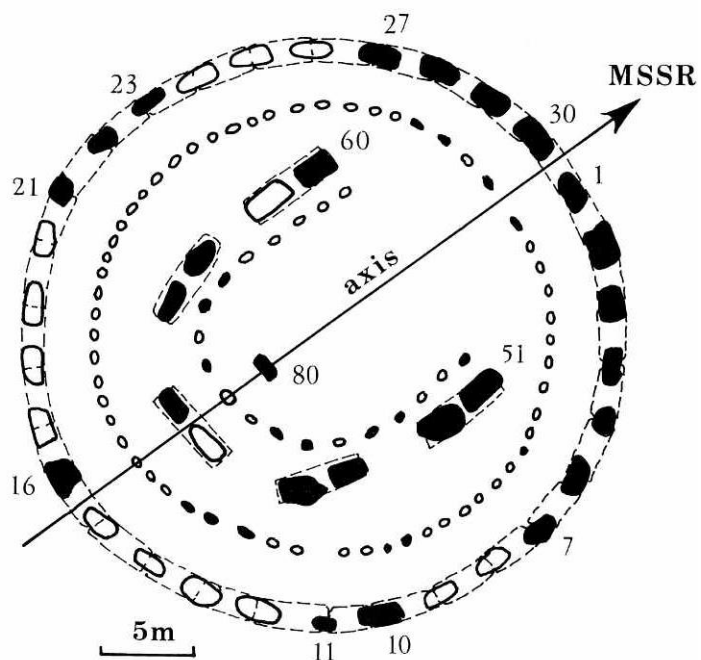
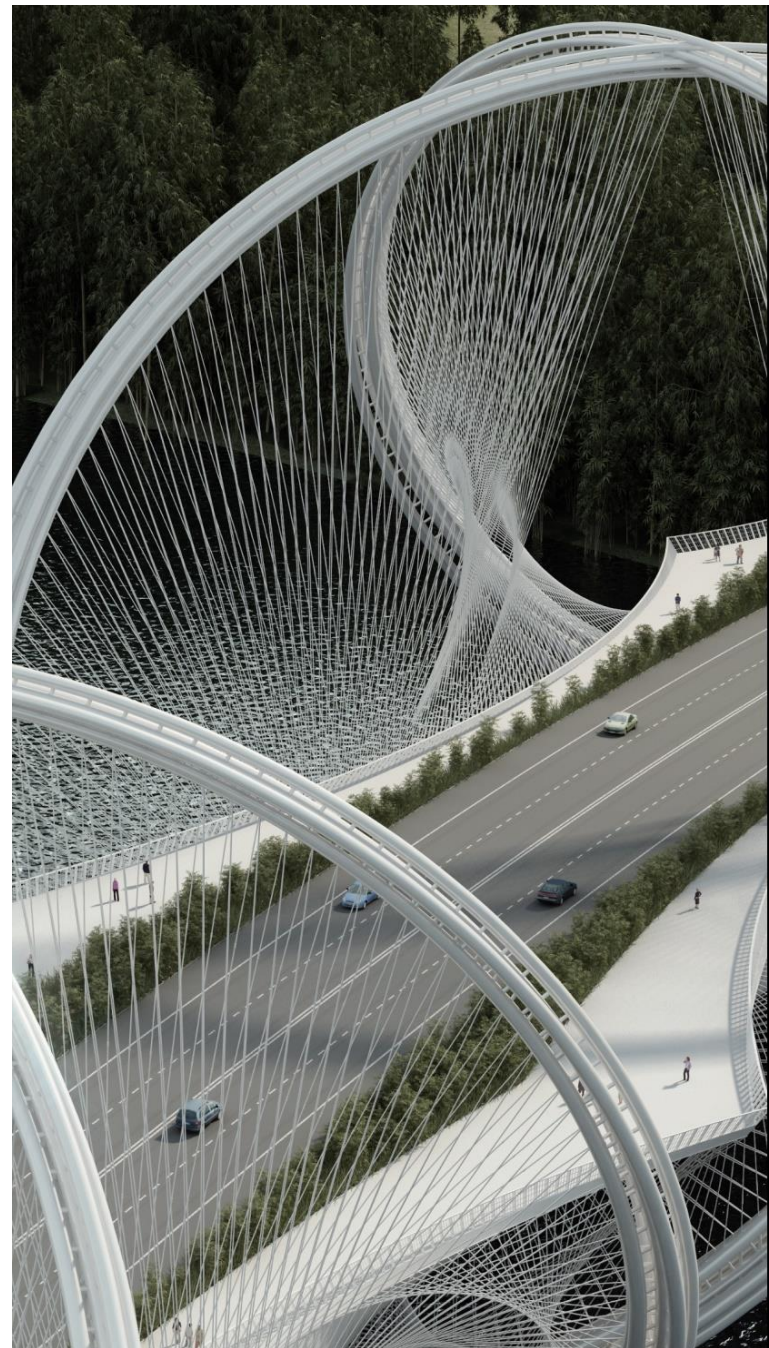


NACRTNA GEOMETRIJA

predavanja 2021



GEOMETRIJA JE SVUDA!

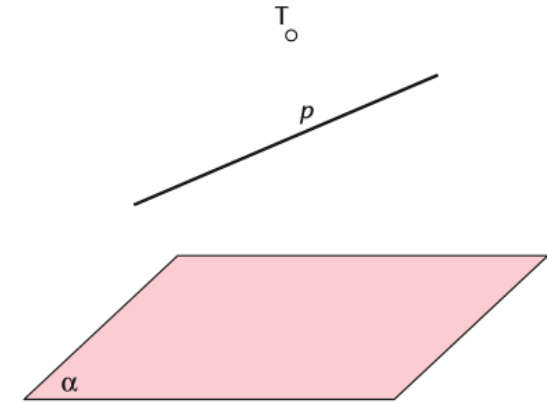


- Euklidska geometrija

OBNOVITI:

Osnovni geometrijski elementi i njihovi odnosi

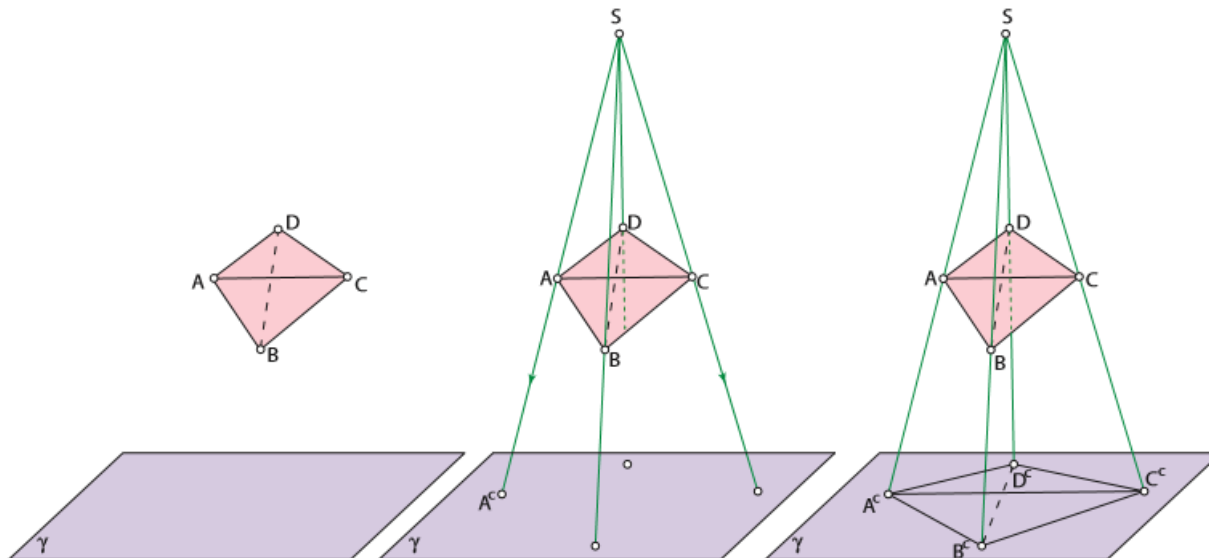
Osnovne geometrijske konstrukcije i postupci



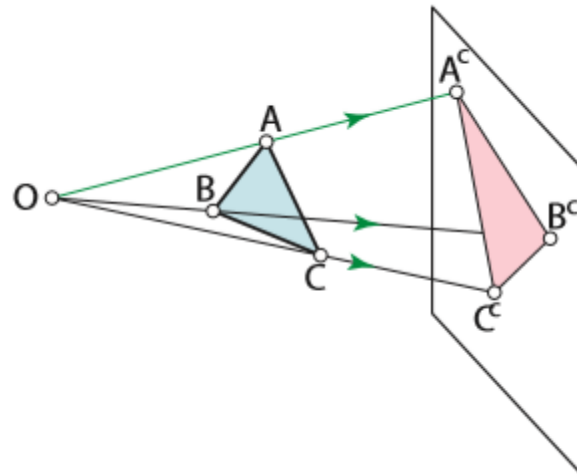
- Nacrtna (deskriptivna) geometrija XVIII v.

- Zašto je važna za inženjere?

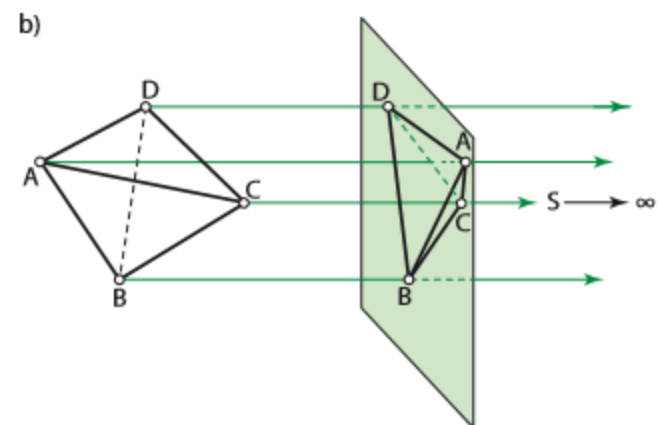
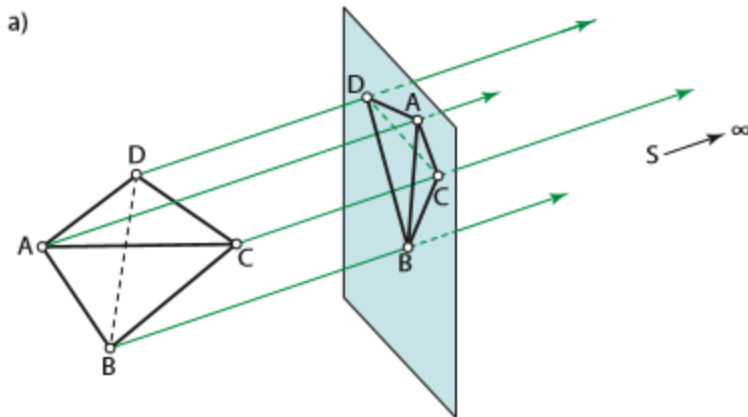
- Projeciranje



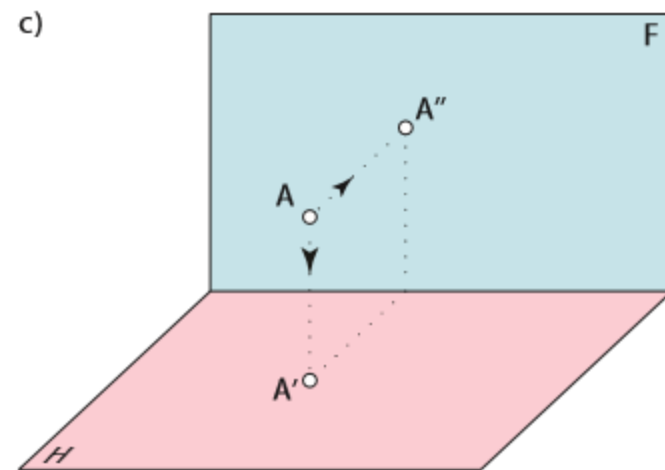
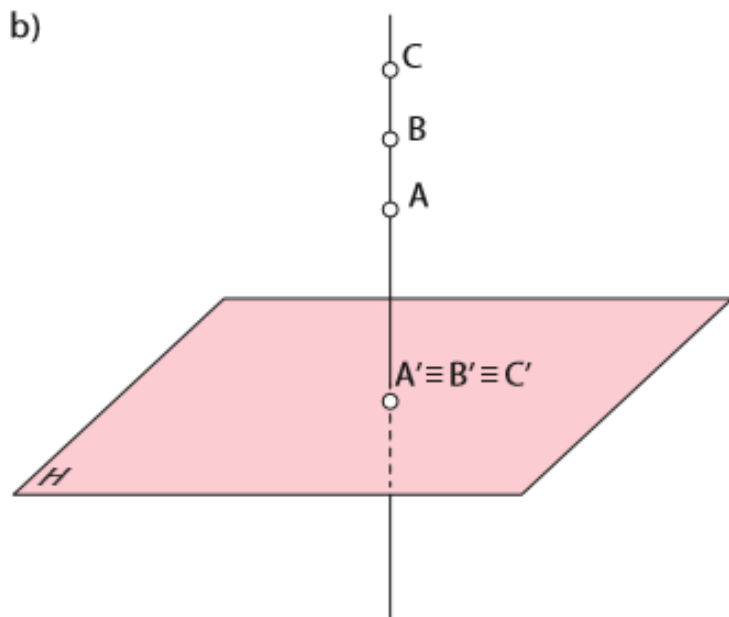
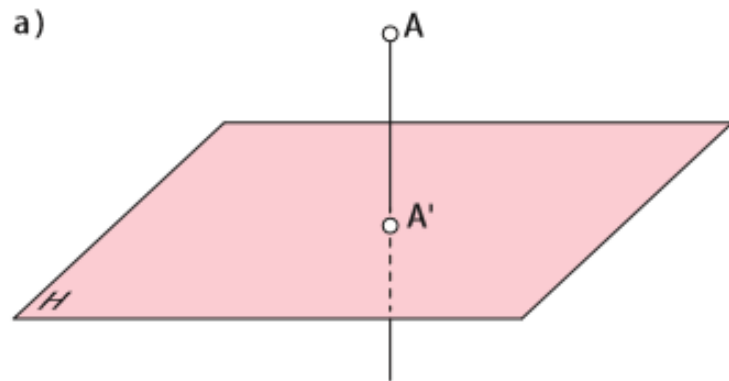
1. CENTRALNO PROJICIRANJE - PERSPEKTIVA



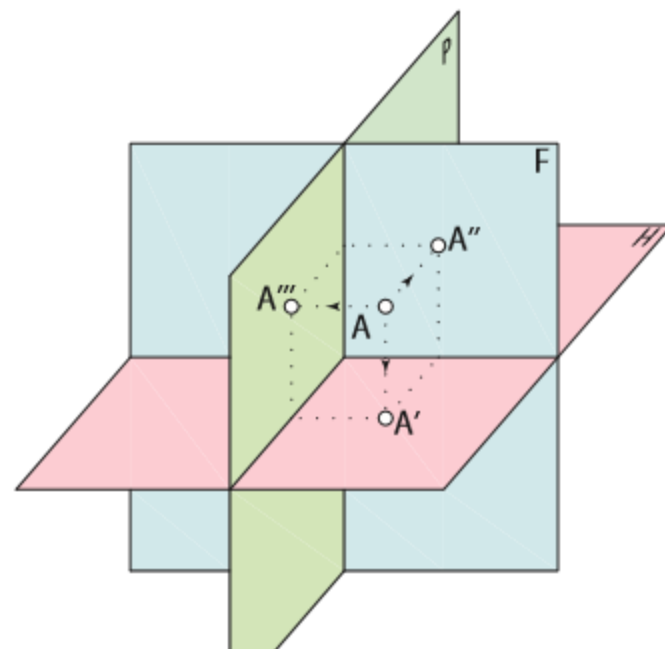
2. PARALELNO: koso – aksonometrija i ortogonalno



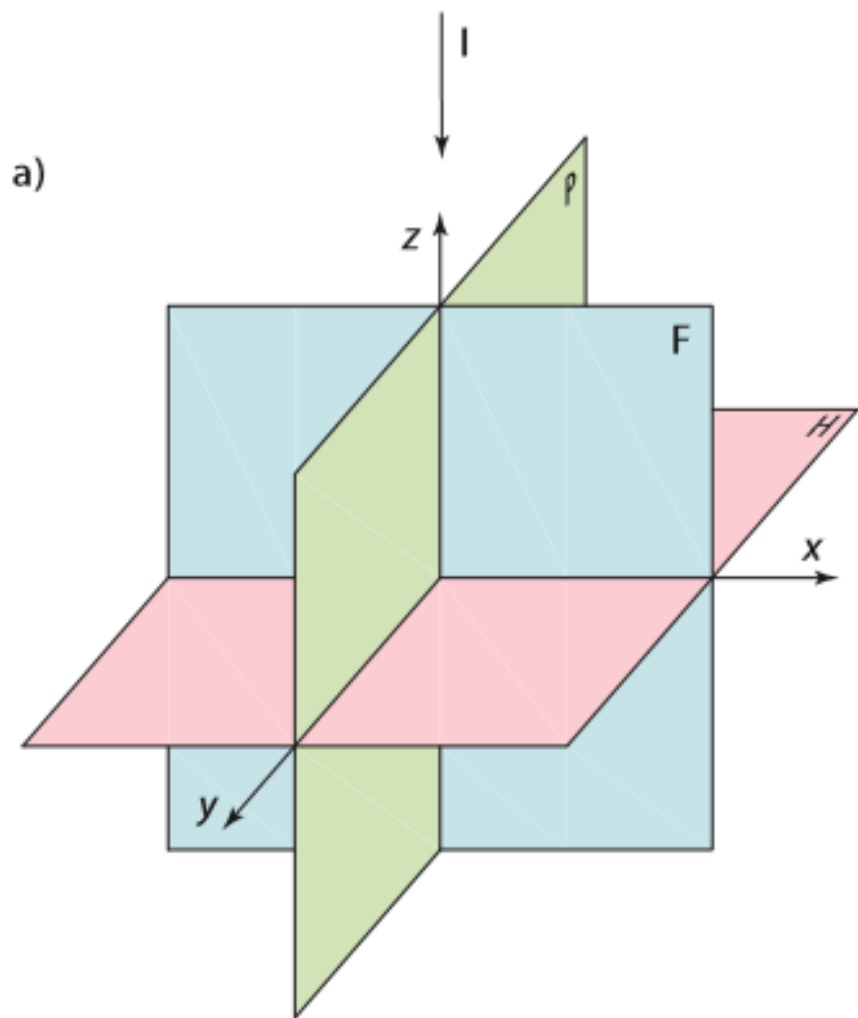
ORTOGONALNA PROJEKCIJA



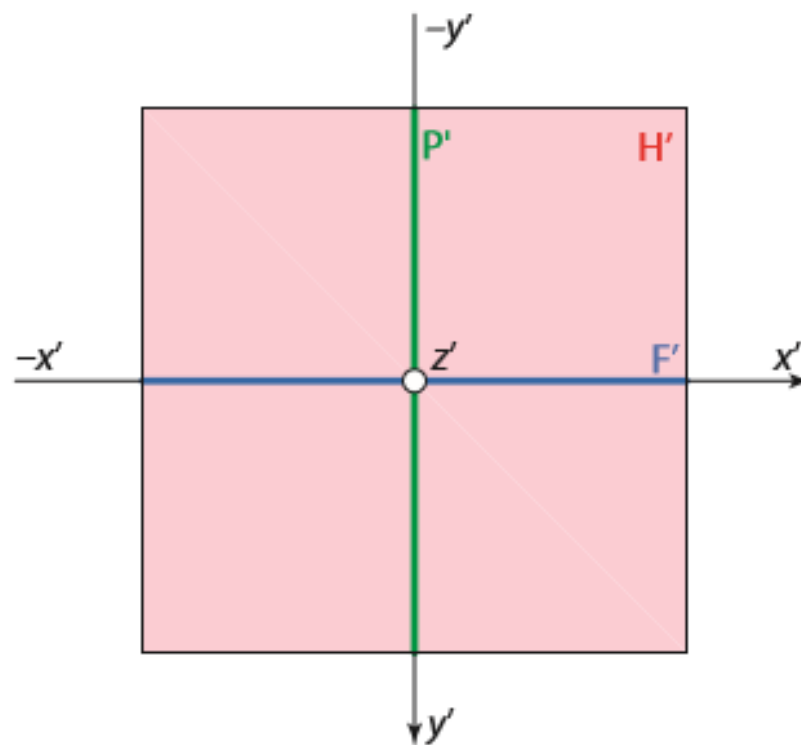
Slika B1.1. Projiciranje tačke na ravni H i F



PRVA PROJEKCIJA TRIEDRA

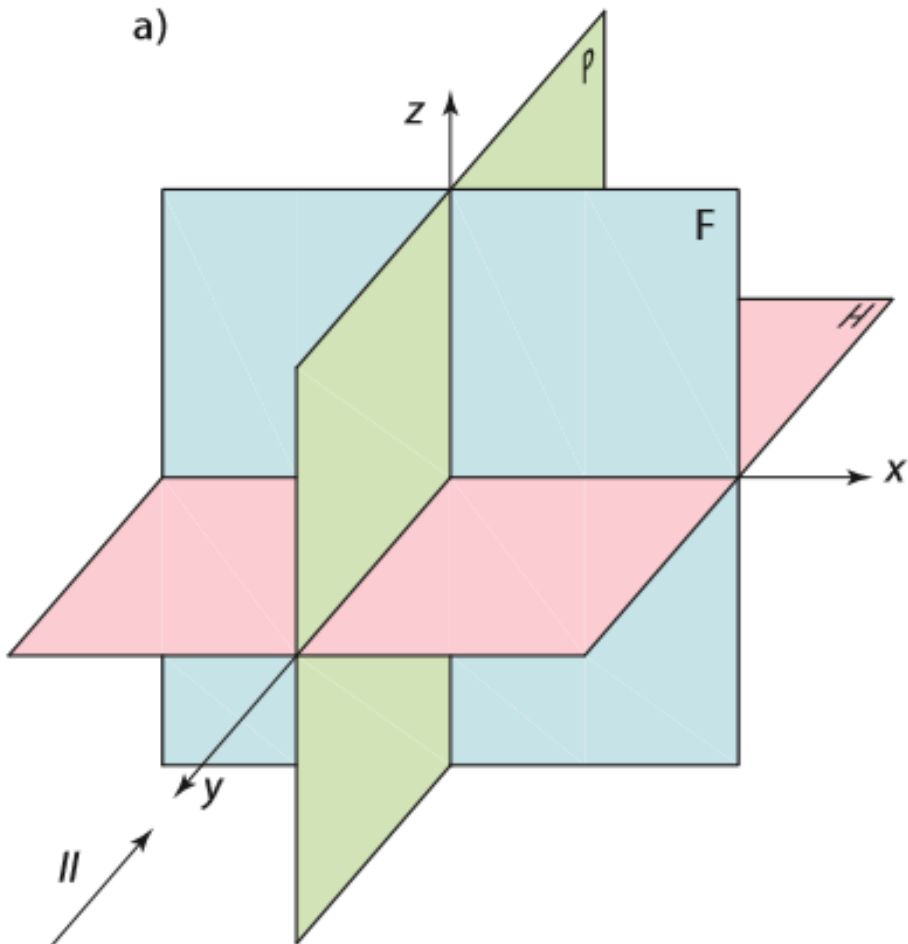


b)

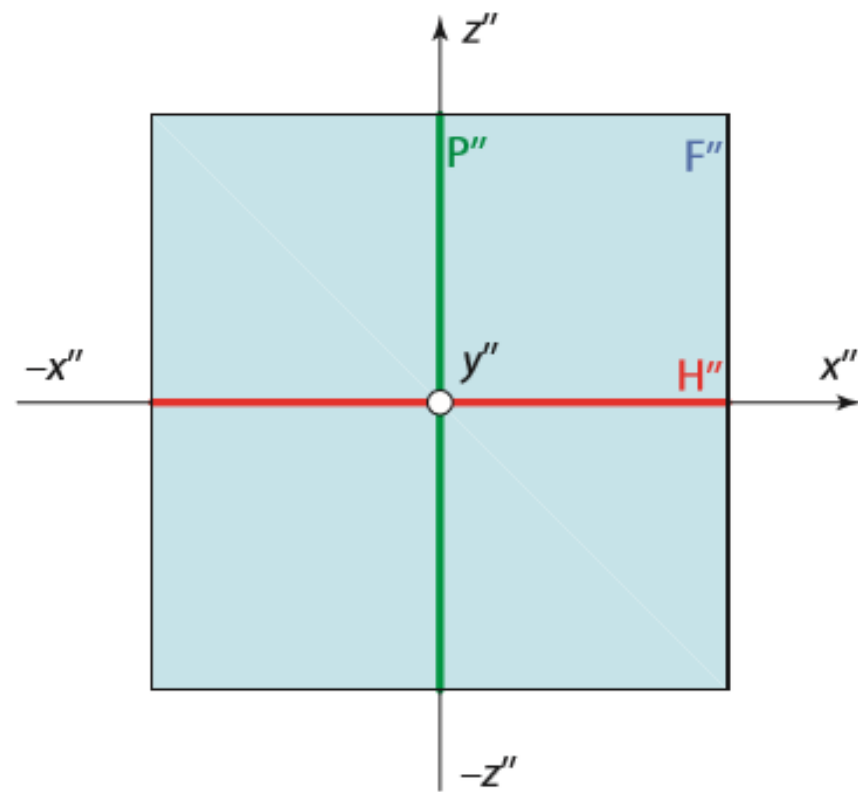


DRUGA PROJEKCIJA TRIEDRA

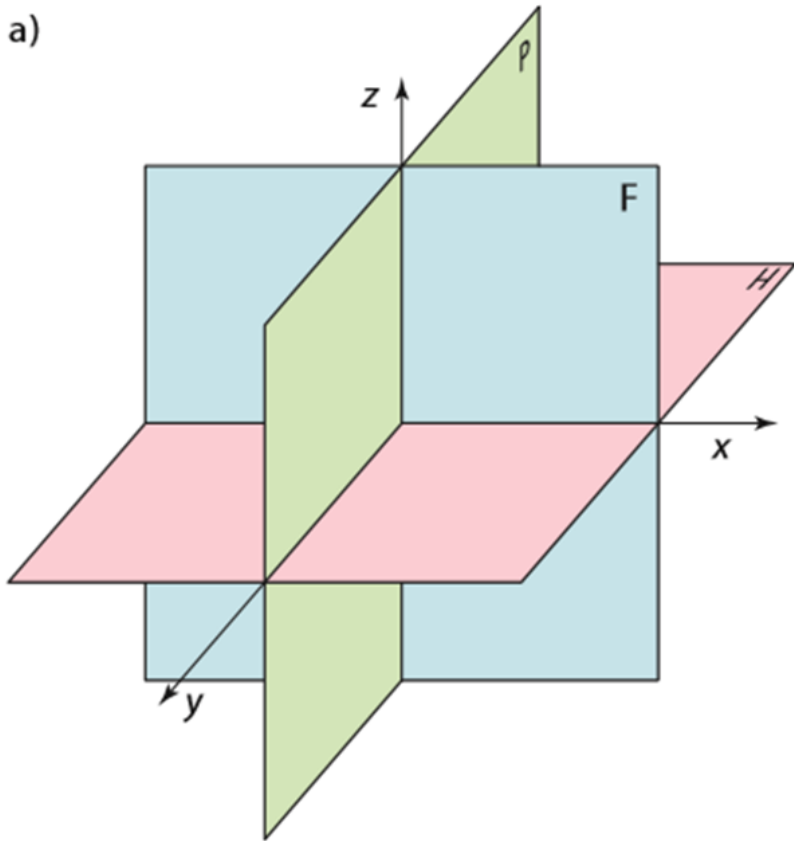
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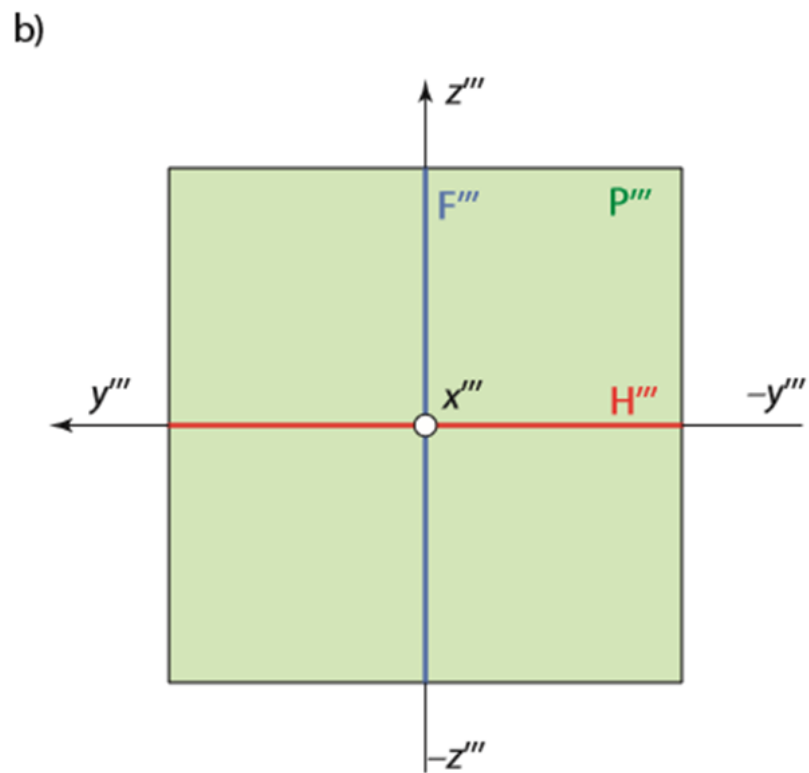
b)



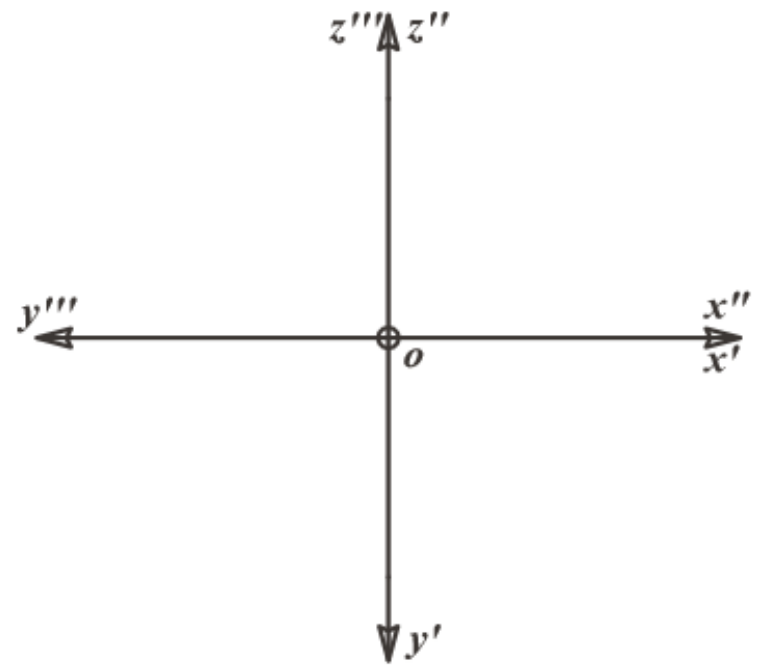
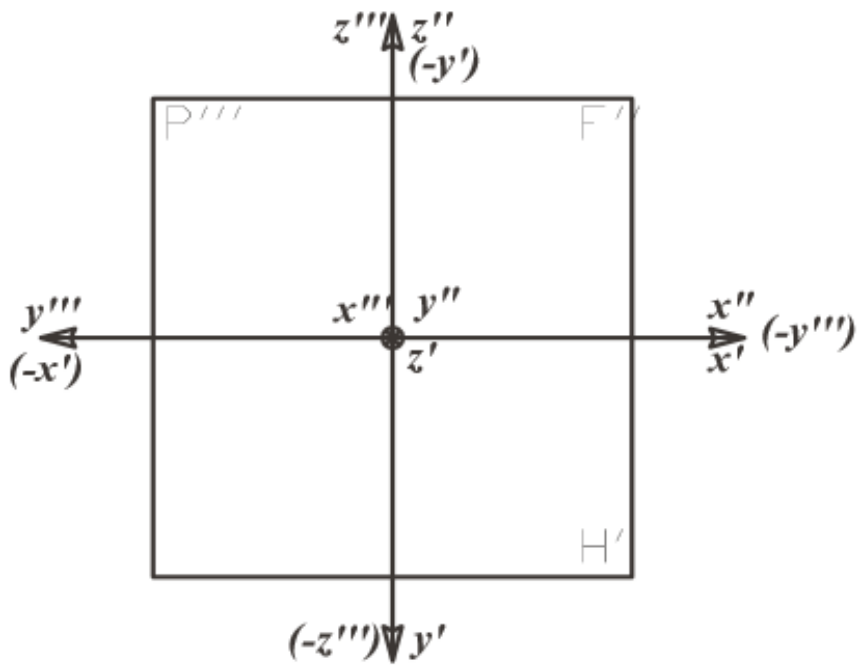
TREĆA PROJEKCIJA TRIEDRA



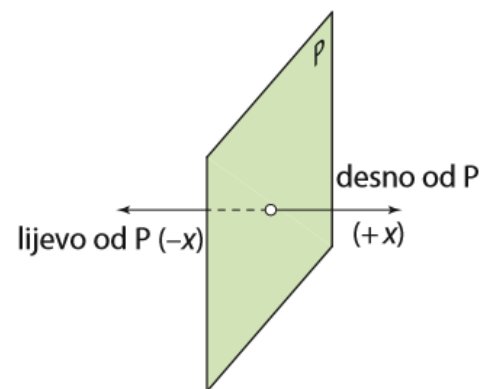
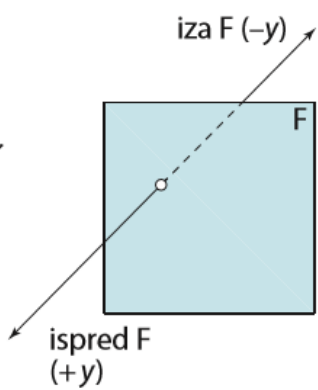
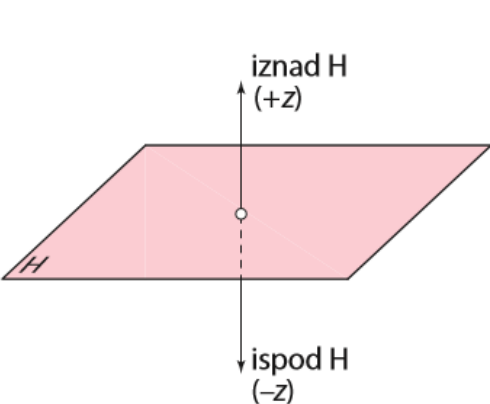
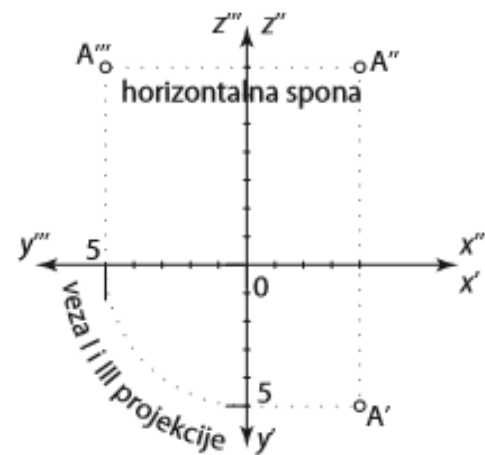
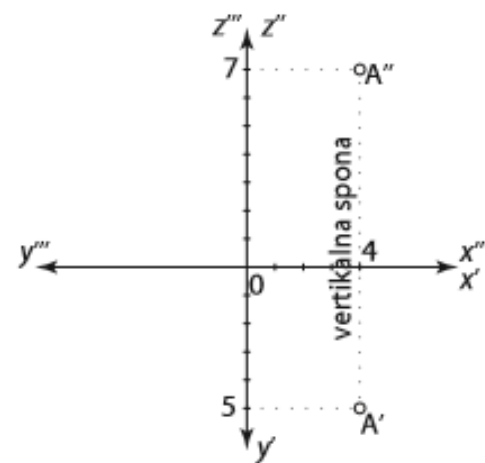
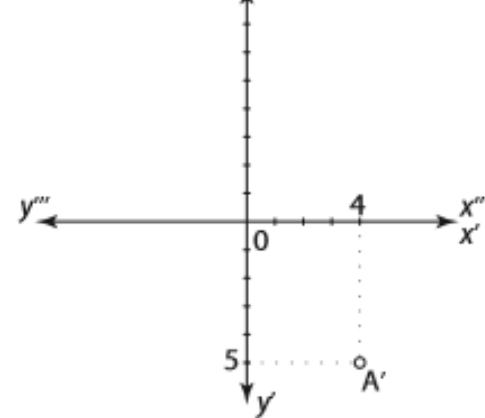
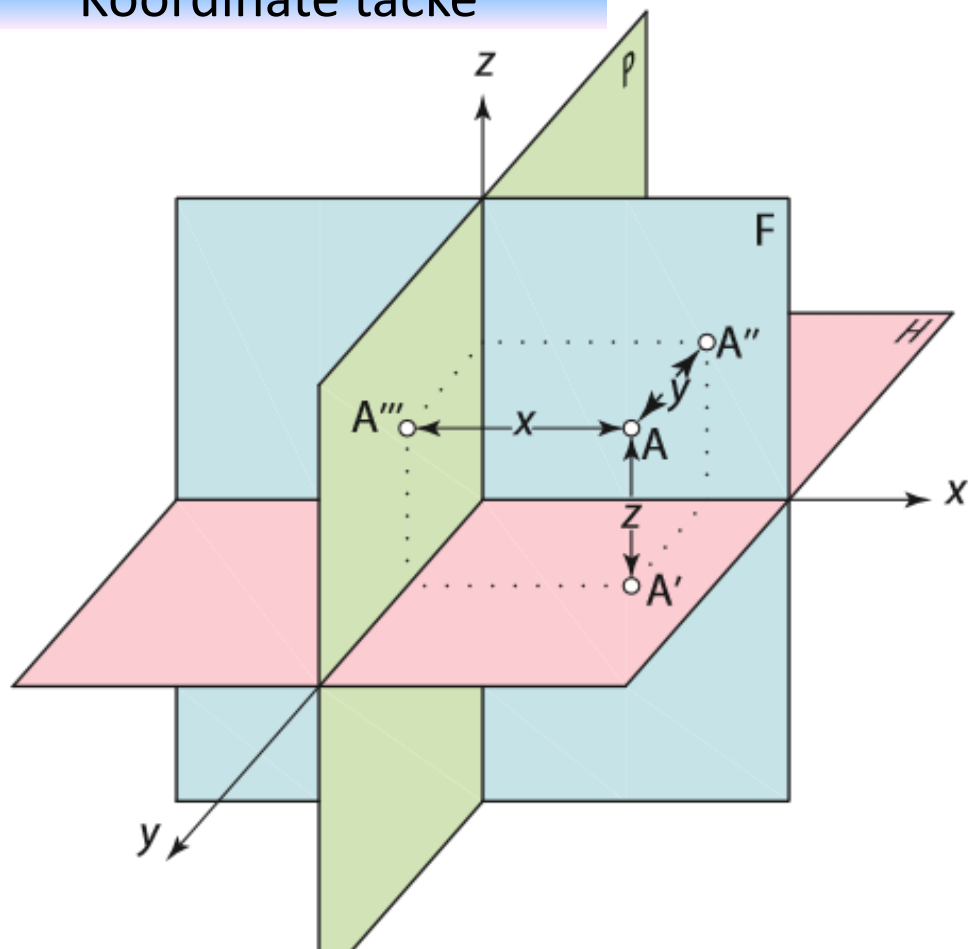
III ←



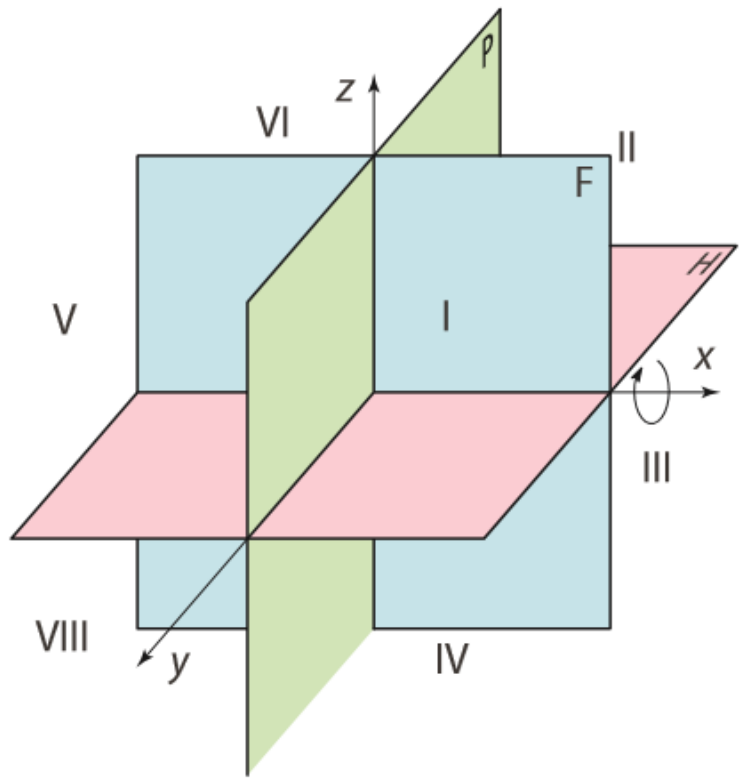
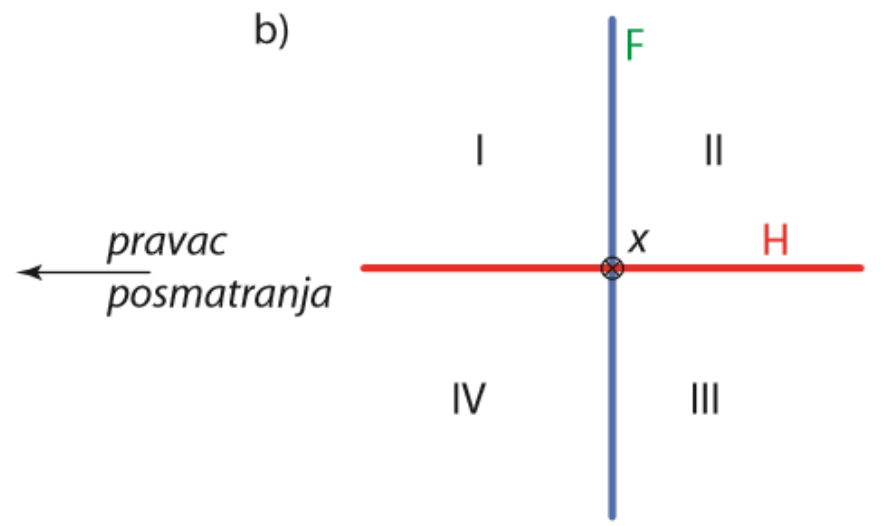
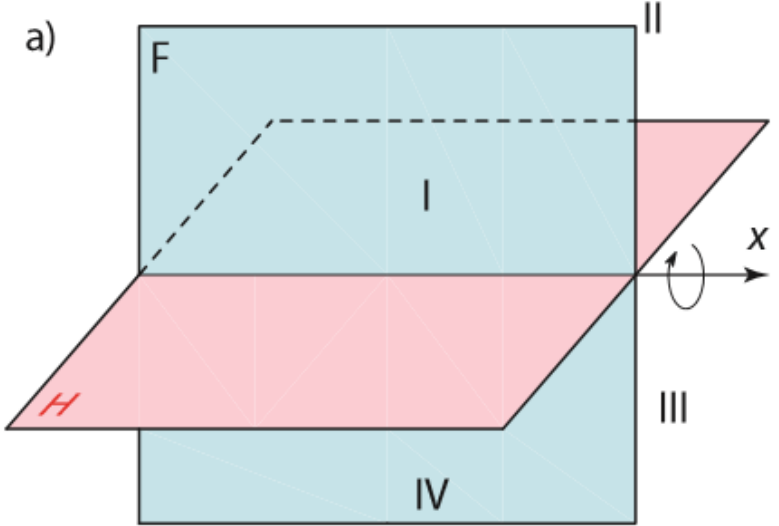
TRIEDAR U TRI ORTOGONALNE PROJEKCIJE



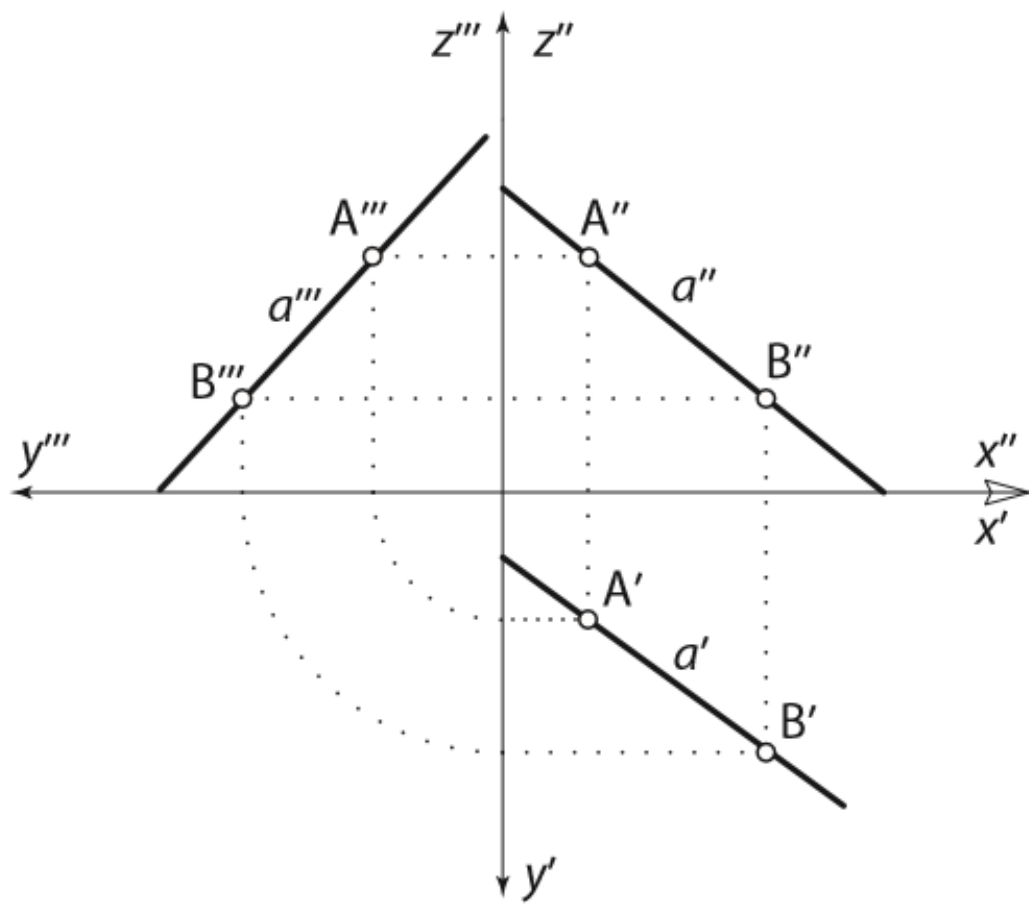
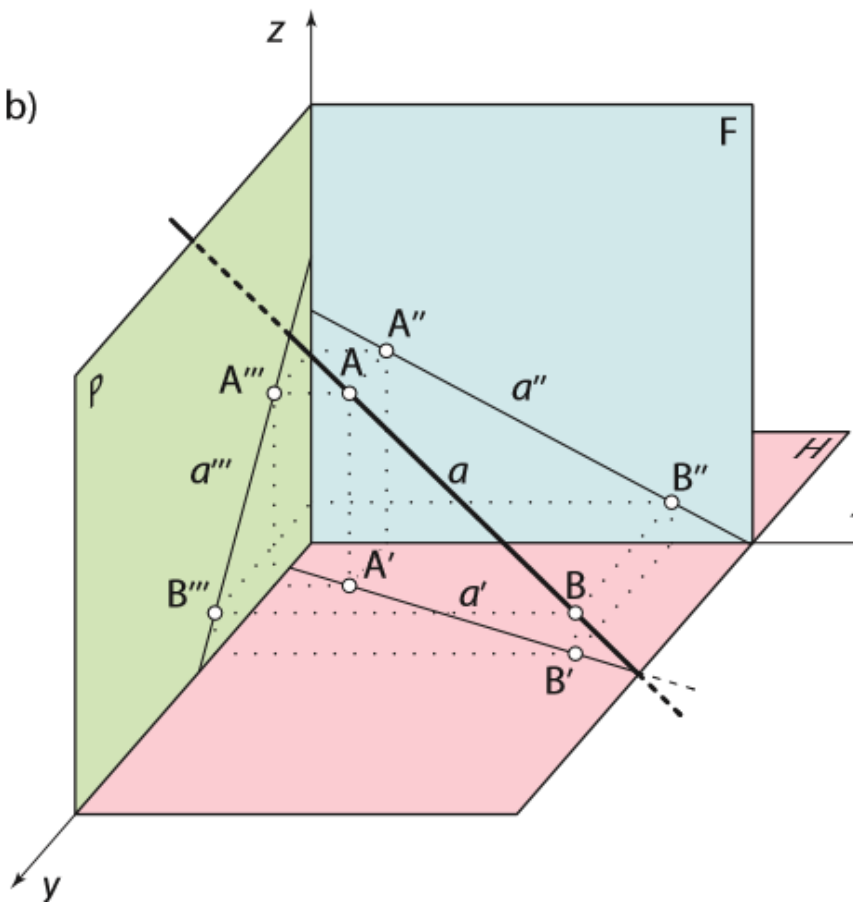
Koordinate tačke



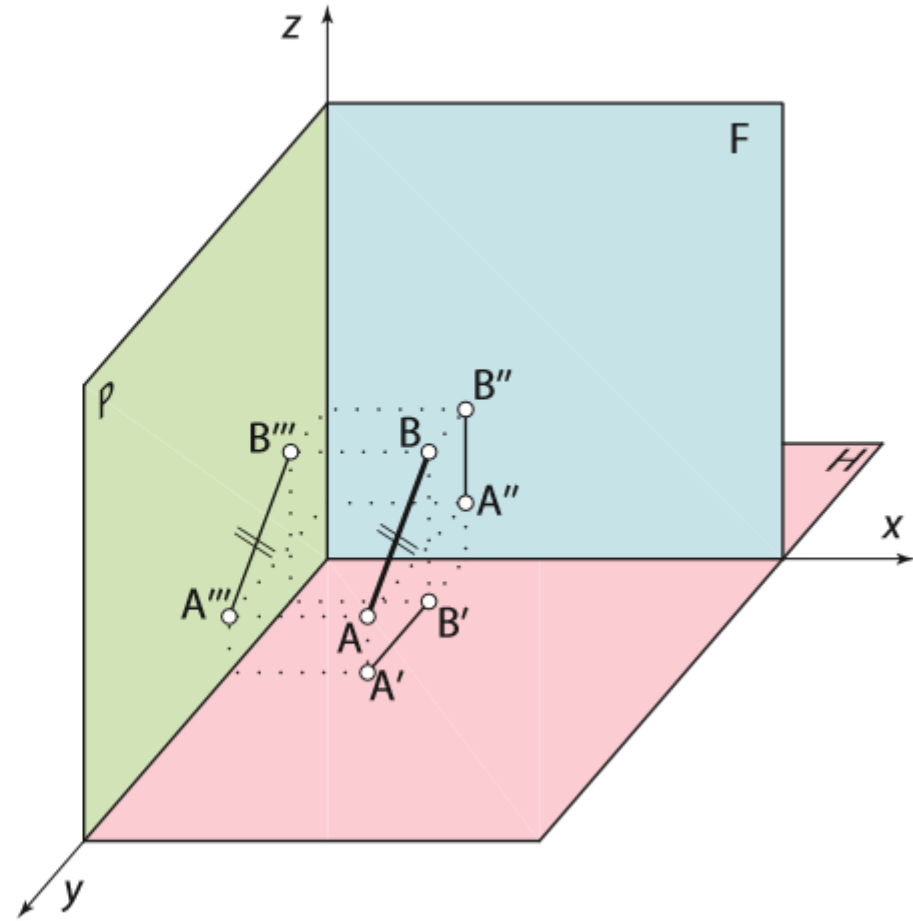
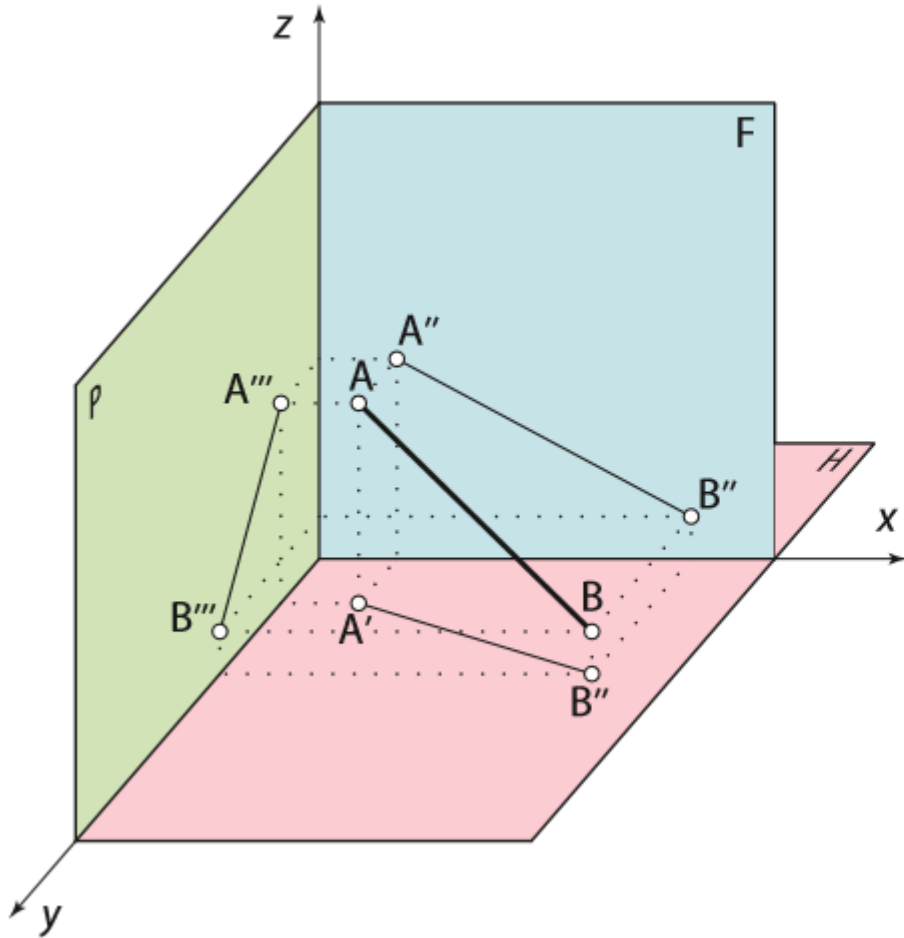
Kvadranti i oktanti



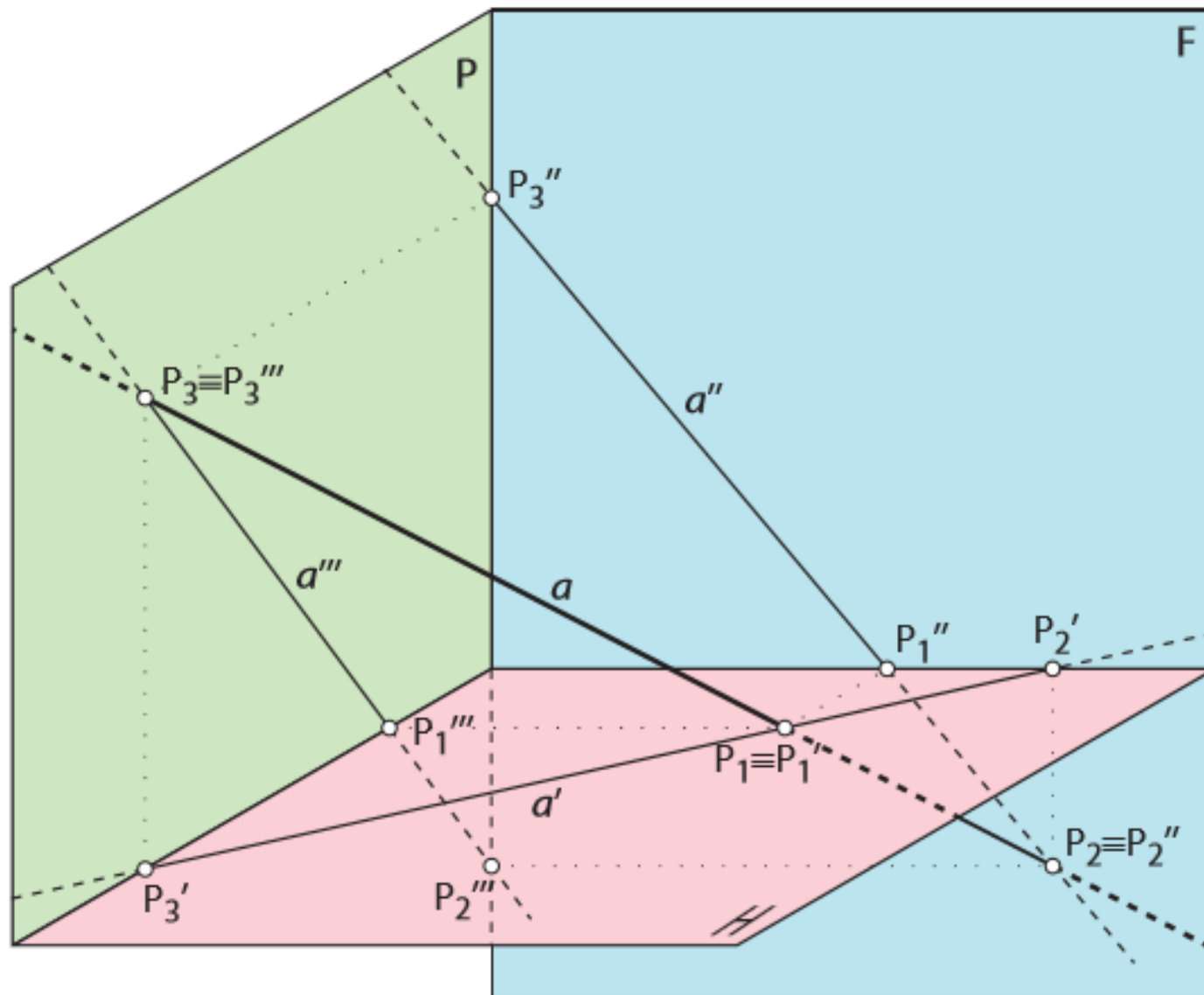
Prava, duž



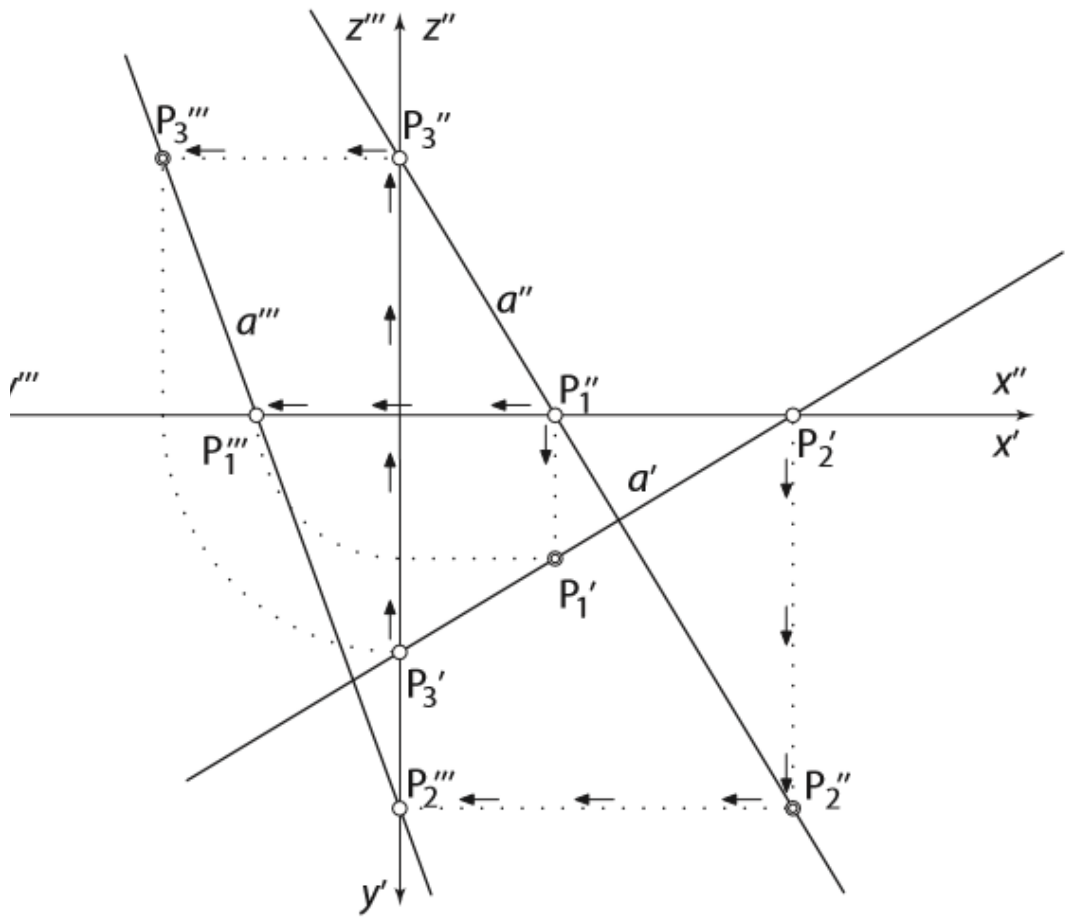
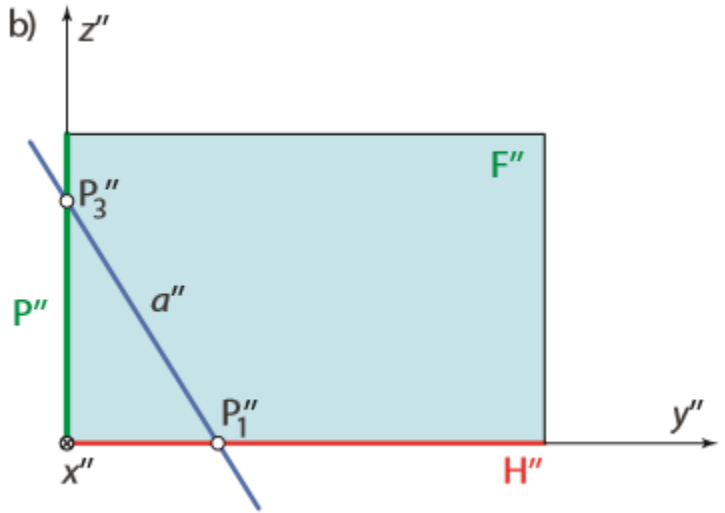
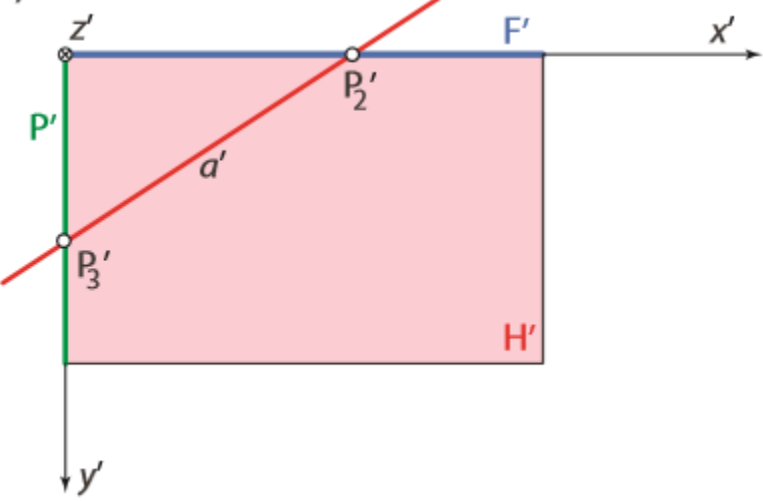
Prava, duž



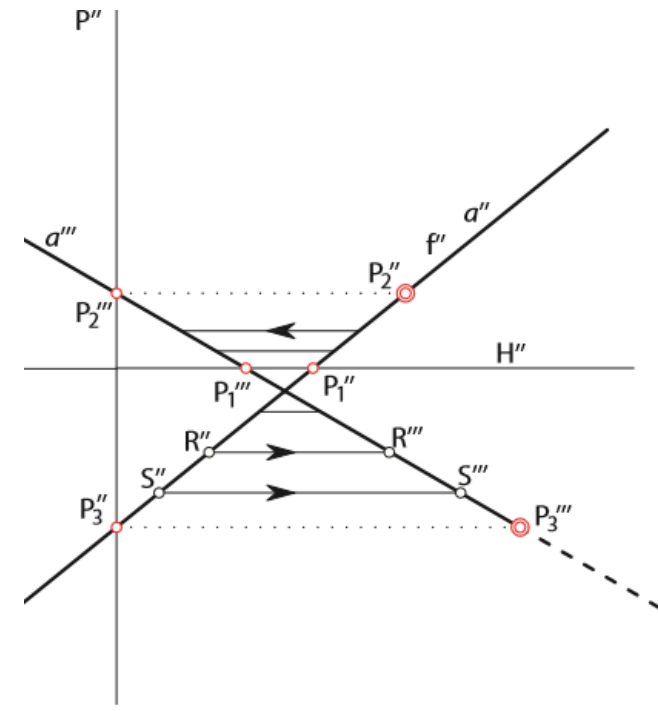
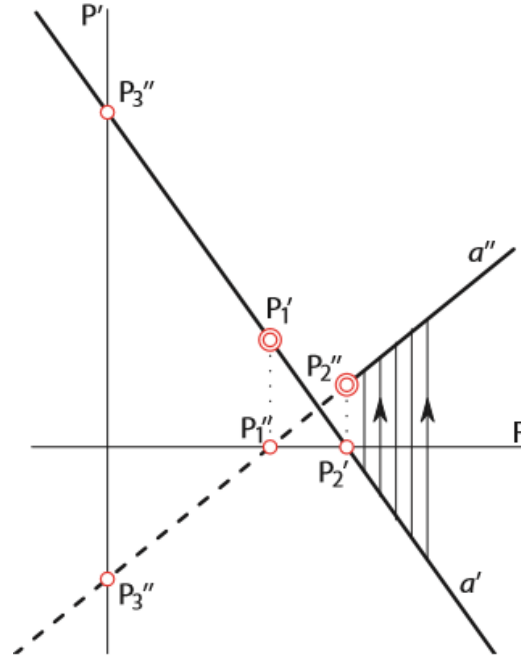
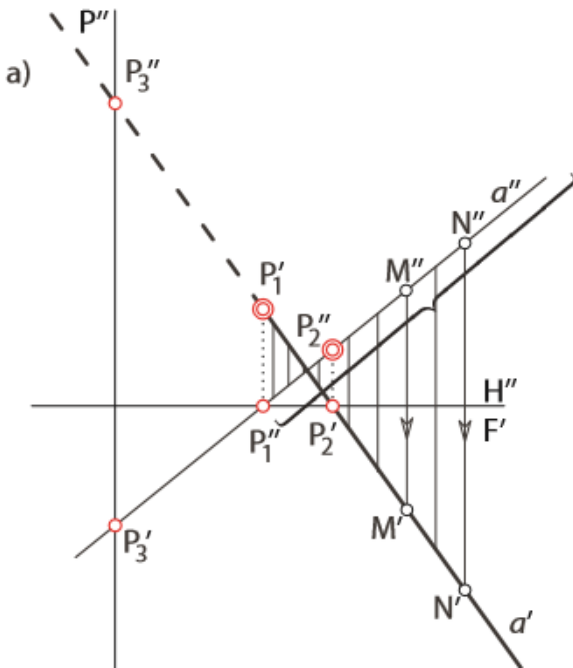
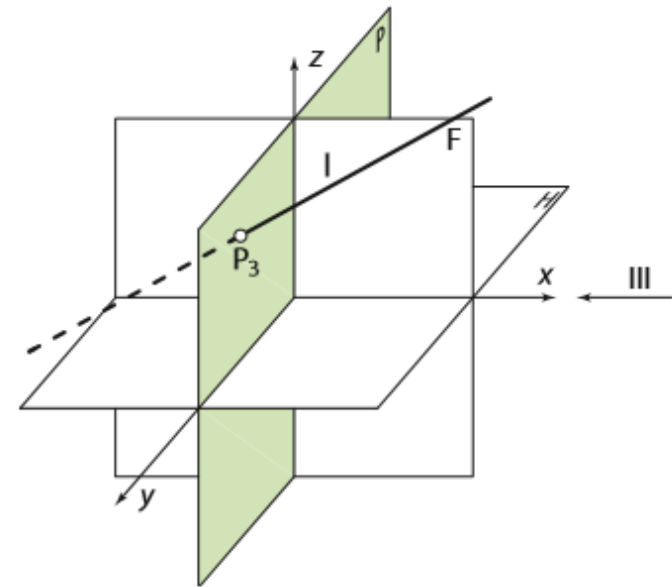
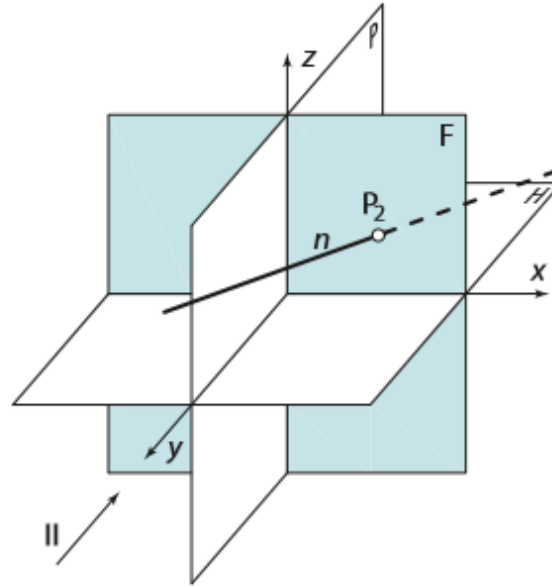
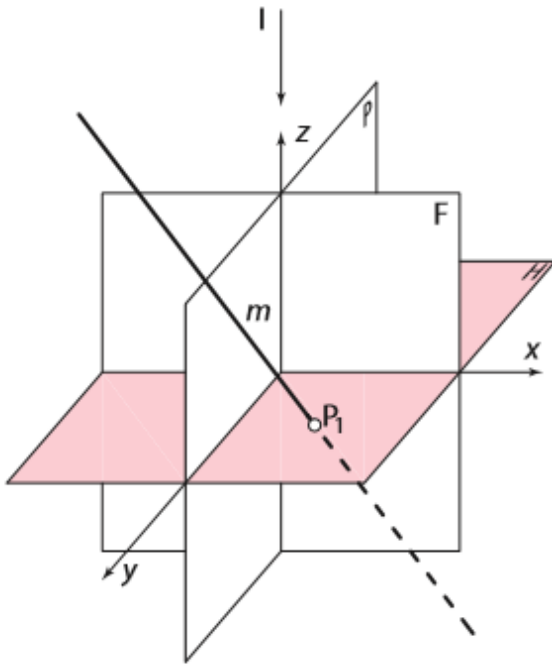
Prodori prave kroz projekcijske ravni



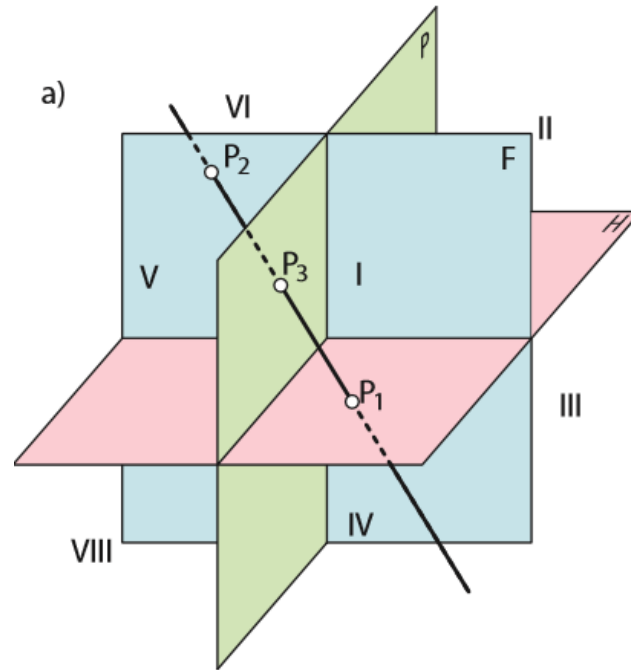
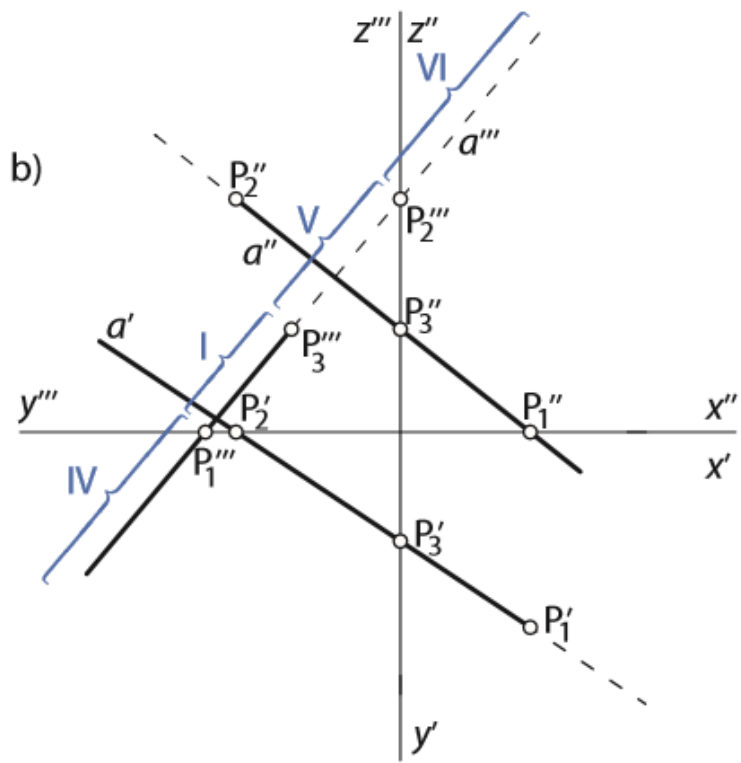
Prodori prave kroz projekcijske ravni



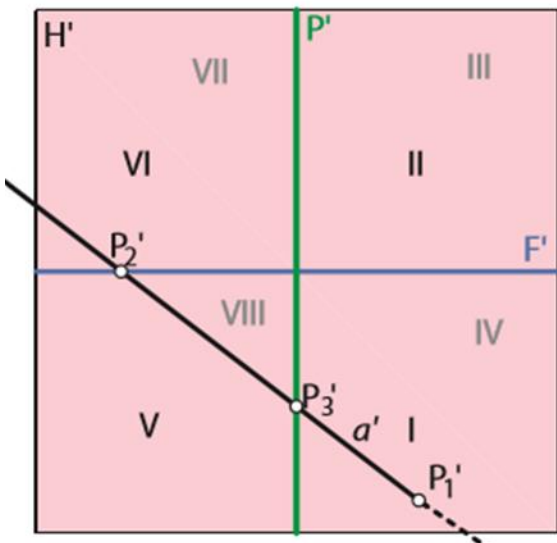
Vidljivost prave u projekcijama



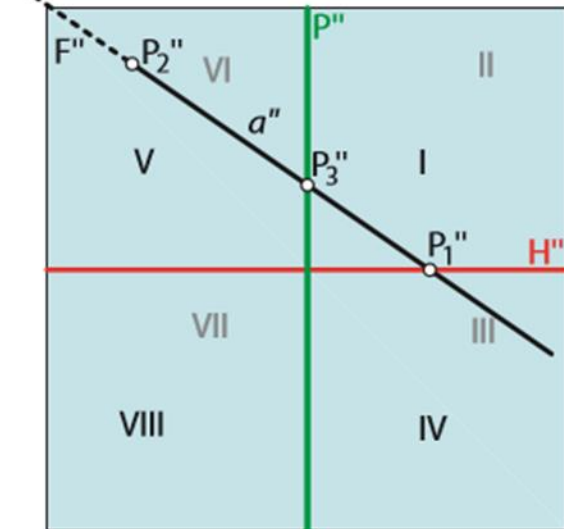
Oktanti kroz koje prava prolazi



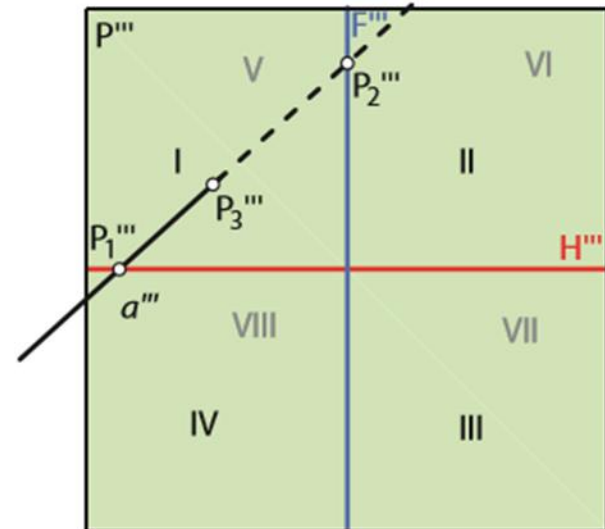
a) Prva projekcija triedra:



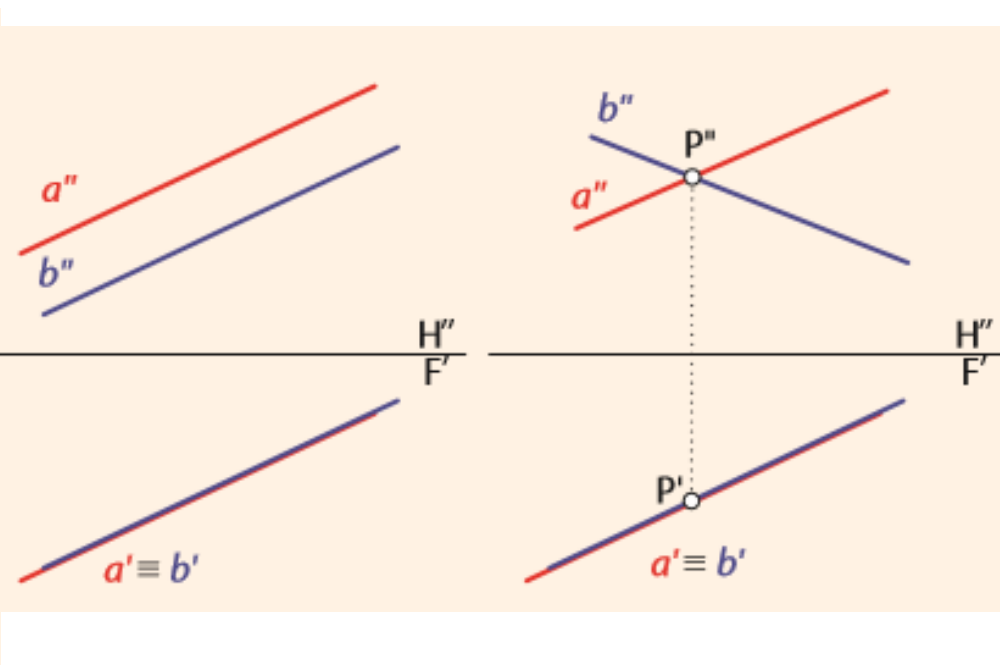
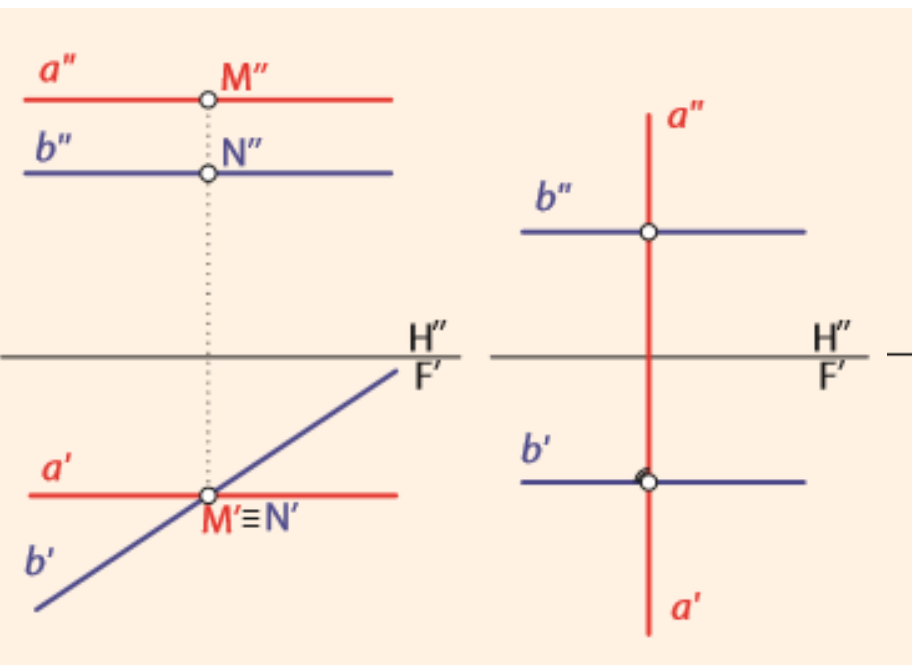
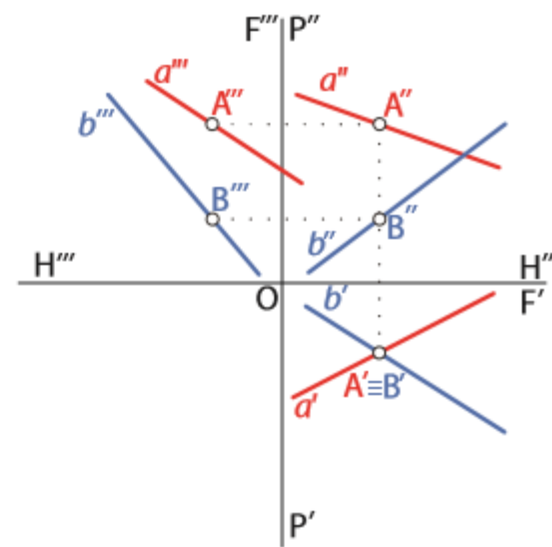
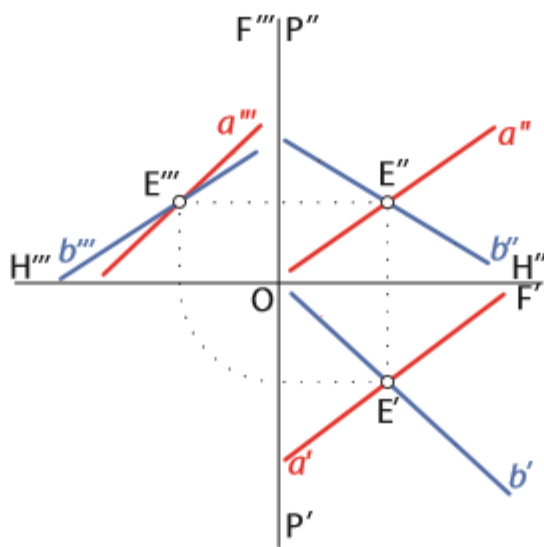
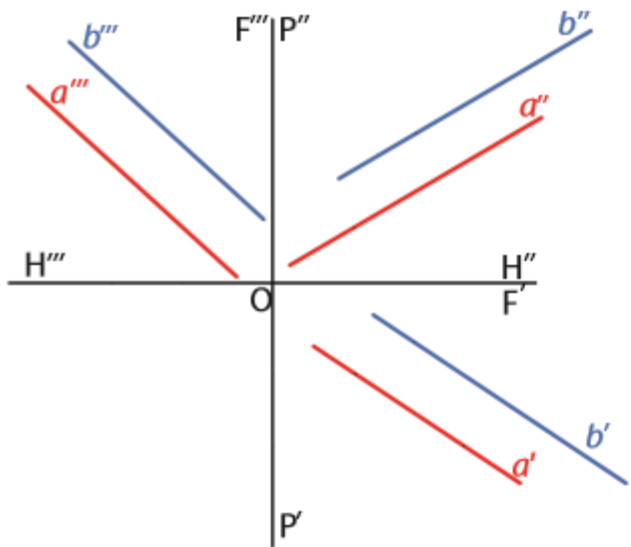
b) Druga projekcija triedra:



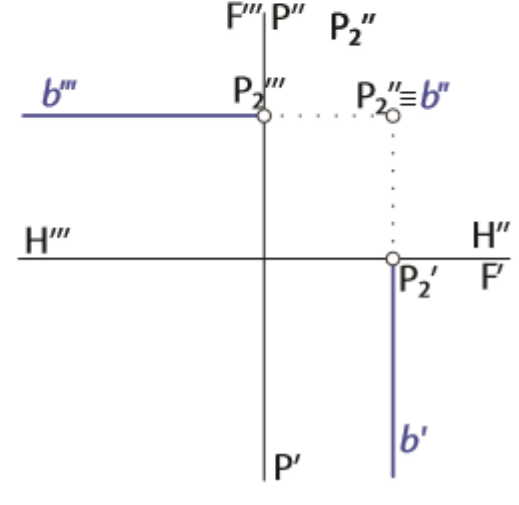
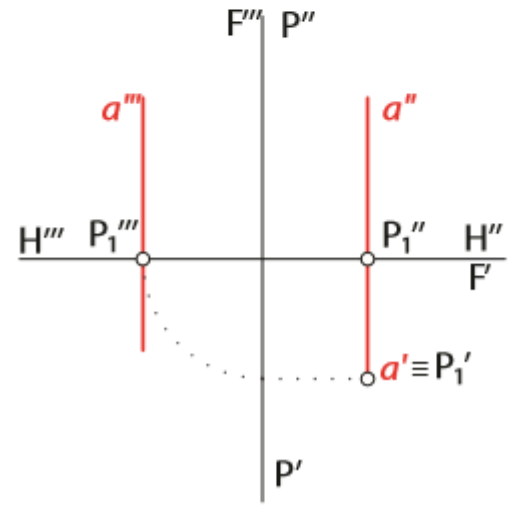
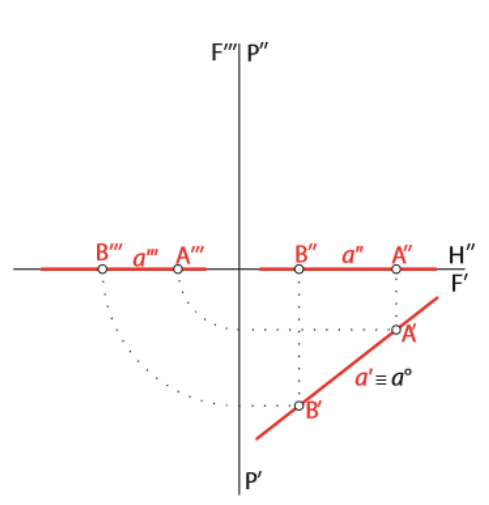
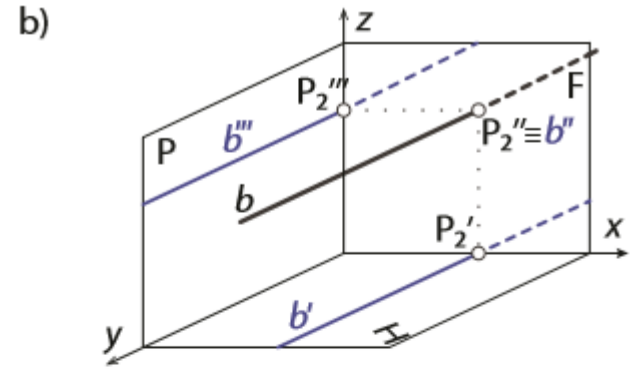
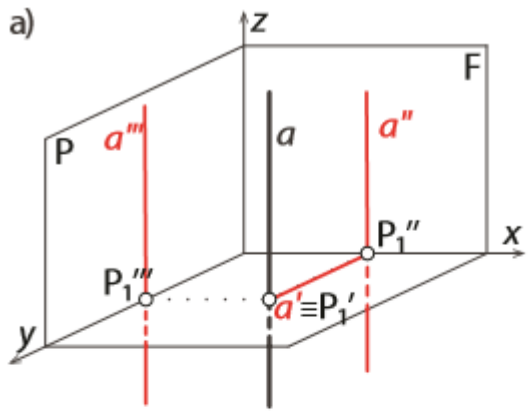
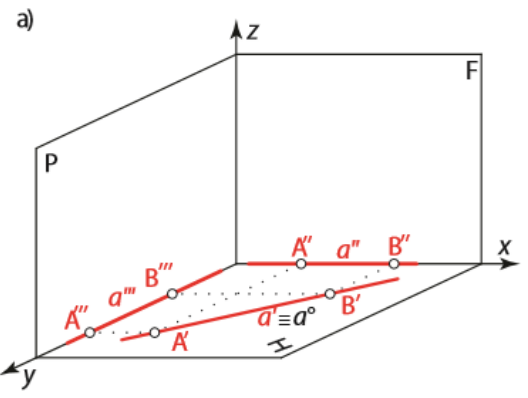
c) Treća projekcija triedra:

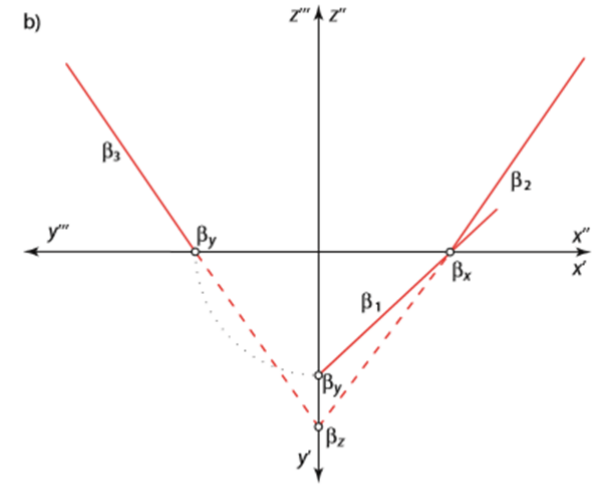
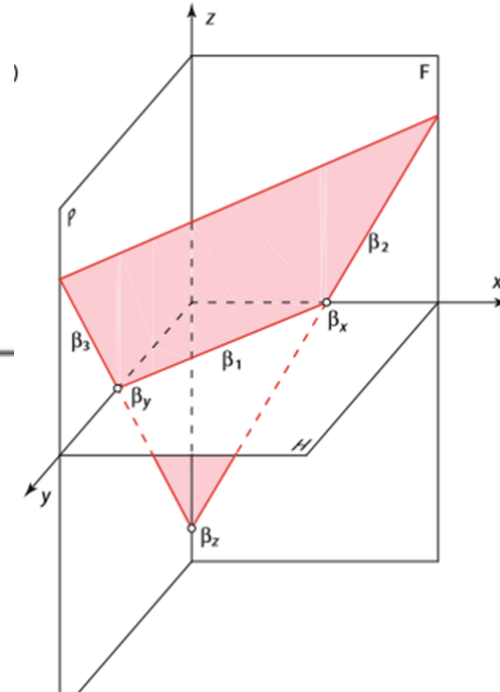
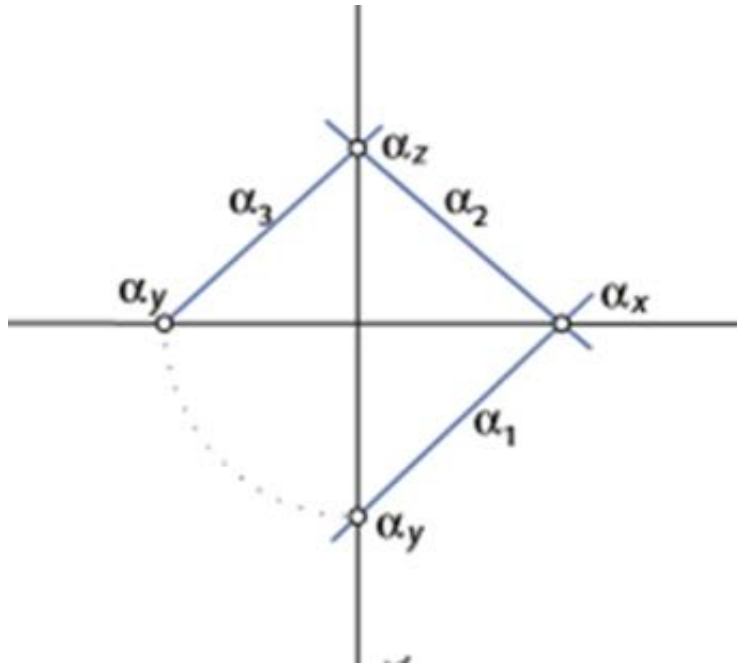
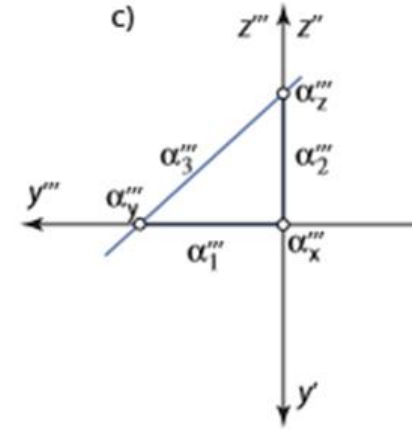
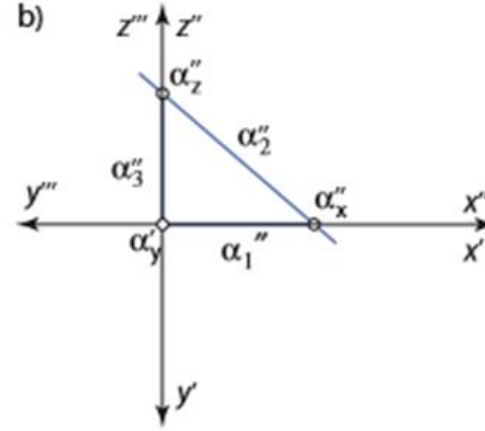
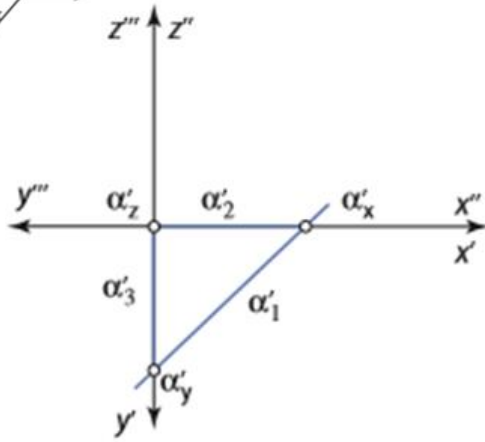
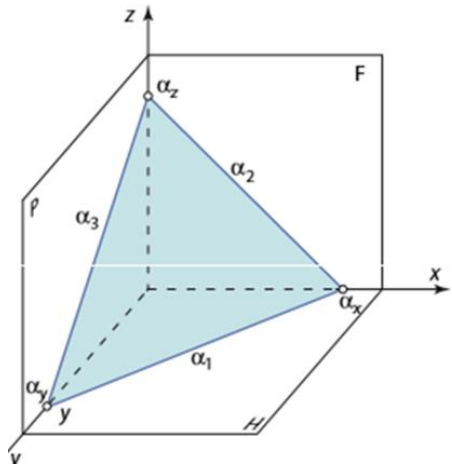


Međusobni položaj dvije prave

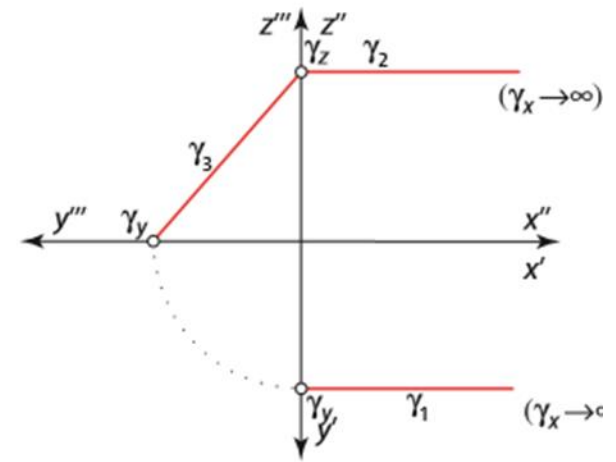
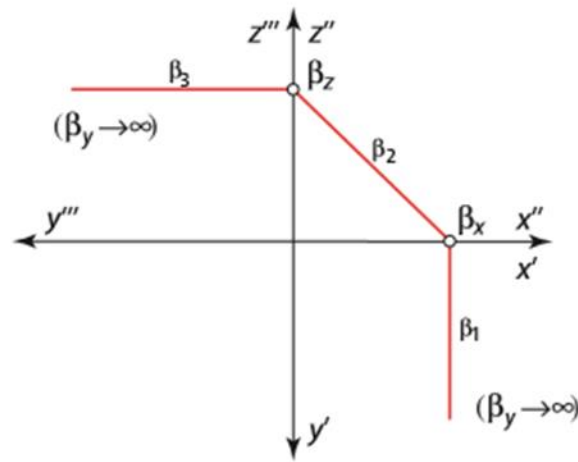
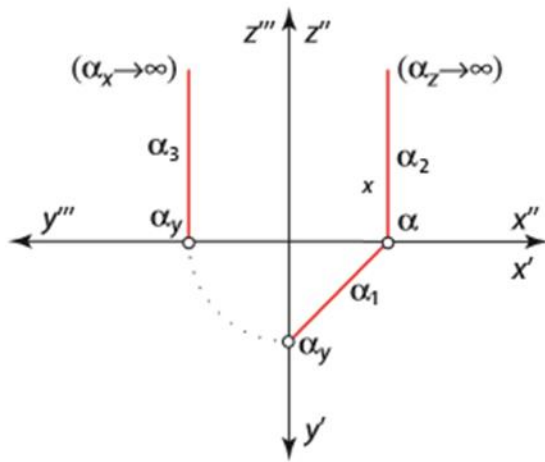
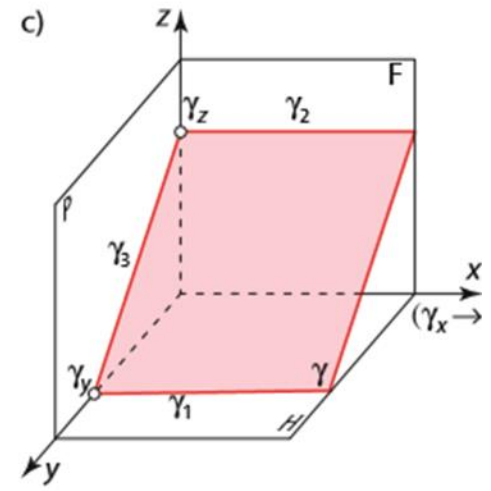
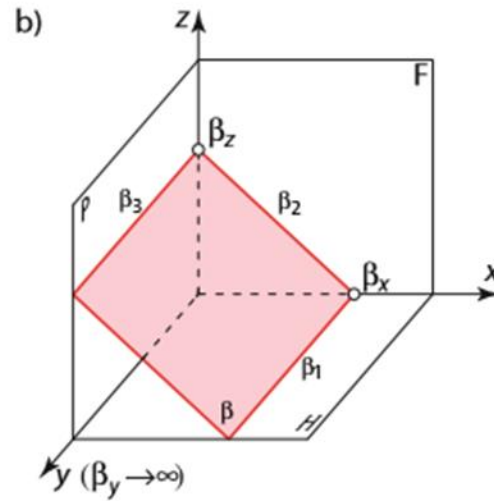
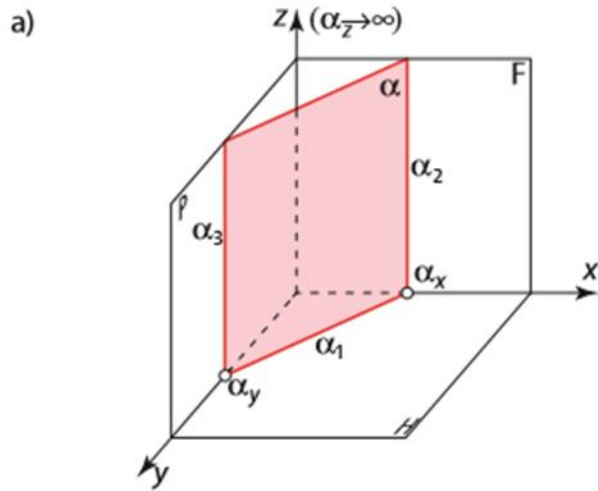


Prave u specijalnom položaju



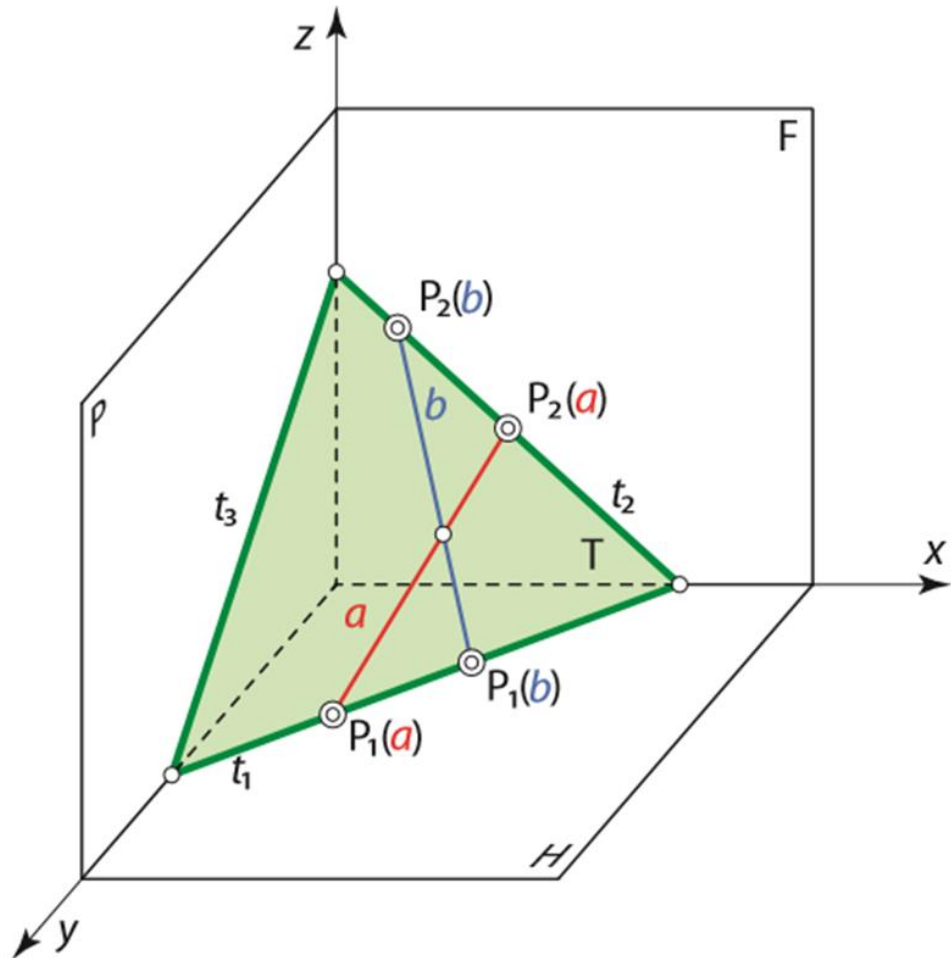
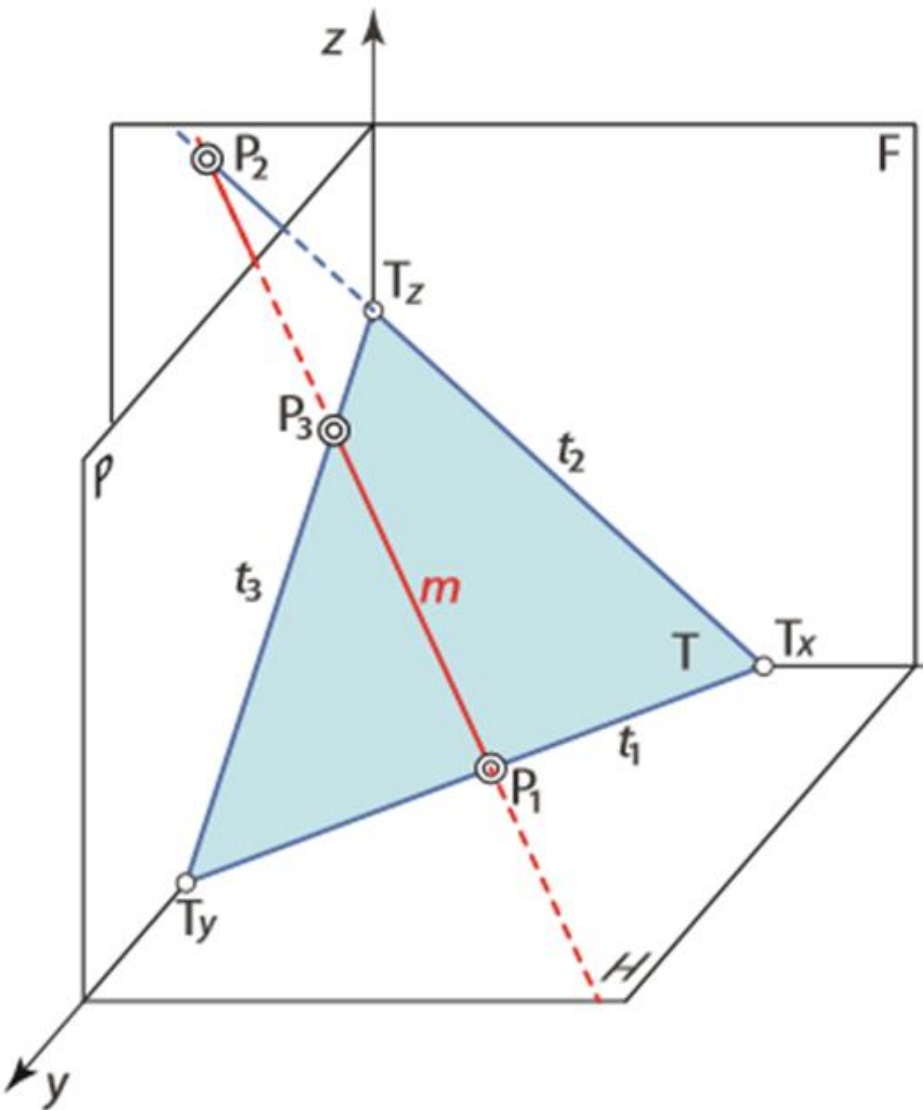


Ravni u specijalnom položaju

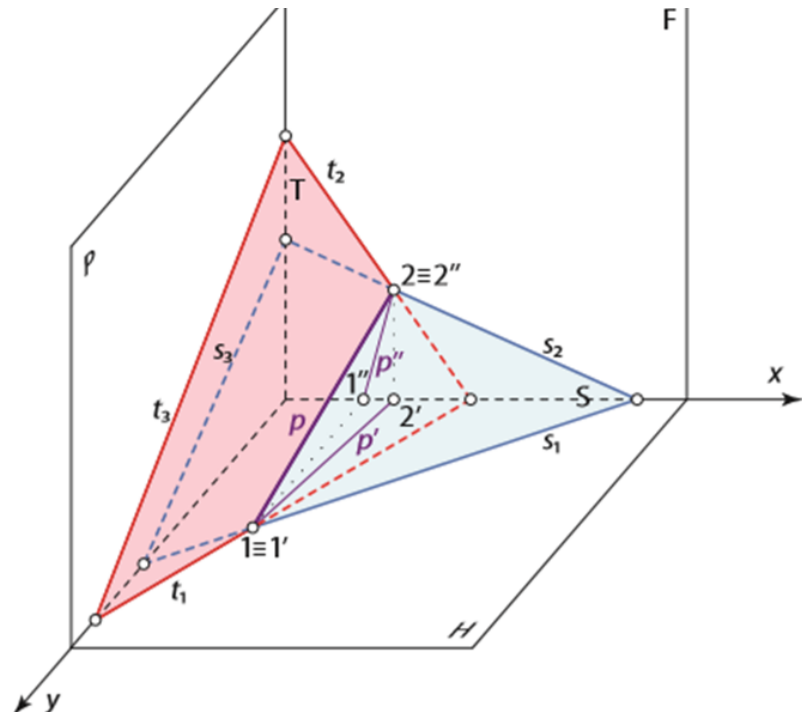
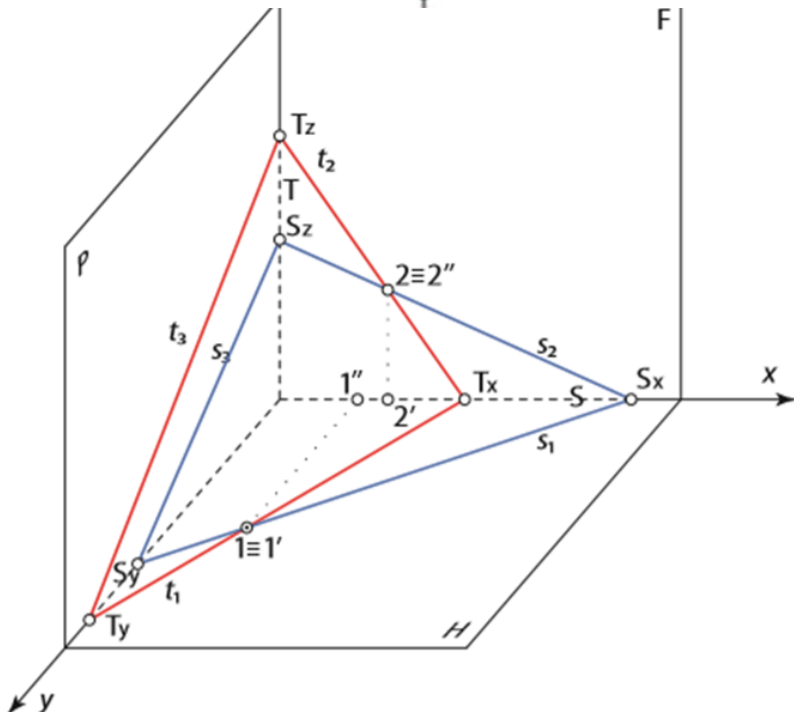
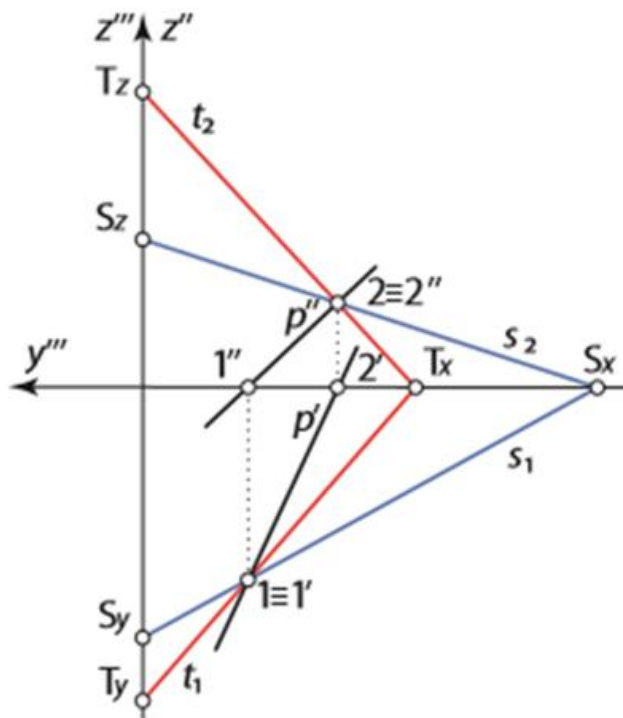


Pripadnost prave i tačke ravni

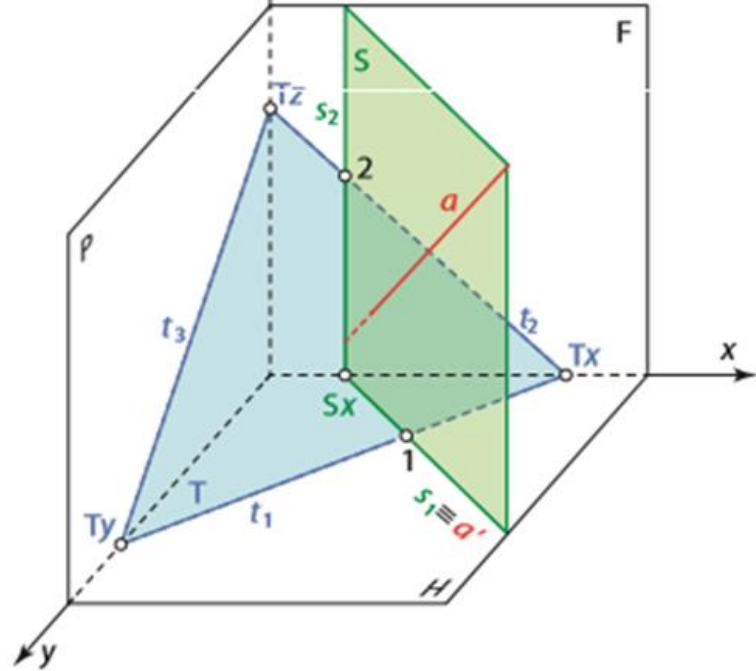
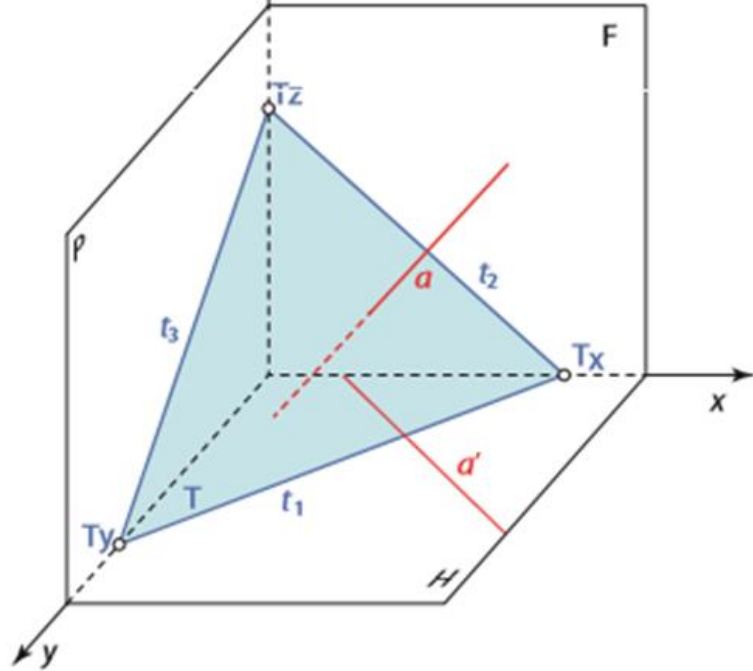
$$m \in T \Leftrightarrow P_1 \in t_1 \wedge P_2 \in t_2 \wedge P_3 \in t_3$$



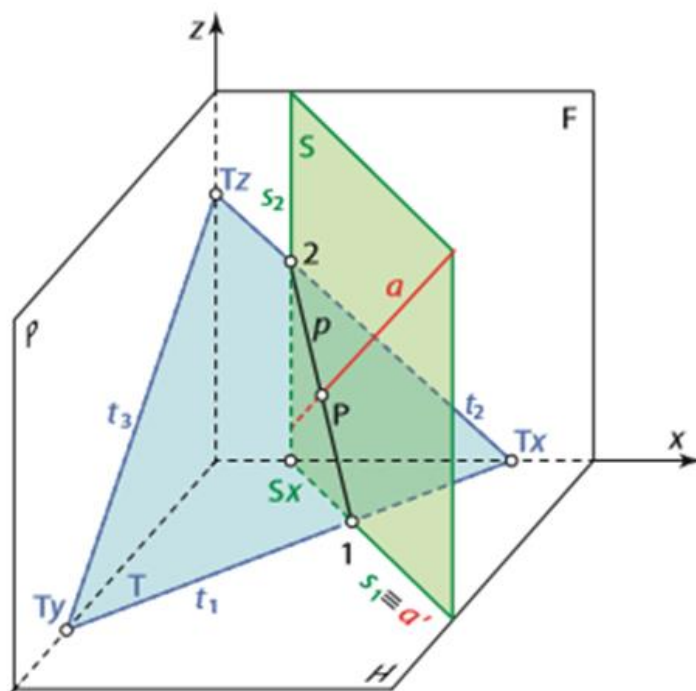
Presjek dvije ravni



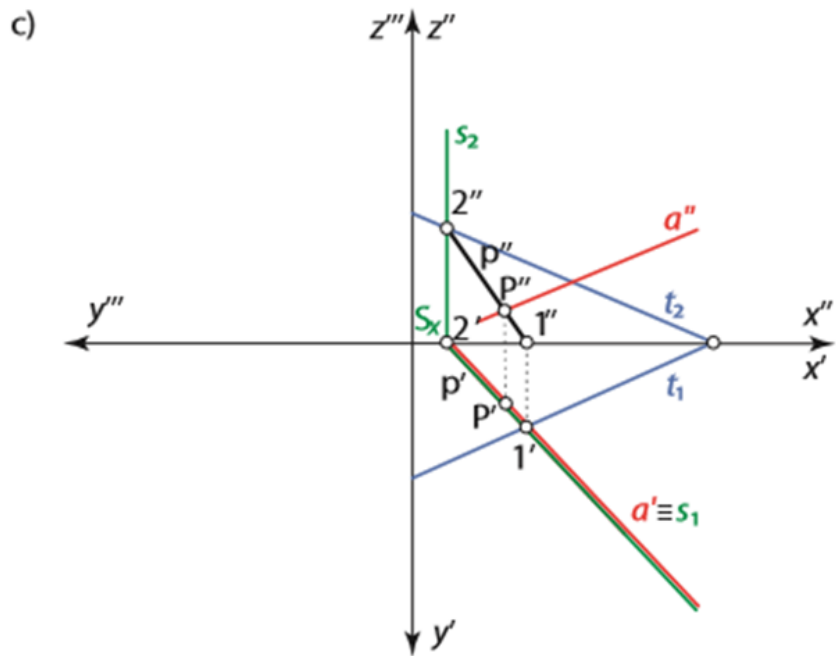
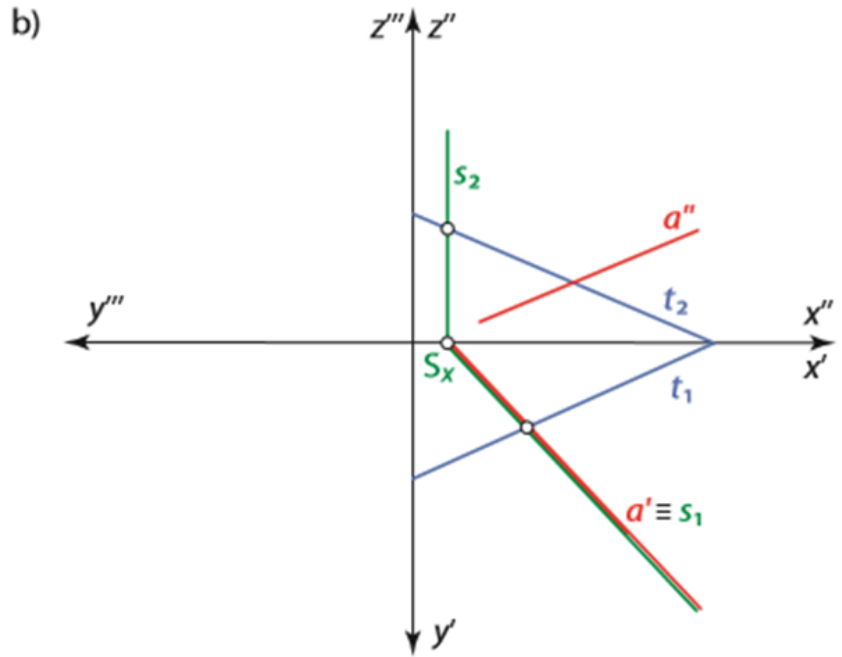
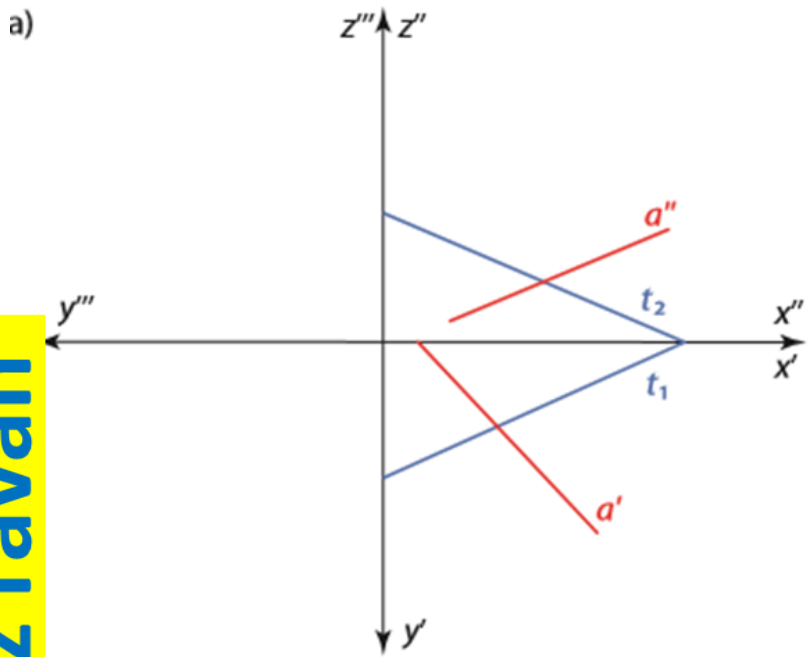
Prodor prave kroz ravan



c)

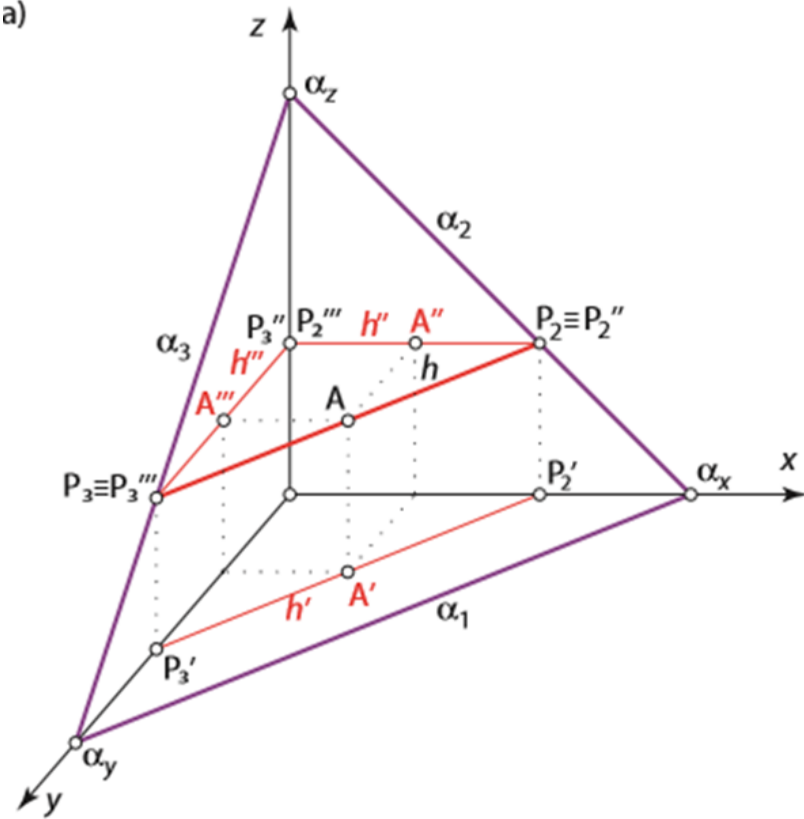


Prodor prave kroz ravan

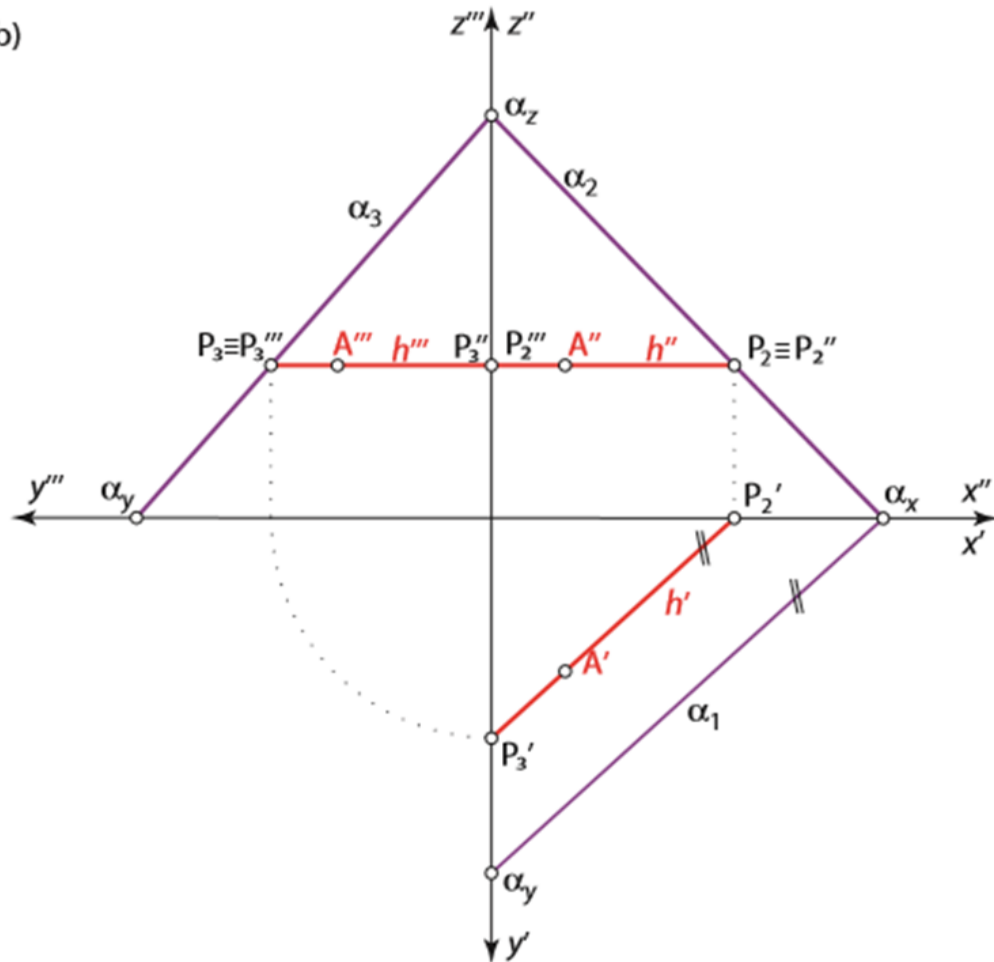


Specijalne prave u ravni – horizontala (h)

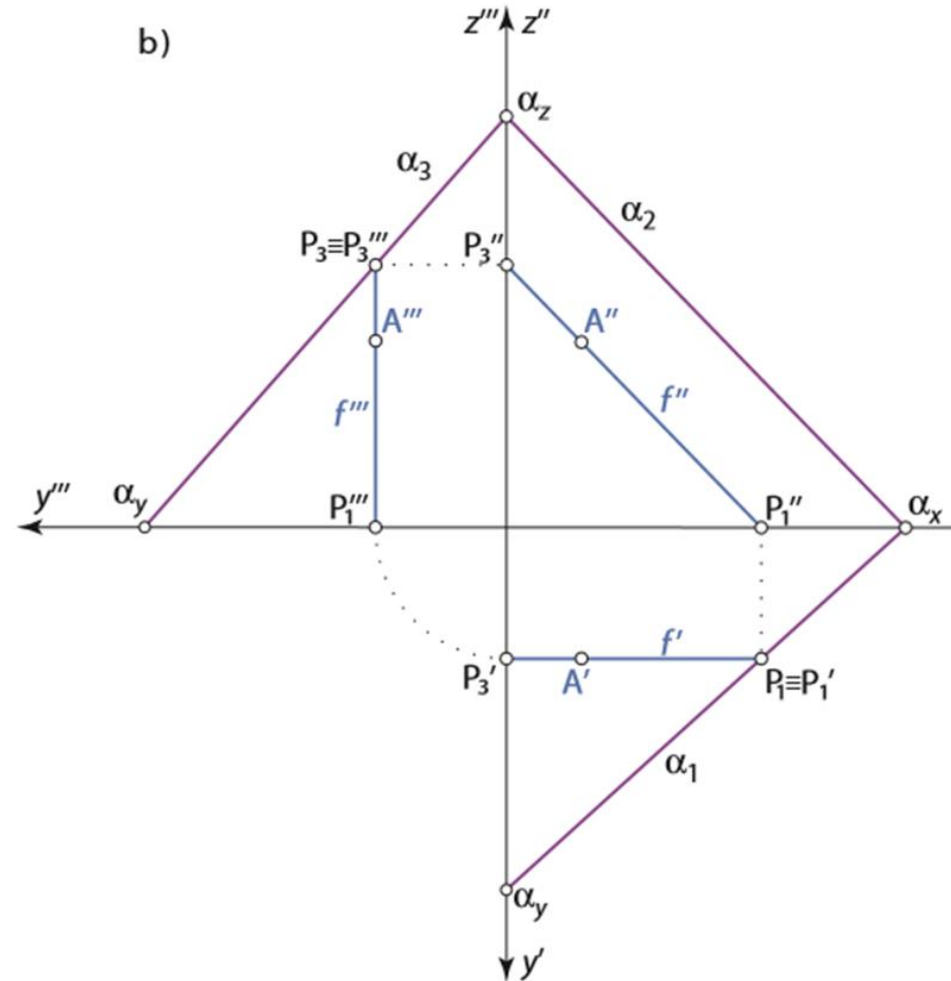
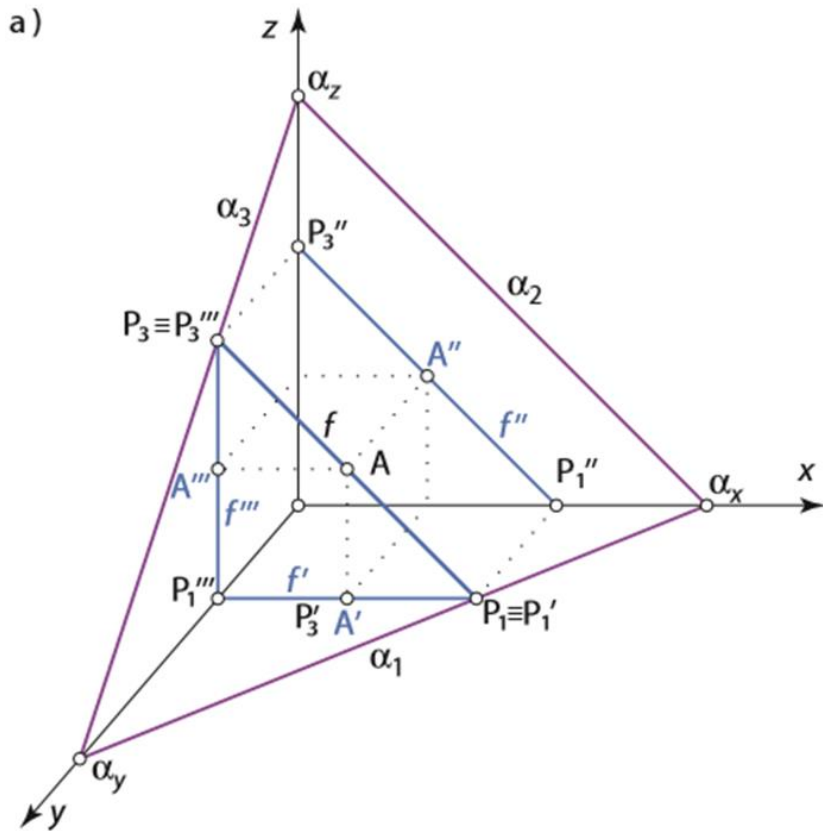
a)



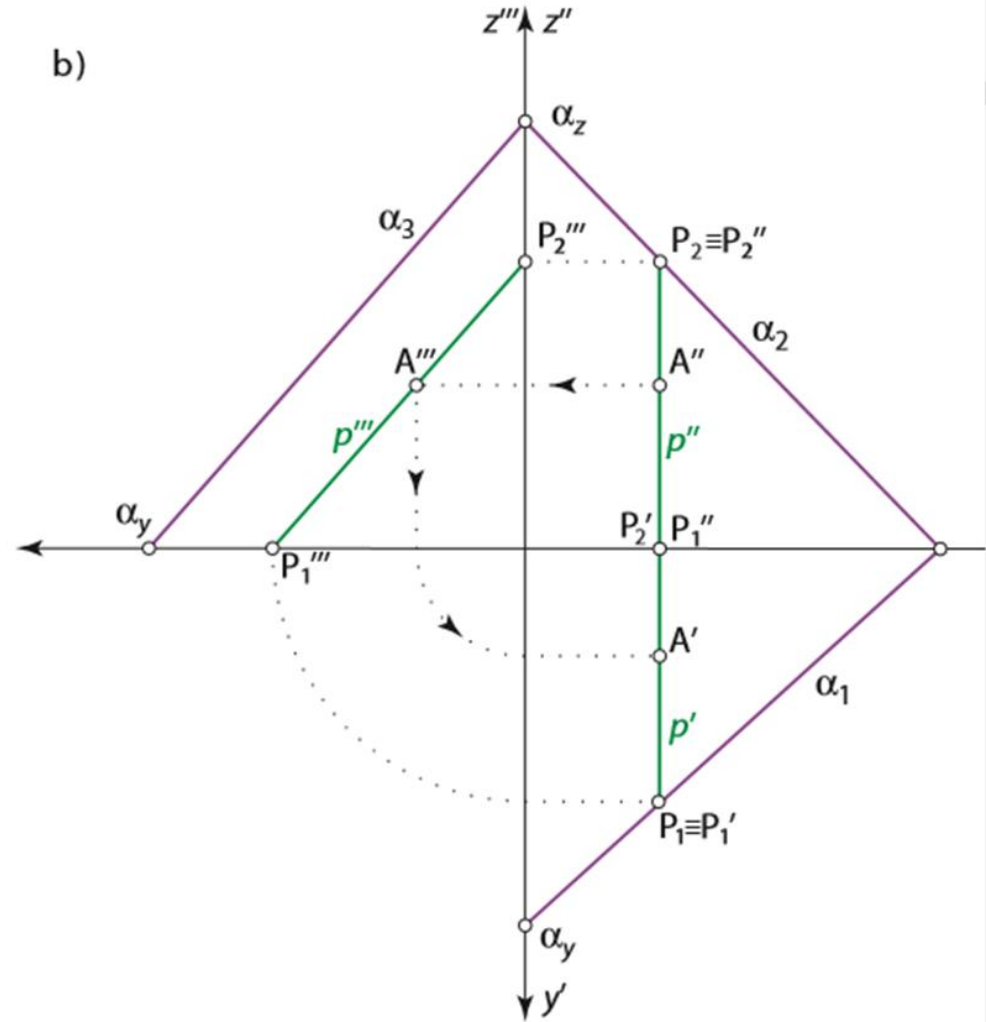
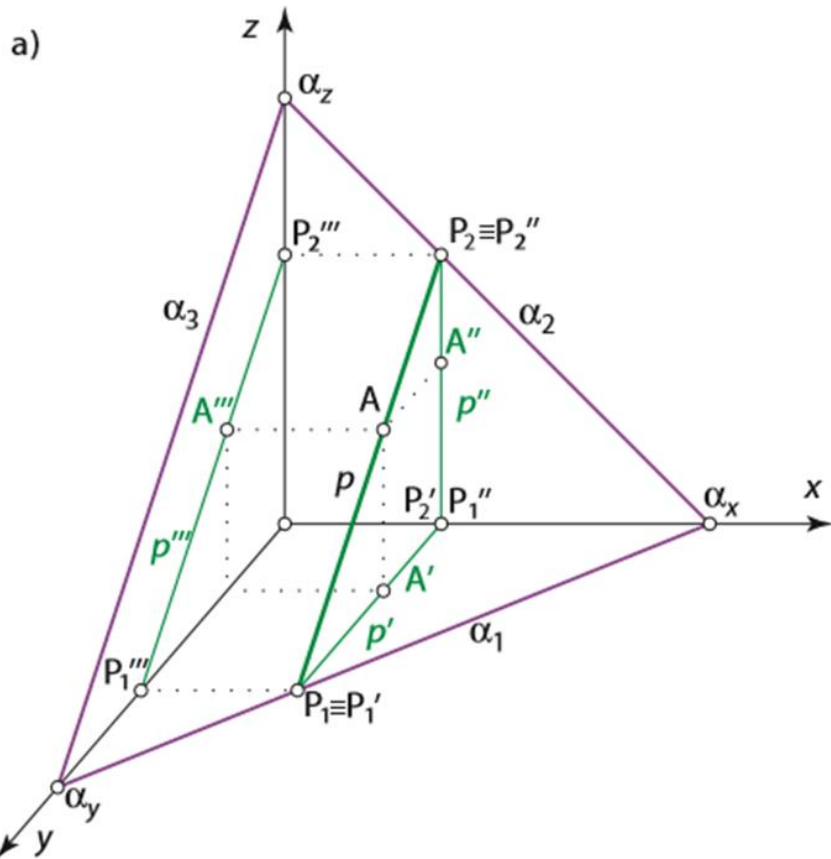
b)



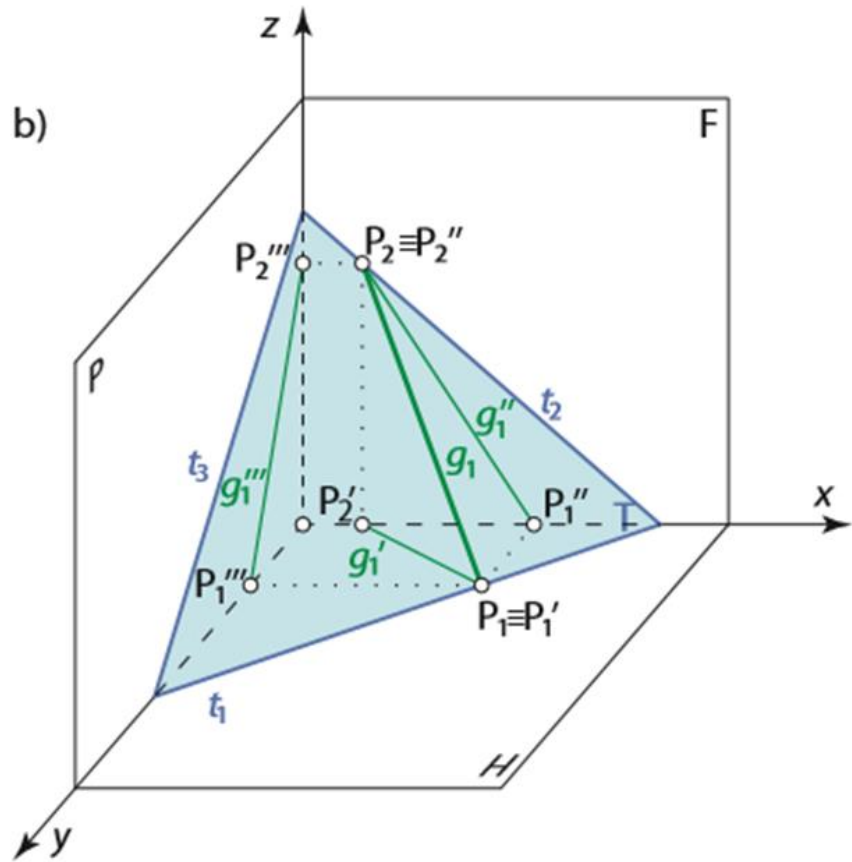
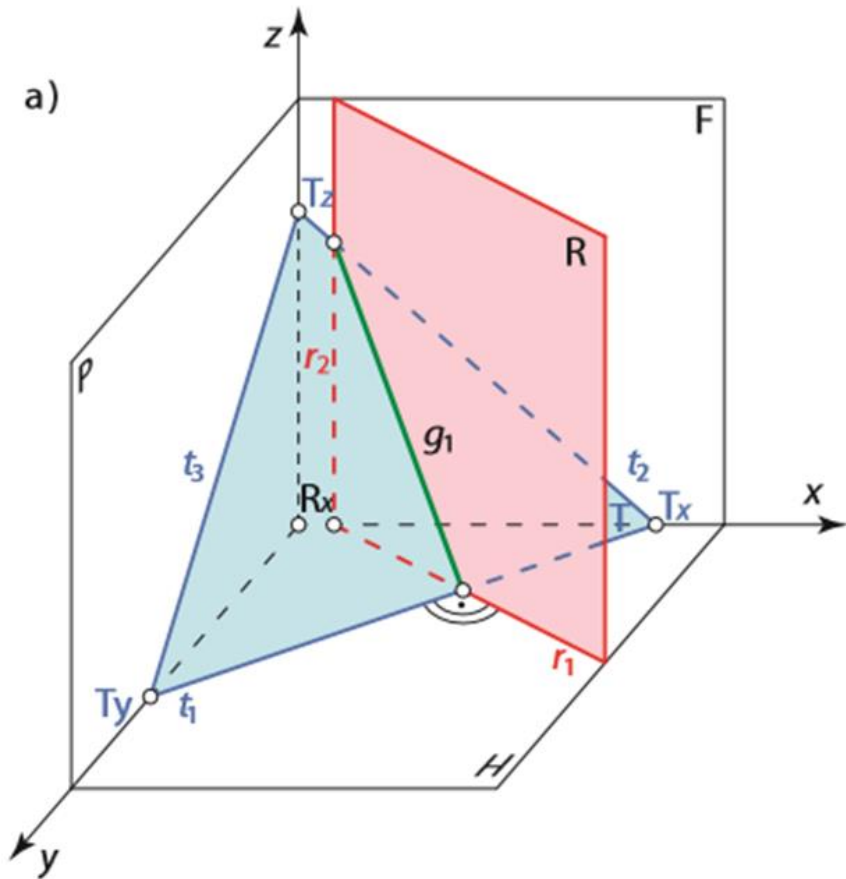
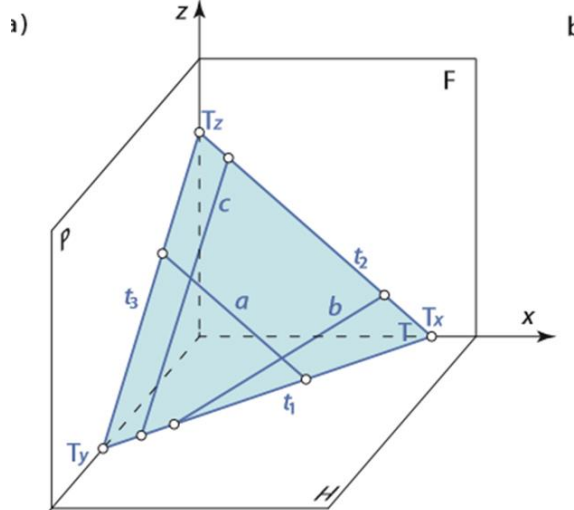
Specijalne prave u ravni – frontala (f)



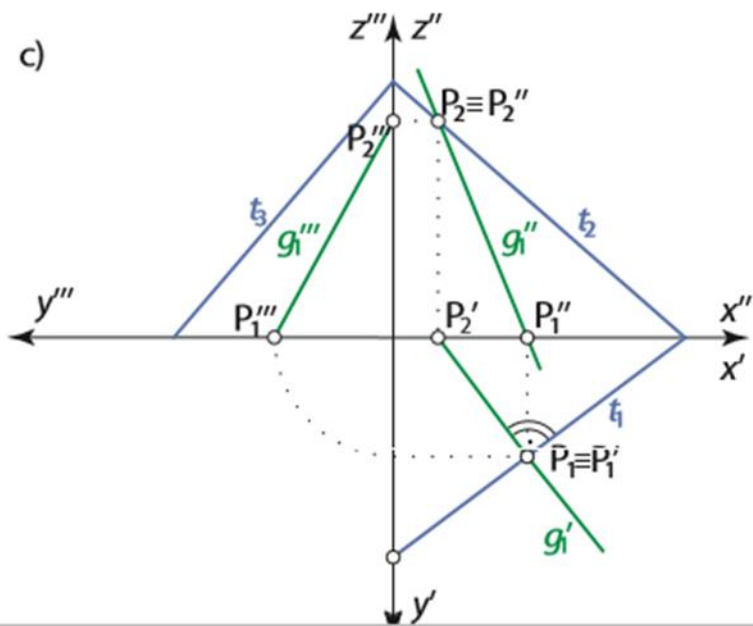
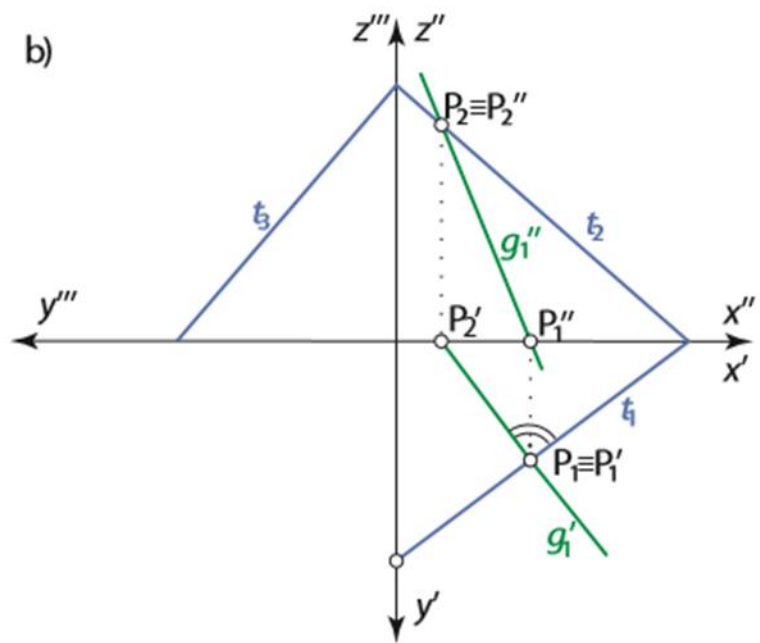
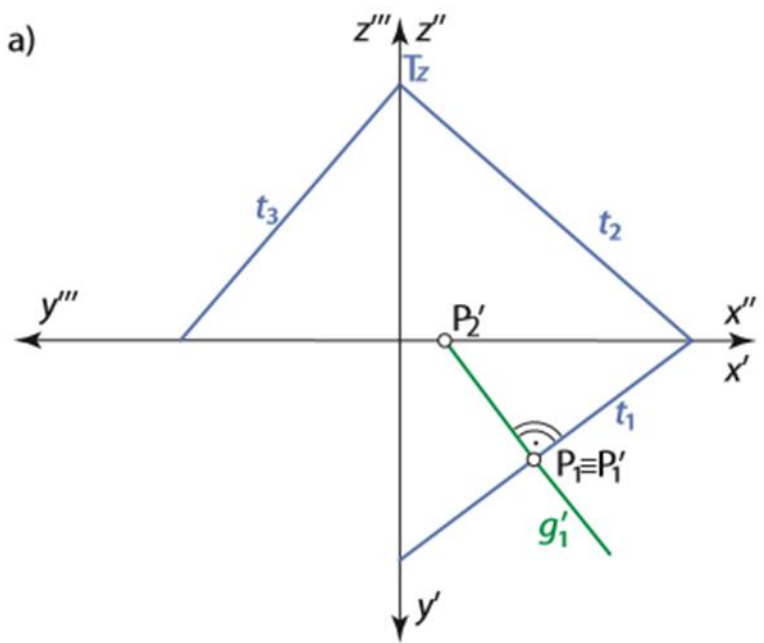
Specijalne prave u ravni – profila (p)



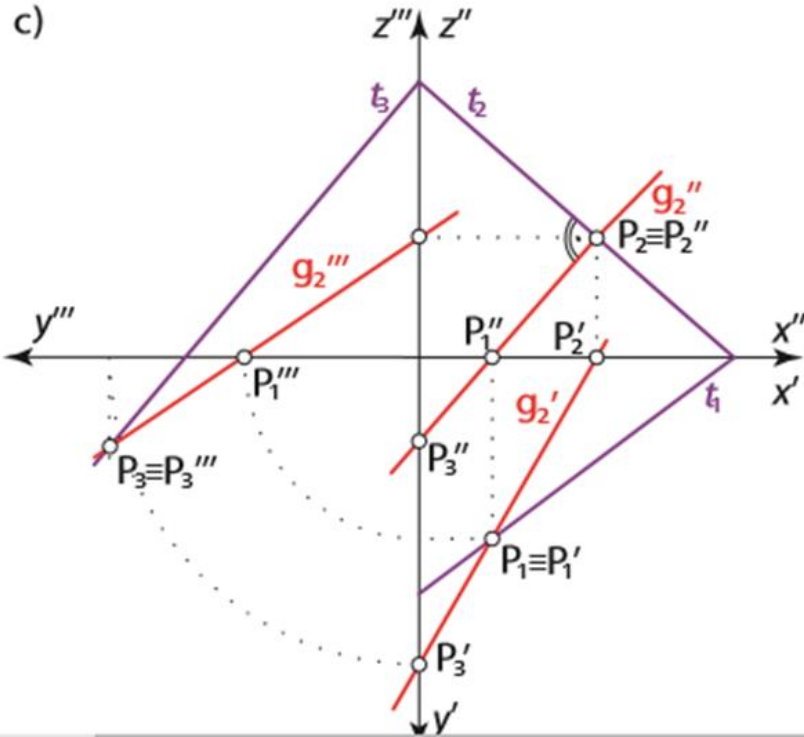
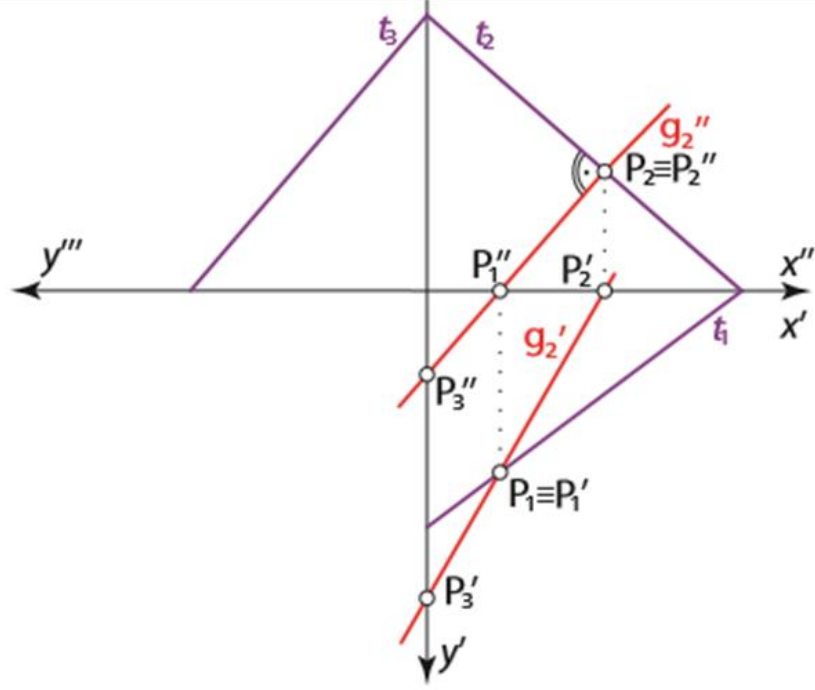
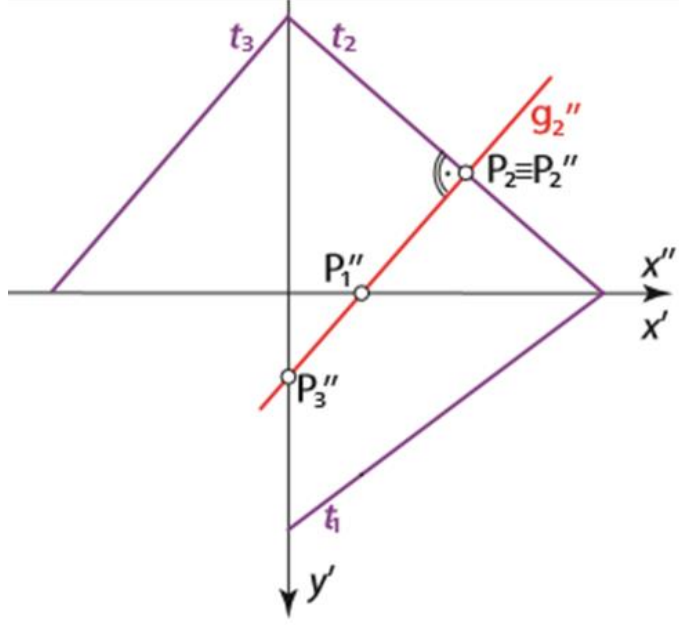
Specijalne prave u ravni – prva nagibnica (g_1)



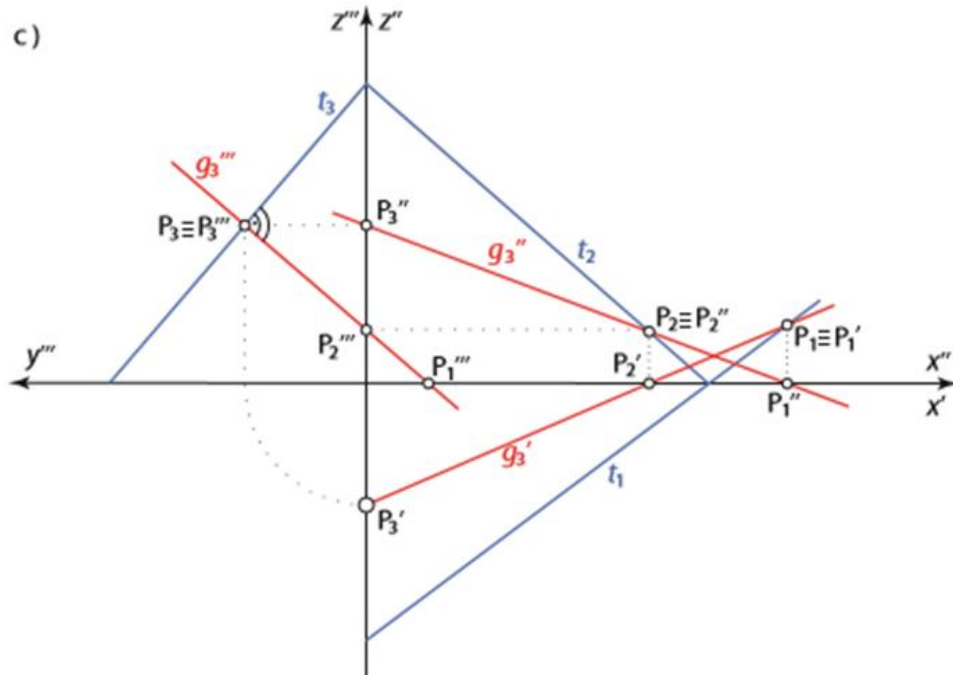
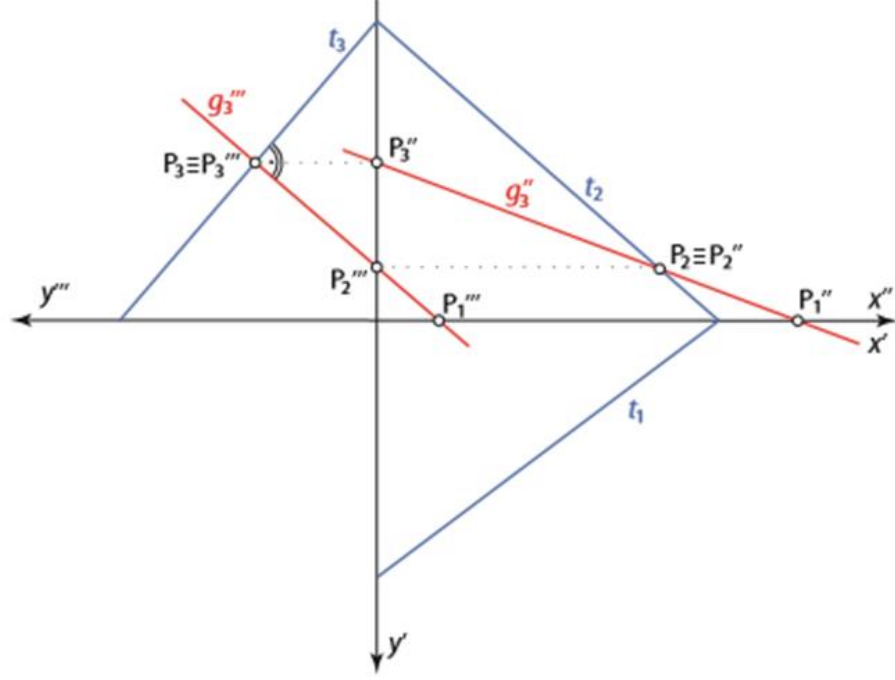
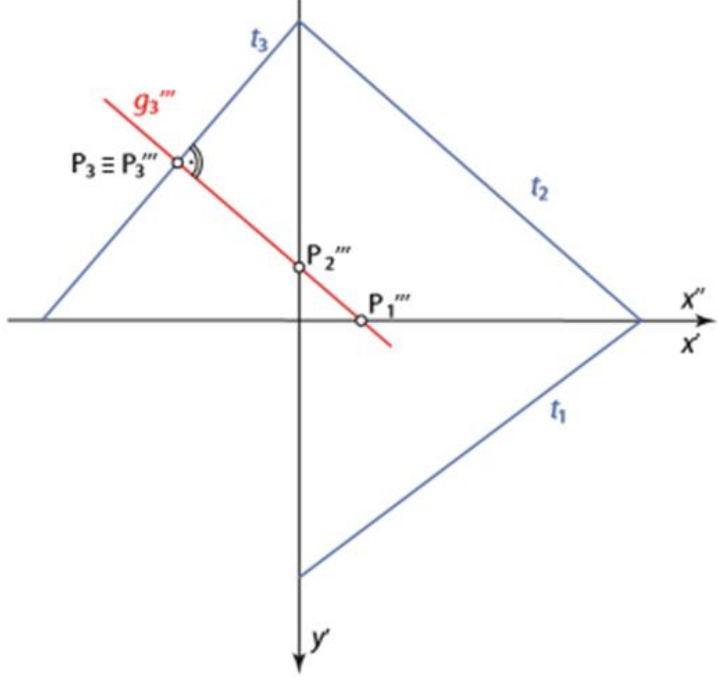
Specijalne prave u ravni – prva nagibnica (g_1)



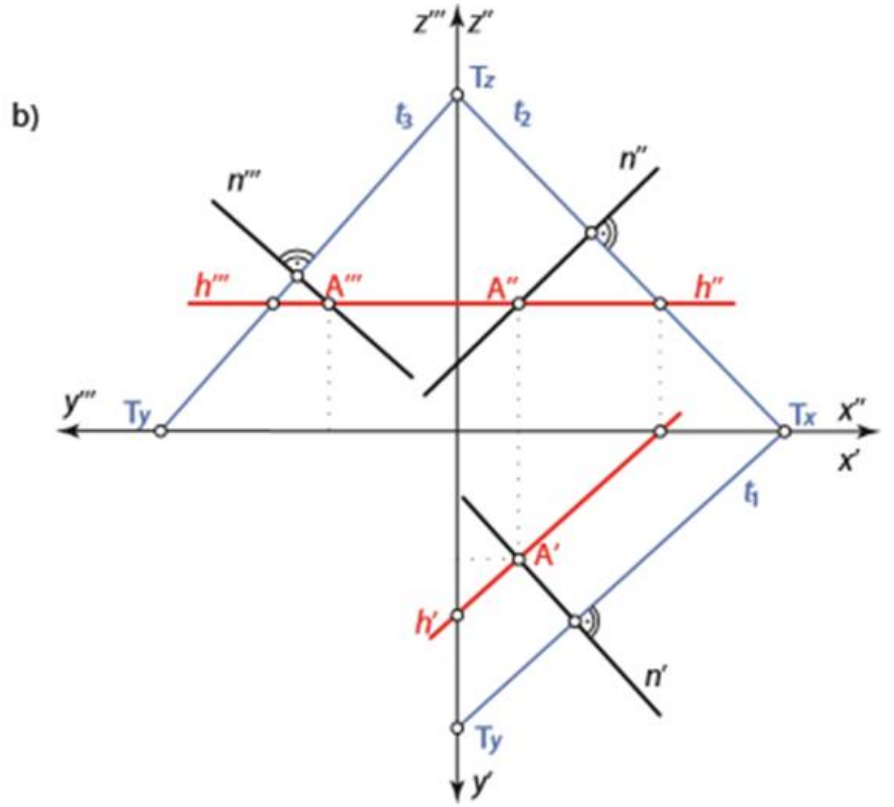
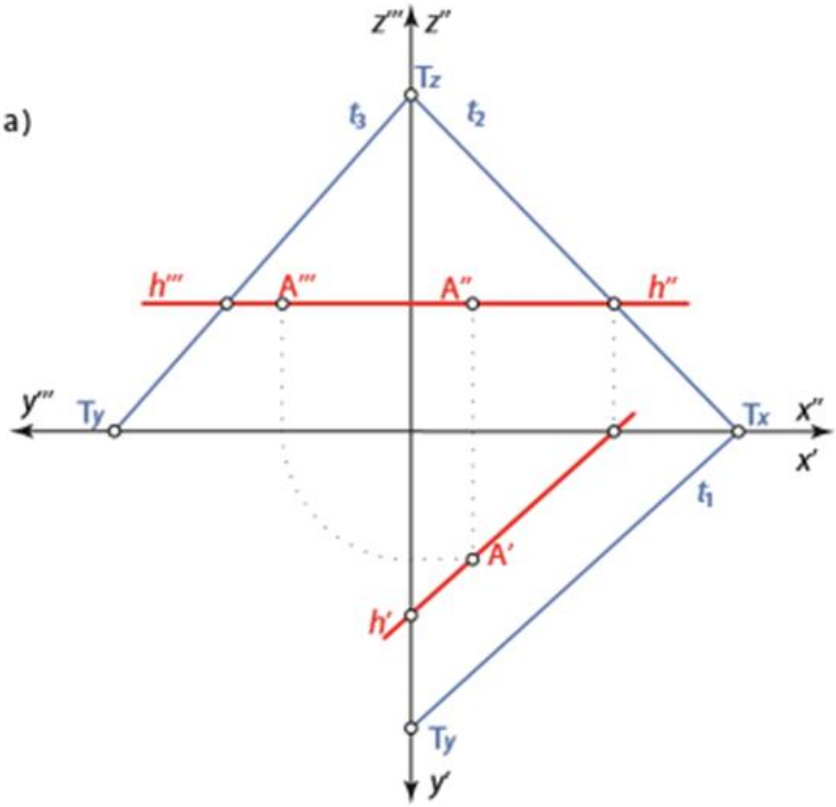
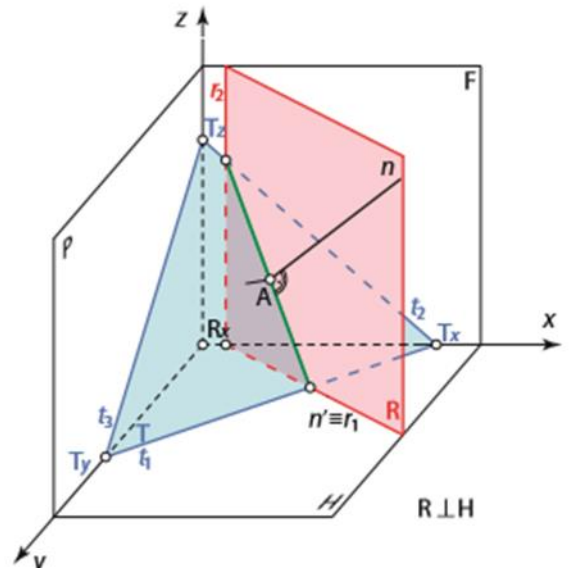
Specijalne prave u ravni – druga nagibnica (g_2)

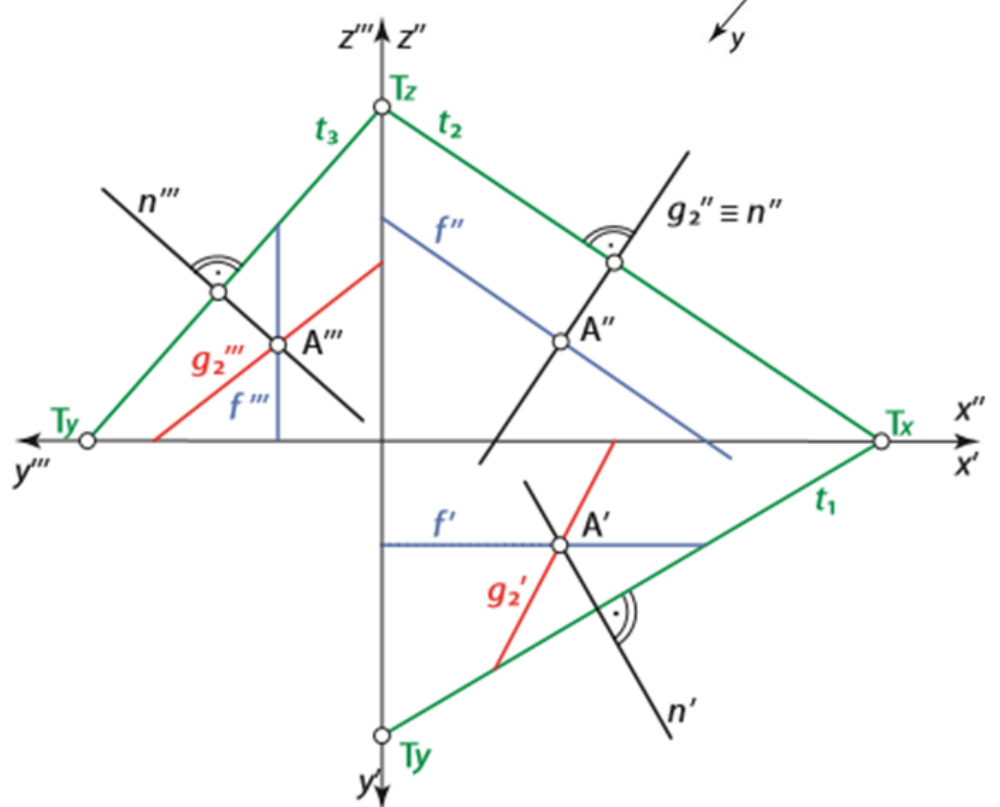
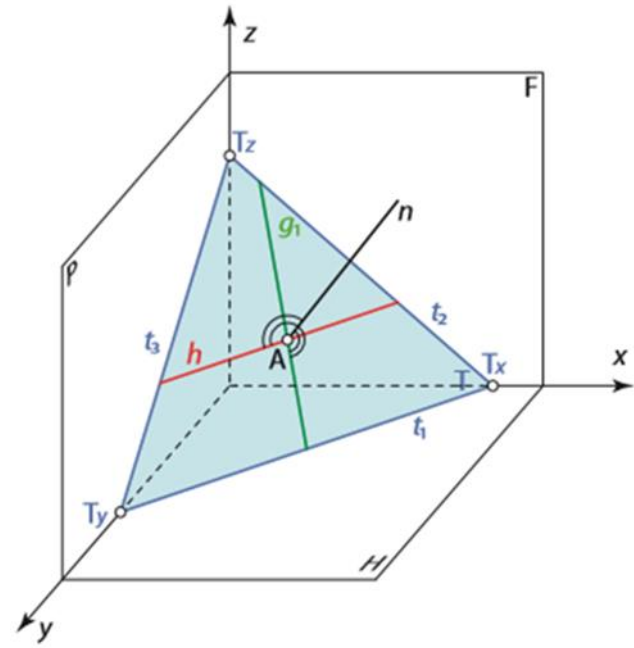


Specijalne prave u ravni – treća nagibnica (g_3)



Normala (n) – prava upravna na ravan



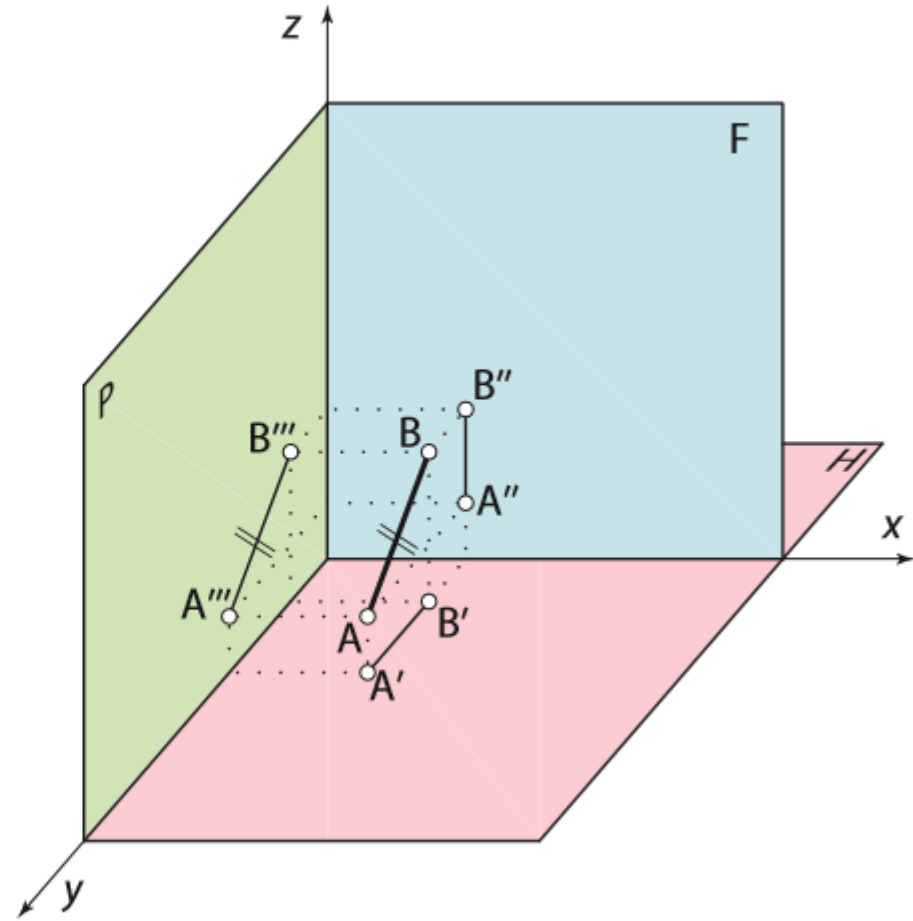
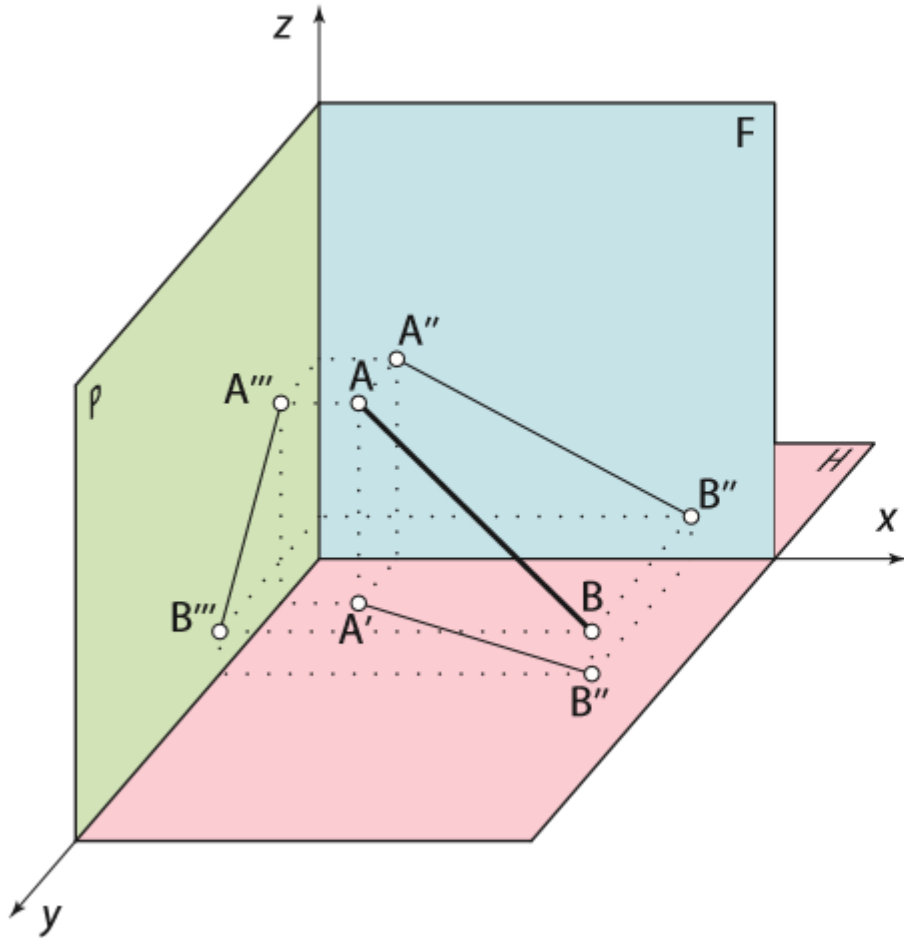


Nagibni triedri

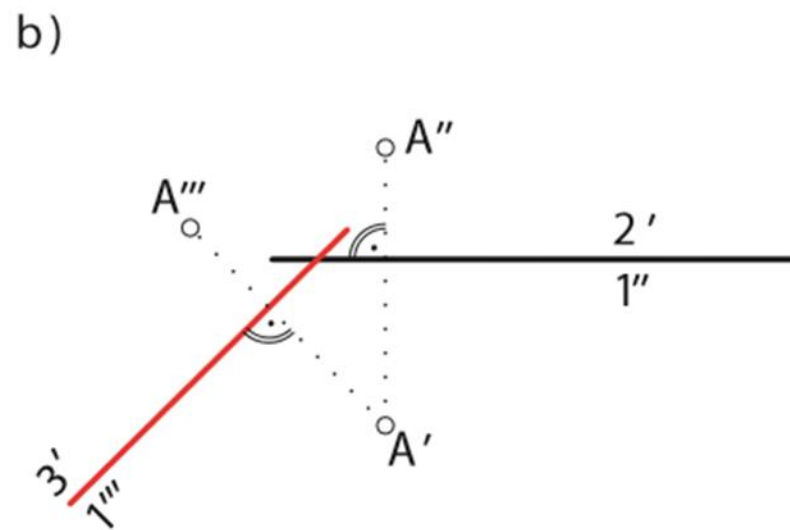
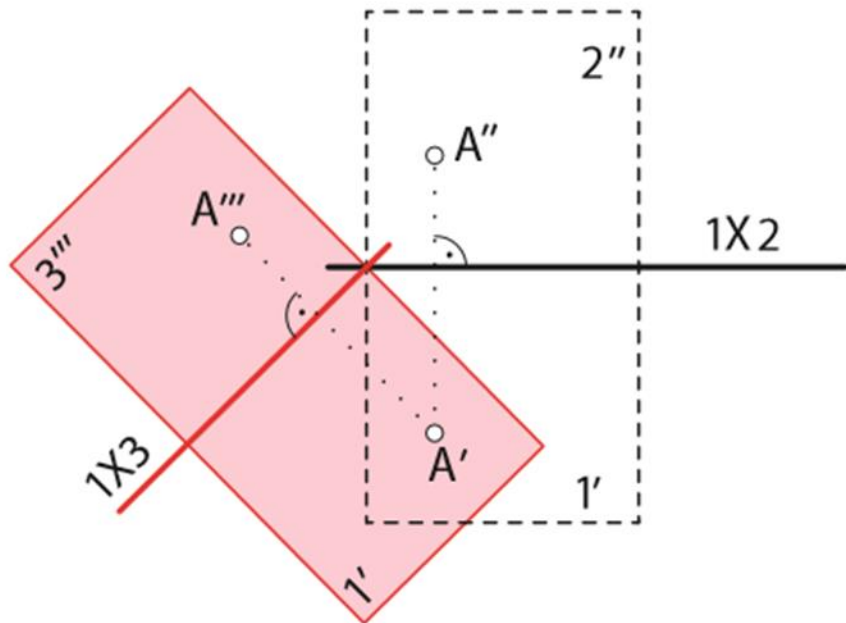
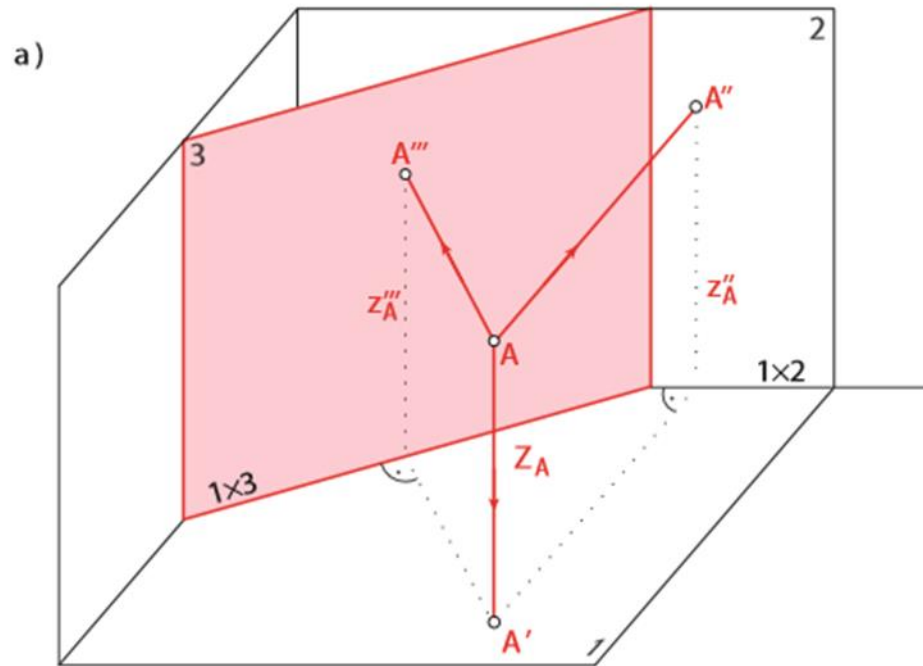
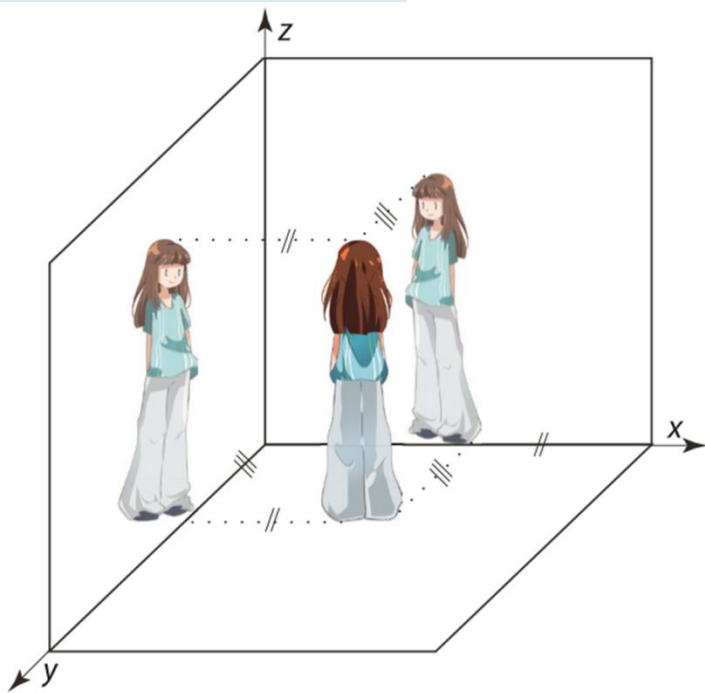
Postupci određivanja prave veličine duži i uglova

- Transformacija
 - Rotacija
- Obaranje ravni

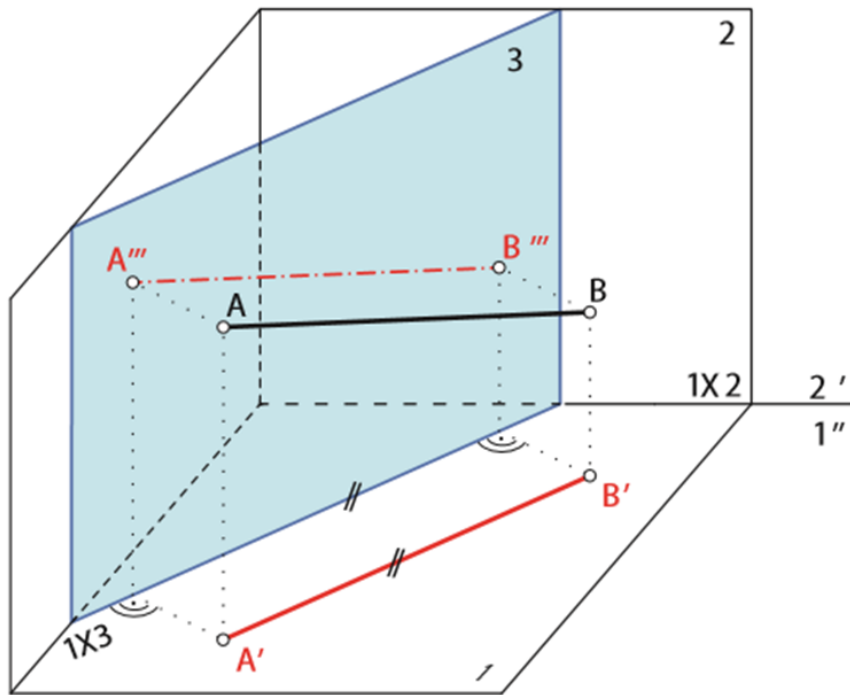
Prava, duž



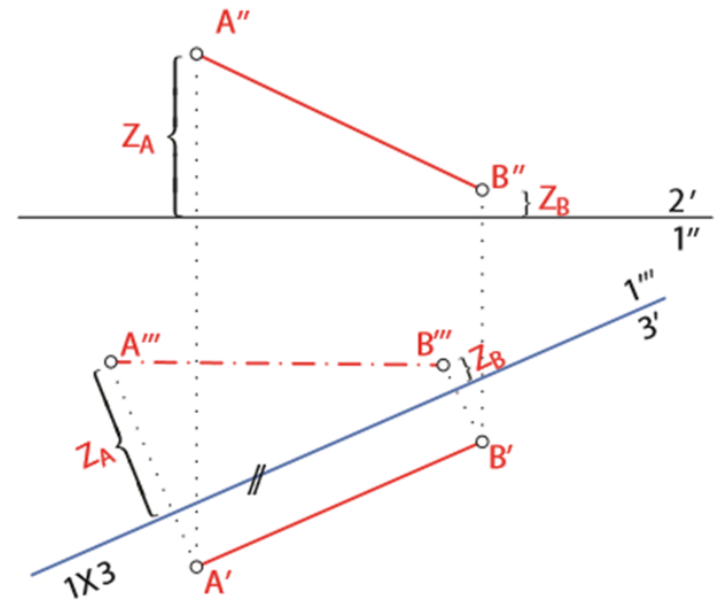
Transformacija



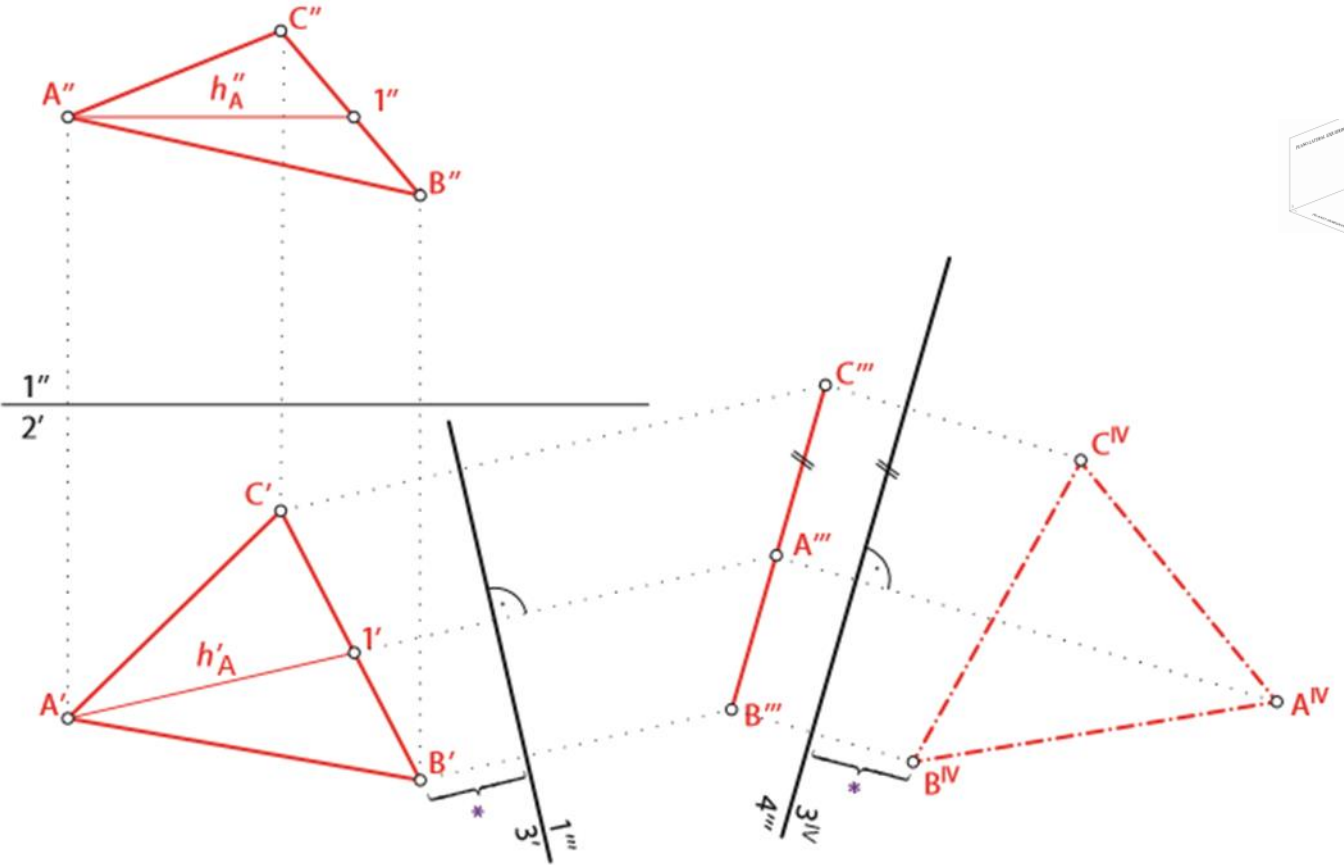
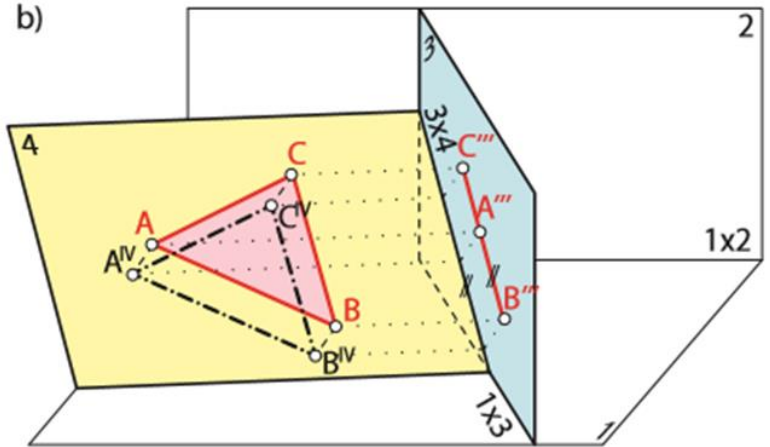
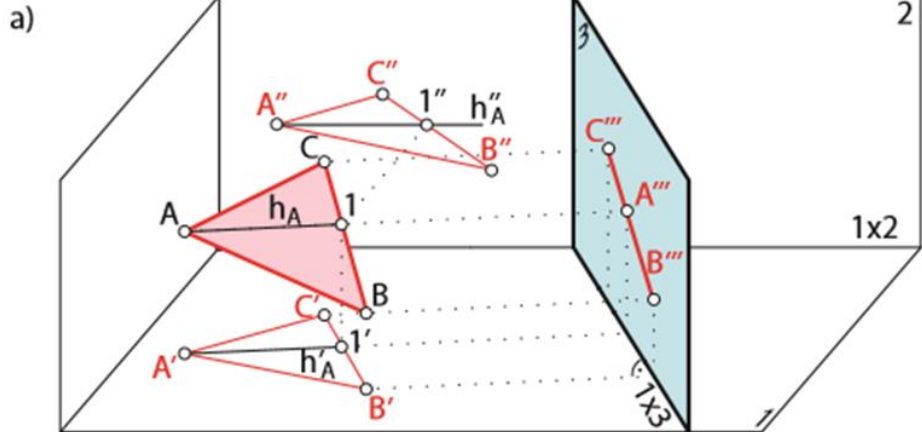
Određivanje prave veličine duži i ugla - transformacija



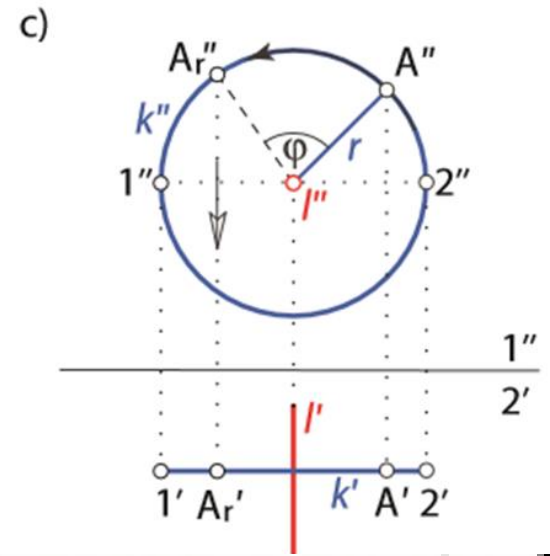
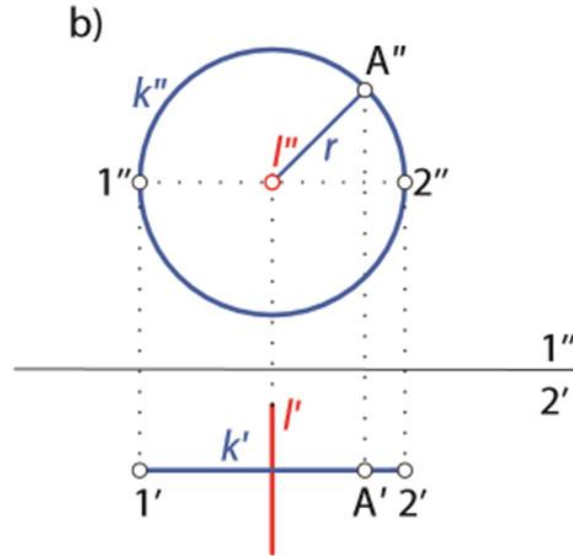
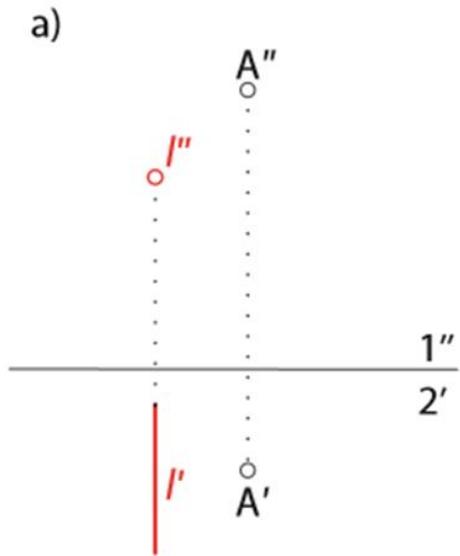
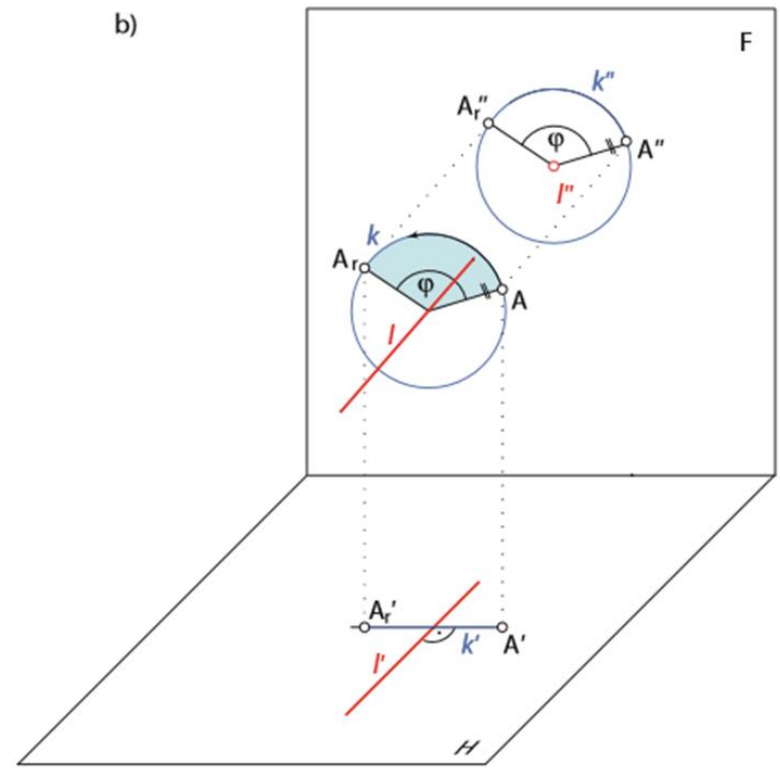
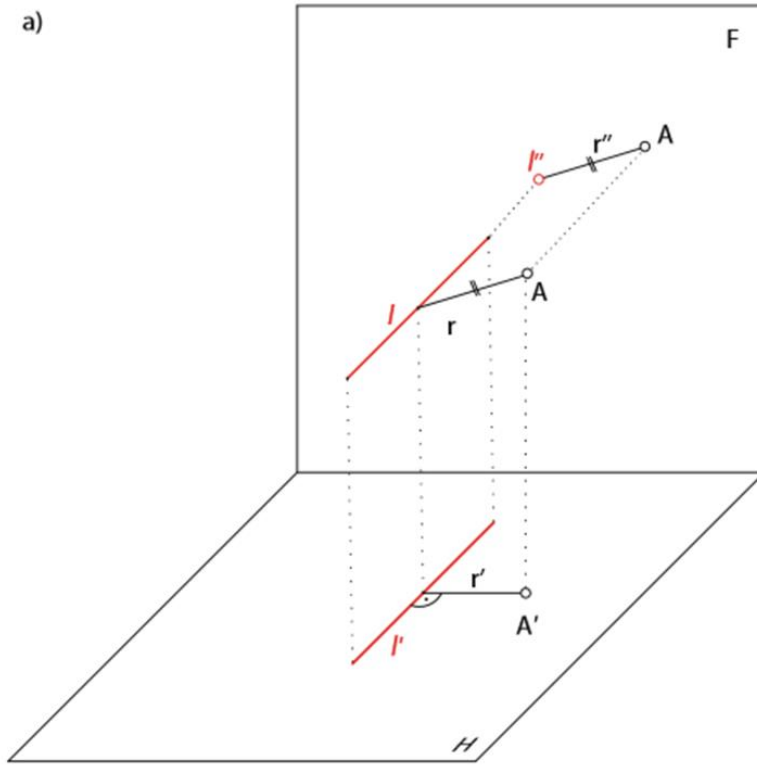
b)



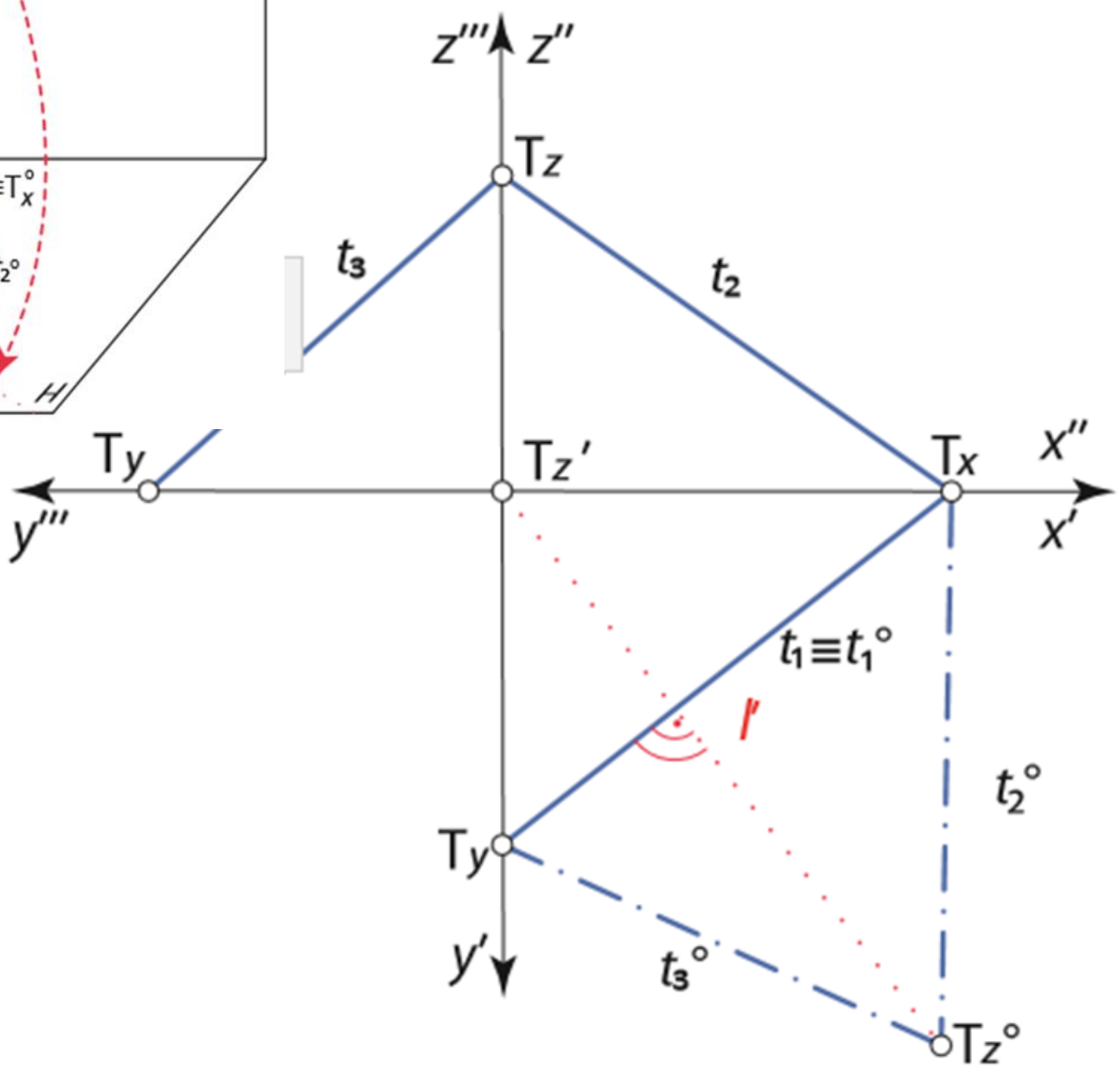
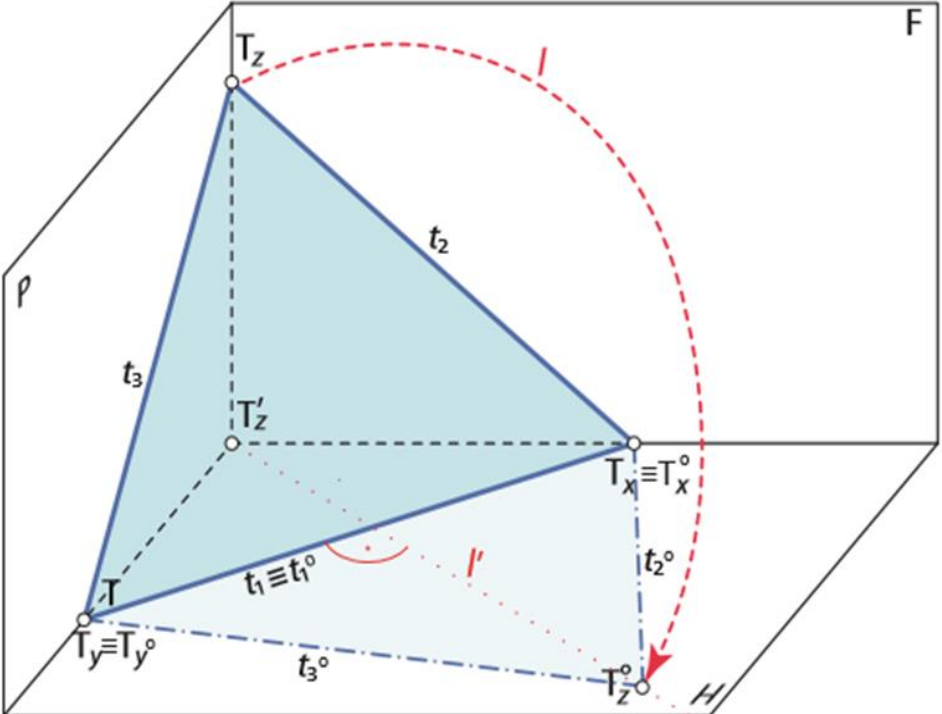
Određivanje prave veličine trougla - transformacija



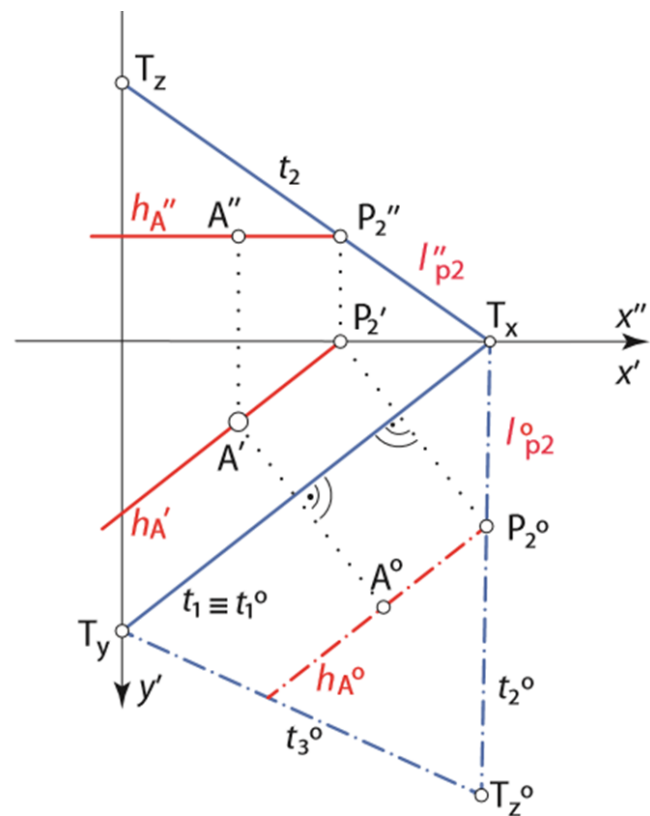
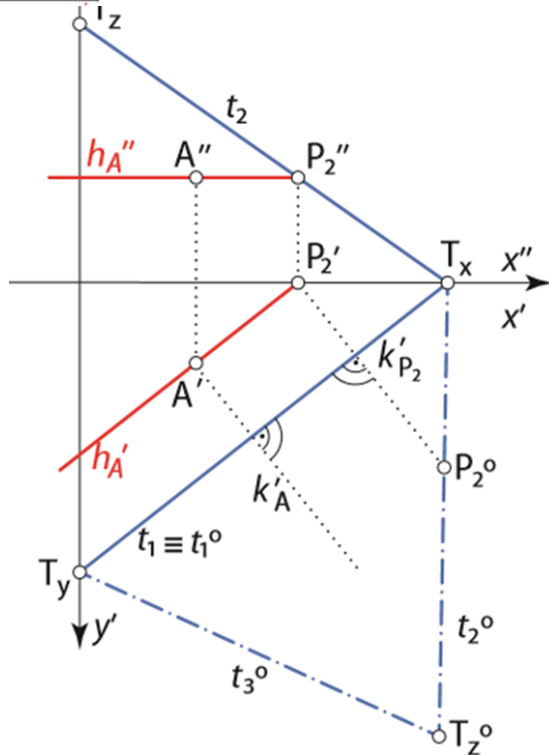
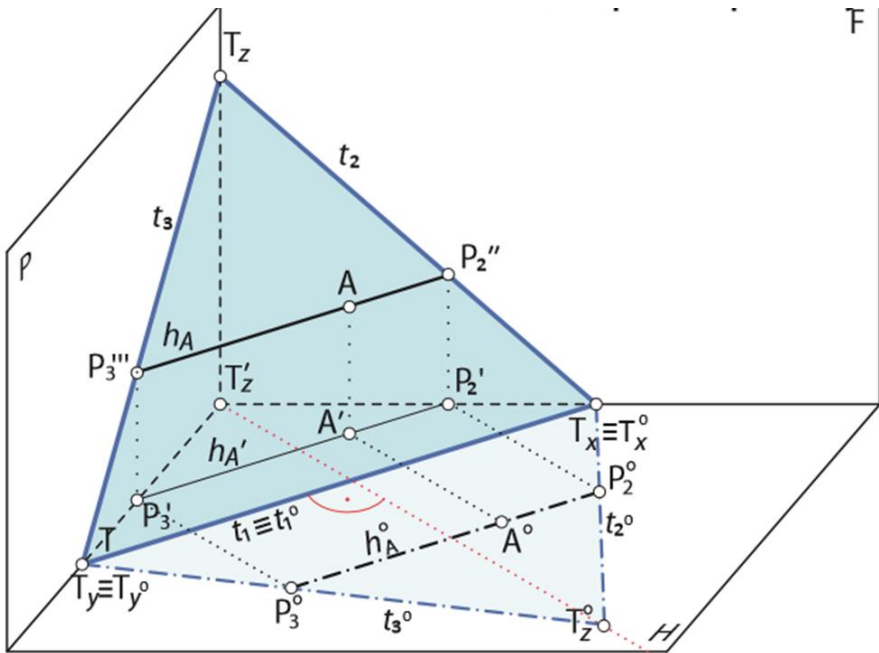
Rotacija



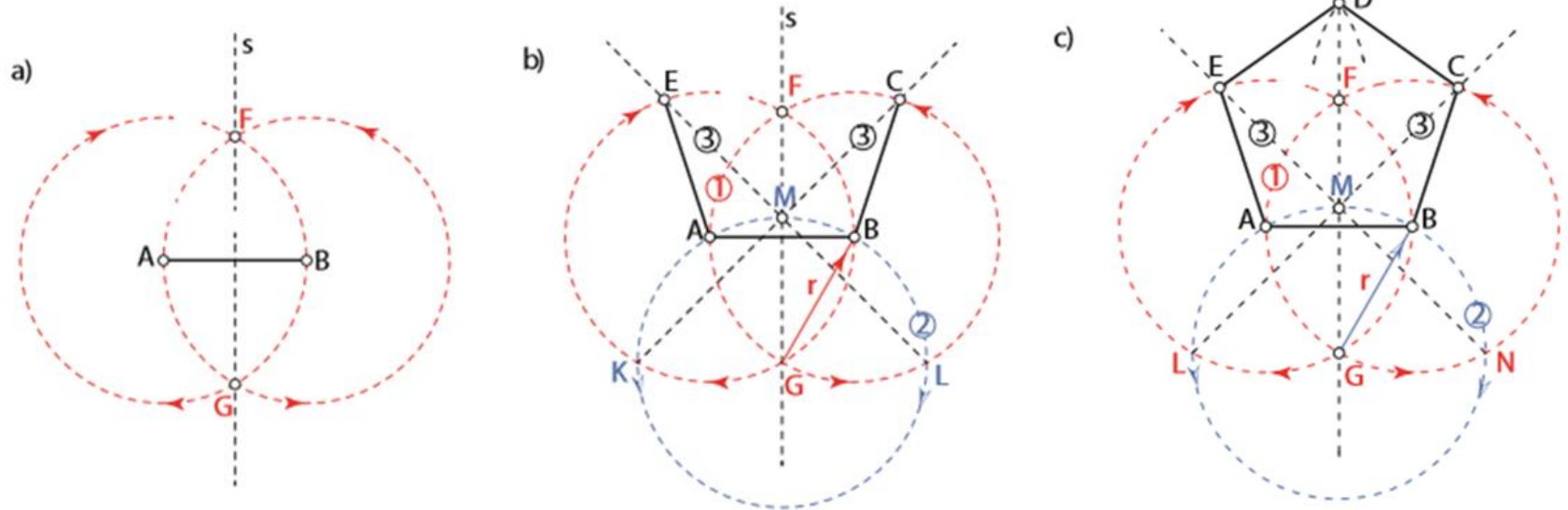
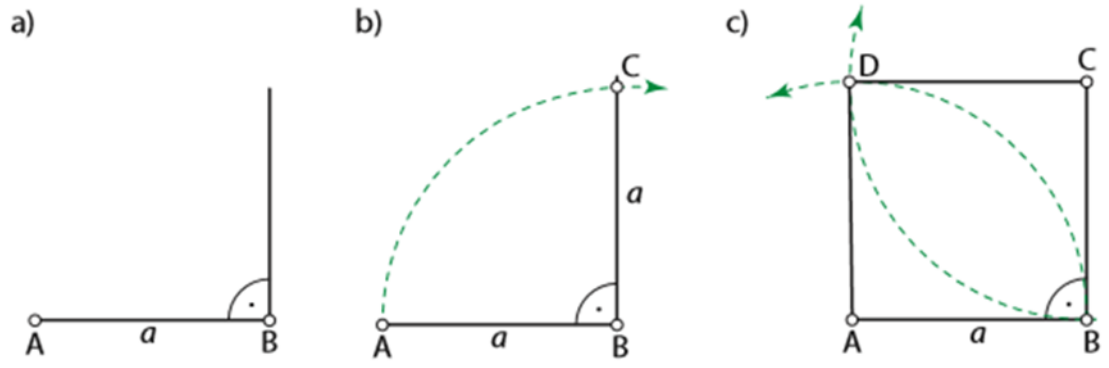
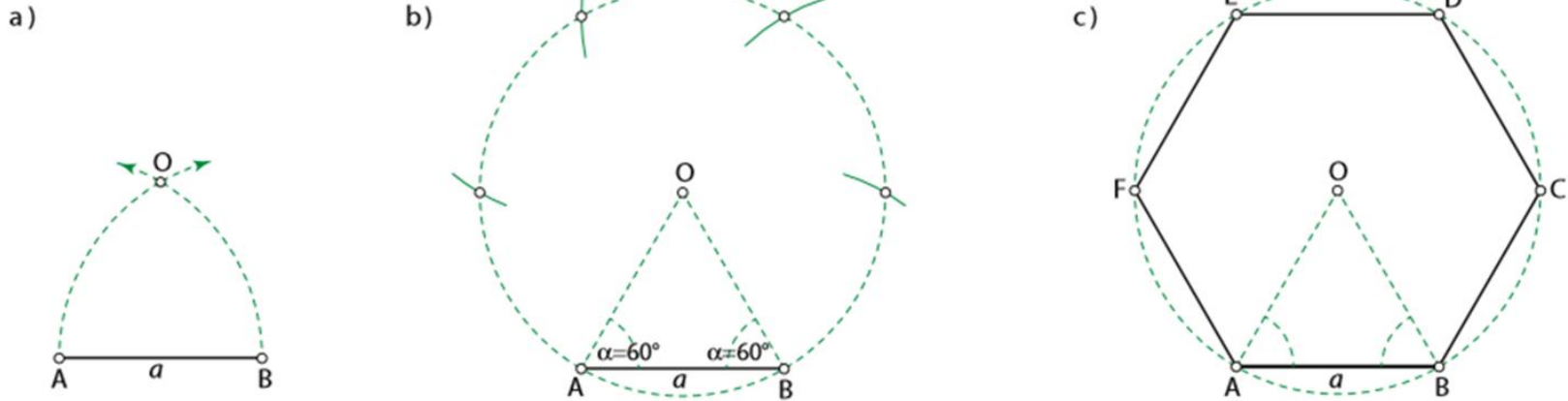
Obaranje ravni



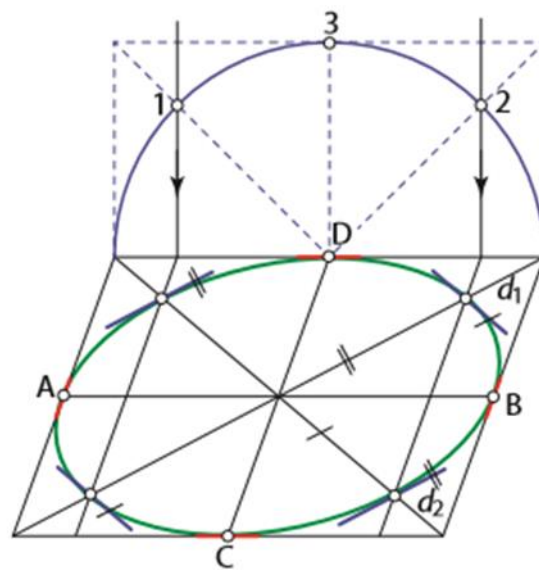
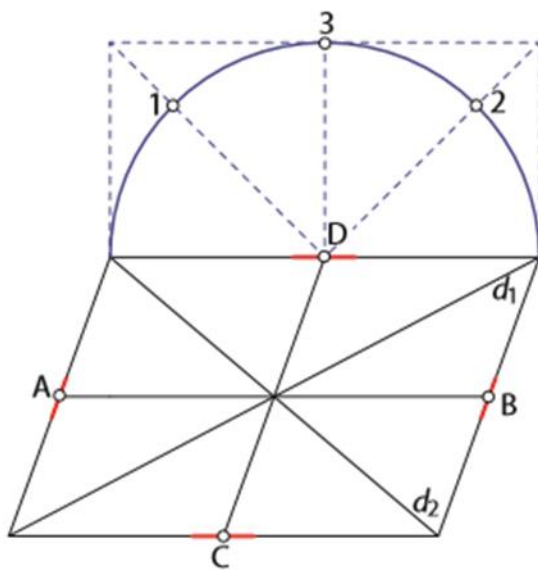
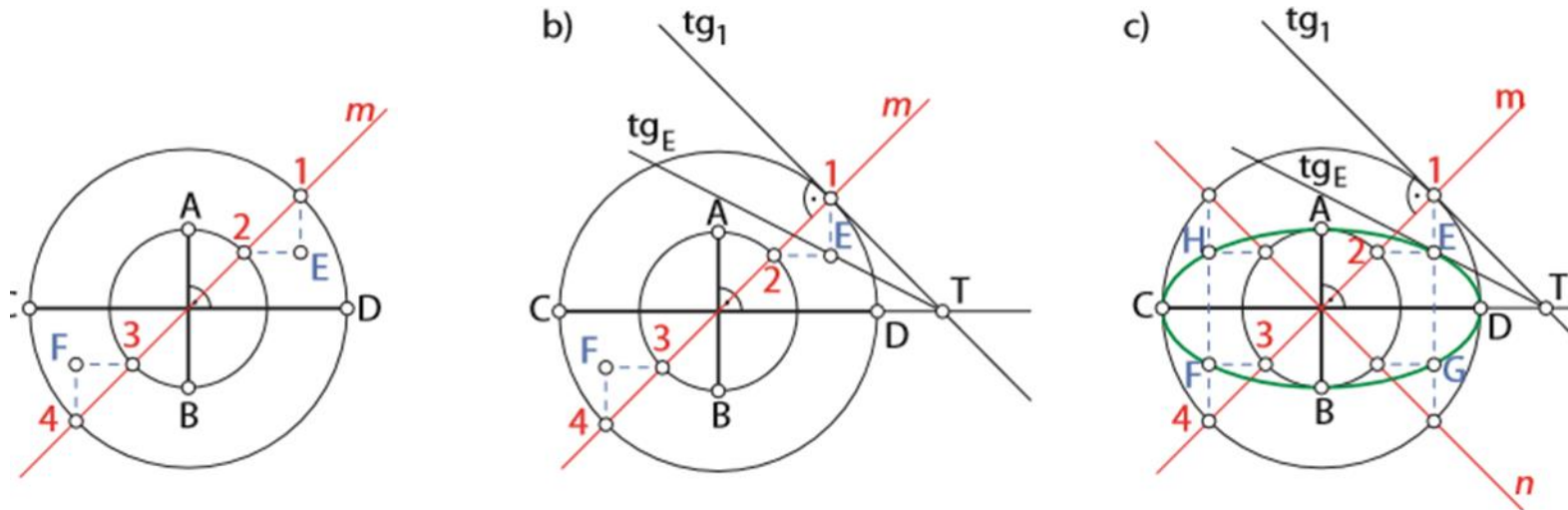
Obaranje ravni



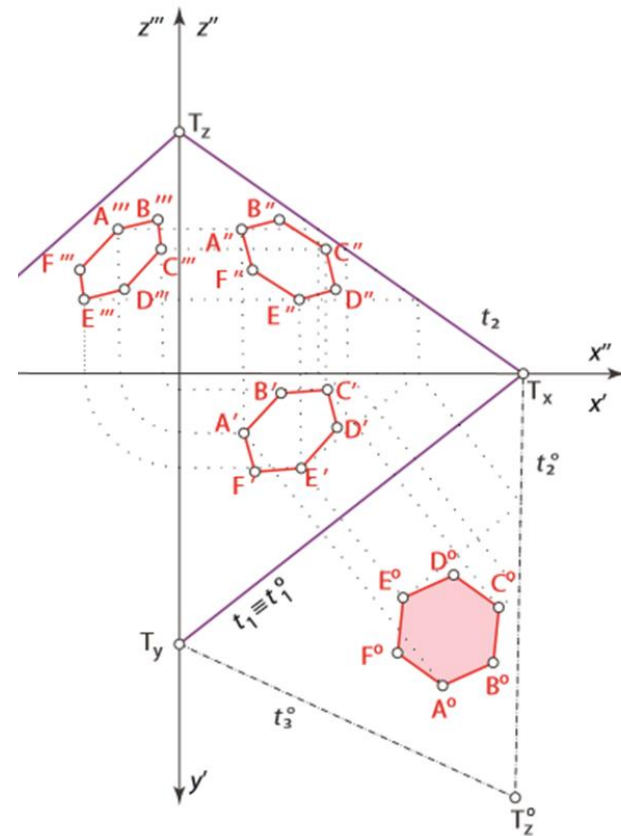
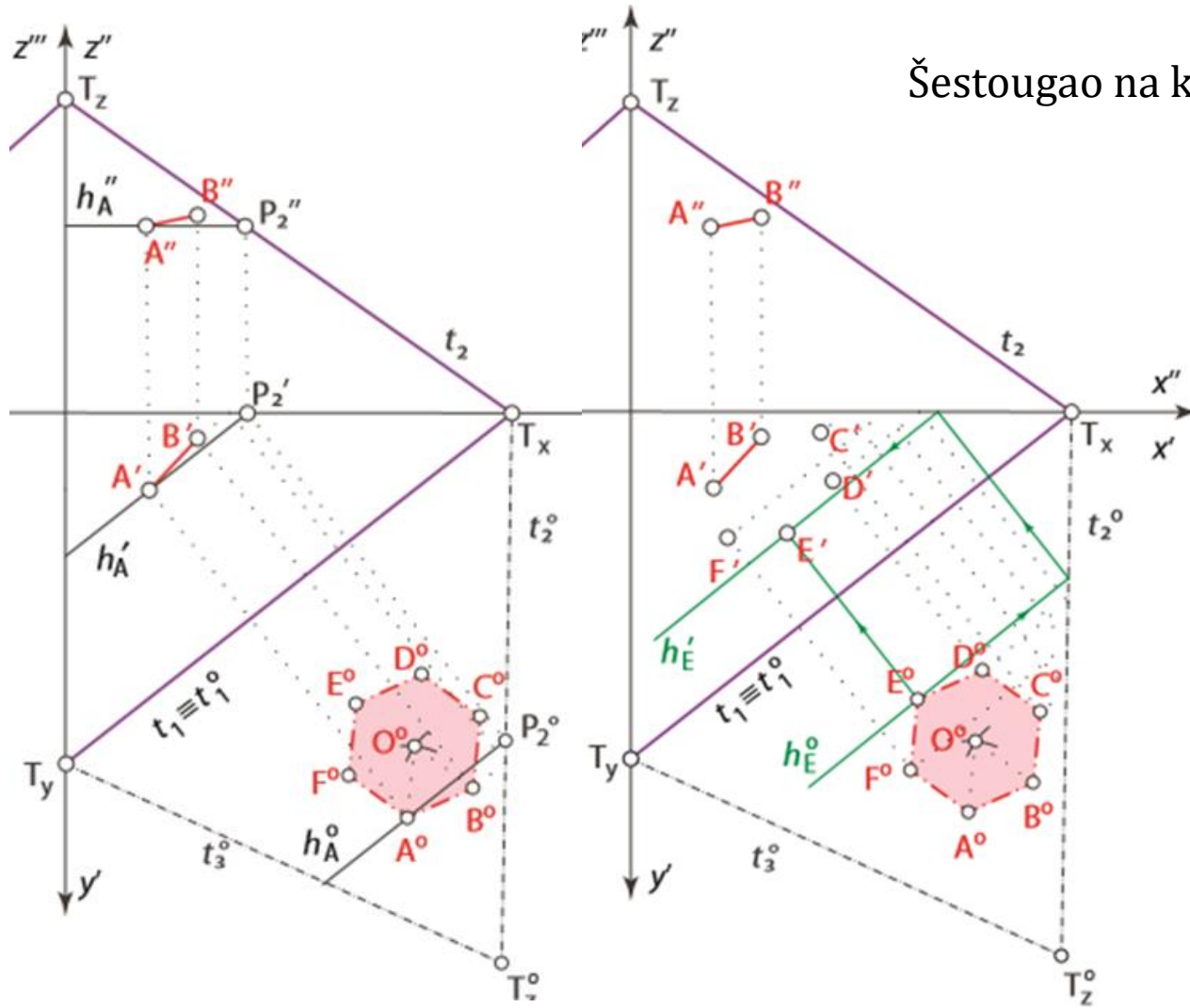
Konstrukcija pravilnih mnogouglova



Konstrukcija elipse nad parom prečnika



Šestougao na kosoj ravni



Geometrijske površi



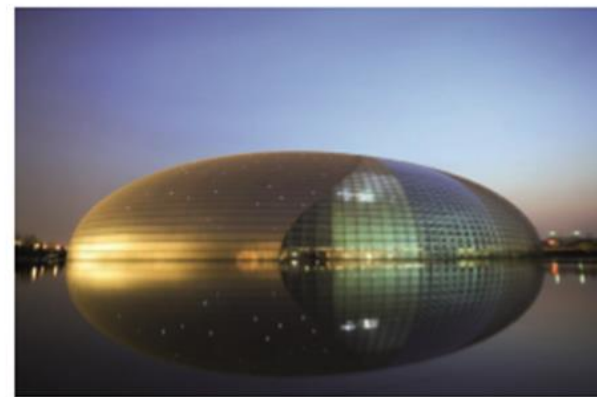
Kanton toranj (Kina) –
jednograni hiperboloid



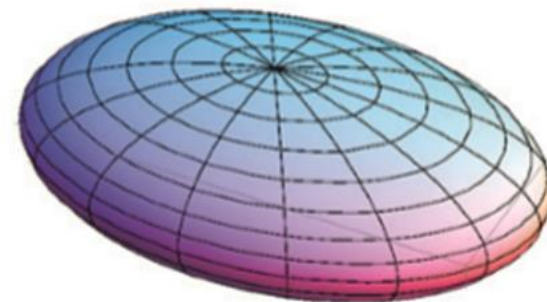
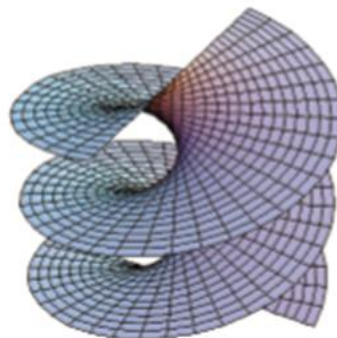
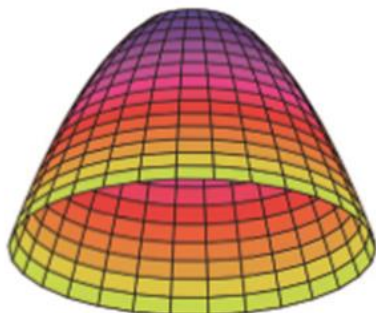
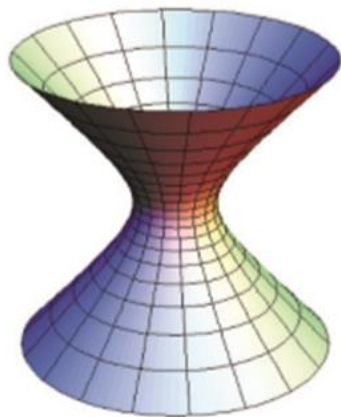
Agbar toranj (Španija) –
rotacioni paraboloid

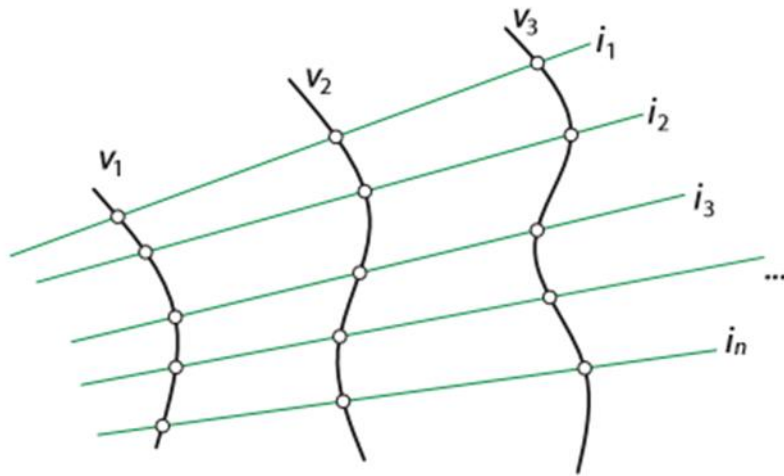


Rotirajući torzo (Švedska)
– zavojna površ



Opera (Kina) –
rotacioni elipsoid



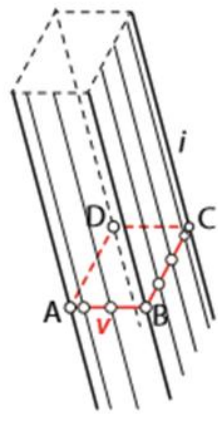
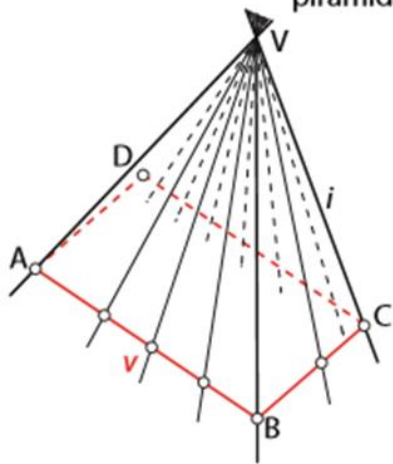


Pravoizvodne površi

rogljaste površi

piramidalne

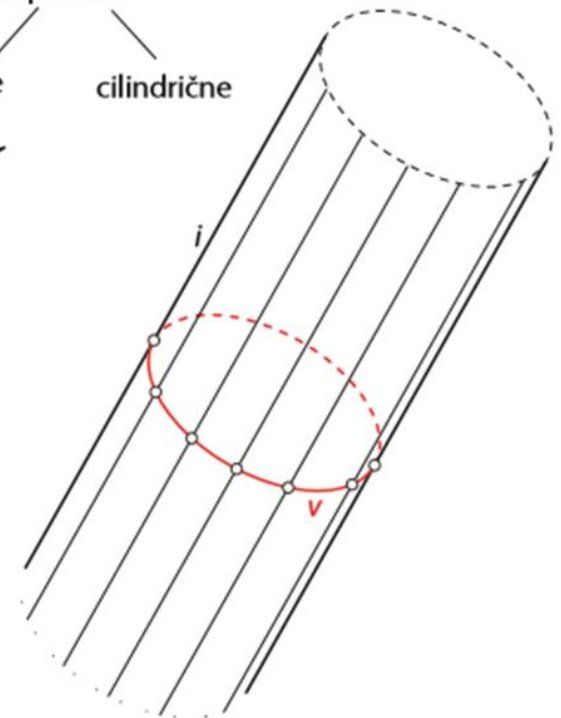
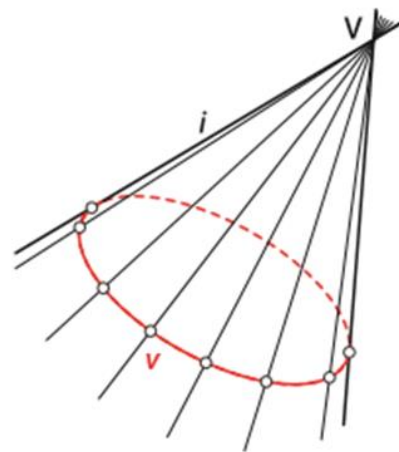
prizmatične

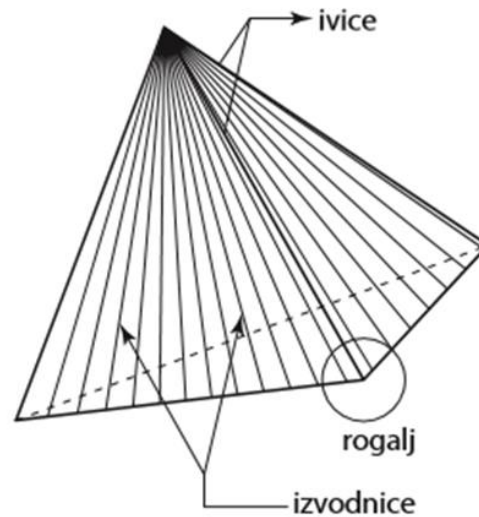
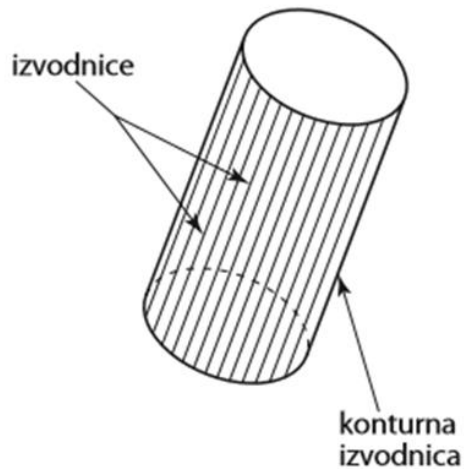
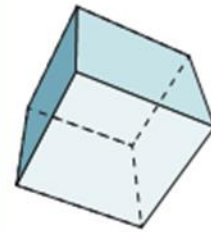
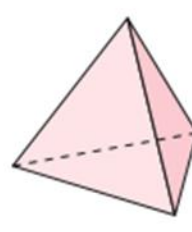
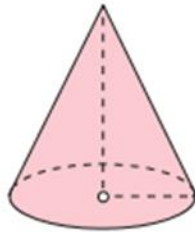
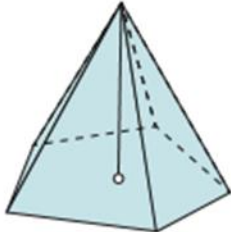
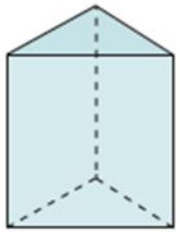
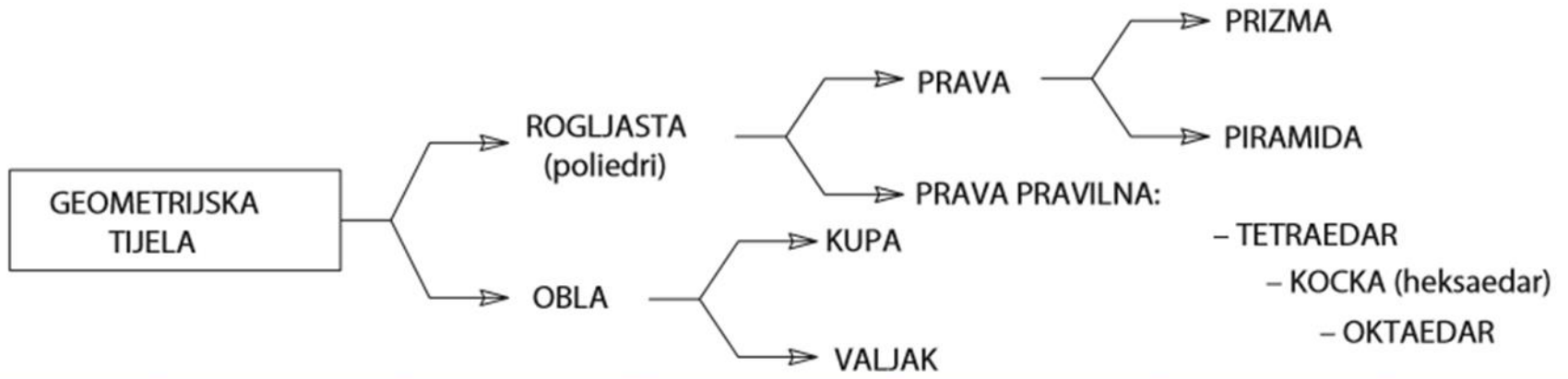


oble površi




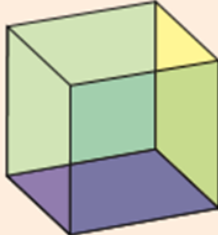


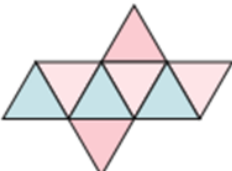
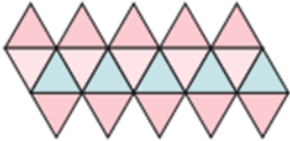
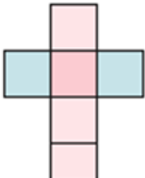

konusne

cilindrične

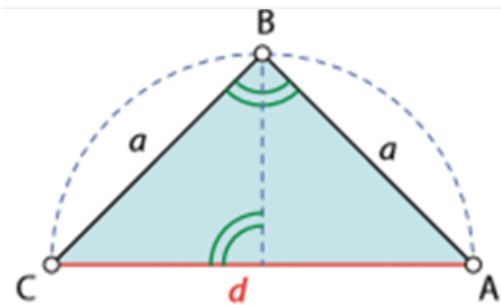
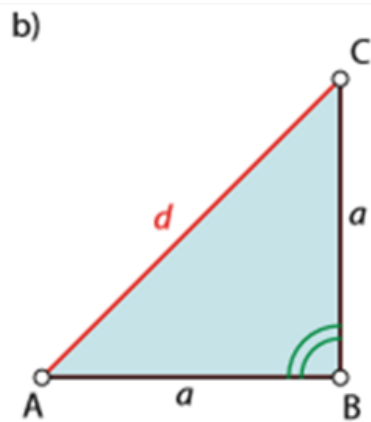
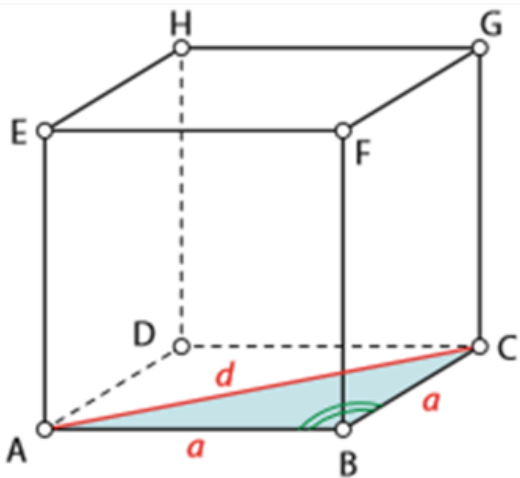
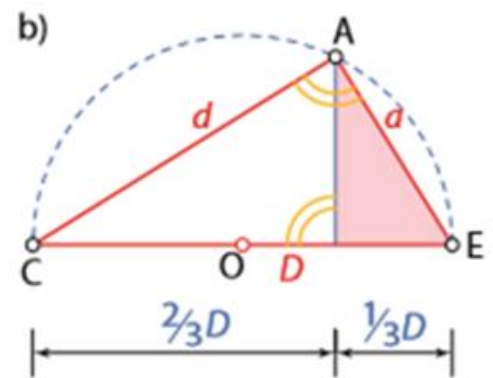
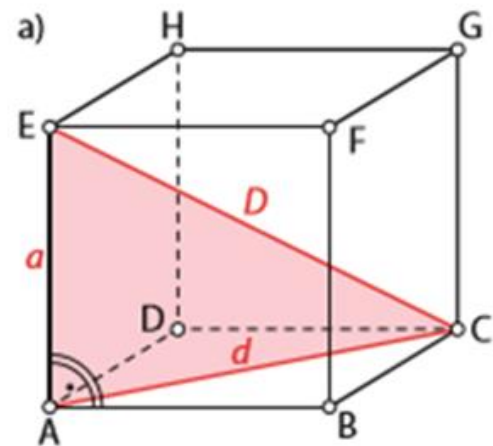
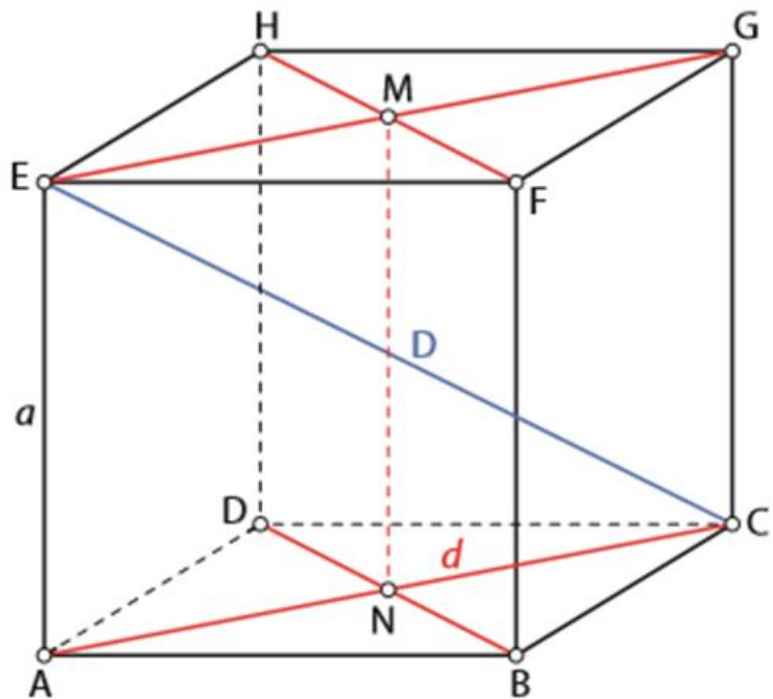


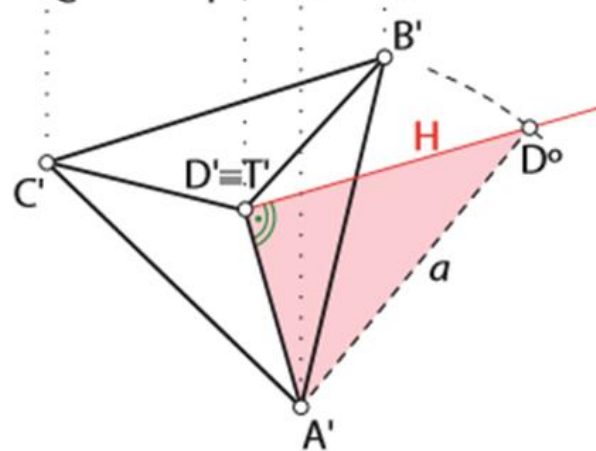
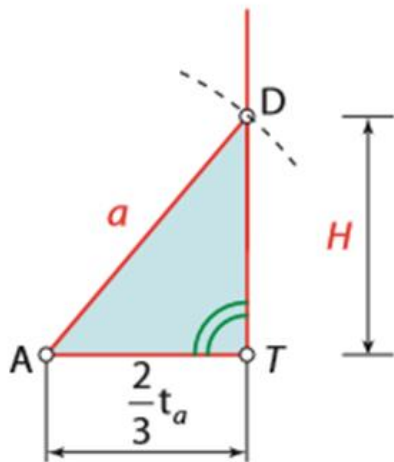
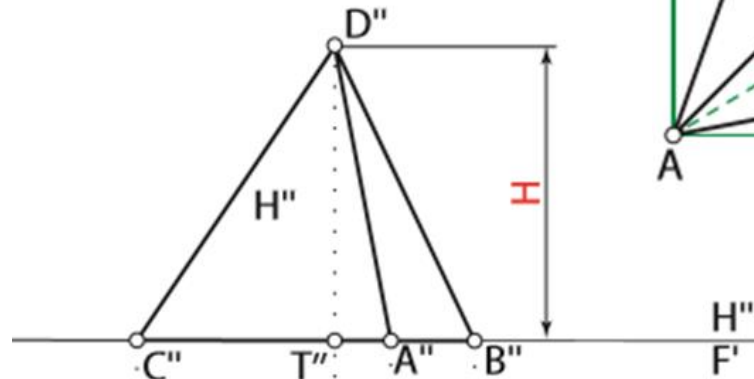
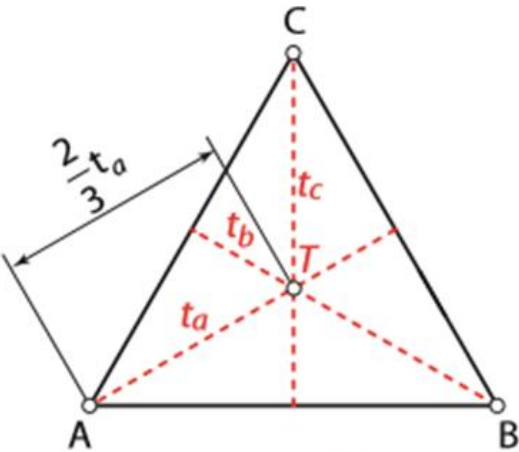
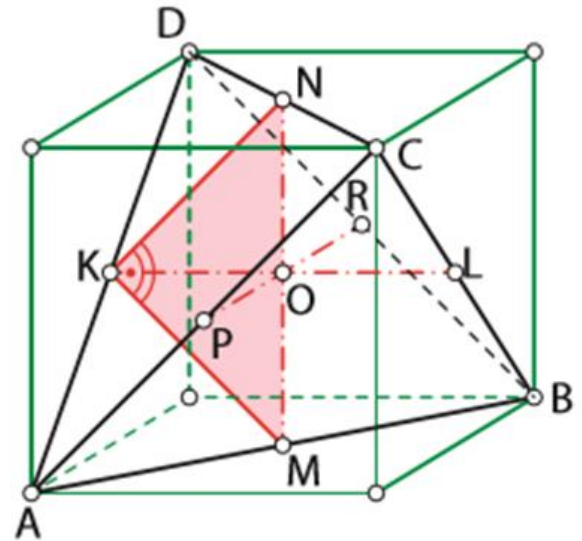
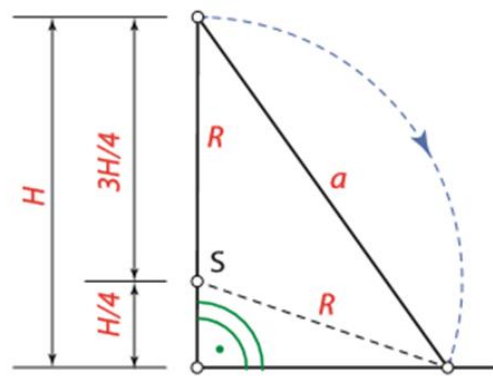
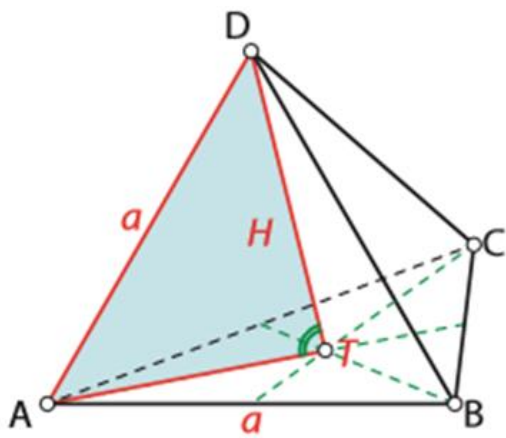


Pravilni poliedri

	Tetraedar	Oktaedar	Ikosaedar	Heksaedar	Dodekaedar
Platonovo tijelo					
Broj strana	4 grč. <i>tetra</i>	8 grč. <i>okta</i>	20 grč. <i>ikosa</i>	6 grč. <i>heksa</i>	12 grč. <i>dodeka</i>
Broj ivica	6	12	20	12	30
Broj tjemena/ rogljeva	4	6	12	8	20
Broj mno- gouglova sučeljenih u jednom roglju	3	4	5	3	3
Mreža					

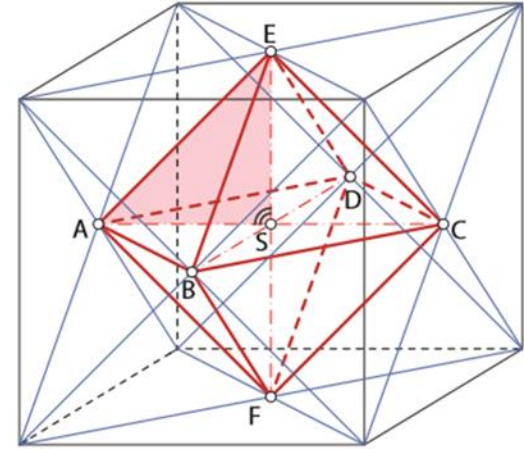
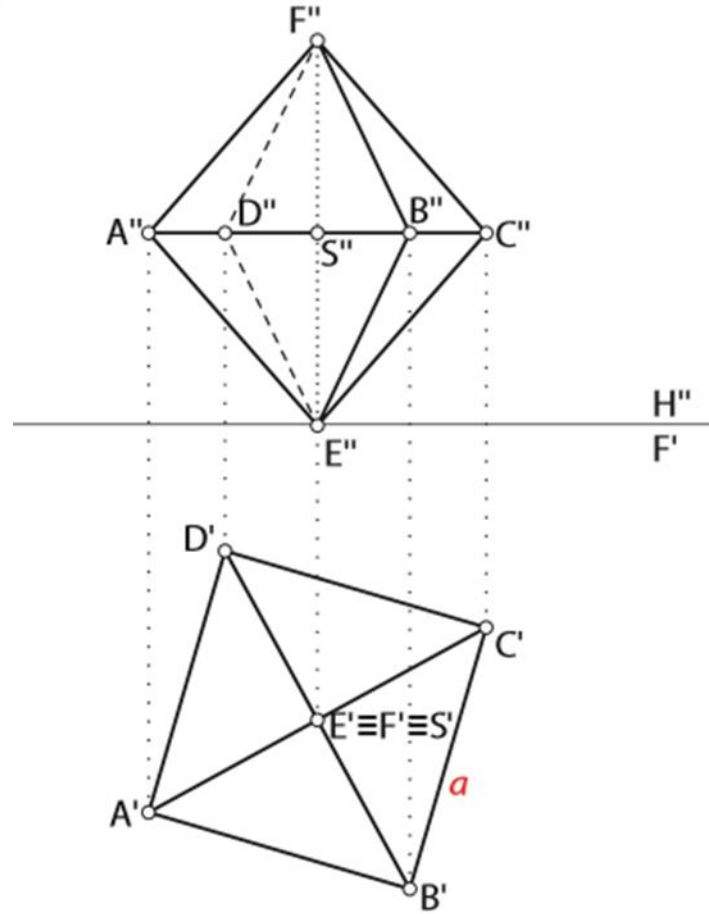
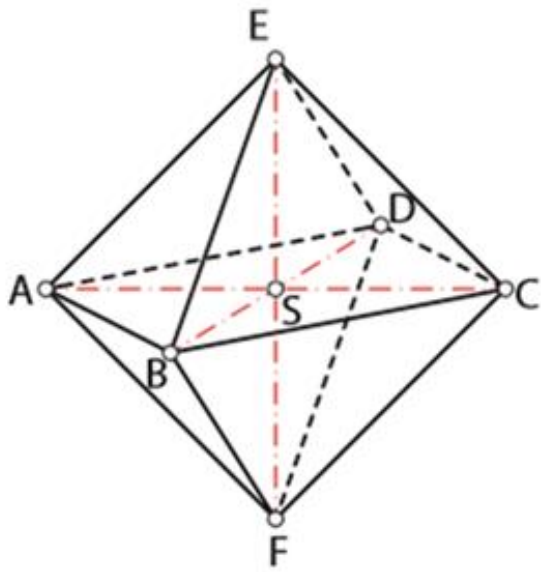
Kocka



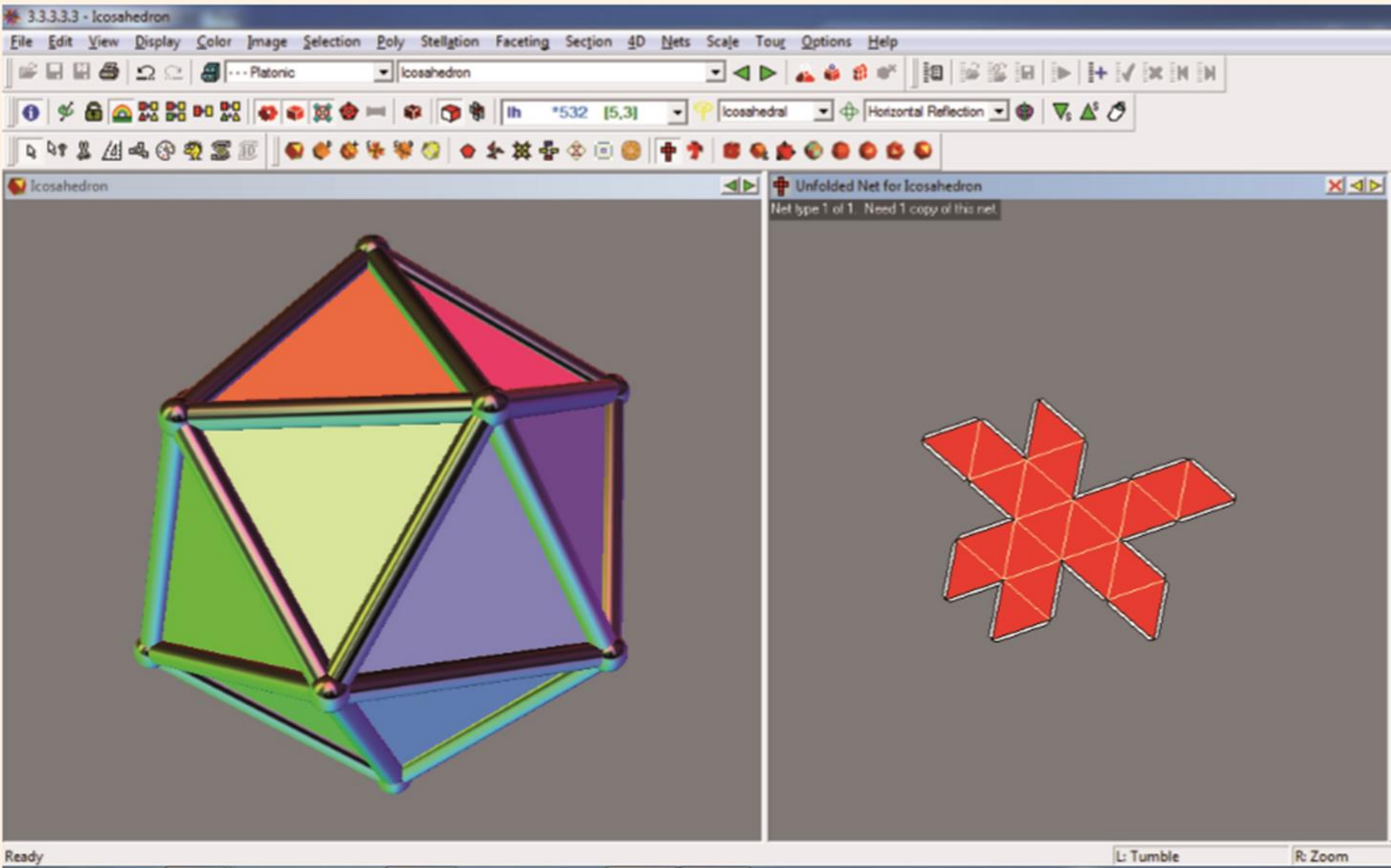


Tetraedar

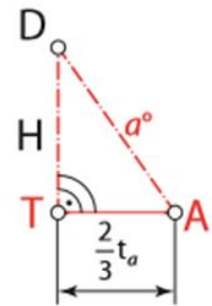
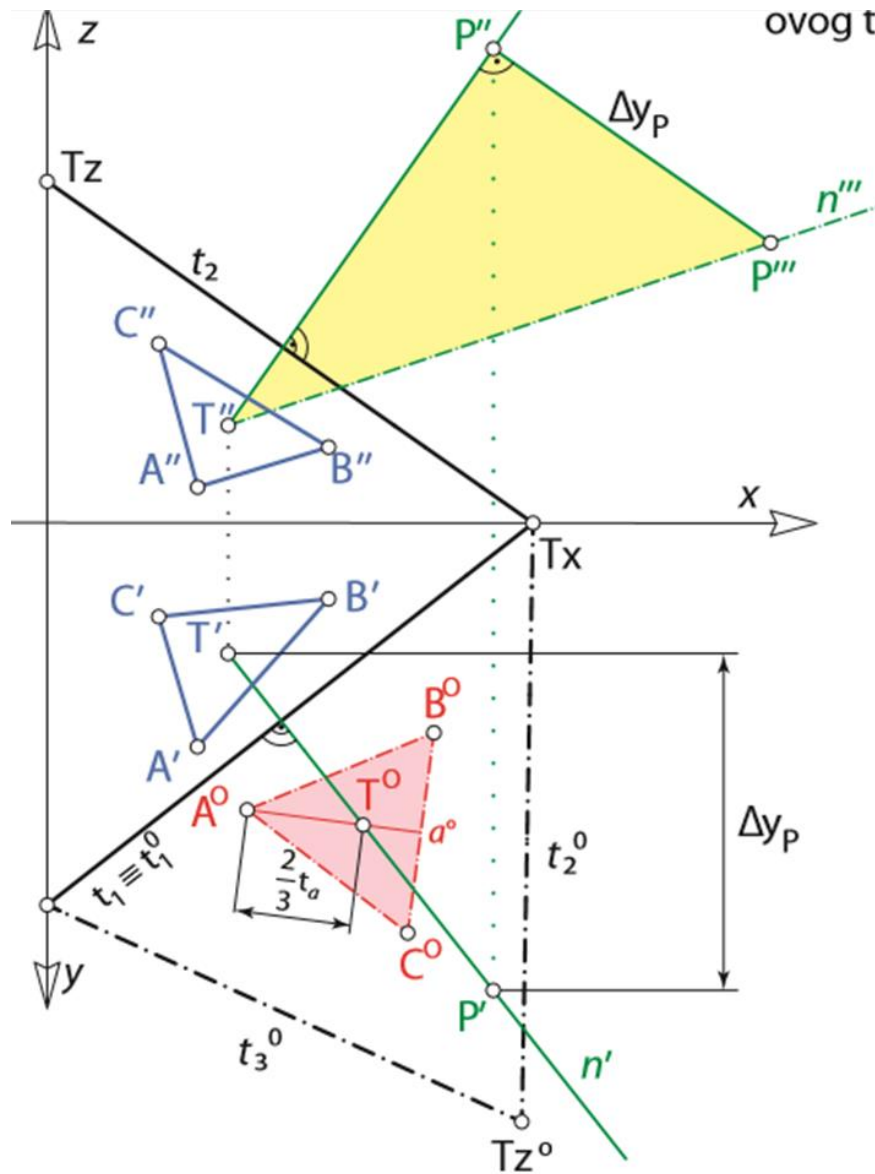
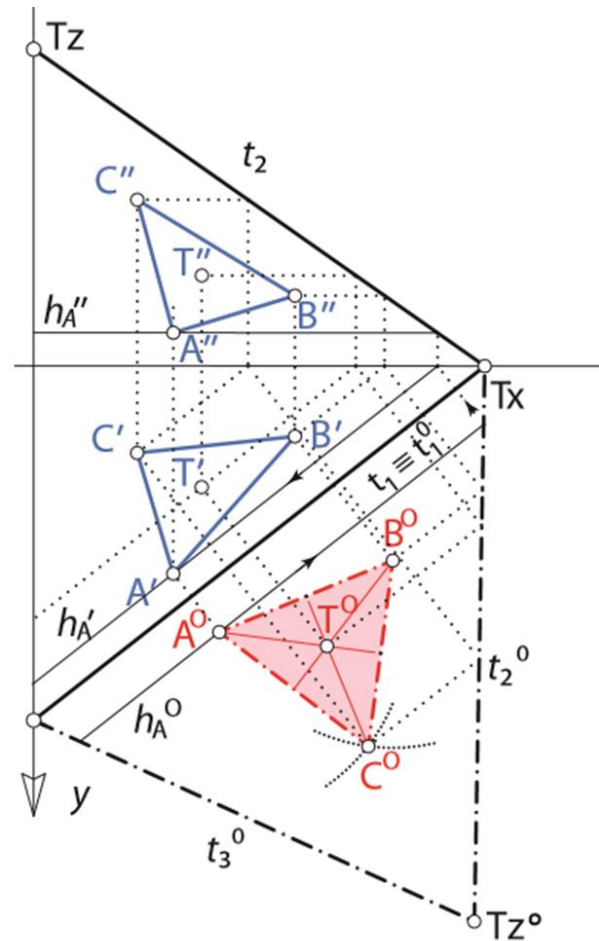
Oktaedar



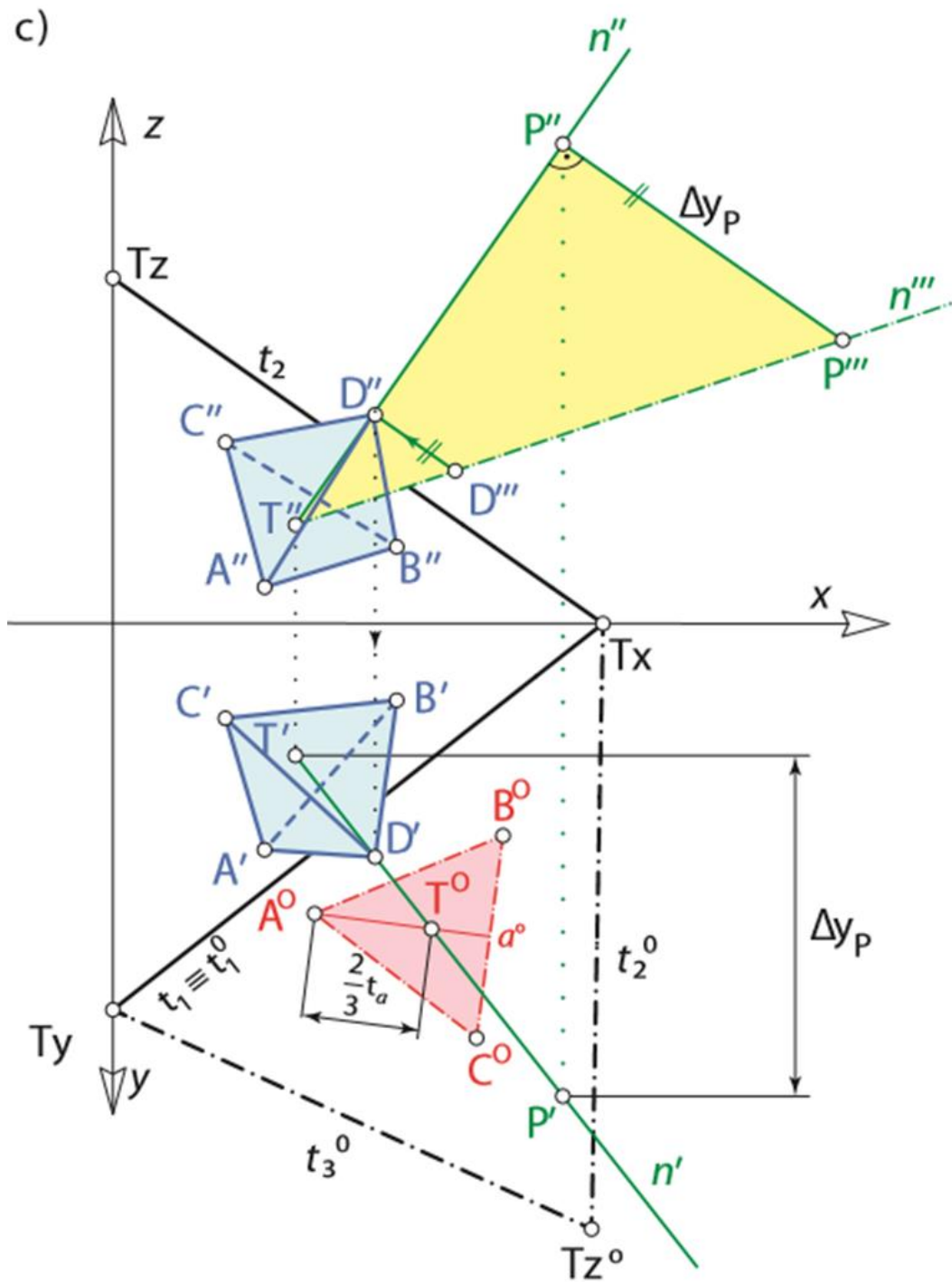
Great Stella



ovog trougla je prava velicin



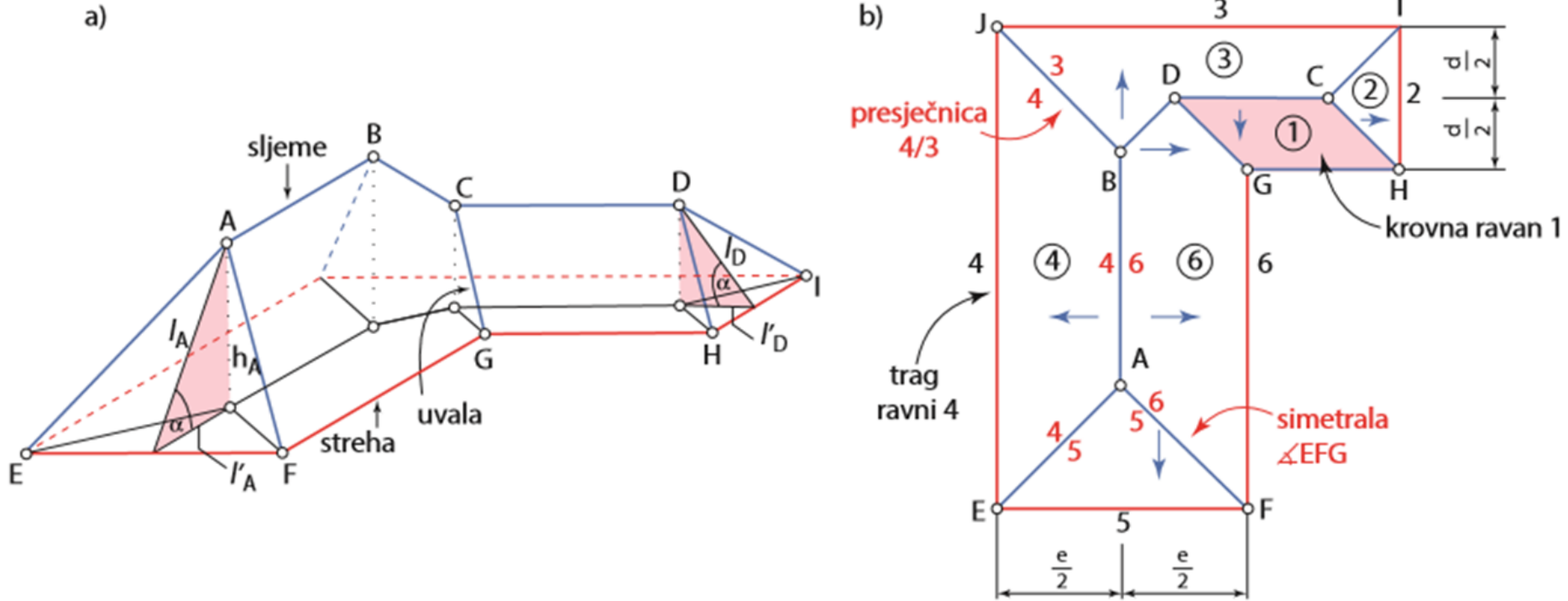
Konstrukcija tetraedra čija baza ABC pripada kosoj ravni



Krovovi

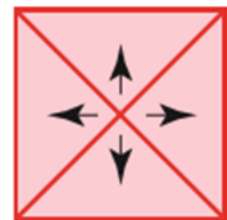
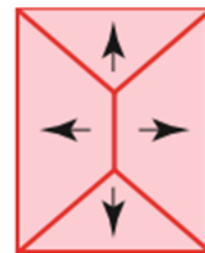
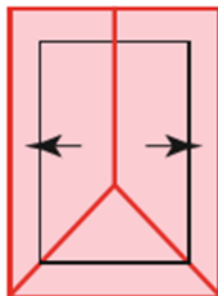
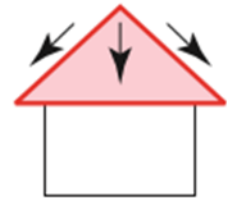
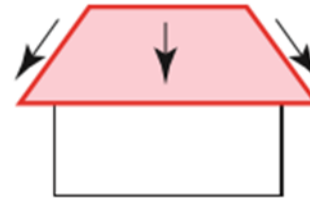
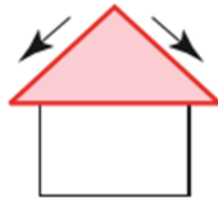
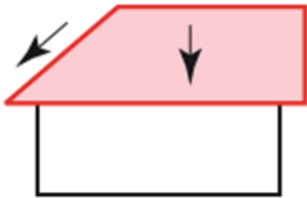
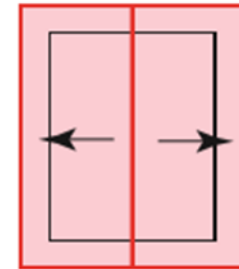
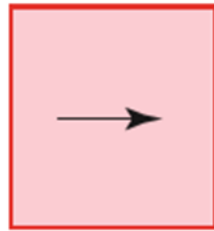
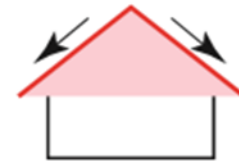
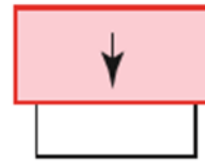
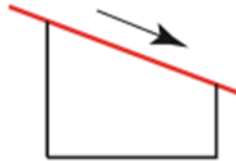


Krovovi

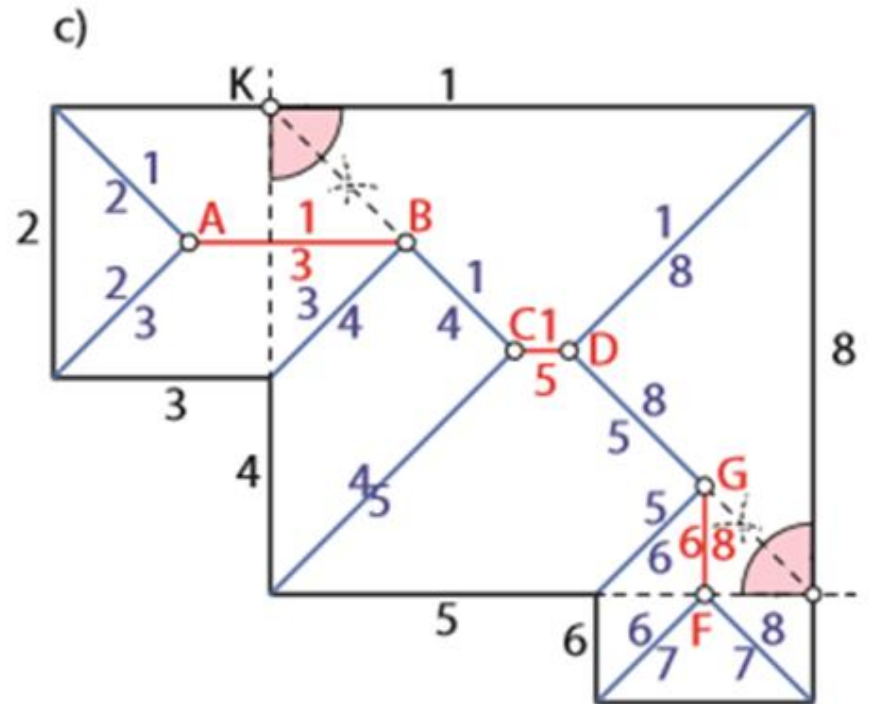
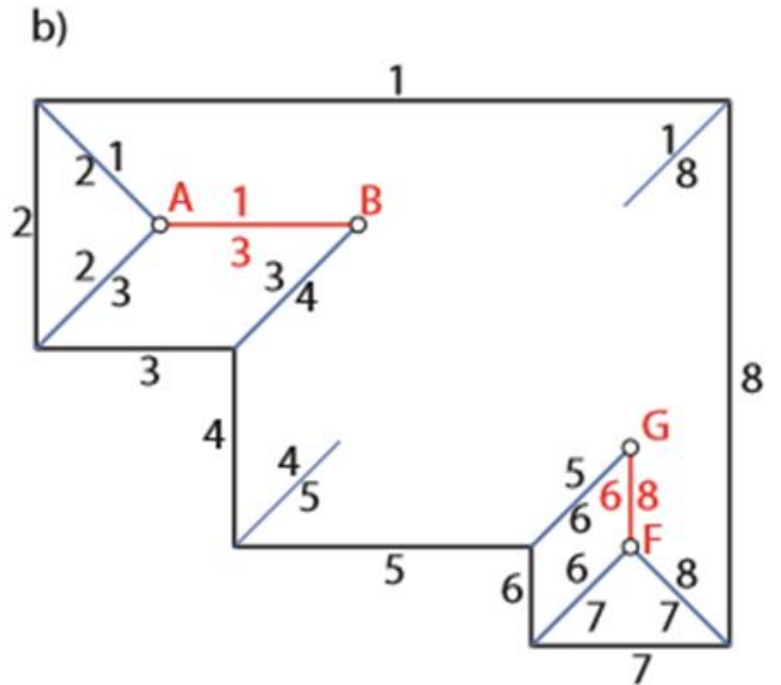
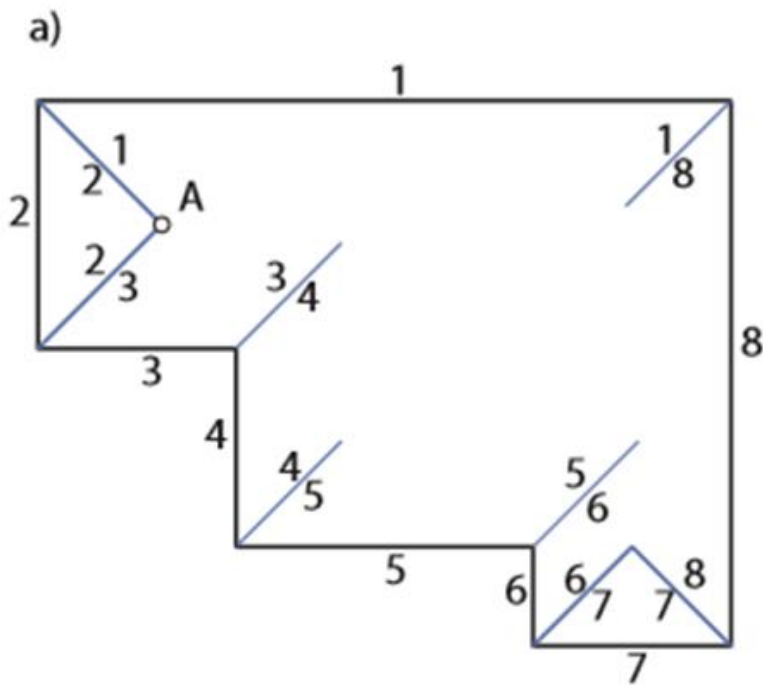


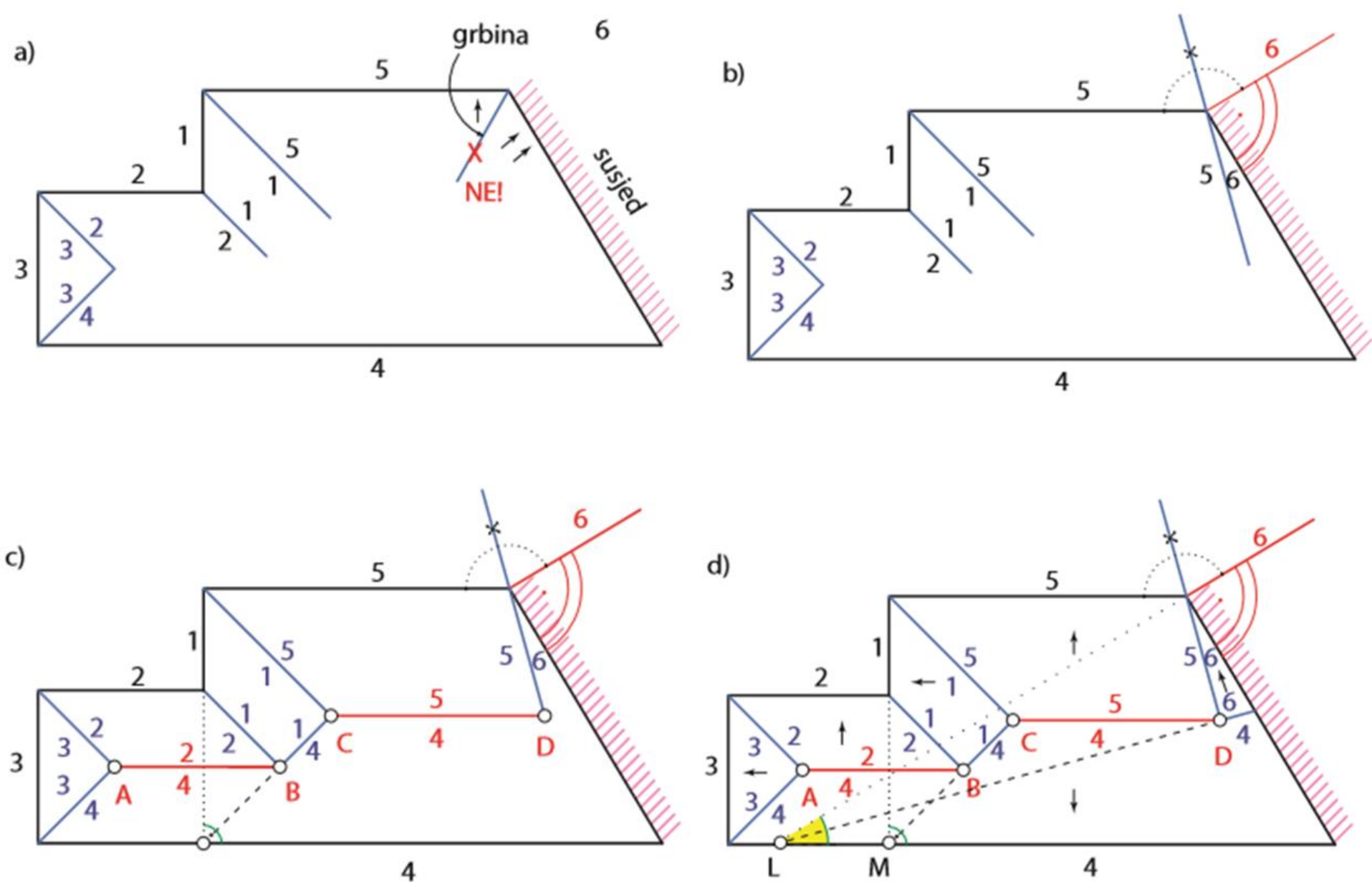
Elementi jednostavnih i složenih krovova

Vrste jednostavnih krovova



Rješavanje složenih krovova

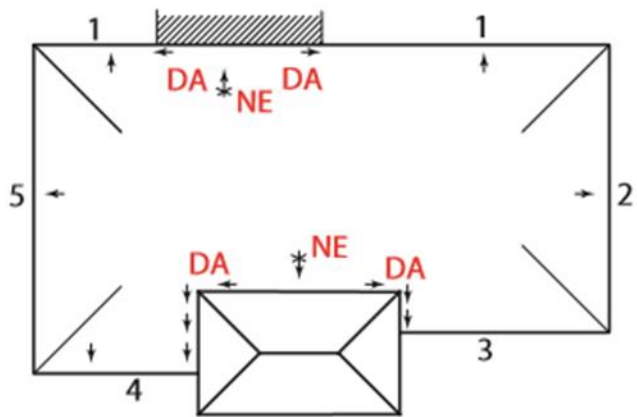




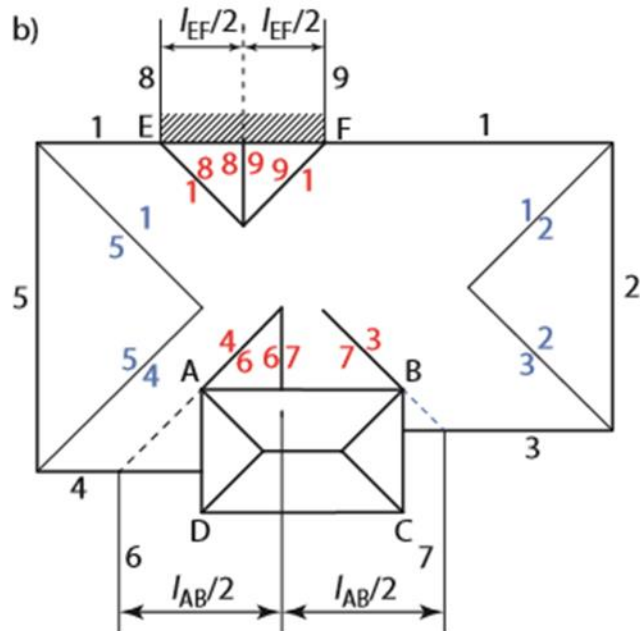
Rješavanje složenih krovova

Rješavanje složenih krovova

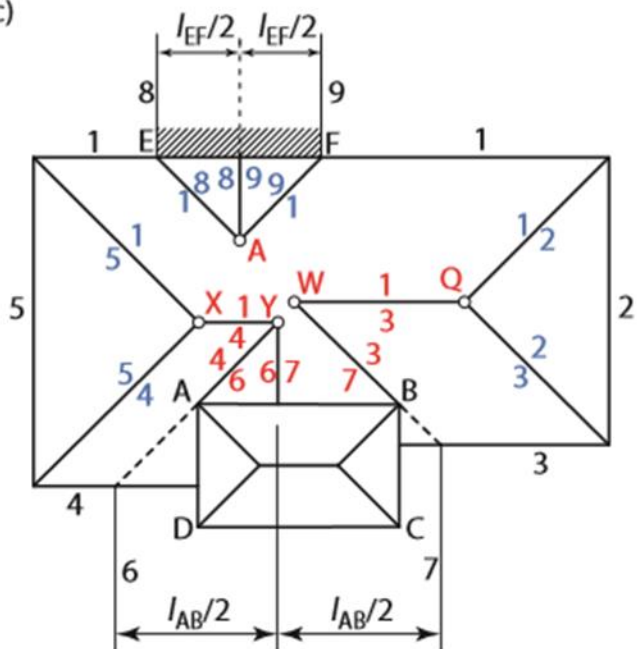
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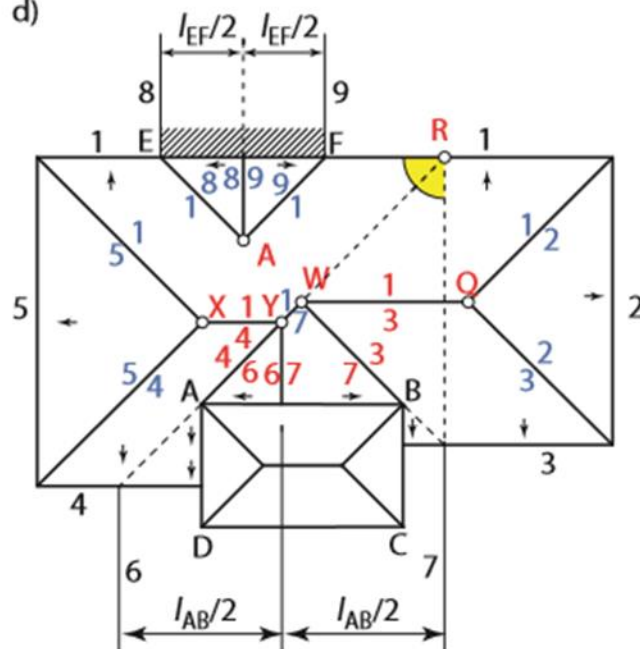
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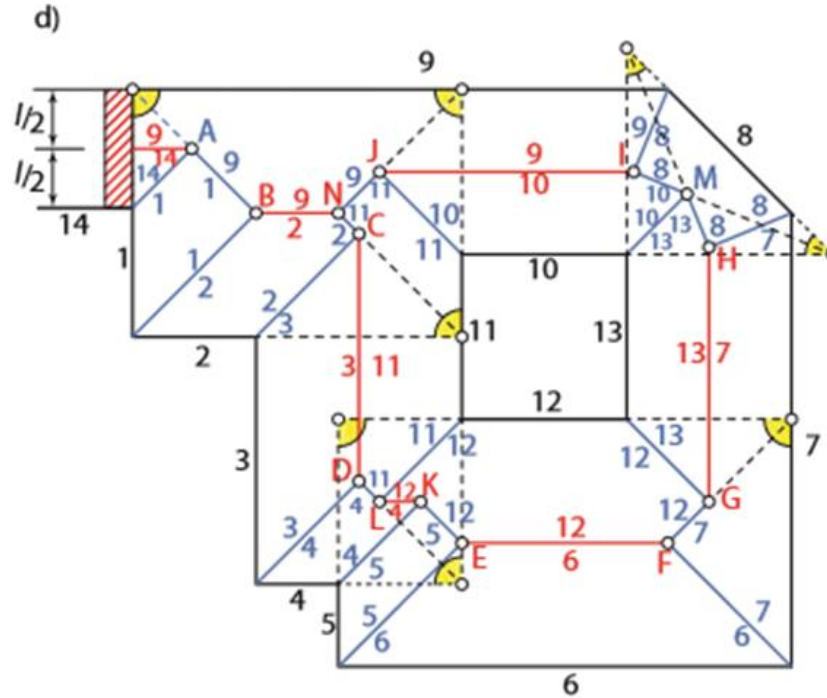
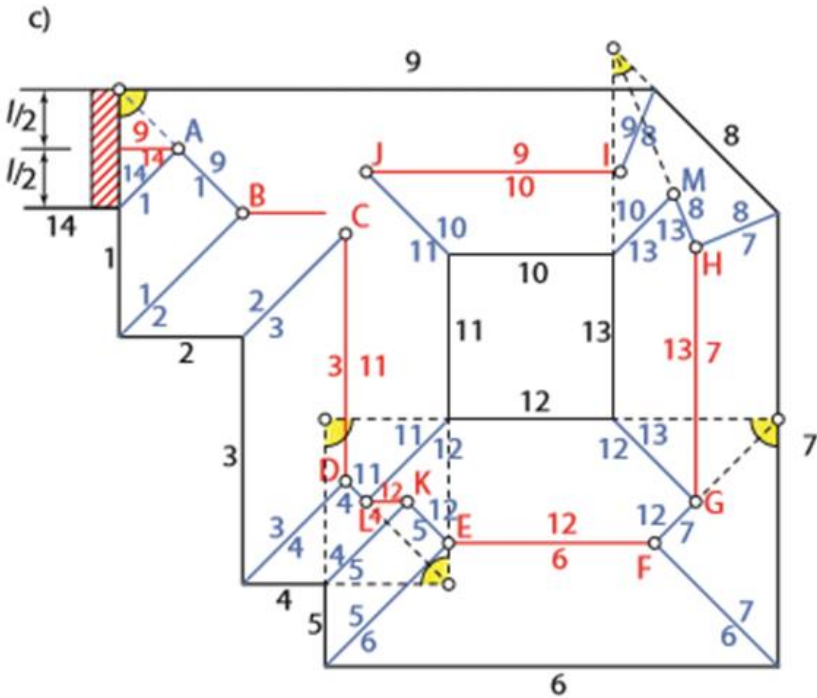
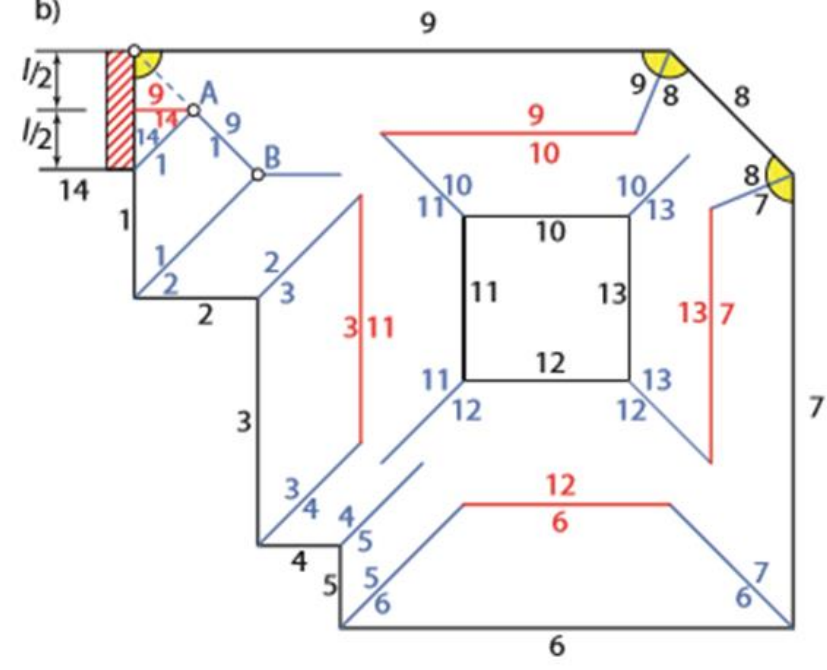
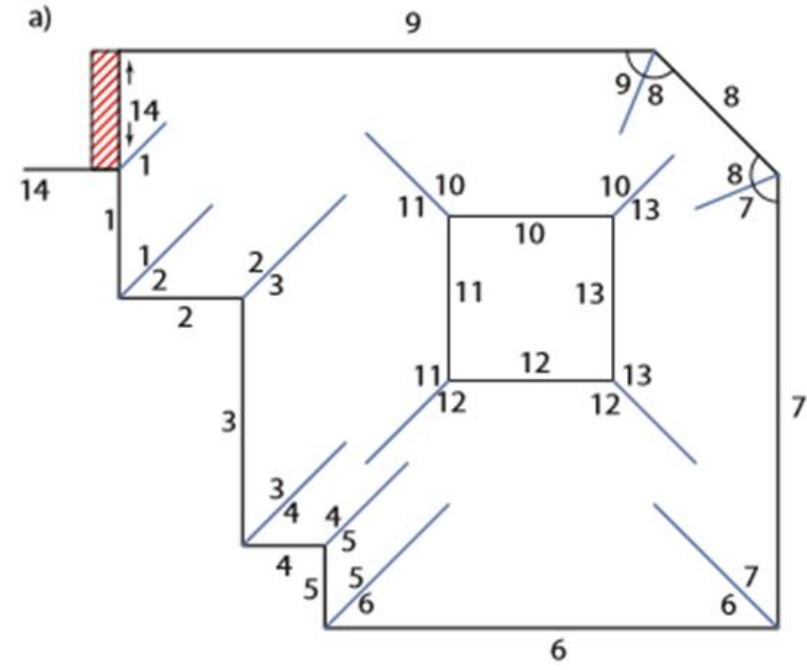
c)



d)



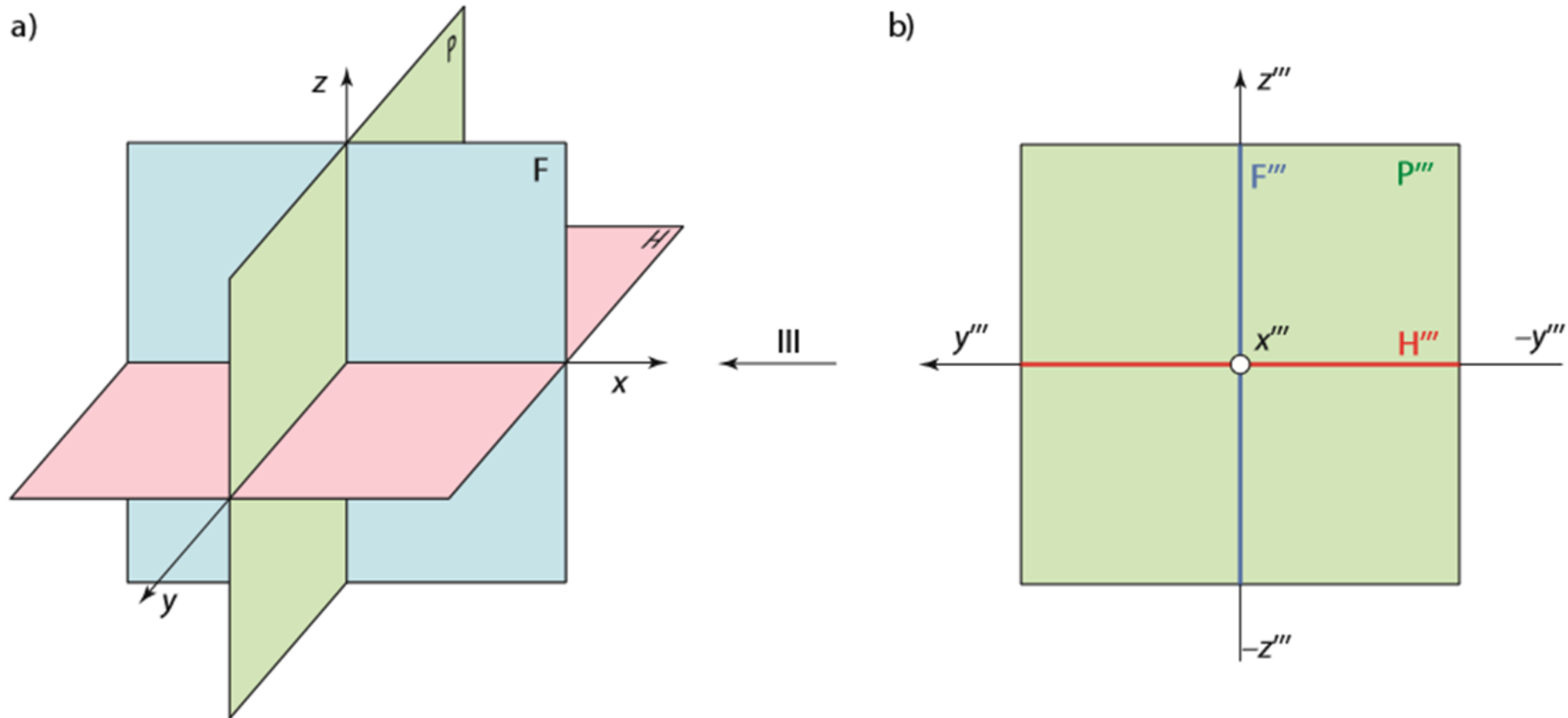
Rješavanje složenih krovova



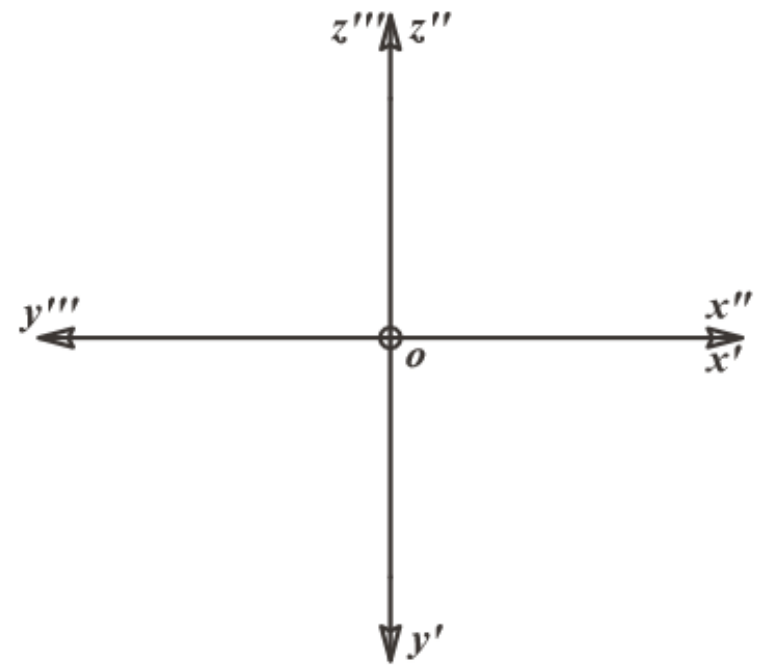
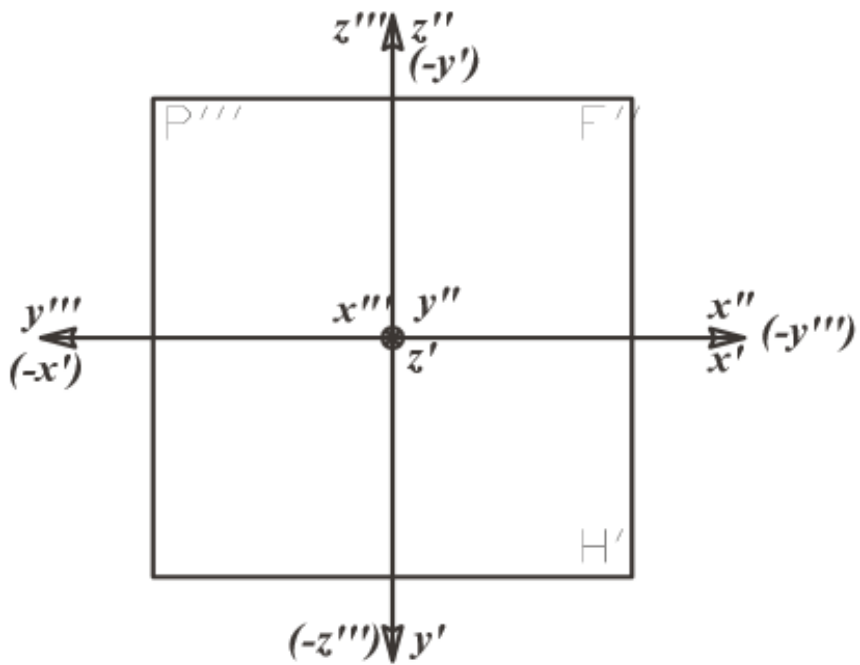


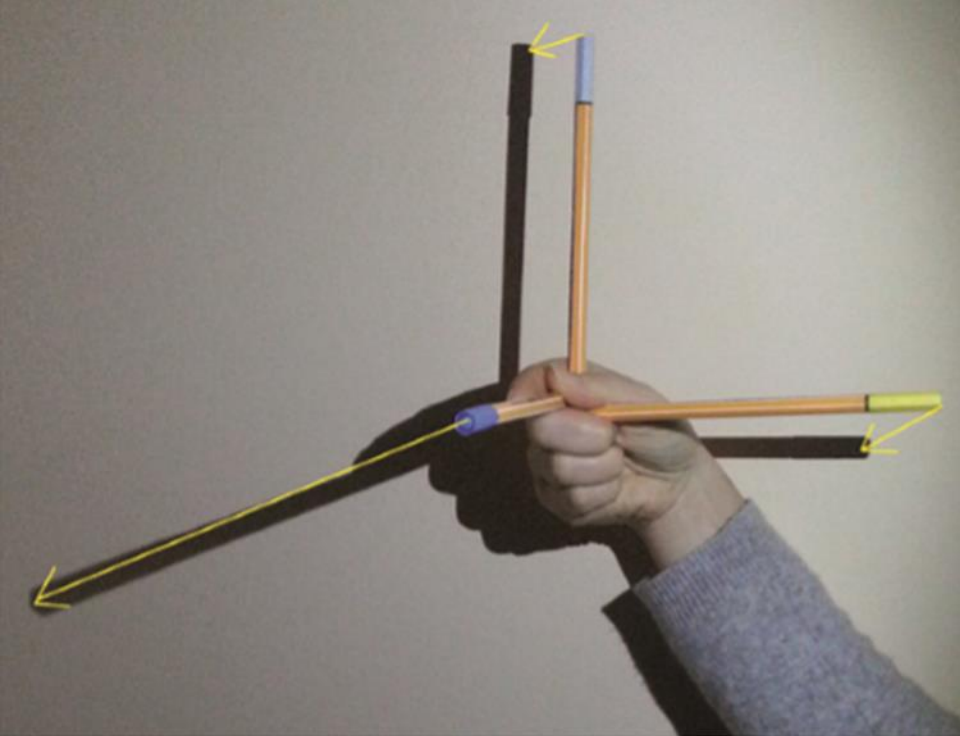


TREĆA PROJEKCIJA TRIEDRA

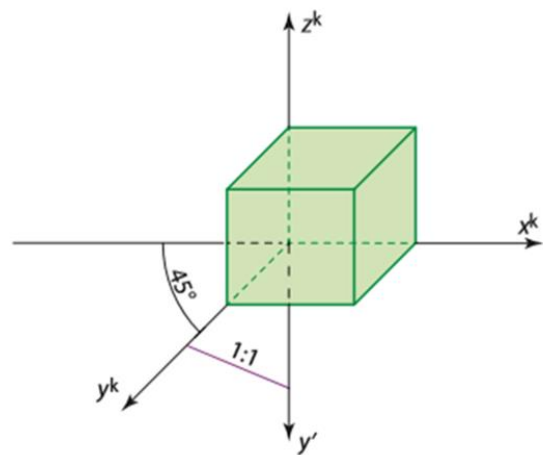
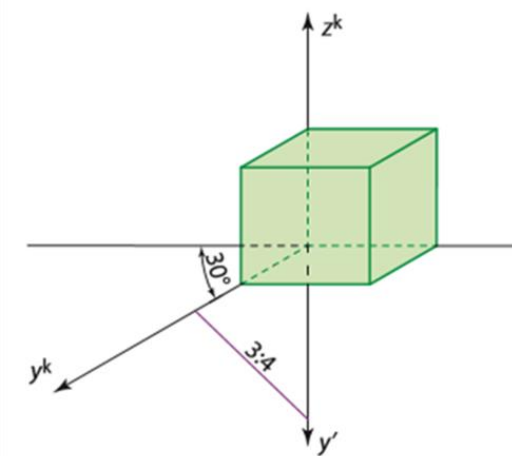
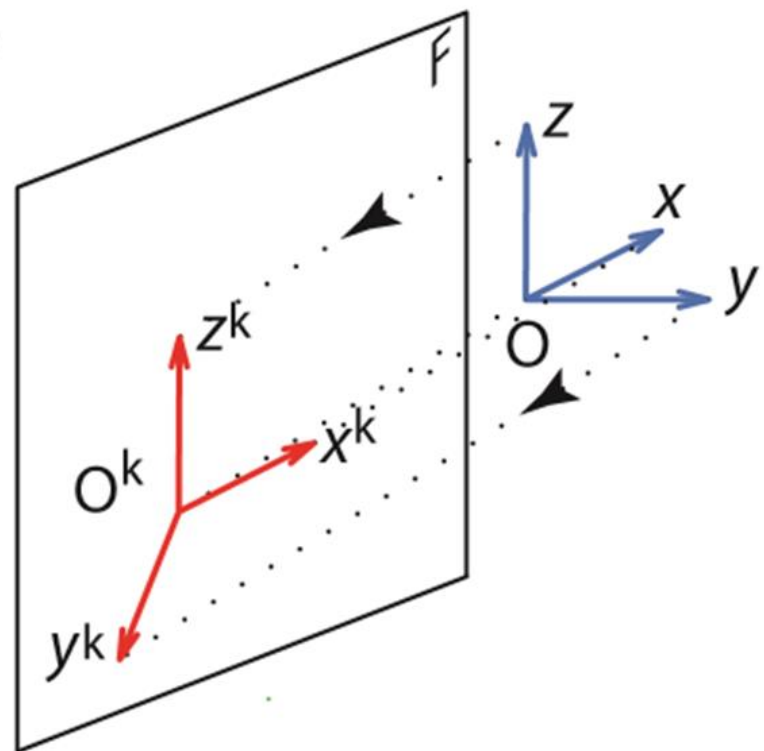


TRIEDAR U TRI ORTOGONALNE PROJEKCIJE

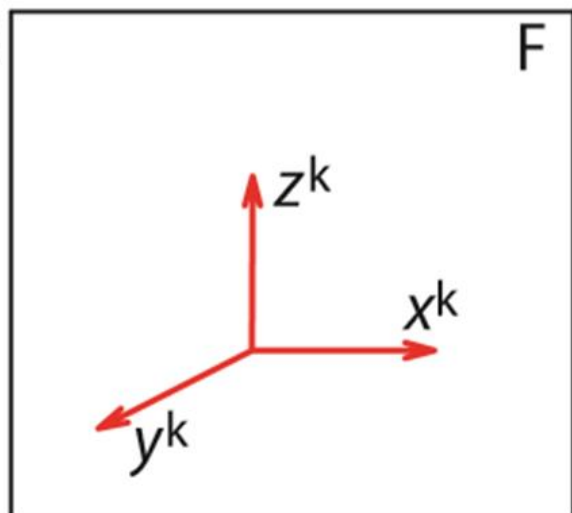


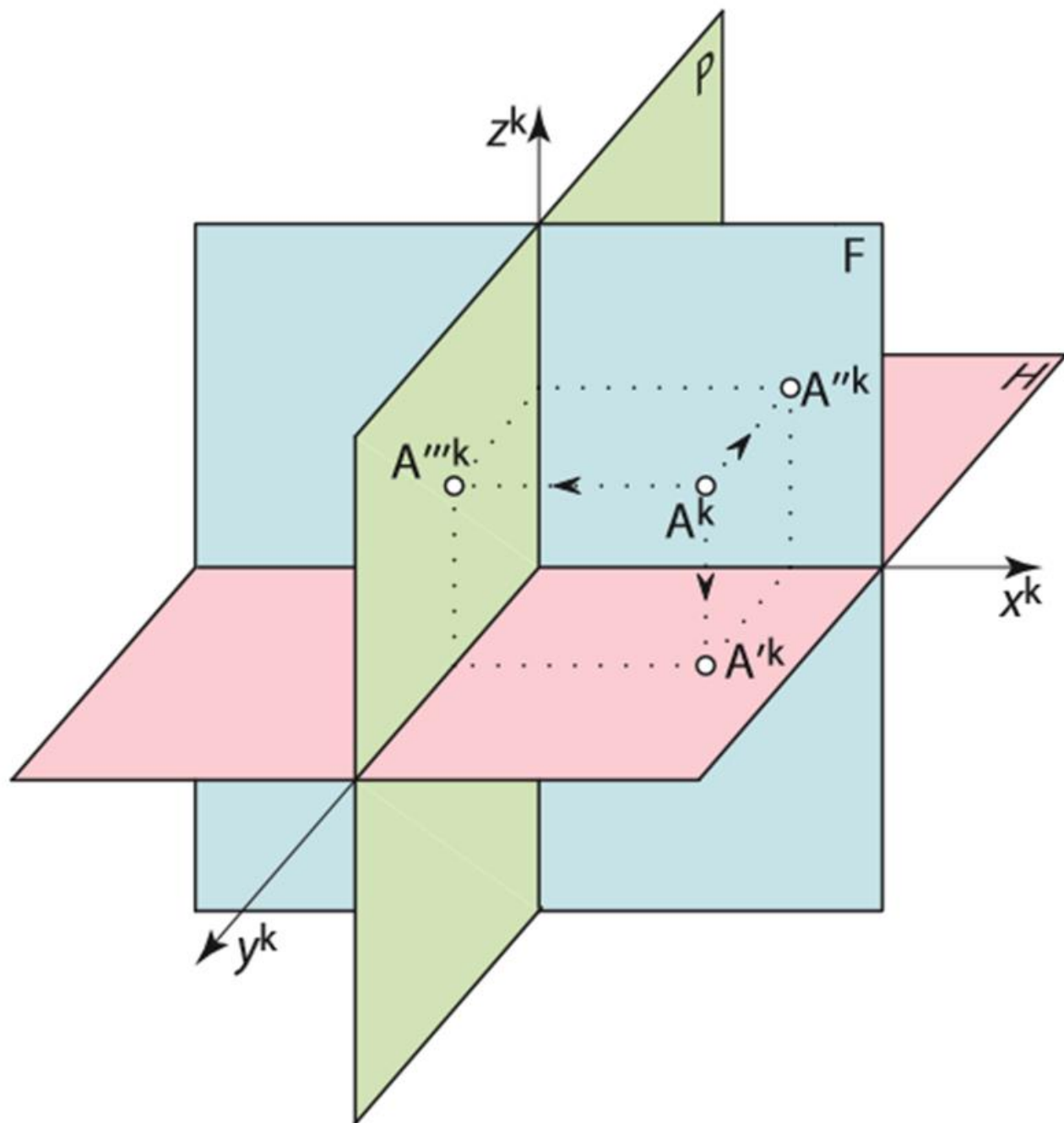


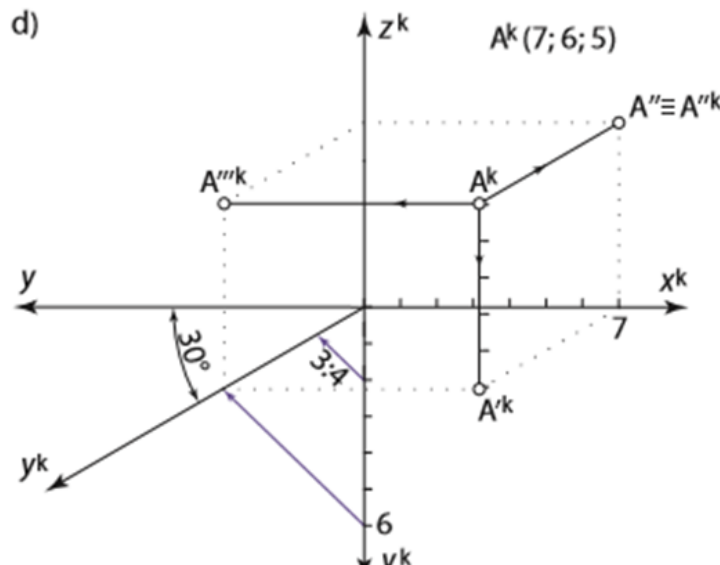
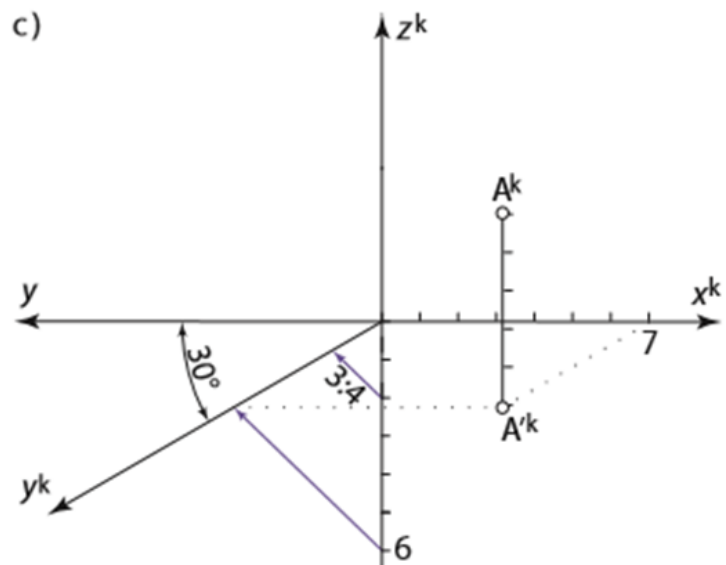
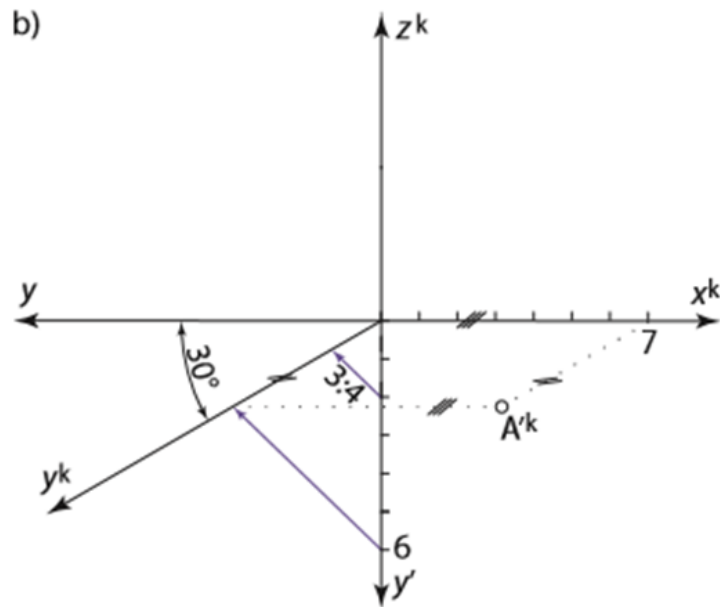
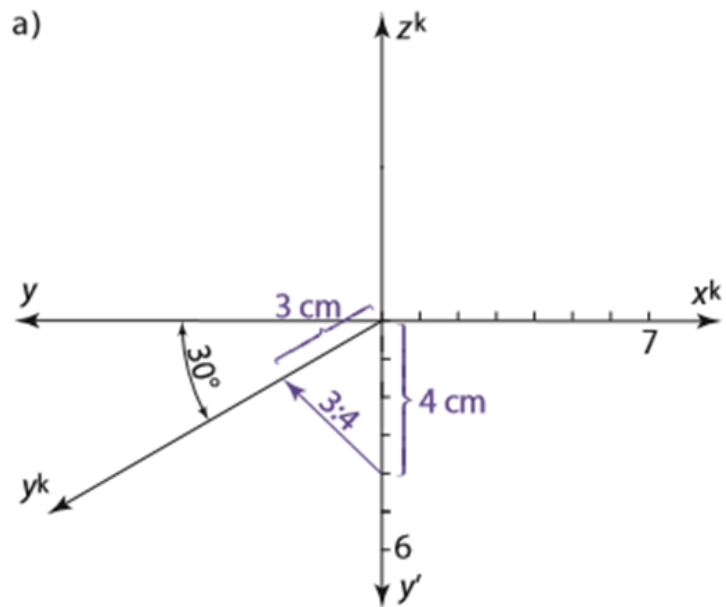
a)

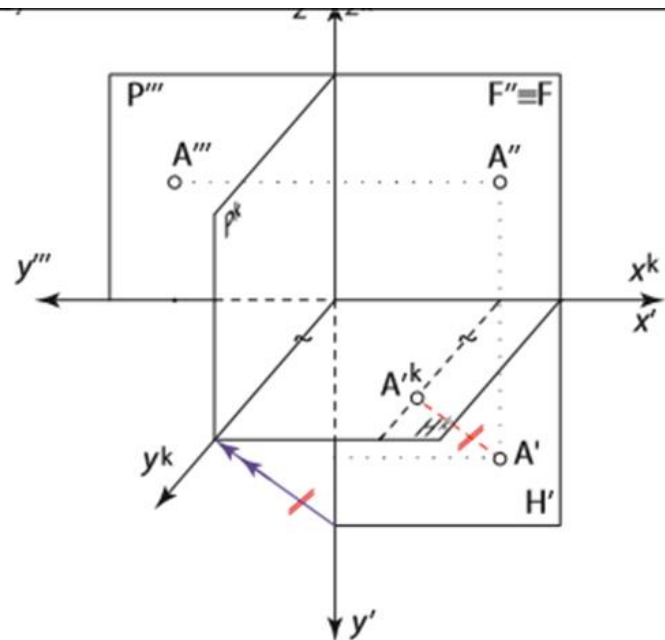
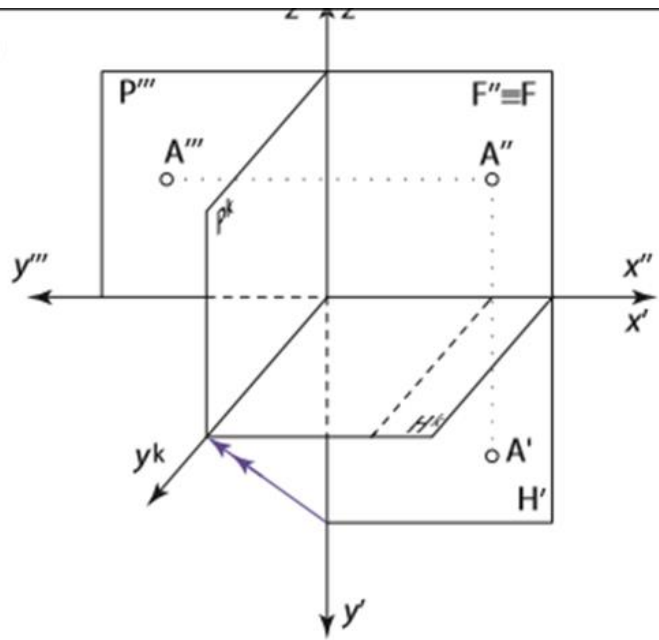


b)

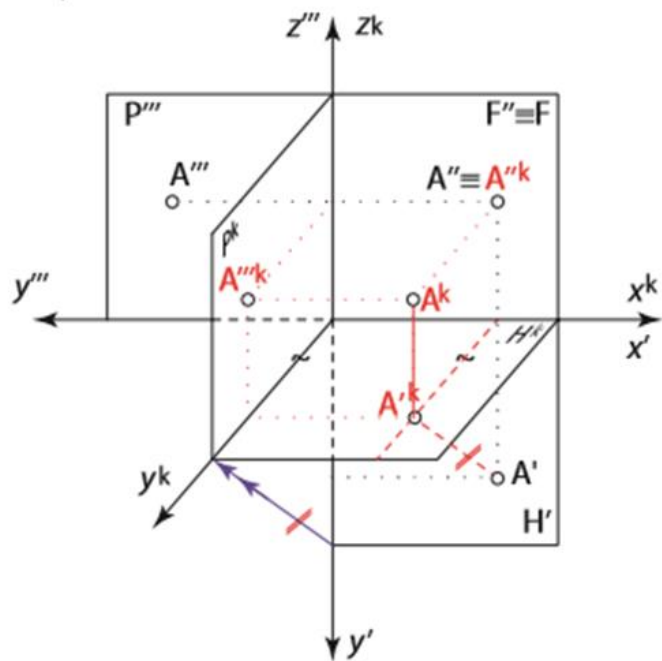


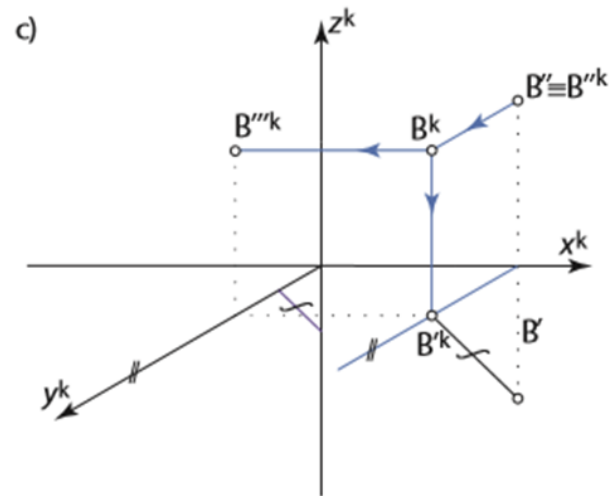
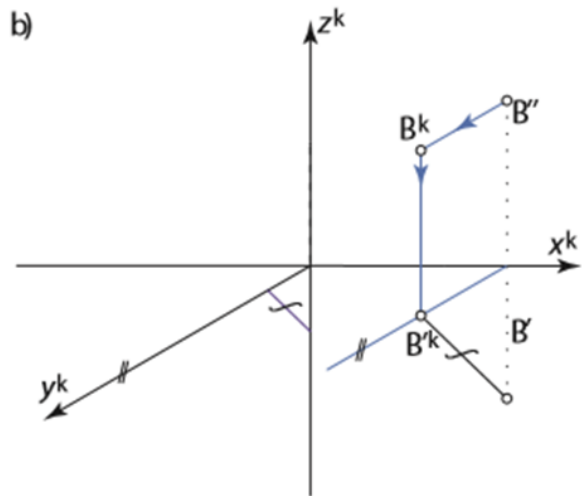
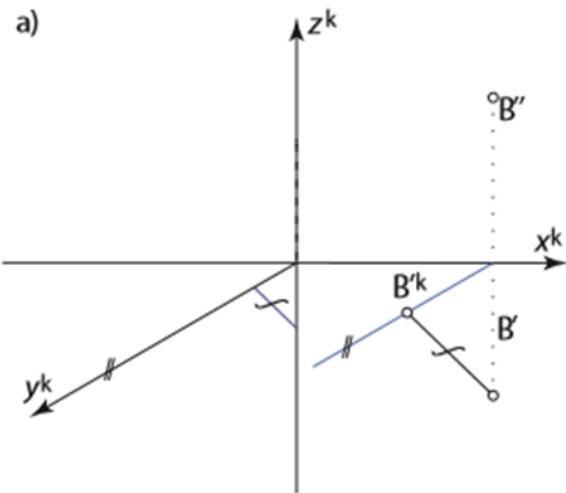


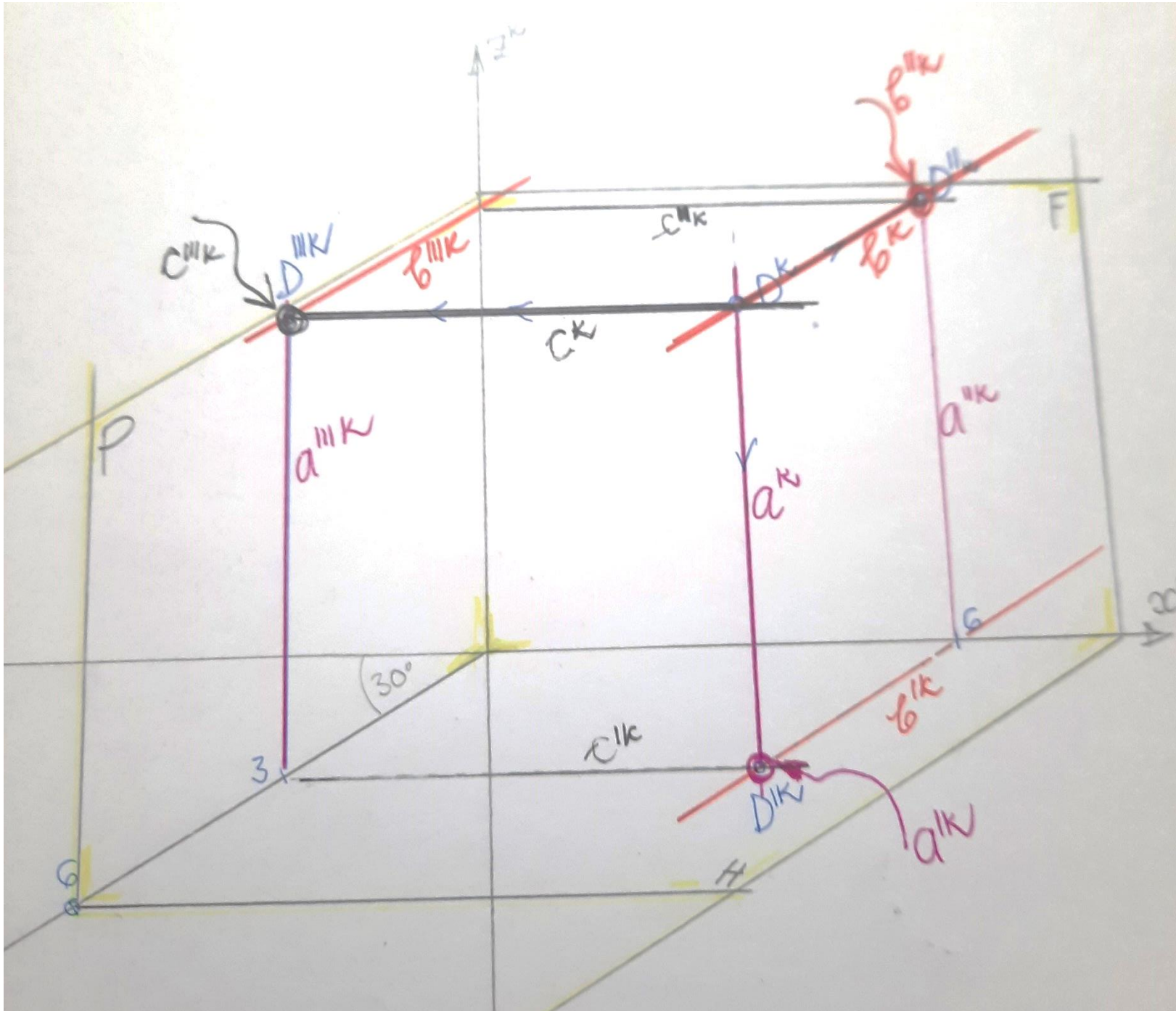




c)



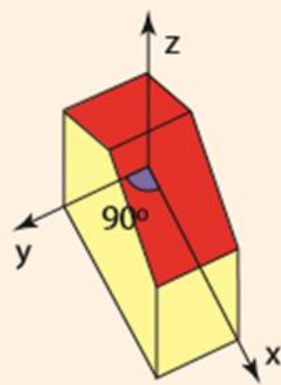
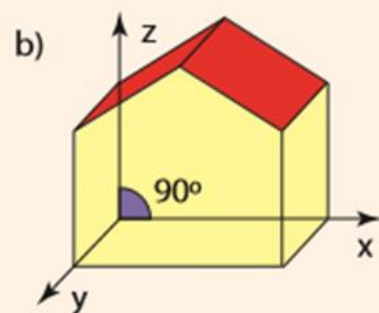
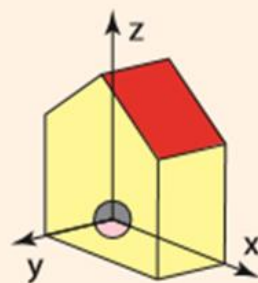
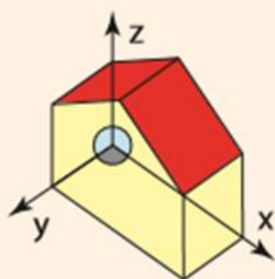
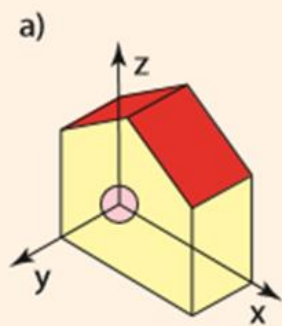


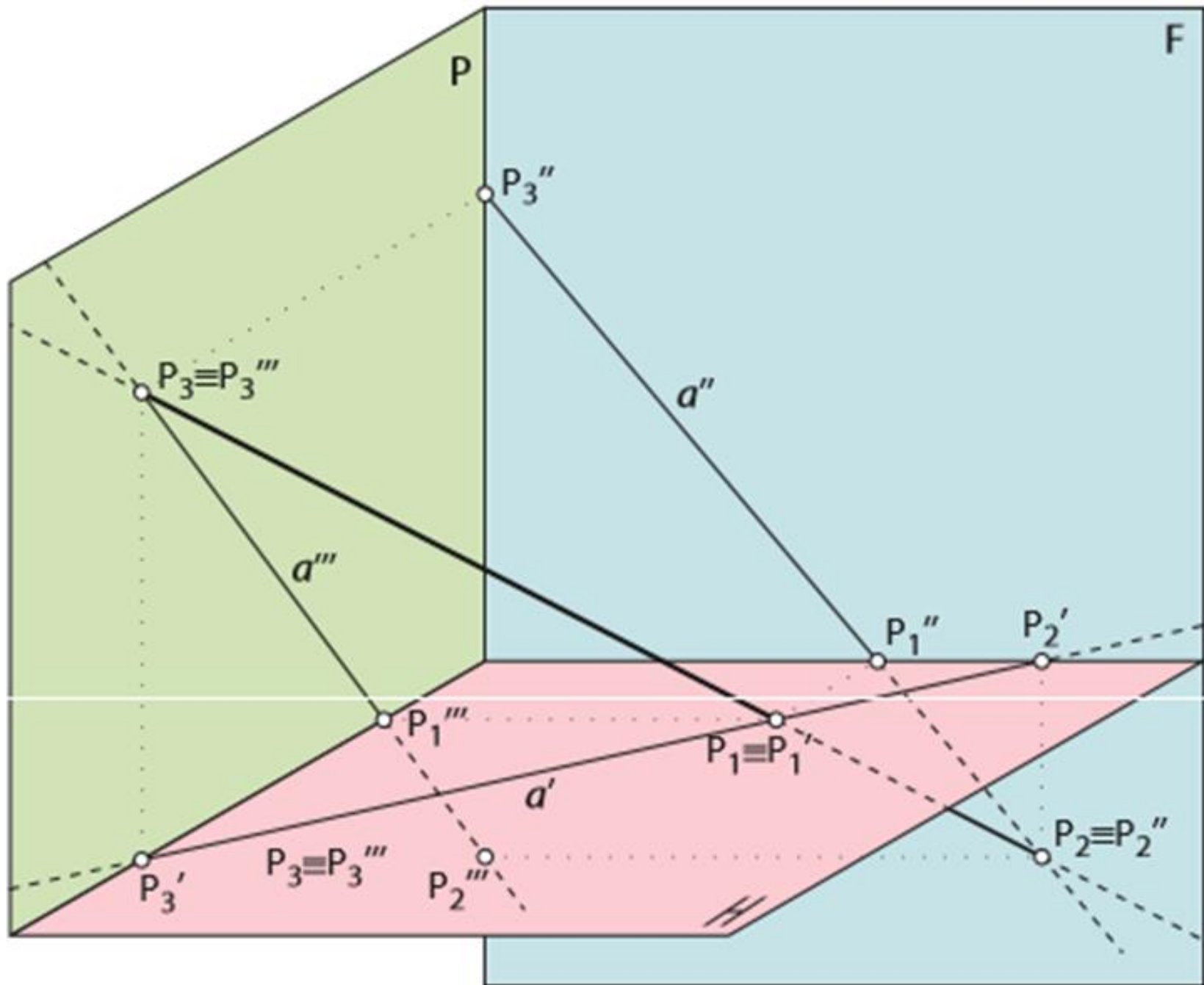


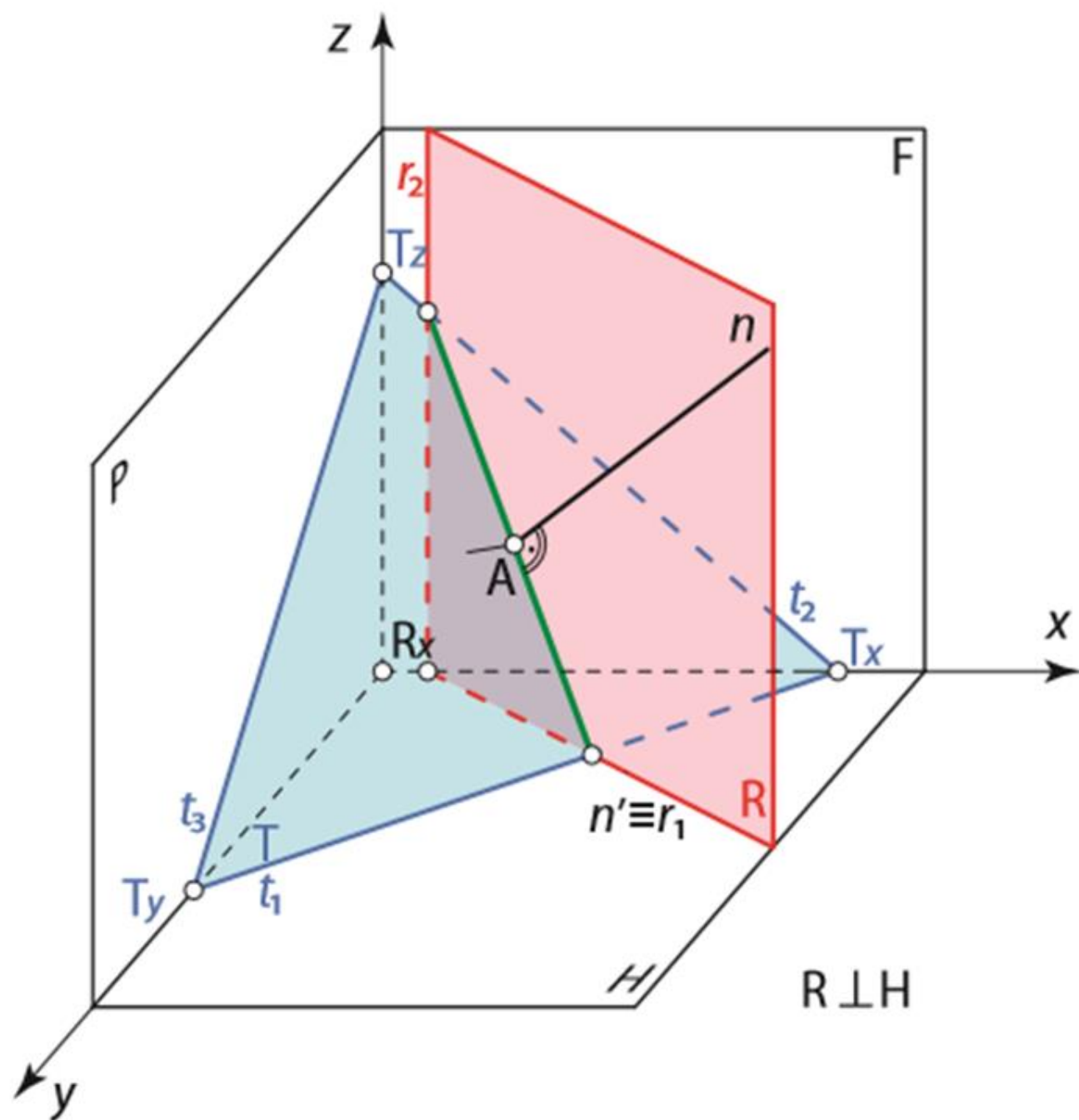
Ako triedar projiciramo samo na jednu ravan, ali zracima ortogonalnim na tu ravan, dobijamo **ortogonalne aksonometrije**: izometriju, dimetriju i trimetriju (slika C1.9a). Od položaja triedra prema projekcijskoj ravni zavisice uglovi između osa x , y i z u aksonometrijskom prikazu:

- izometrija – svi uglovi jednaki (120°),
- dimetrija – uglovi yOz i xOz jednaki,
- trimetrija – sva tri ugla različita.

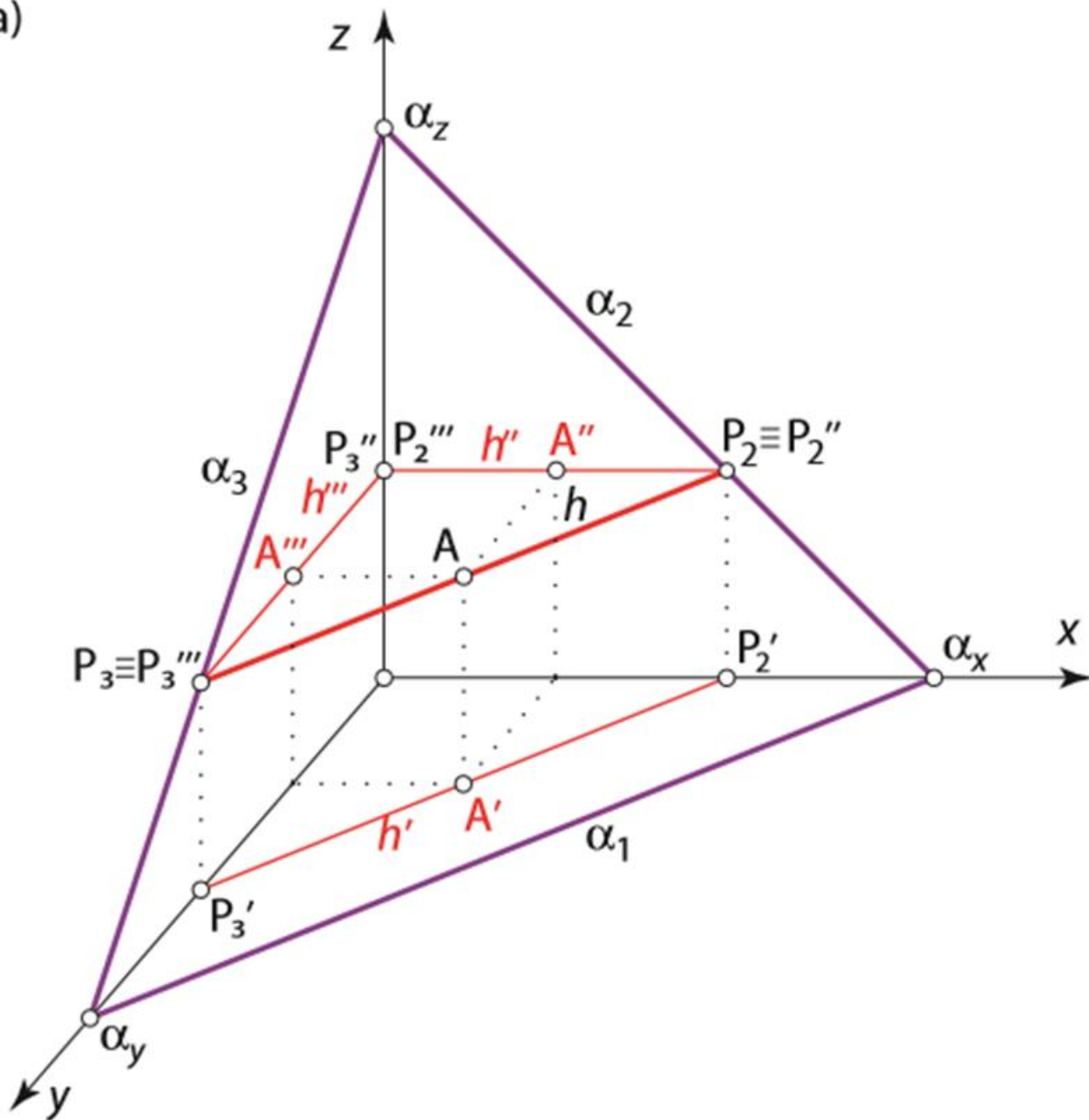
Vrste **kose aksonometrije** prikazane su na slici C1.9b. To su frontalna kosa projekcija, koju proučavamo i kod koje ugao xOz ostaje prav, i planimetrijska, kod koje ugao xOy ostaje prav.

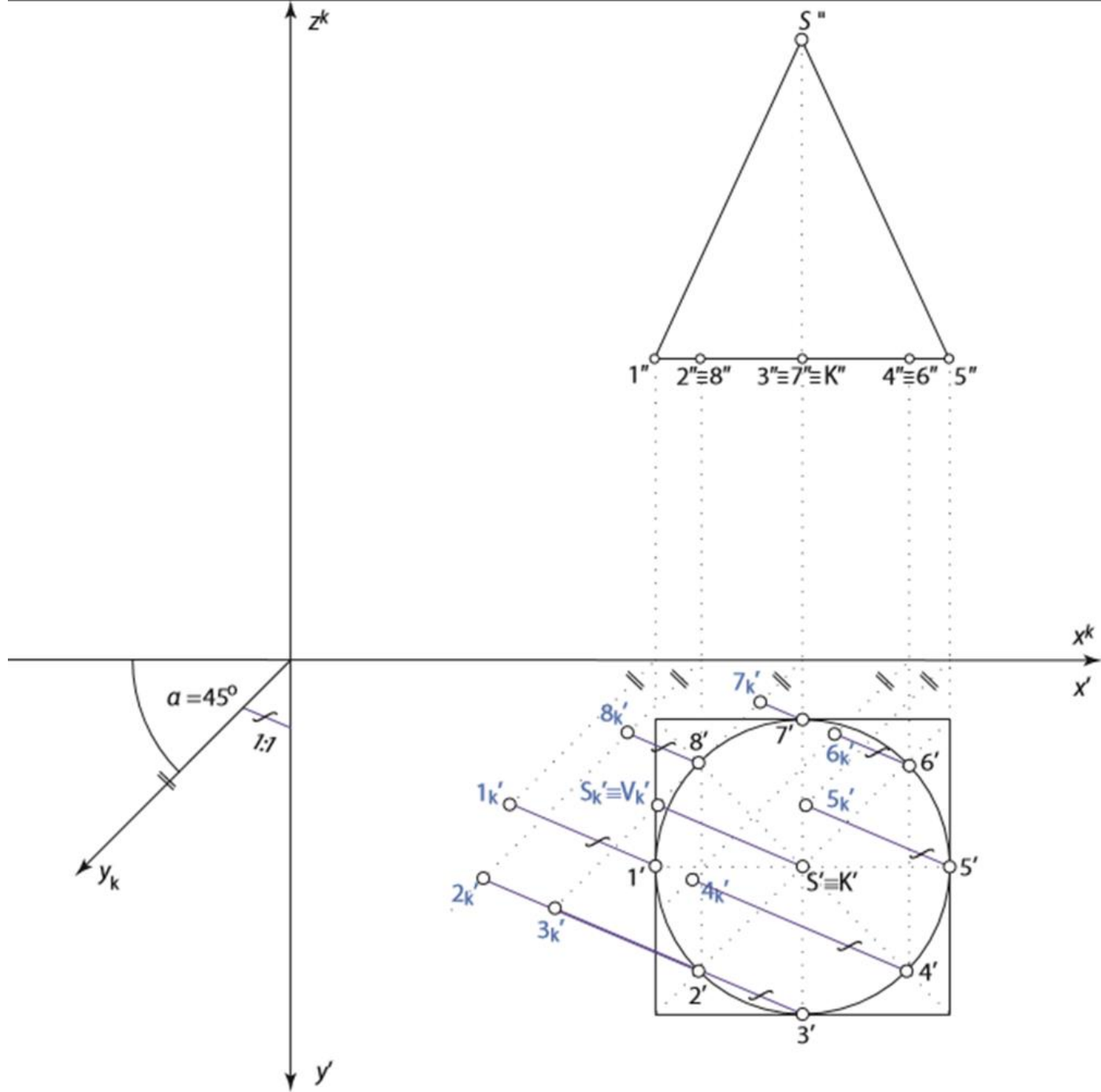


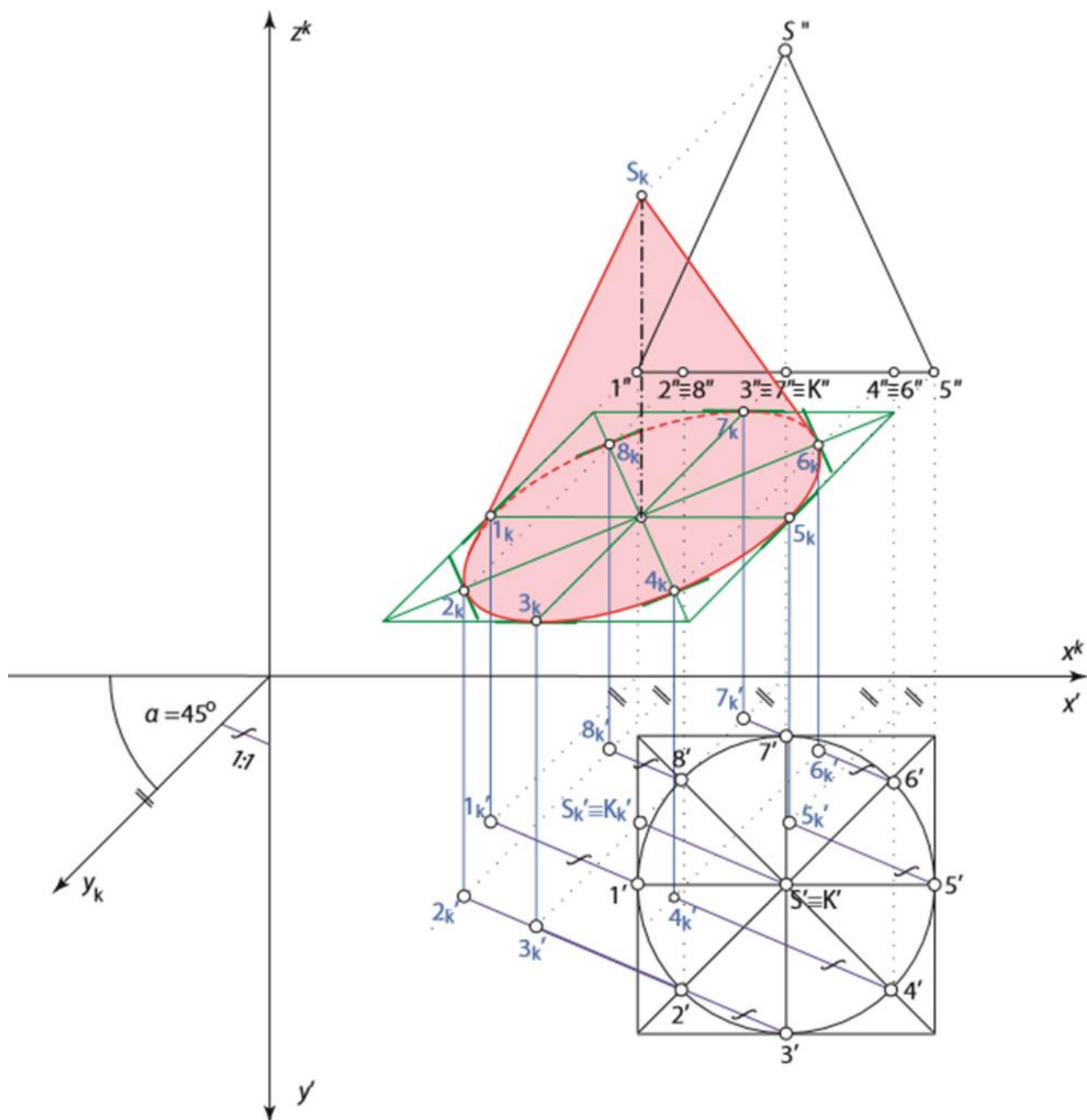




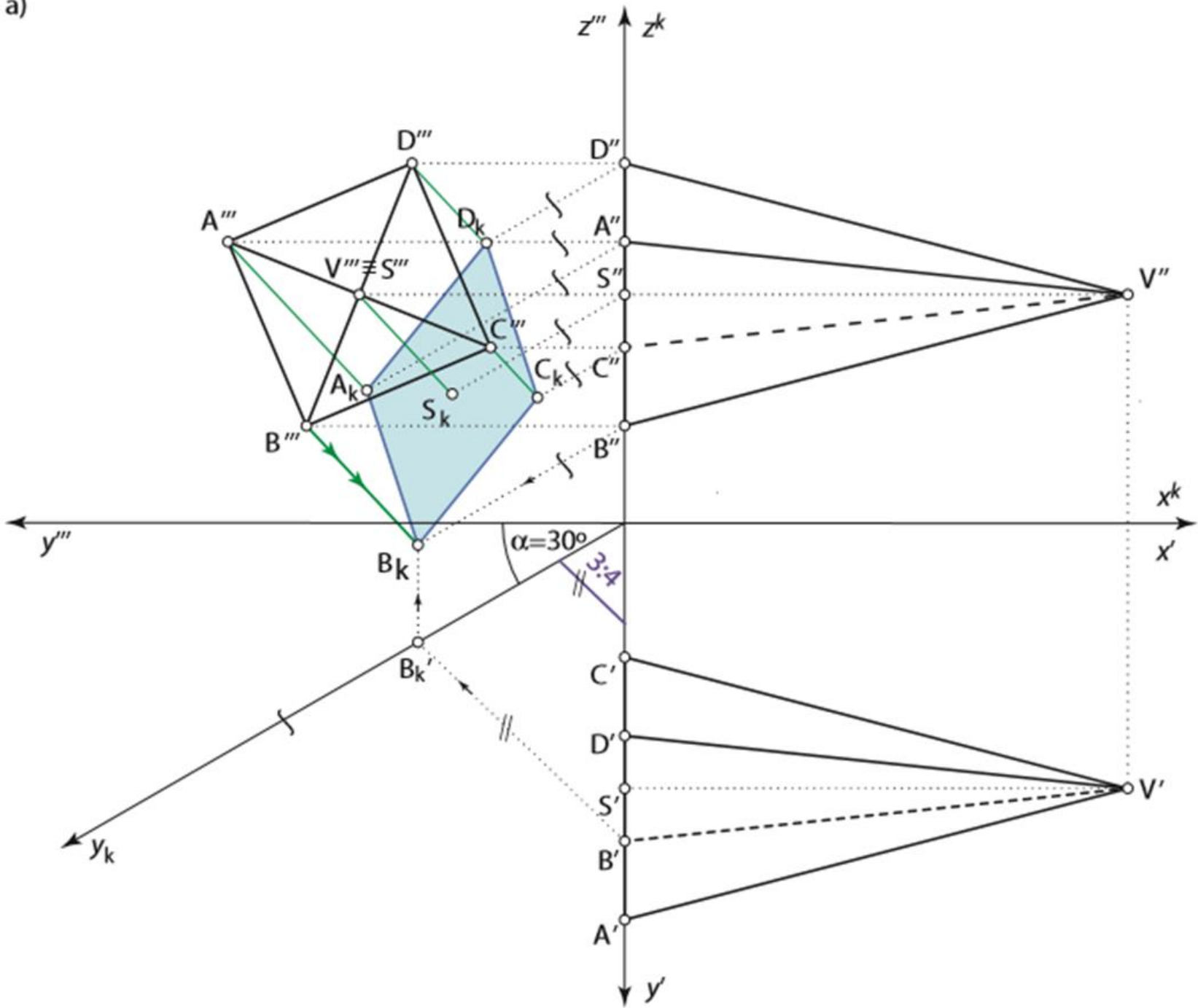
a)



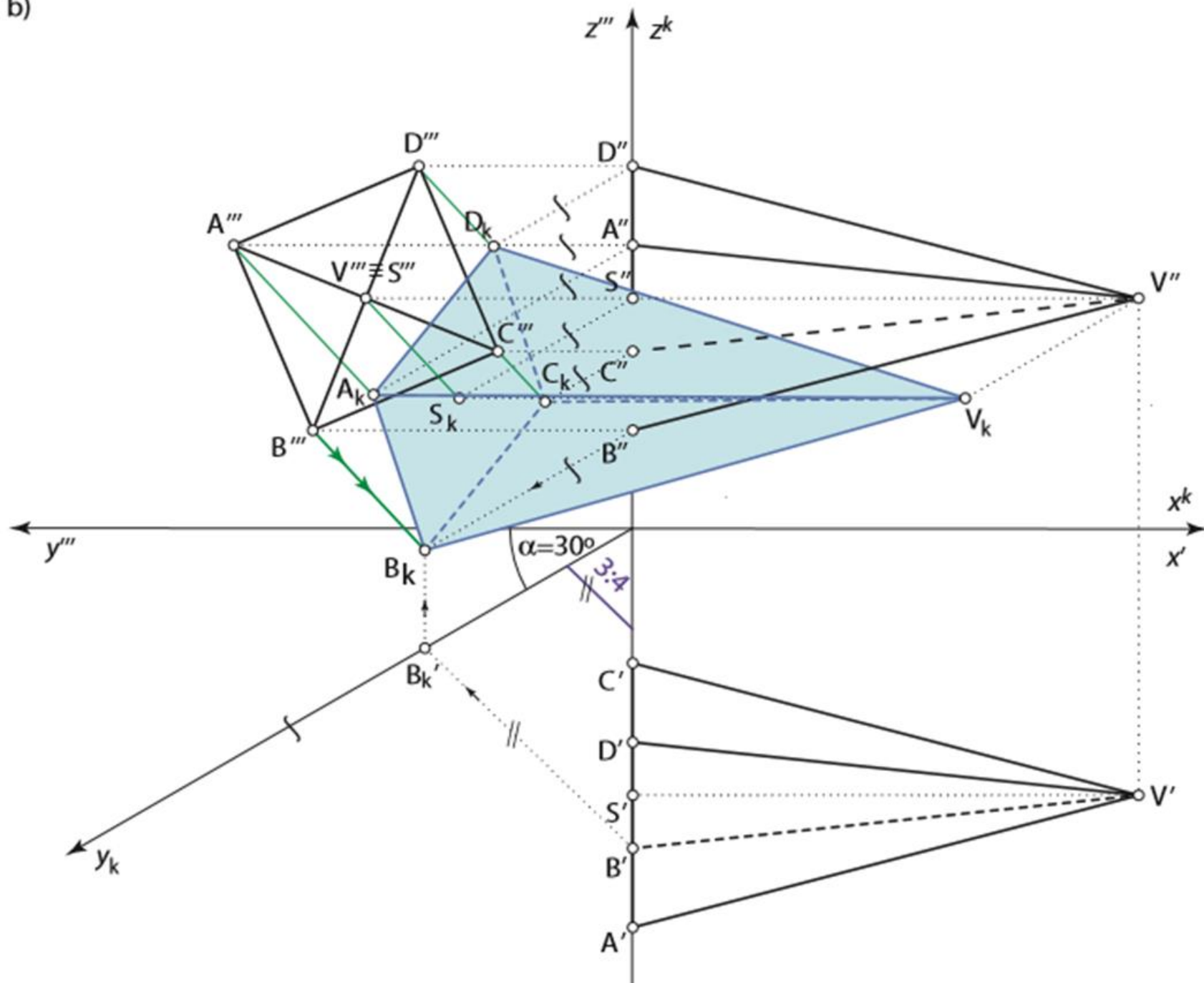




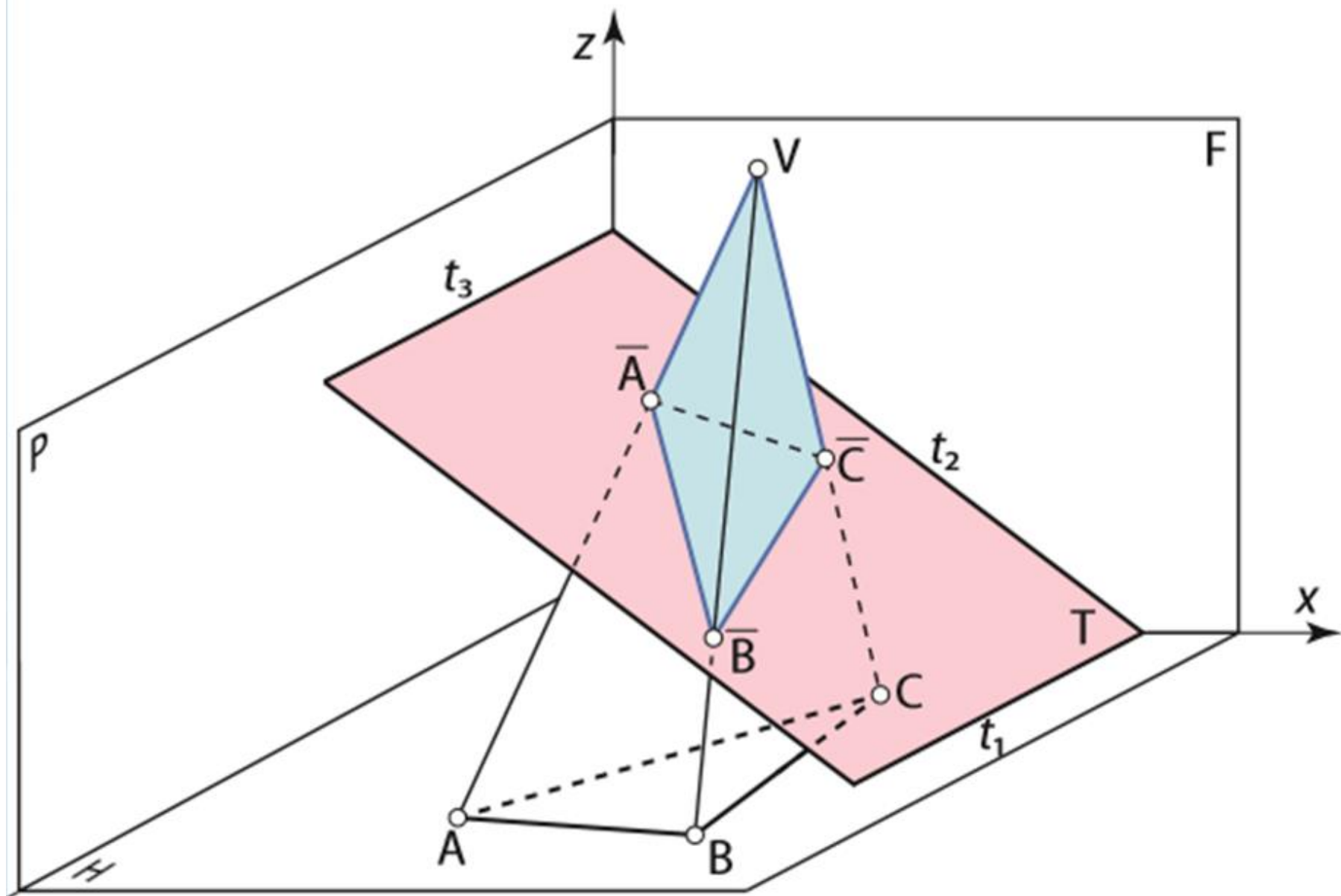
a)

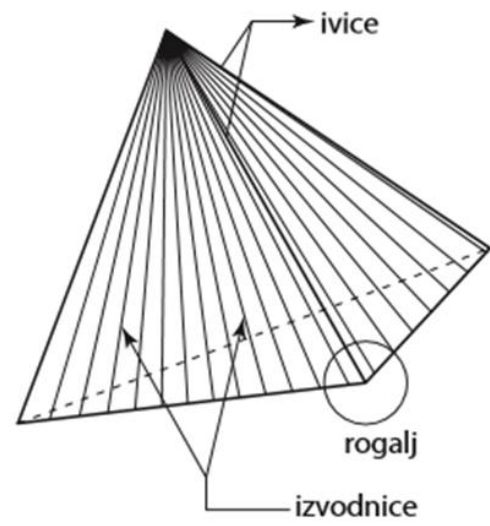
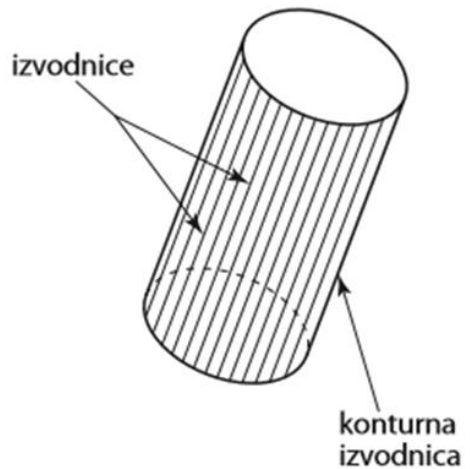
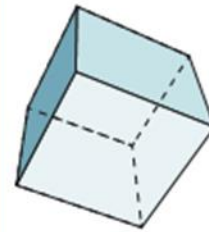
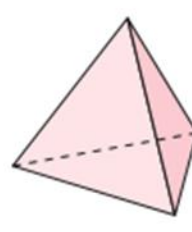
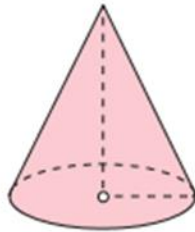
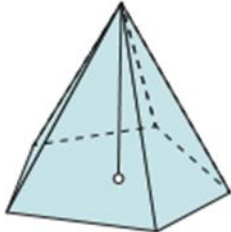
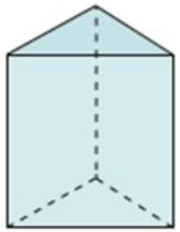
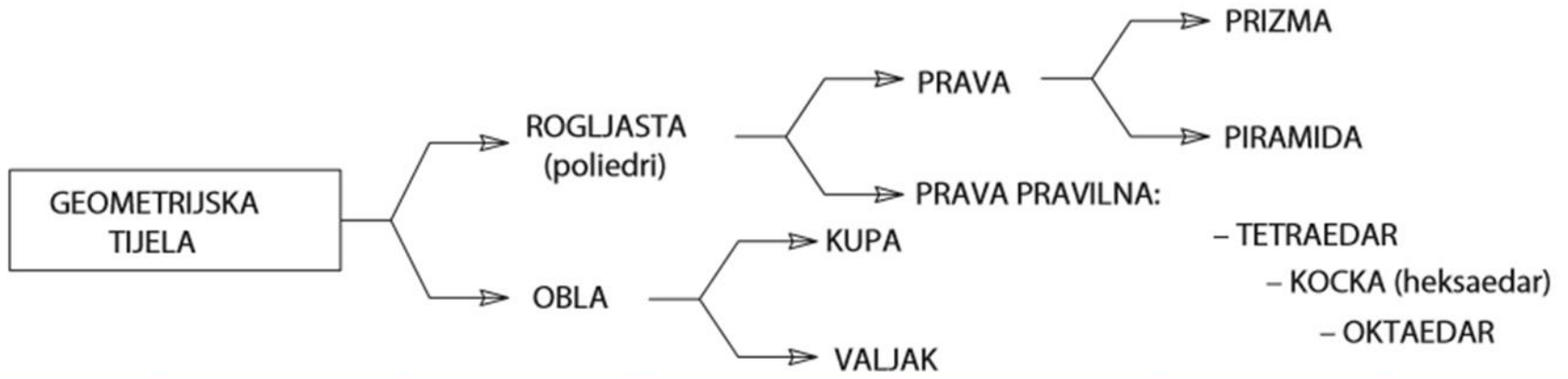


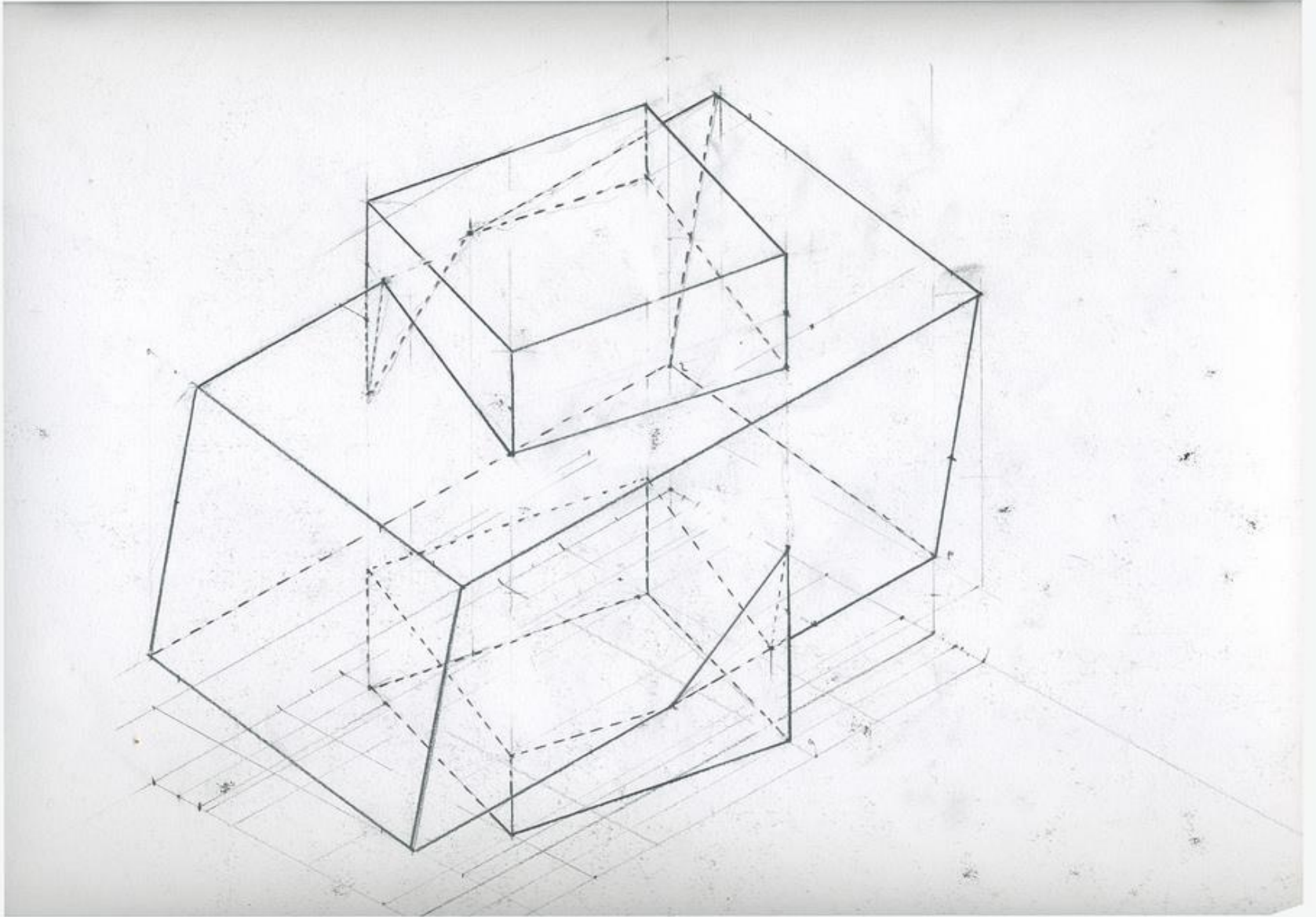
b)



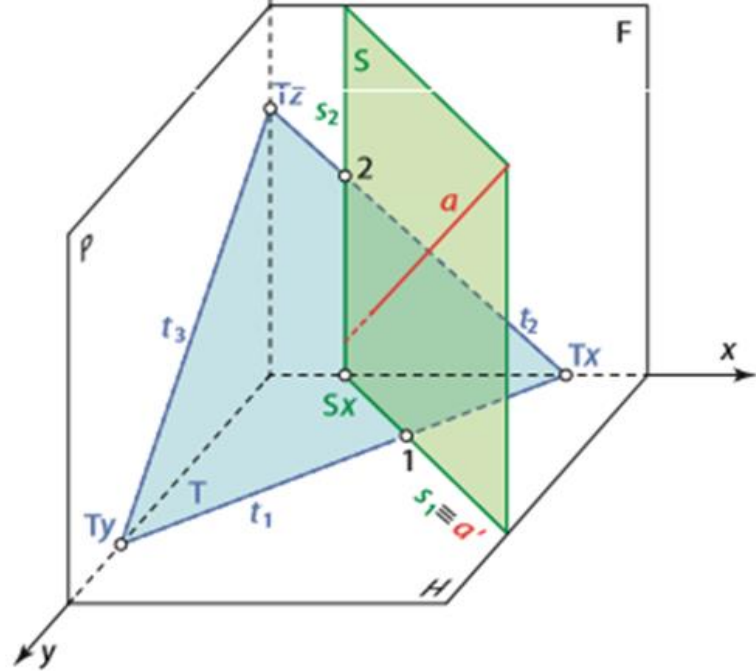
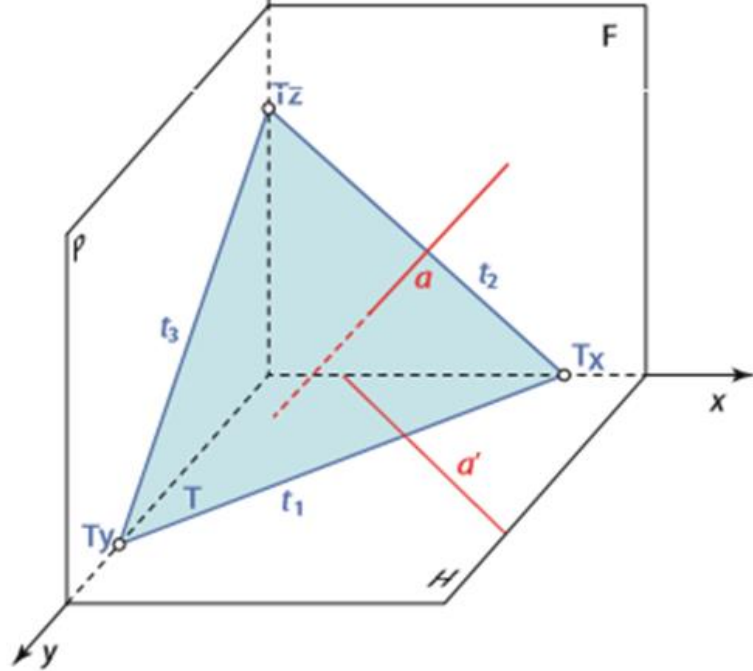




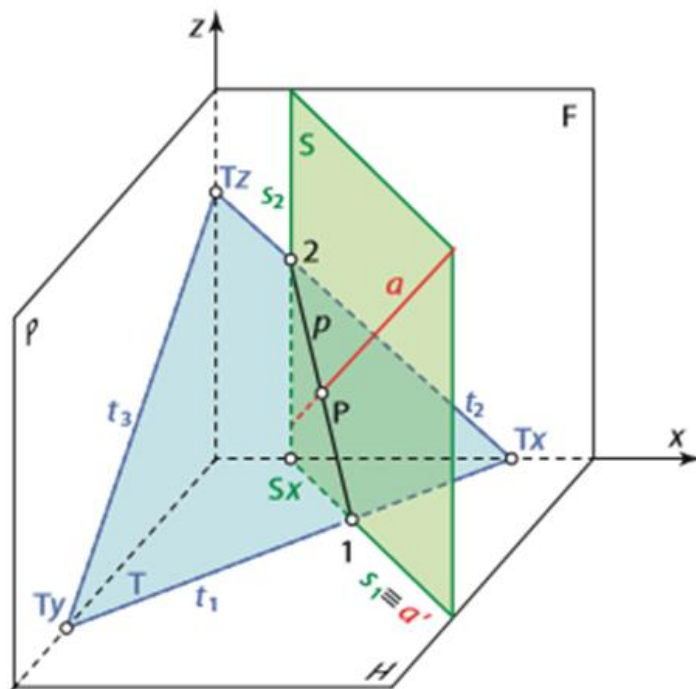


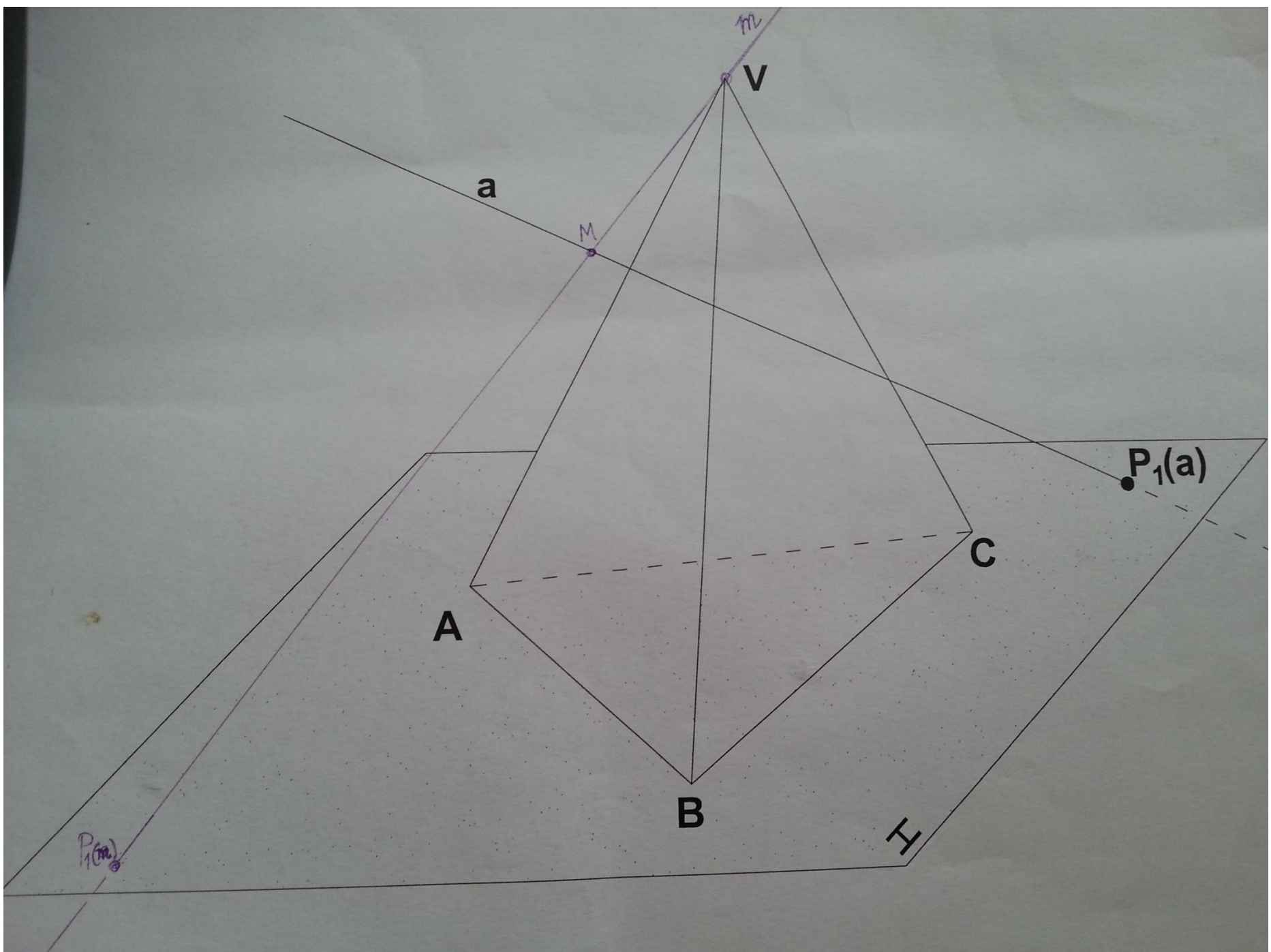


Prodor prave kroz ravan



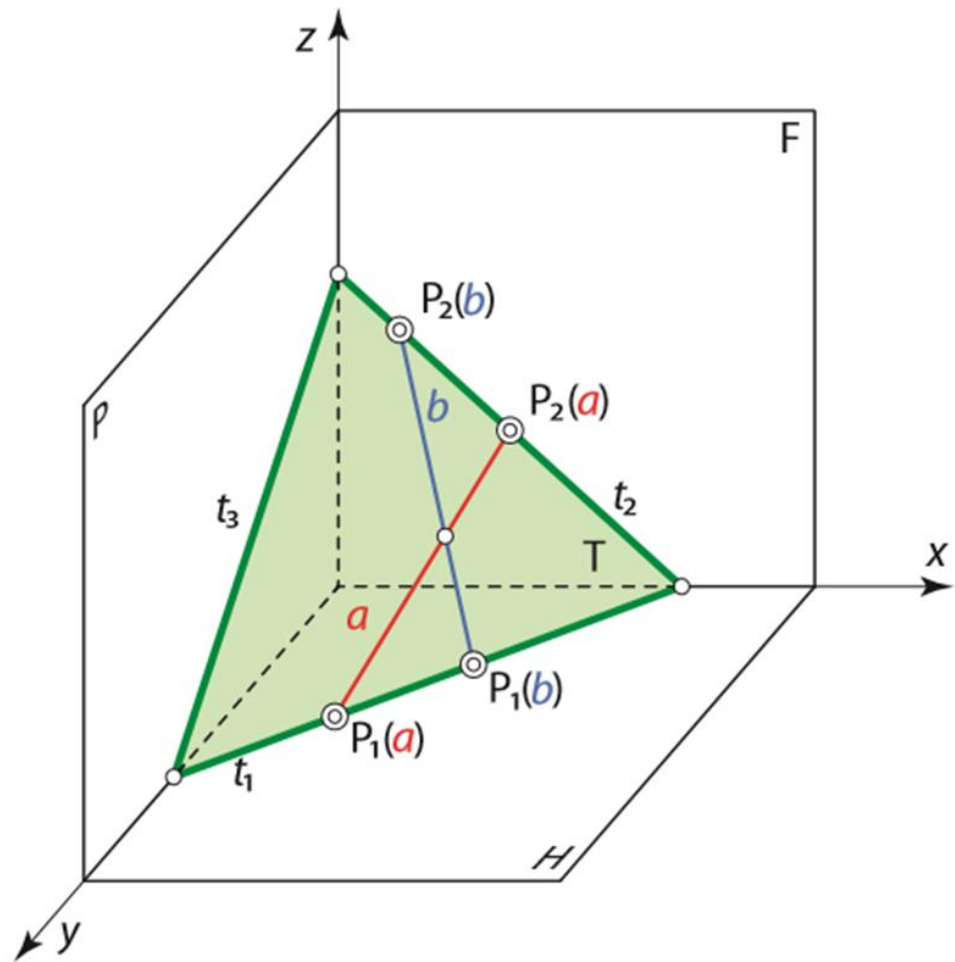
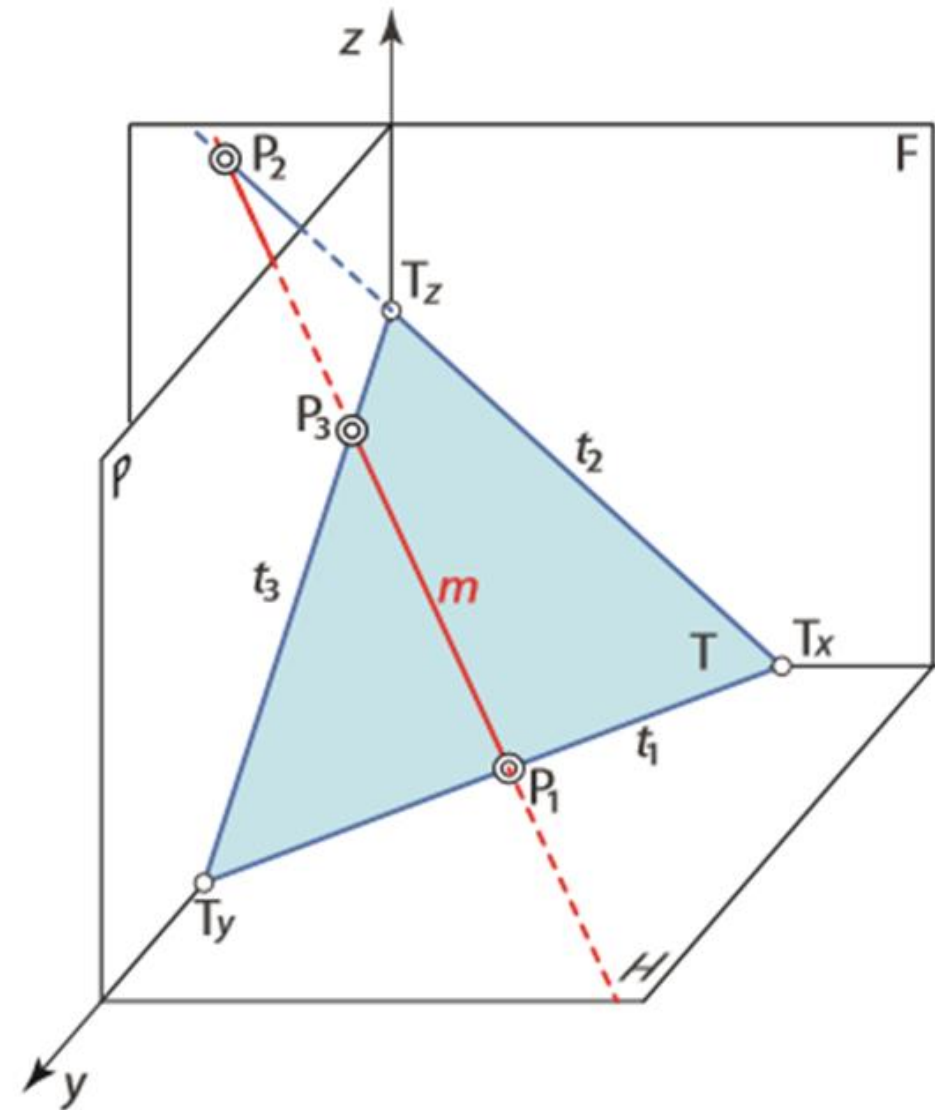
c)



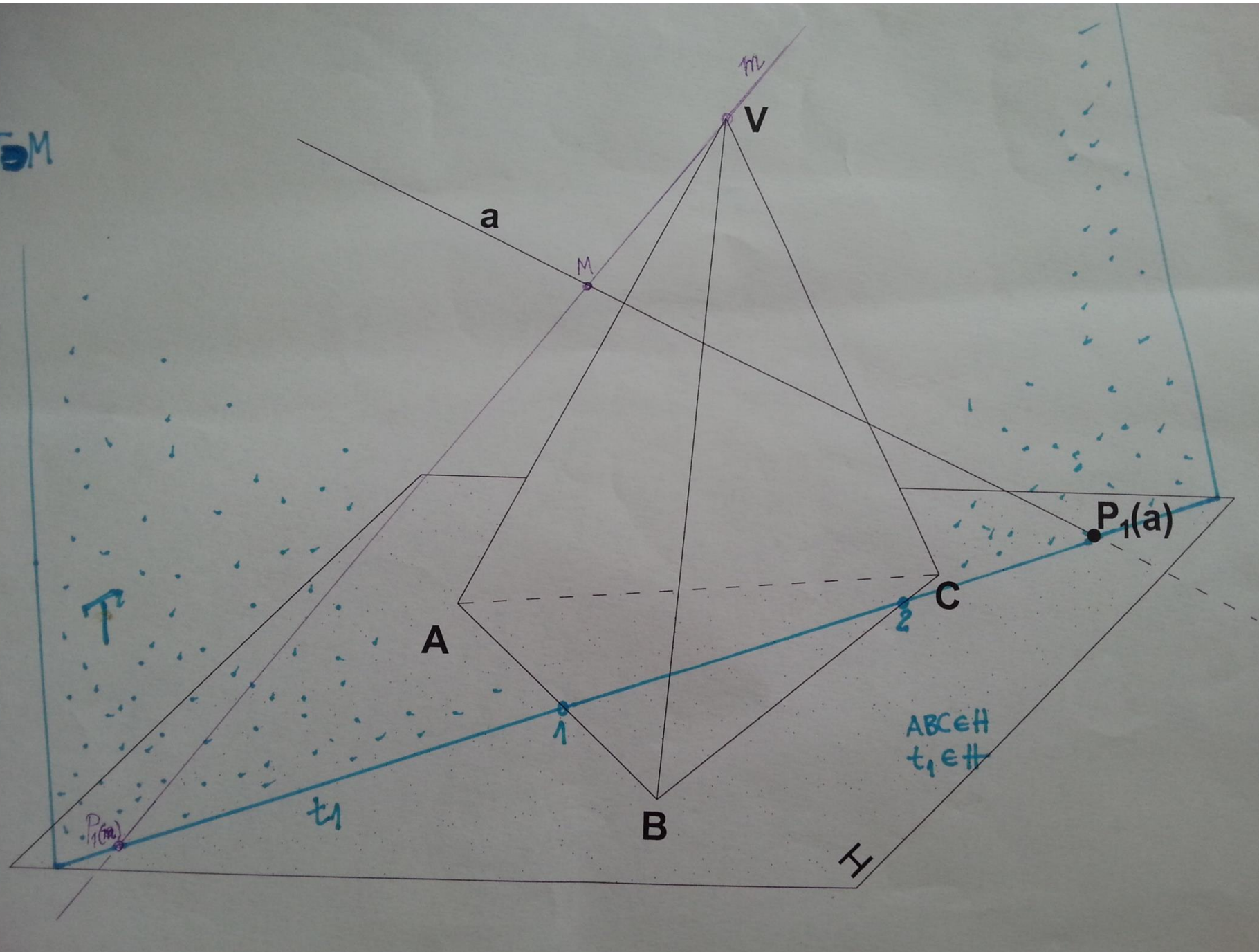


Pripadnost prave i tačke ravni

$$m \in T \Leftrightarrow P_1 \in t_1 \wedge P_2 \in t_2 \wedge P_3 \in t_3$$



TM



$P_1(m)$

t_1

A

B

C

Π

M

V

a

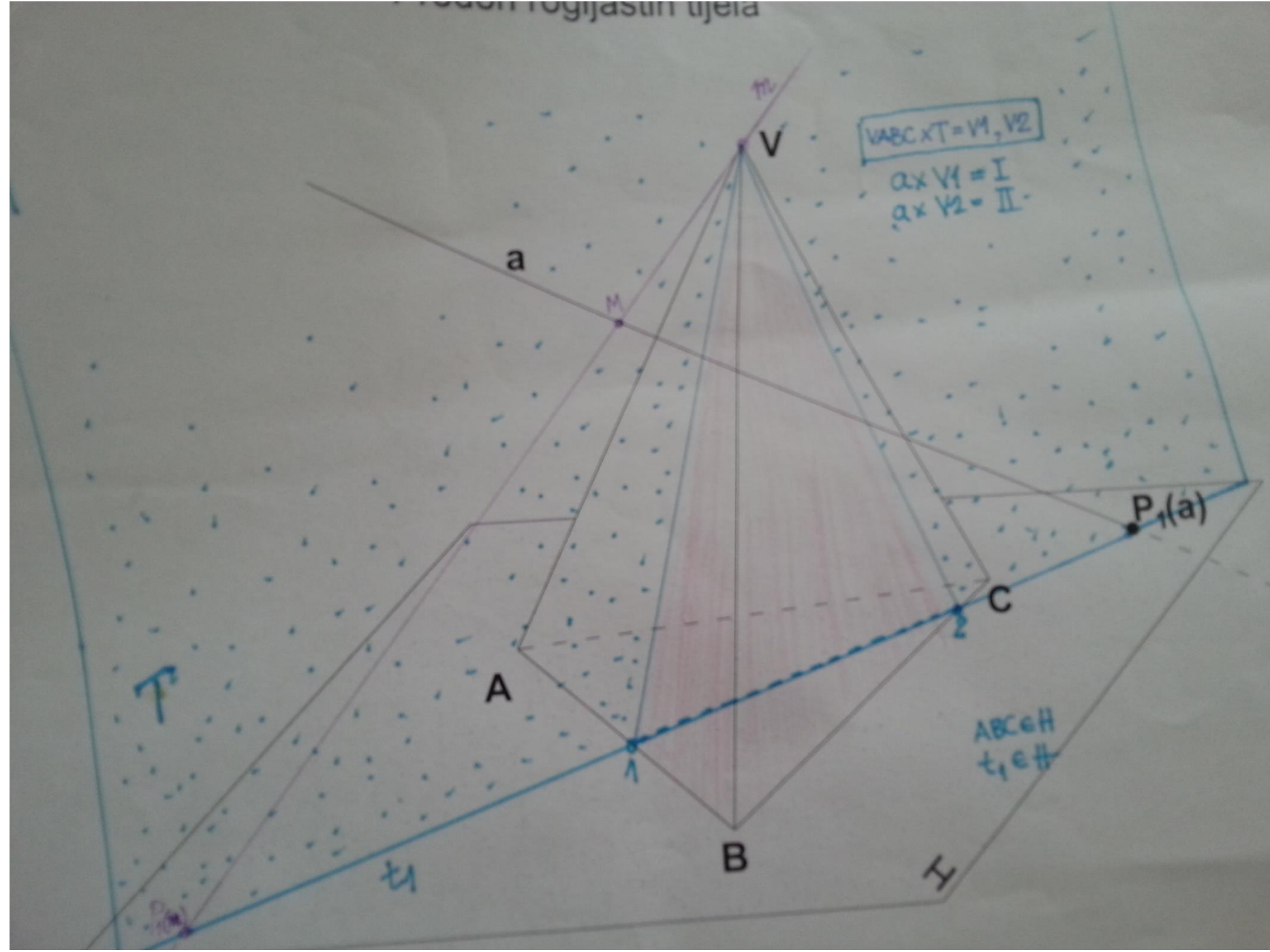
$P_1(a)$

$ABCEH$
 $t_1 \in \Pi$

2

T

... roudn rogiastin tijela



$VABC \times T = V1, V2$

$a \times V1 = I$

$a \times V2 = II$

$ABCEH$
 $t_1 \in H$

T

a

M

V

V

$P_1(a)$

A

C

A'

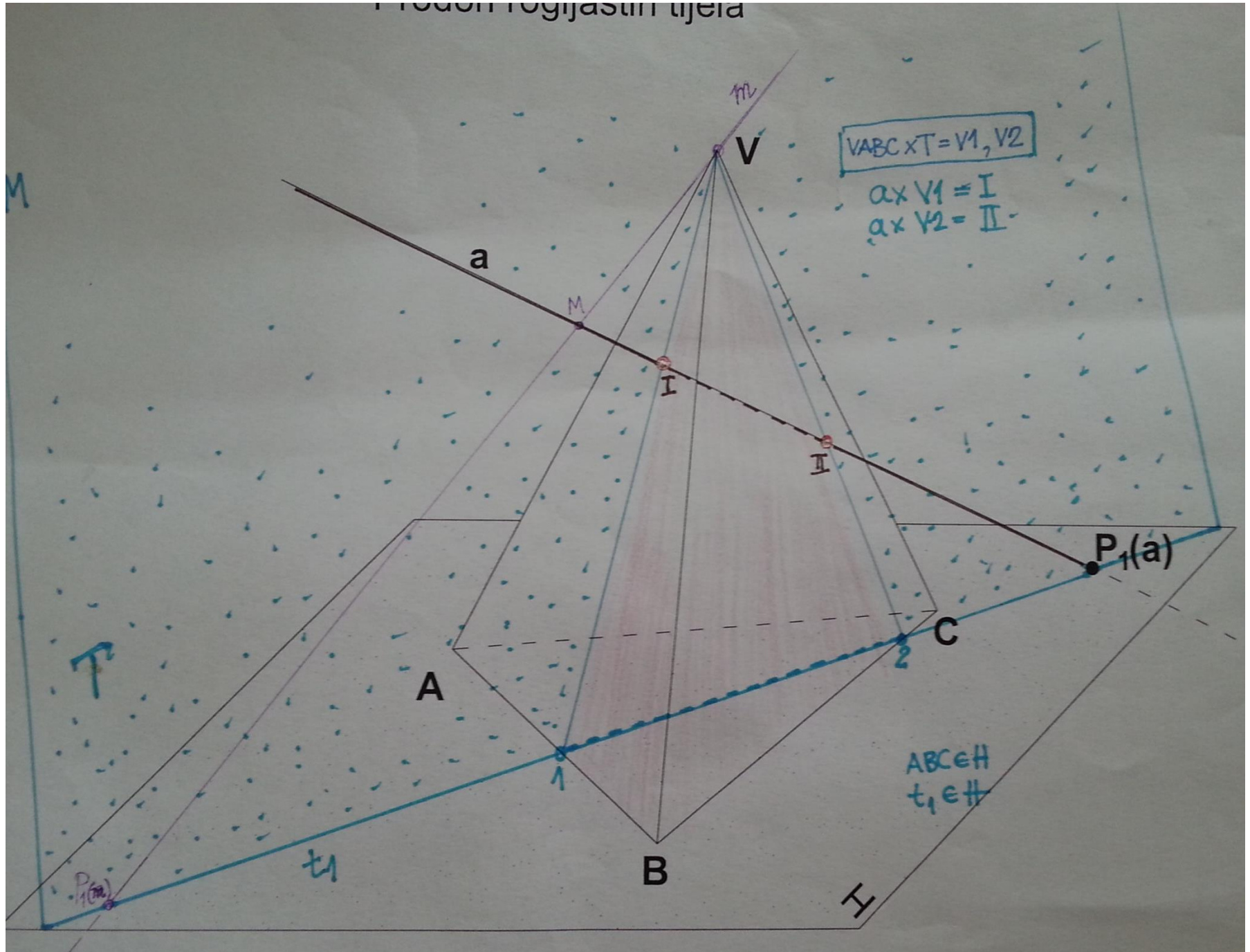
B

H

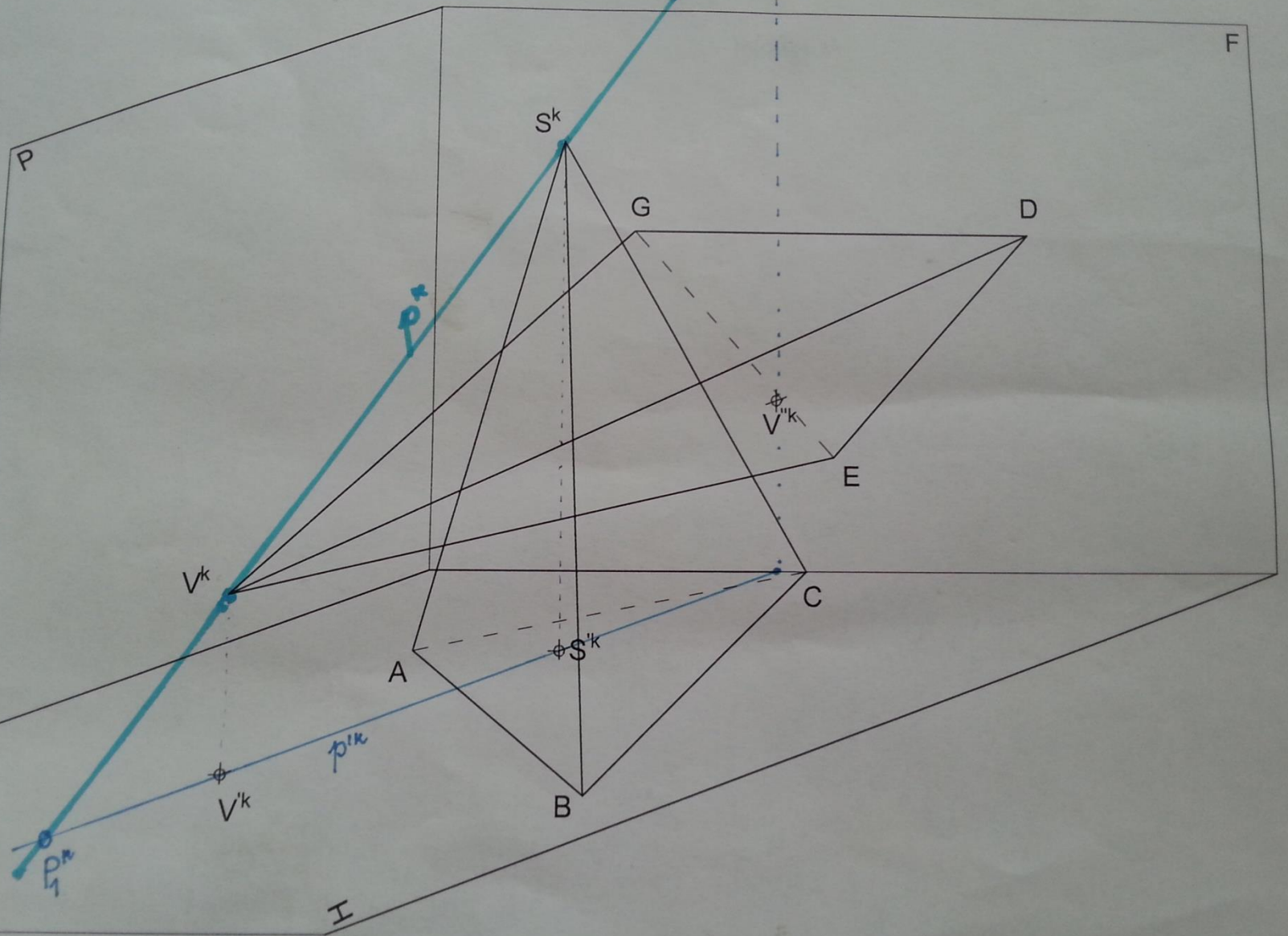
t_1

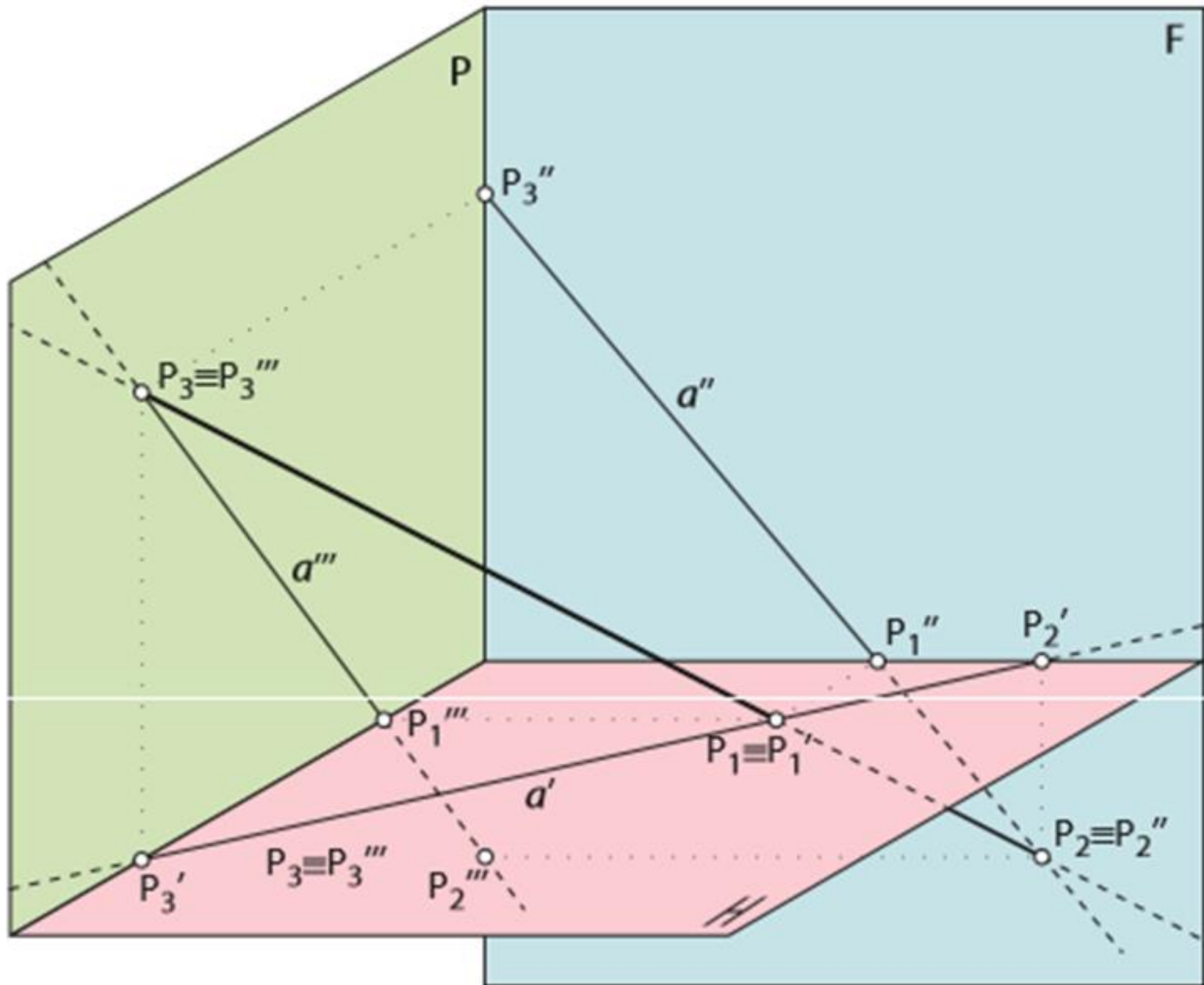
$P_2(a)$

Projeon togijastin tijela



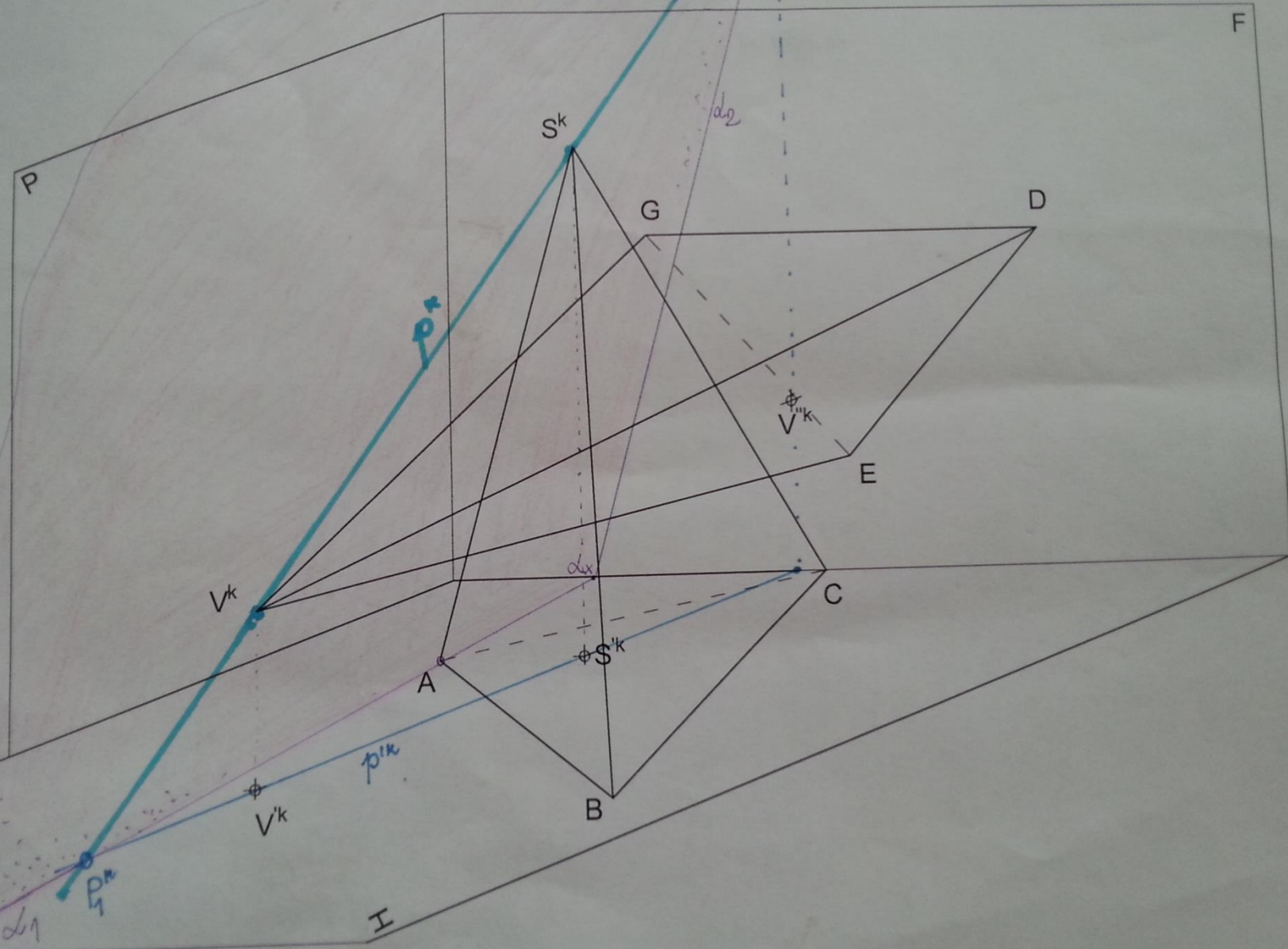
Nacrtna geometrija - Predavanja
Prodori rogljastih tijela

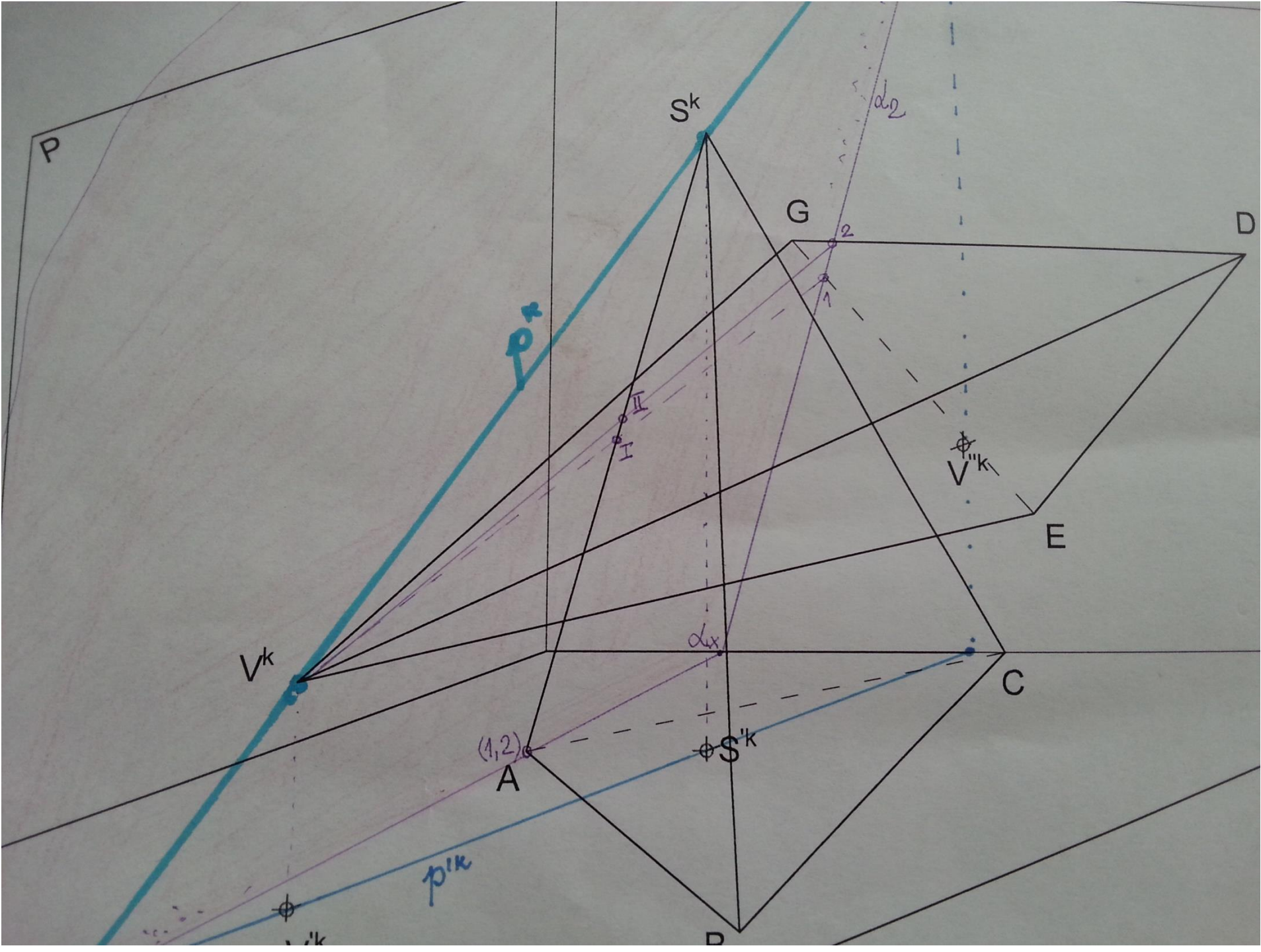


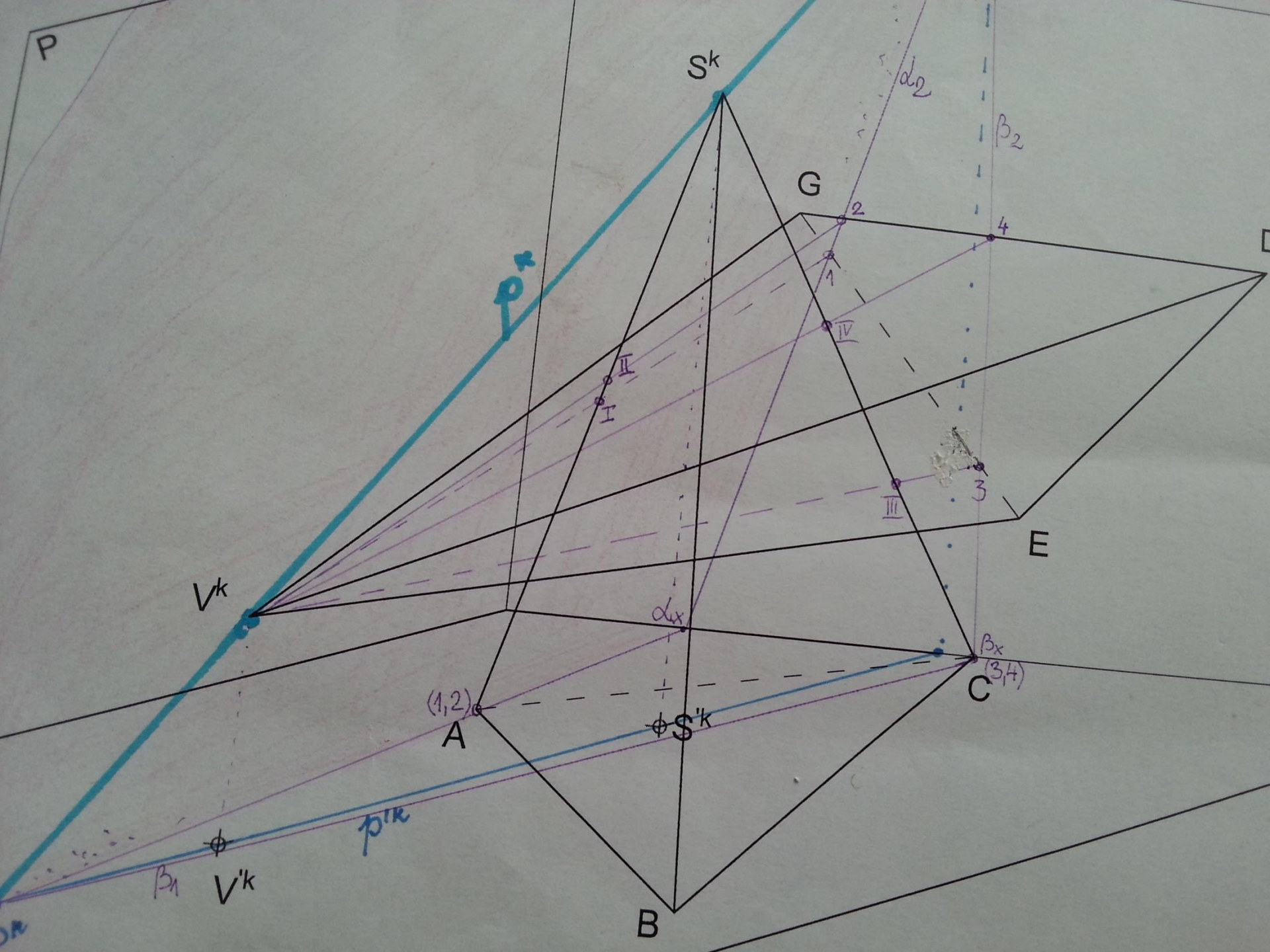


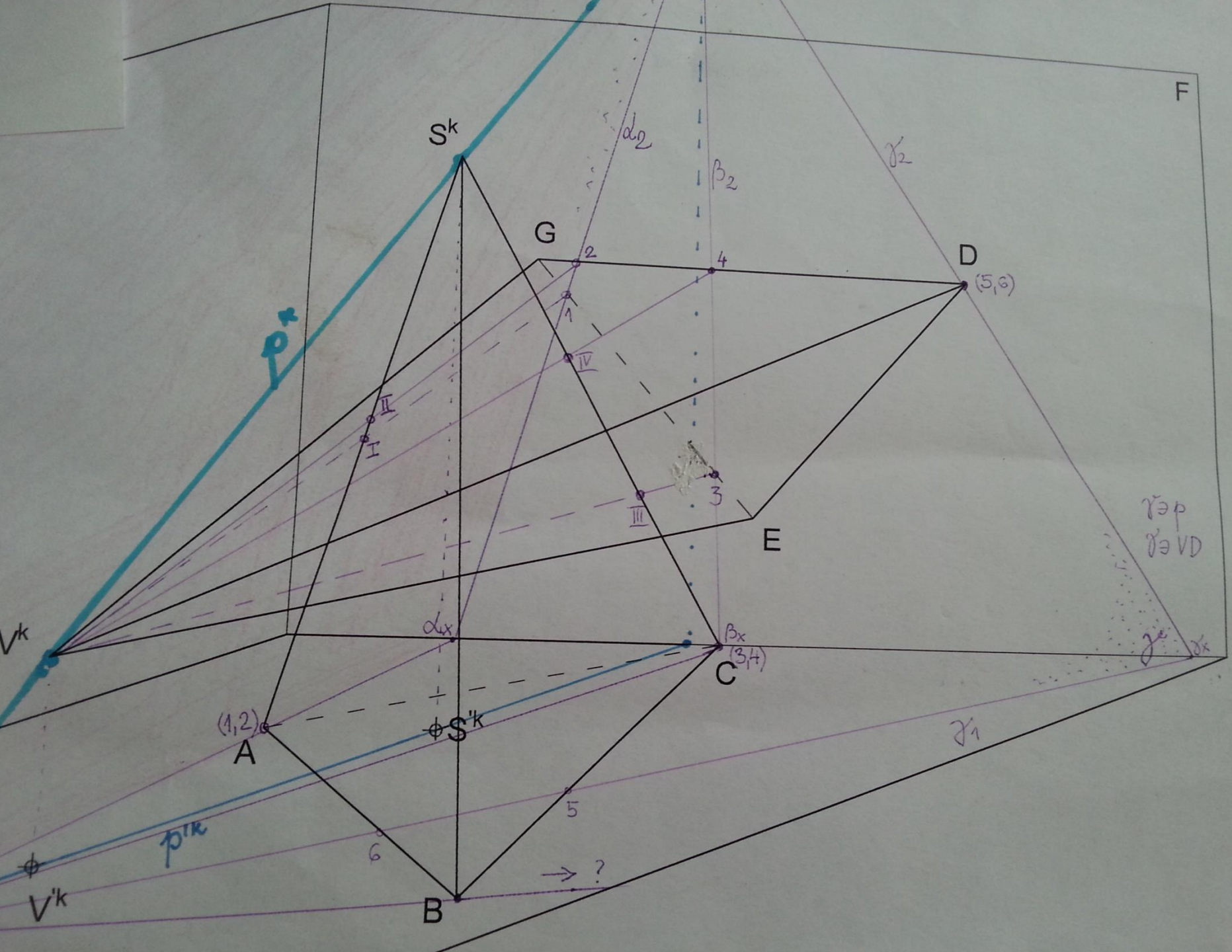
Nacrtna geometrija - Predavanja
 Prodori rogljastih tijela

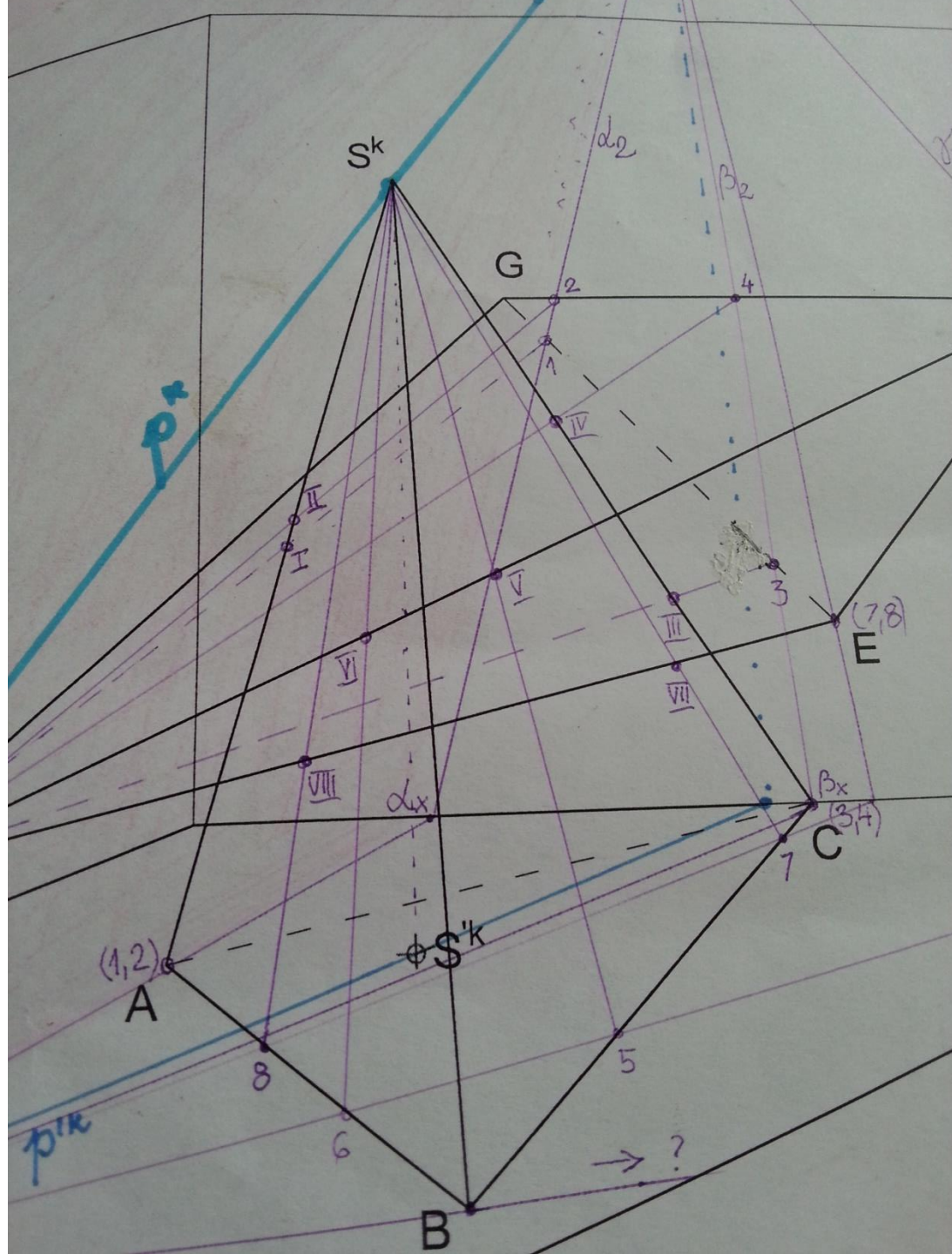
- 4;4;0)
- 13;11;0)
- 6⁵;0;0)
- 6;4;9)
- 10⁵;0;6)
- 7;0;2)
- 3⁵;0;6)
- 6;10;3)





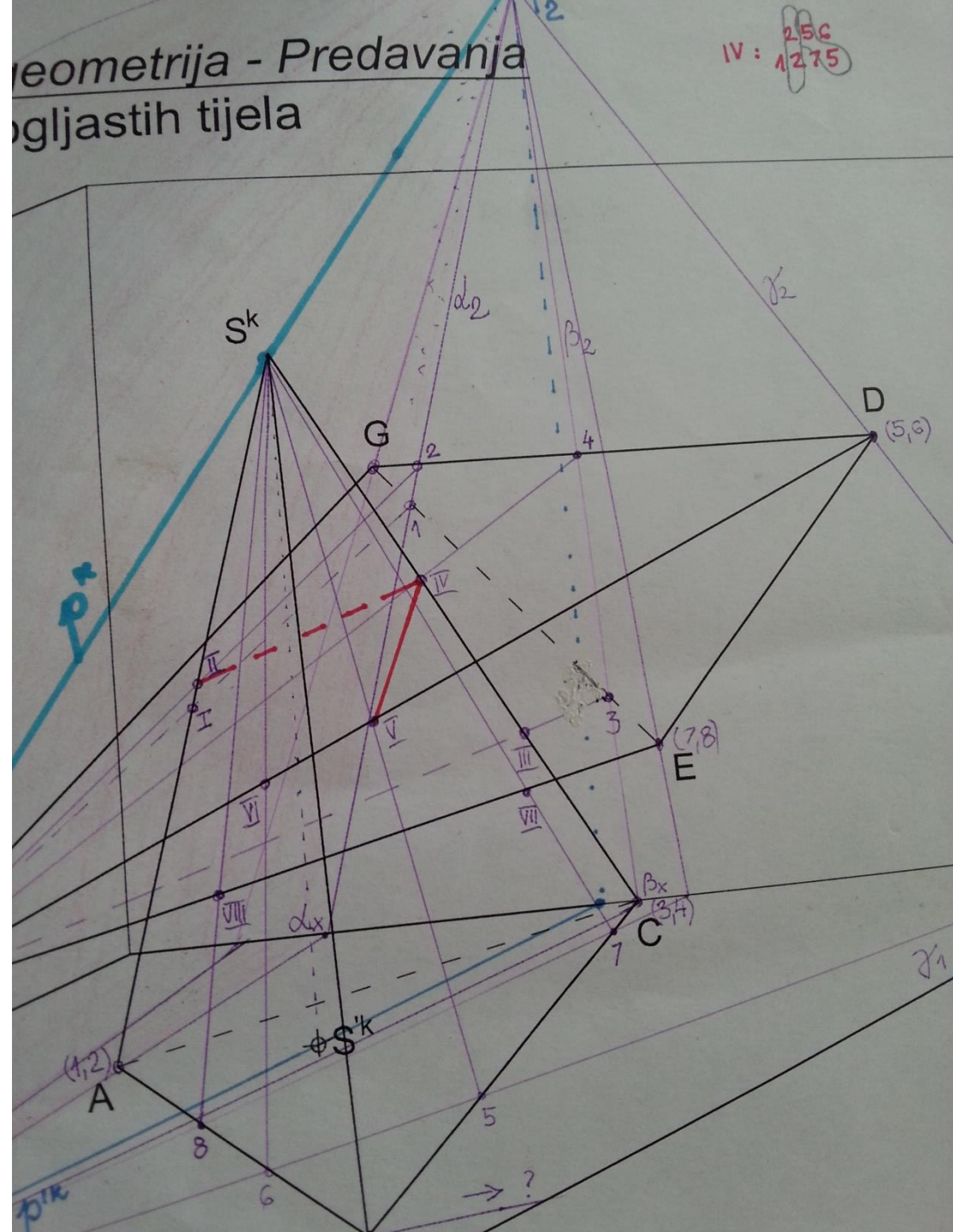






Geometrija - Predavanja Duglastih tijela

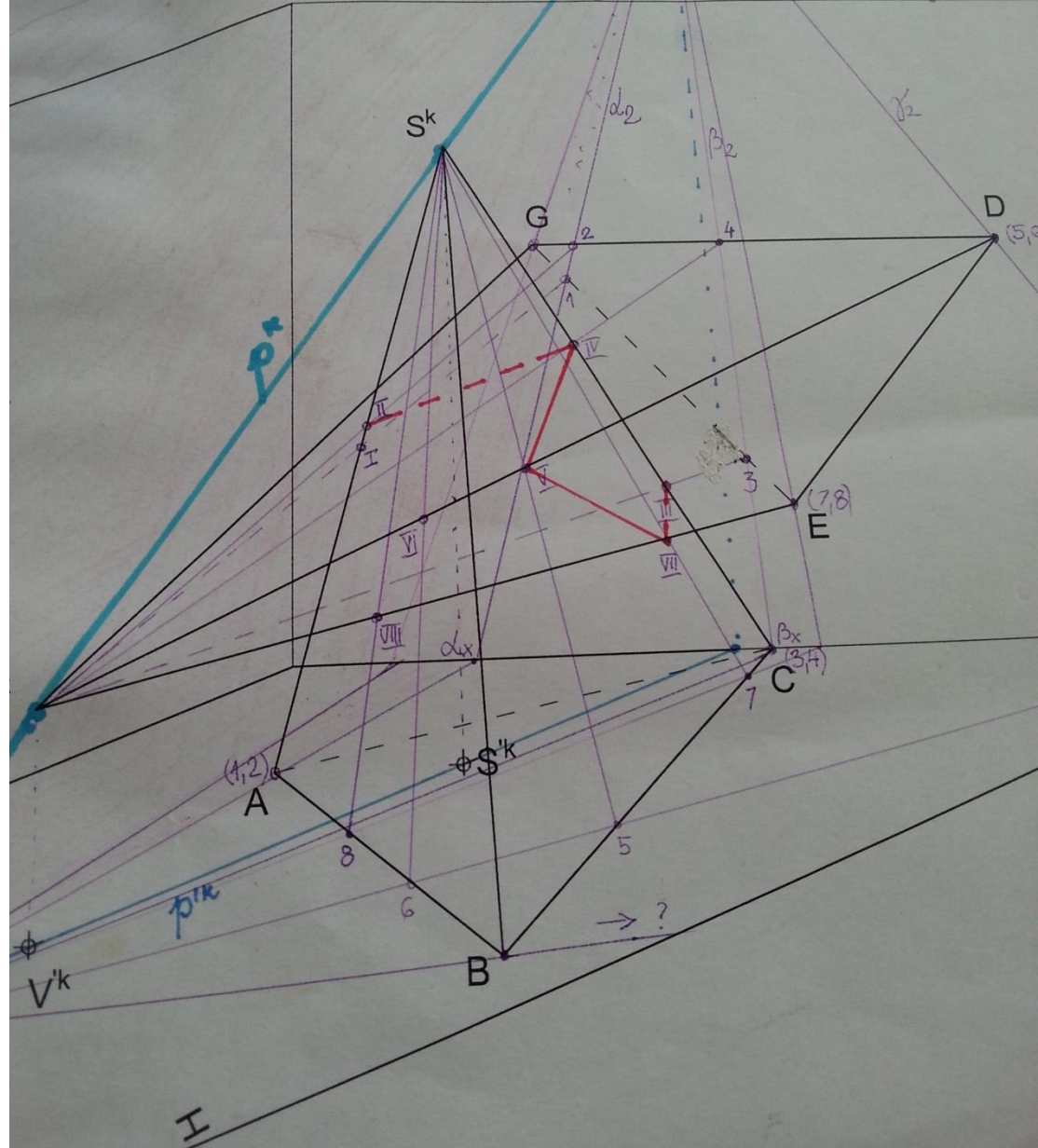
IV: 256
1275



Nacrtna geometrija - Predavanja
Prodori rogljastih tijela

IV: 256
1275

VII: 345
1356

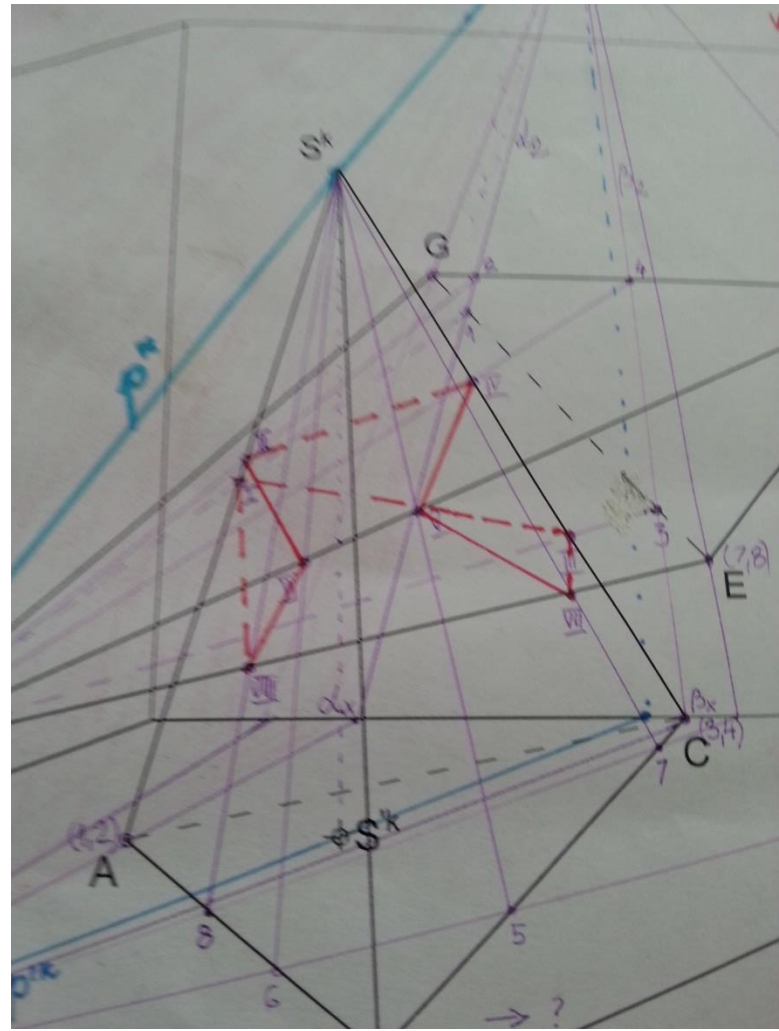
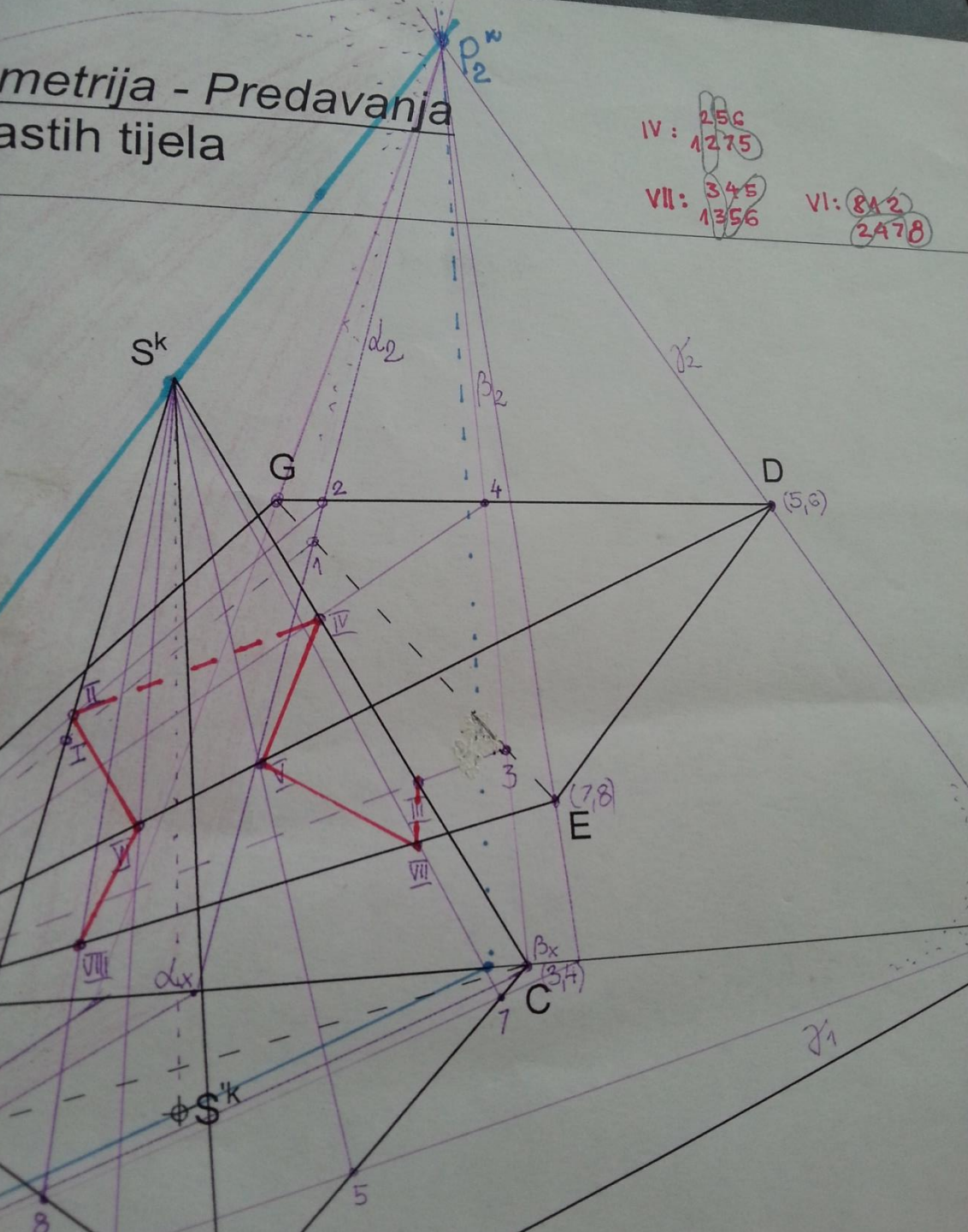


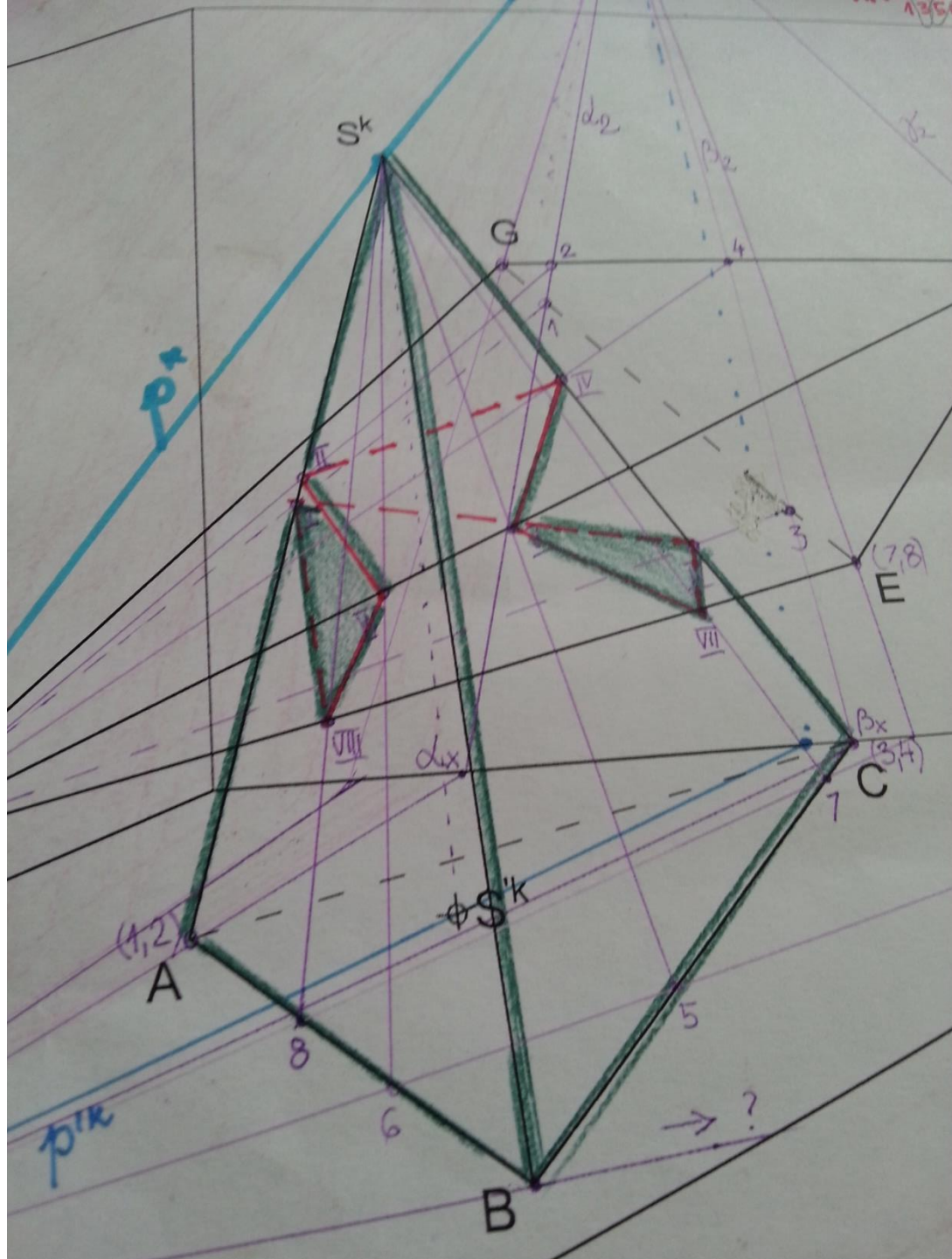
metrija - Predavanja
astih tijela

IV: 256
1275

VII: 345
1356

VI: 842
2478

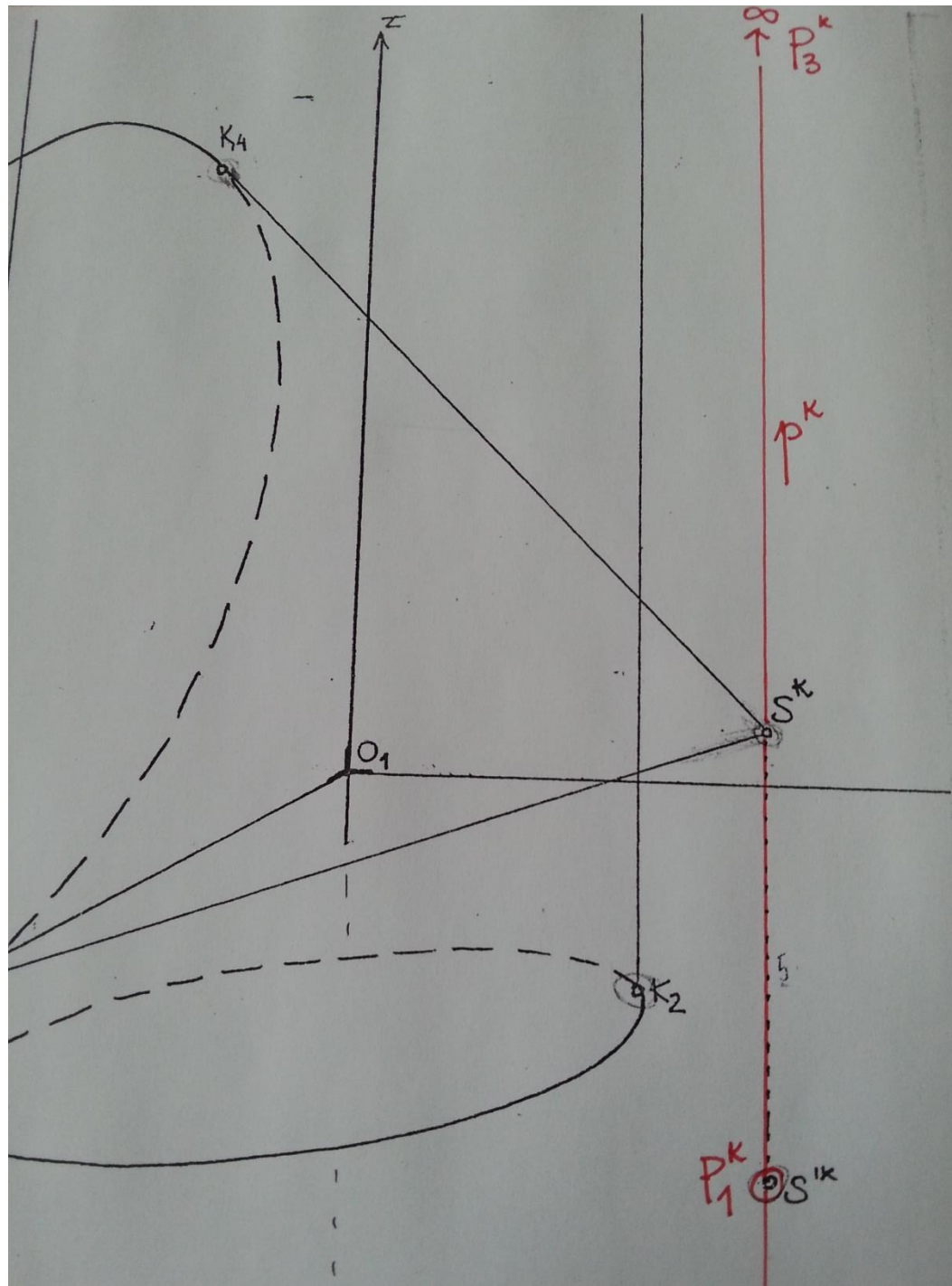




Prodor oblih tijela

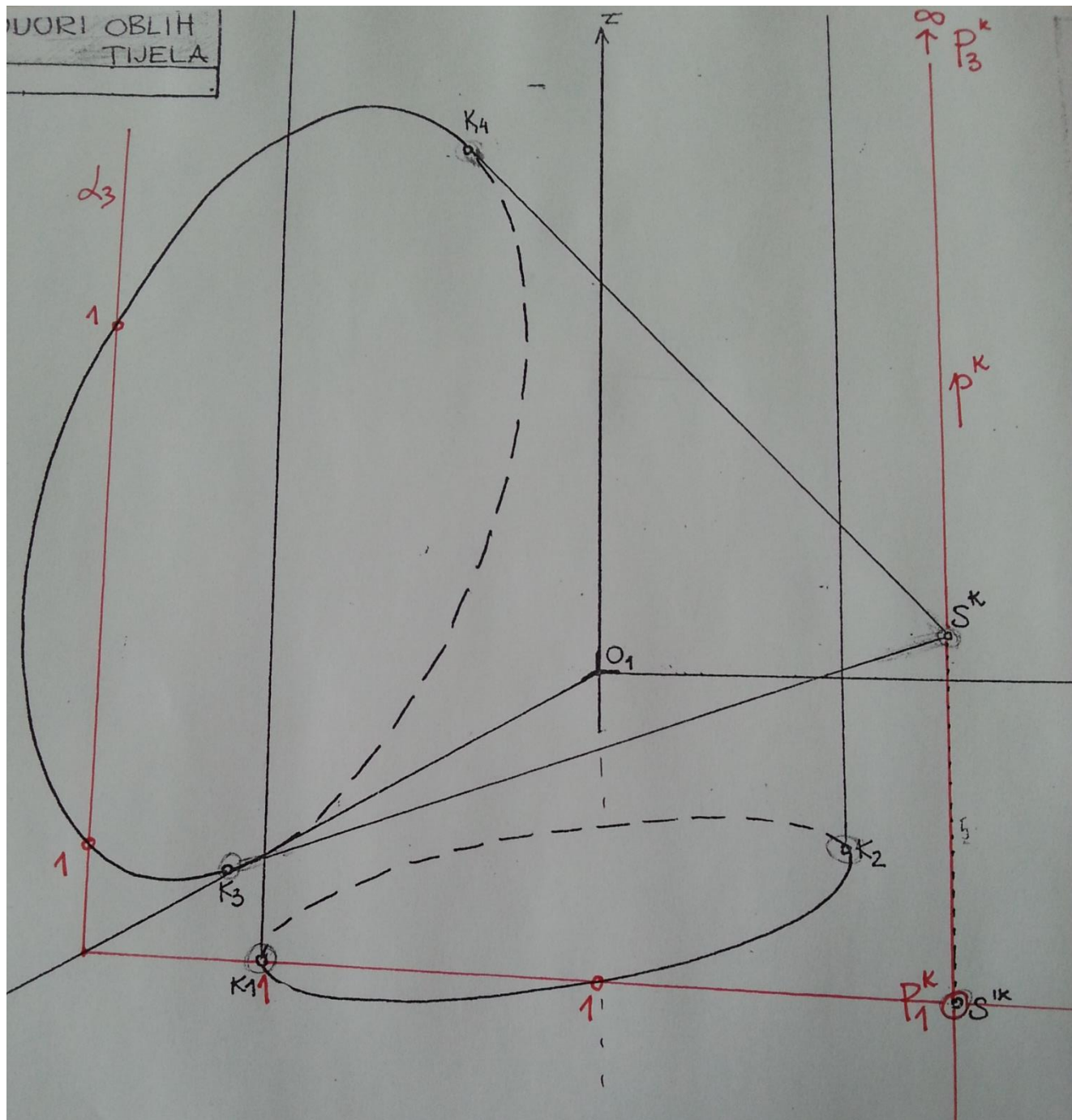
1. Postavljanje pramenjače

2. Određivanje prodora pramenjače kroz one projekcijske ravni u kojima leže bazisi tijela

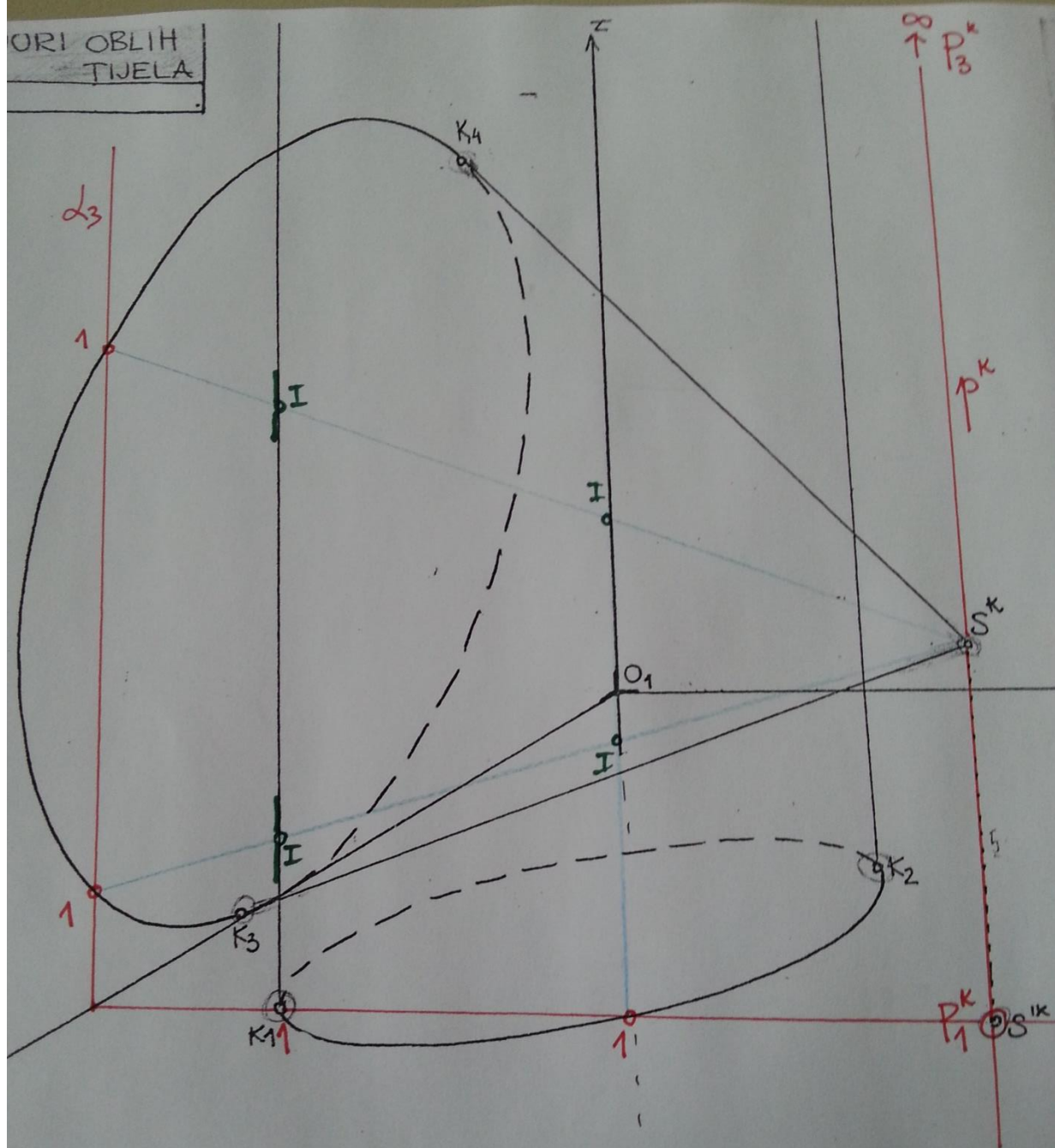


3. Postavljanje
pomoćnih ravni:
a) kroz konturne
izvodnice

ravan α



ORI OBLIH
TJELA

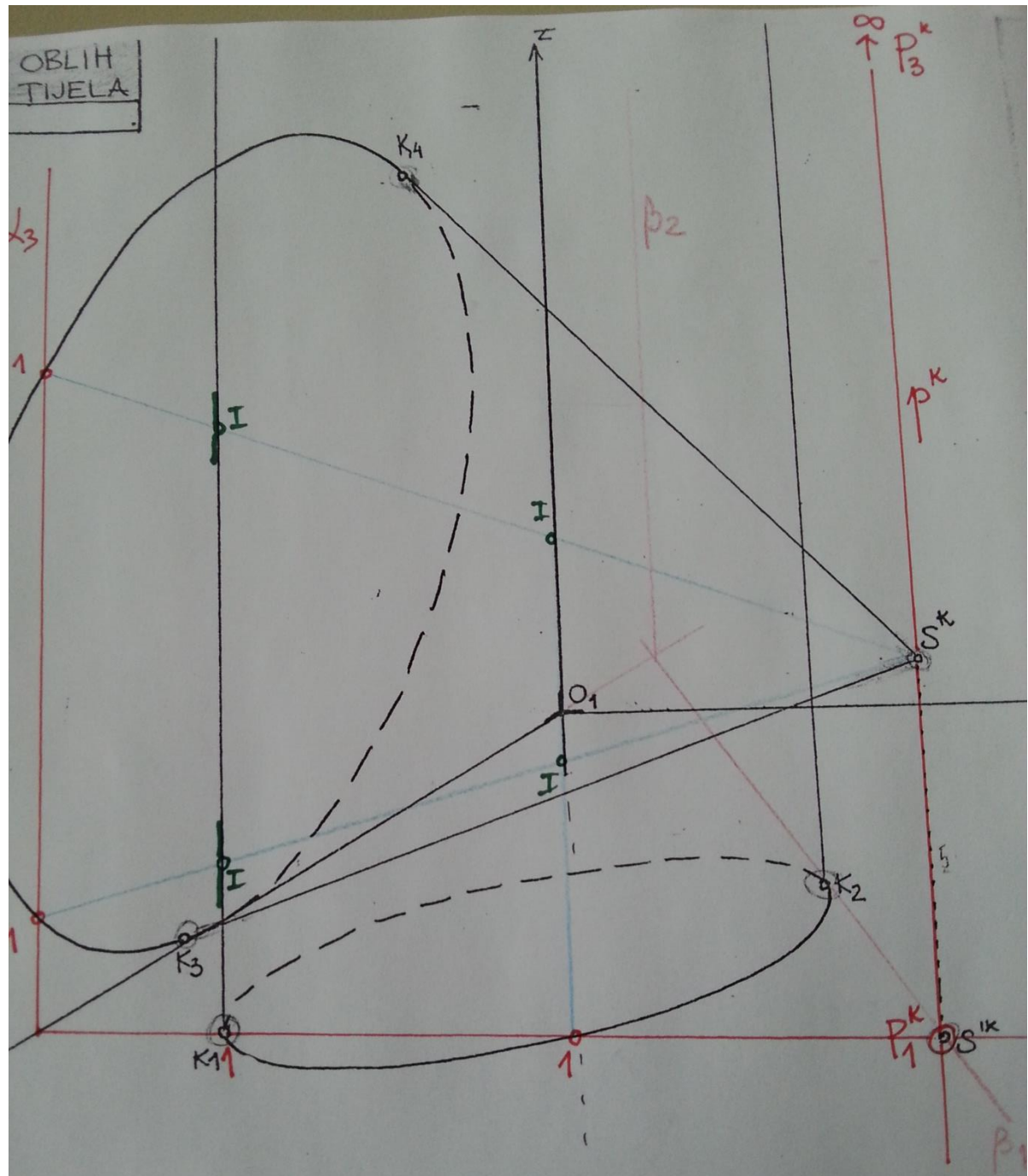


3. Postavljanje pomoćnih ravni:

a) kroz konturne izvodnice

i određivanje prodornih tačaka (I) i tangenti na prodornu krivu (u tačkama I i I' na konturnoj izvodnici kroz koju smo postavili ravan)

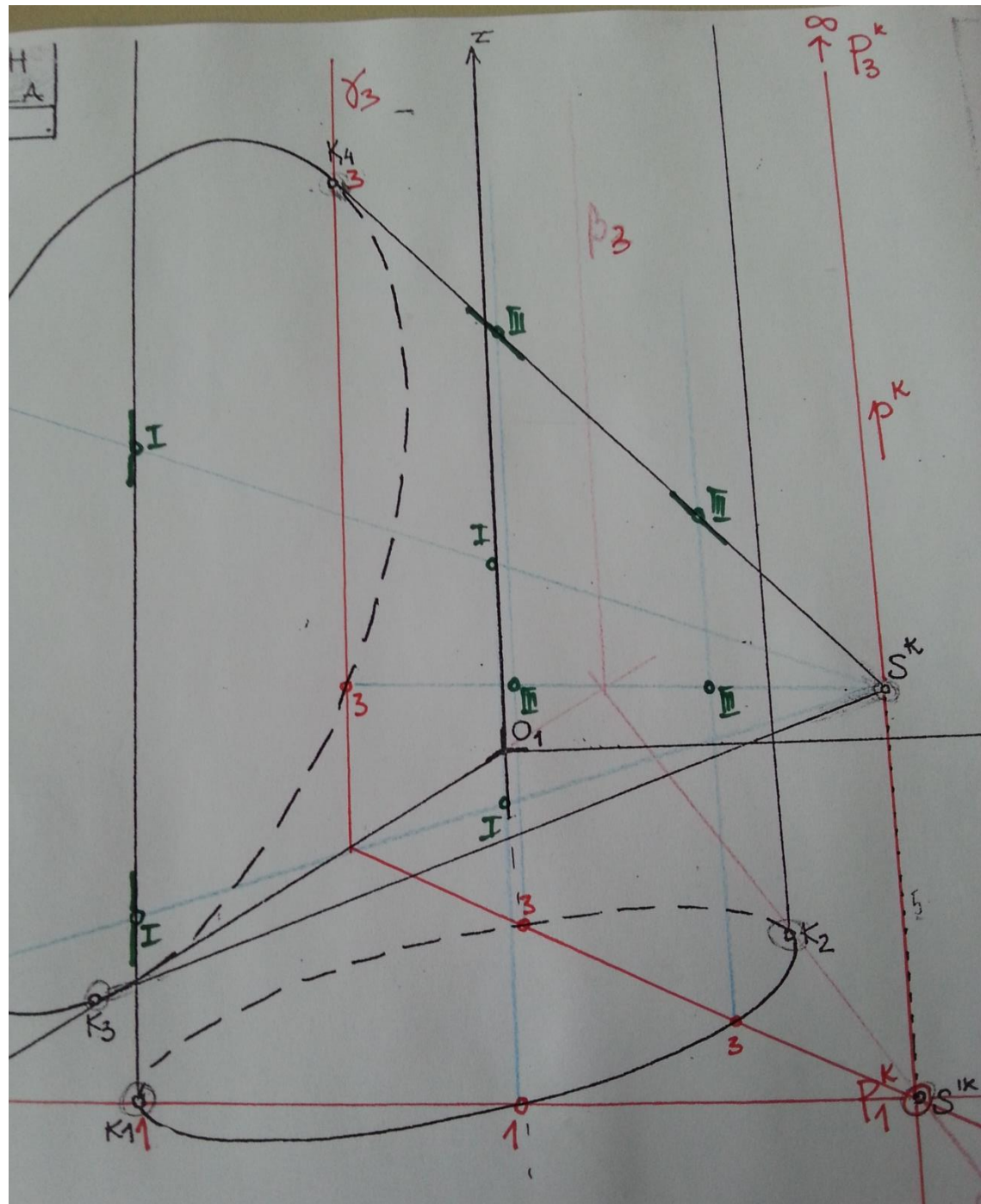
3. Postavljanje pomoćnih
ravni:
a) kroz konturne izvodnice
ravan β

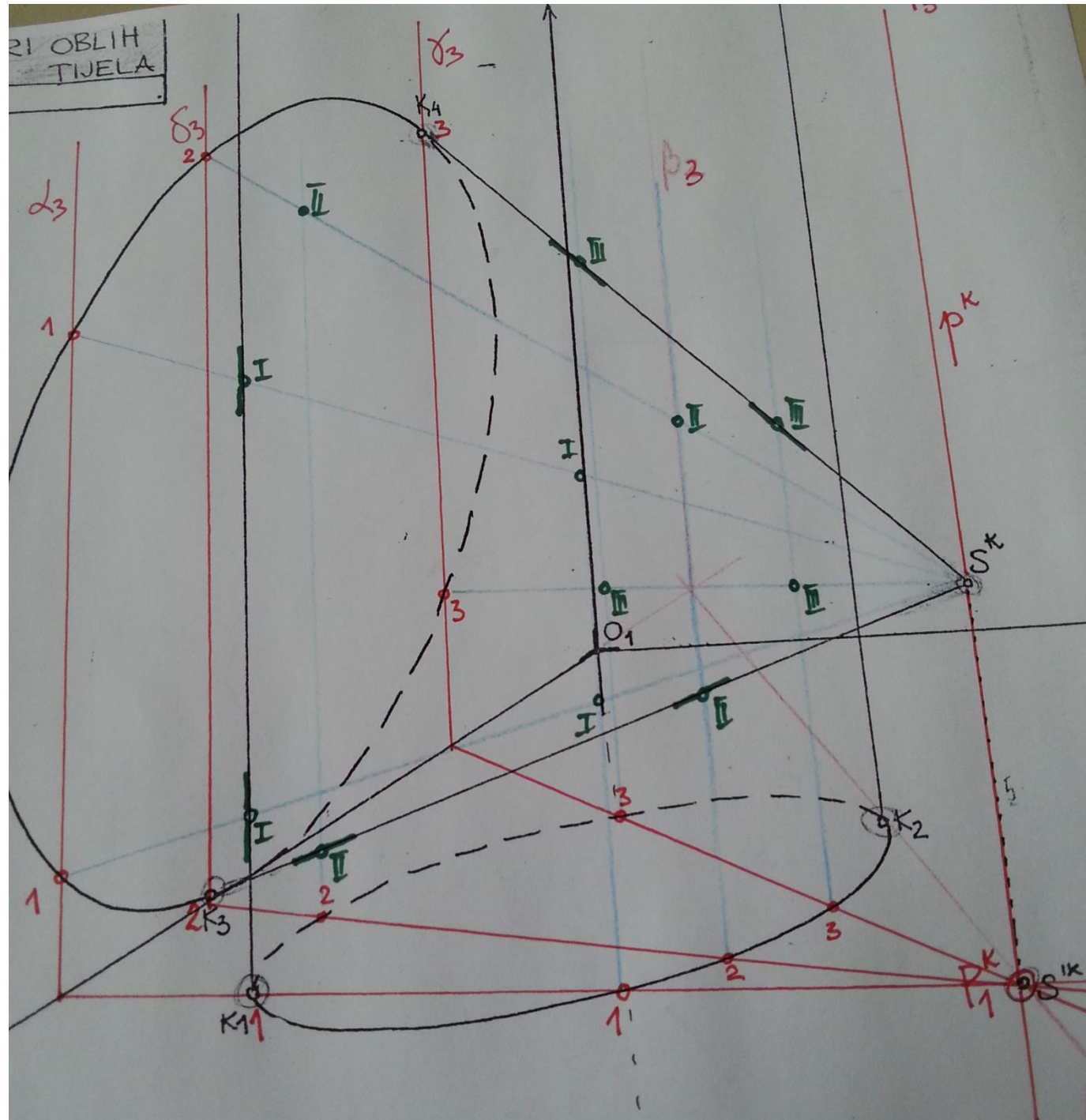


3. Postavljanje pomoćnih ravni:

a) kroz konturne izvodnice (ravan γ)

i određivanje prodornih tačaka (III) i tangenti na prodornu krivu (u tačkama III i III na konturnoj izvodnici kroz koju smo postavili ravan γ)





3. Postavljanje pomoćnih ravni:
 a) kroz konturne izvodnice (ravan δ)

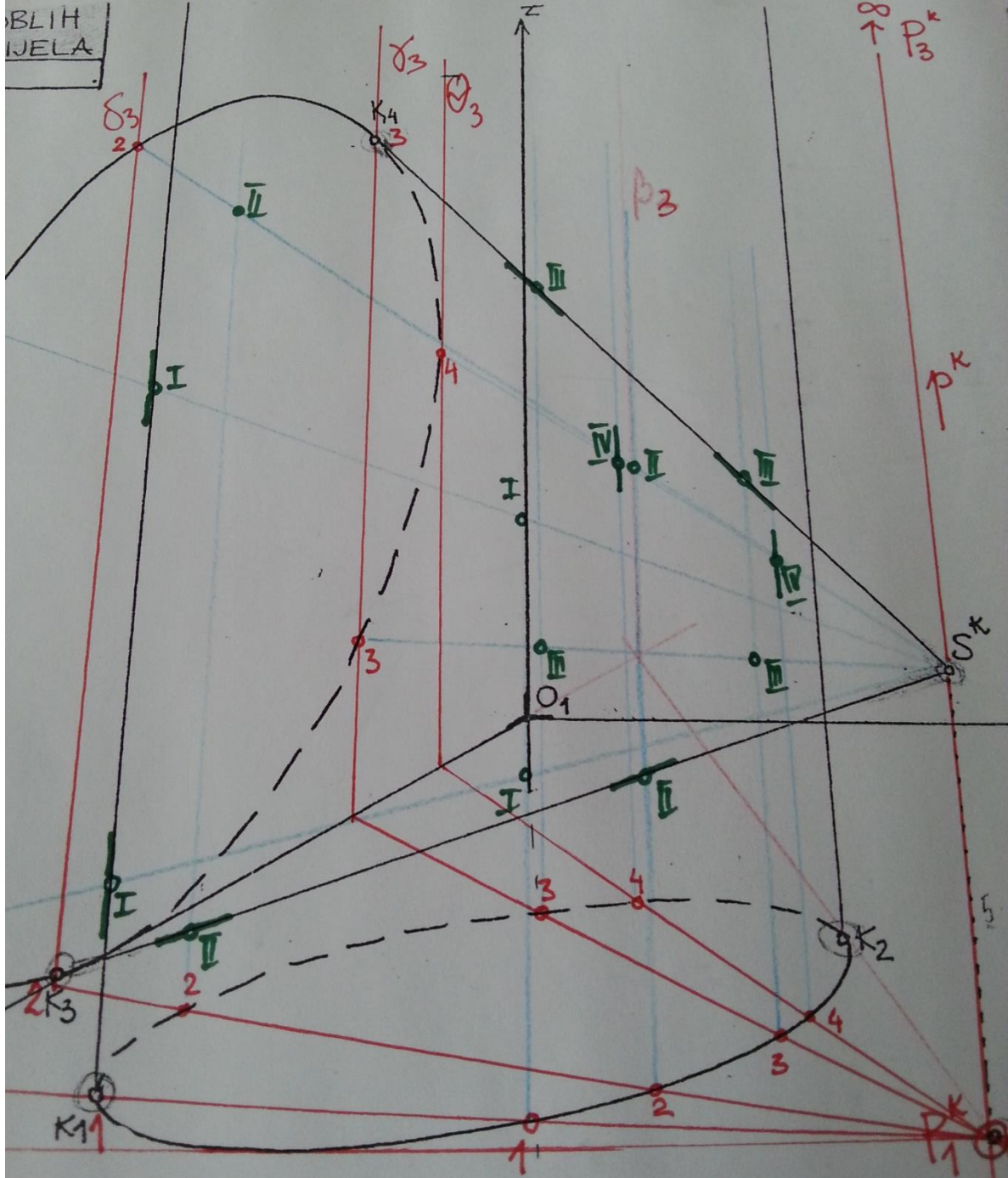
i određivanje prodornih tačaka (II) i tangenti na prodornu krivu (u tačkama II i II na konturnoj izvodnici kroz koju smo postavili ravan δ)

BLIH
NELA

3. Postavljanje pomoćnih
ravni:

b) tako da budu dirne ravni
(ravan θ)

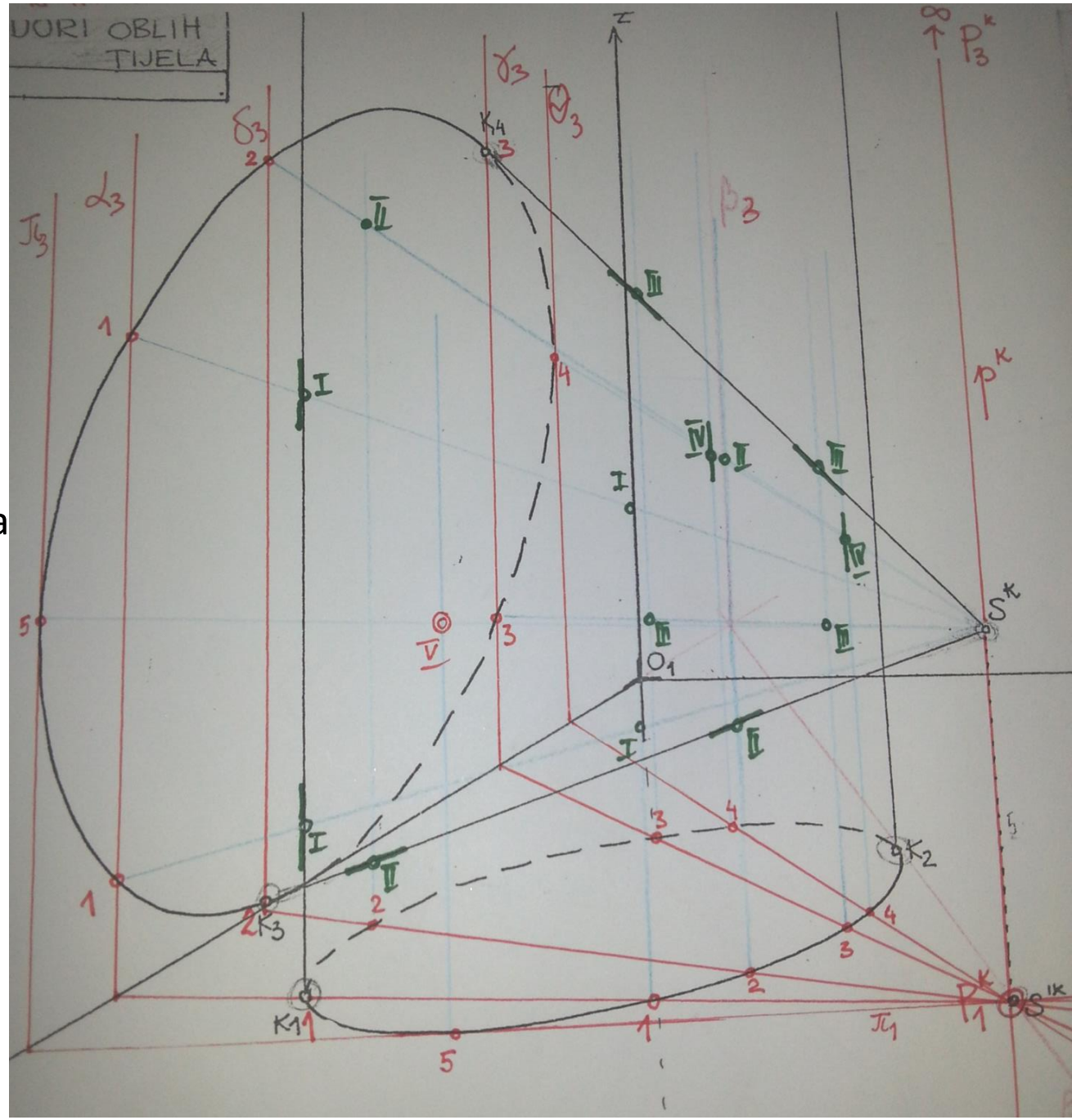
i određivanje prodornih
tačkaka (IV) i tangenti na
prodornu krivu (u tačkama
IV i IV); tangente su u pravcu
tijela koje ta dirna ravan
siječe.



OBRAZLOŽENJE
OBLI
TIJELA

3. Postavljanje pomoćnih
ravni:
b) tako da budu dirne
ravni
(ravan π)

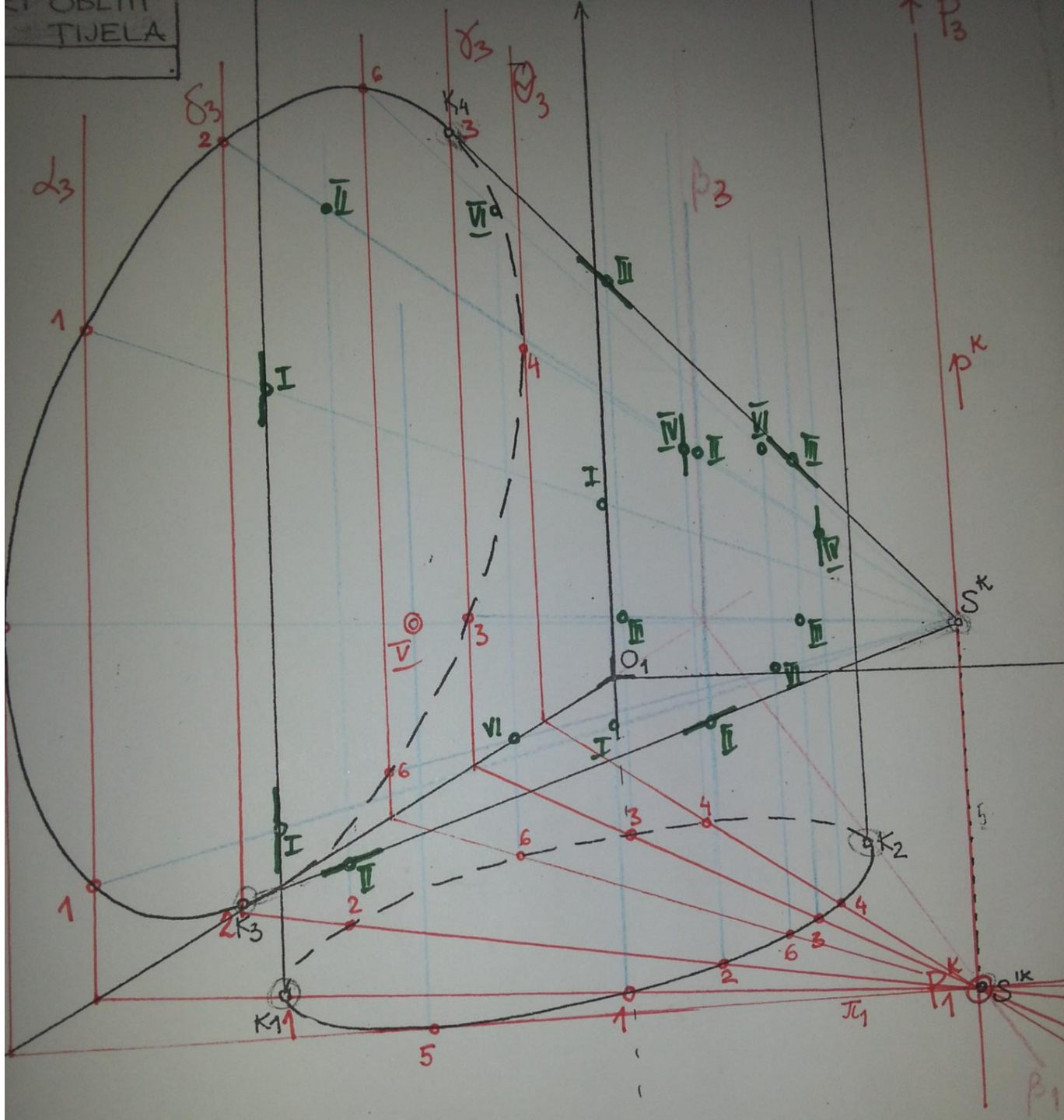
i određivanje prodornih
tačaka (V); to je dvostruka
tačka – kriva kroz nju
prolazi dva puta.



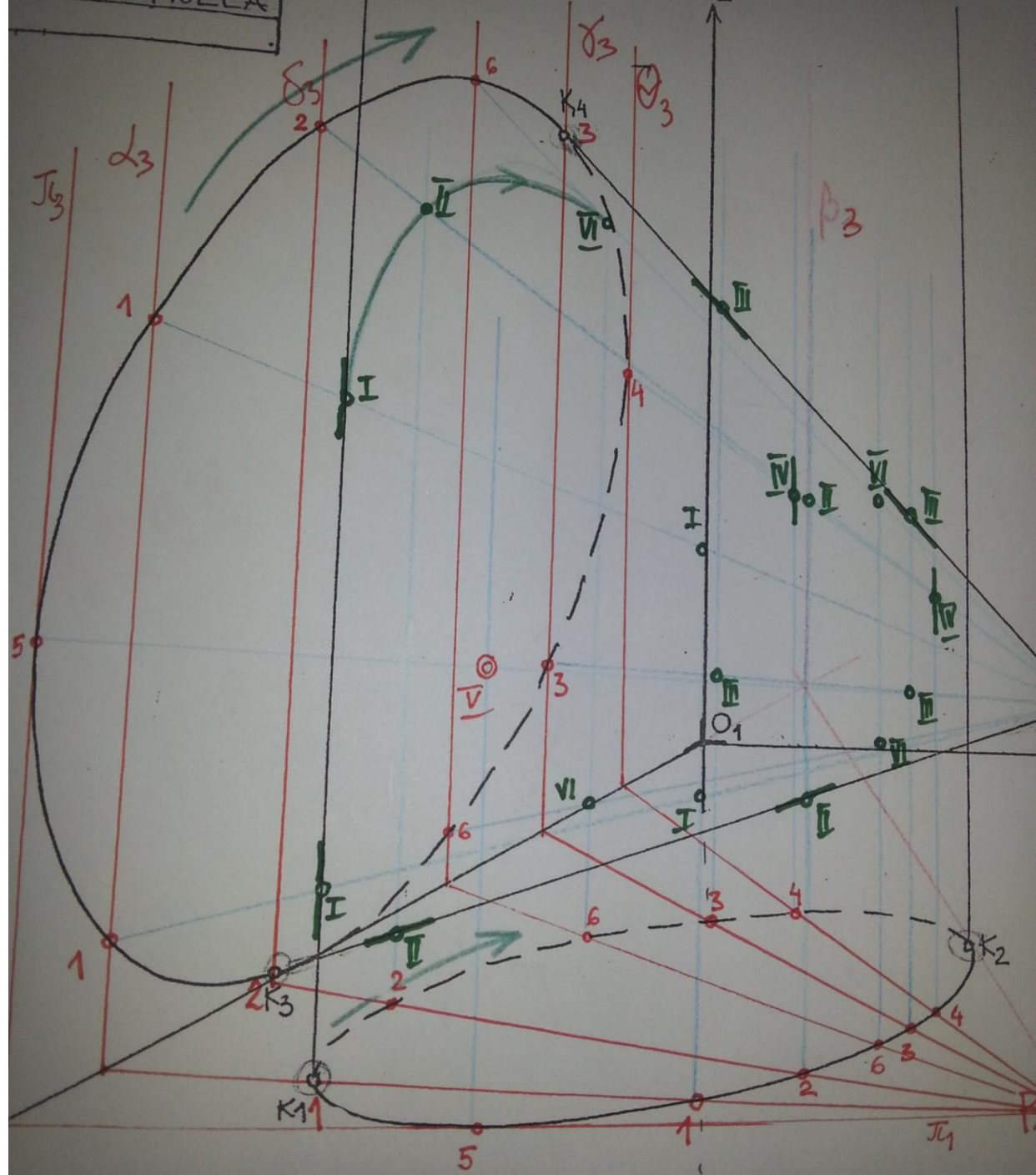
PROBLEMI
TIJELA

3. Postavljanje
pomoćne ravni:
c) kroz najvisočiju
tačku
(ravan 6)

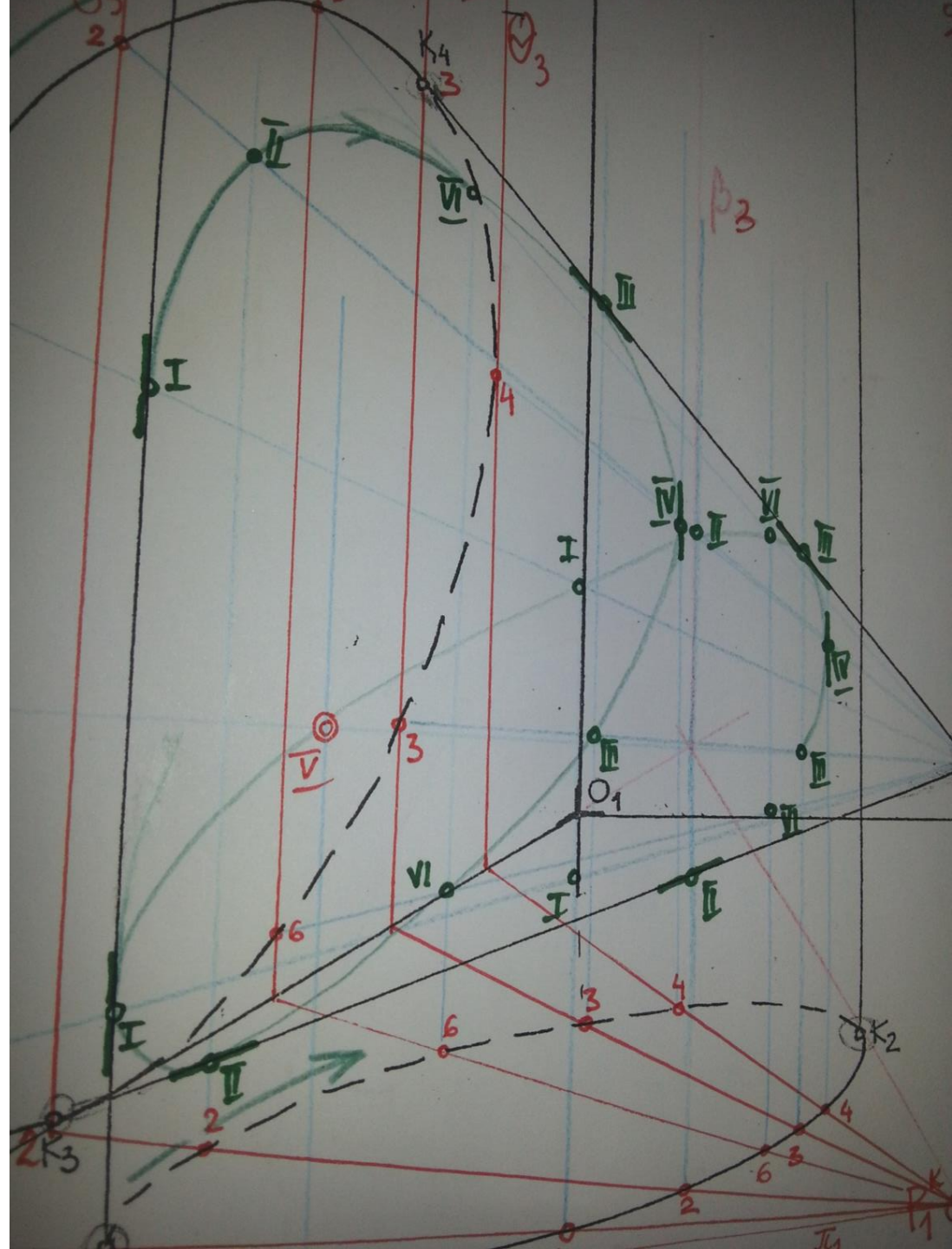
i određivanje
prodornih tačaka (VI);
u njima ne
poznajemo tangente.



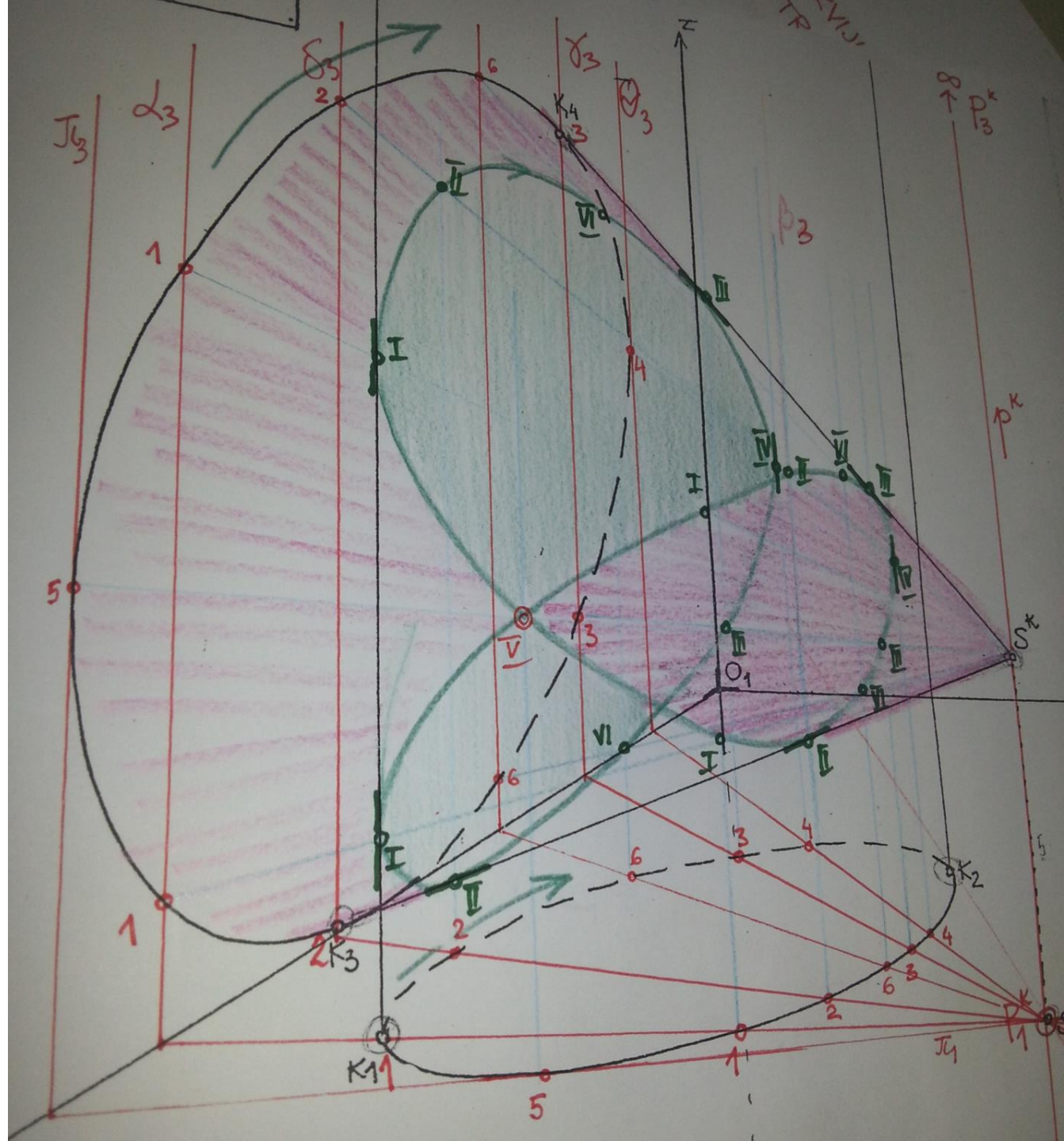
4. Spajanje prodornih tačaka u prodornu krivu, prateći smjer kretanja oko bazisa i poštujući tangente.



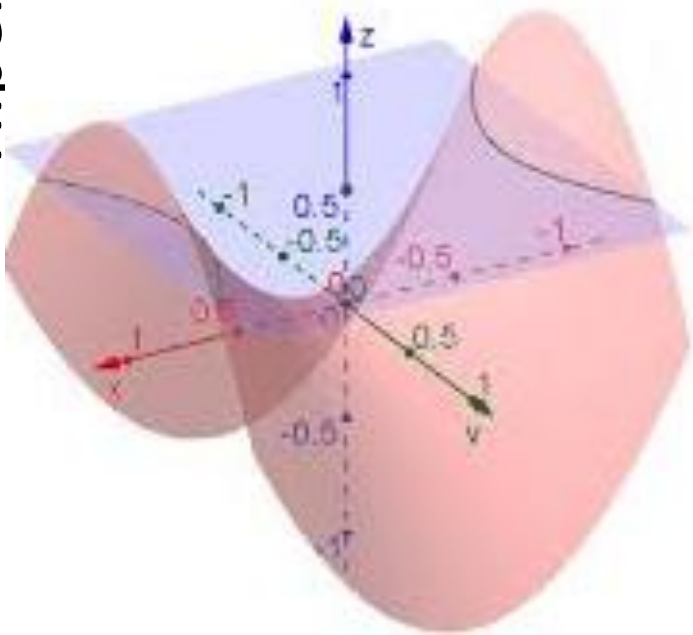
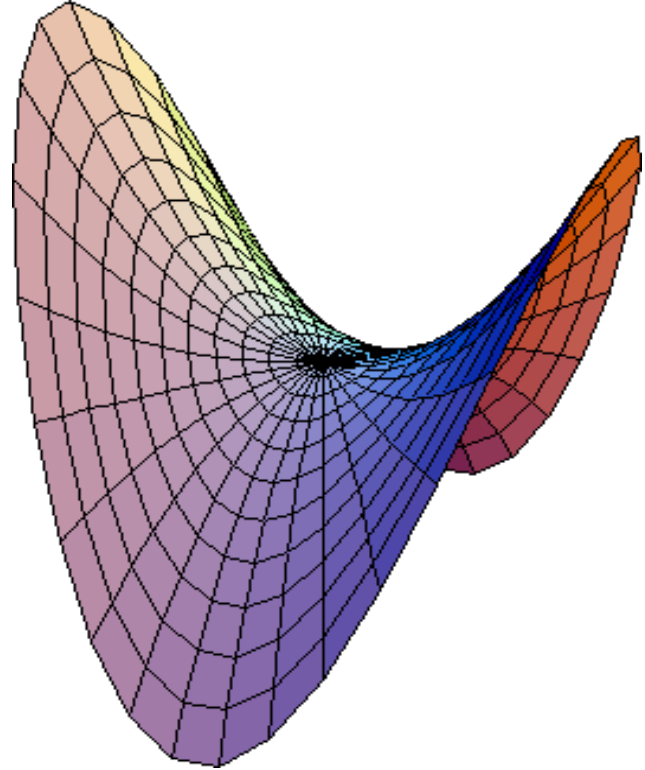
4. Spajanje prodornih tačaka u prodornu krivu, prateći smjer kretanja oko bazisa i poštujući tangente.



4. Spajanje prodornih tačaka u prodornu krivu, prateći smjer kretanja oko bazisa i poštujući tangente.



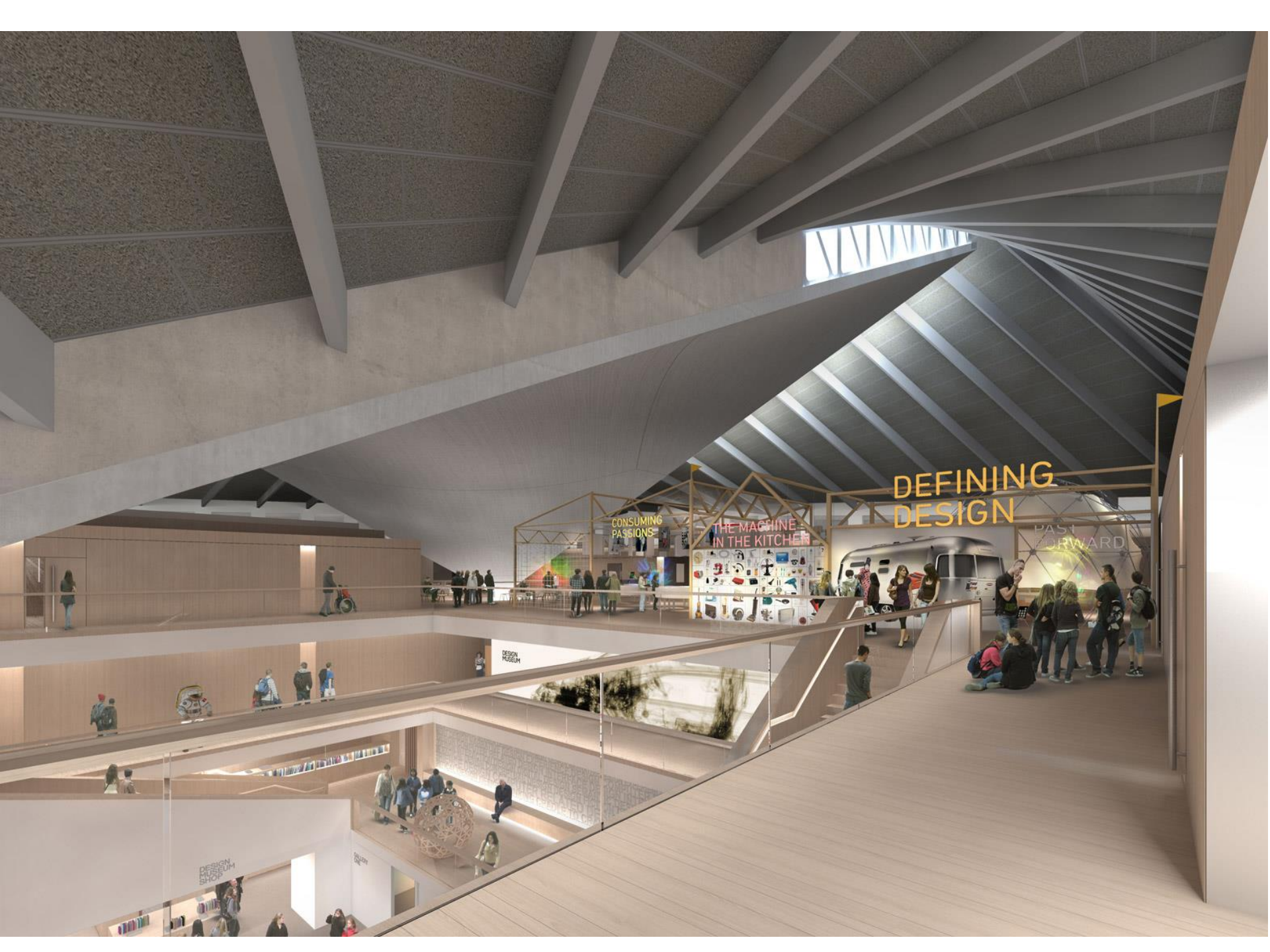
Hiperbolički paraboloid











DEFINING DESIGN

CONSUMING PASSIONS

THE MACHINE IN THE KITCHEN

PAST FORWARD

DESIGN MUSEUM

DESIGN MUSEUM SHOP

Fig 5

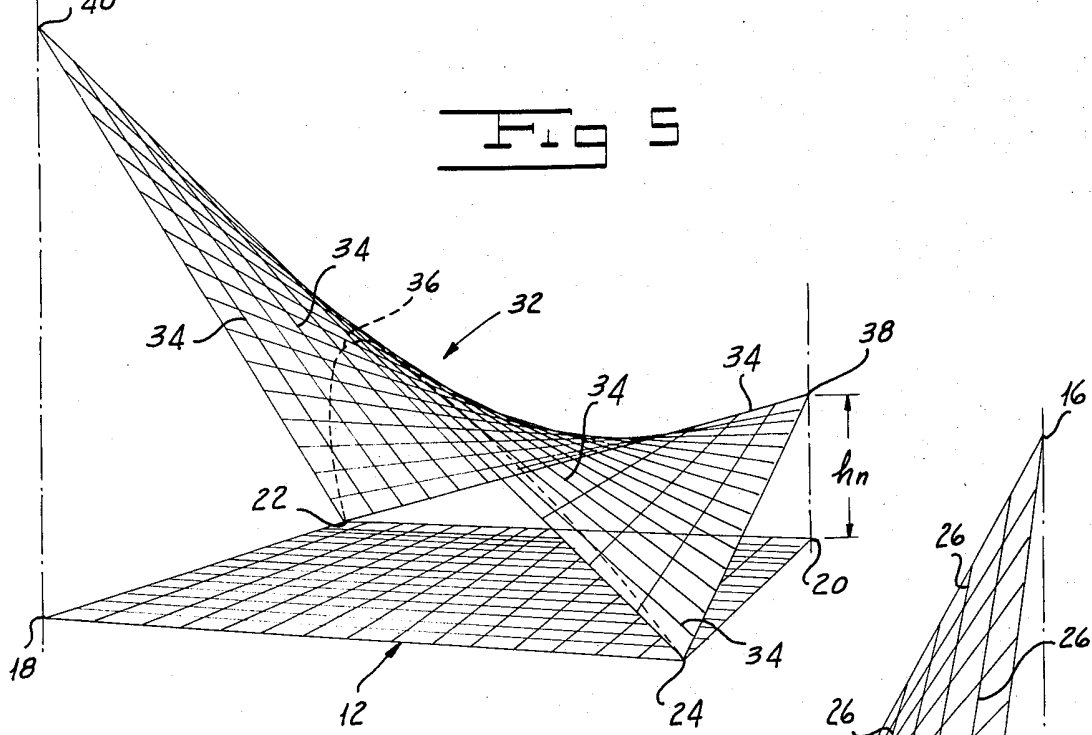
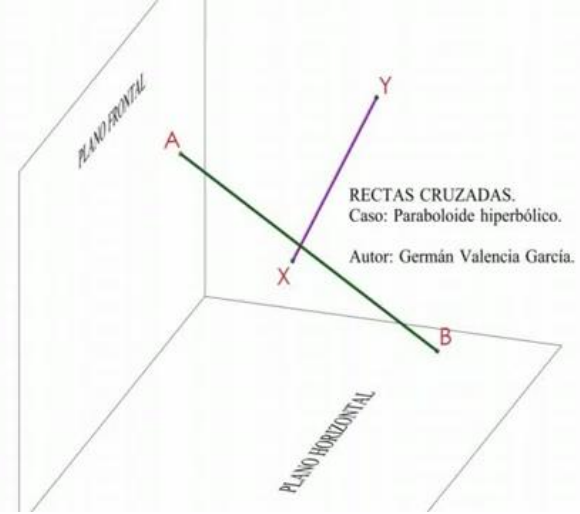
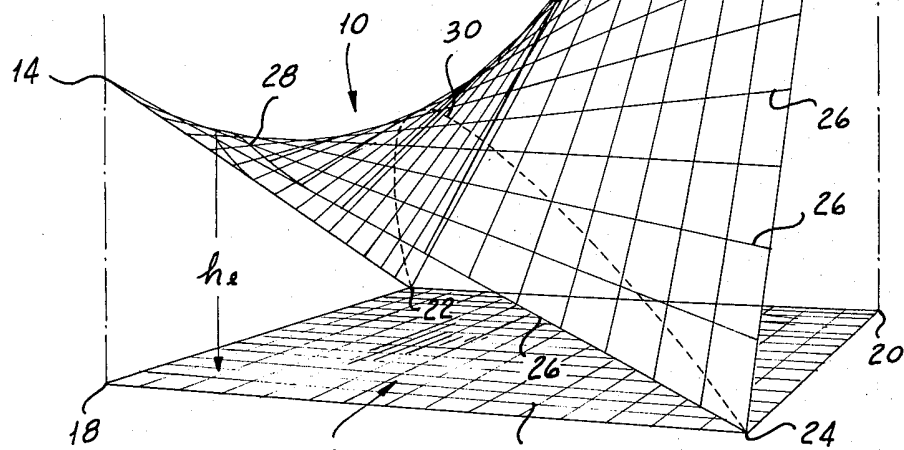
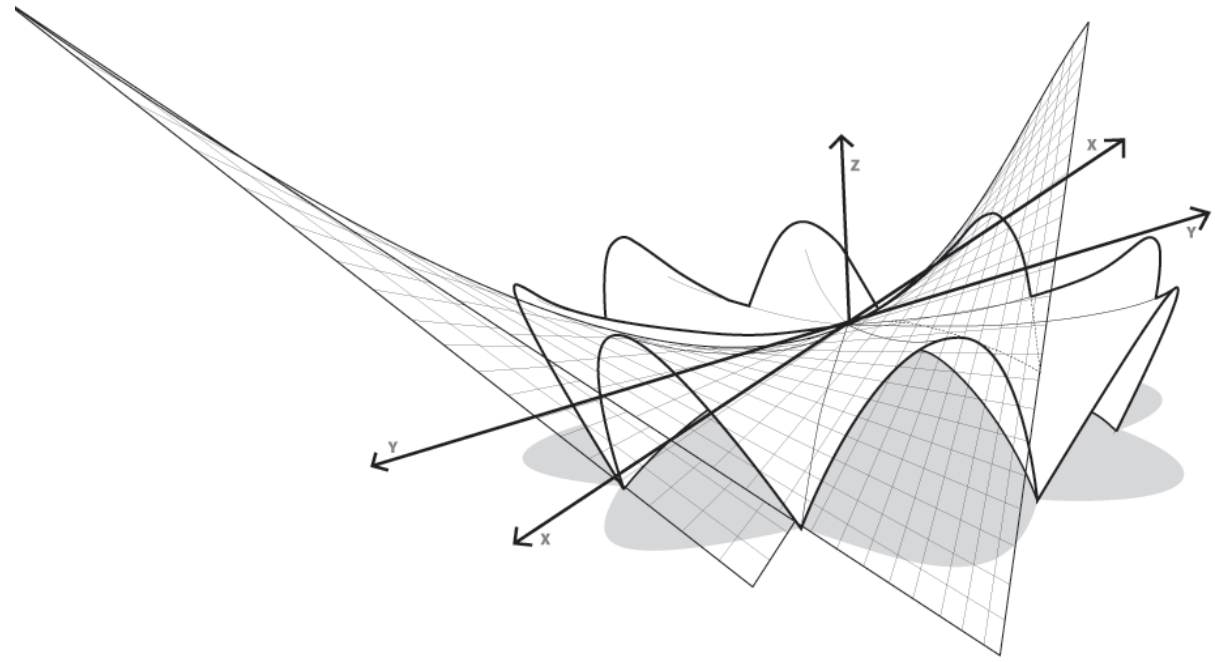
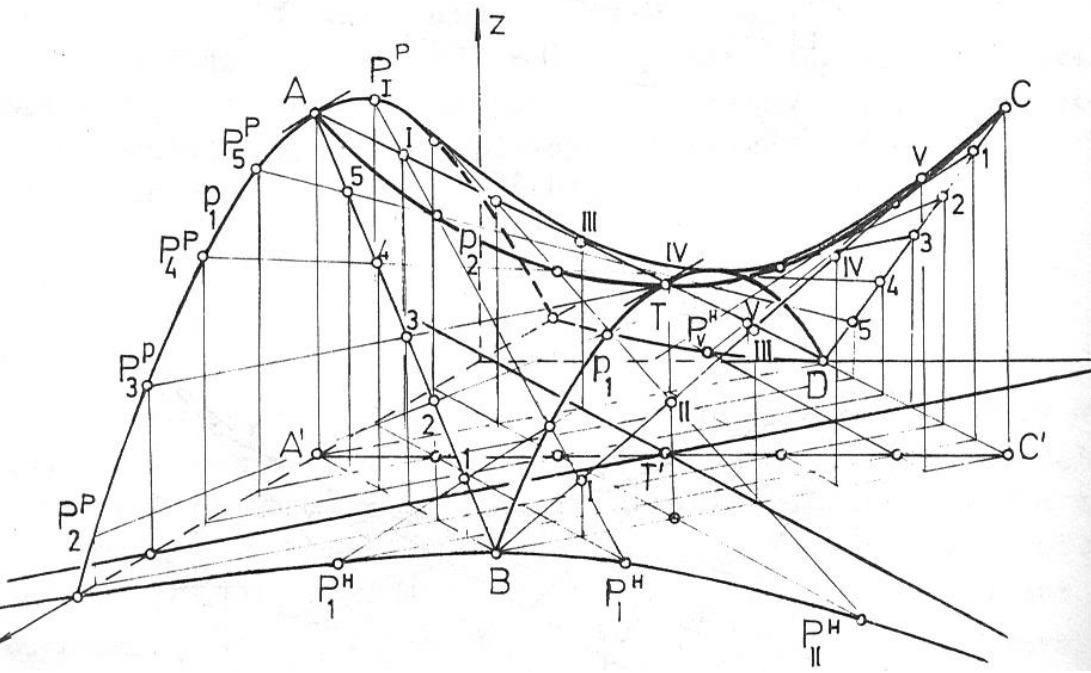
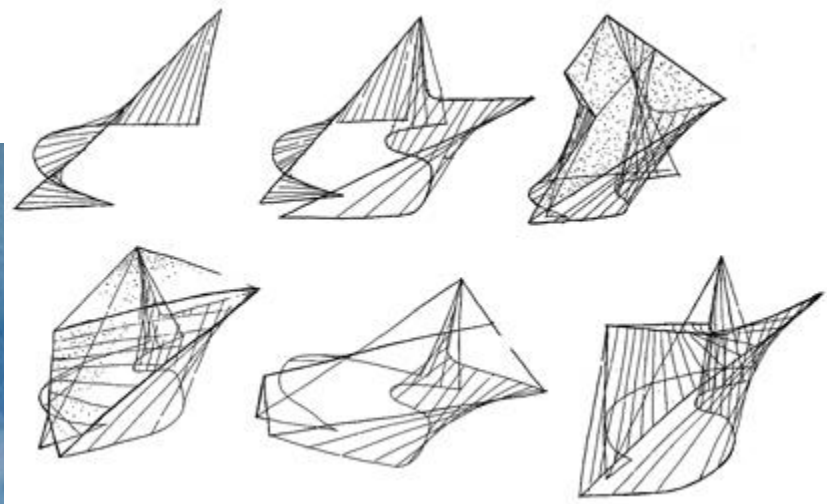
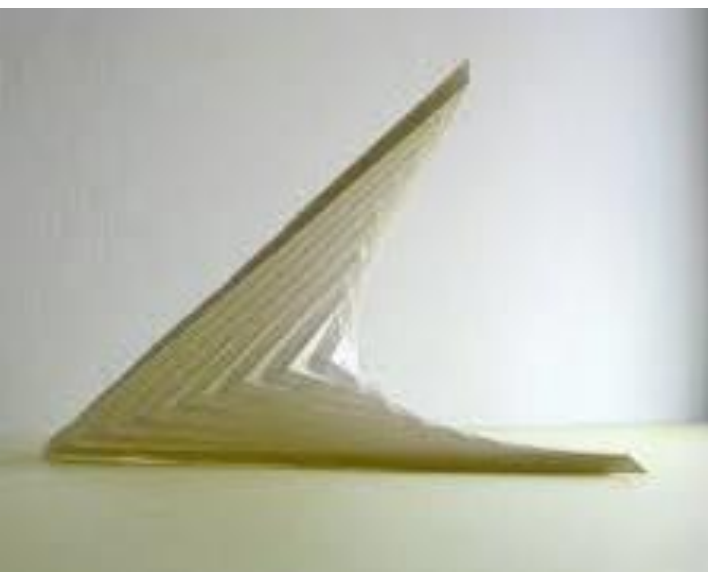


Fig 4



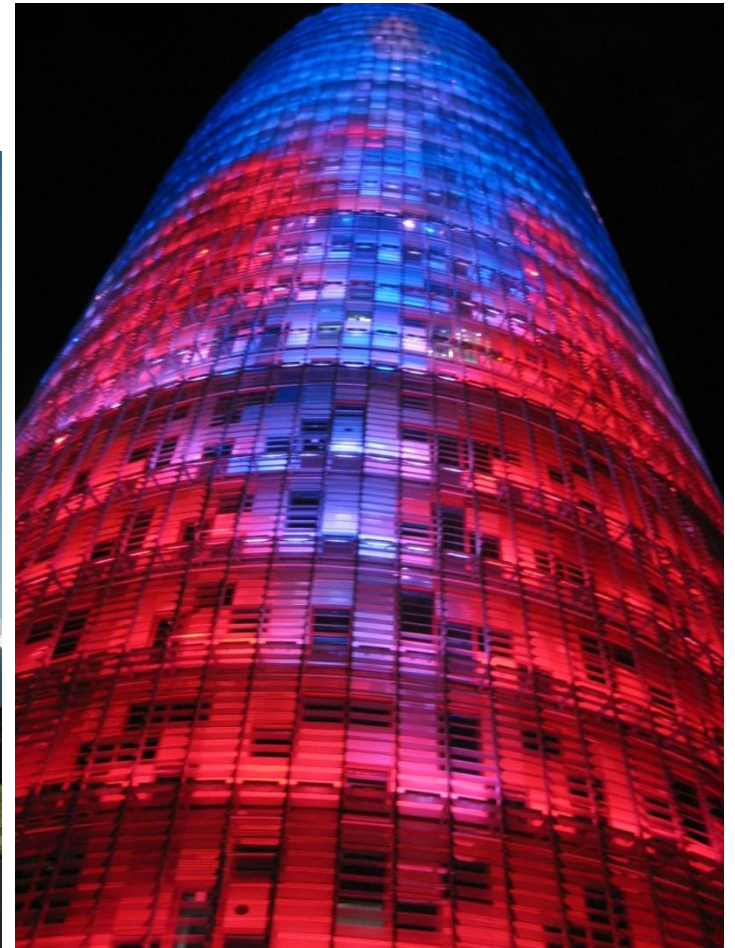
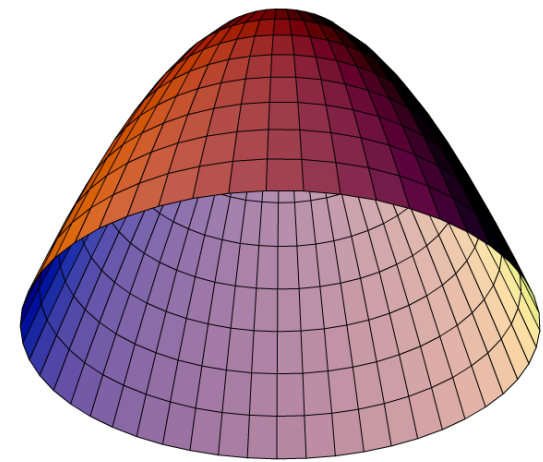




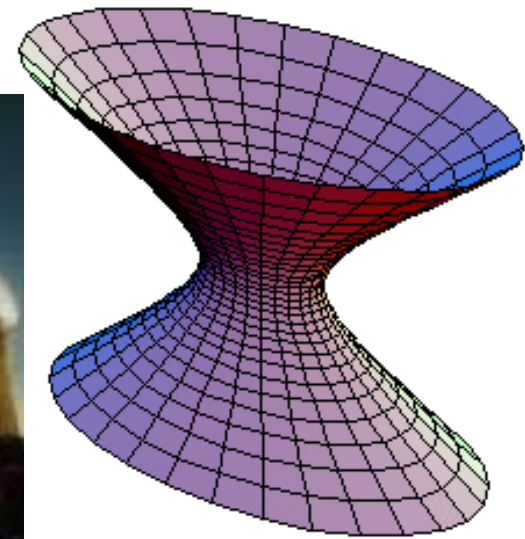


An Exhibit on the Work of Félix Candela

Paraboloid rotacioni



Hiperboloid jednograni (rotacioni)



HIPERBOLOIDE DE REVOLUCIÓN

Autor:
Germán Valencia García.



VISTA HORIZONTAL

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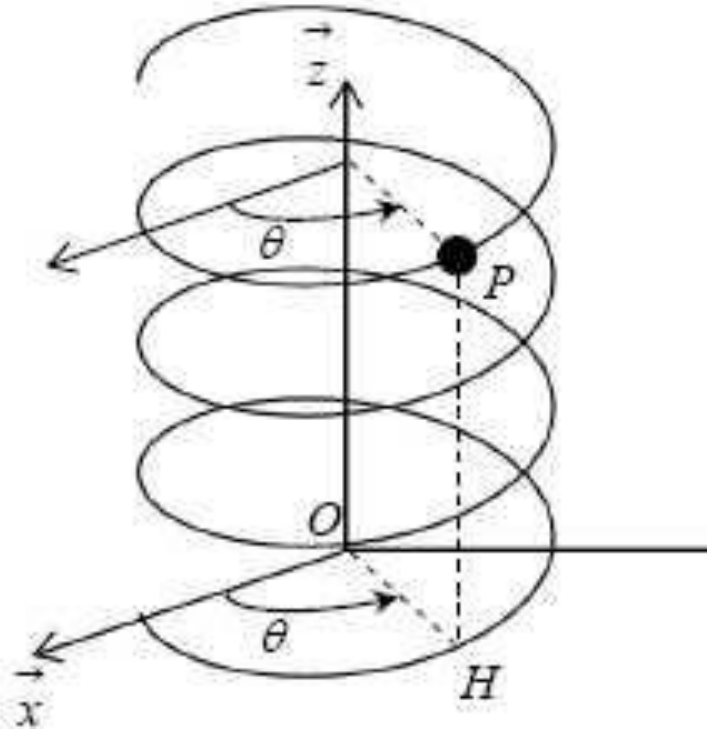
Photomatrix

Photomatrix

Photomatrix

W.H. Smith

Zavojnica (helikoida)



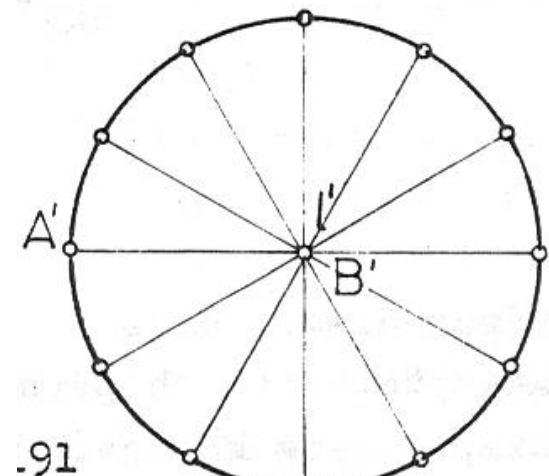
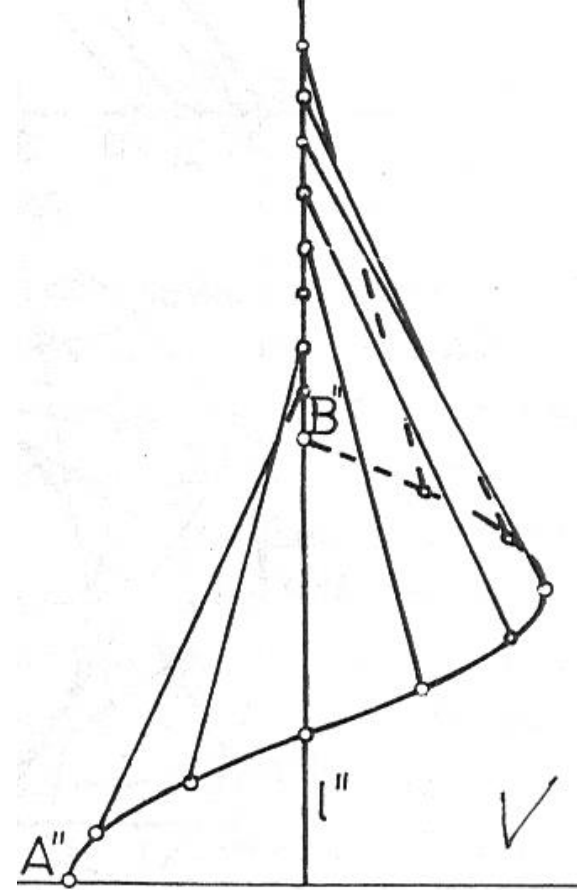
Helikoid

HELICOIDE RECTO.

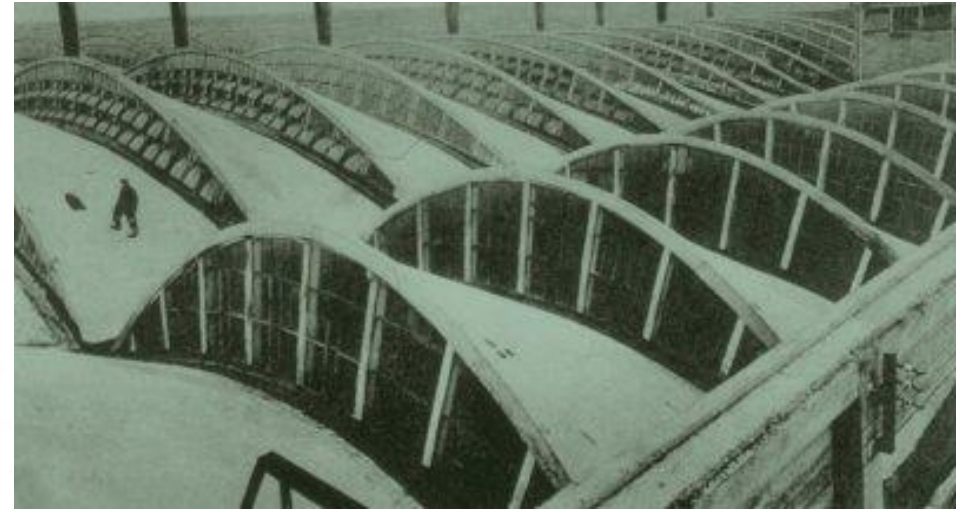
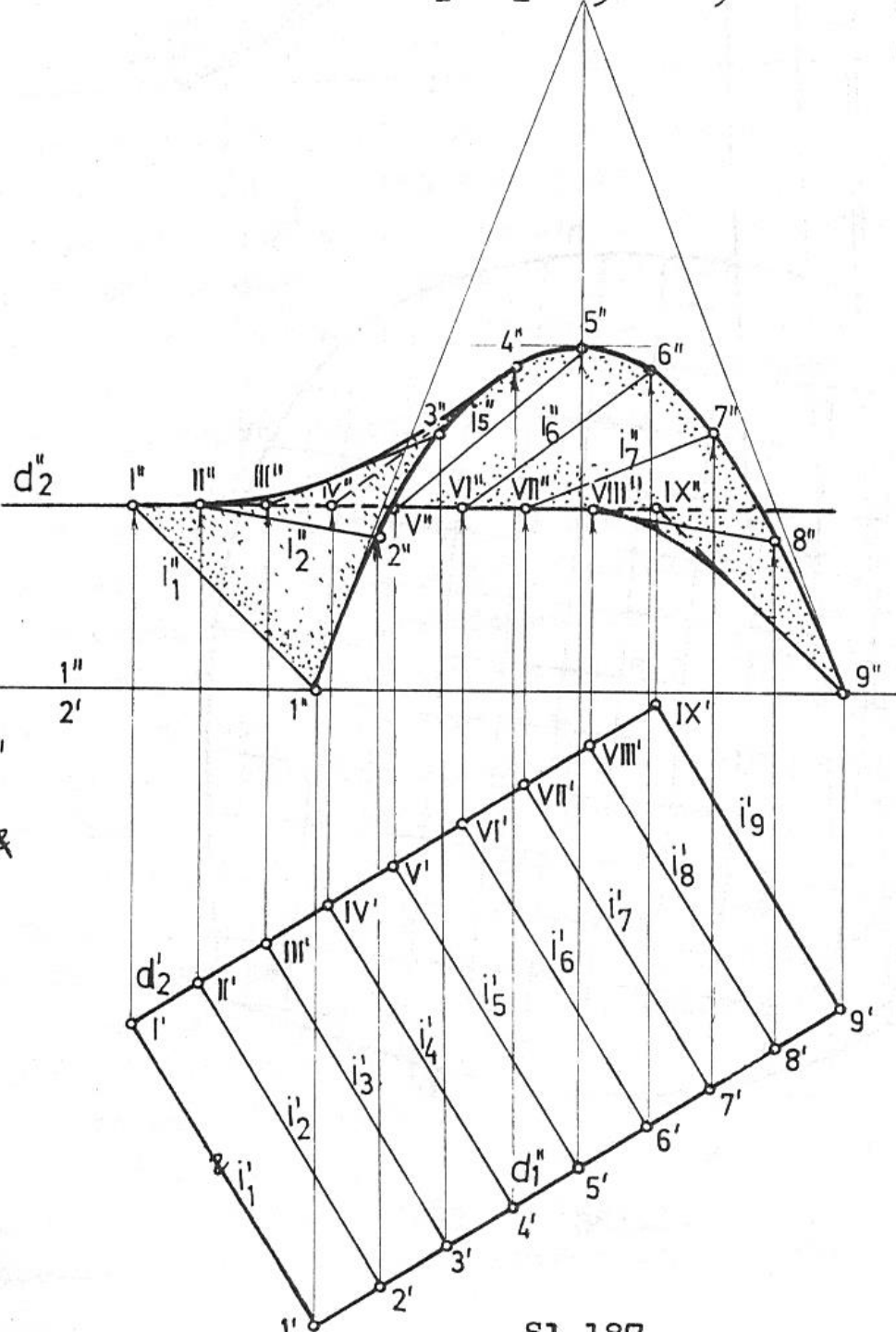
Autor:
Germán Valencia García.

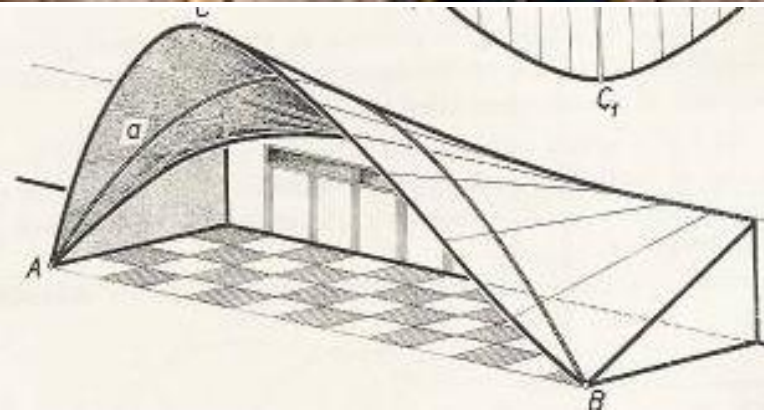
C1



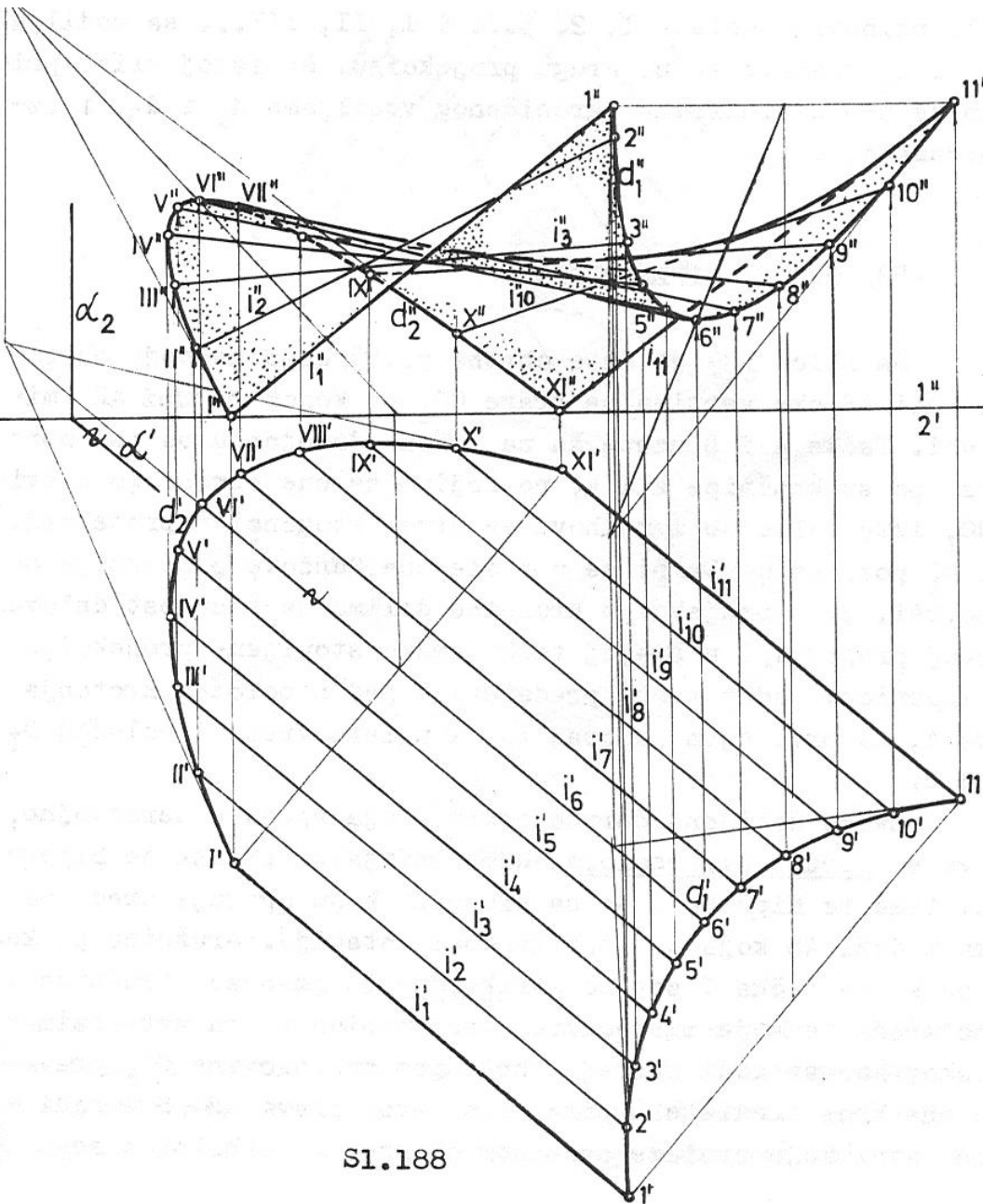


Konoid





Cilindroid



EL CONOIDE RECTO - THE RIGHT CONOID. 1

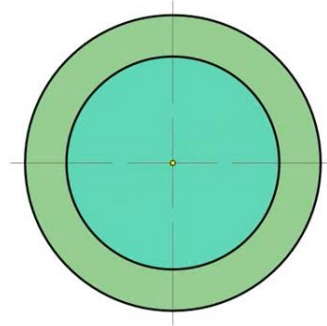
Autor: Germán Valencia García.
Arquitecto.

E-mail: gervalengar_67@hotmail.com



Još neke površi...

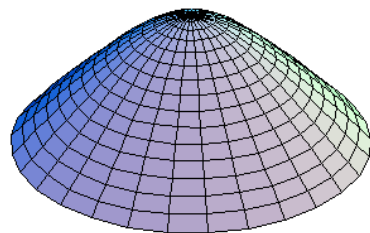
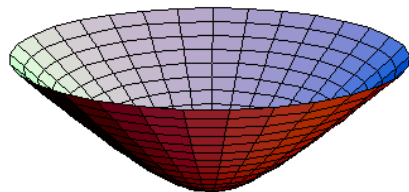
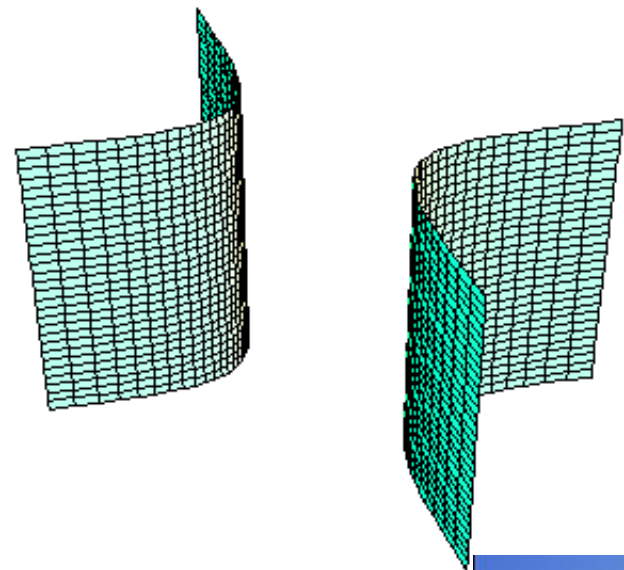
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LA TORRE DEL CUERNO DE VACA
Arquitecto: Germán Valencia García.
Arquitecto.

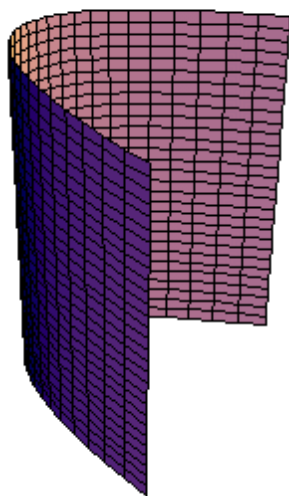


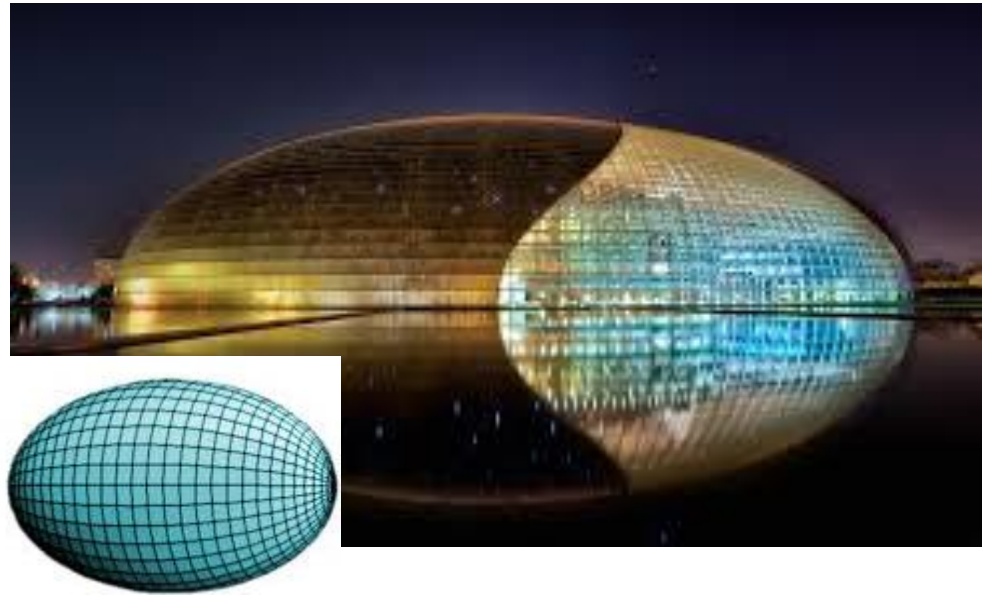
Hiperbolički cilindar

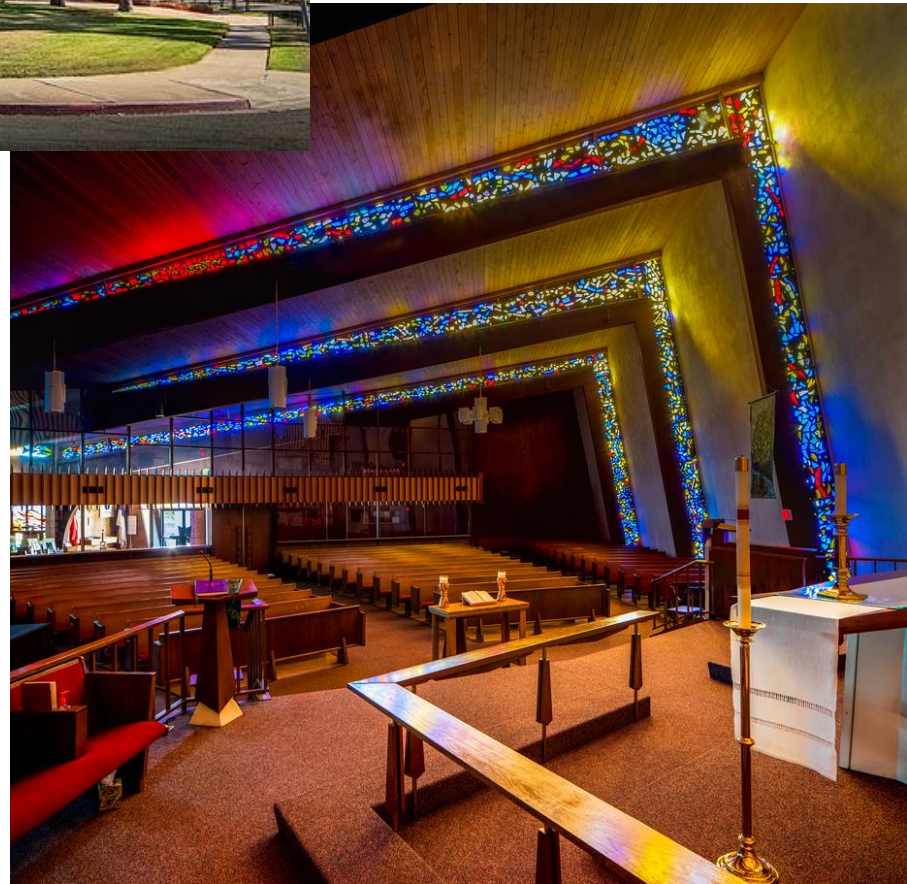


... i njihove kombinacije

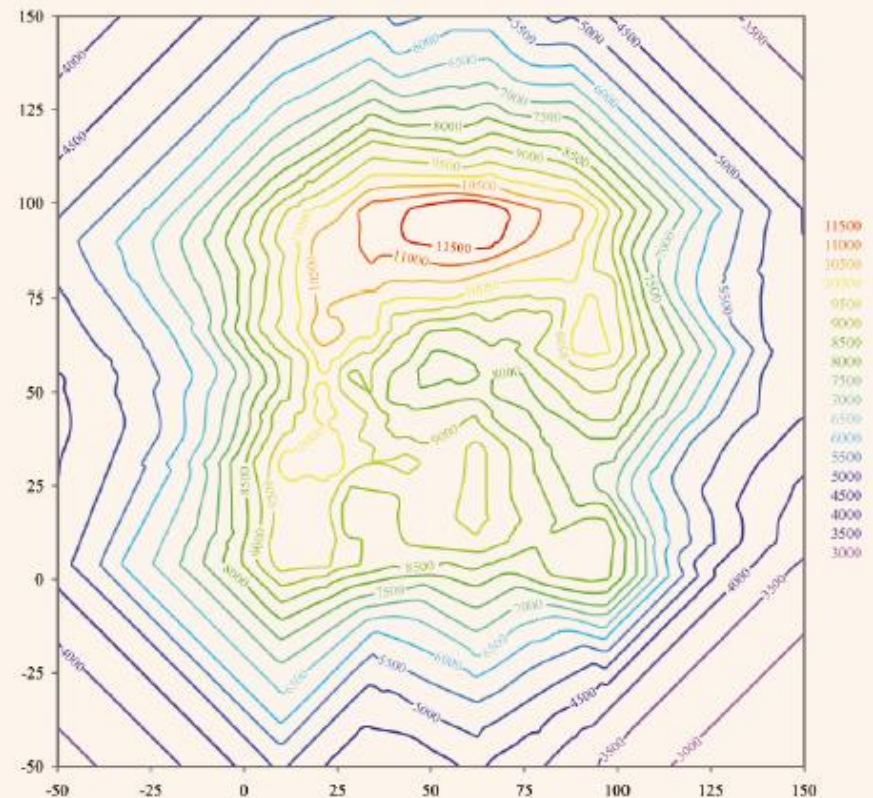
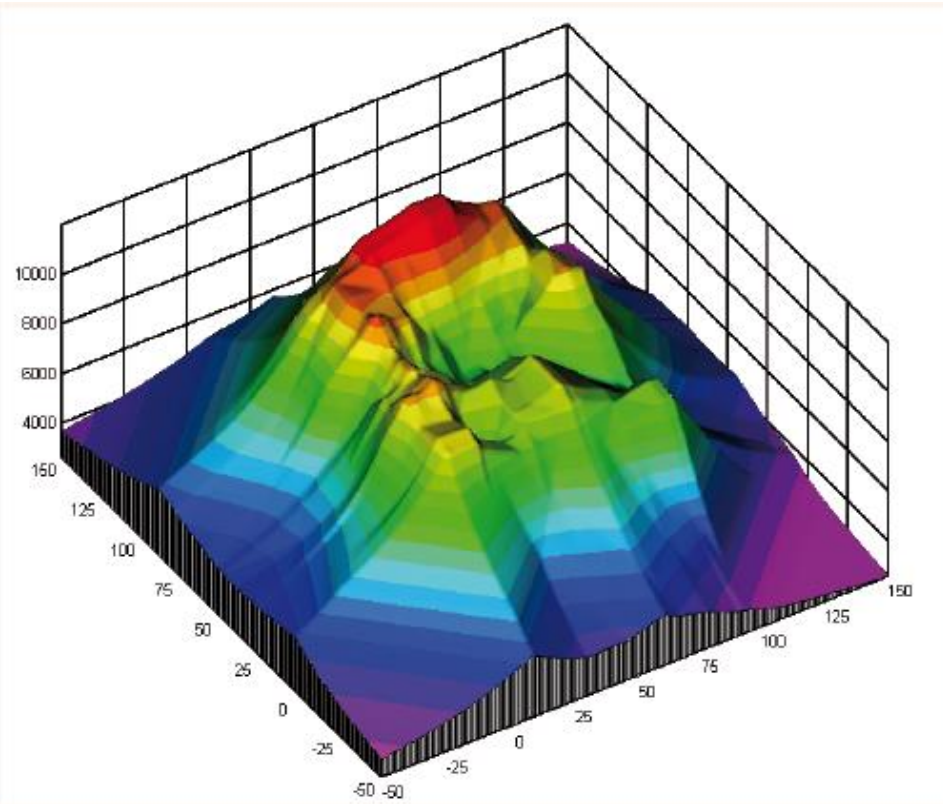
Parabolički cilindar



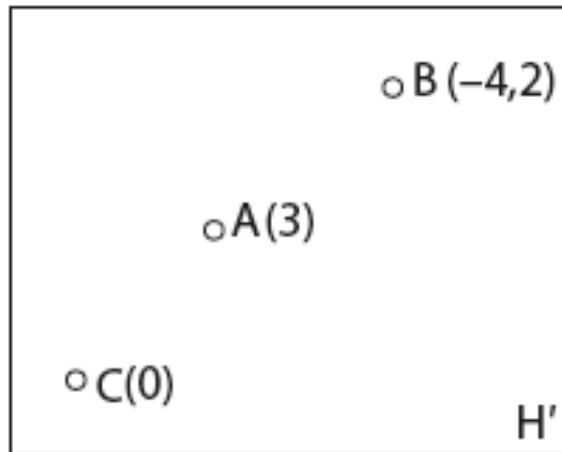
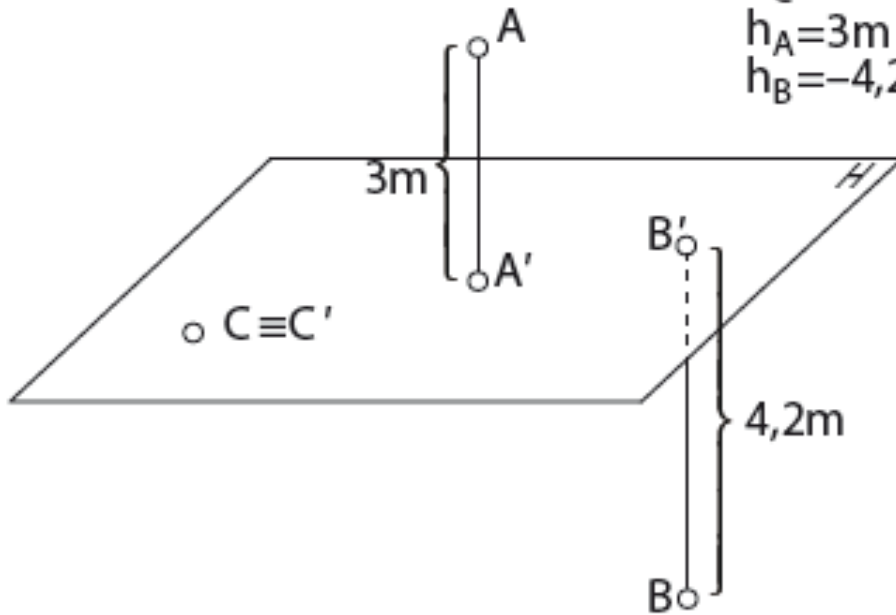




Kako predstaviti teren na crtežu?

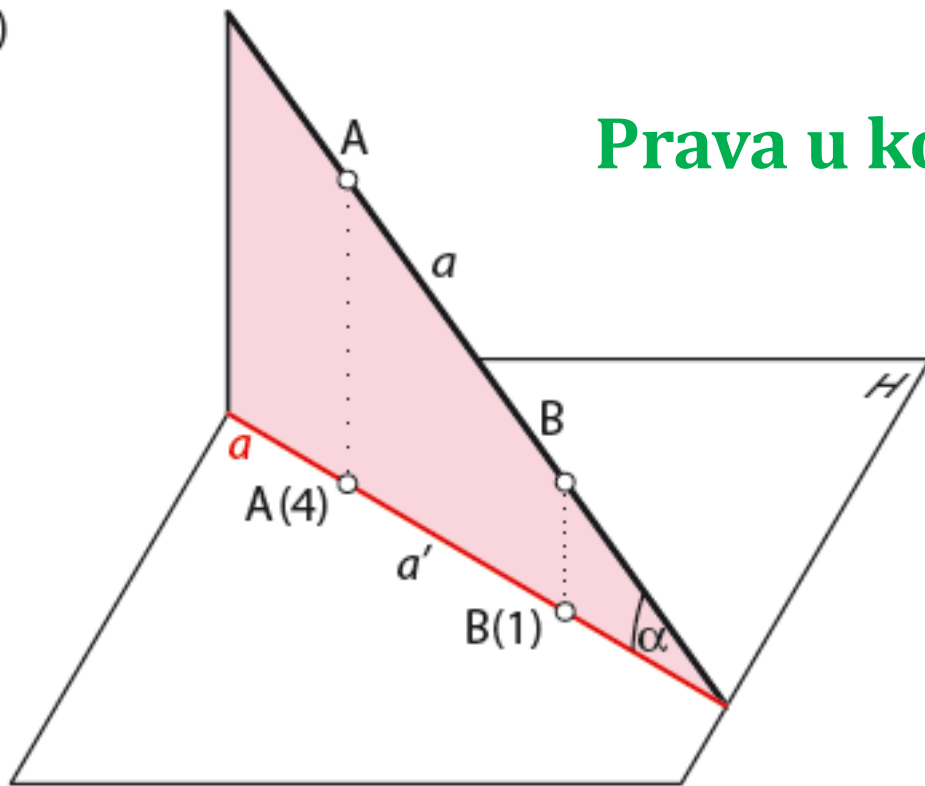


$h_C = 0\text{m}$
 $h_A = 3\text{m}$
 $h_B = -4,2\text{m}$



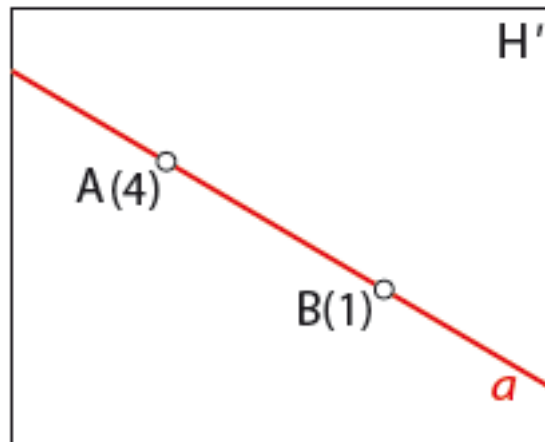
Tačka u kotiranoj projekciji

a)

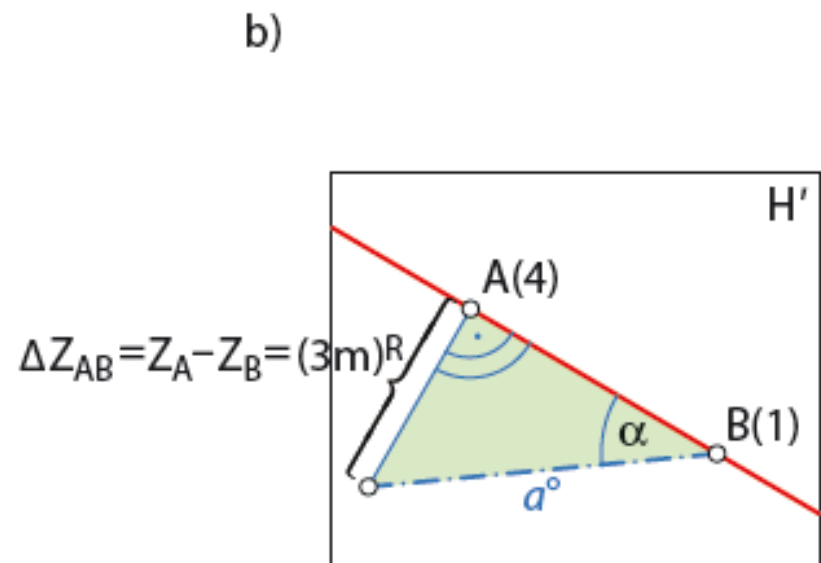
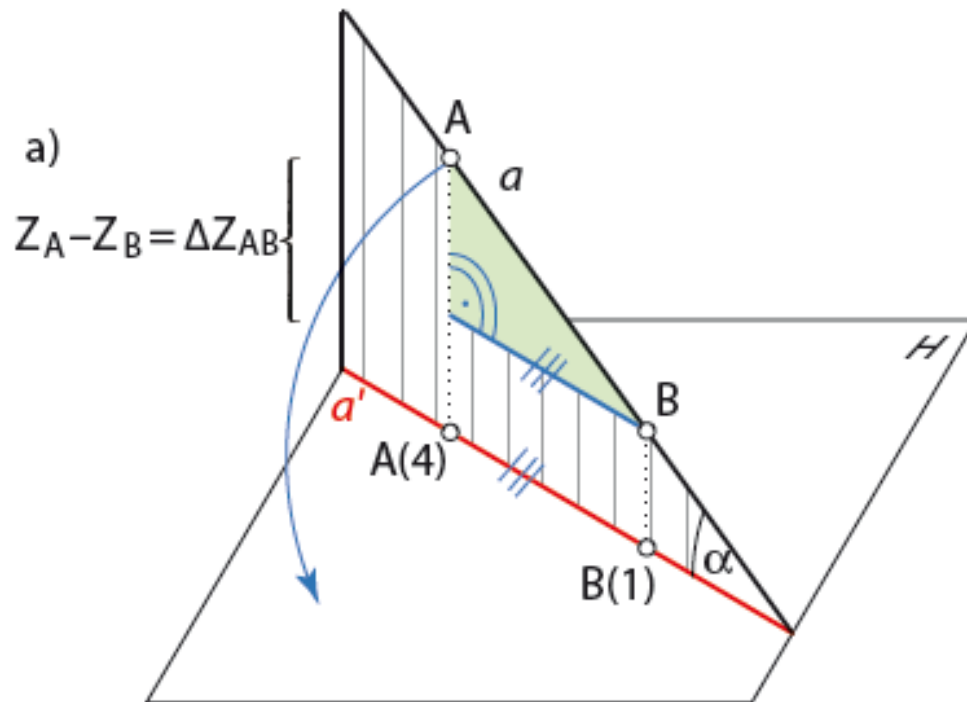


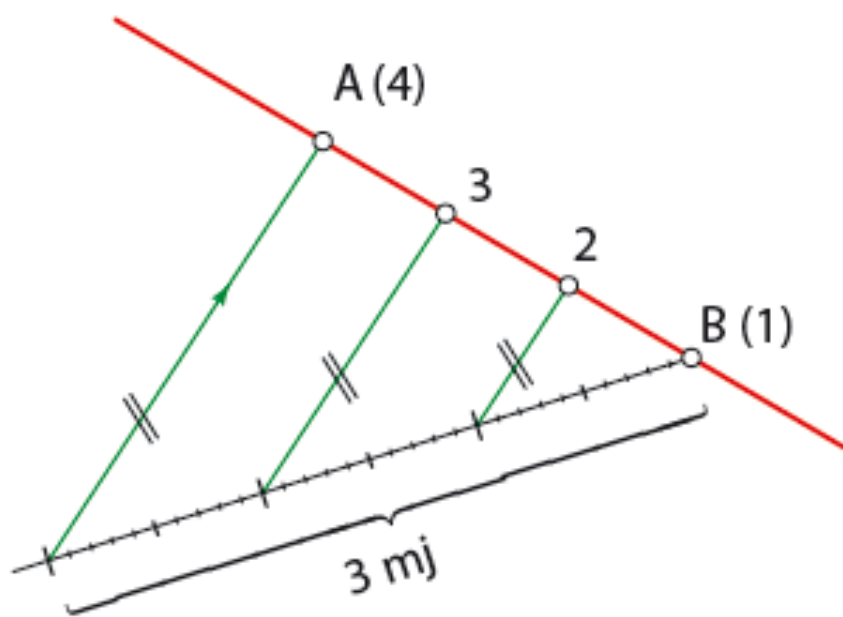
Prava u kotiranoj projekciji

b)

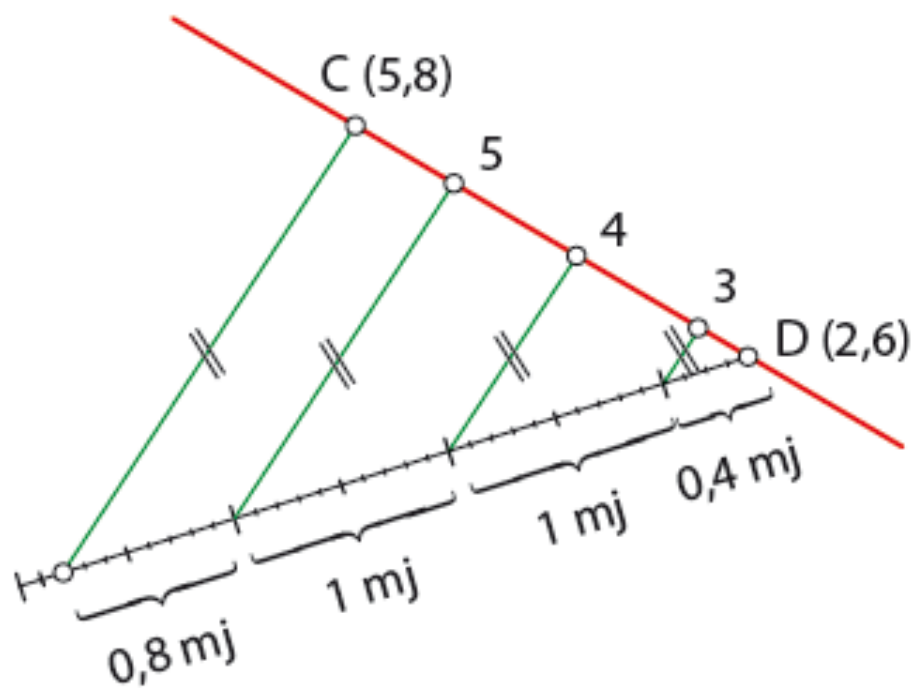


Prava veličina duži

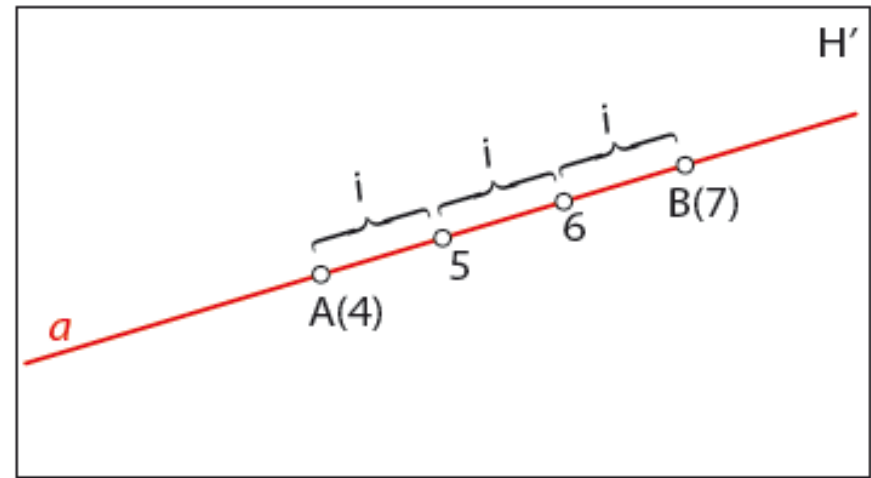




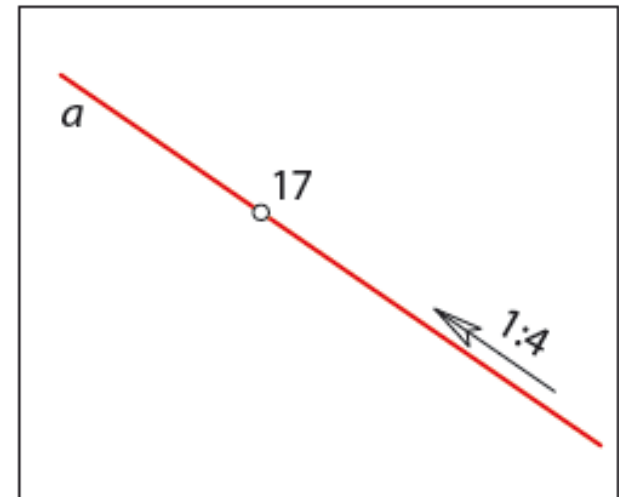
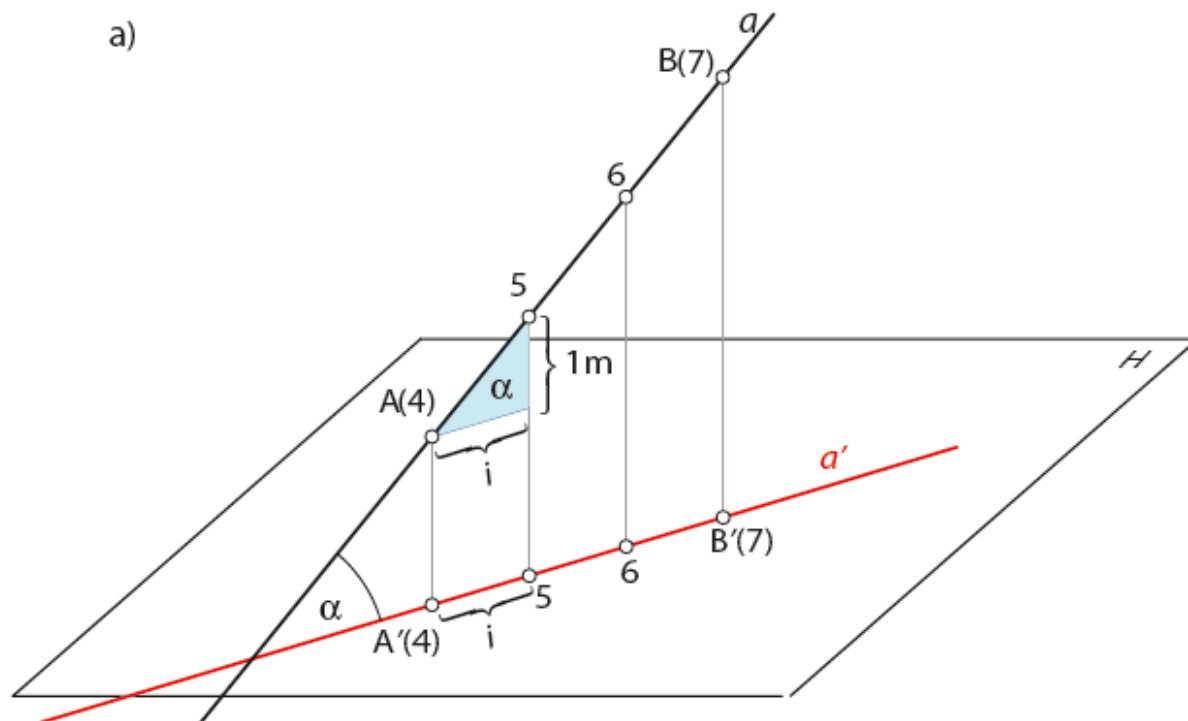
Graduisanje prave



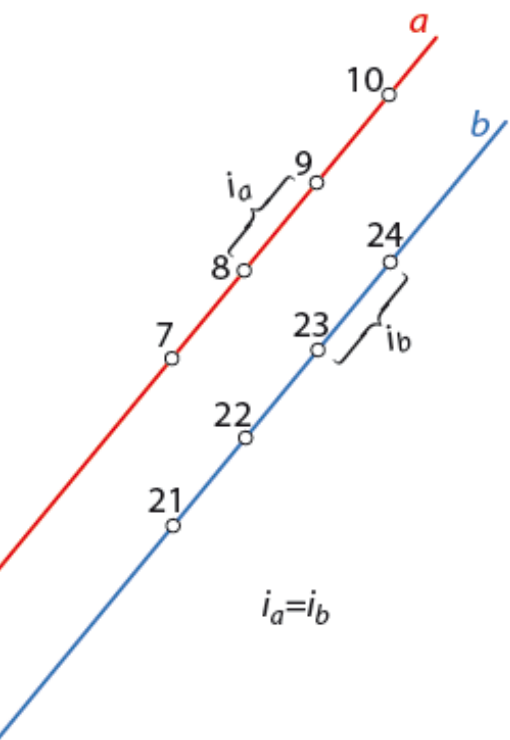
INTERVAL I PAD PRAVE



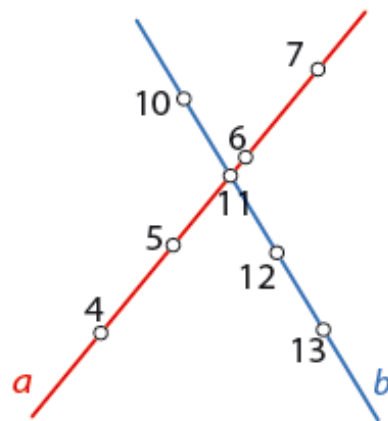
a)



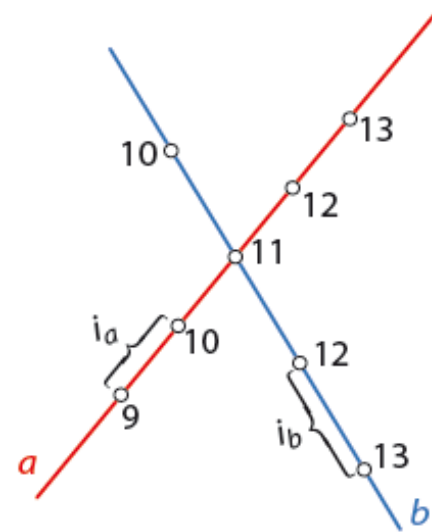
Međusobni odnos pravih u prostoru

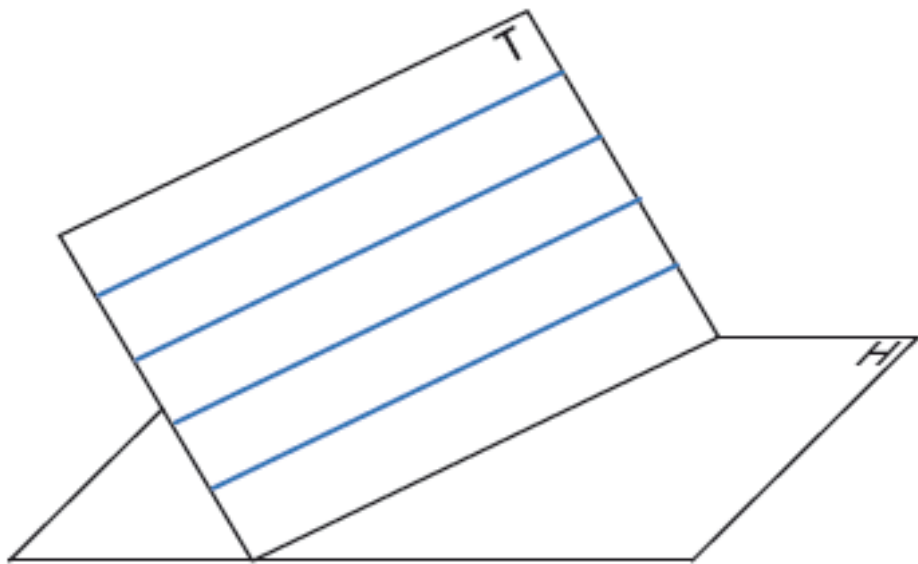


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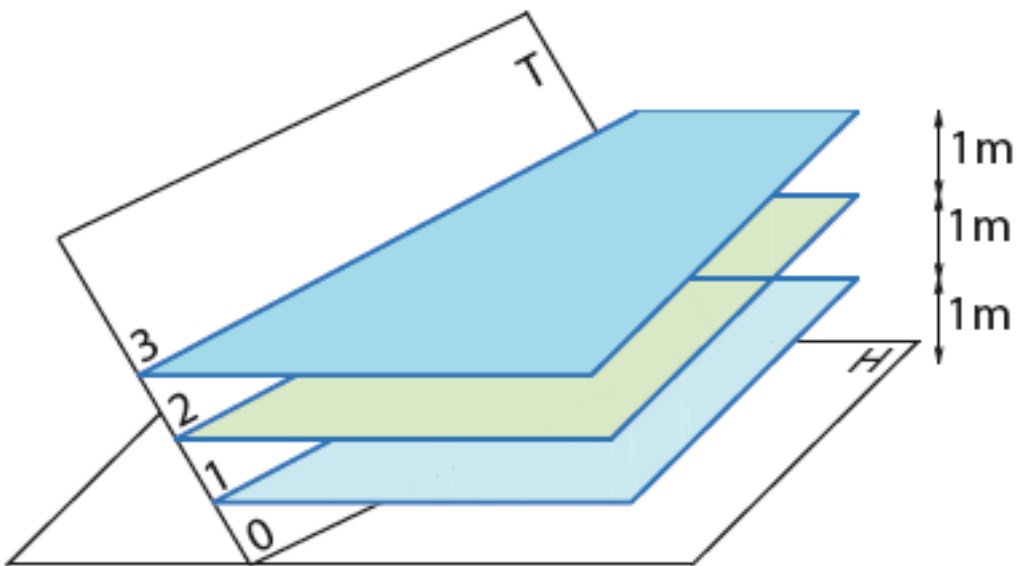


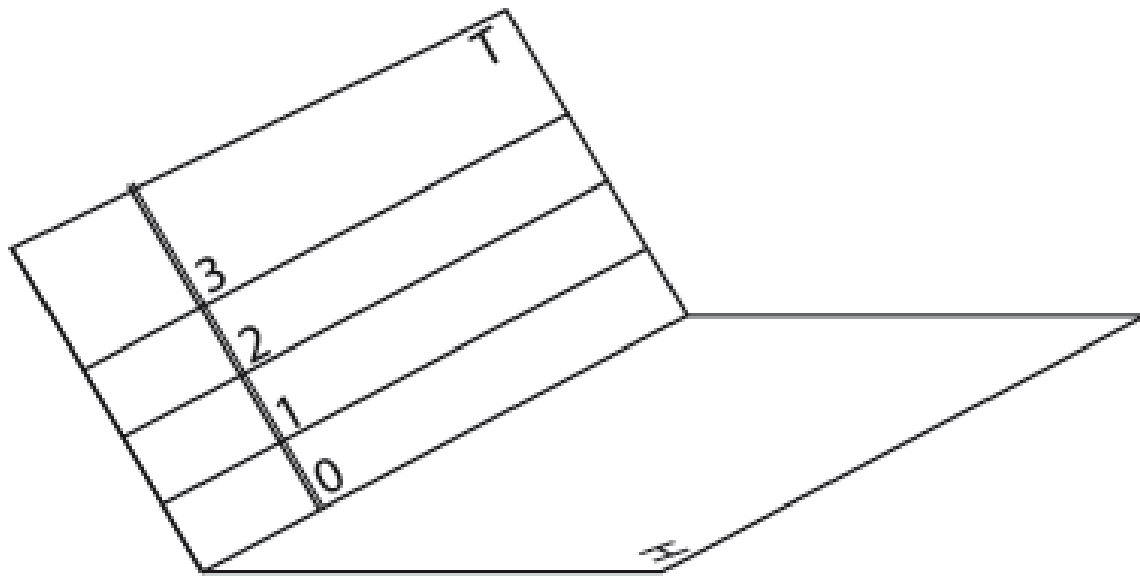
c)



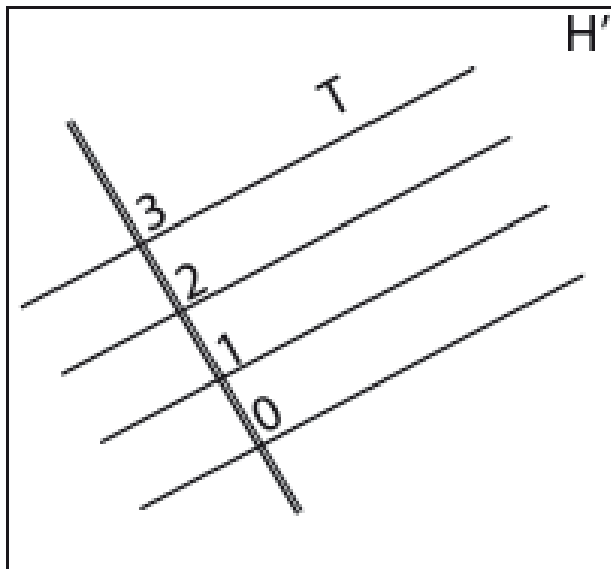


Ravan u kotiranoj projekciji

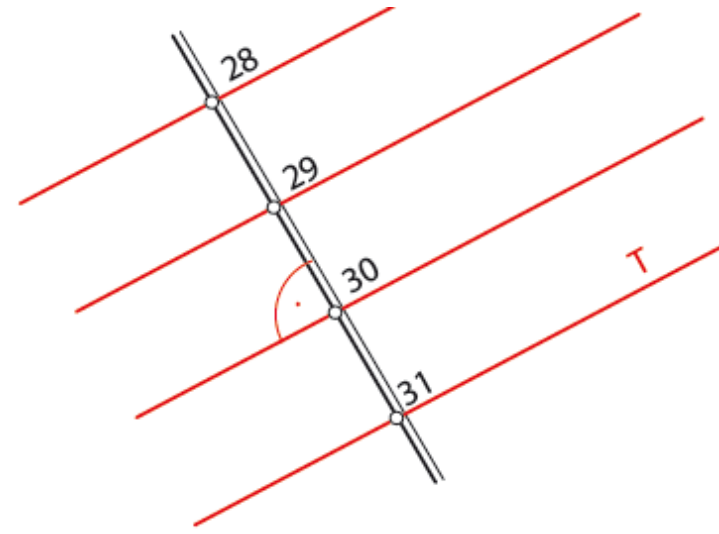
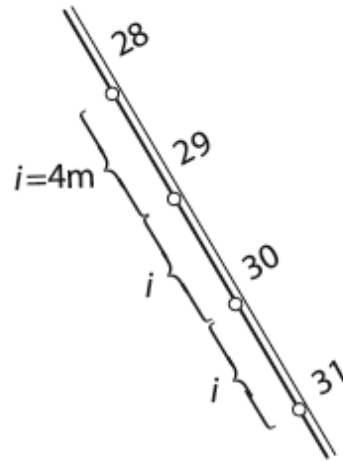
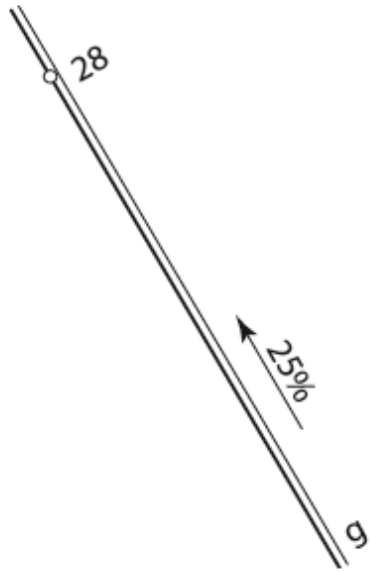




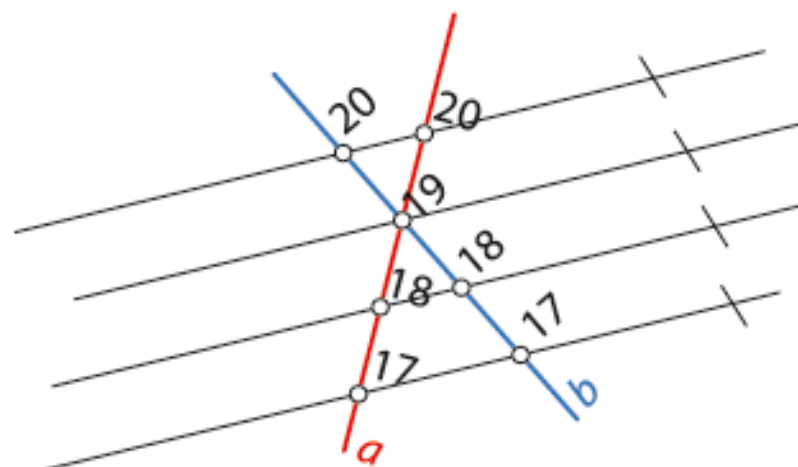
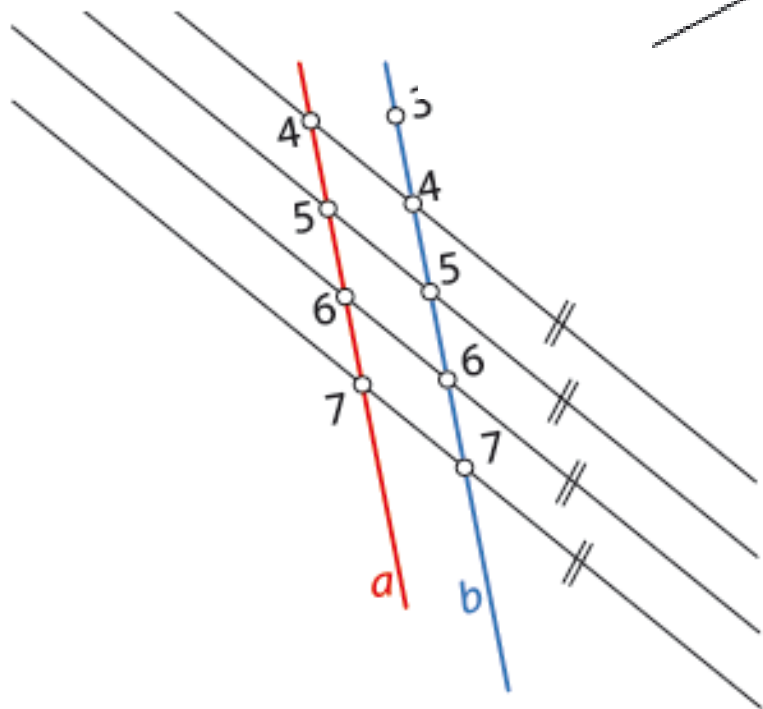
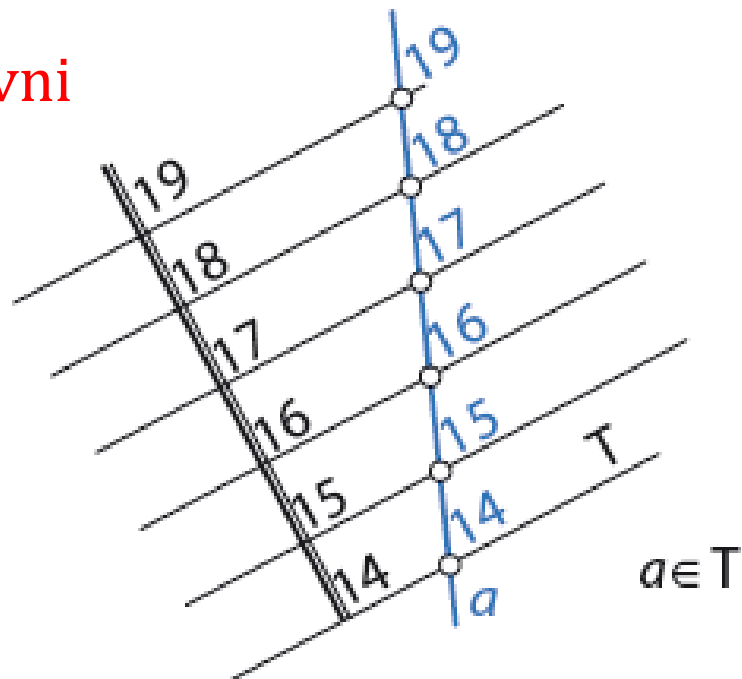
Izohipse
i nagibnica
ravni



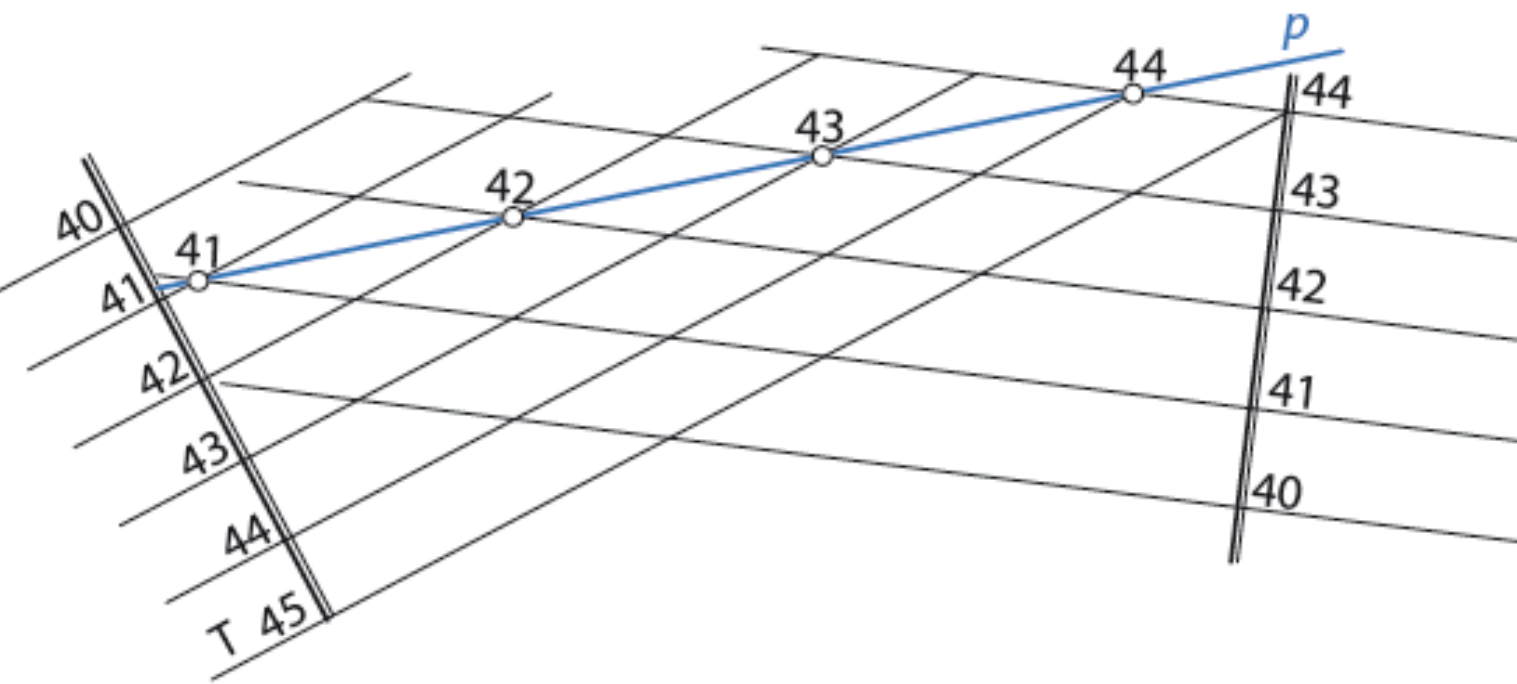
Ravan određena samo jednom pravom - nagibnicom



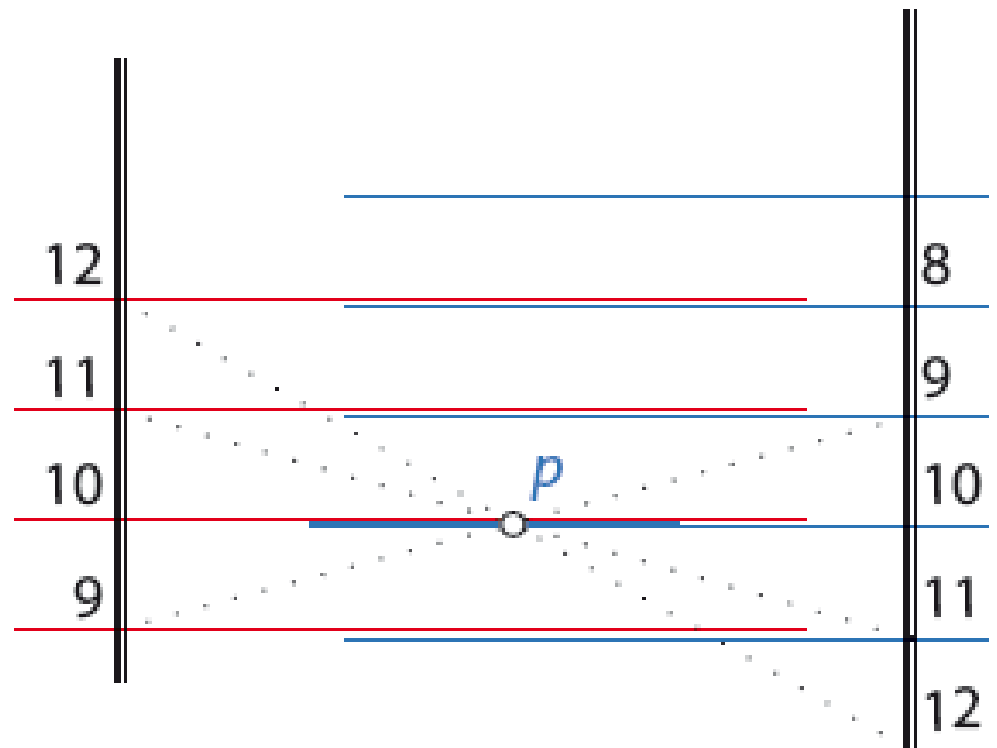
Prava pripada ravni

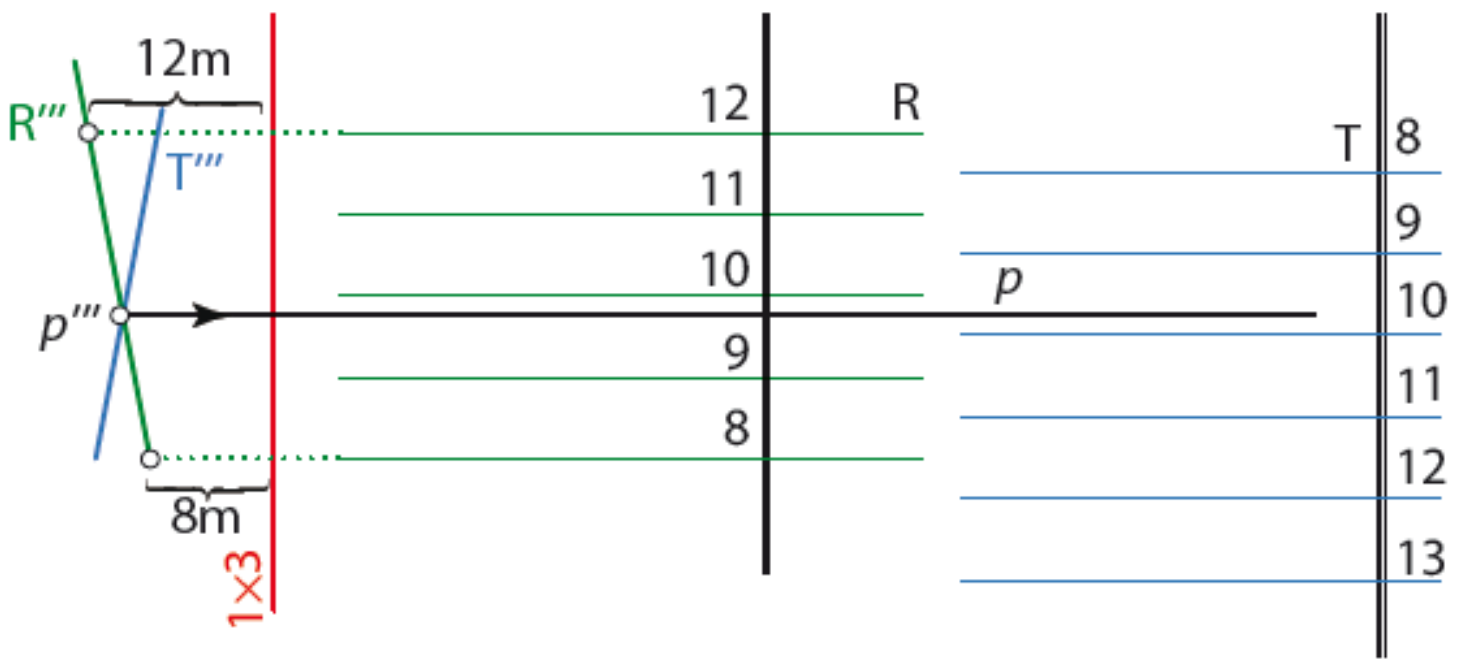
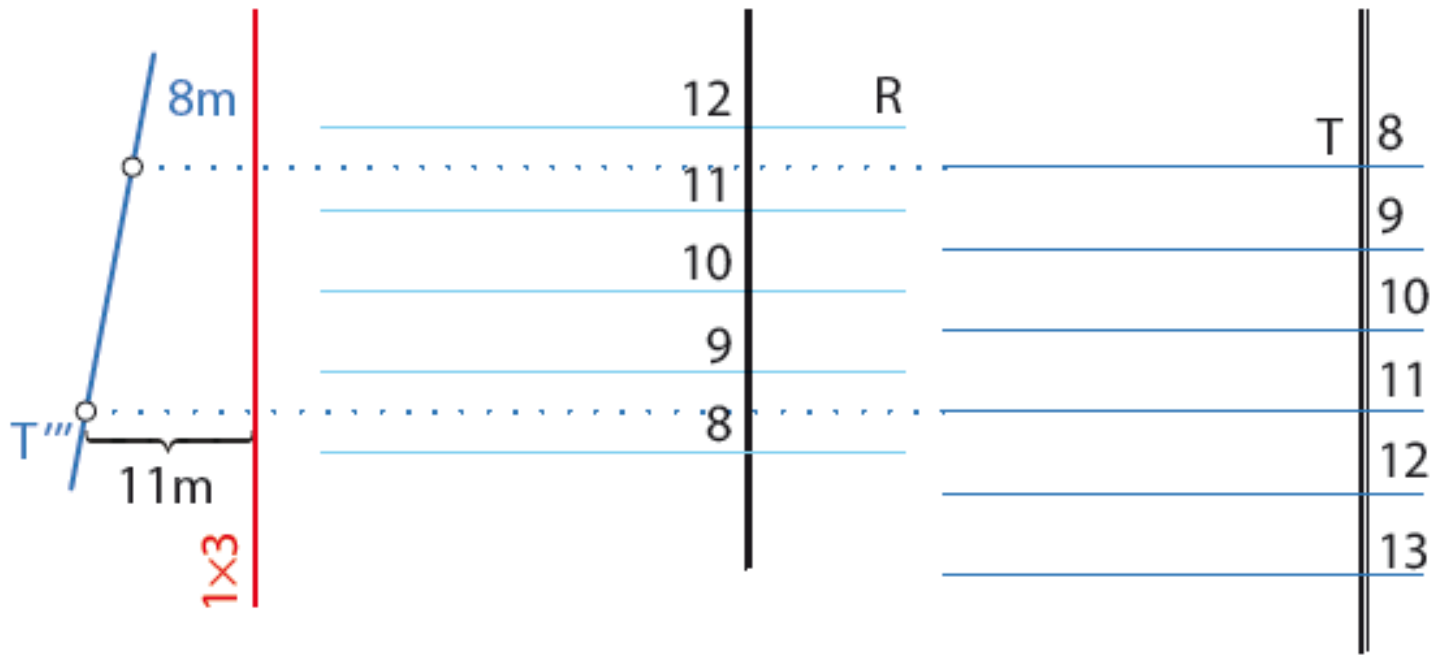


Dvije prave određuju ravan



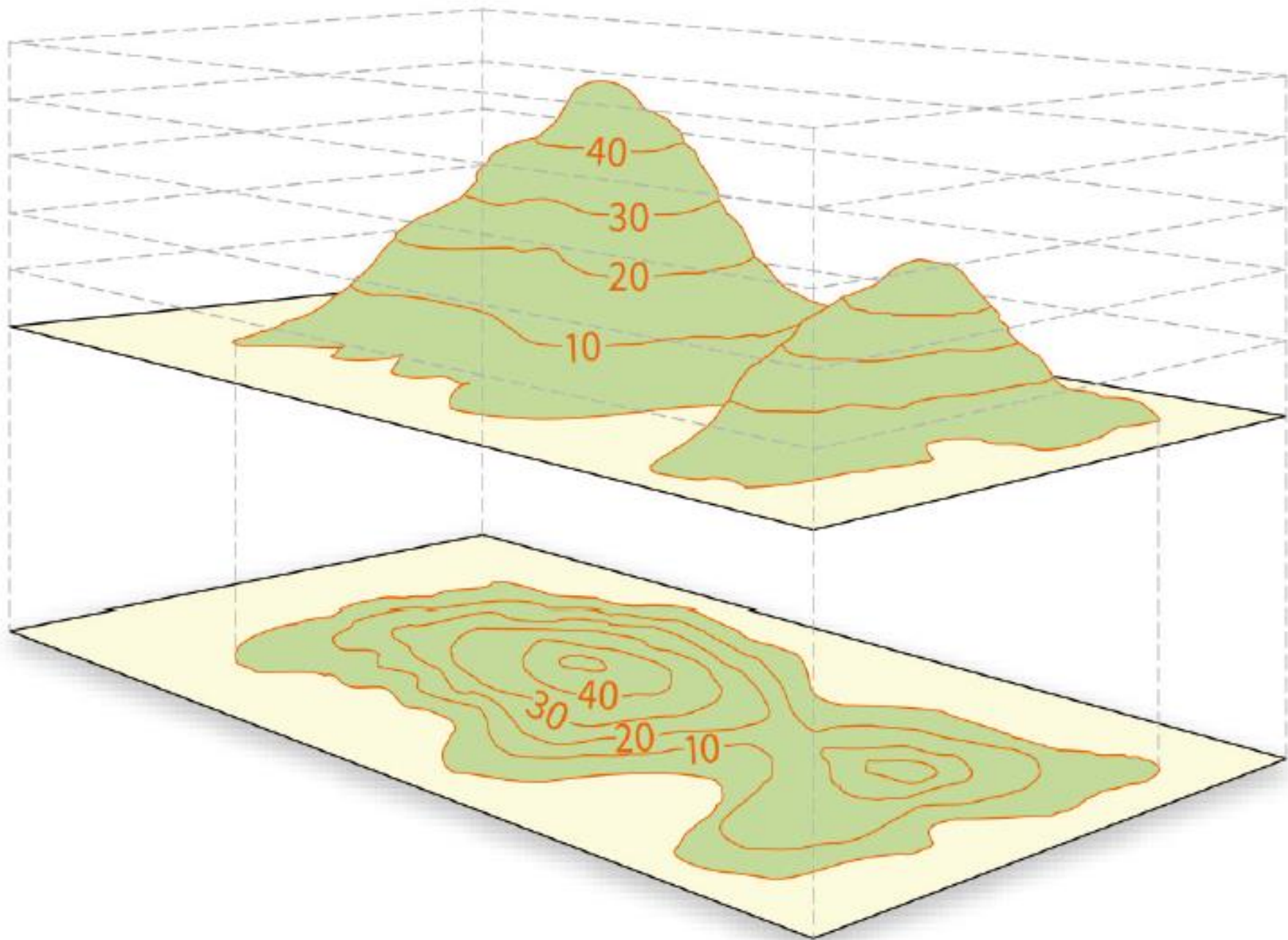
Presjek dvije ravni

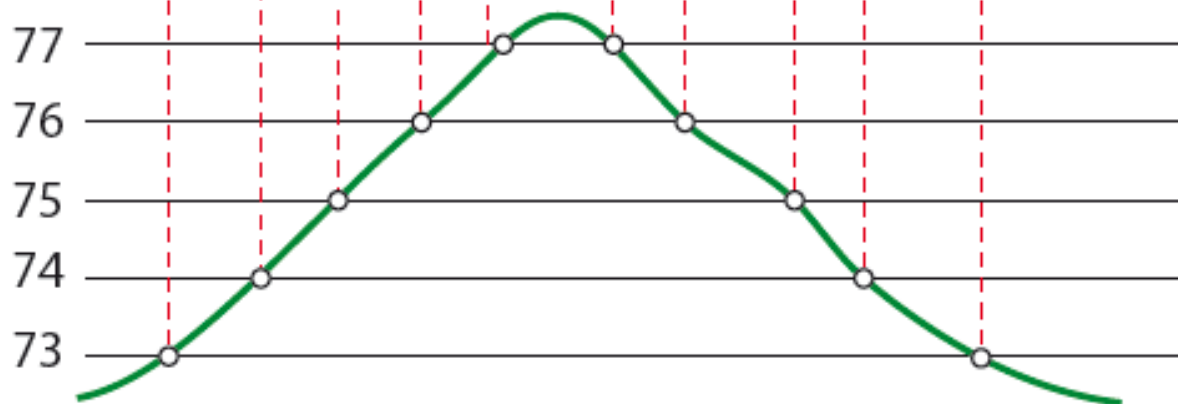
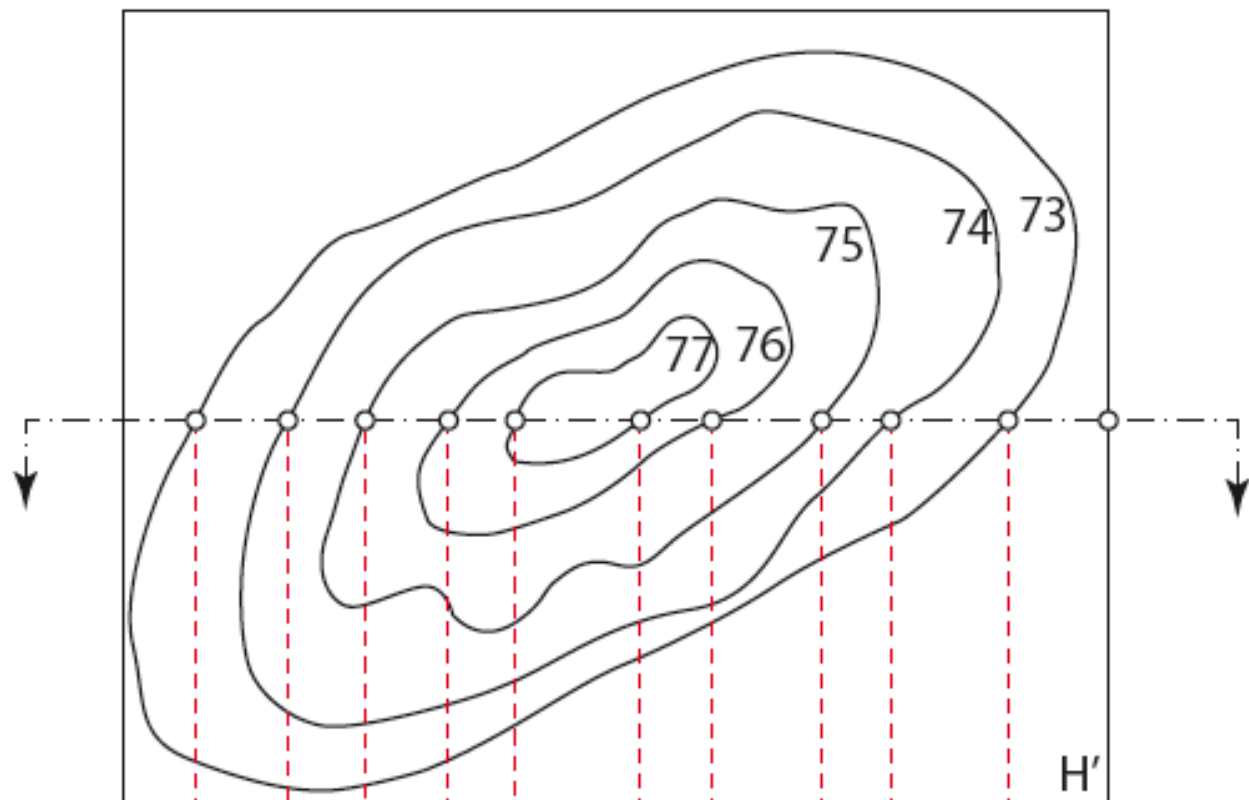




Presjek dvije ravni

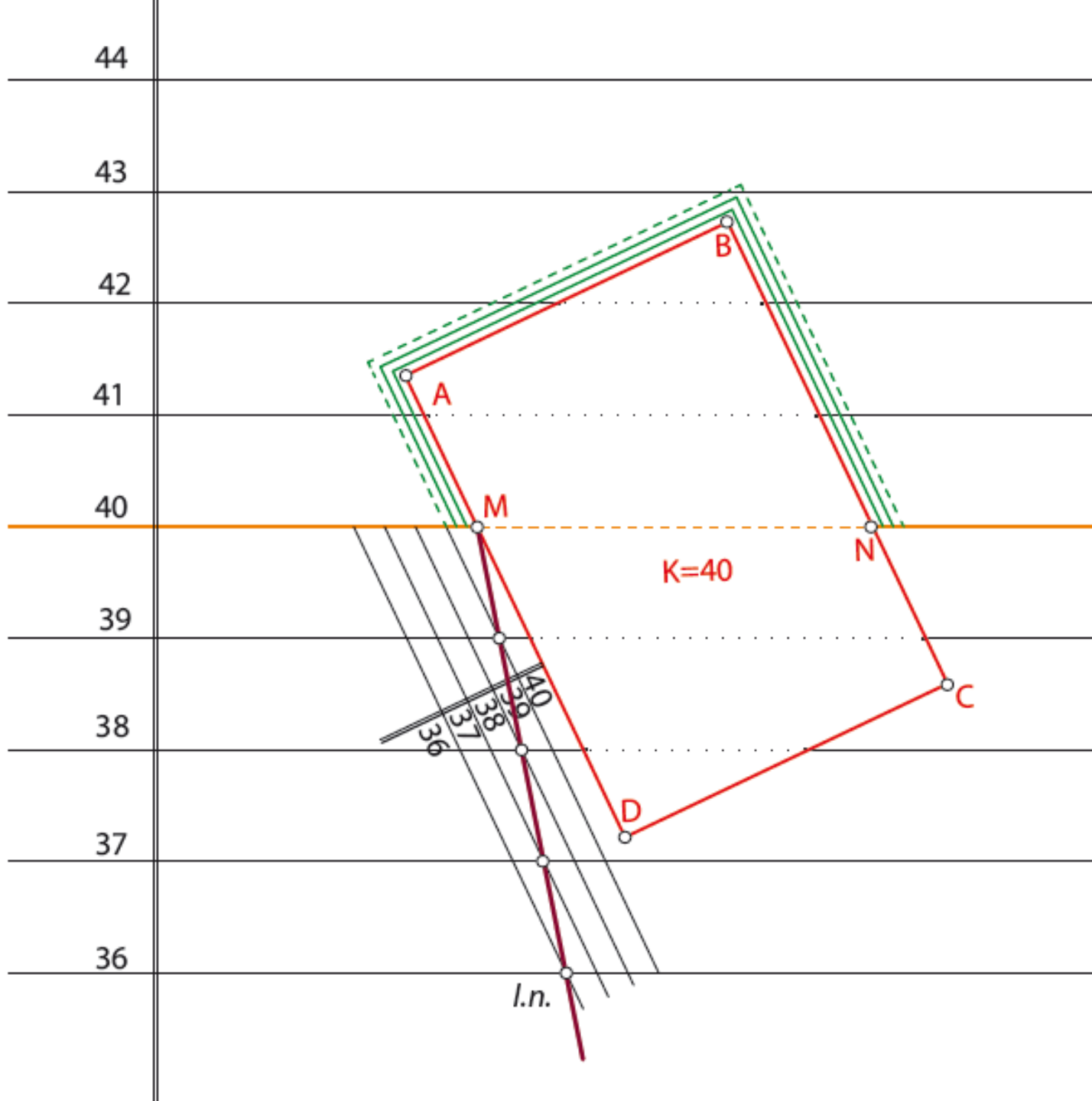
TOPOGRAFSKA POVRŠ - TEREN







PLATO



43

42

41

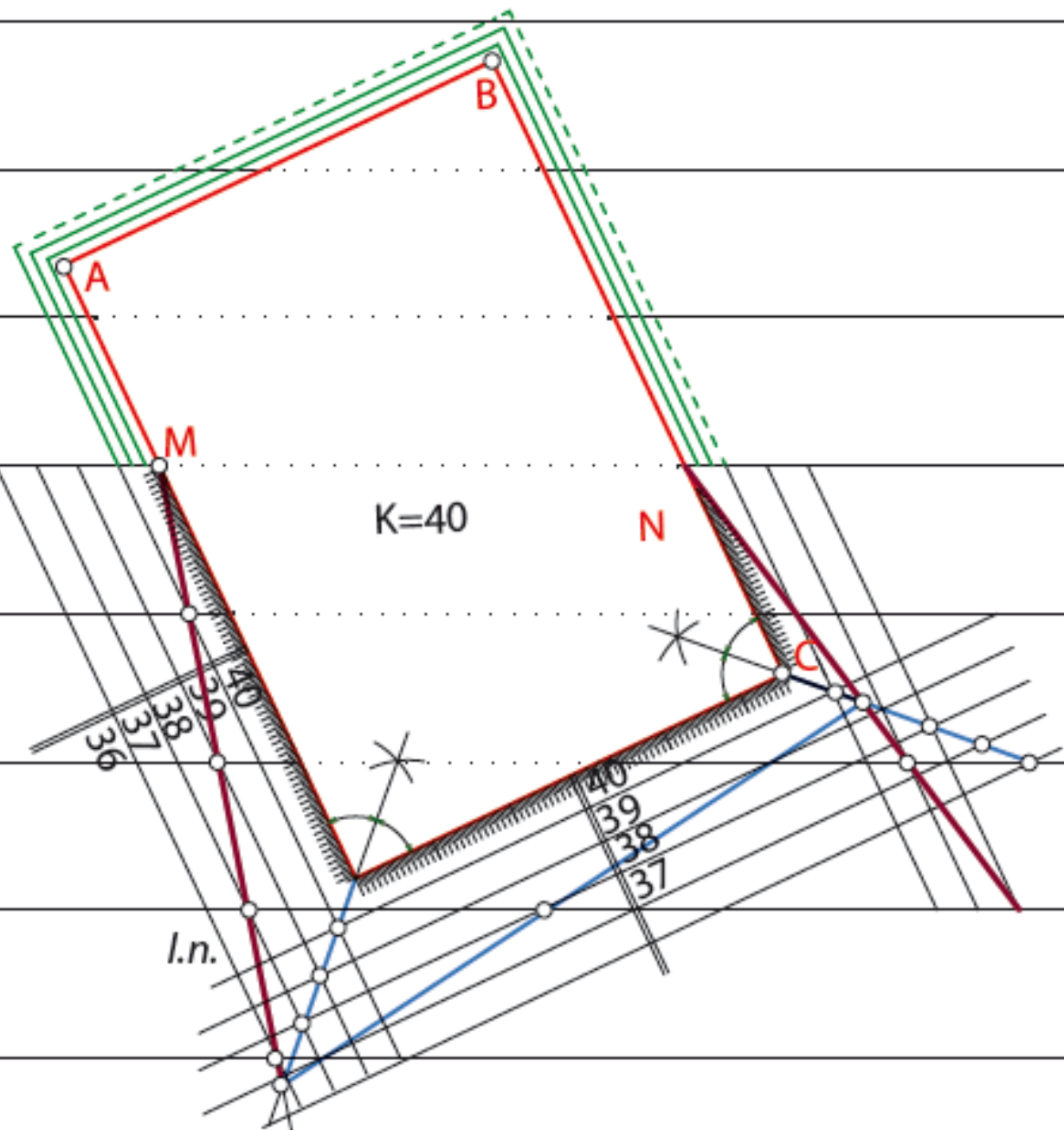
40

39

38

37

36



$K=40$

N

$l.n.$

36
37
38
39
40

40
39
38
37

43

42

41

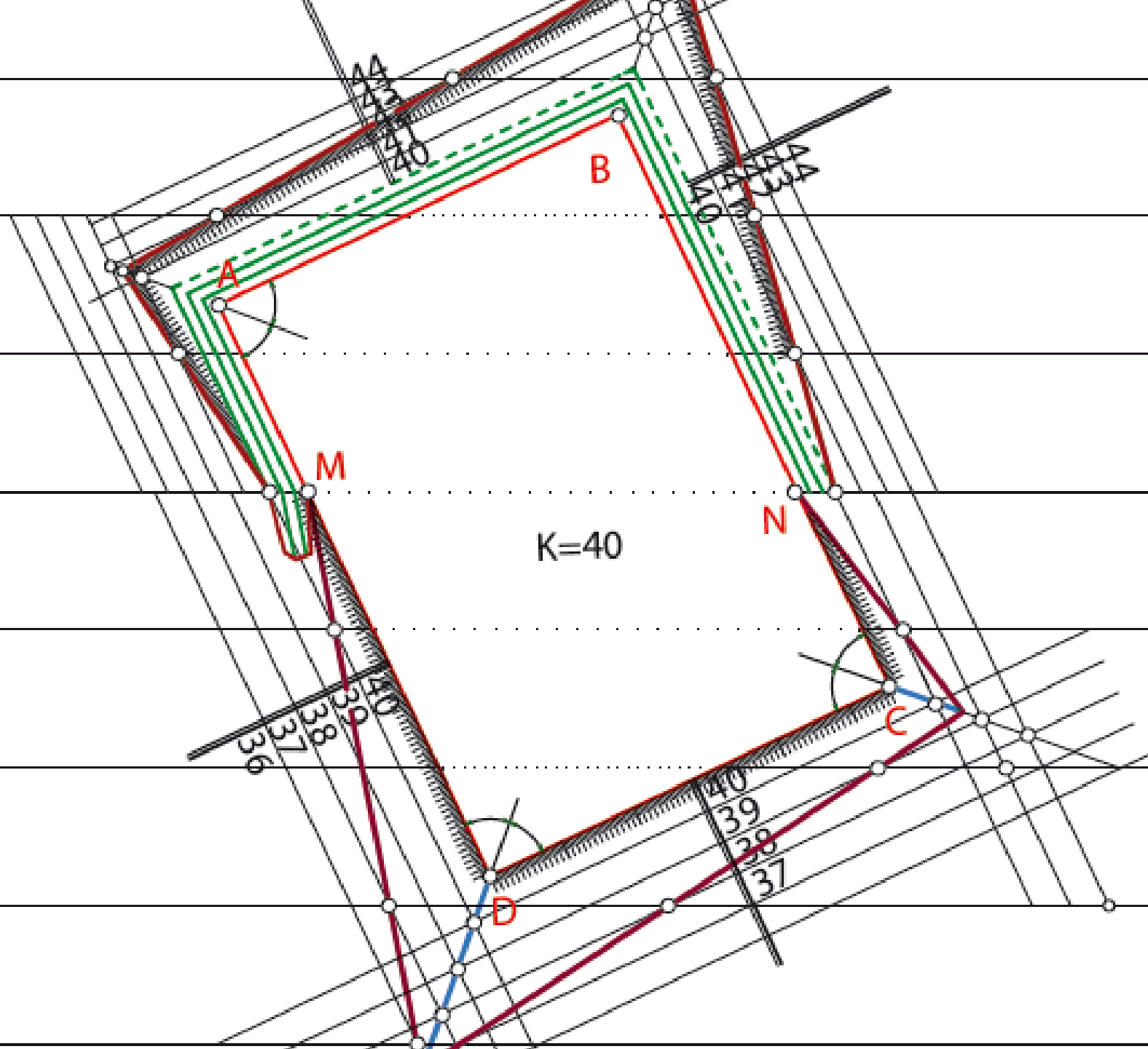
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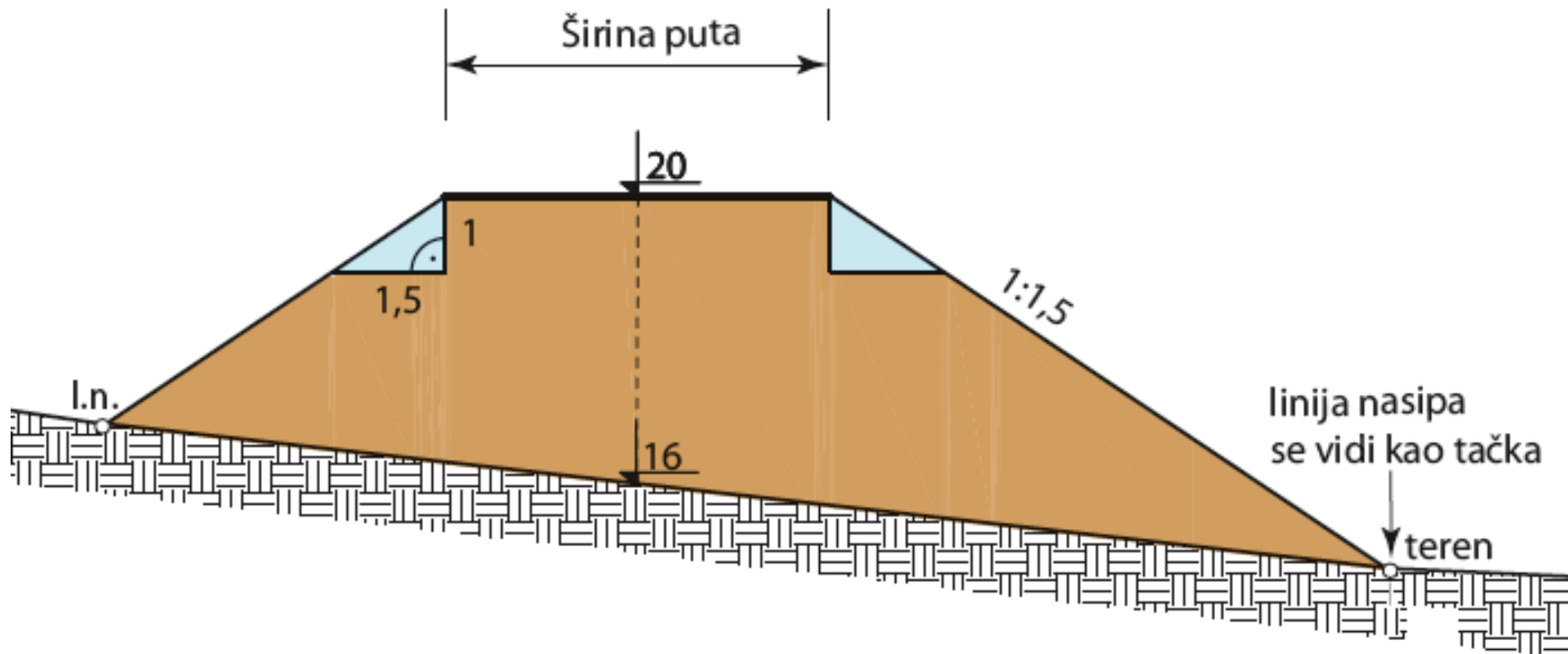
38

37

36

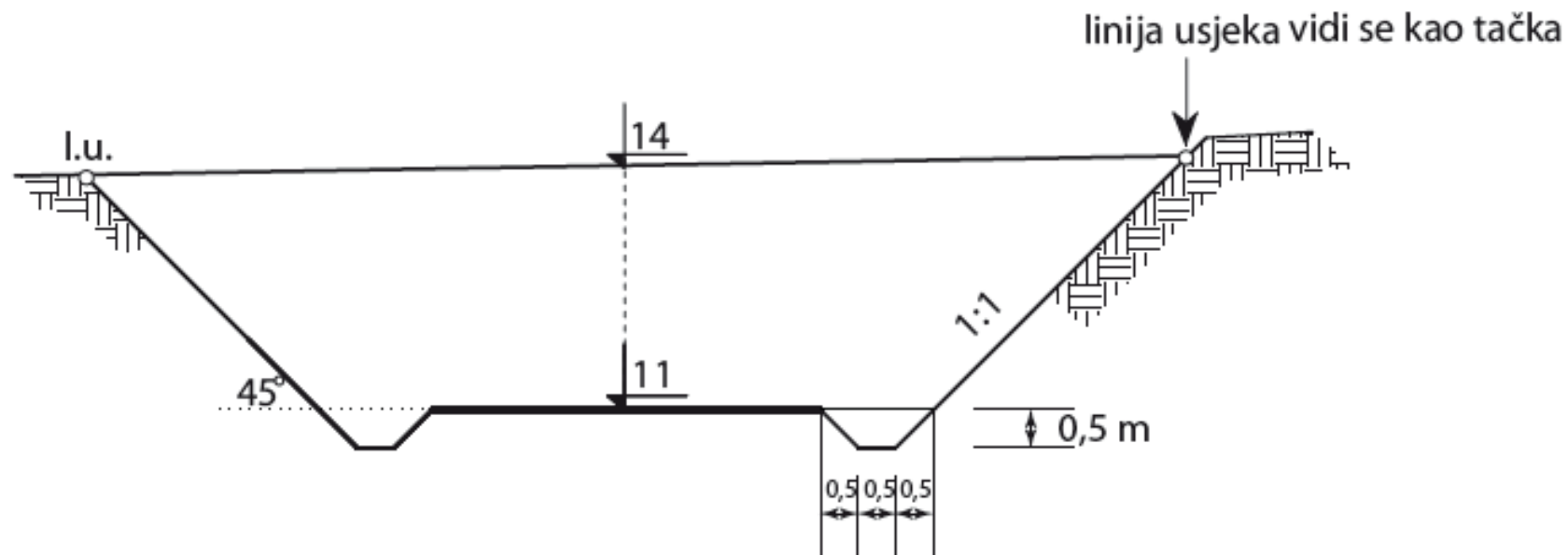








b)



c)

teren

