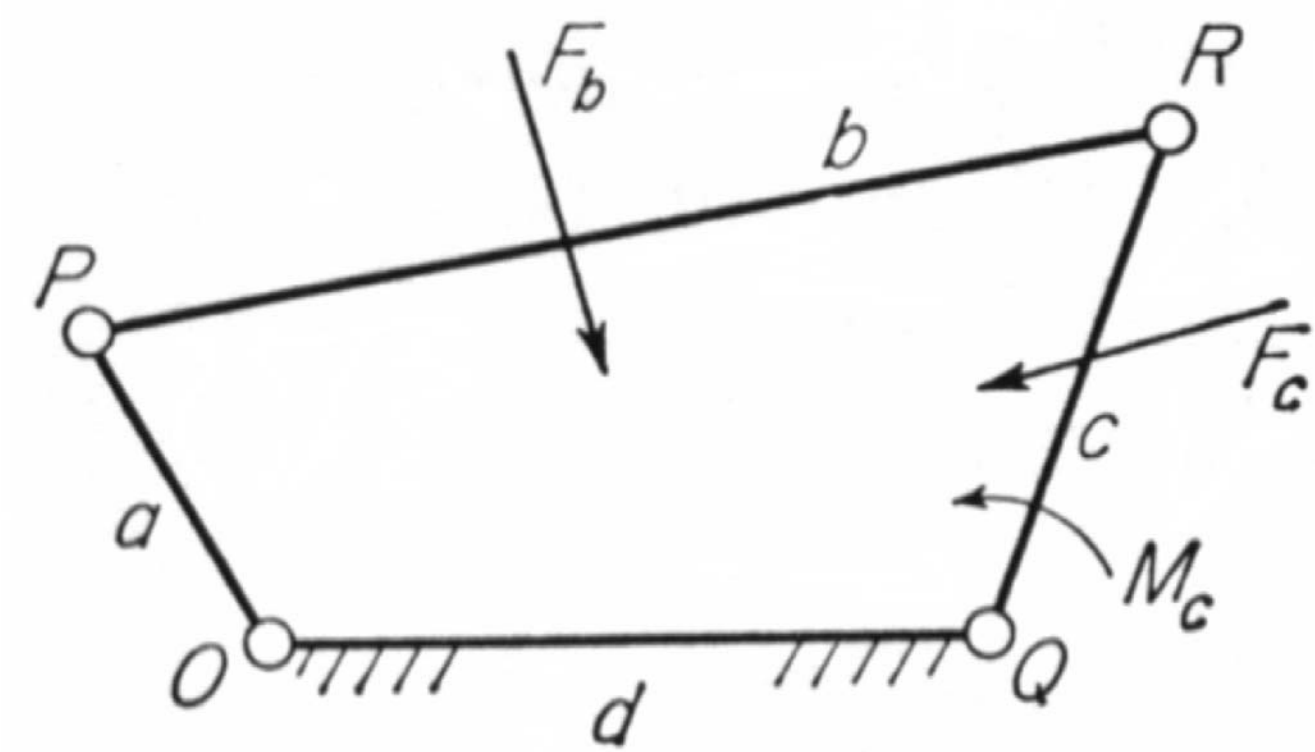


$\Sigma F = 0$ grafik olarak çözüldü. İki kuvvetin kesişim noktasında $F_{b/c}$ ve $F_{d/c}$ nin büyüklükleri belirlenir. $F_{b/c} = -F_{c/b}$ ve $F_{a/b} = -F_{c/b}$, olduğu için sistemi dengede tutabilmek için M_a momenti gereklidir.

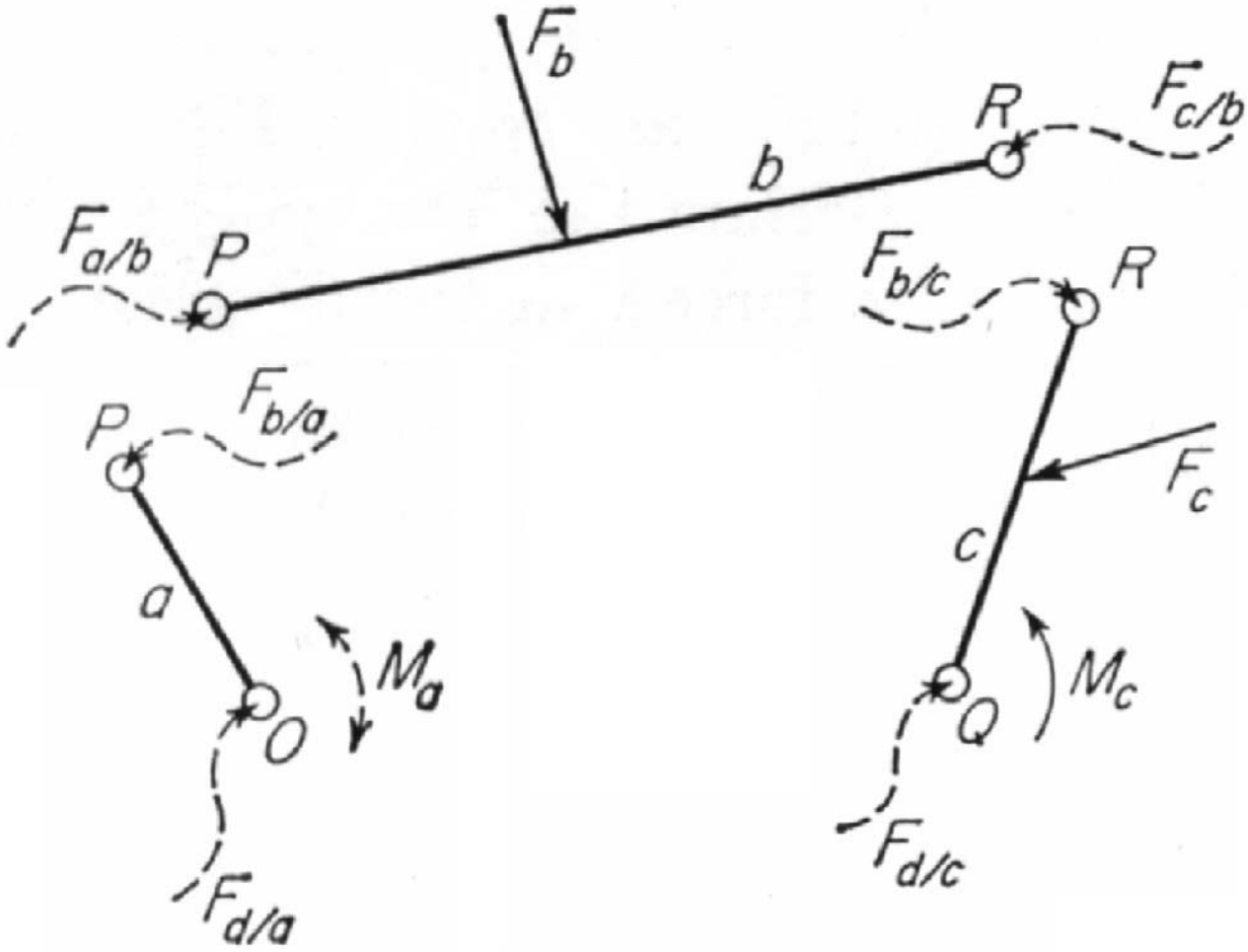
$$M_a = F_{b/a}\bar{x}$$

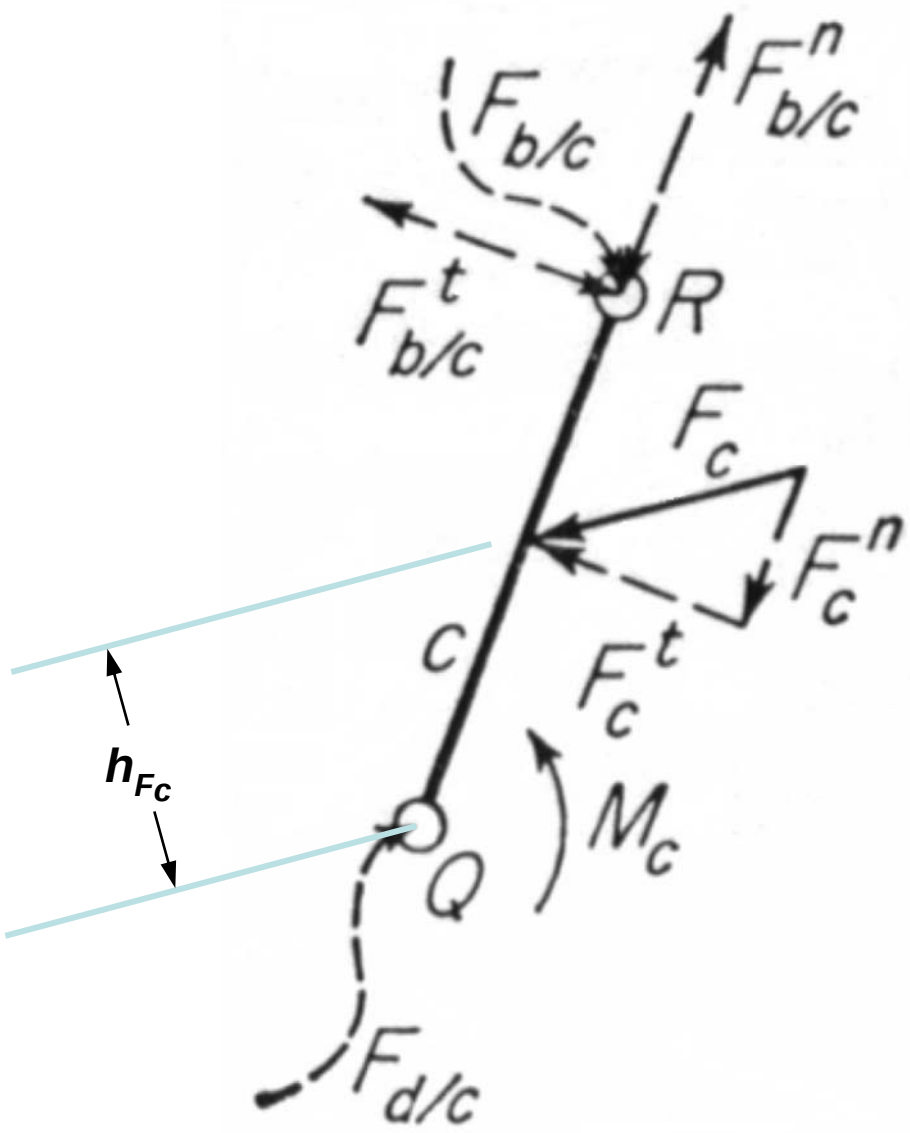
Örnekler

Kuvvet Analizi



QR = 140 mm.; QF_c = 75 mm.; PR = 285 mm.
PF_b = 126 mm.; OP = 94 mm.; F_b = 90 N
F_c = 85 N; M_c = 1000 Nm

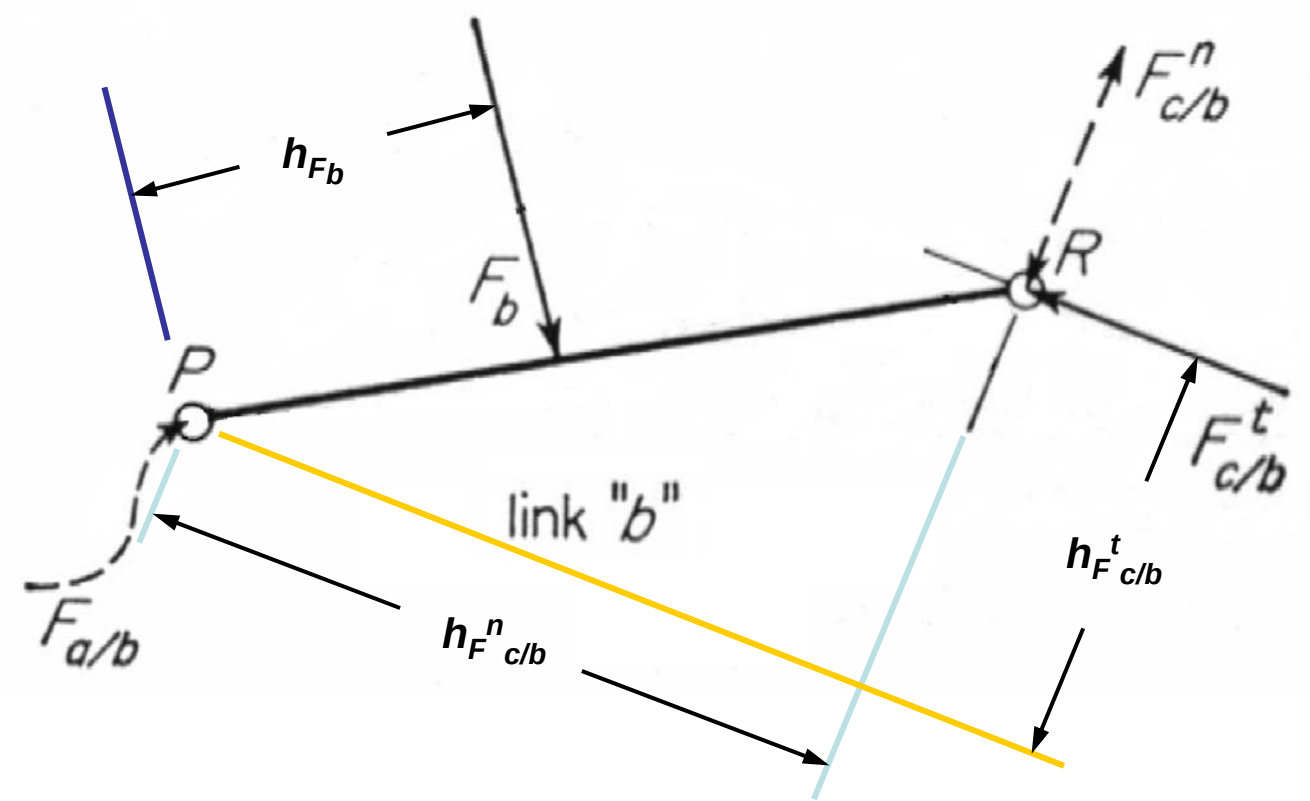

F_b
R
$F_{c/b}$
b
$F_{a/b}$
P
$F_{b/c}$
R
P
$F_{b/a}$
F_c
a
c
M_a
M_c
O
Q
$F_{d/a}$
$F_{d/c}$



$$F^t_{b/c} = \frac{F_c * h_{F_c} + M_c}{QR}$$

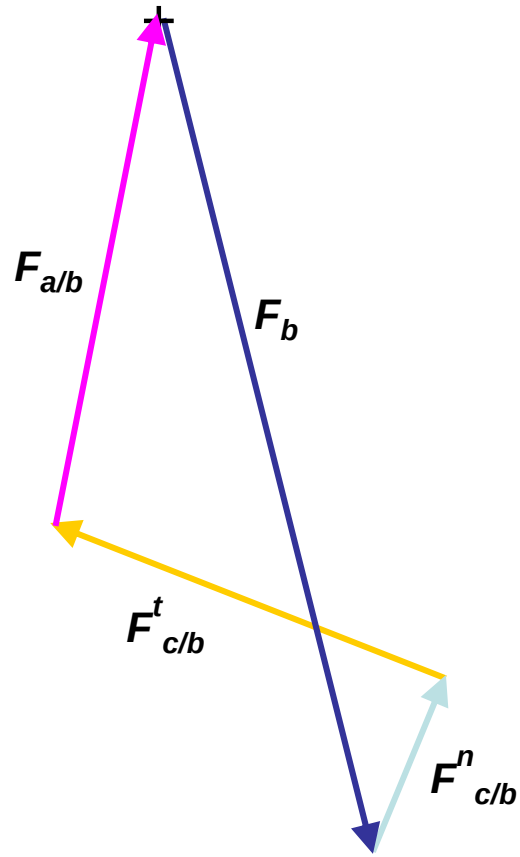
$$F^t_{b/c} = \frac{85 * 61.875 + 1000}{140}$$

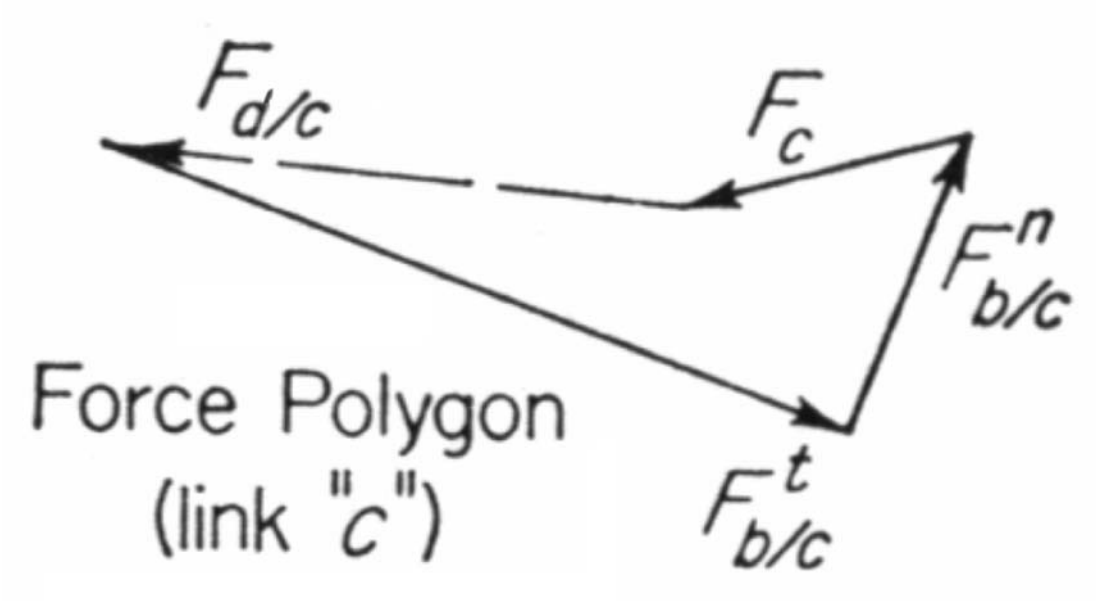
$$F^t_{b/c} = 44.7\,N$$



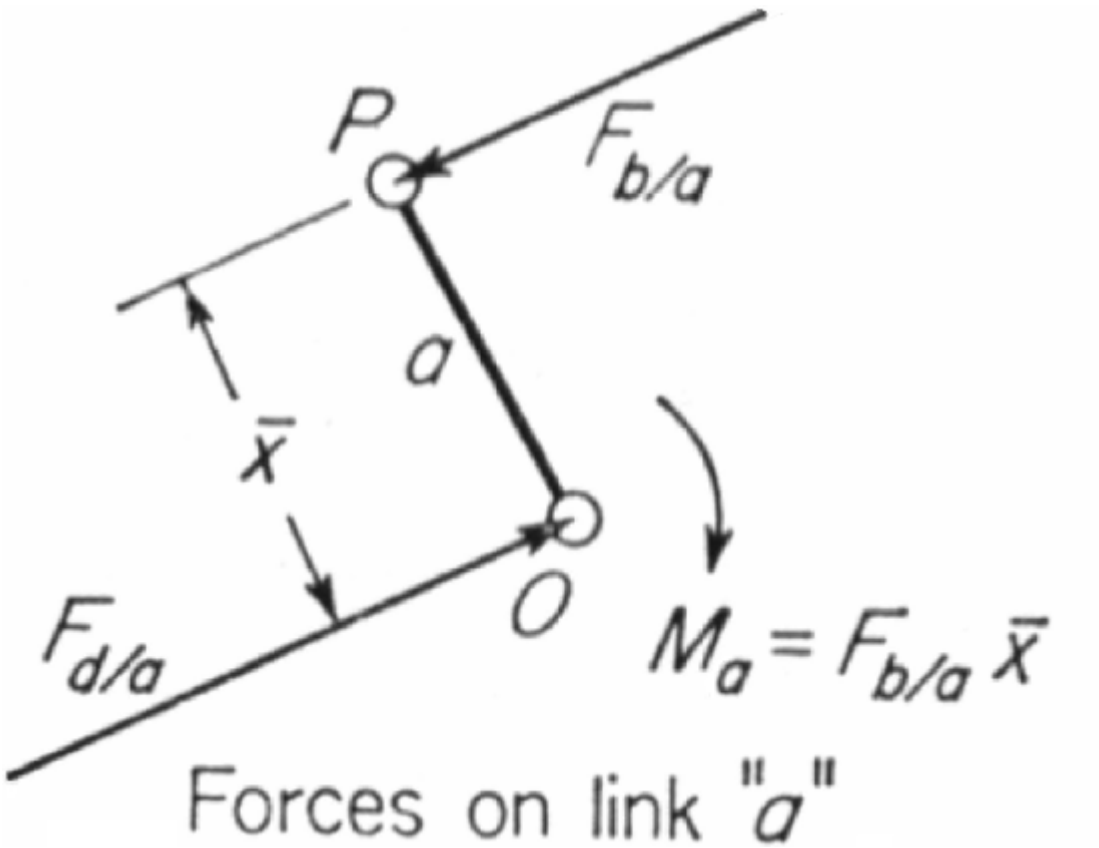
$$F^n_{c/b} = \frac{F_b * h_{F_b} - F^t_{c/b} * h_{F^t_{c/b}}}{h_{F^n_{c/b}}} = \frac{90 * 125.7 - 44.7 * 145.1}{244.8} = 19.7\,N$$

$F_{a/b}$ yi bulmak için kuvvet poligonu kullan.

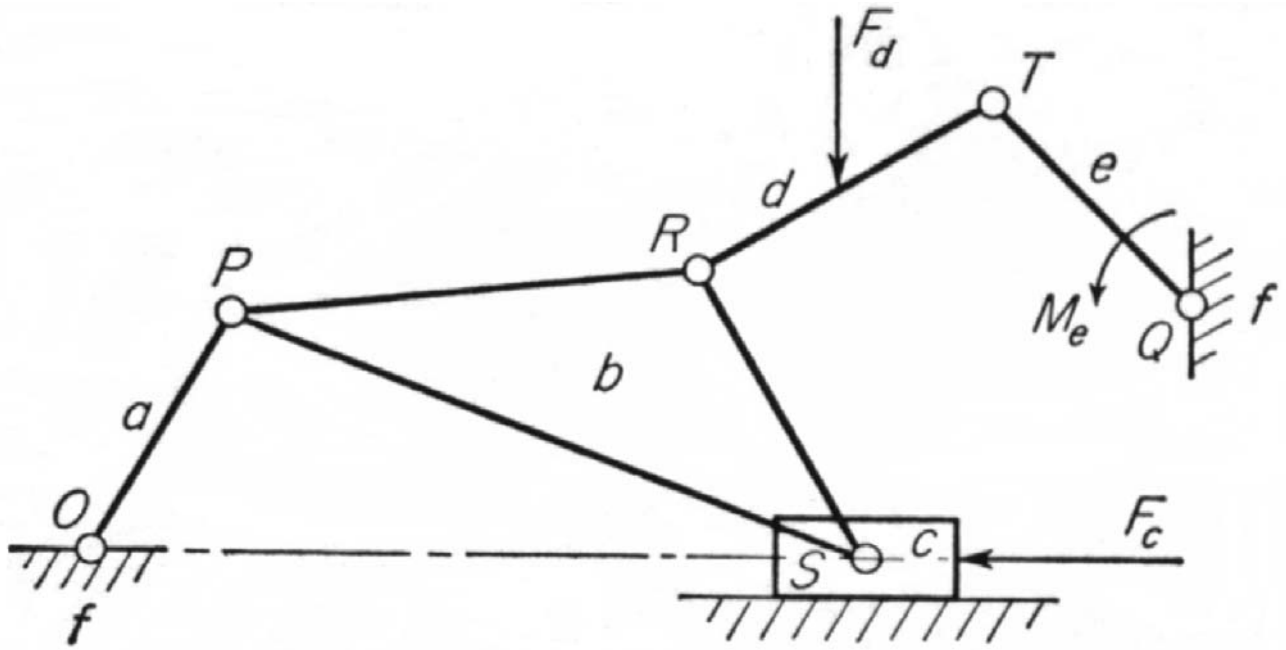

$F_{a/b}$
F_b
$F^t_{c/b}$
$F^n_{c/b}$



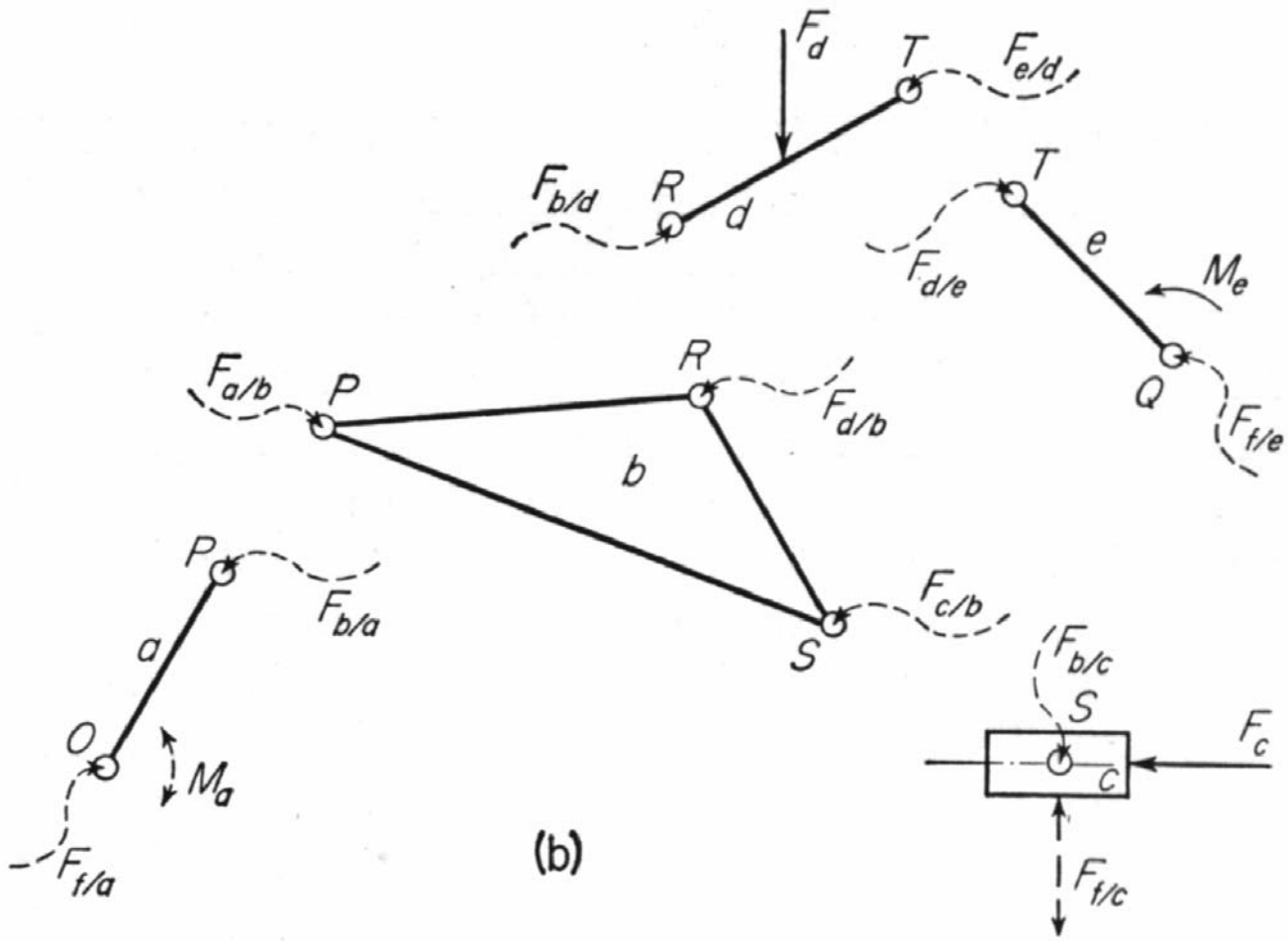
For illustration purposes only – NOT to scale

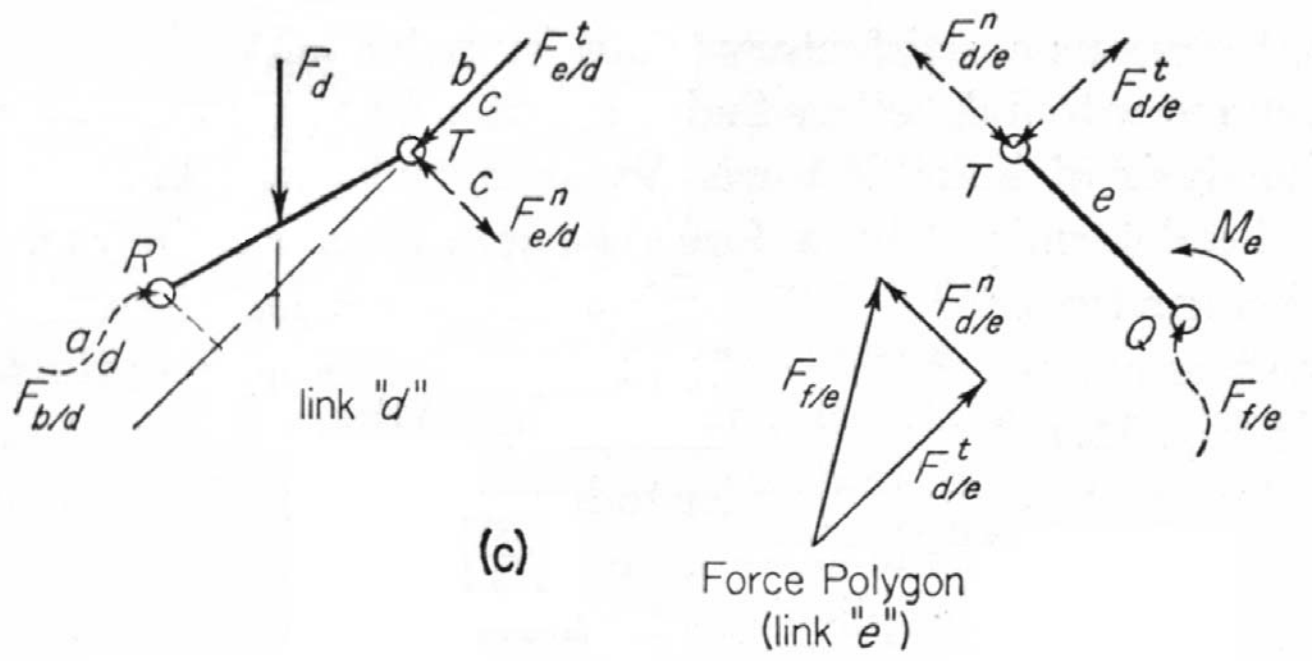


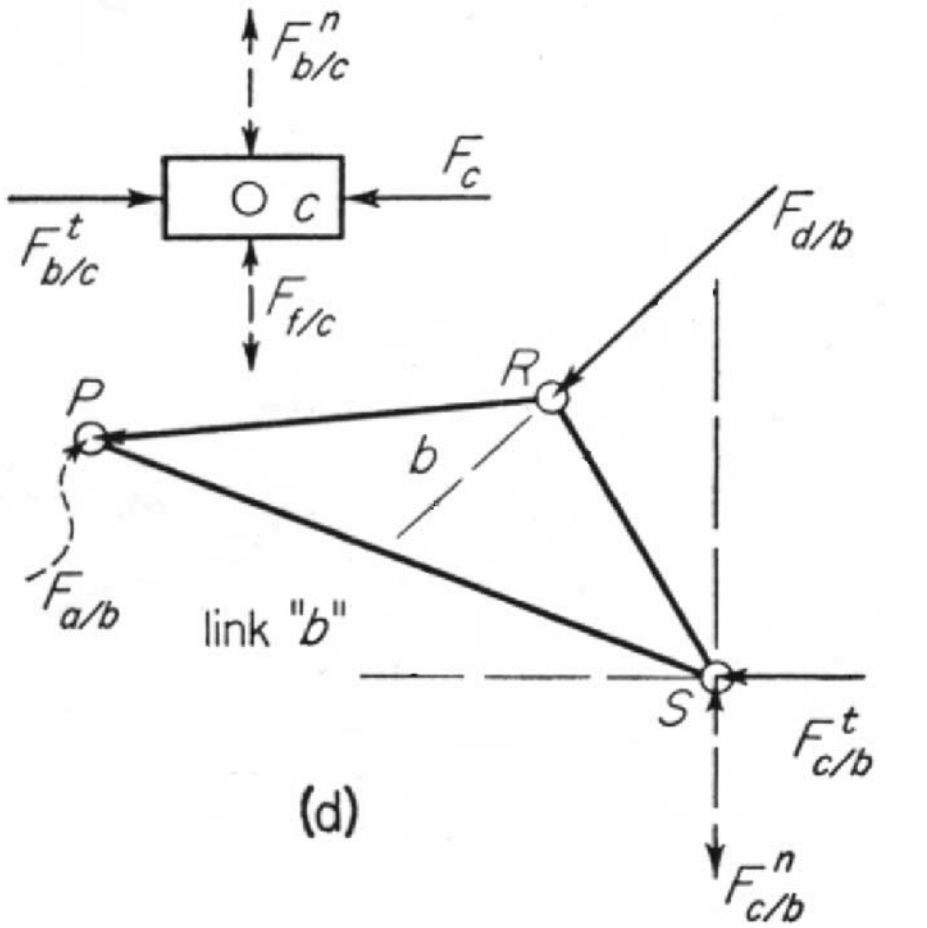
Forces on link "a"



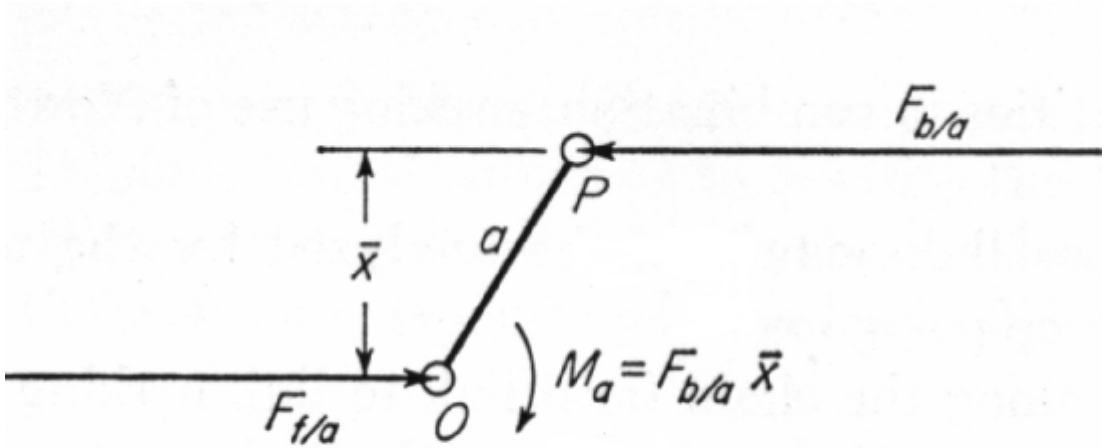
(a)


F_d
T
$F_{e/d}$
$F_{b/d}$
R
d
T
e
$F_{d/e}$
M_e
Q
$F_{f/e}$
$F_{a/b}$
P
R
$F_{d/b}$
b
P
$F_{b/a}$
a
O
M_a
$F_{f/a}$
$F_{c/b}$
S
$F_{b/c}$
S
F_c
C
$F_{f/c}$
(b)


F_d
b
c
$F^t_{e/d}$
T
c
$F^n_{e/d}$
R
a
d
$F_{b/d}$
link "d"
(c)
$F^n_{d/e}$
$F^t_{d/e}$
T
e
M_e
Q
$F^n_{d/e}$
$F_{f/e}$
$F^t_{d/e}$
$F_{f/e}$
Force Polygon
(link "e")



(d)



(e)