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Fundamentals of engineering drawing

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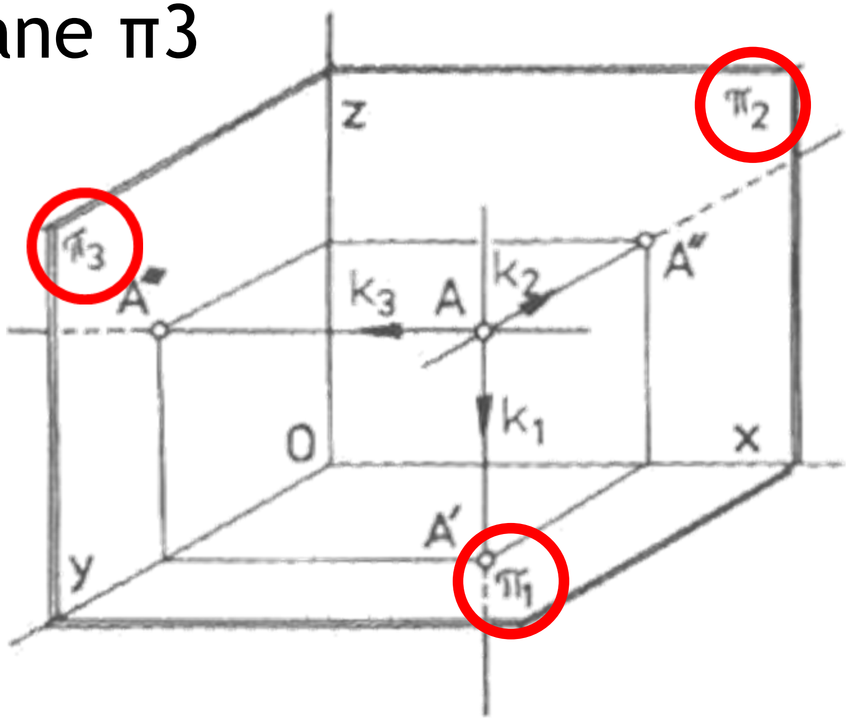
Parallel orthogonal projection according to Monge's method

Let's assume:

x and y horizontal projection plane π1

x and z vertical projection plane π2

y and z side projection plane π3



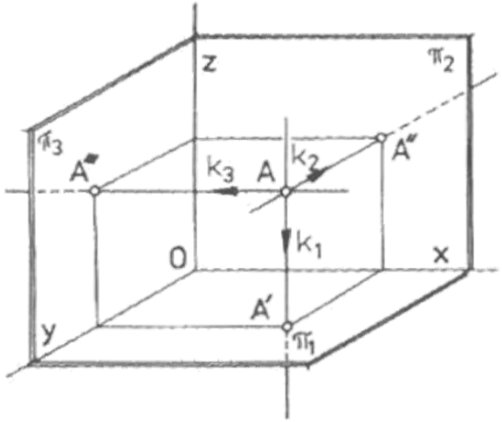
Parallel orthogonal projection according to Monge's method

The projecting rays form parallel beams that pass through the points A, B, C ... and pierce successively the projection planes π1, π2, π3

π1 – projection direction k1 || to the z-axis (′)

π2 – projection direction k2 || to y-axis (")

π3 – projection direction k3 || to the x-axis (‴)



Parallel orthogonal projection according to Monge's method

Each pair of planes among π1, π2, π3 intersect at right angles along the axes, called projection axes:

$\pi_1 \cap \pi_2 \rightarrow x$

$\pi_1 \cap \pi_3 \rightarrow y$

$\pi_2 \cap \pi_3 \rightarrow z$

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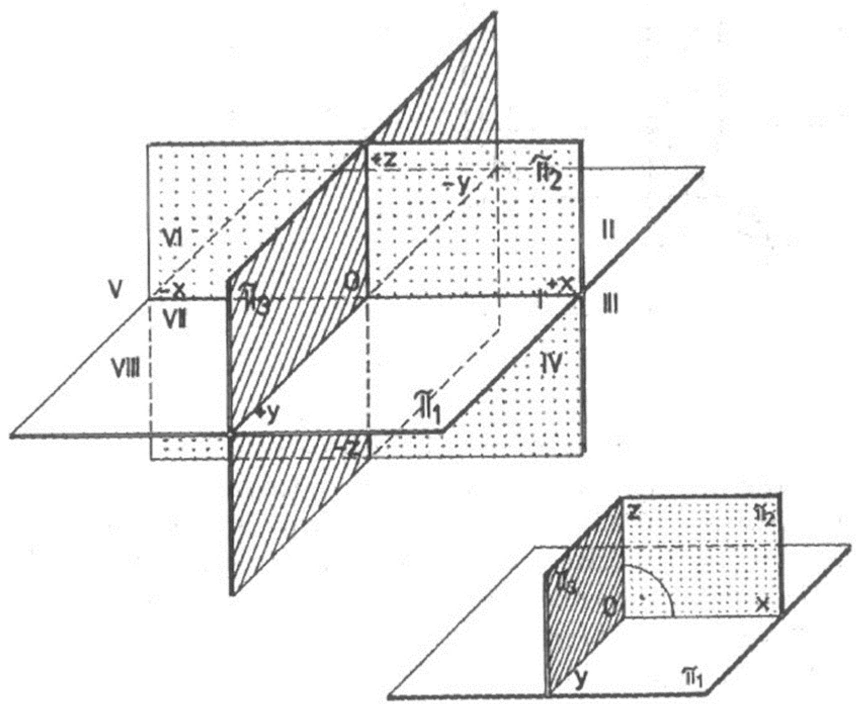
Parallel orthogonal projection according to Monge's method

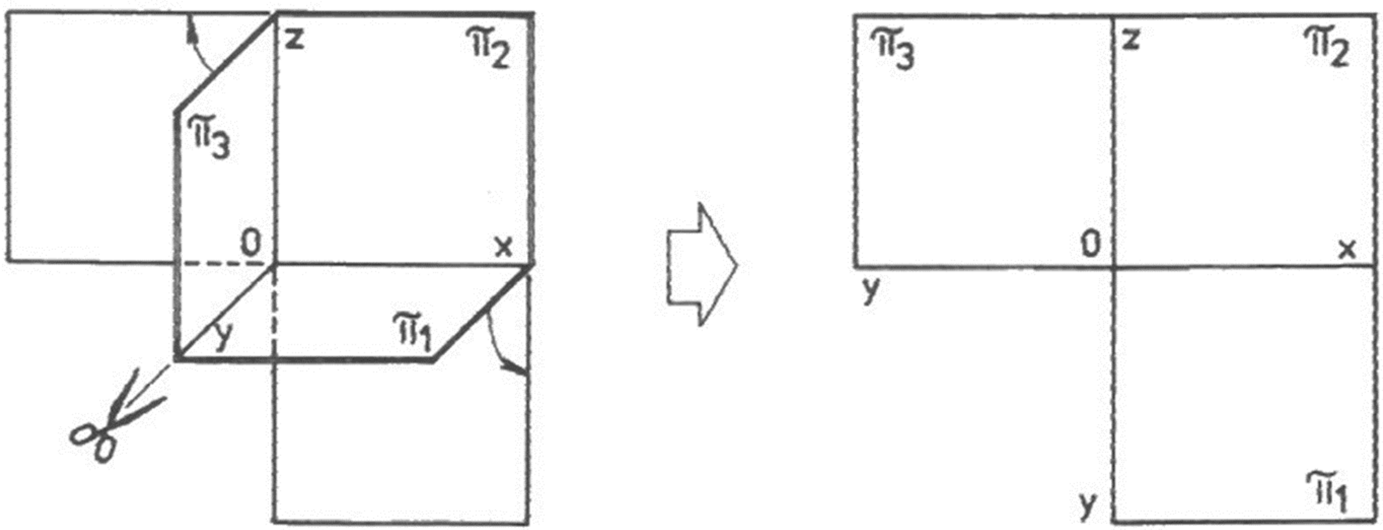
- The planes π1, π2, π3 divide space into eight areas
- Let’s stick to

area „I”



Parallel orthogonal projection according to Monge's method

Monge's method consists in projecting the elements of space onto three mutually perpendicular projection planes, assuming a perpendicular projection direction



Parallel orthogonal projection according to Monge's method

The plane of the drawing as a result of unifying viewports is a plane π_2

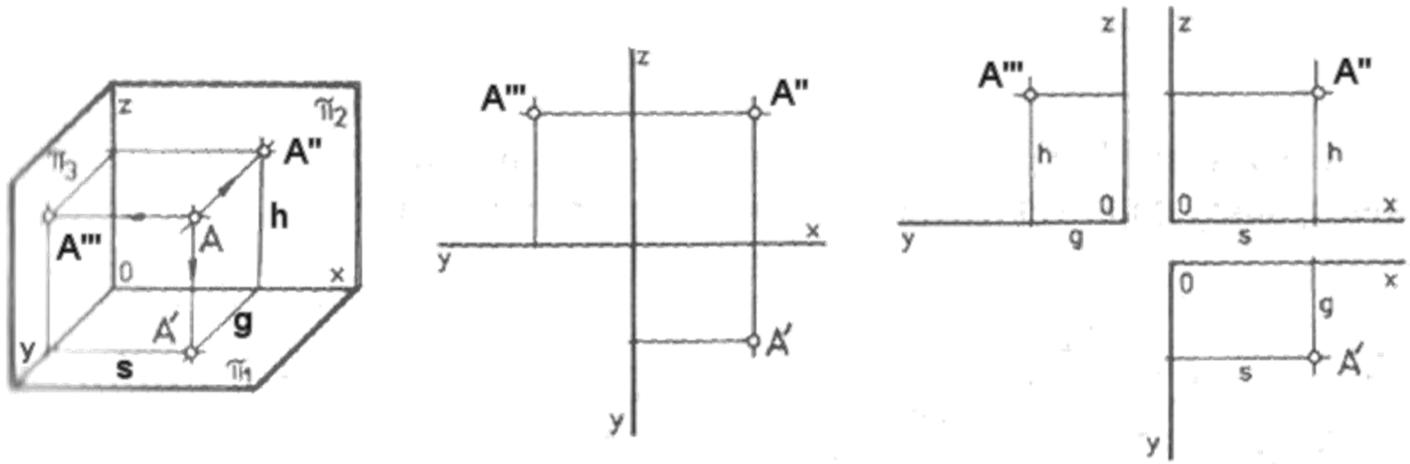
The image of a point in Monge projections

Guiding the projecting rays:

AA' = h, height of point A relative to π1

AA" = g, depth of point A relative to π2

AA''' = s, width of point A relative to π3



The image of a point in Monge projections

- We consider the dimensional number of the height (h) to be positive when the point is located above the horizontal viewport
- We consider the depth dimensional number (g) to be positive when the point is in front of the vertical viewport

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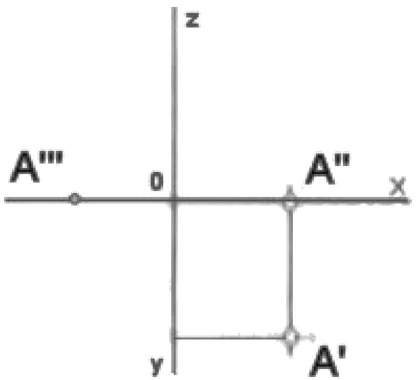
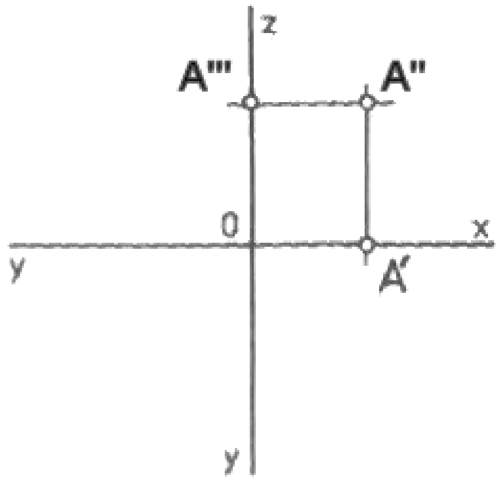
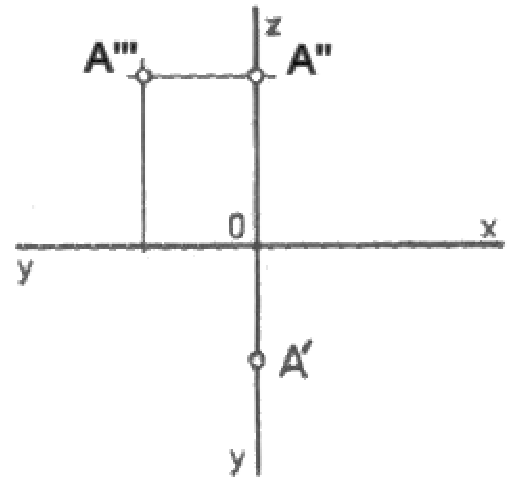
Specific point locations







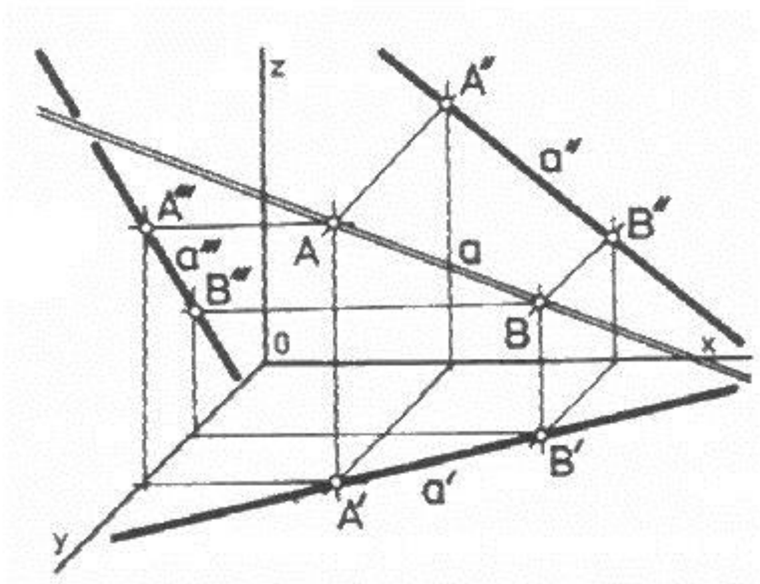
height h = 0
Point A lies on π1

depth g = 0
Point A lies on π2

width s = 0
Point A lies on π3

The image of a straight line in Monge projections

- We choose two points A and B in space that uniquely determine the line **a**.
- The projections of these points determine the projections of the line **a**



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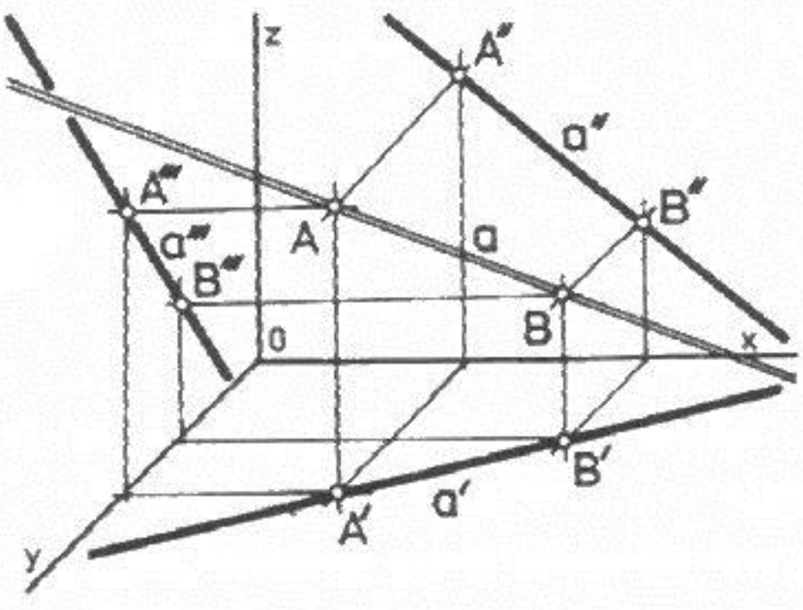
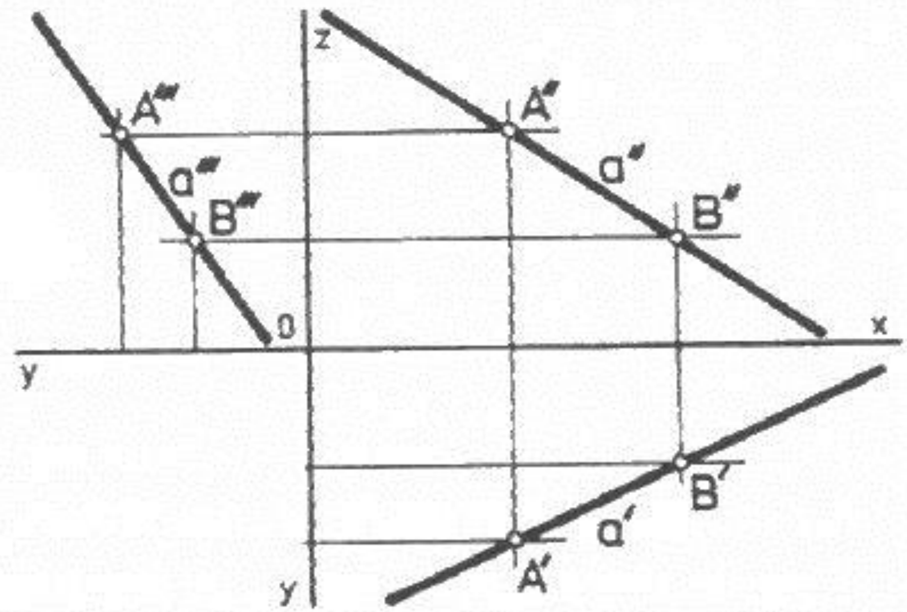
The image of a straight line in Monge projections

- Line **a** and in any position



Axonometry (dimetry)



Parallel orthogonal projection (Monge method)

Plane in Monge projections

- The plane in space is determined by the basic elements:
  - 3 points not on one straight line (A, B, C)
  - line and a point not on this line (a, A)
  - two intersecting lines (a, b)
  - two parallel lines (a, b)

Traces of lines and planes

- In Monge's projections, due to the clarity of information transfer, we present lines and planes in the form of traces.
- Traces are points of projection plane piercing (through a line or a plane)

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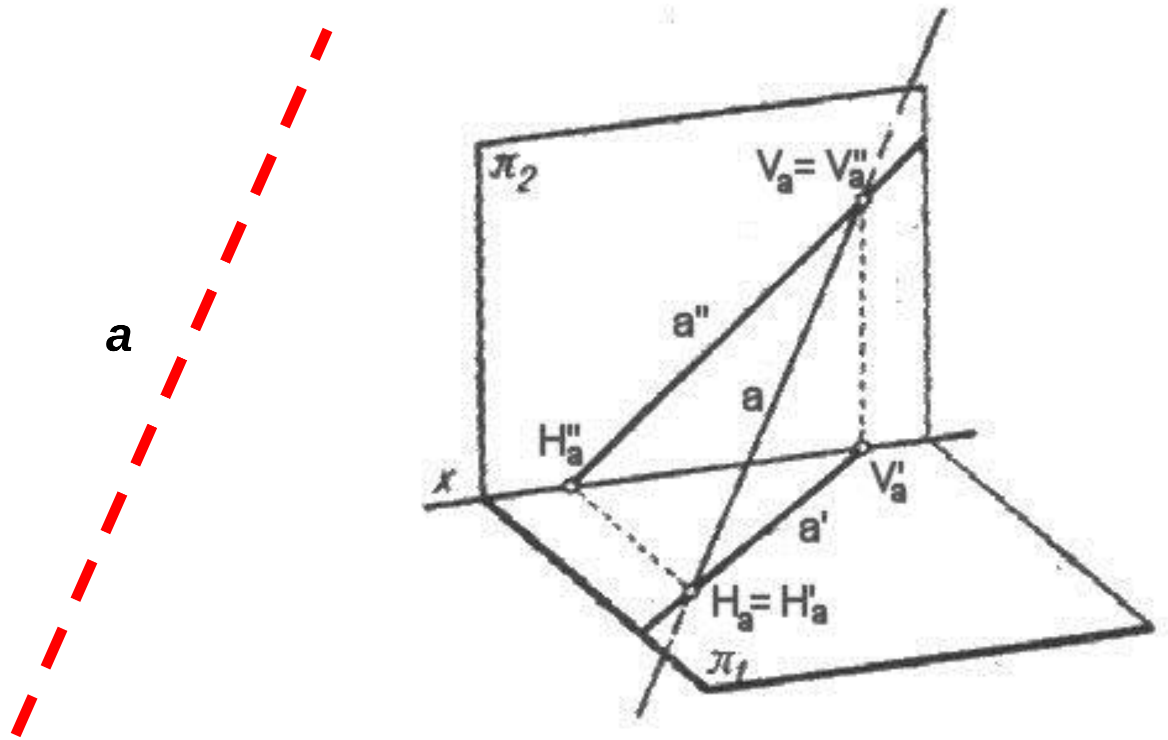
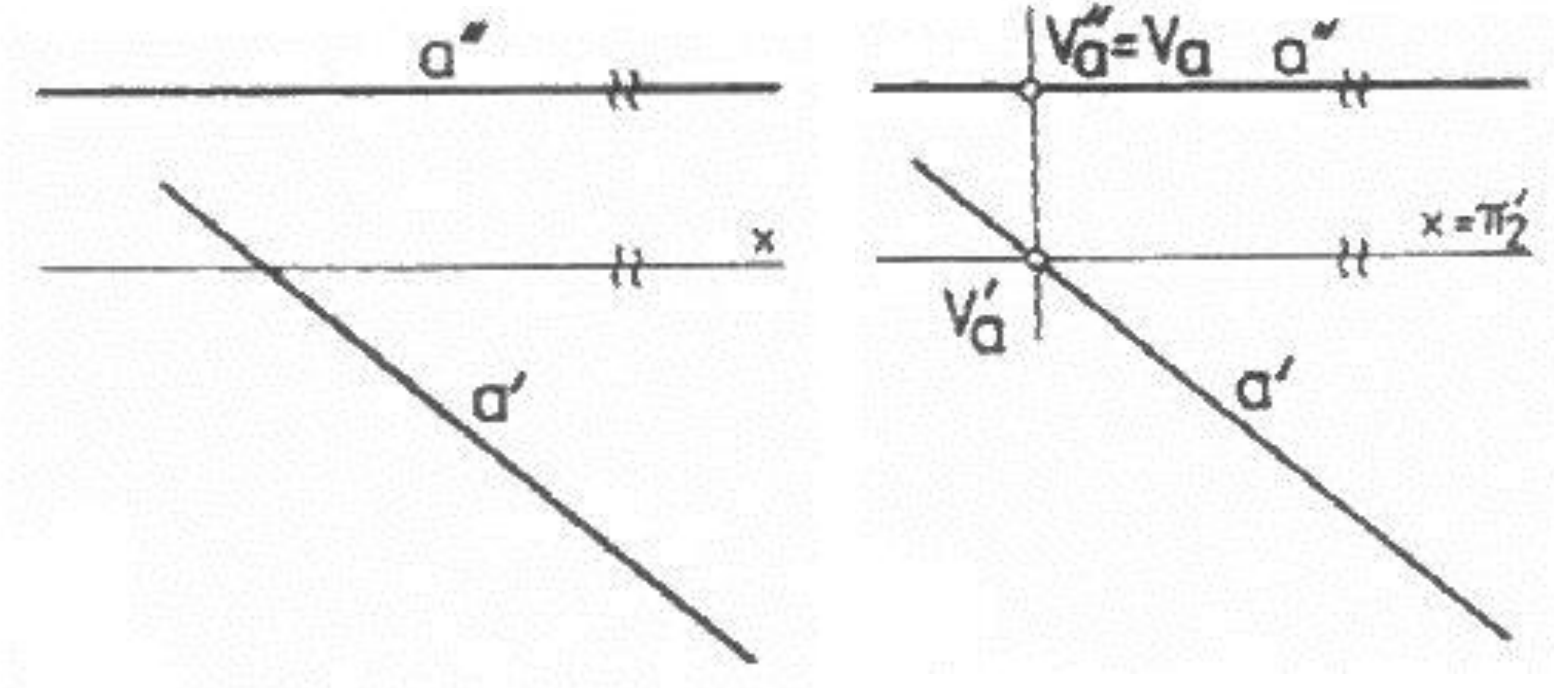
Traces of line

- trace of the horizontal straight line (a') - piercing point π1 = Ha
- trace of the straight line (a”) – piercing point π2 = Va
- trace of a straight line (a'") - piercing point π2 = Ka



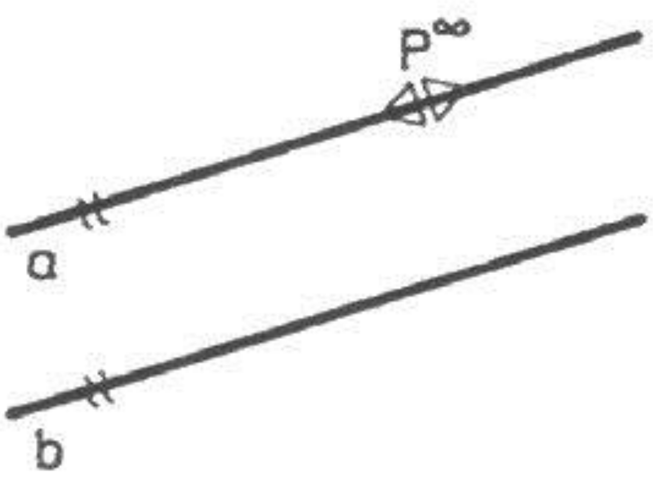
Construction of traces of a straight line in a particular position

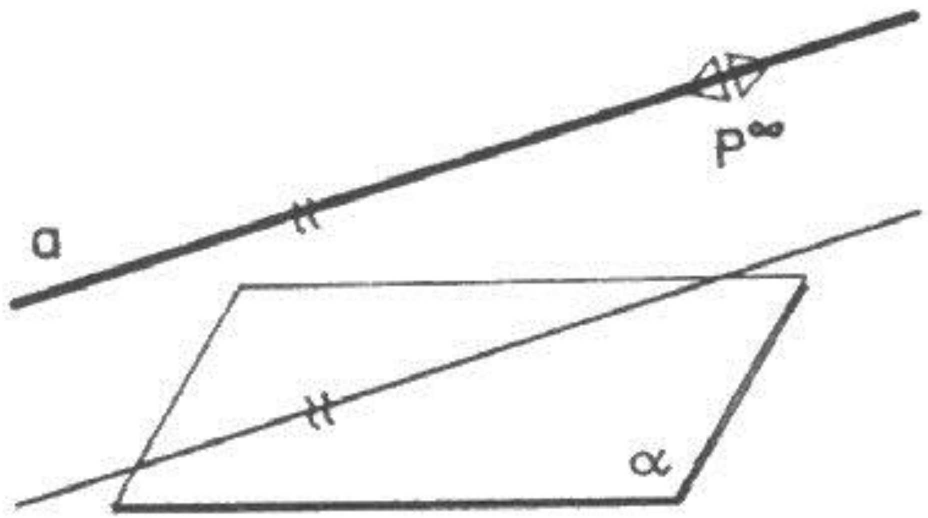
- the line a' intersects the x-axis as the horizontal projection of π2 at the point Va' (the horizontal projection of the vertical trace)



Improper items

- Cases when:
  - straight lines are parallel
  - the planes are parallel
  - the line and the plane are parallel

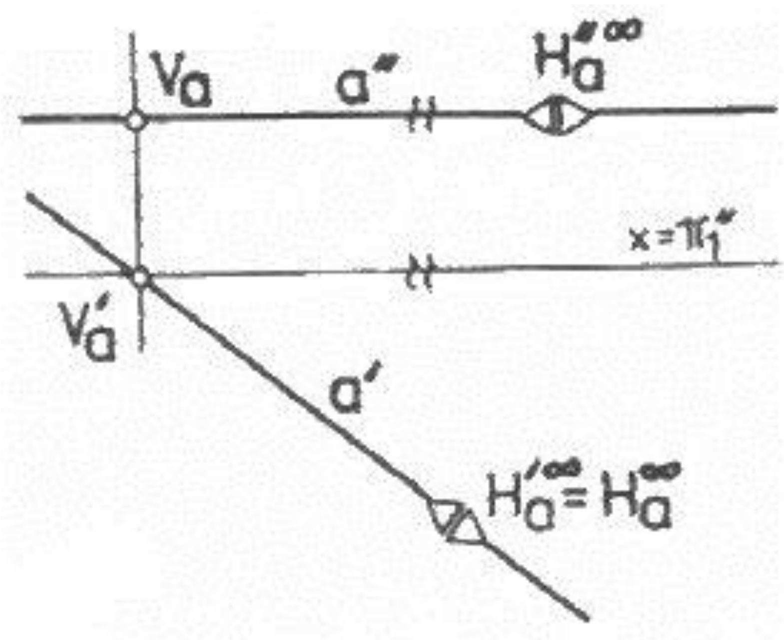


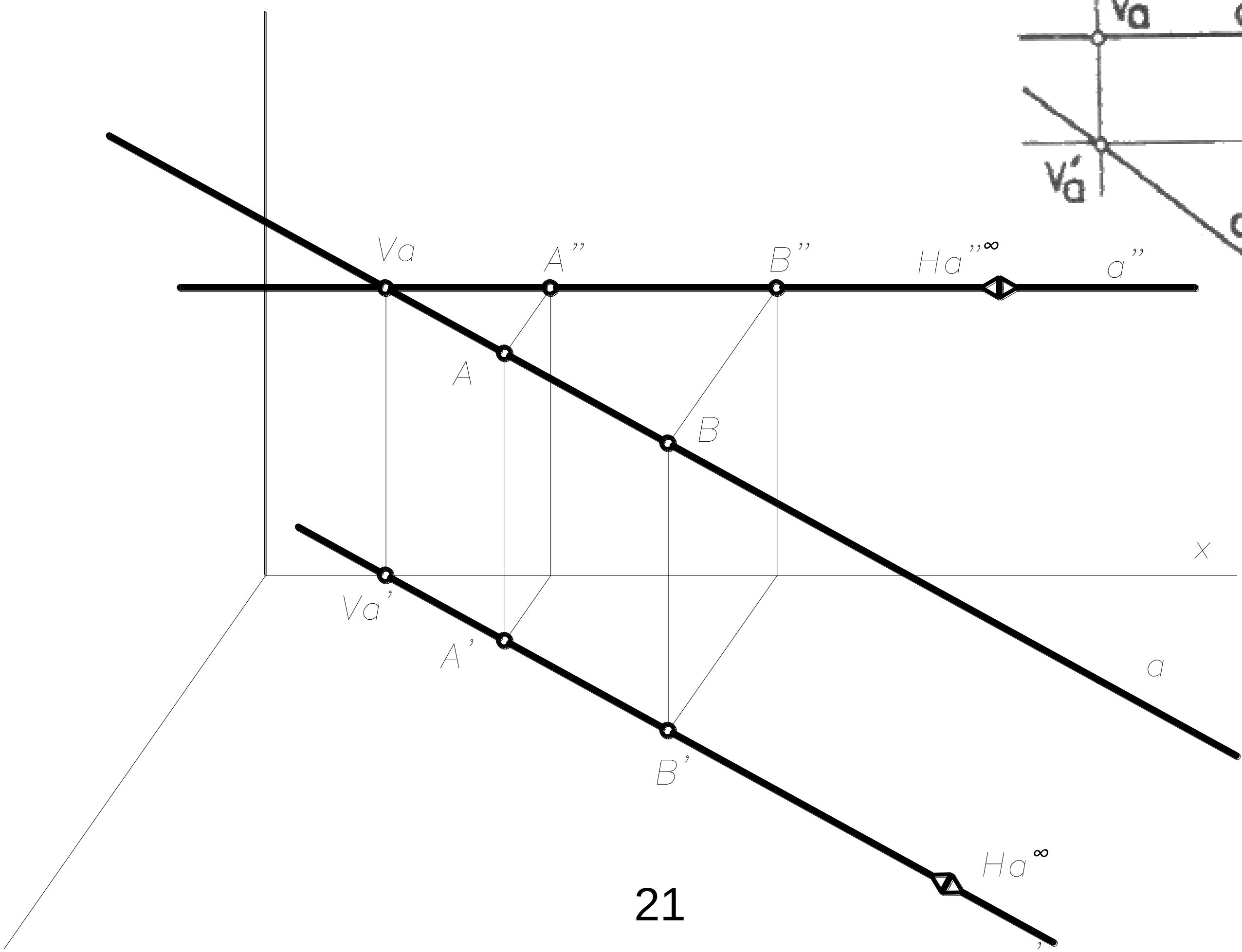


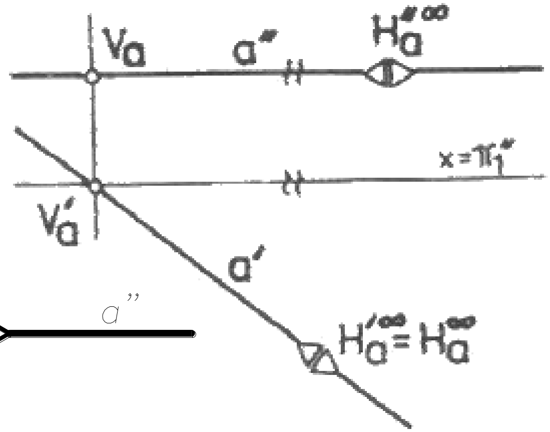
Improper items

- Then we are talking about improper elements - not taken into account by Euclidean geometry, and introduced by projective geometry.
- Inappropriate elements were introduced for the purposes of descriptive geometry to enable the preservation of spatial problem solving schemes
- We assume that mutually parallel elements are "almost parallel", i.e. that they intersect at a point that is infinitely far away

- line a" intersects the x-axis as the vertical projection of the viewport π1 at the improper point Ha"∞
- The point Ha"∞ lies "infinitely far" on the direction of line a", will intersect the horizontal projection of line a (a') at the point "infinitely far" Ha'∞ = Ha∞

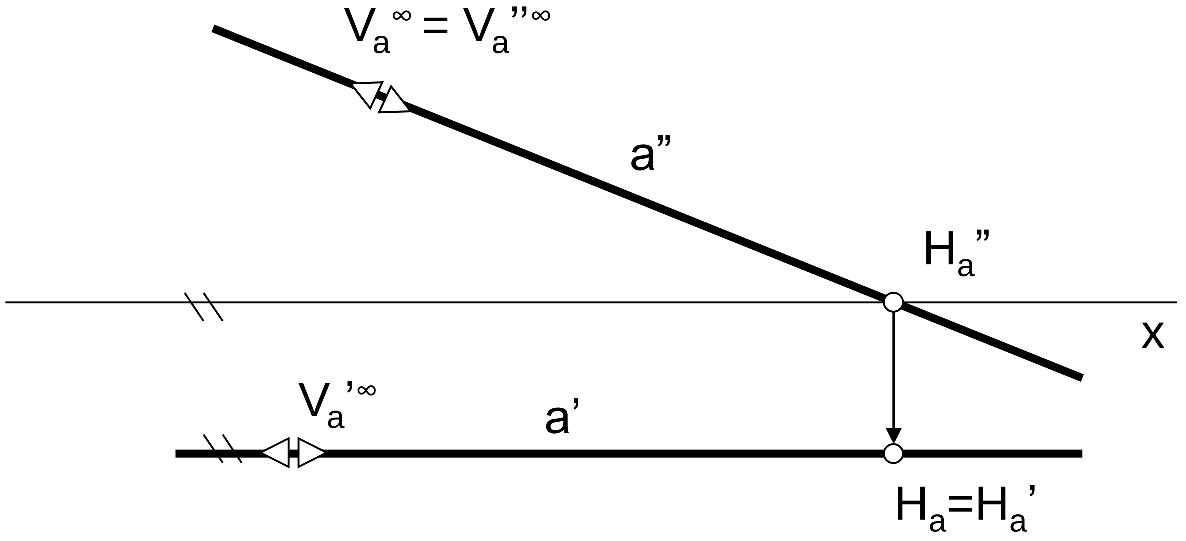



Va
A''
B''
Ha''∞
a''
A
B
x
Va'
A'
a
B'
Ha∞
a'

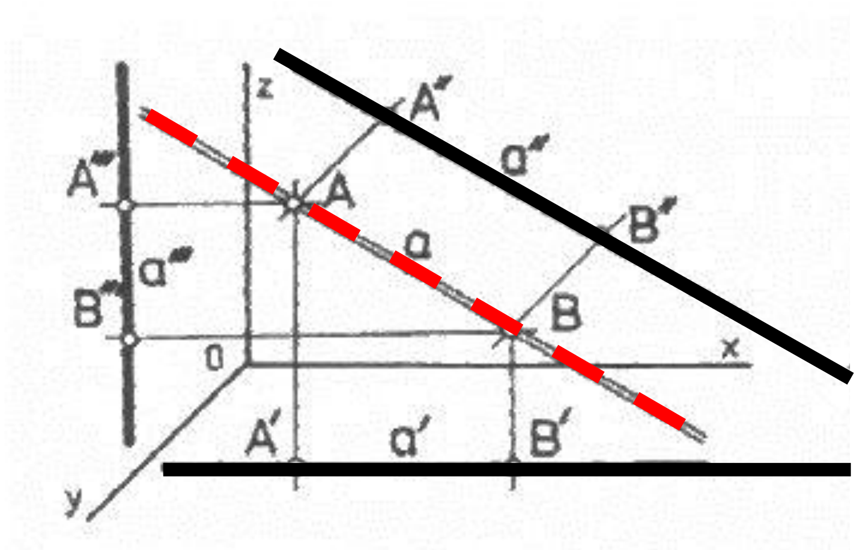

Va
a''
Ha''∞
x = π1''
Va'
a'
Ha'∞ = Ha∞

Example

- H_a, V_a = ?

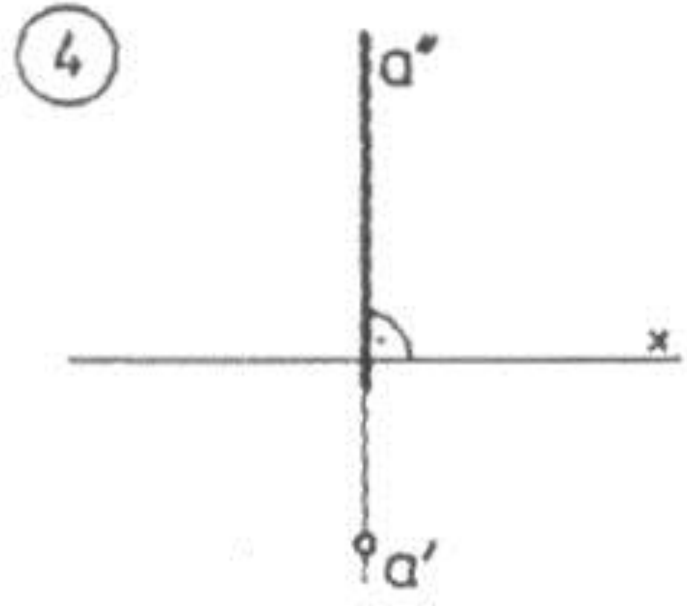


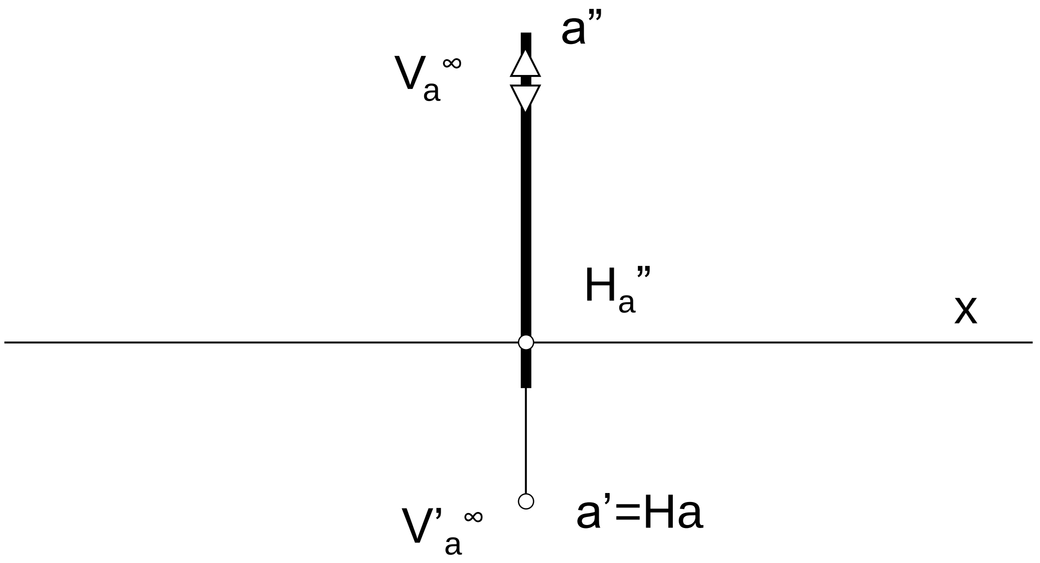
Example - view in axonometry



Example

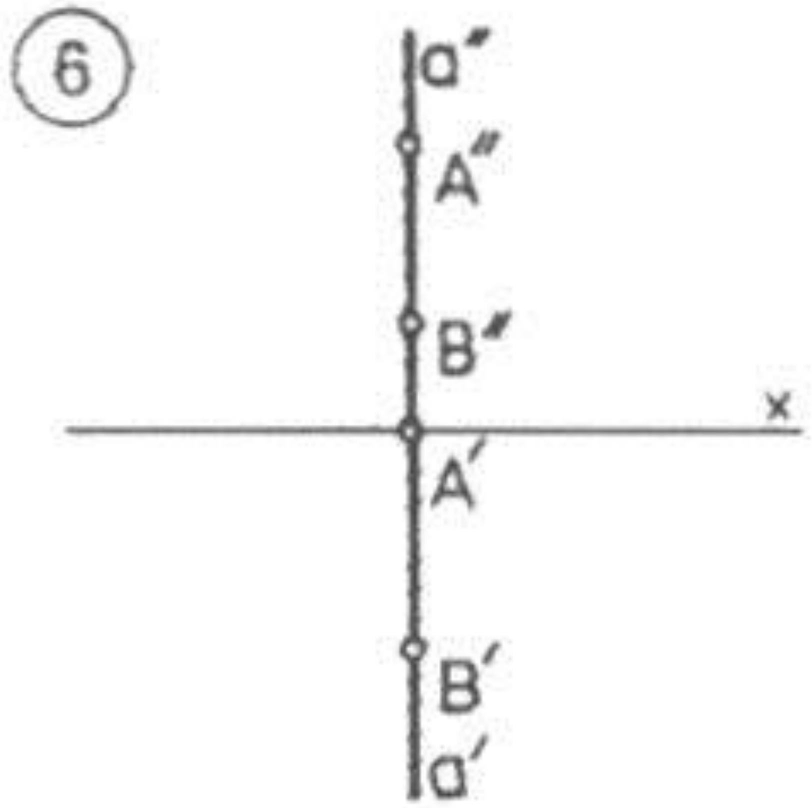
- H_a, V_a = ?

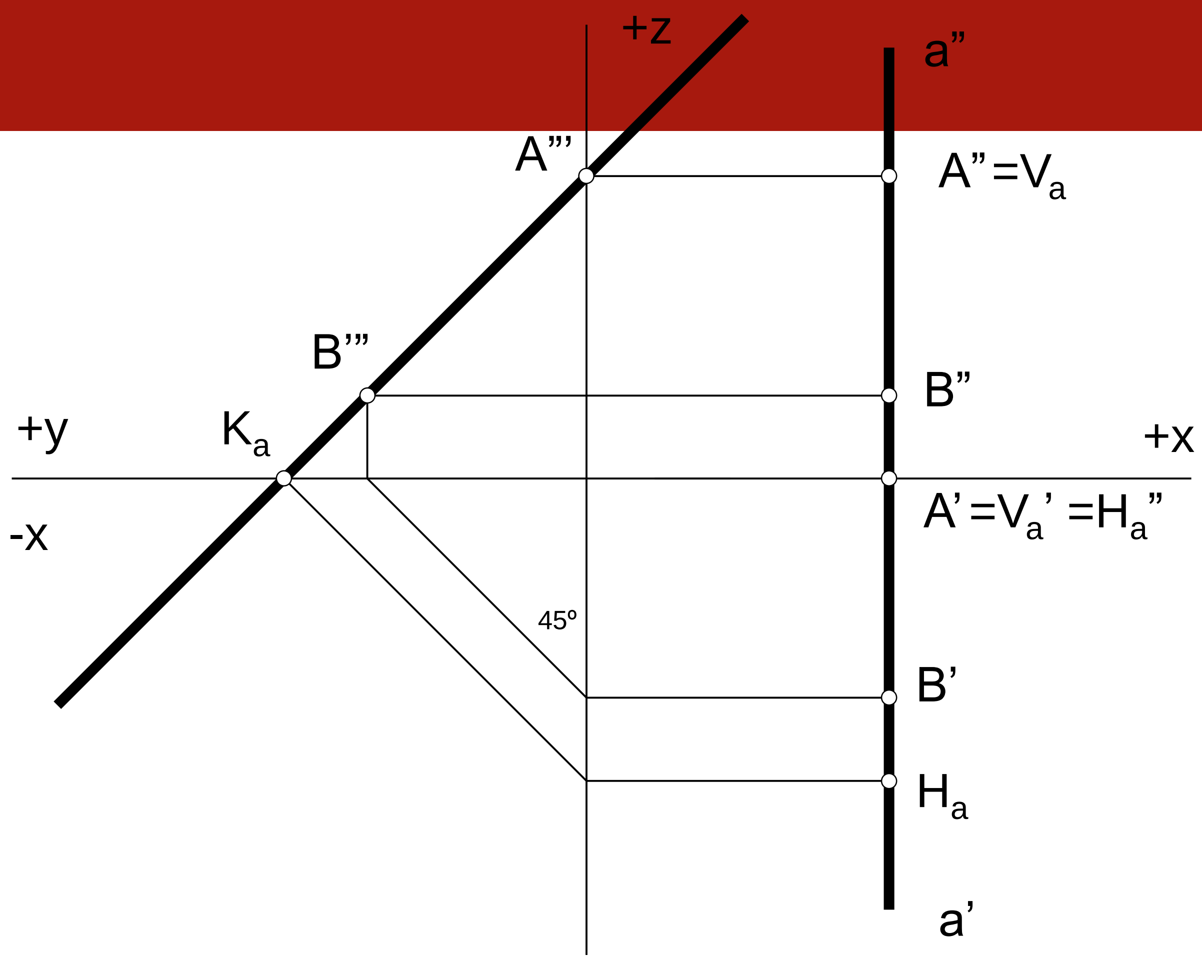



a”
V_a^∞
H_a”
x
V’_a^∞
a’=Ha

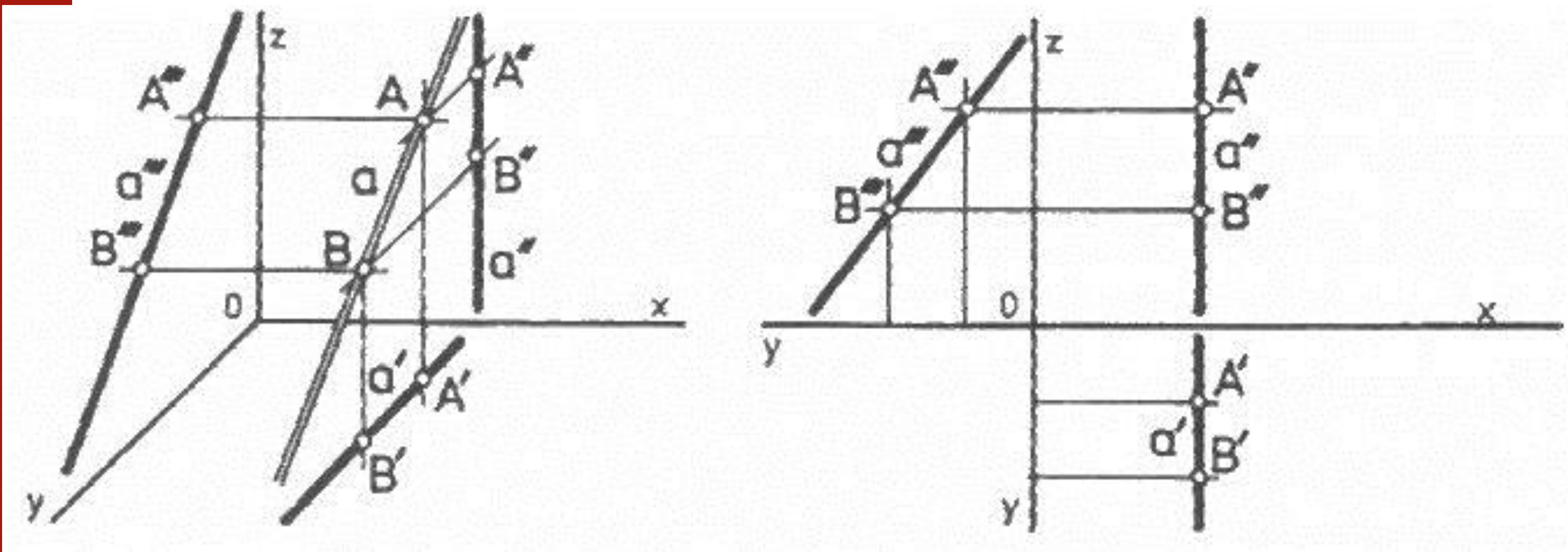
Example

- H_a, V_a = ?



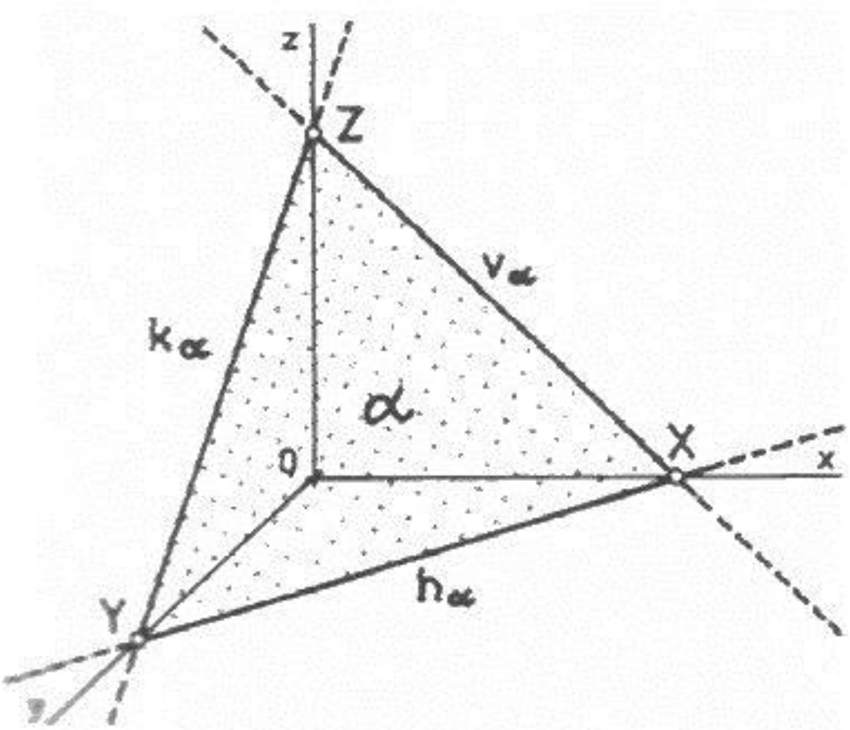

+z
a”
A’’’
A”=Va
B’’’
B”
+y
Ka
+x
-x
A’=Va’ =Ha”
45º
B’
Ha
a’

Example - view in axonometry



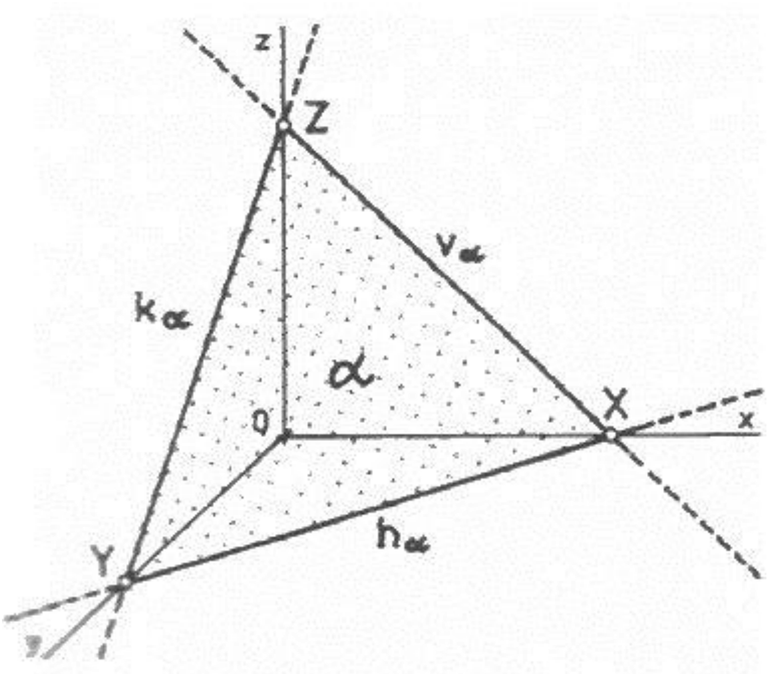
Traces of the plane

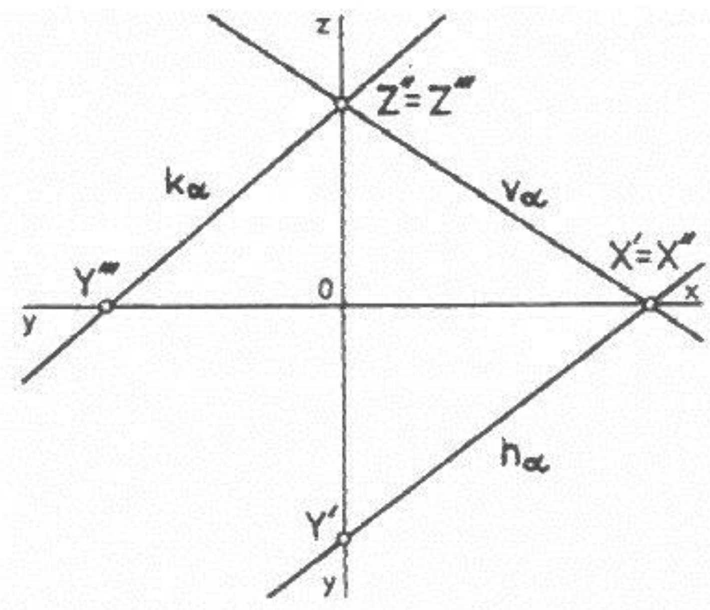
- Let's take three points X, Y, Z defining an arbitrary plane on the axes x, y, z of the reference system. The pairs of points X and Y, X and Z, Y and Z belong simultaneously to the plane α and subsequent projection planes - thus determining the traces of the plane α in the proj. planes



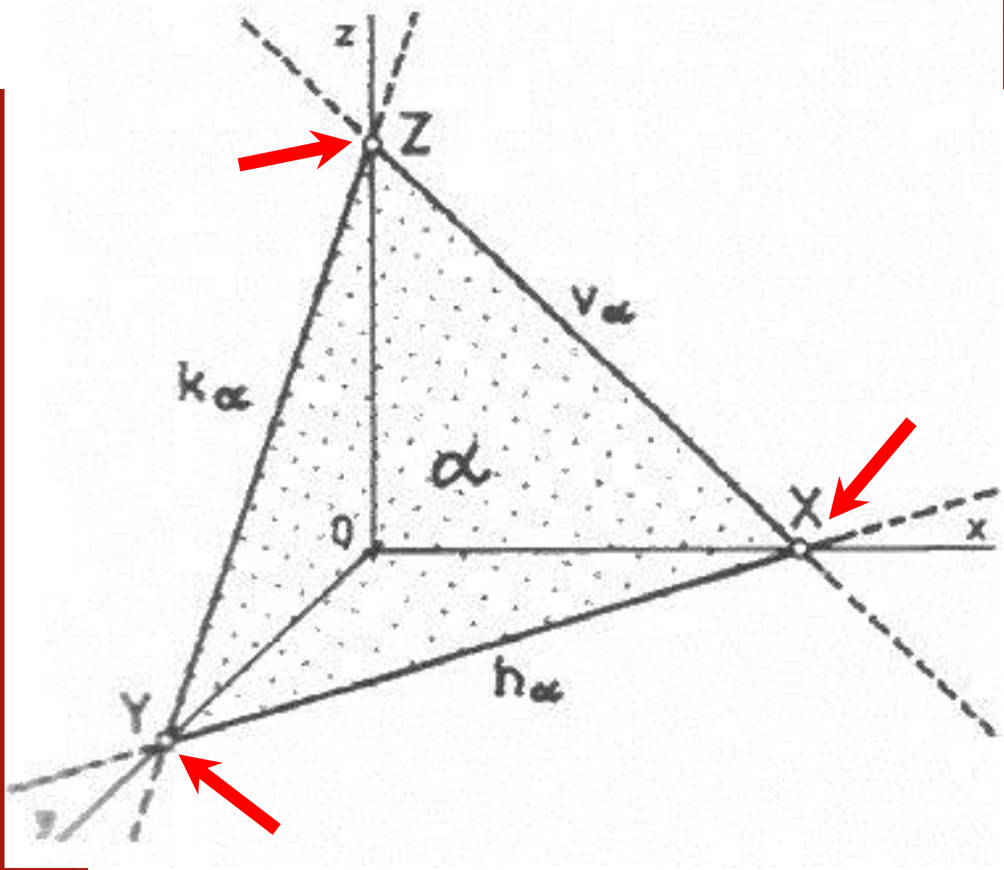
Traces of the plane

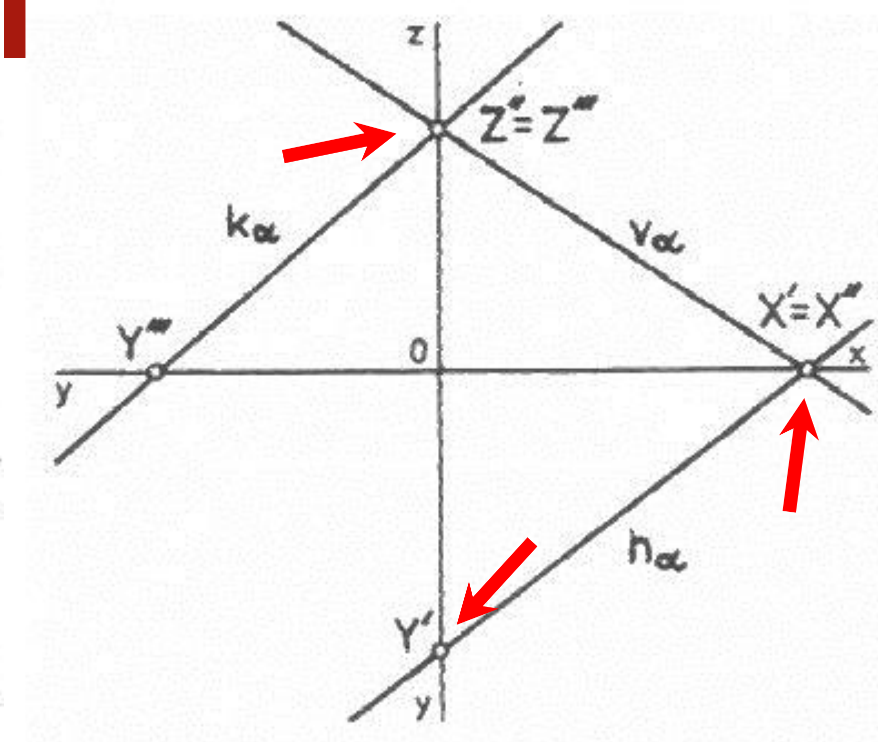
- horizontal trace of the plane - straight line - intersection of the planes α and π1 = hα
- vertical trace of the plane - straight line - common part of the plane α and π2 = vα
- trace of the plane - straight line - common part of the plane α and π3 = kα





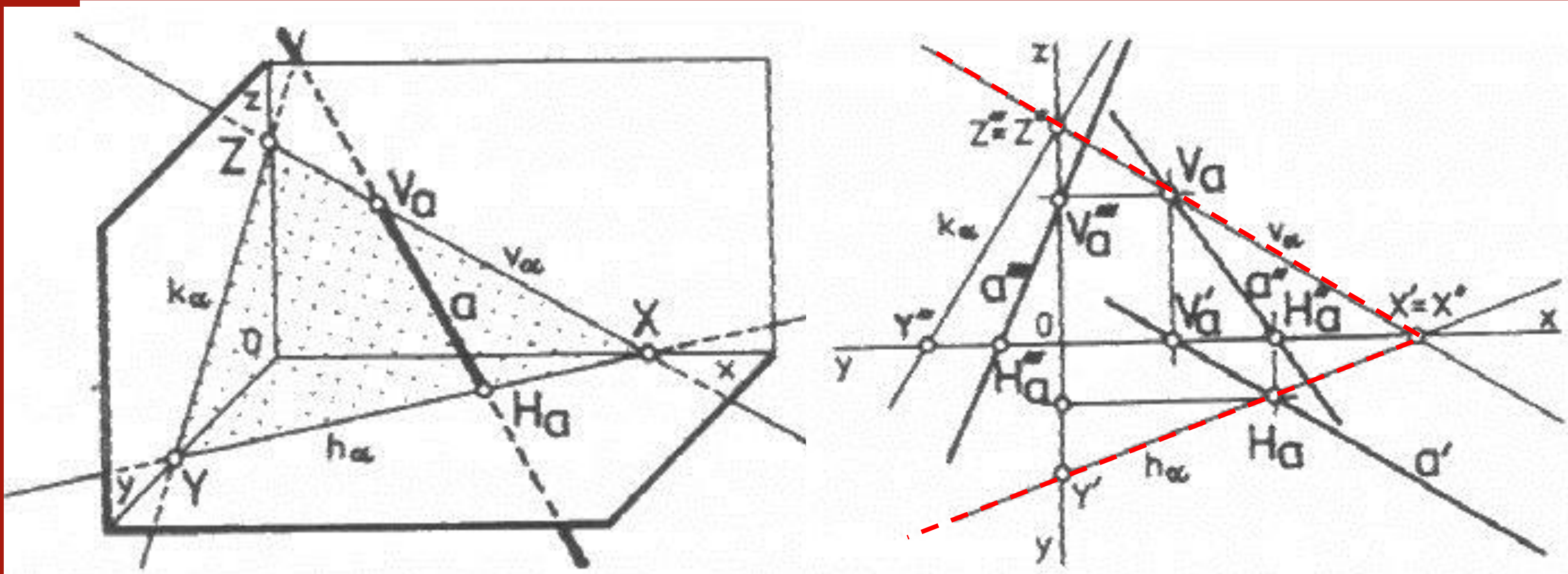
punkty węzłowe





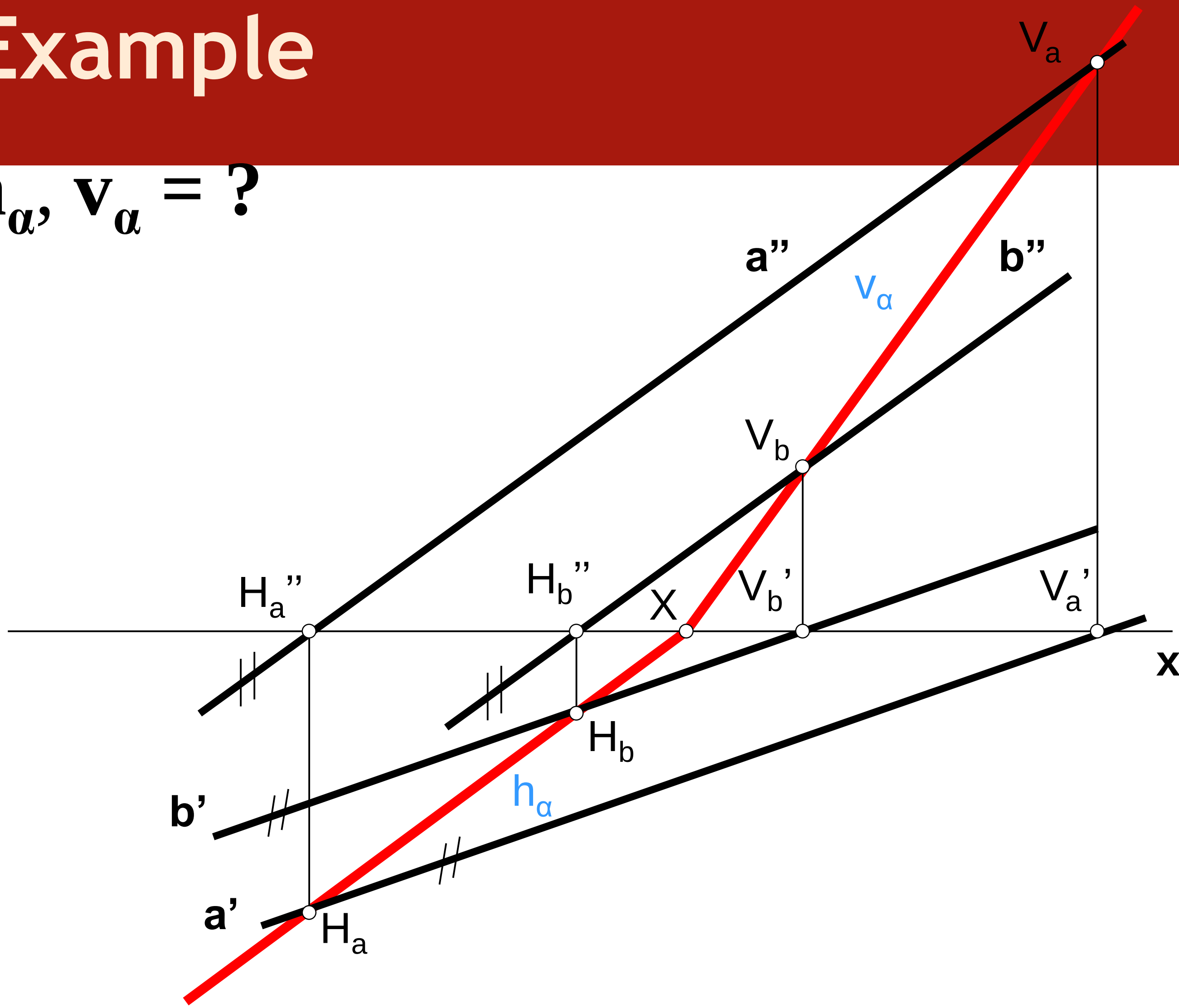
Determination of traces of a plane defined by points and lines

- "If the line **a** belongs to the plane α defined by traces, then the traces of this line (points) lie on the corresponding traces of the plane (lines)„
- Knowing the traces of lines belonging to the plane α, we can unambiguously determine the traces of this plane


z
Z
Va
vα
kα
a
0
X
x
Ha
hα
y
Y
z
Va
kα
vα
a
0
x
y
Ha
hα
a'
Y'
y

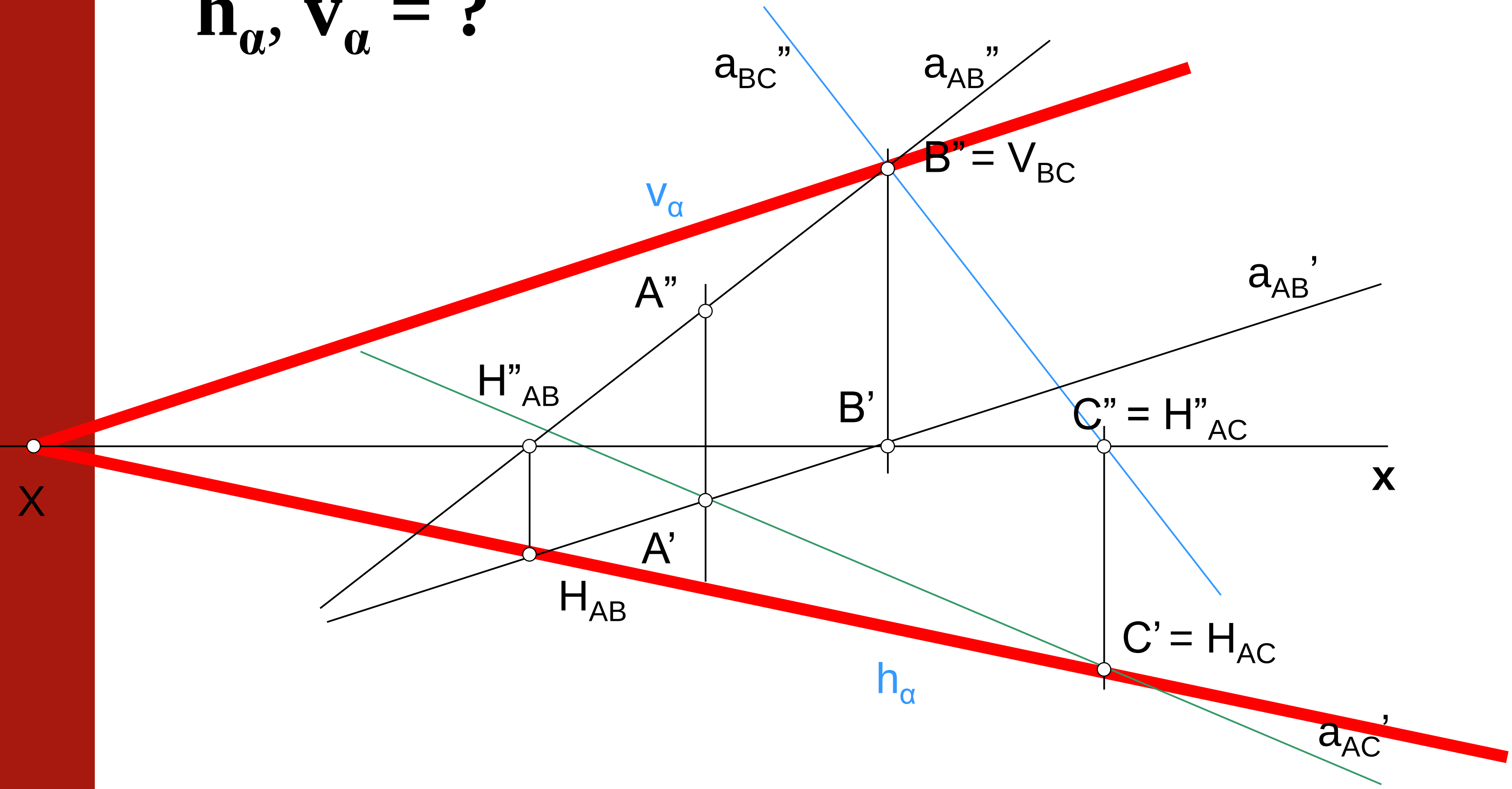
Example

$h_\alpha, v_\alpha = ?$



Example

$h_\alpha, v_\alpha = ?$

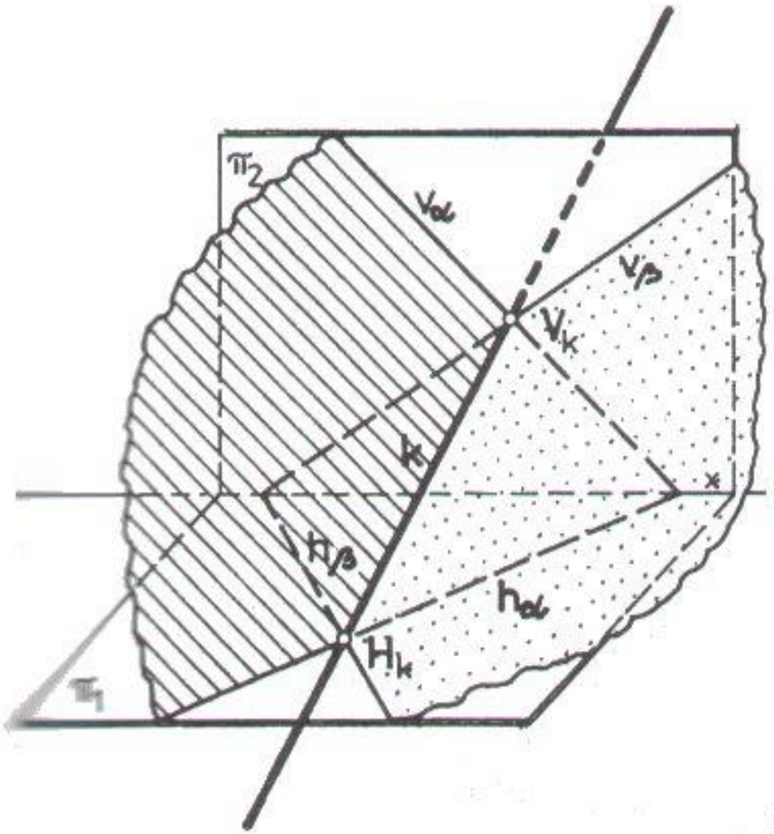


Associated elements

- Common edge (intersection) of two planes ($\alpha \cap \beta = k$)
- Piercing point of a straight line ($a \cap \alpha = P$)

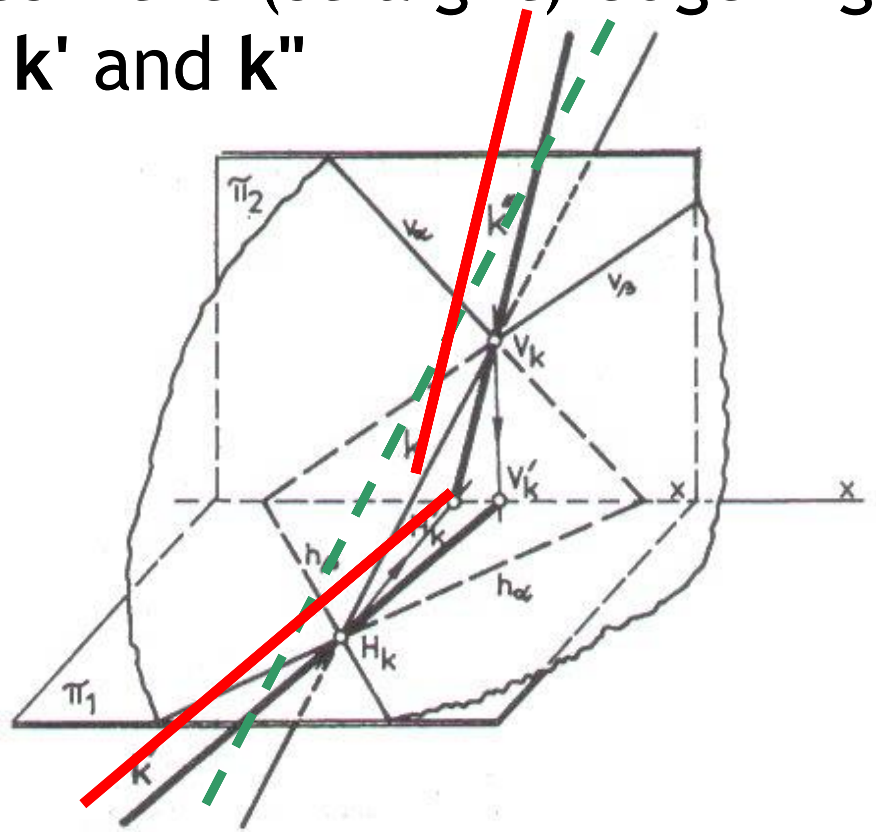
Common edge of two planes

- The horizontal traces hα and hβ of the planes intersect at the point Hk
- The vertical traces vα and vβ of the planes intersect at the point Vk



Common edge of two planes

- The points Hk and Vk determine the intersection of the planes - the (straight) edge **k** given by projections **k'** and **k"**



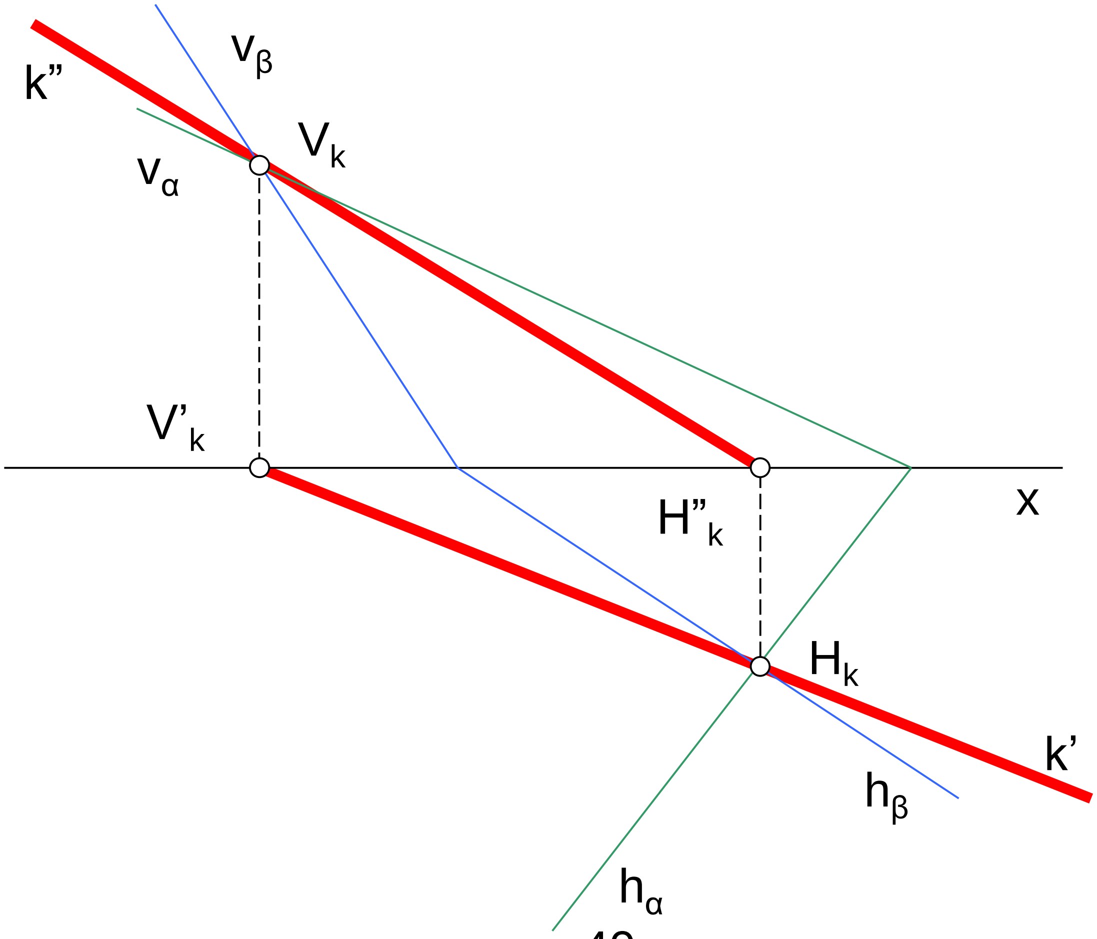
Common edge of two planes

To specify edge k in projections:

- define the horizontal and vertical projection of the Hk point (horizontal trace of the intersection edge)
- define the horizontal and vertical projection of the point Vk (vertical trace of the intersection edge)

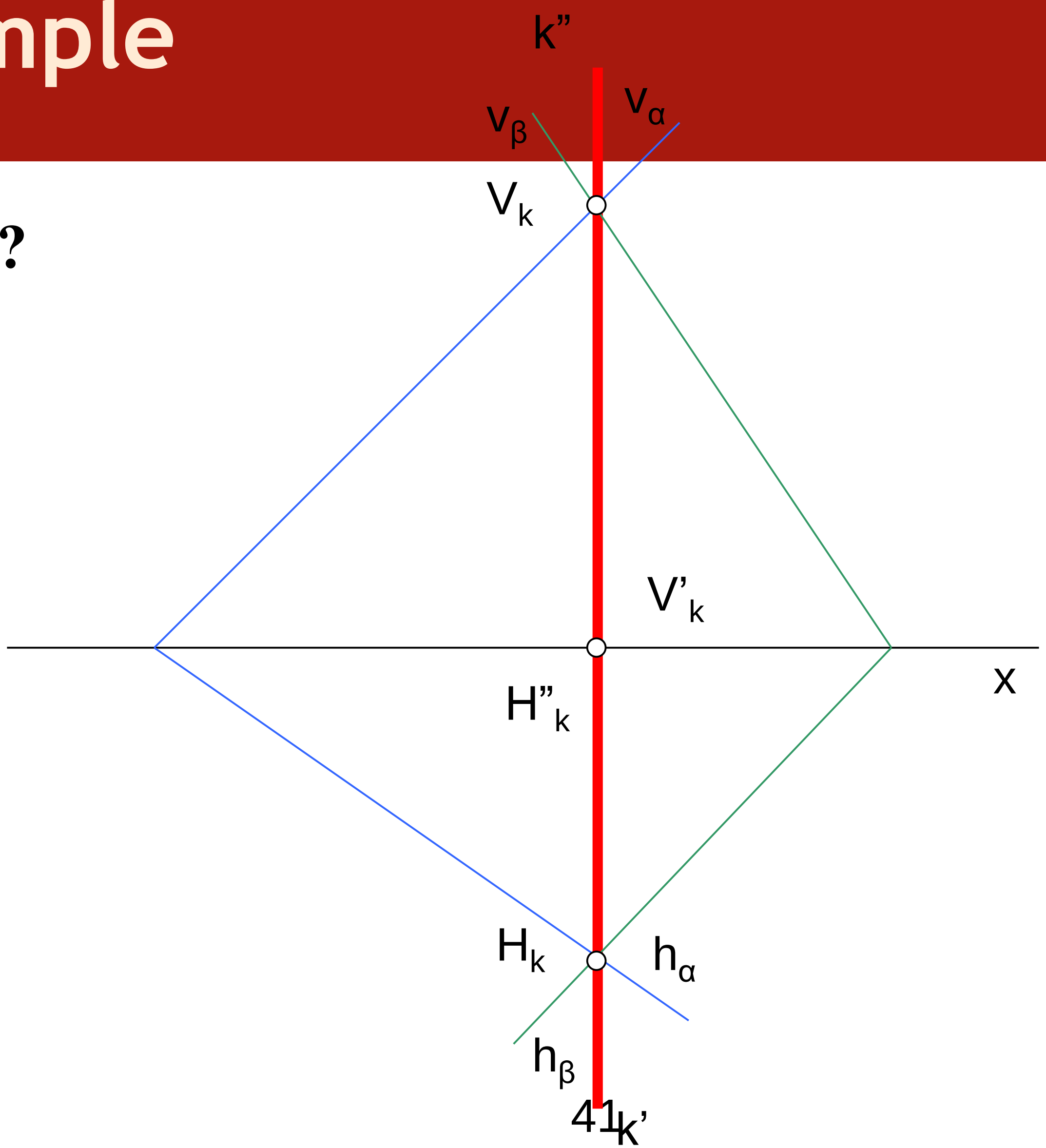
Example

k’, k”=?



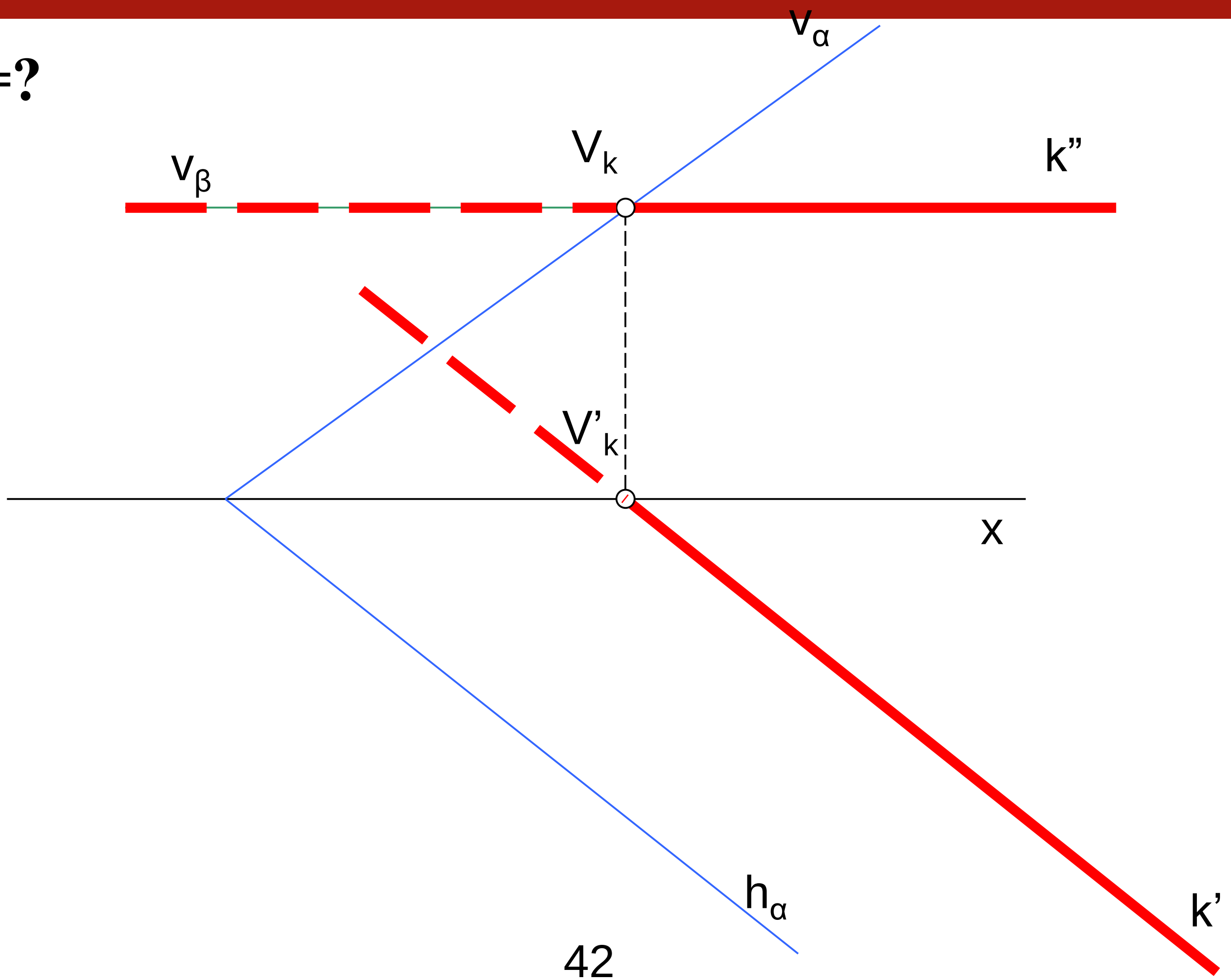
Example

k’, k”=?



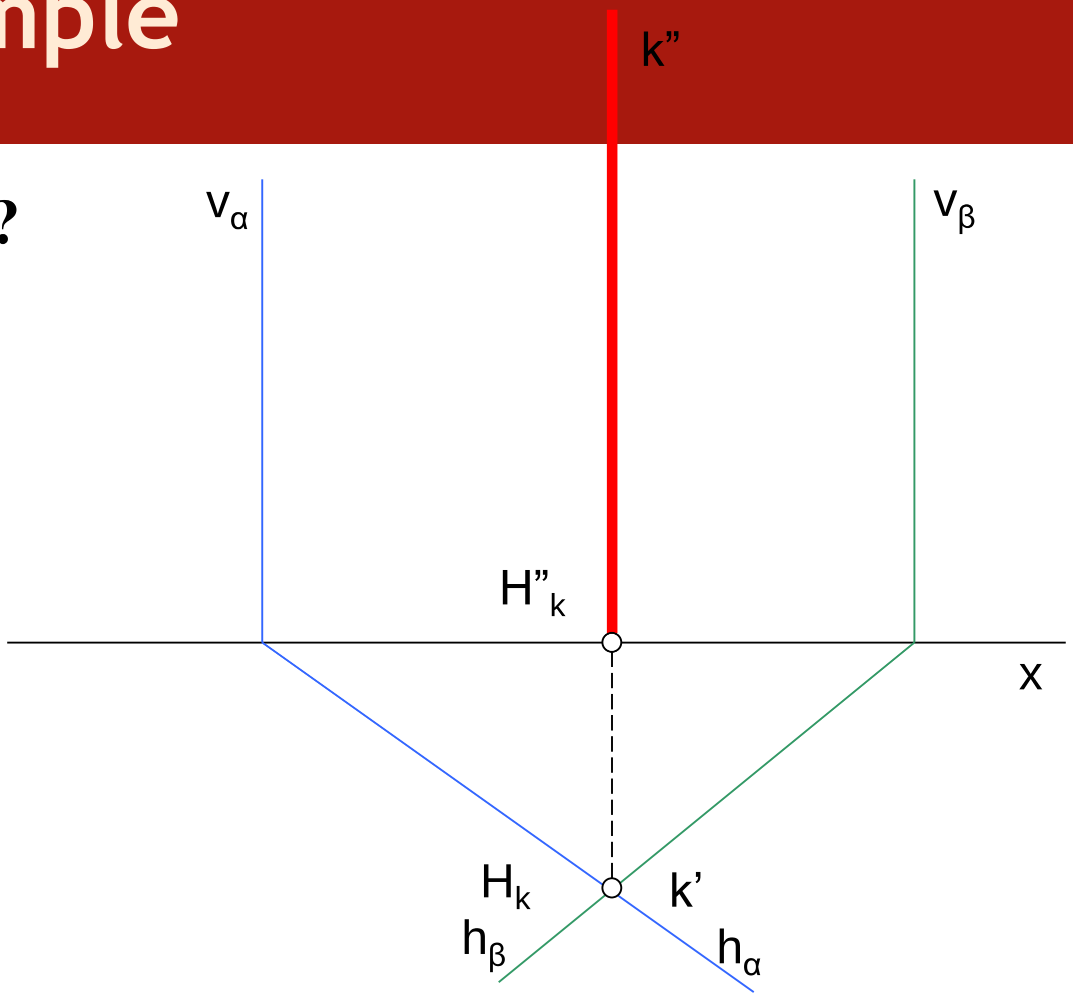
Example

k’, k”=?



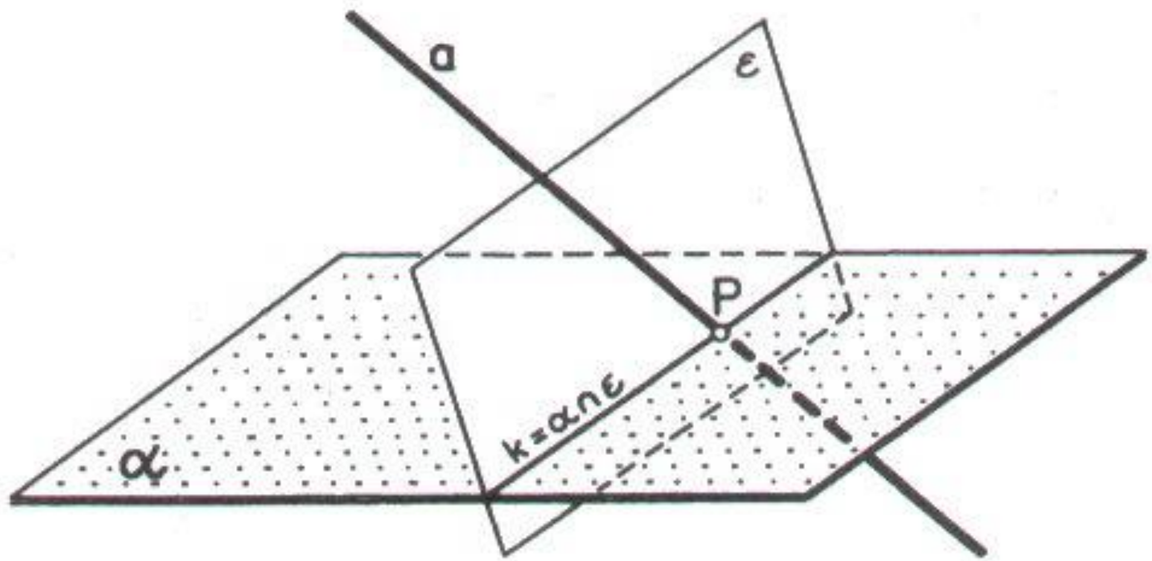
Example

k’, k”=?



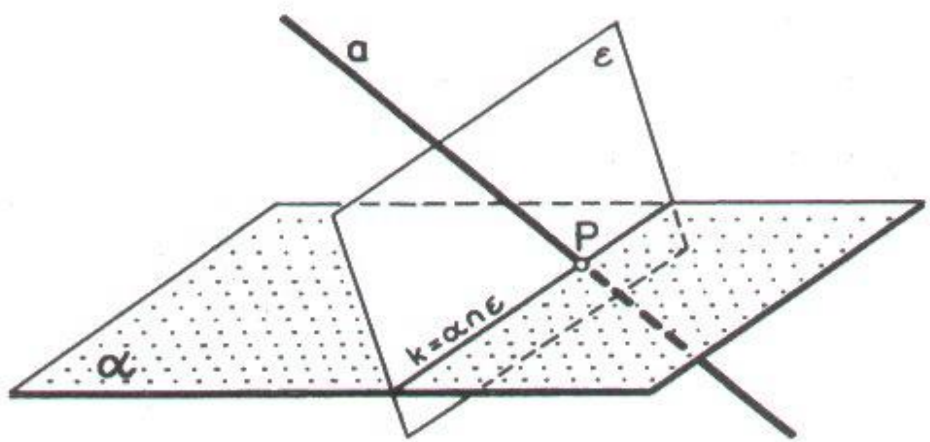
Piercing point of a straight line through a plane

- Piercing point ($a \cap \alpha = P$)

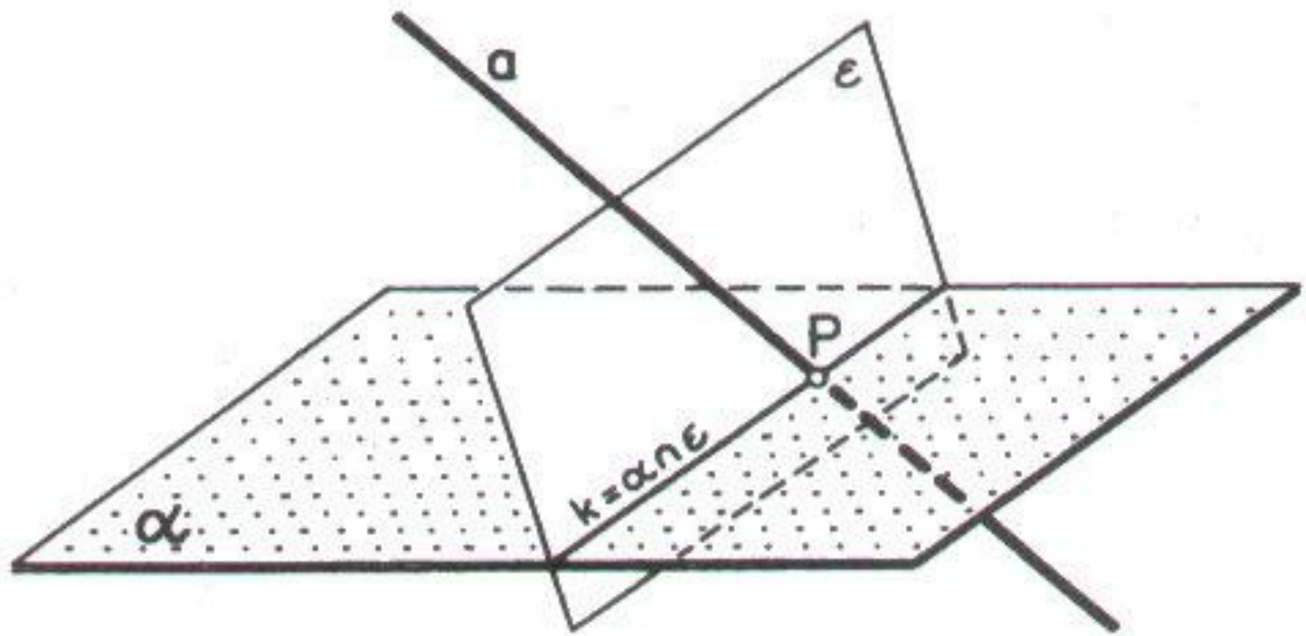


Piercing point of a straight line through a plane

The procedure for searching for the piercing point of a straight line: we determine the auxiliary plane ε passing through the line **a** we find the edge (k) common to the planes a and ε (a ∩ ε = k)

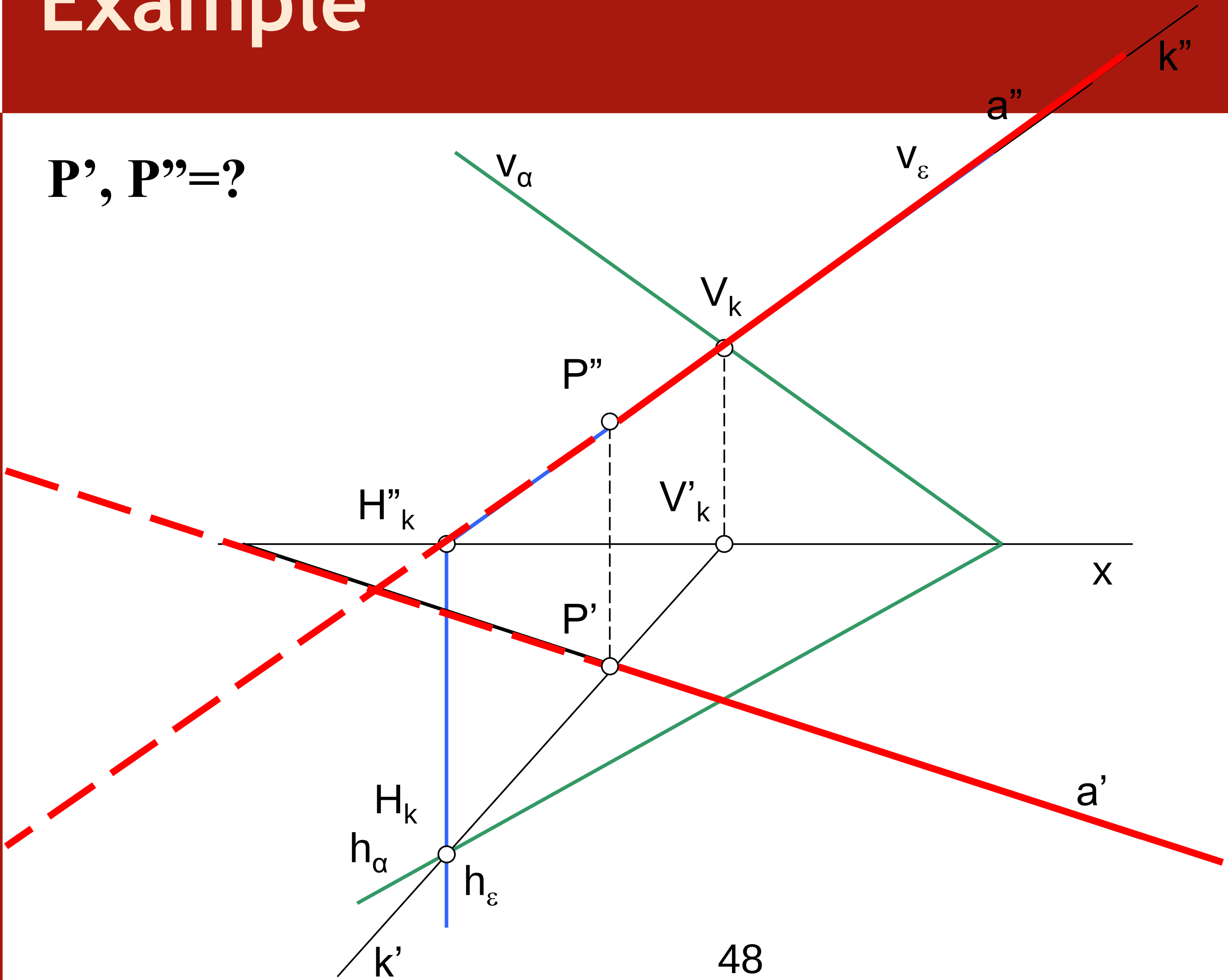


Since line **a** lies on plane ε and line k lies on plane, so these lines will intersect at point P, which is the intersection point of plane **a**



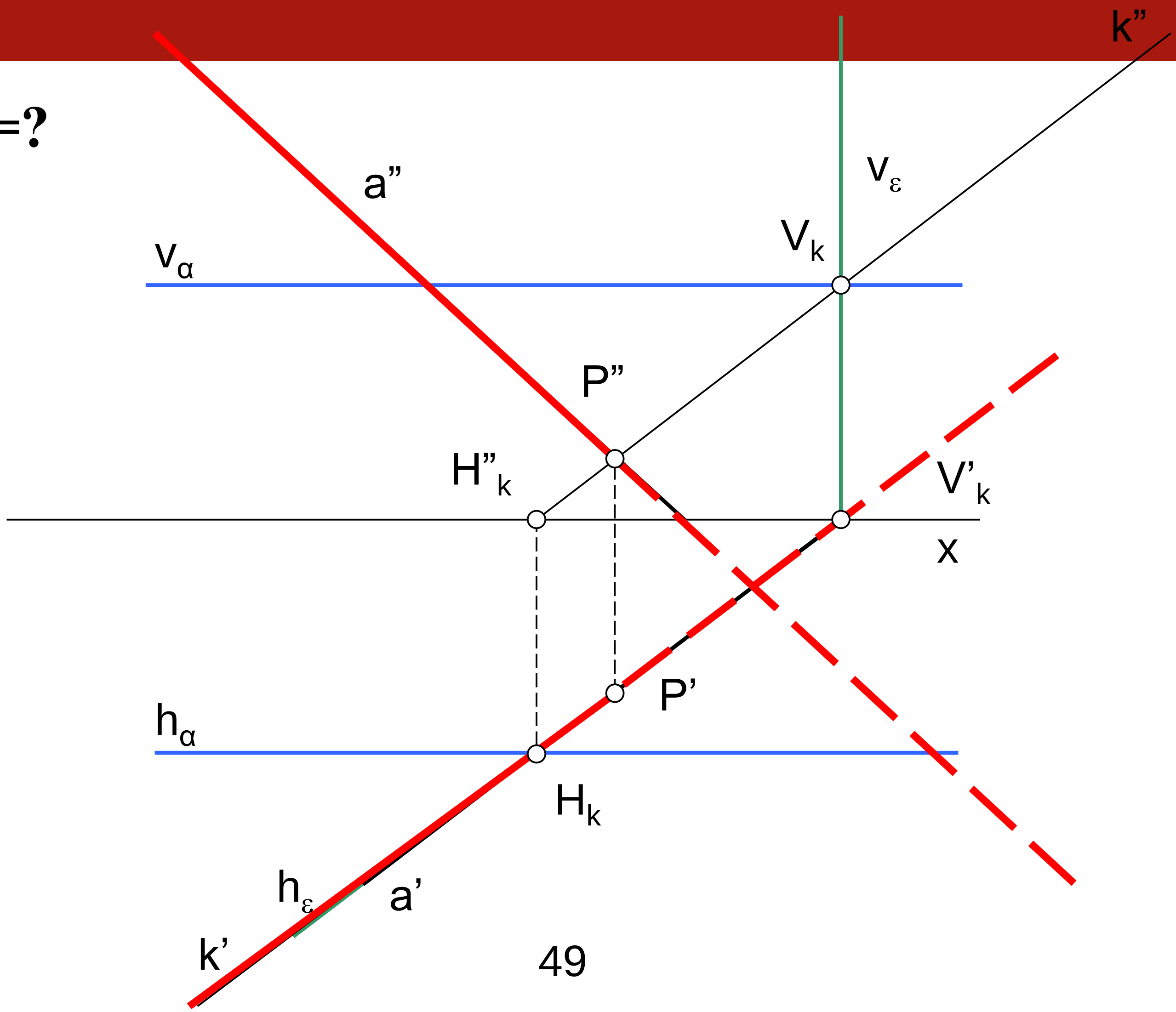
Example

P', P''=?



Example

P’, P”=?



Homework

2/1

- Find traces of line *a*, *Ha*, *Va* = ?
- Find traces of plane α, h_α, v_α = ?

2/2

- Find intersection between planes *α* and *β*
- Find piercing point of plane *α* by line ***a***