



# 1. Gaia III

## Analisi eta sintesi estrukturala II

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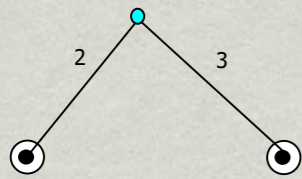
Analisi eta sintesi estrukturala II

# Aurkibidea

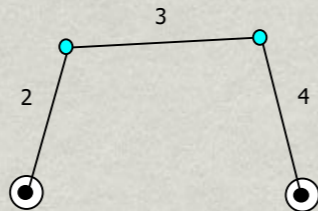
1. Grüber eta Malishev-en irizpideak.
2. Grüber eta Malishev-en irizpideen mugak.
3. Mekanismoen lorpenerako metodoak.

# Grübler-en irizpidea

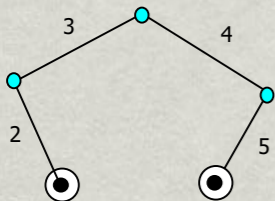
## Mekanismo planoak



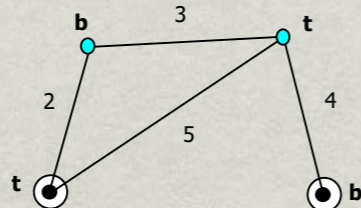
$$G = 3(3 - 1) - 2 \cdot 3 = 0$$



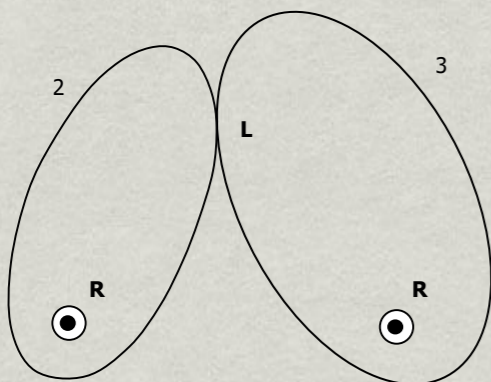
$$G = 3(4 - 1) - 2 \cdot 4 = 1$$



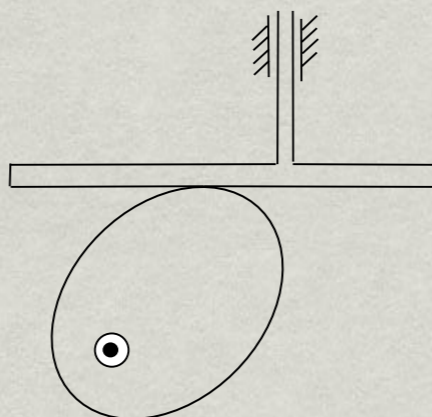
$$G = 3(5 - 1) - 2 \cdot 5 = 2$$



$$G = 3(5 - 1) - 2 \cdot 6 = 0$$



$$G = 3(3 - 1) - 2 \cdot 2 - 1 = 1$$



$$G = 3(3 - 1) - 2 \cdot 2 - 1 = 1$$

Askatasun gradu kopurua:

$$G = 3(N - 1) - 2 \cdot P_I - P_{II}$$

$N$  = elementuen kopurua

$P_I$  = 1go klaseko loturen kopurua

$P_{II}$  = 2. klaseko loturen kopurua

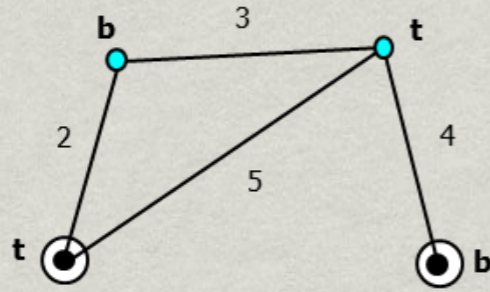
$G < 0$ , egitura hiperestatikoa.

$G = 0$ , egitura isostatikoa.

$G = 1$ , mekanismo desmodrom.

$G = 2$ , mekanismo diferentziala.

$G = n > 2$ ,  $n$  a.g.-tako mekanismoa.



$$G = 3(5 - 1) - 2 \cdot 6 = 0$$

Baliokidetasuna:  
Lotura hirutarra = 2 lotura bitarrak

Beste era: elementu hirutar bat izango balitz bezala

# Malishev-en irizpidea

Kasu espazial batera orokortu dezakegu Grübler-en formula

Kendu behar da lotura bakoitzak murrizten duen a.g. kopurua

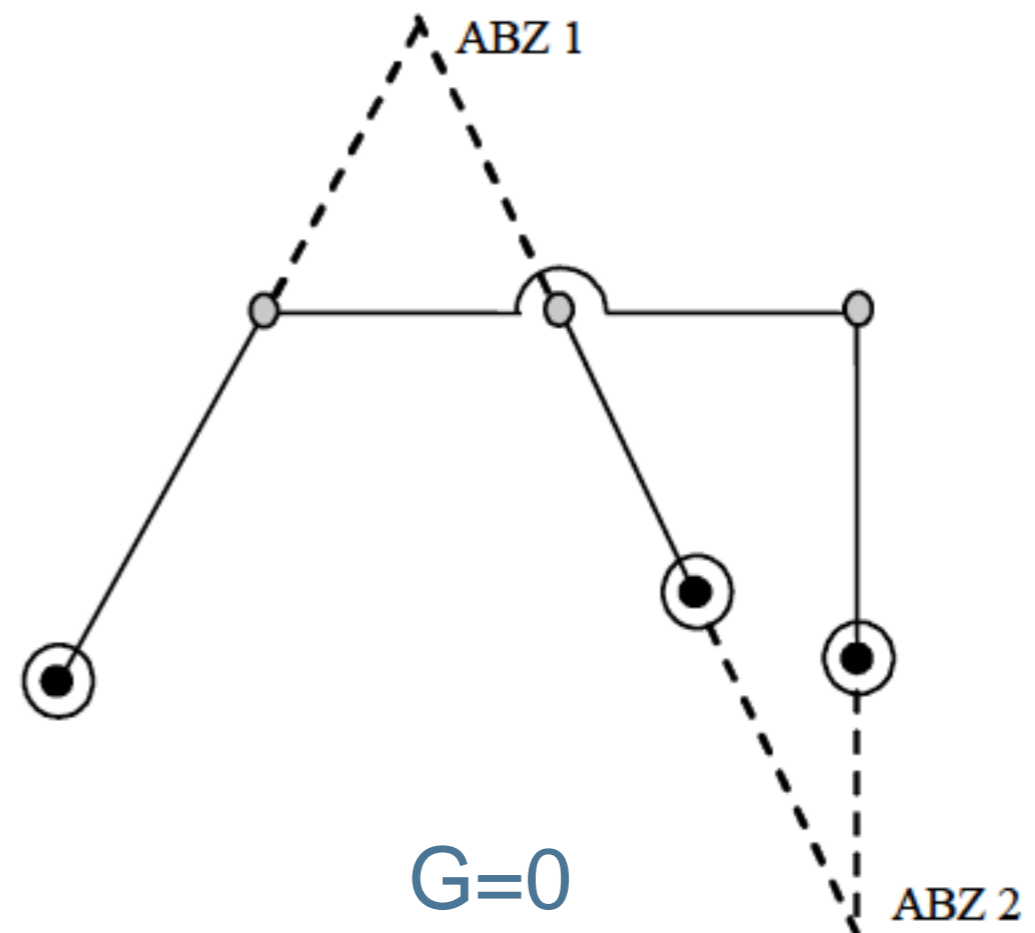
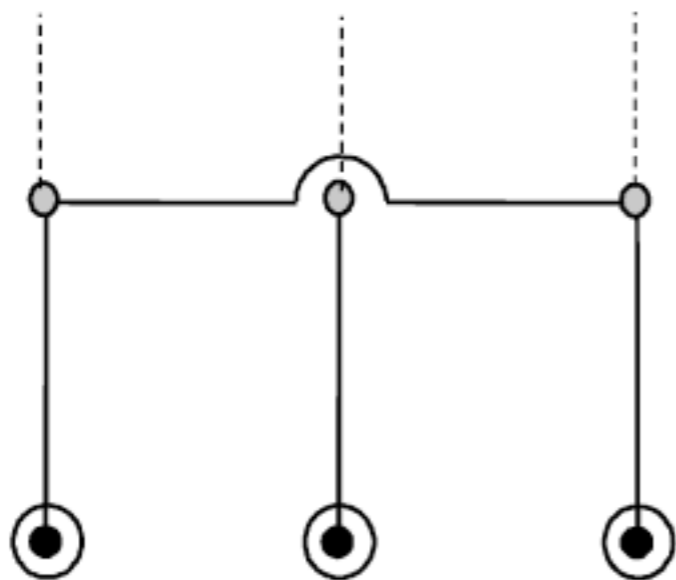
$$G = 6(N - 1) - 5 \cdot P_I - 4 \cdot P_{II} \\ - 3 \cdot P_{III} - 2 \cdot P_{IV} - P_V$$

# Grübler-en irizpidearen mugak

\* Behar ez diren murrizpenak

a.g. kopurua aldatzen da: geometria bereziagatik edo loturen kokapen partikularragatik

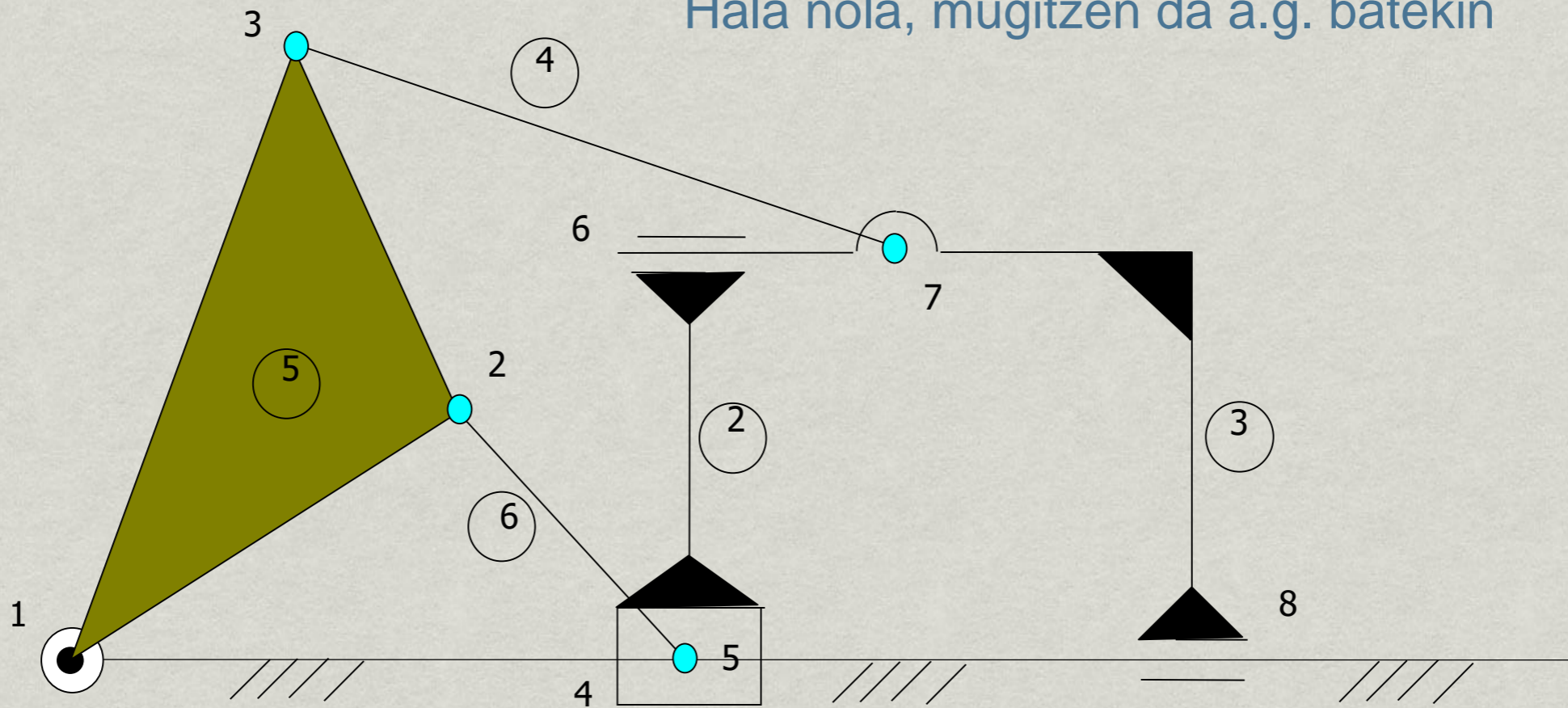
Grübler aplikatuz:  $G=0$   
Hala nola,  $G=1$   
 $ABZ \infty$



# \* Behar ez diren murrizpenak

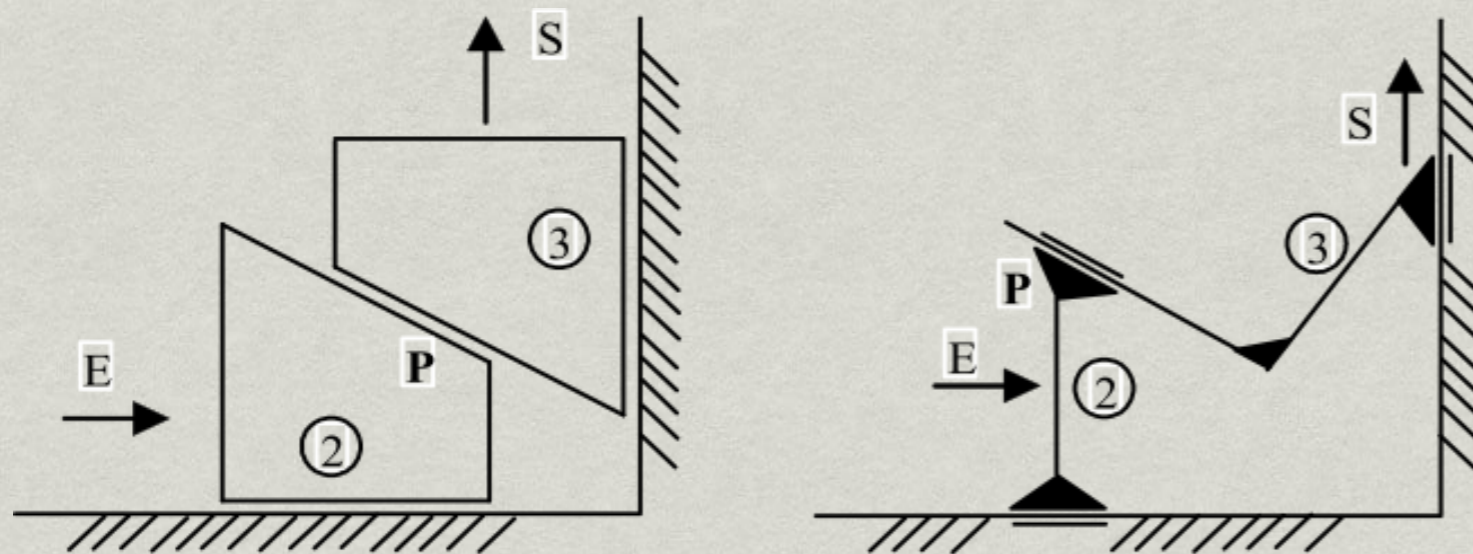
Grübler aplikatuz:  $G = -1$

Hala nola, mugitzen da a.g. batekin



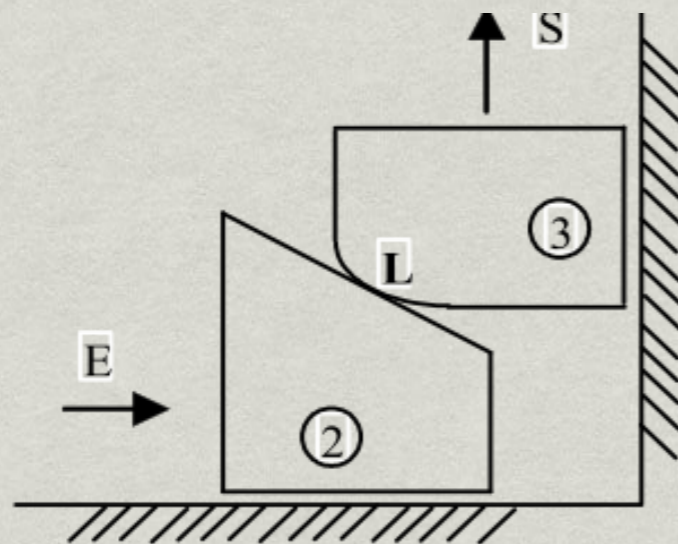


## \* Behar ez diren murrizpenak



$$G=3*(3-1)-2*3=0$$

Baina mugitzen da  
1 a.g.-arekin



3. elementuaren biraketa murriztuta dago bi lotura prismatikoen bidez. Baina, bakar batekin ziurtatzen da biraketa ez dagoela baimenduta.

Beraz, espeka lotura bat erablitzearekin nahikoa da:

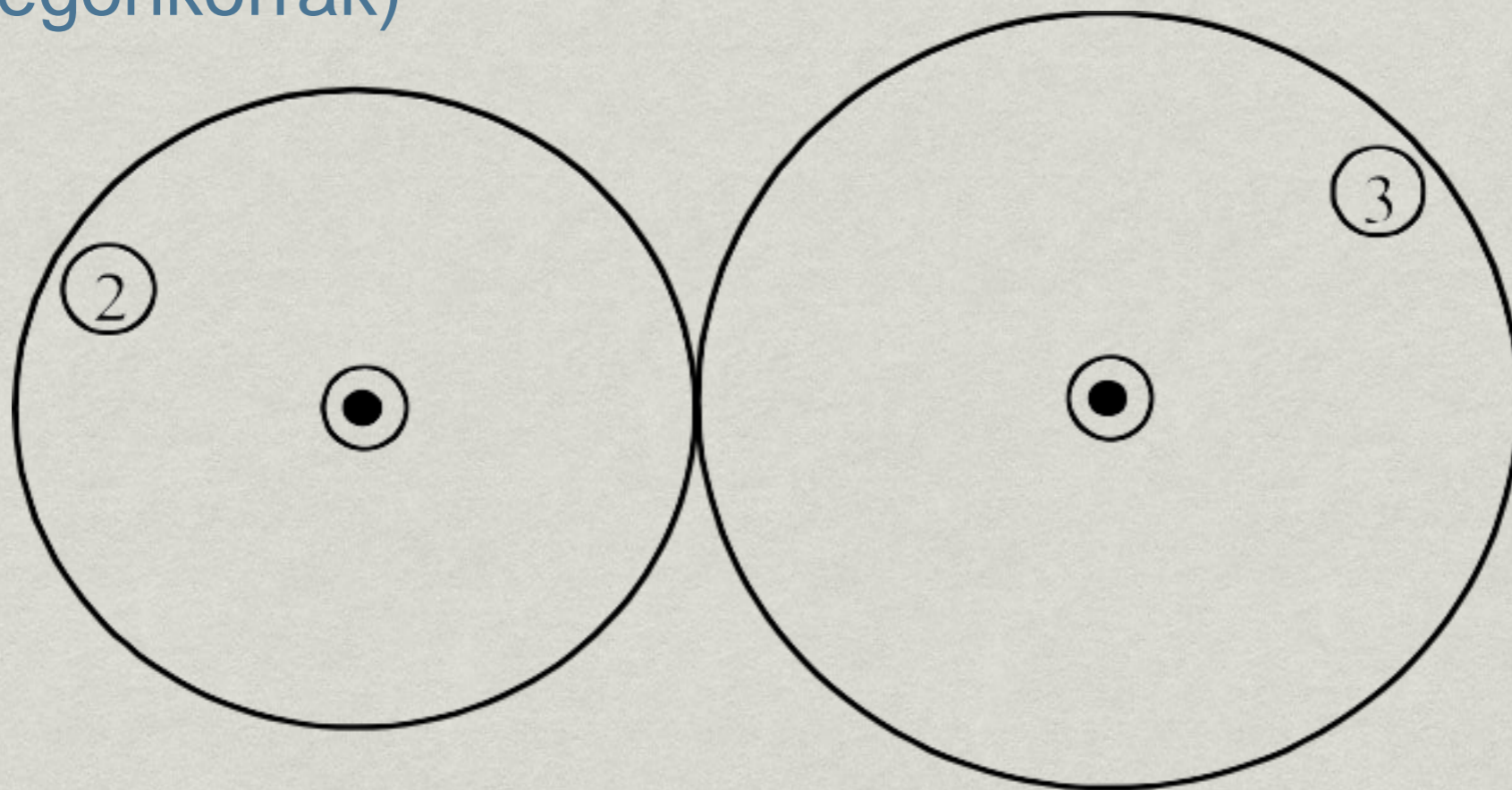
$$G=3*(3-1)-2*2-1=1$$

Kasu hau beti gertatzen da mekanismo mota hauetan: kate itxia, elementu bitarrekin osatuta eta bakarrik lotura prismatikoekin lotuta

\* Behar ez diren murrizpenak

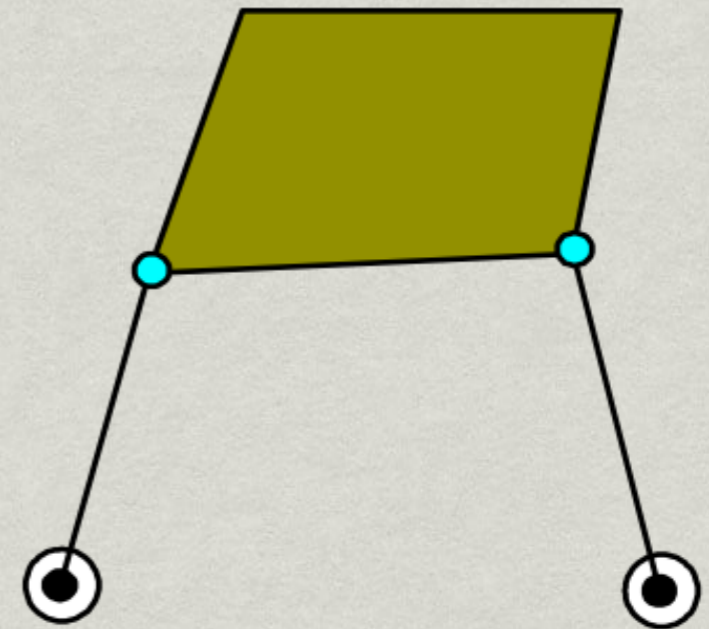
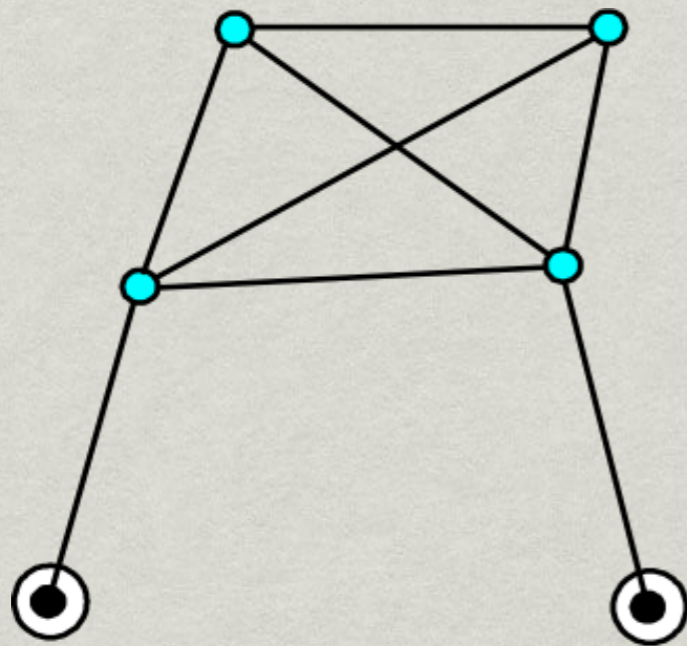
**Errodadurazko mugimendua:**

gurpil hauen geometria bereziagatik mugitzen da mekanismo hau  
(erradio egonkorak)

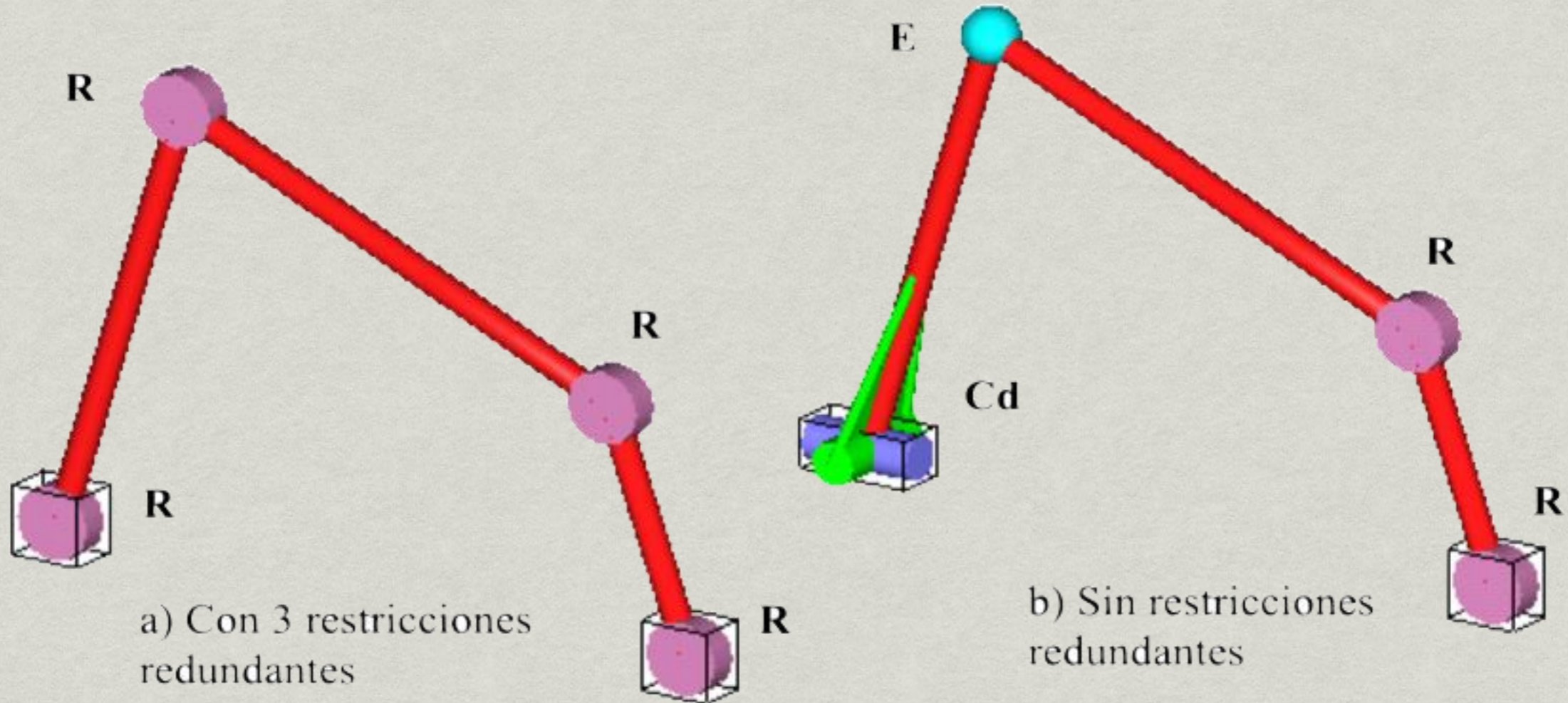


\* Behar ez diren murrizpenak

Mekanismoen azpiegiturak



✱ Behar ez diren murrizpenak

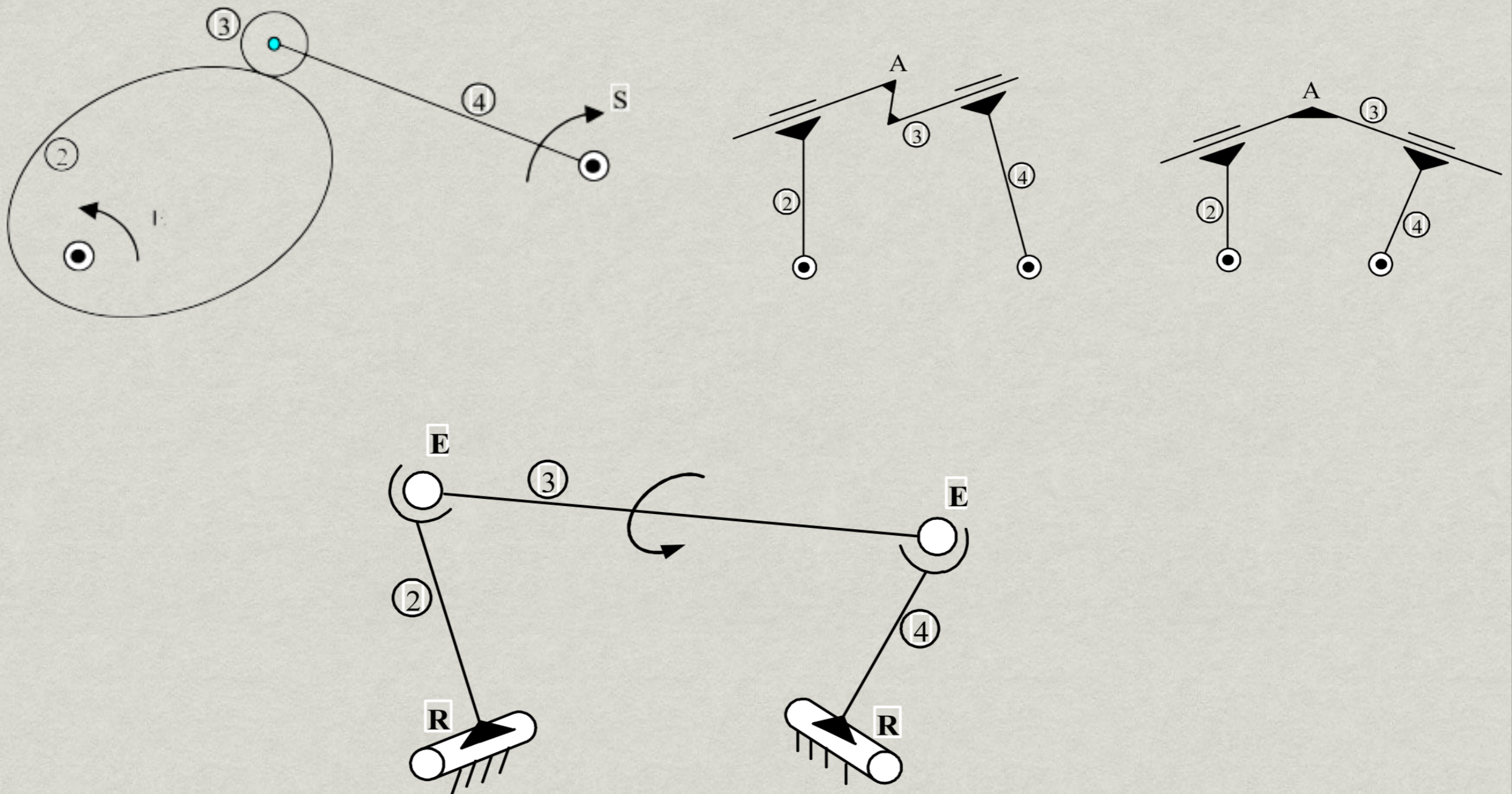


$$G=6*(4-1)-5*4=-2$$

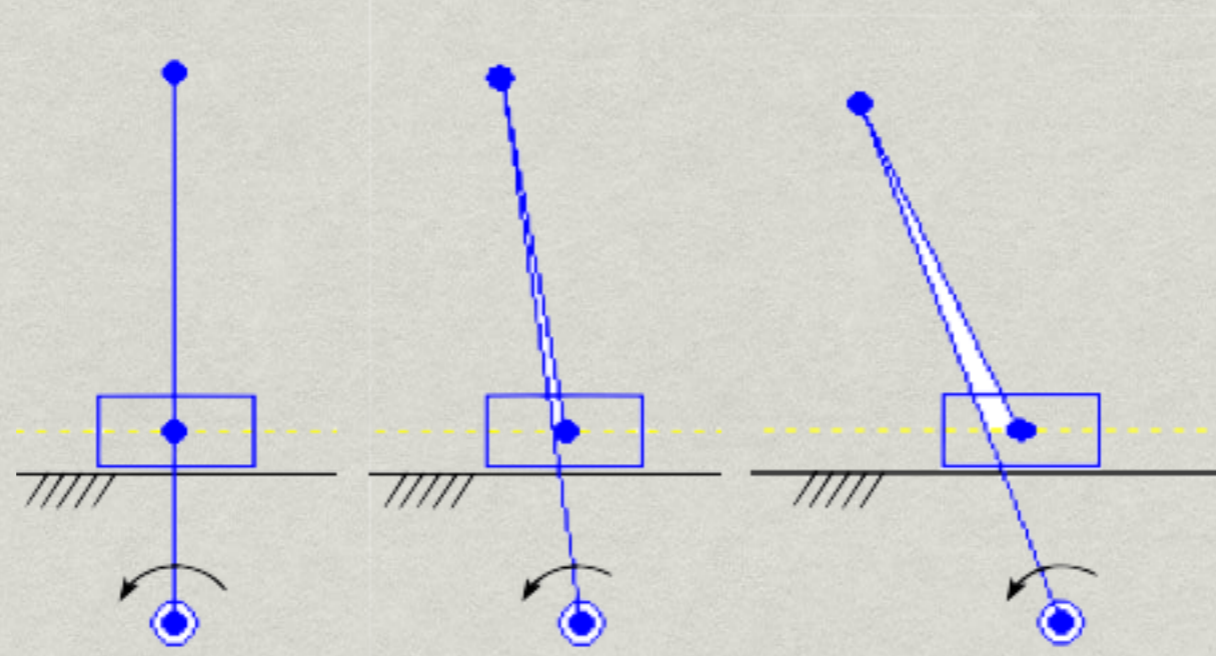
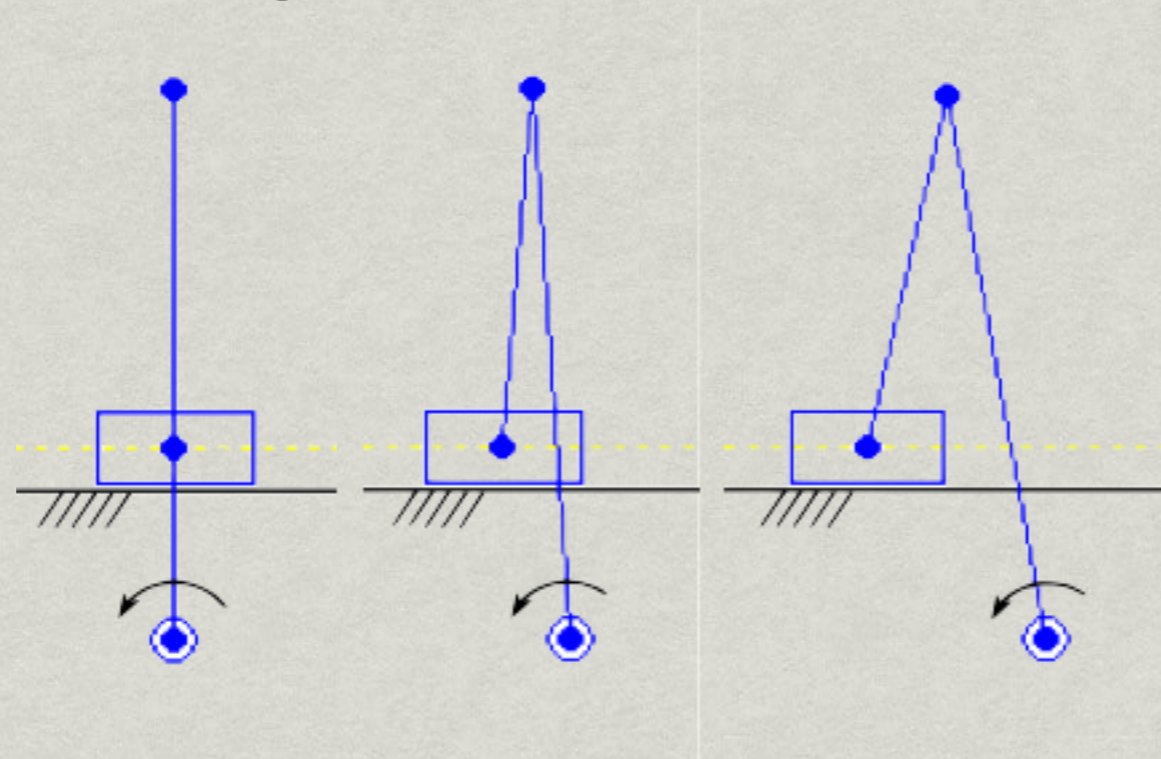
Baina badauka  $G=1$

Bi lotura biraketa hauek ziurtatzen dute barra guztiak plano berberean egongo dira kokatuta

✦ Askatasun gradu inoperanteak

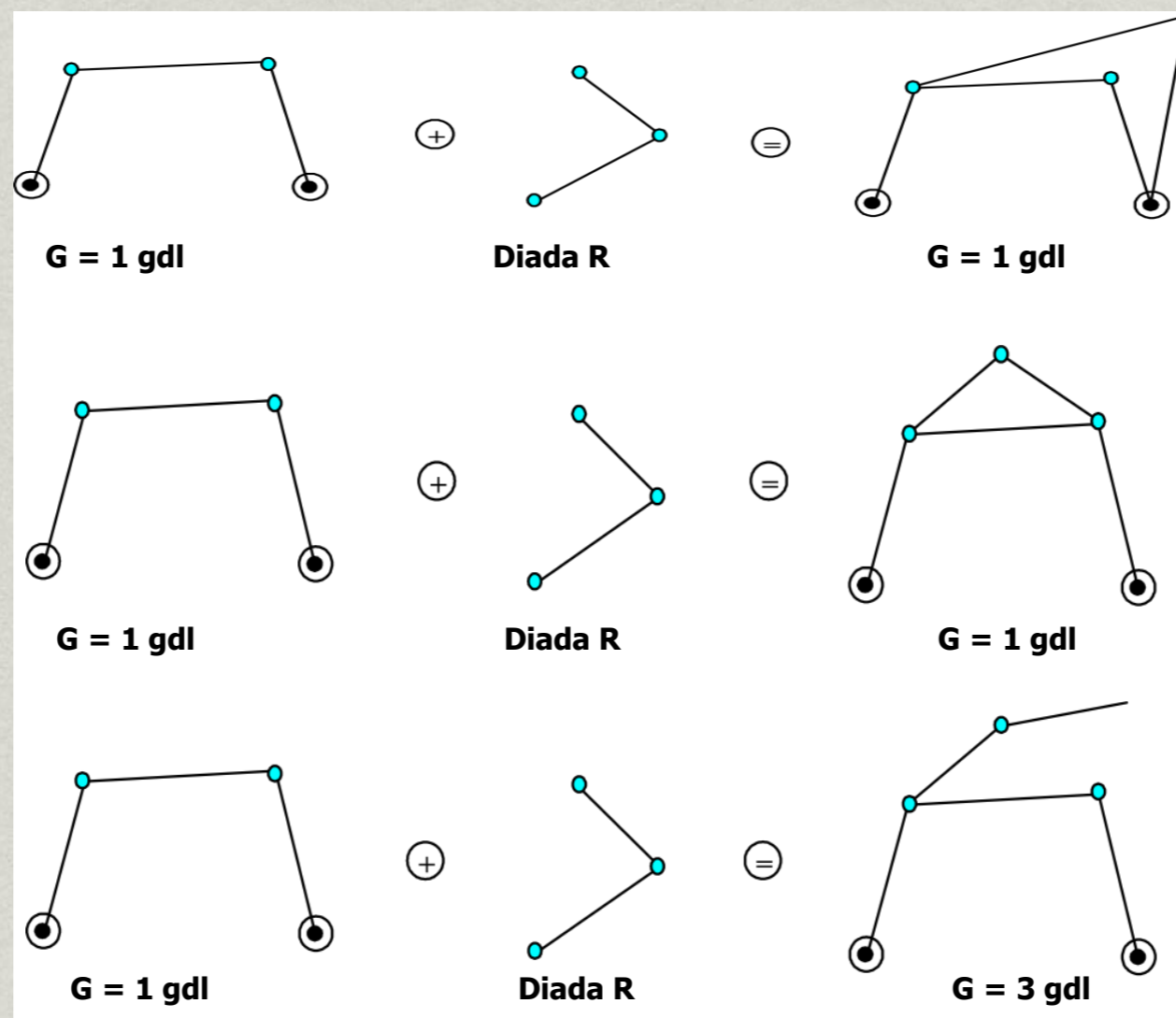


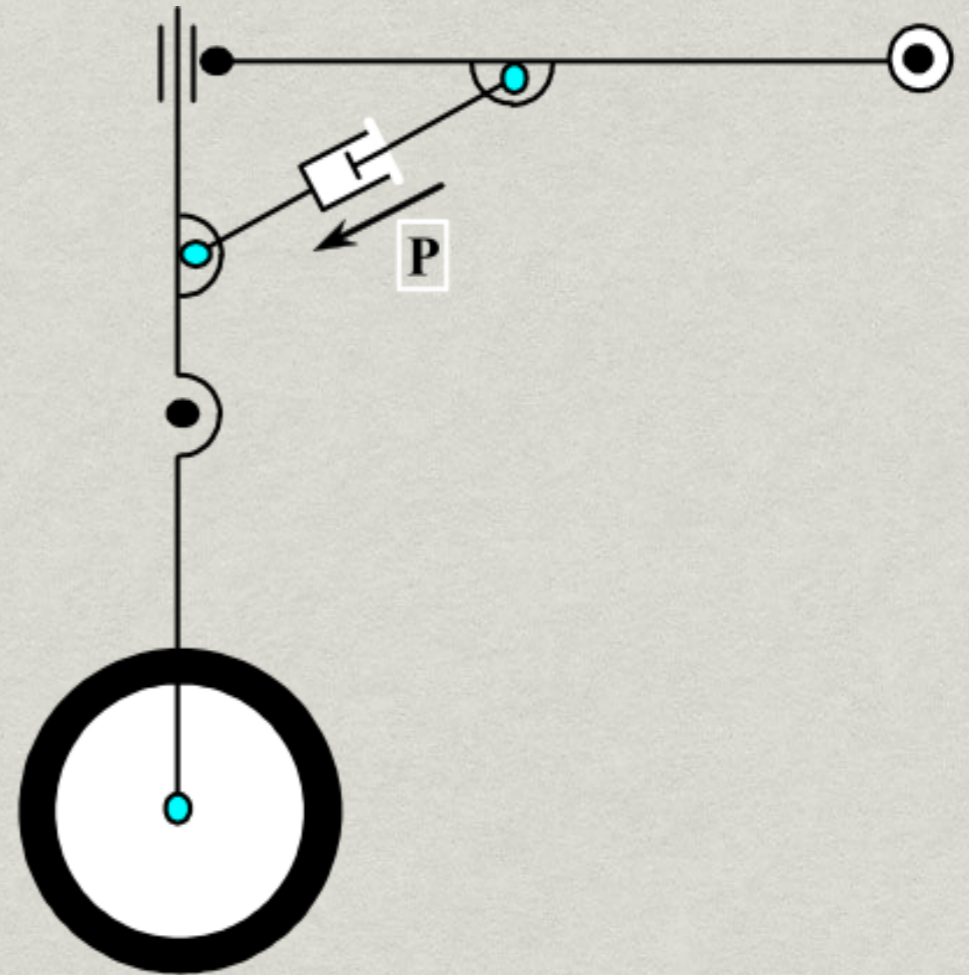
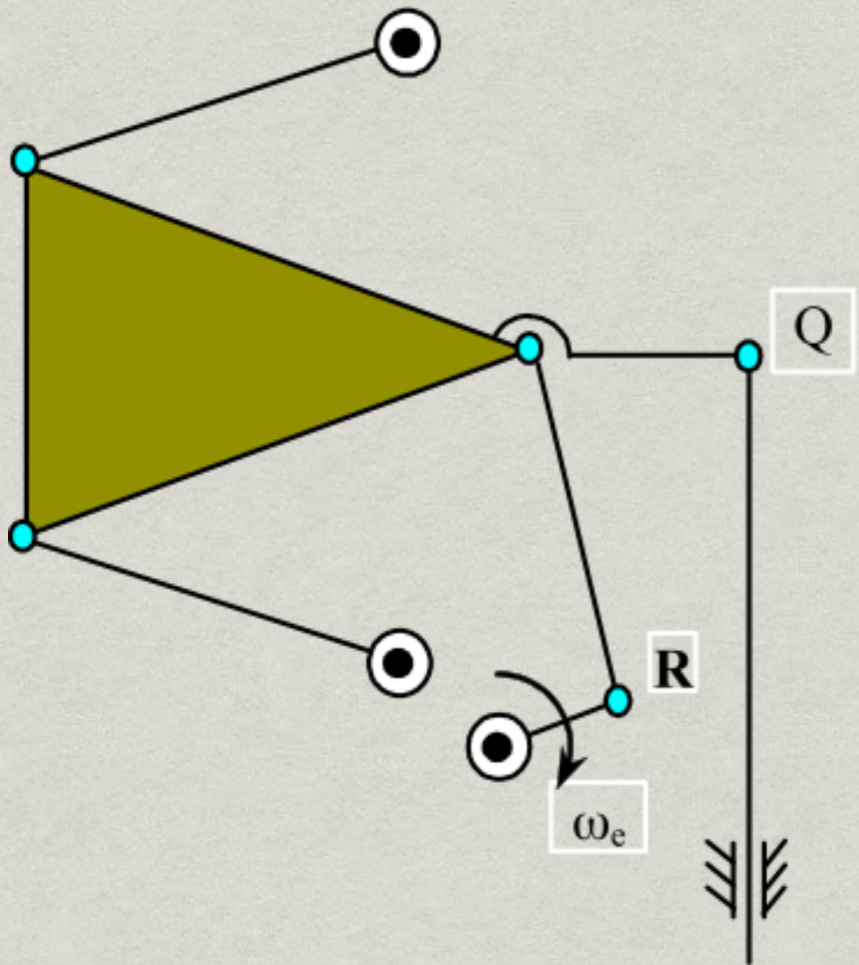
\* Kokapen singulararak



# Mekanismoen eskuraketarako metodoak

## \* Elementuen gehikuntza

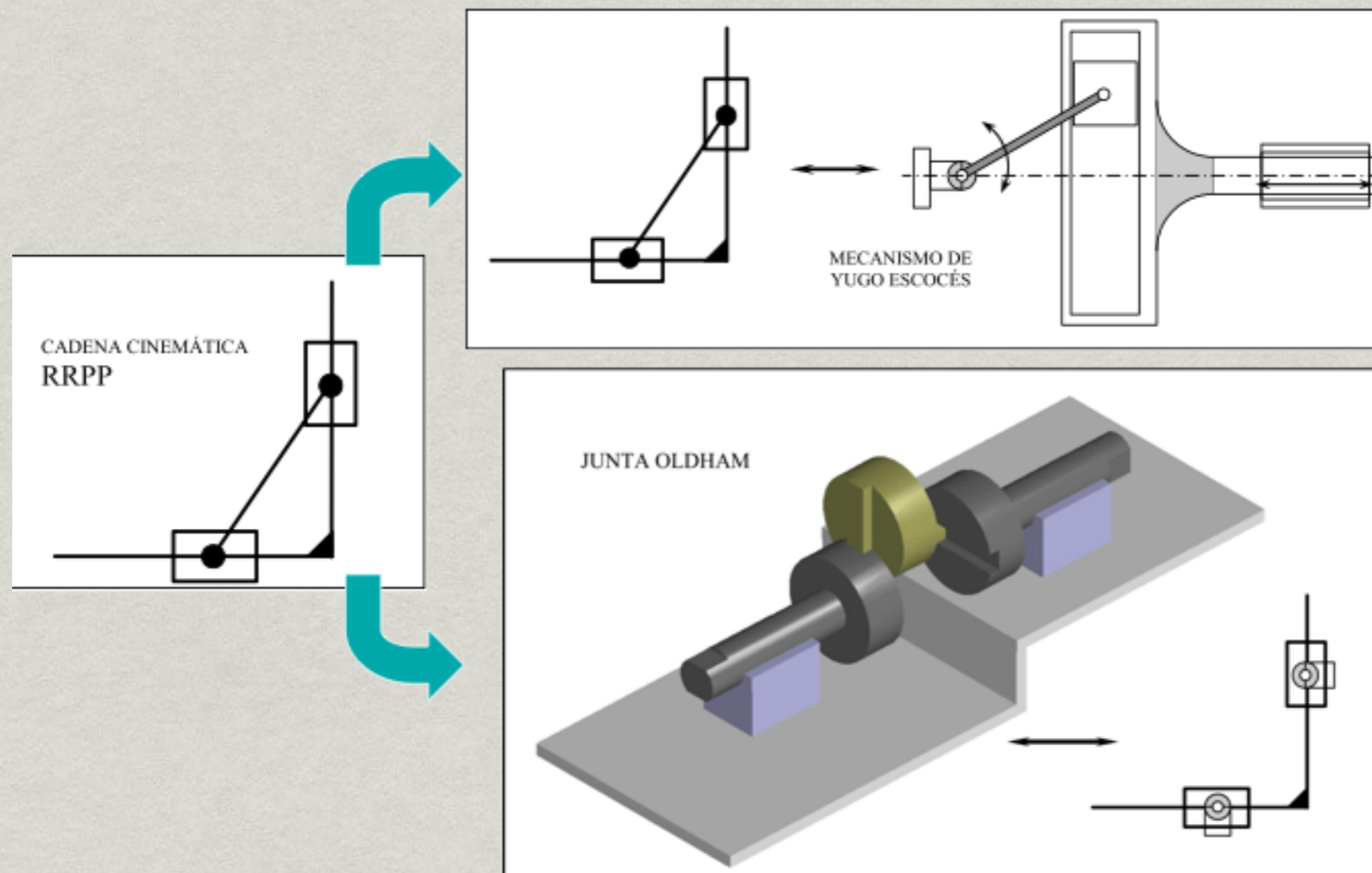






# Mekanismoen eskuraketarako metodoak

- \* Alderantzpenak erabiliz

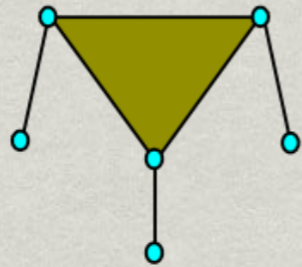


# Mekanismoen eskuraketarako metodoak

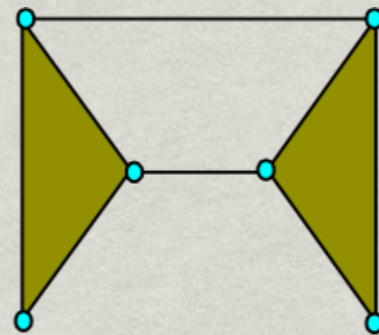
\* Assur-en taldeak  $3n-2p=0$ .



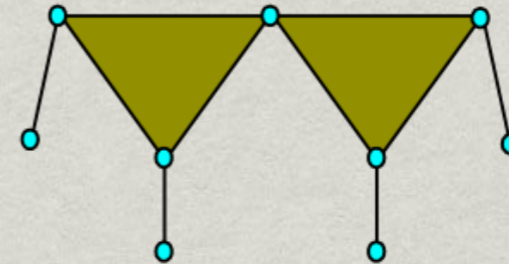
1go taldea  
 $n=2$ ;  $p=3$



2. taldea  
 $n=4$ ;  $p=6$



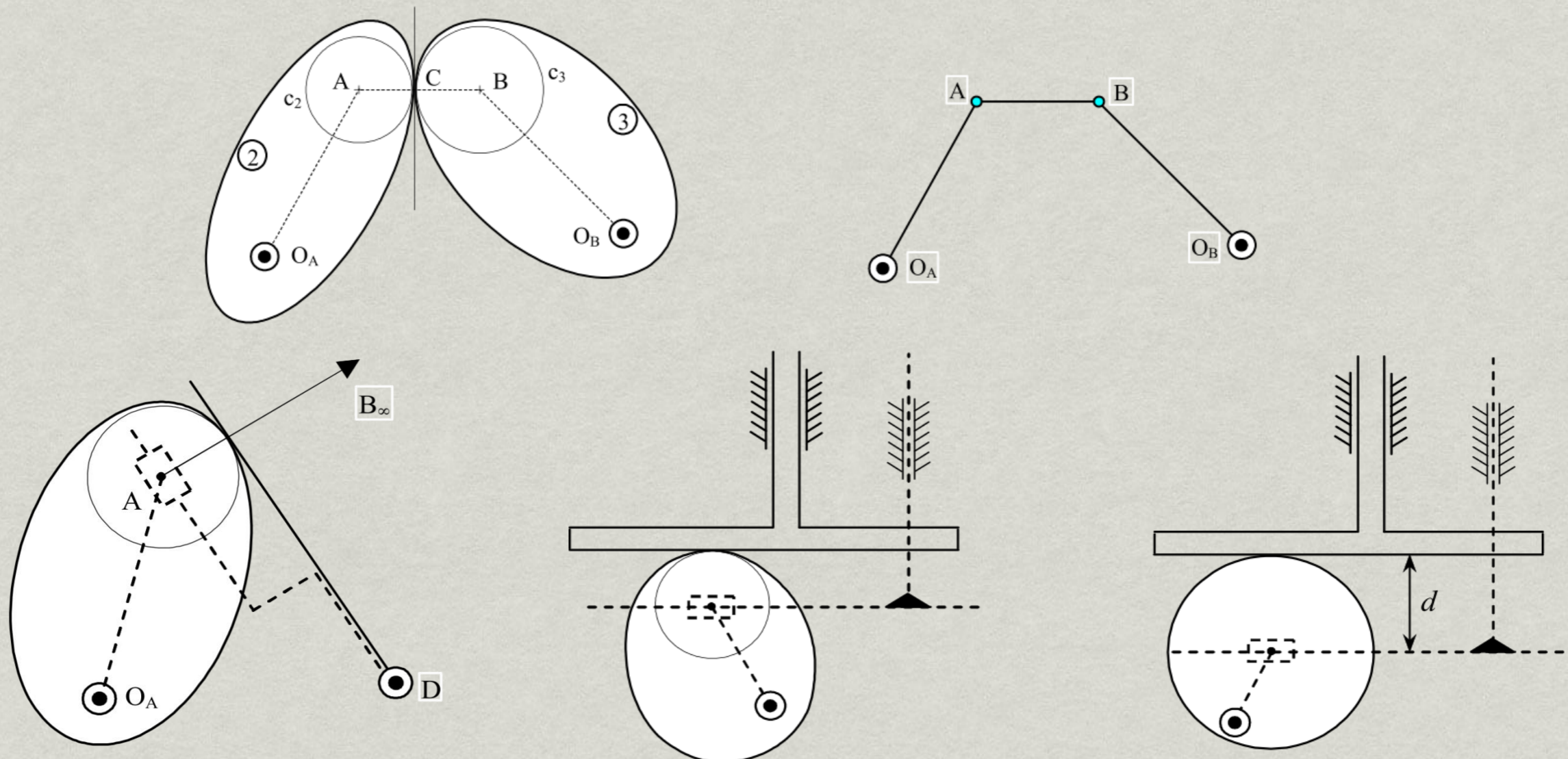
2. taldea  
 $n=4$ ;  $p=6$



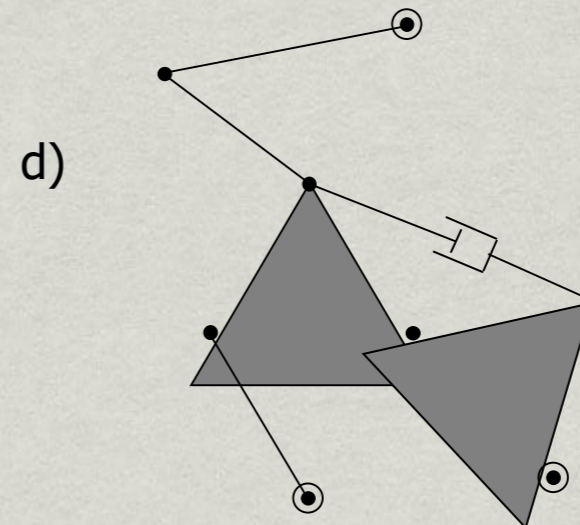
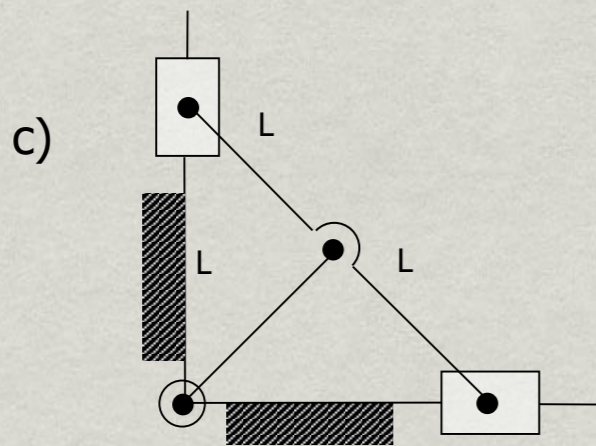
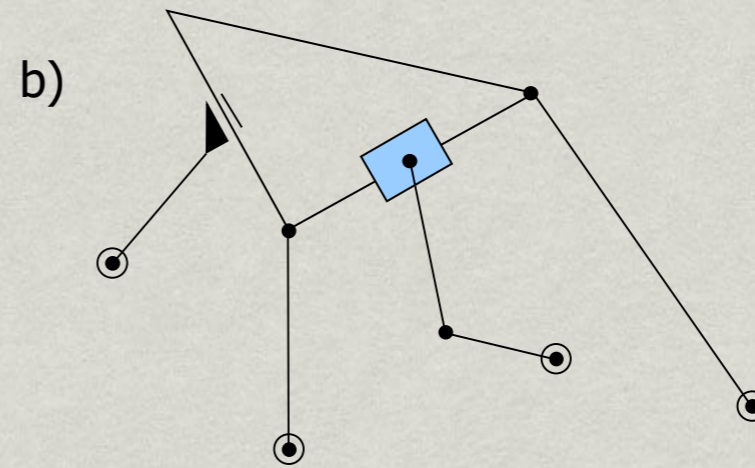
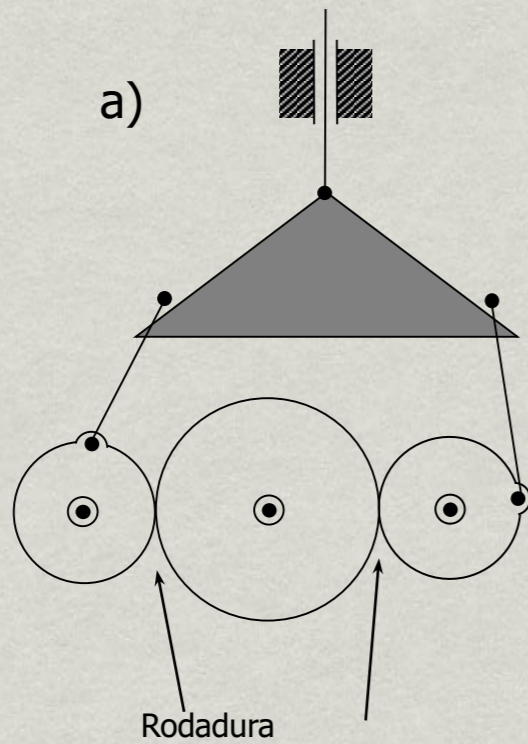
3. taldea  
 $n=6$ ;  $p=9$

# Mekanismoen eskuraketarako metodoak

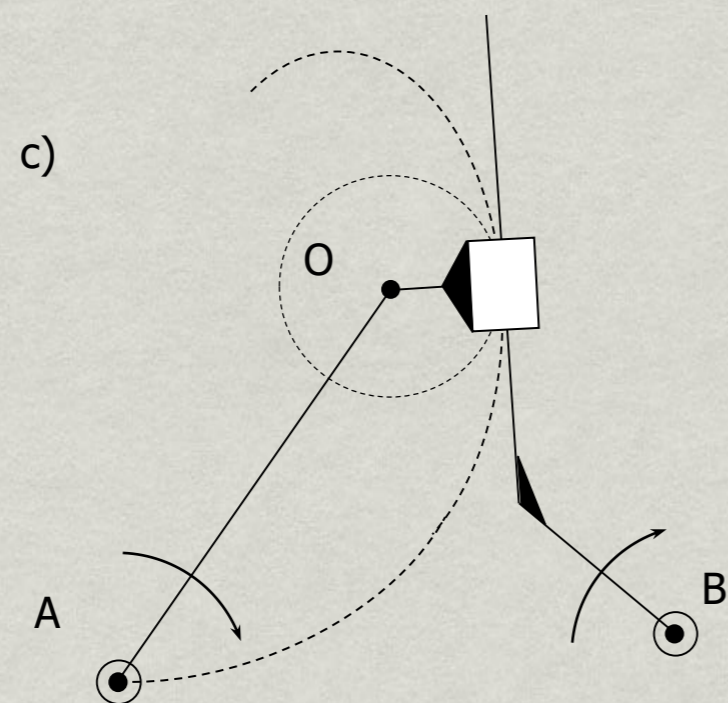
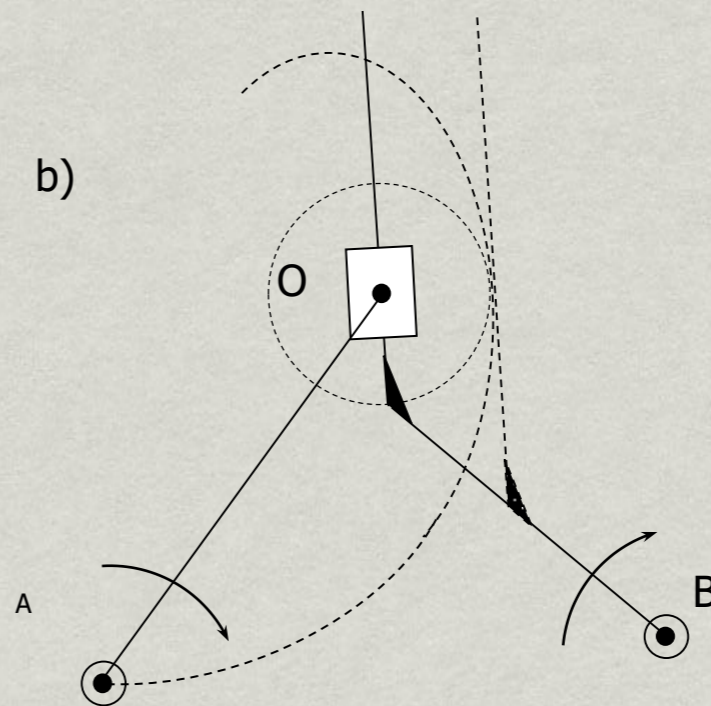
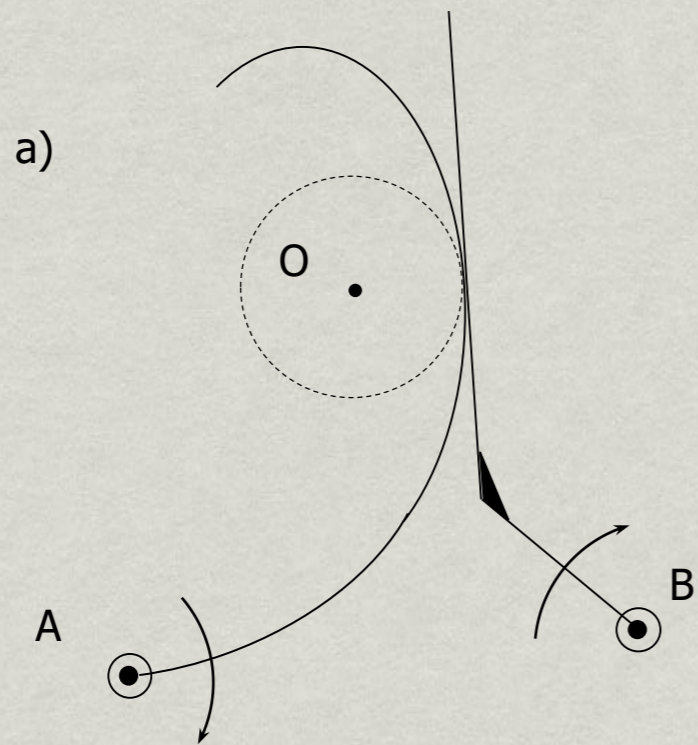
## \* Baliokidetasun zinematikoa



\* Ariketa 1: Grübler-en irizpidea aplikatu eta arzoitu benetazko ag. kopuruarekin bat egiten duen.



✱ Ariketa 2: Estabaidatu irudiko mekanismoen baliokidetasuna.



- \* Ariketa 3: Irudiko mekanismorako hurrengoa eskatzen da:
  - \* Mekanismoaren akzionamendu sistema.
  - \* Ag. kopurua.
  - \* kate zinematikoa eta bere alderanzpen guztiak.
  - \* Mekanismoaren diseinurako behar diren analisi zinemtaiko, estatiko eta dinamikoak.

