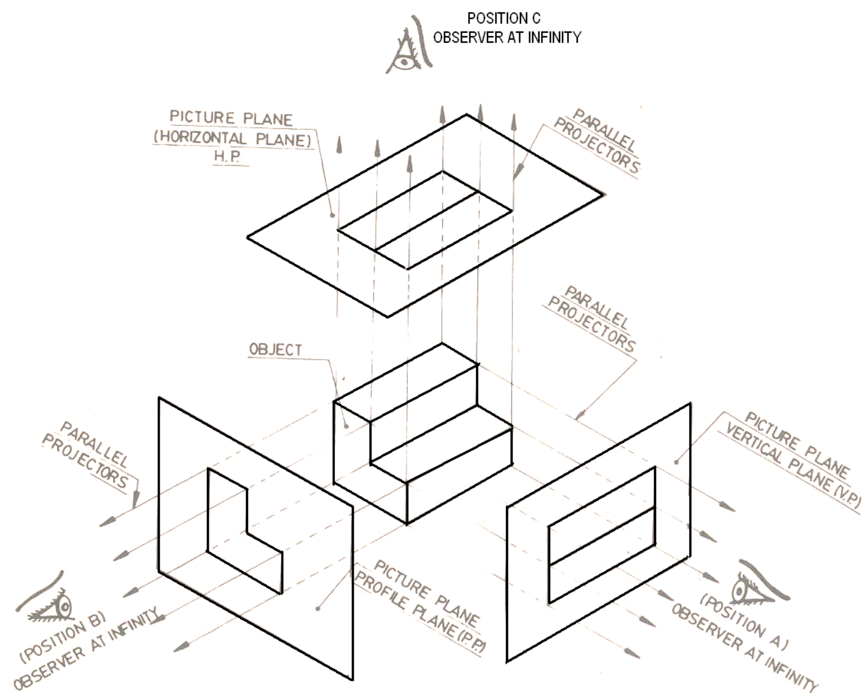
Technical Drawing in Engineering

Lecture 2. Orthographic Projection:
Basic concepts

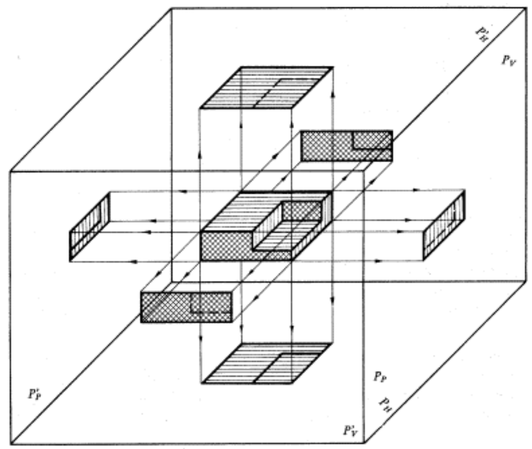
What is Orthographic Projection

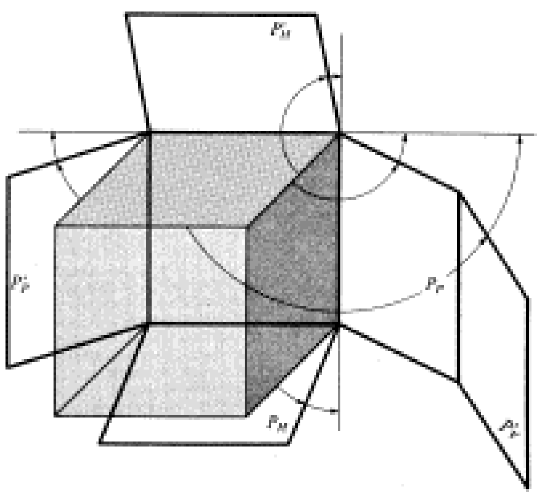
- Orthographic means straight projection.
- It stands for the projection of the shadow of the object on a plane.

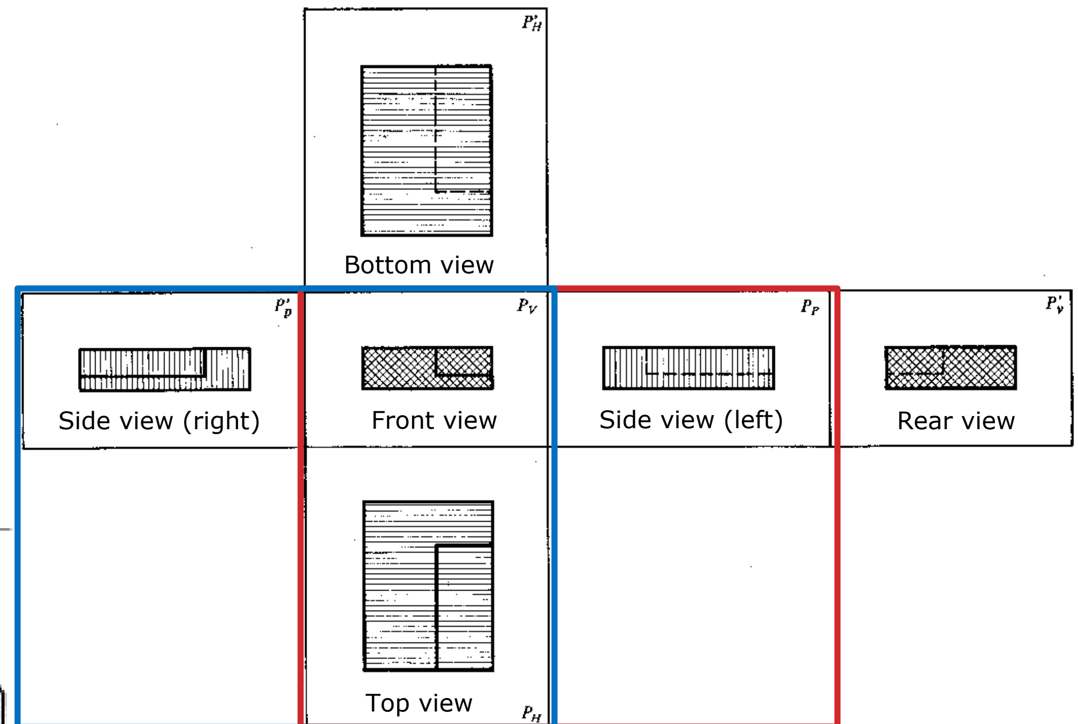


Basic concepts I

- **European system**

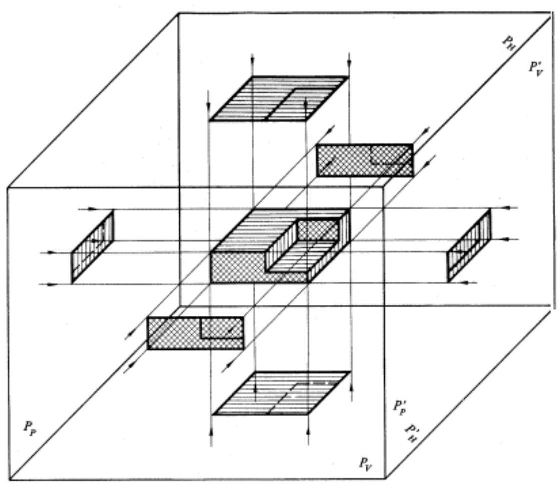


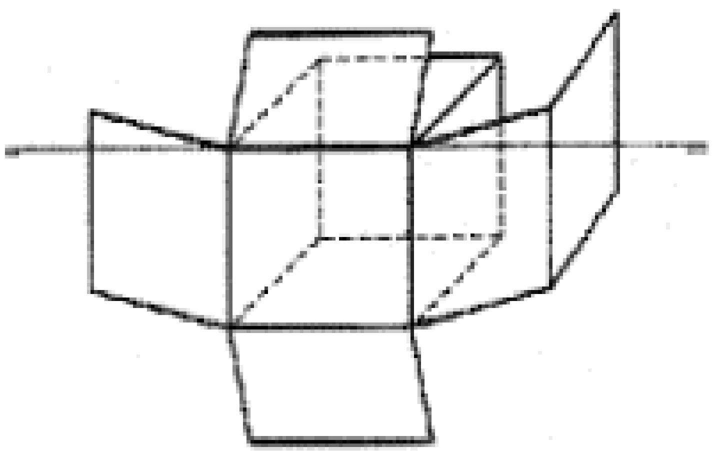




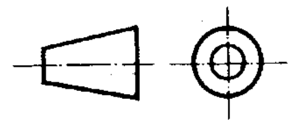
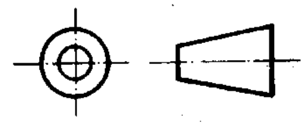
Basic concepts II

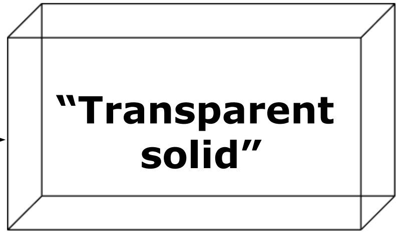
- **American system**



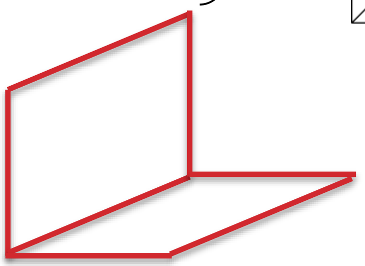


Basic concepts III

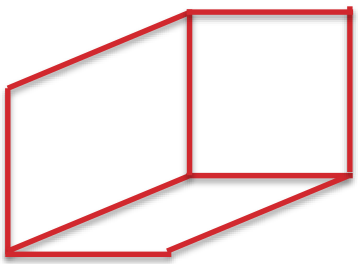
- **European system** ⇨ 
- **American system** ⇨ 

Solids in O.P. → **Edges** → **Visible and hidden lines** → 

- **To represent simple objects:**
  2 projection planes



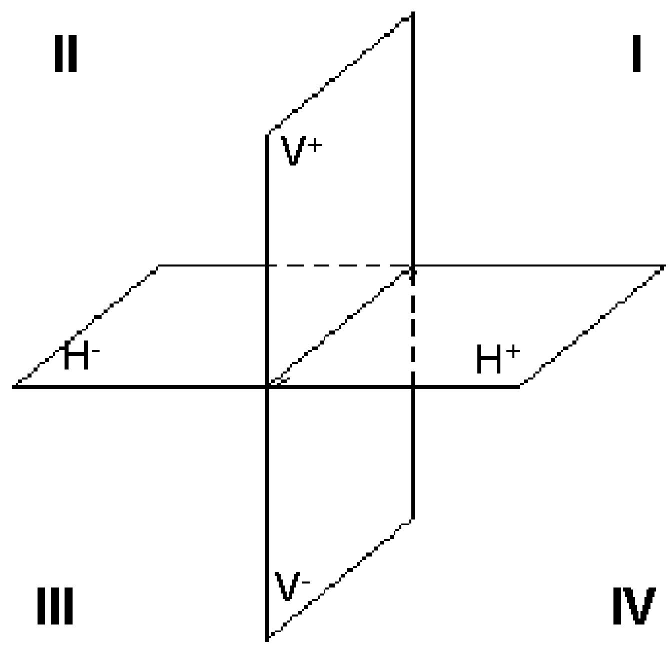
- **To represent complicated object:**
  3 projection planes

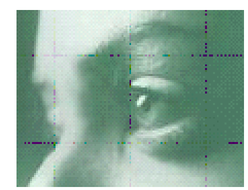


Basic concepts IV

- Double orthogonal projection in two perpendicular planes called **vertical** and **horizontal projection planes**.

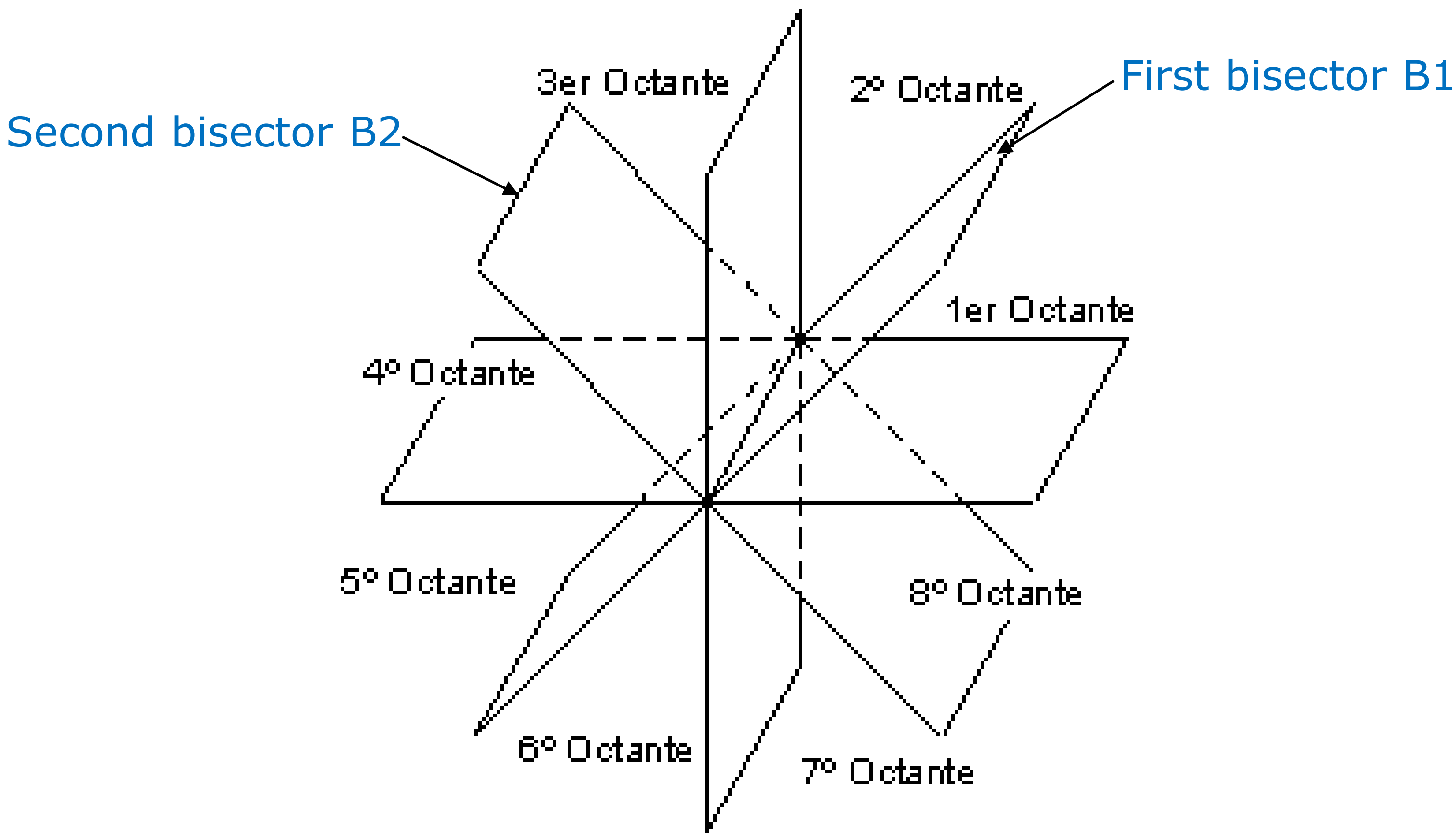
- Division by quadrants:
  - 4 quadrants with the following projection planes:
    - 1^{st} quadrant: V+ H+
    - 2^{nd} quadrant: V+ H-
    - 3^{rd} quadrant: V- H-
    - 4^{th} quadrant: V- H+



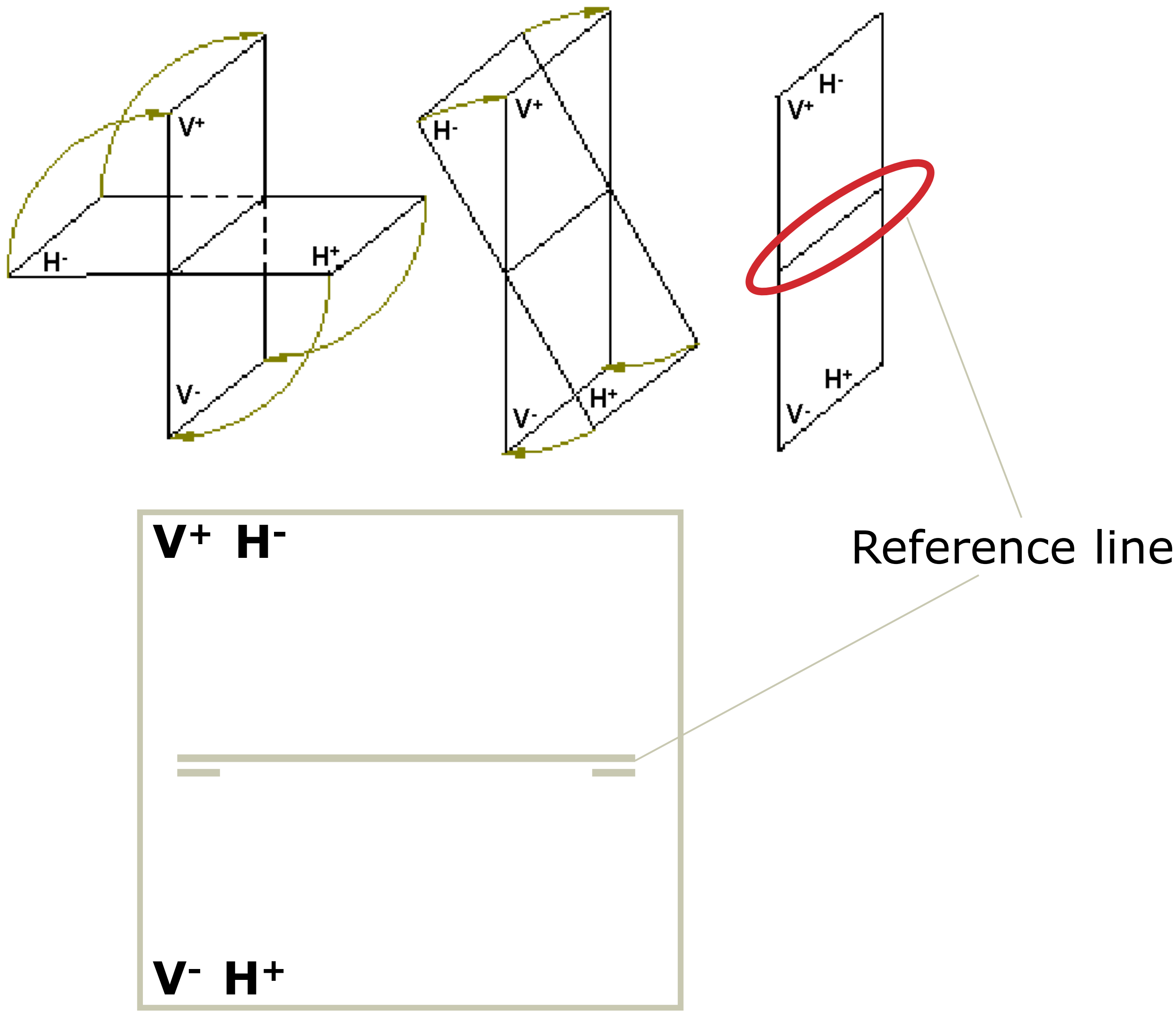


Basic concepts V

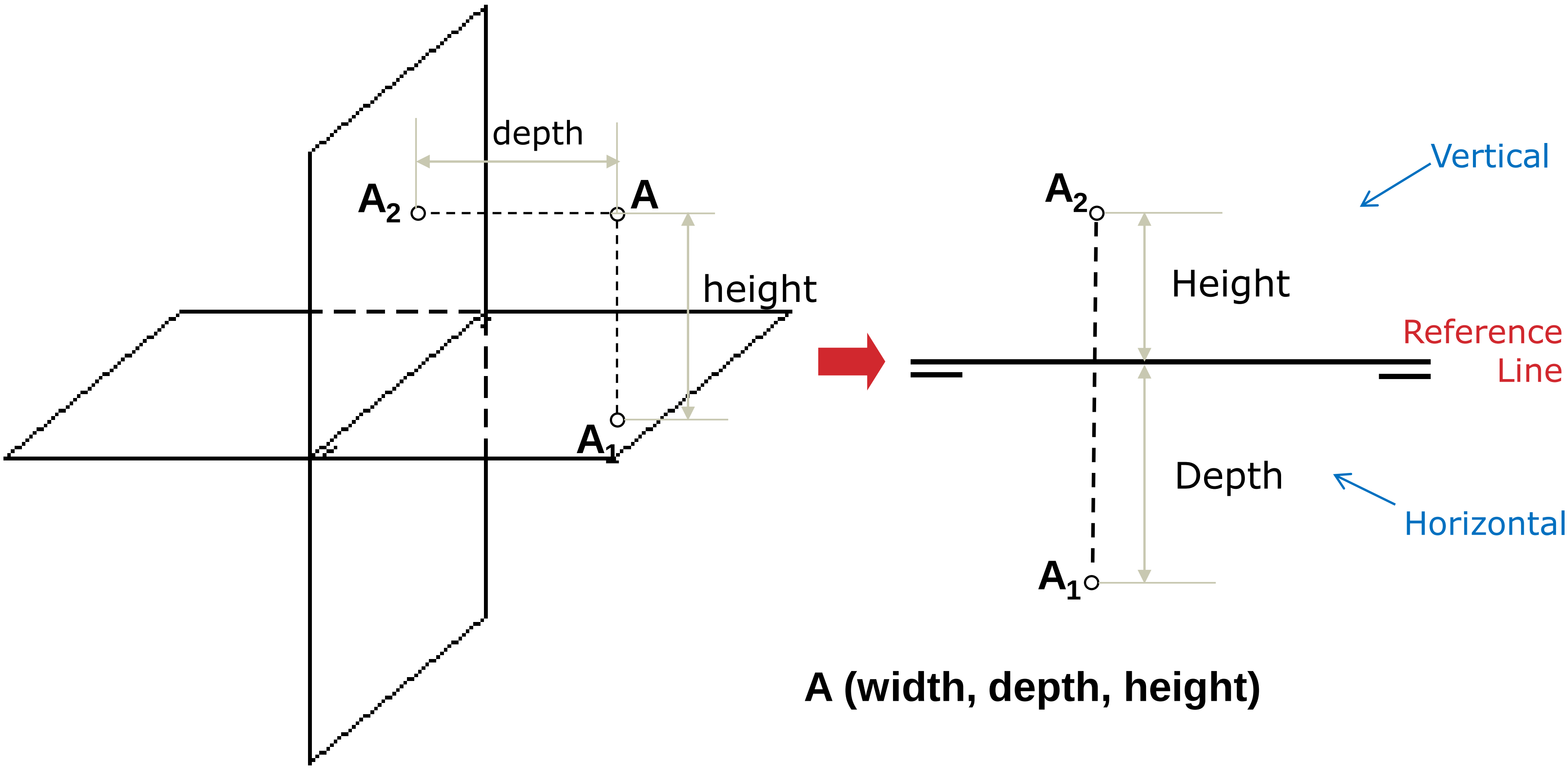
- 2 bisectors + 8 octants



Basic concepts VI



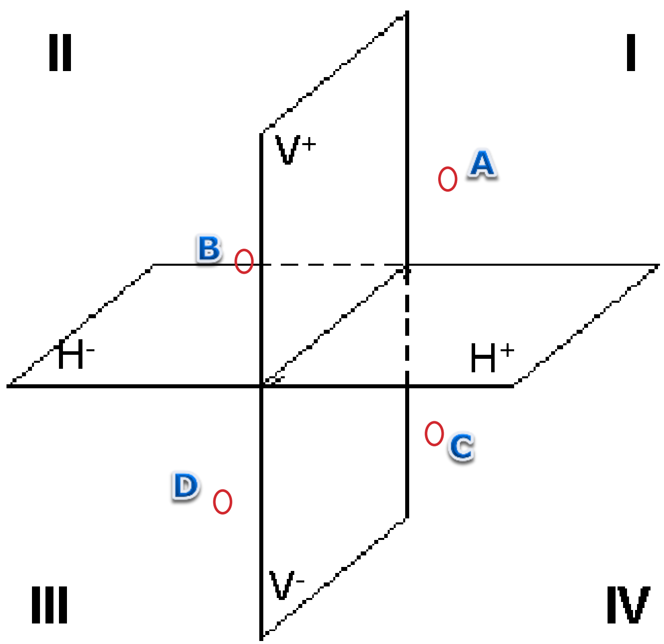
Representation of a point I

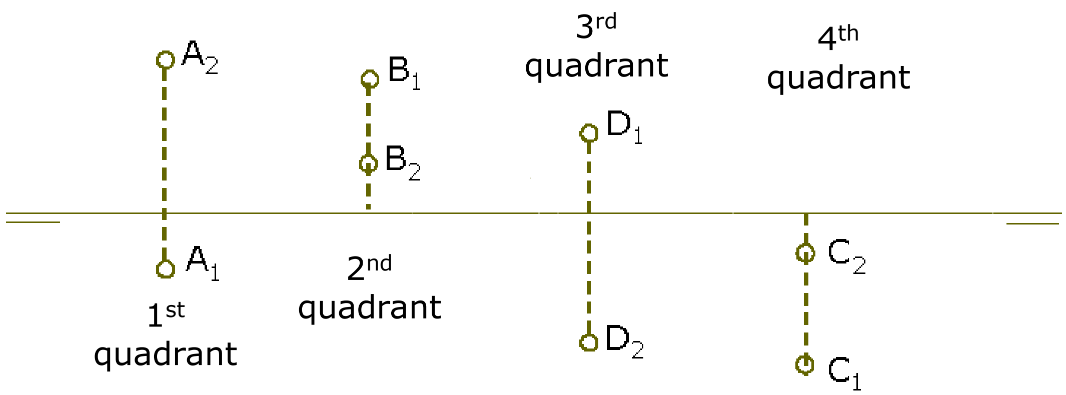


A (width, depth, height)

Representation of a point II

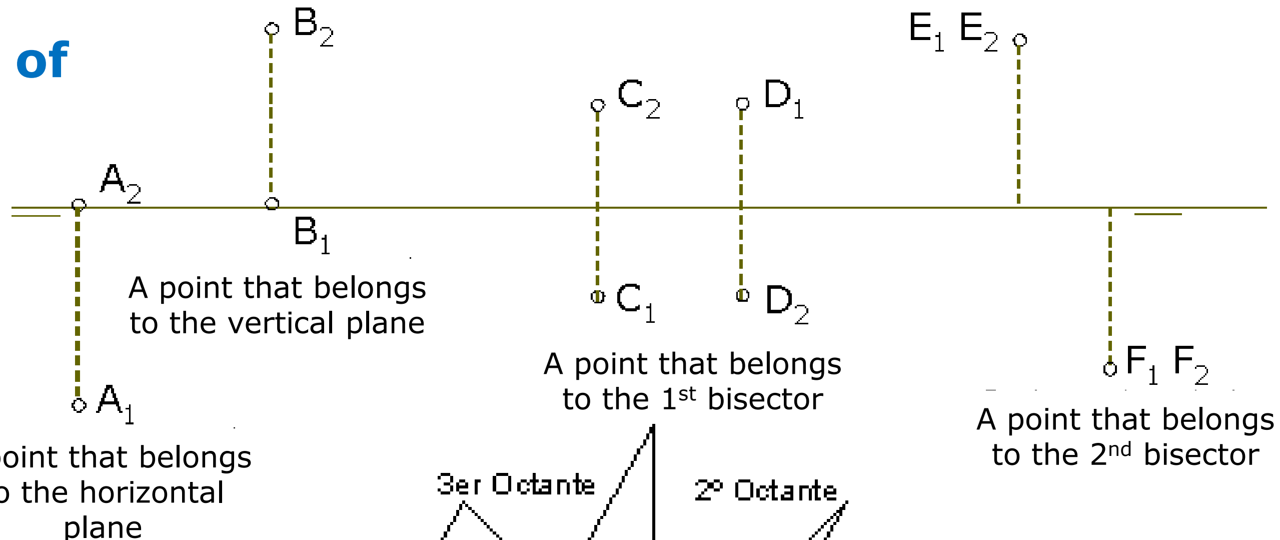
Positions of the points

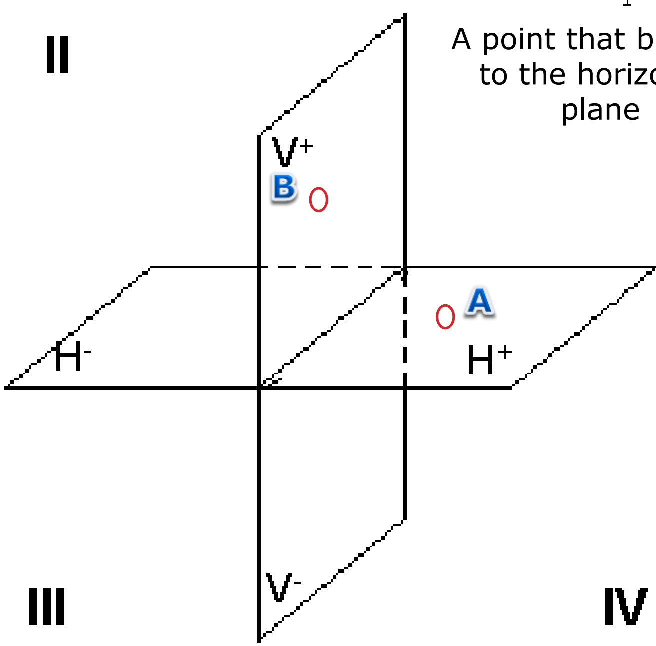


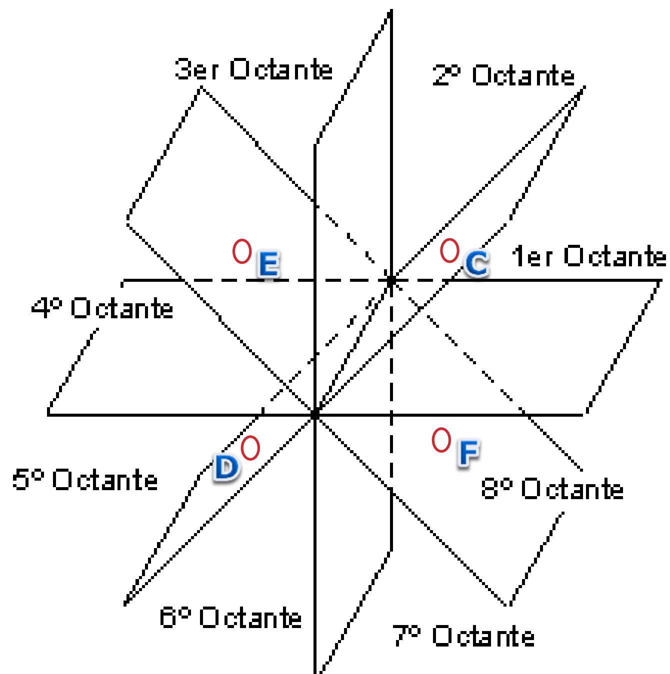


Representation of a point II

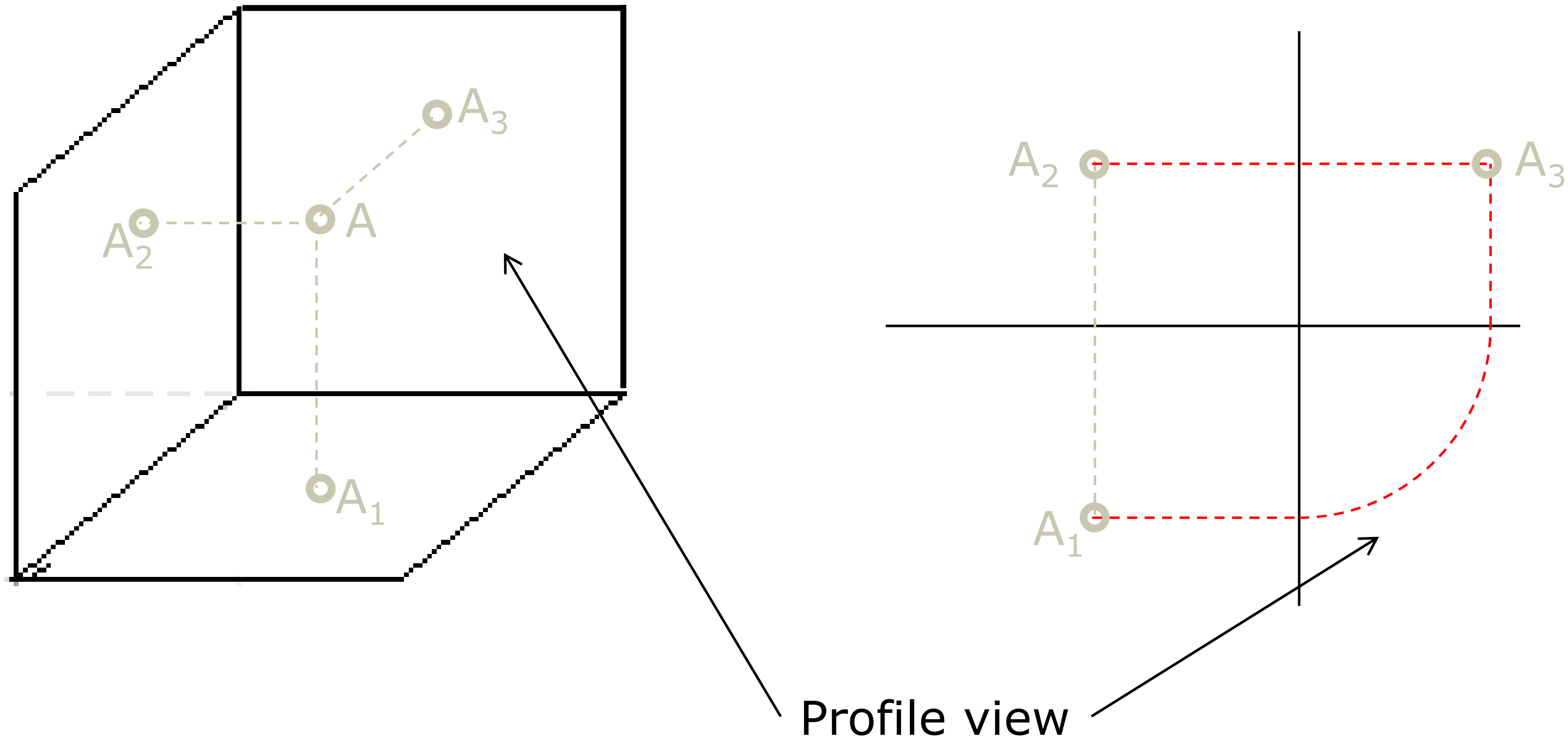
Special positions of the points



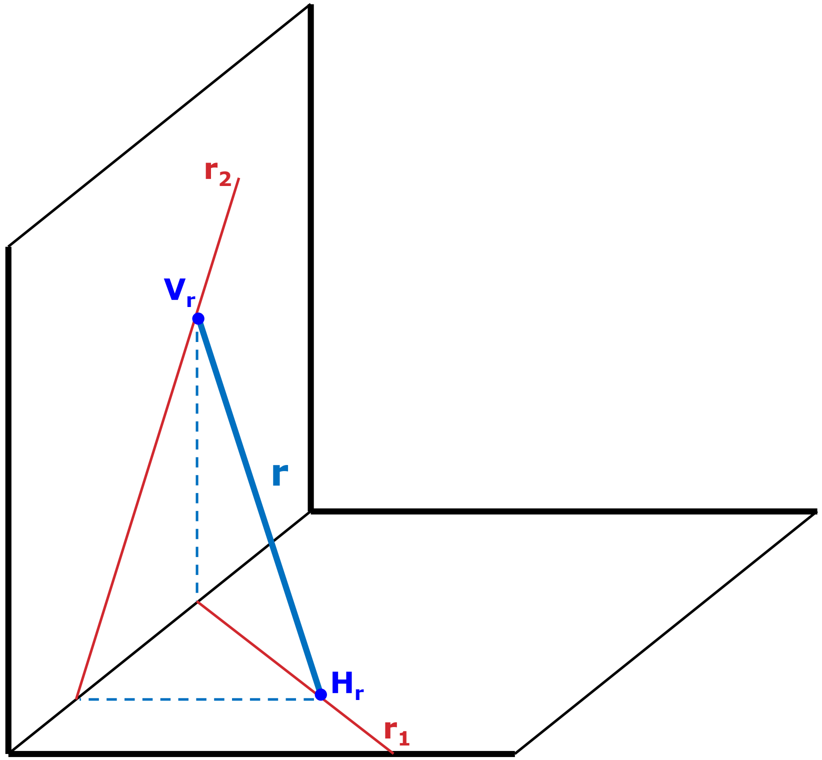


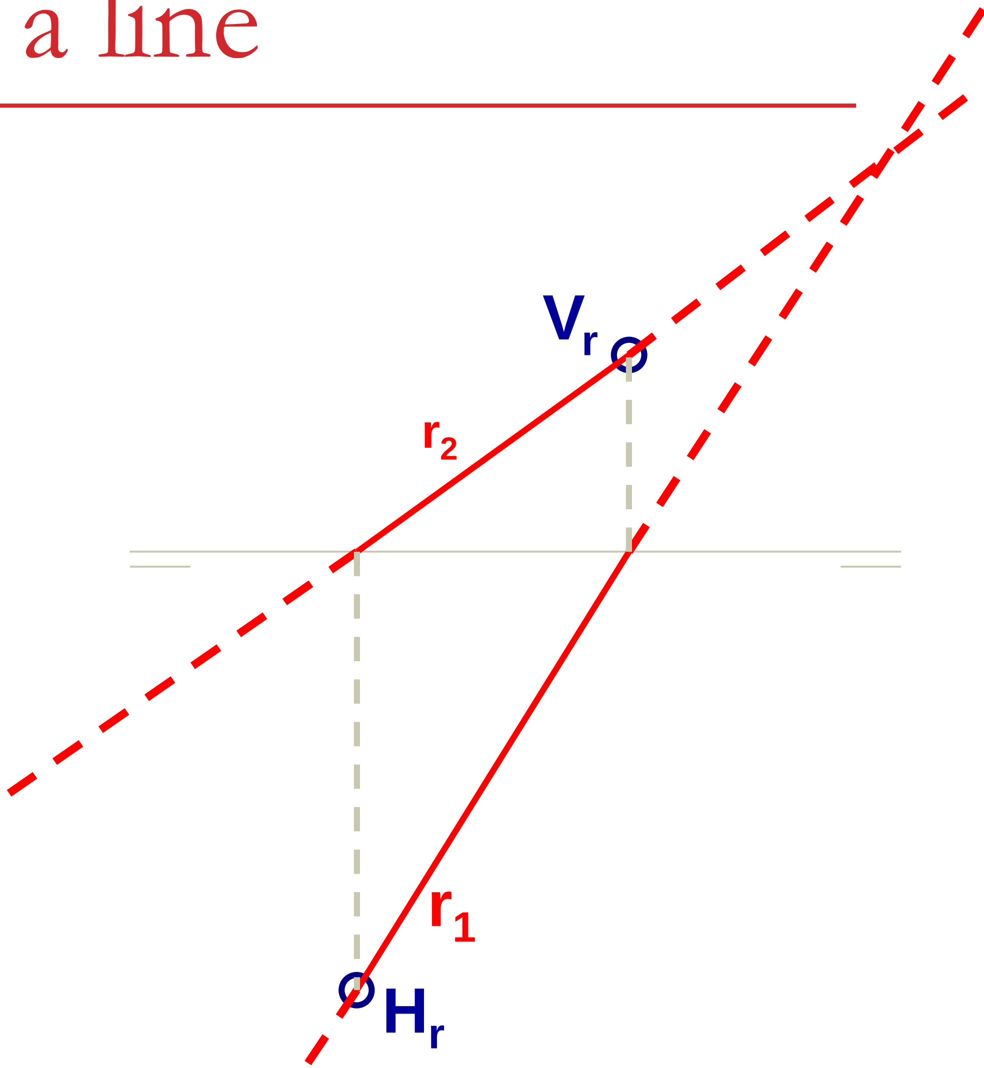


Representation of a point III



Representation of a line

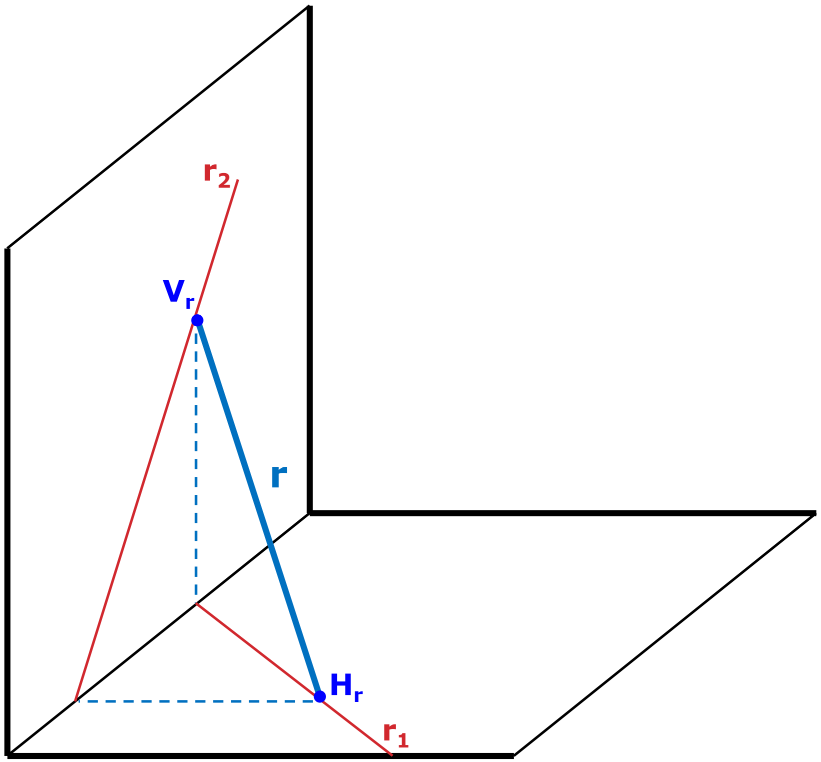


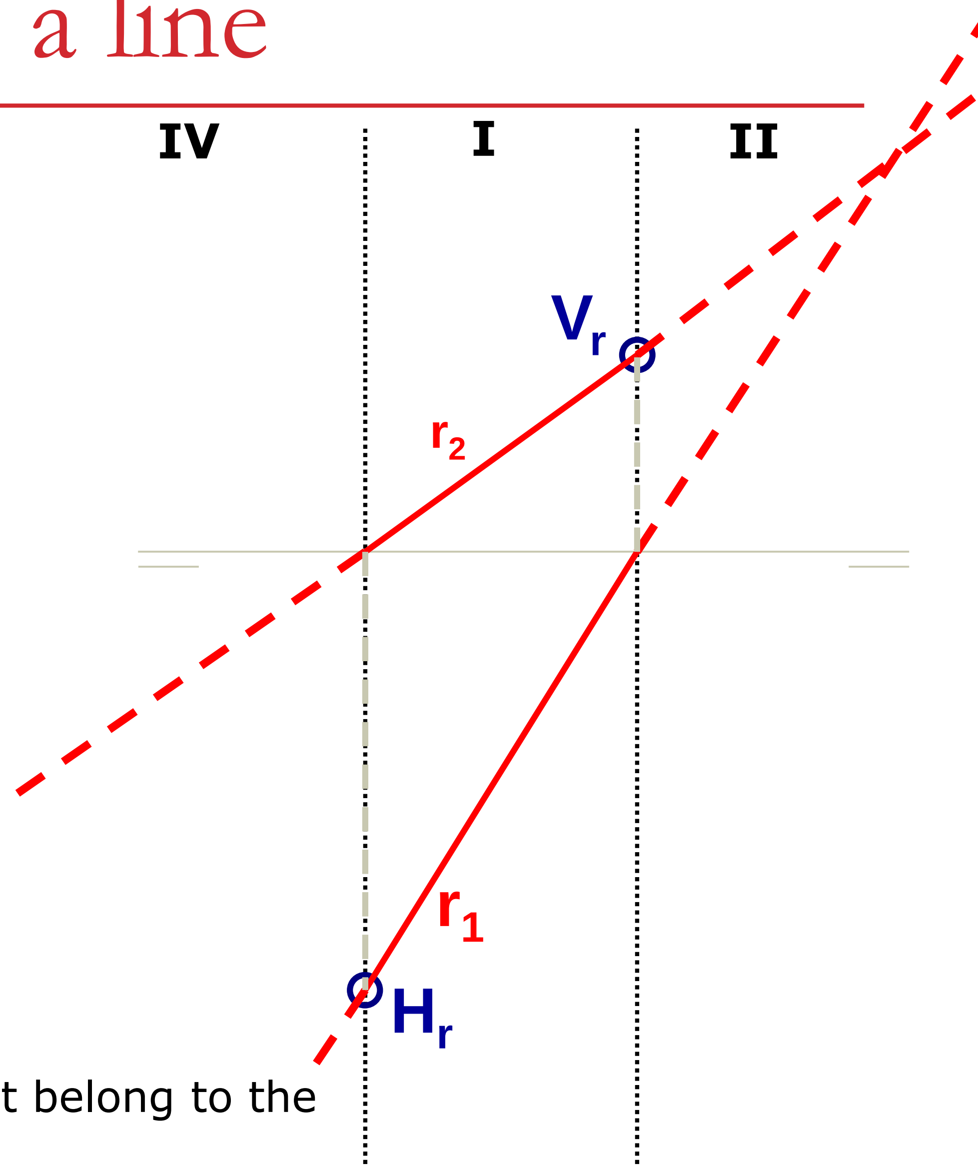


Visible and hidden parts of a line:

The visible parts of a line are those that belong to the **first quadrant.**

Representation of a line





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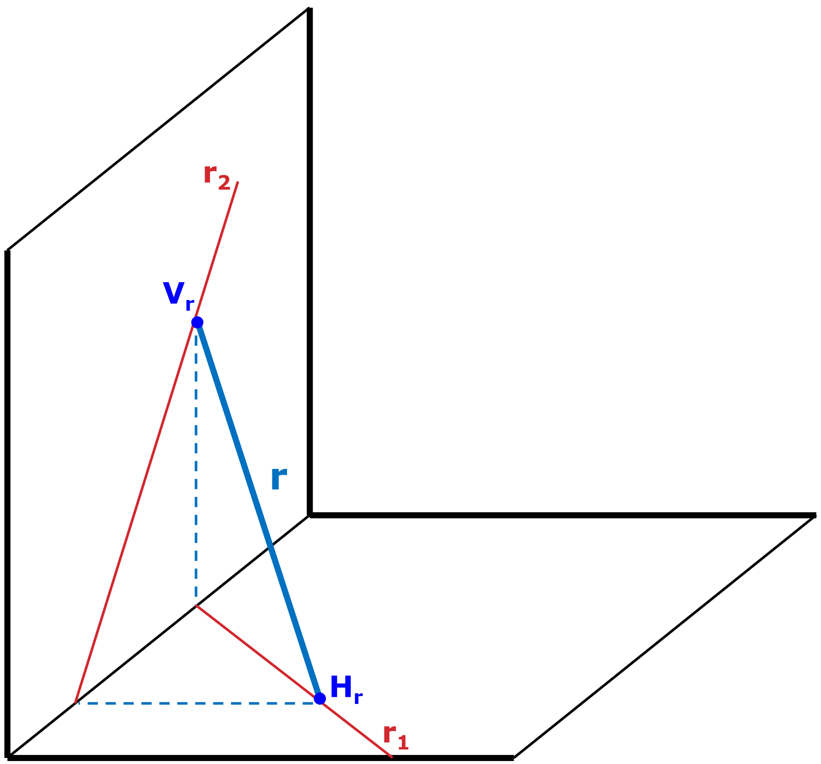

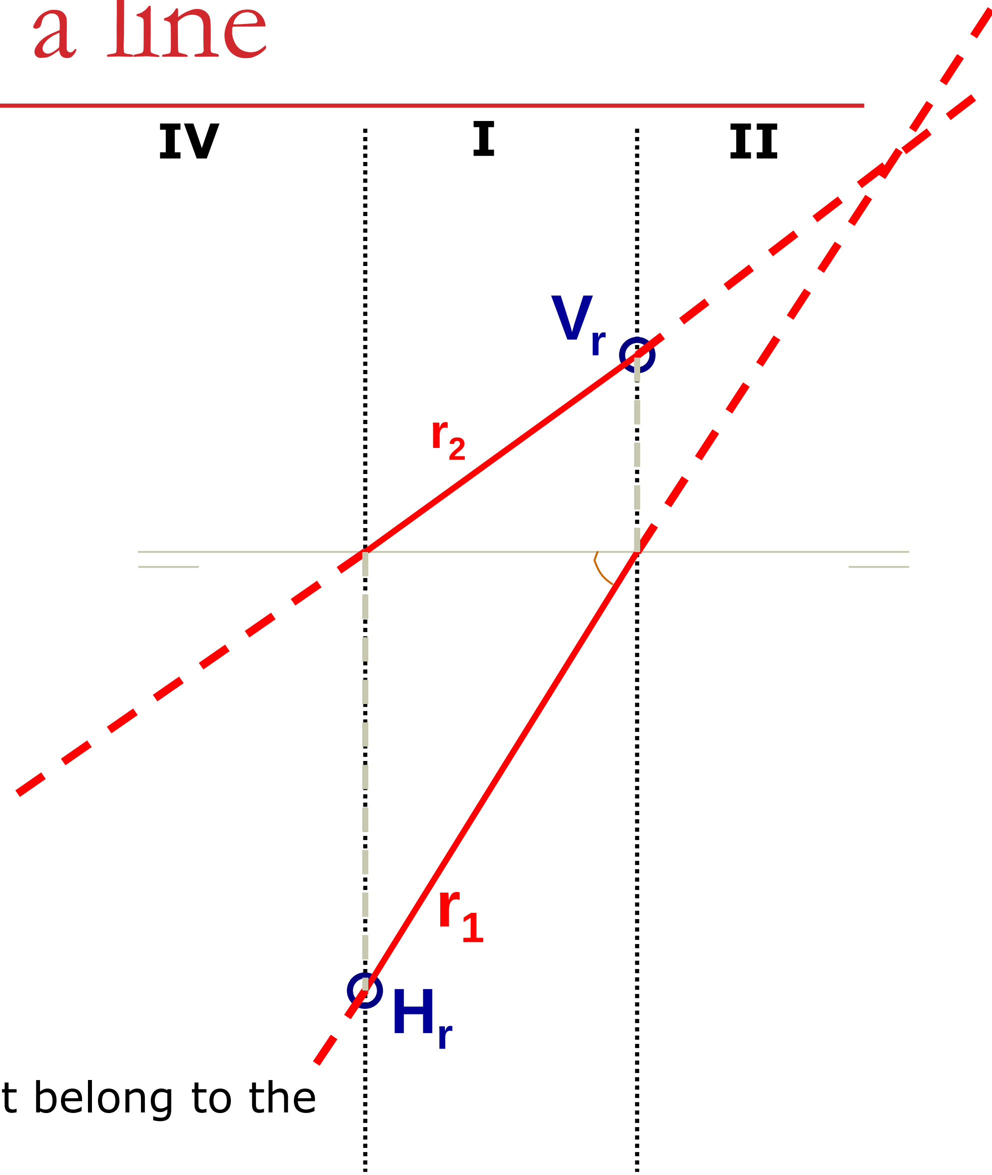

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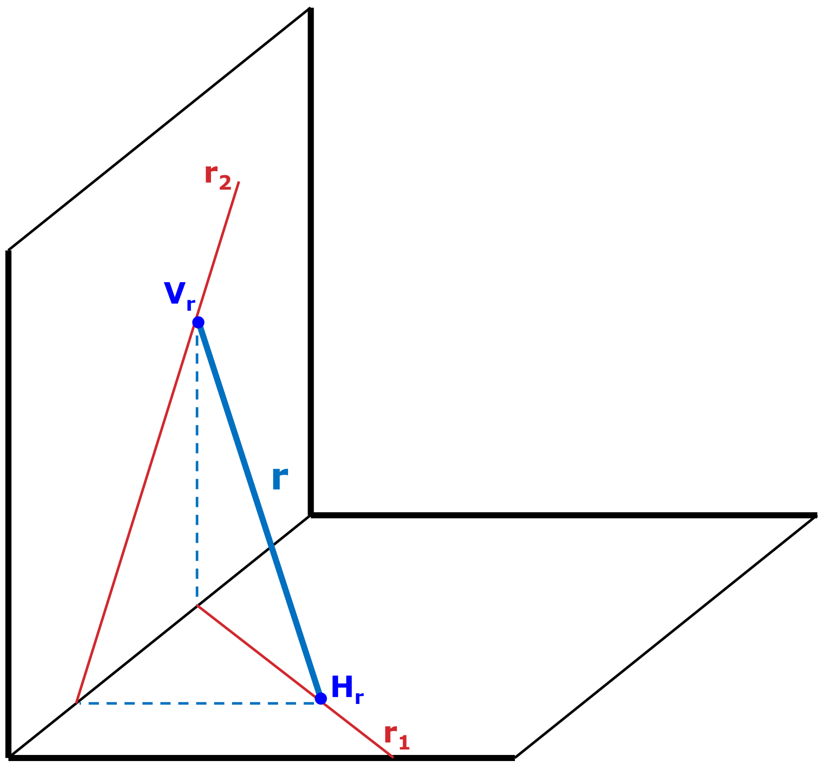

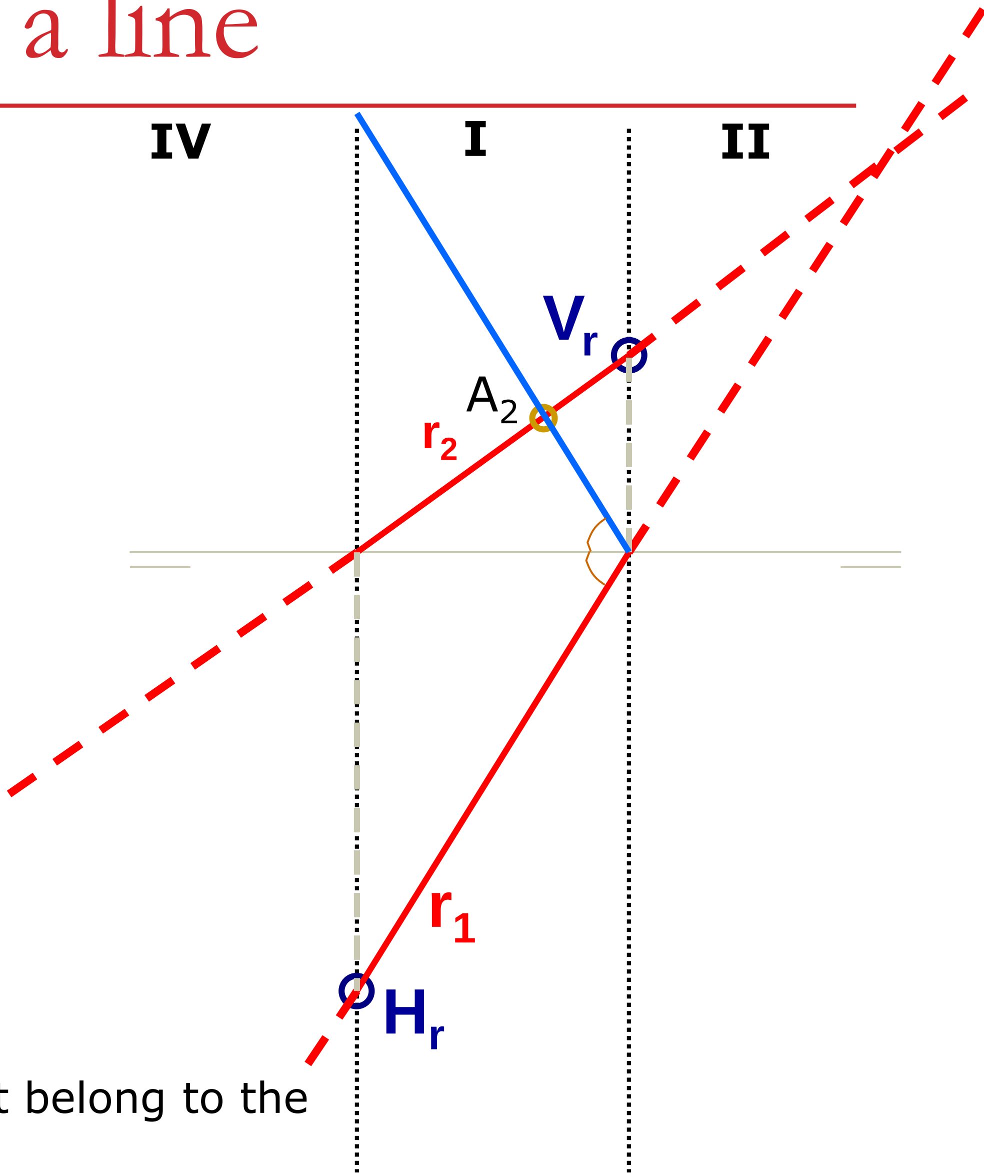

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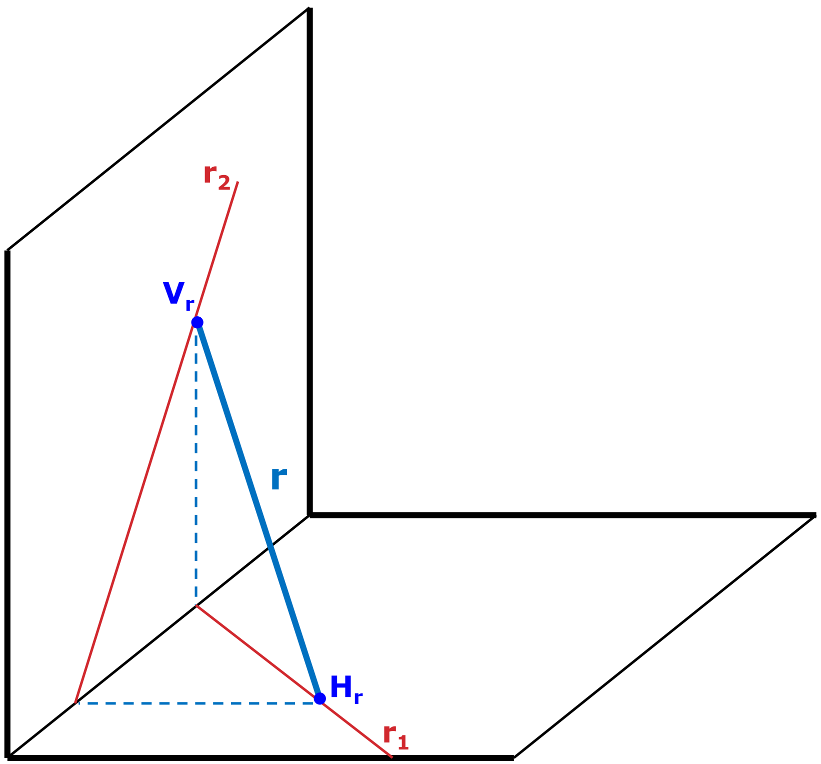

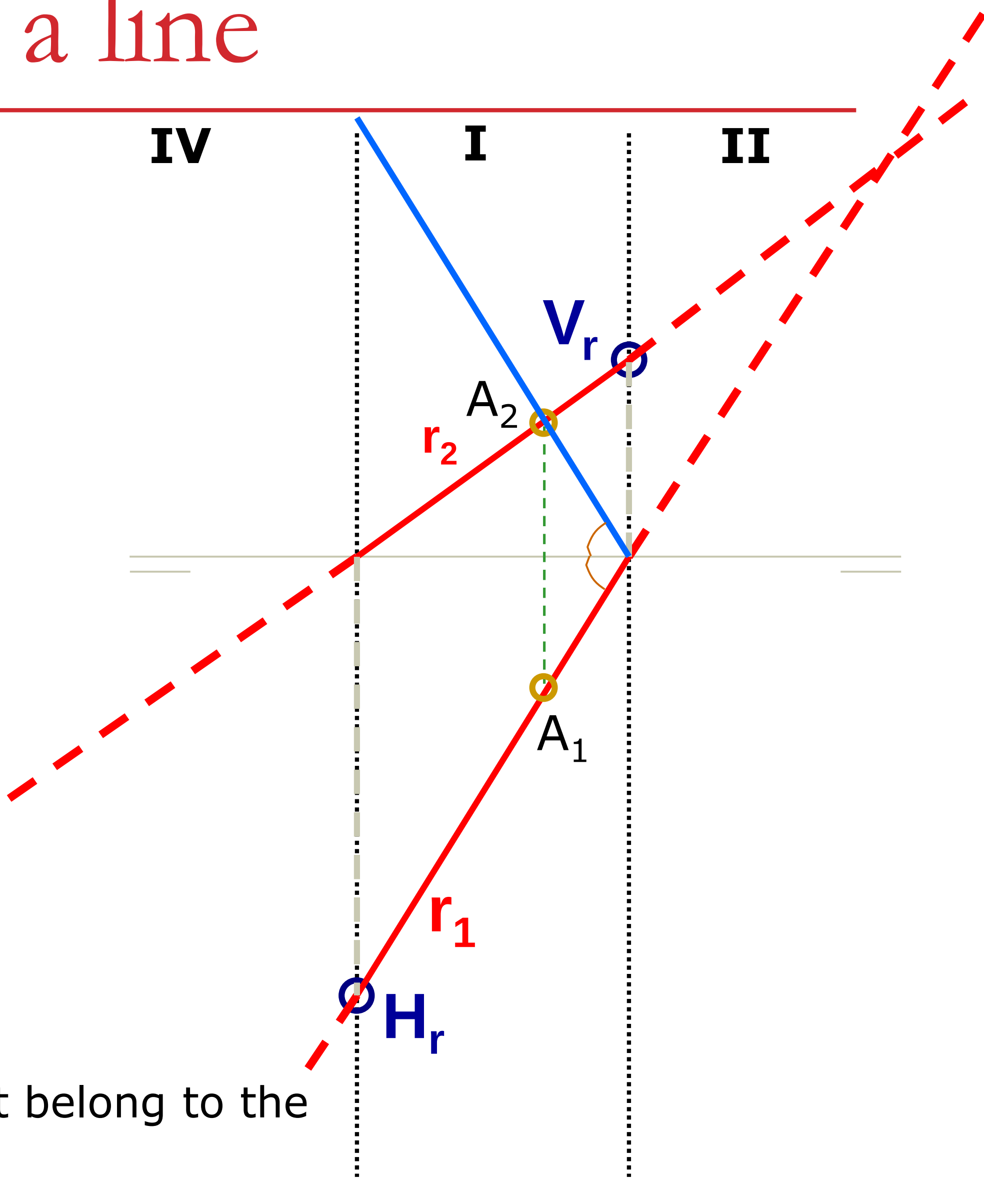

Visible and hidden parts of a line:

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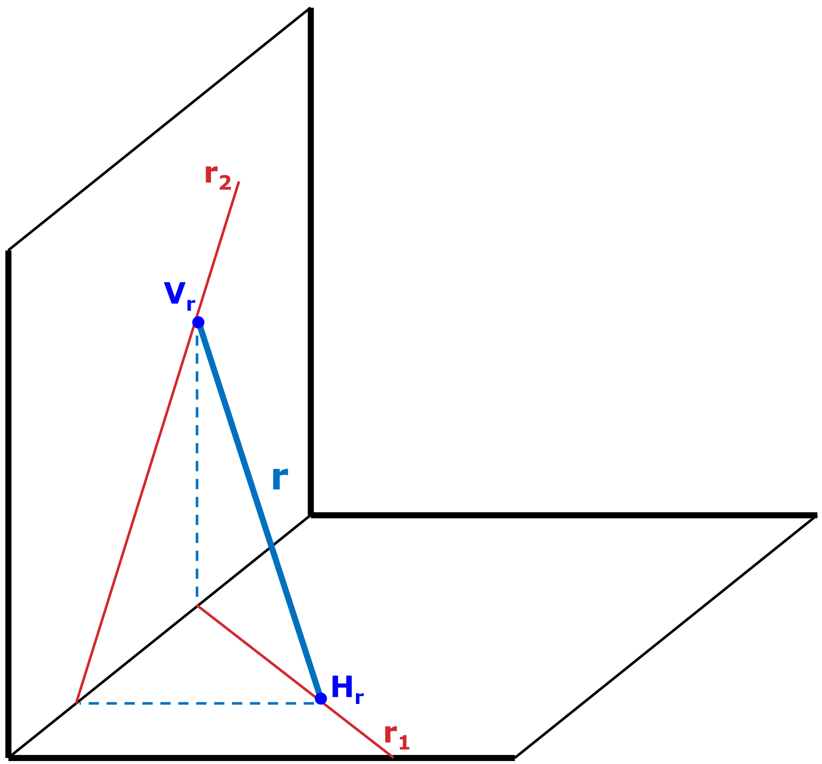

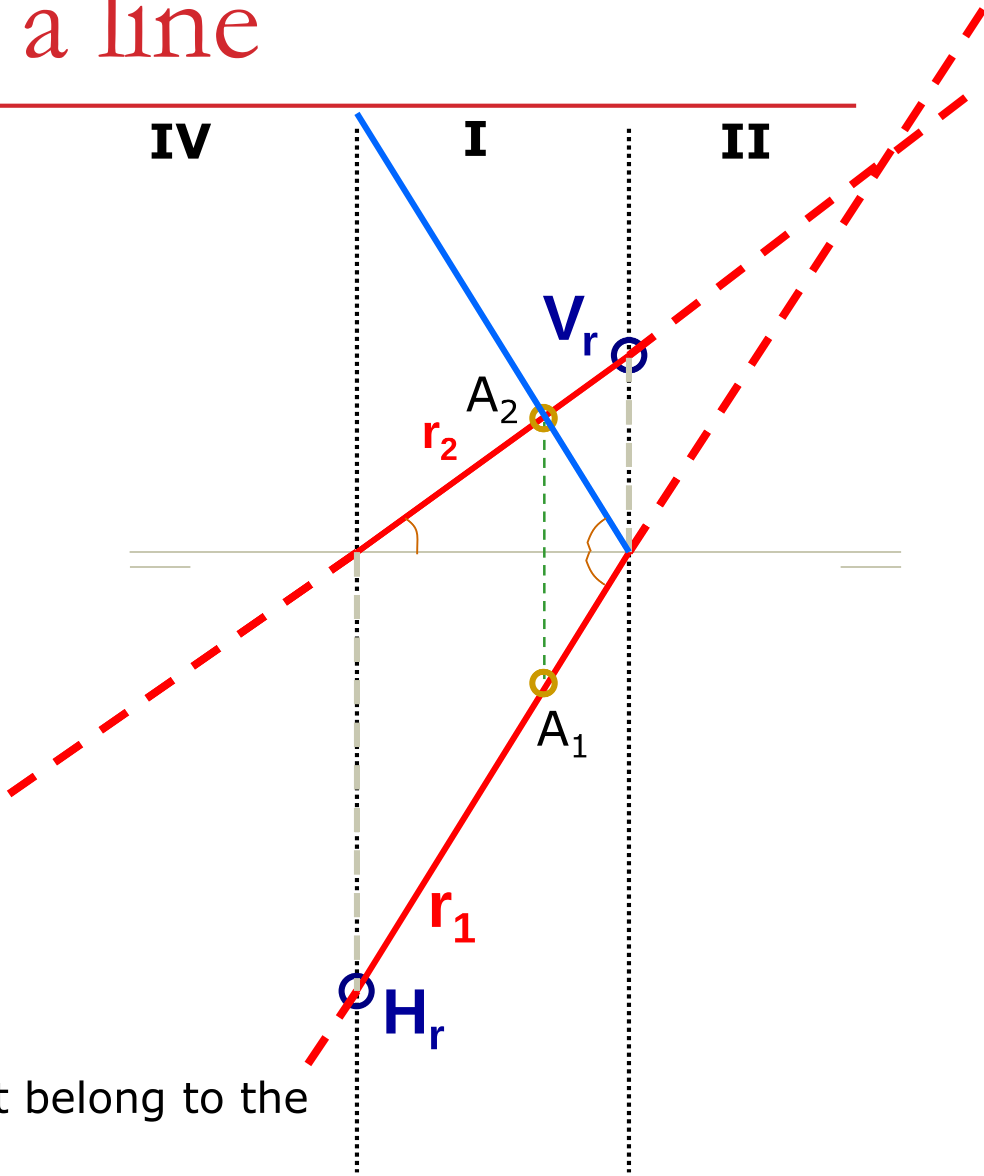

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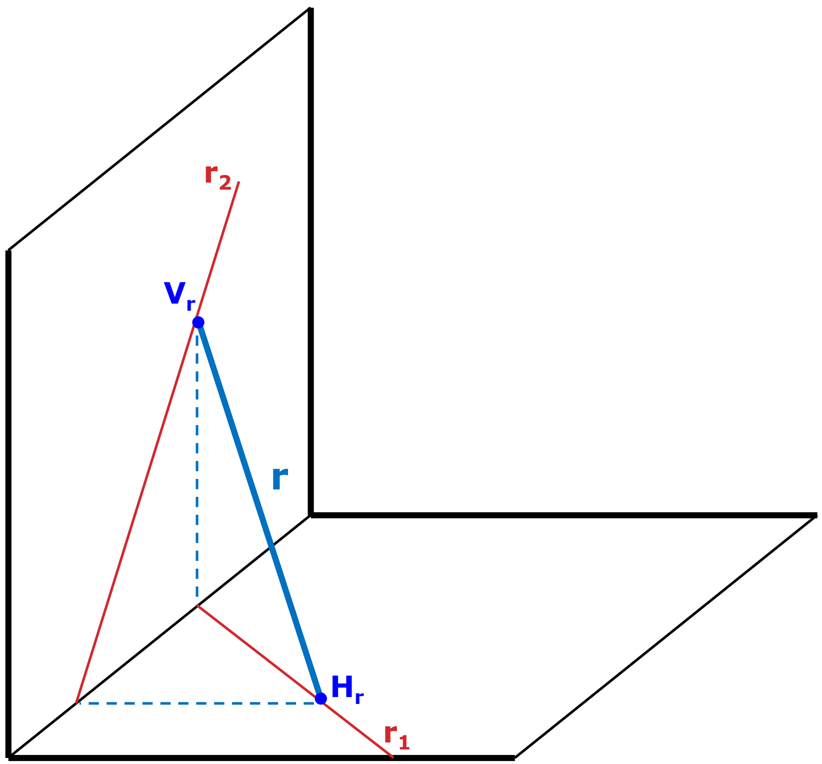

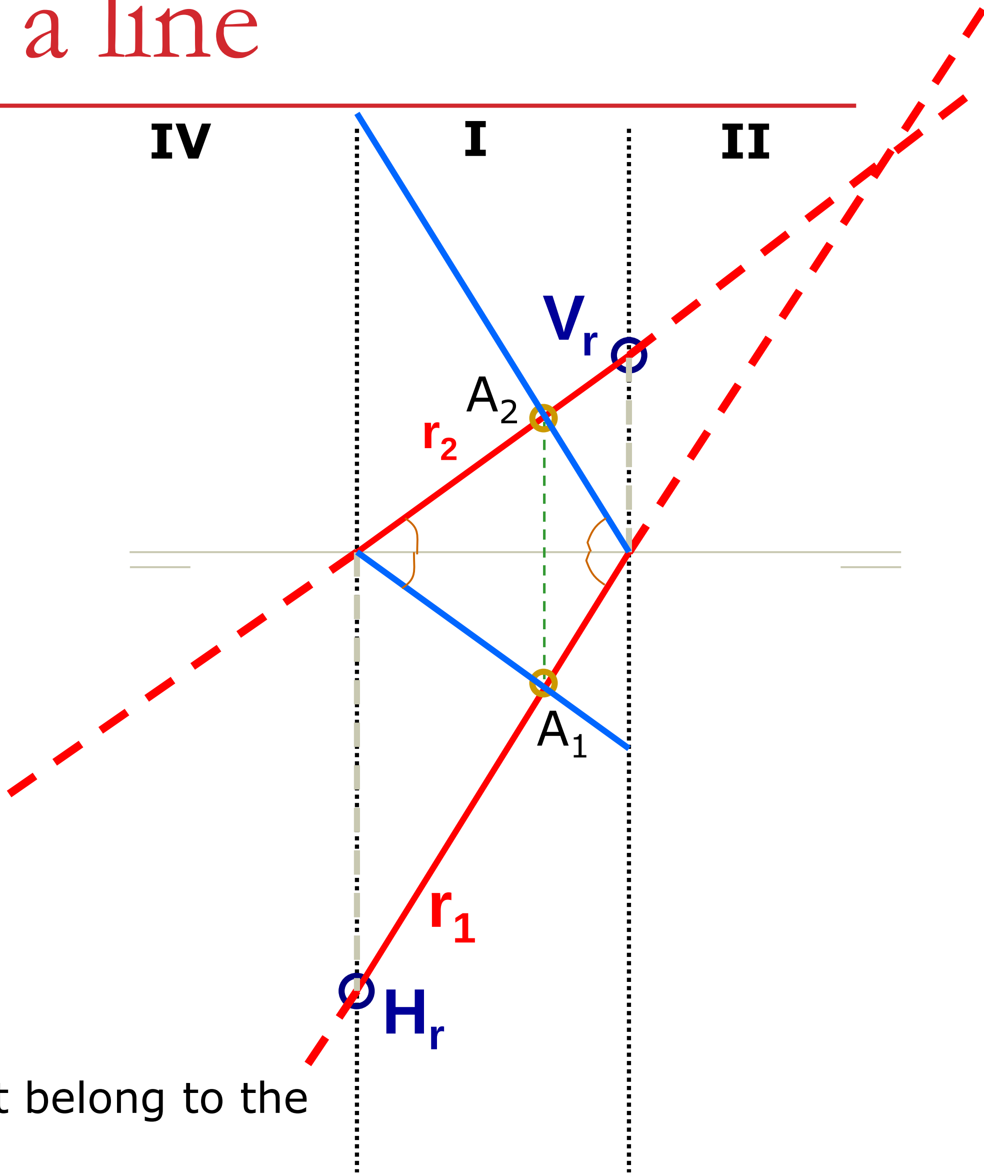

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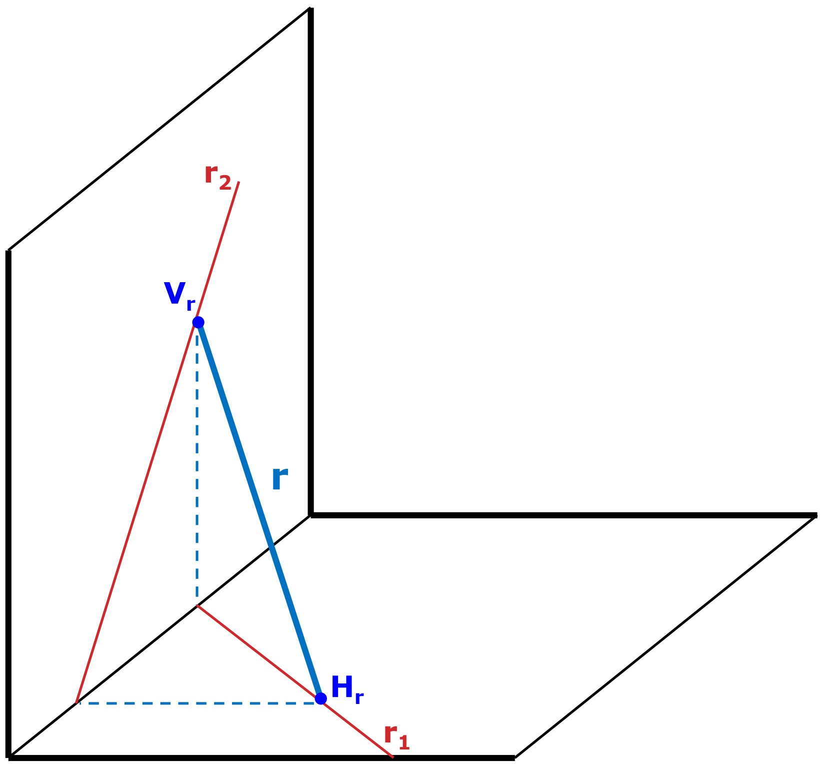

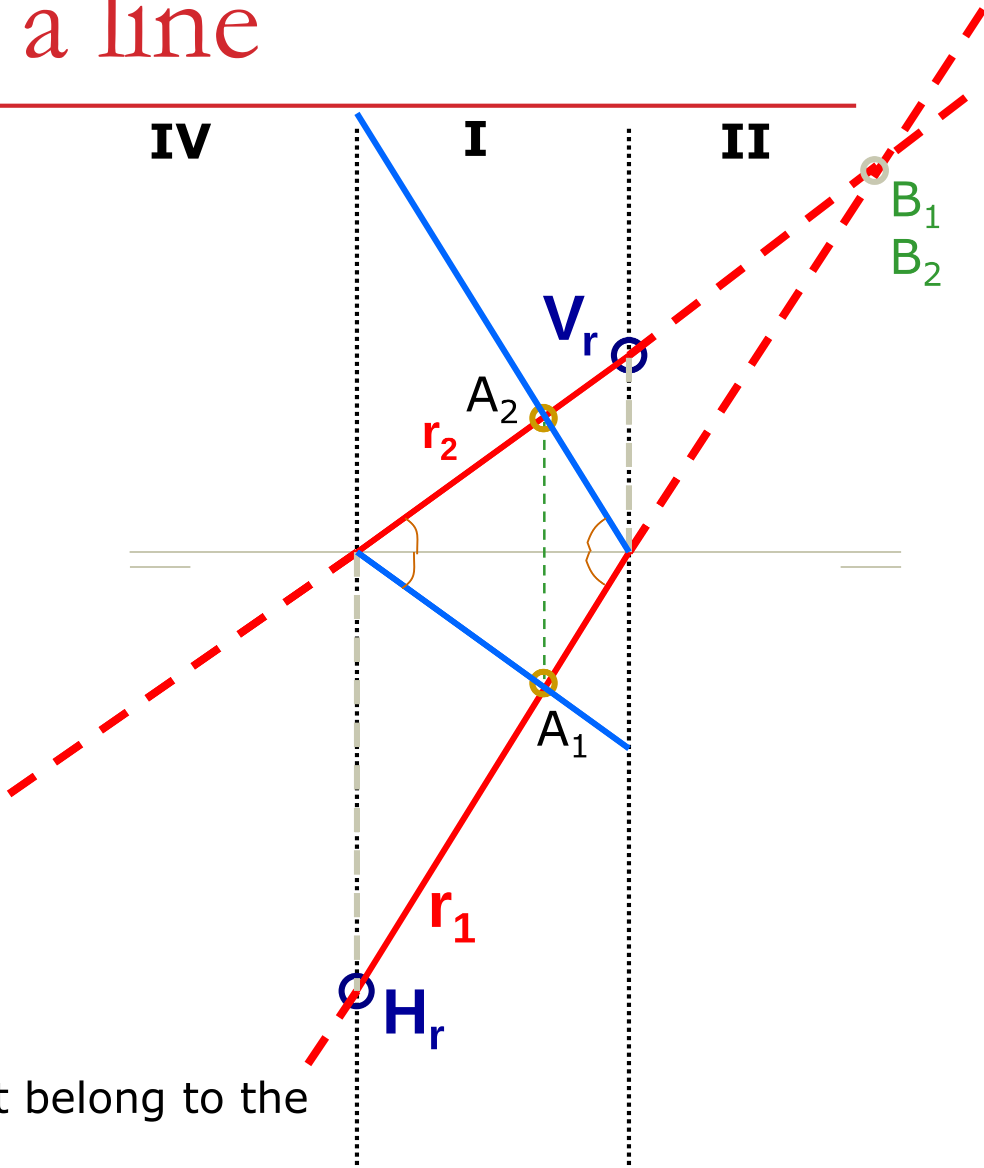

Visible and hidden parts of a line:

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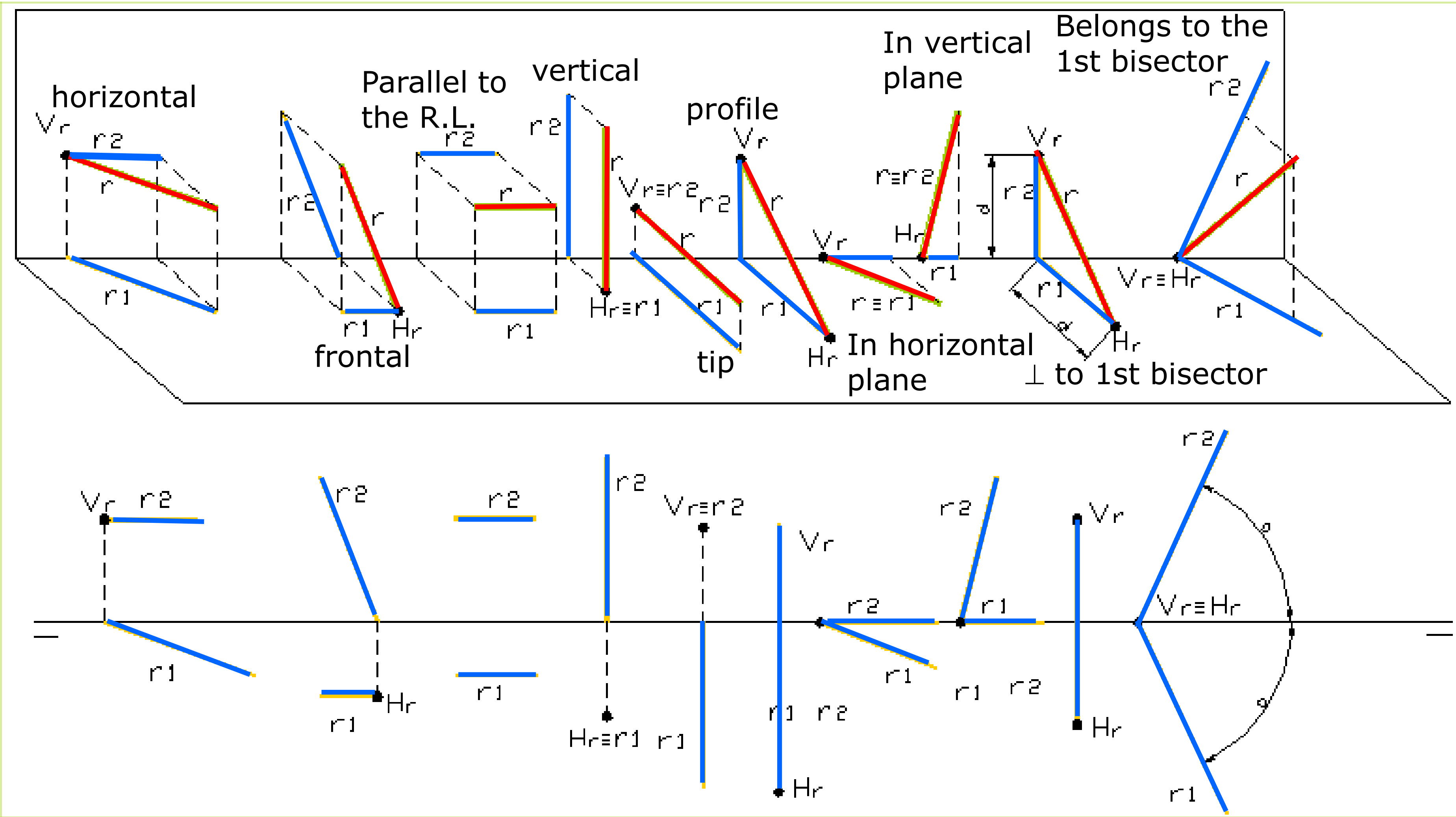
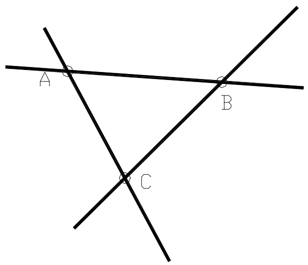
Particular positions of a line



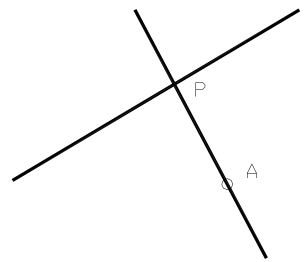
Representation of a plane

DEFINITION OF A PLANE

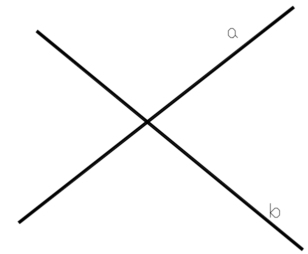
3 NON ALLIGNED POINTS

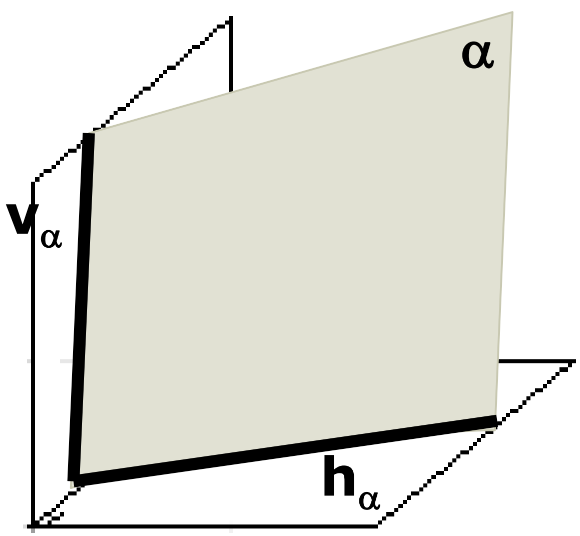


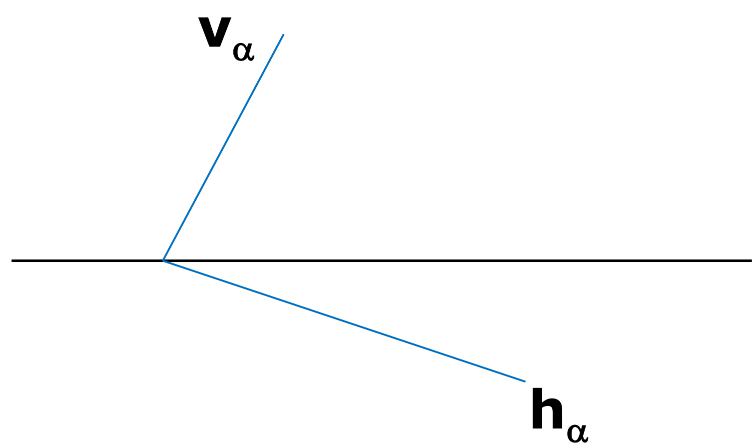
POINT AND LINE



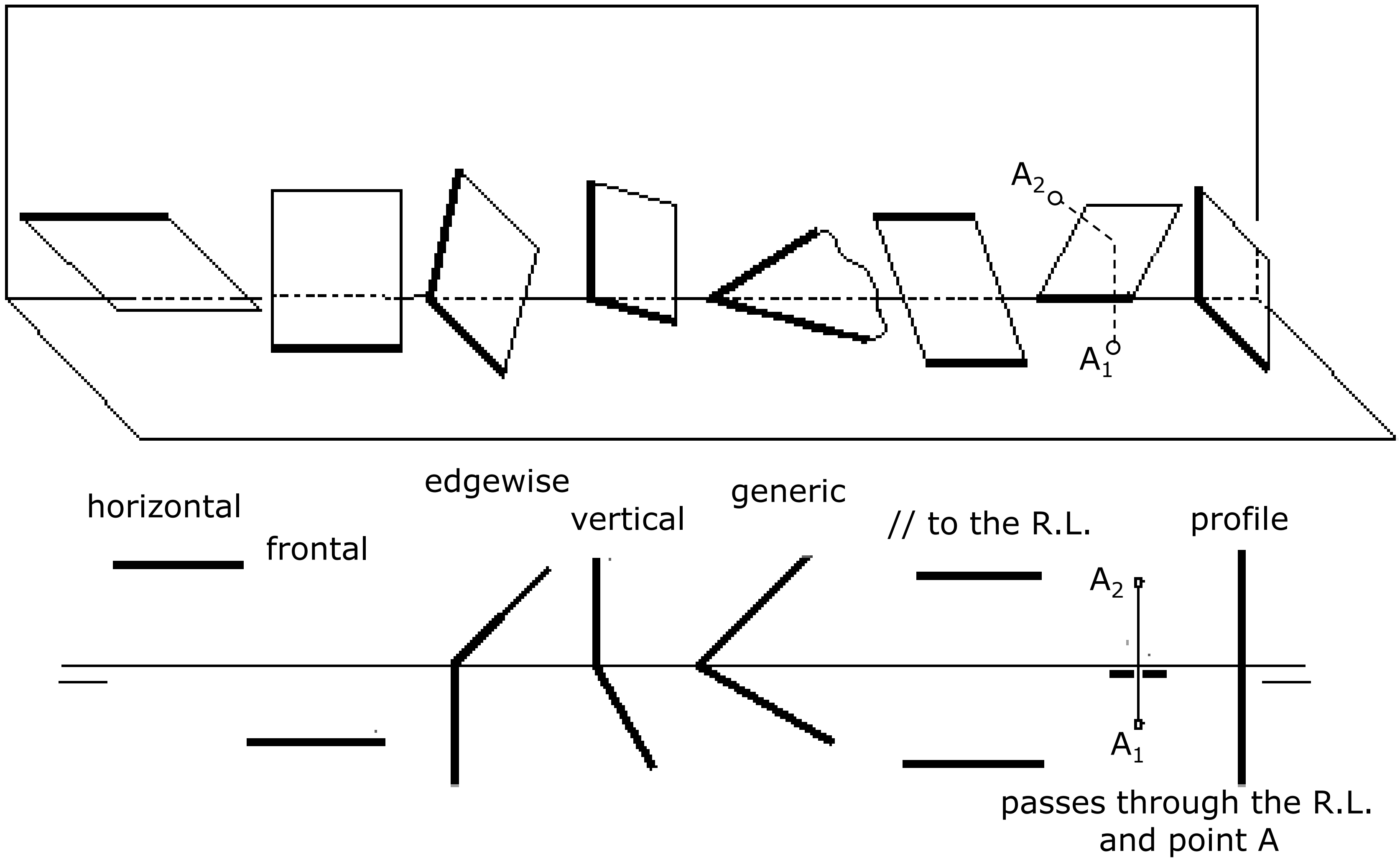
TWO LINES THAT CUT EACH OTHER







Special positions of a plane



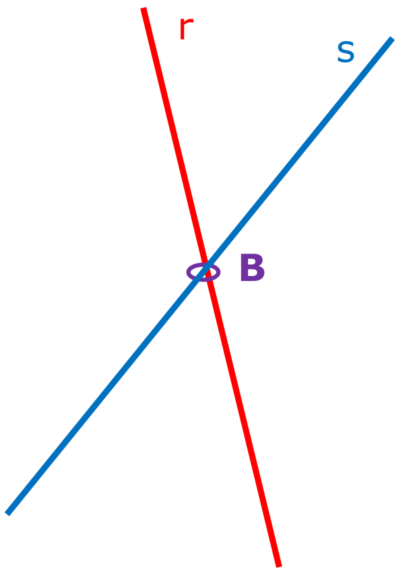
Membership

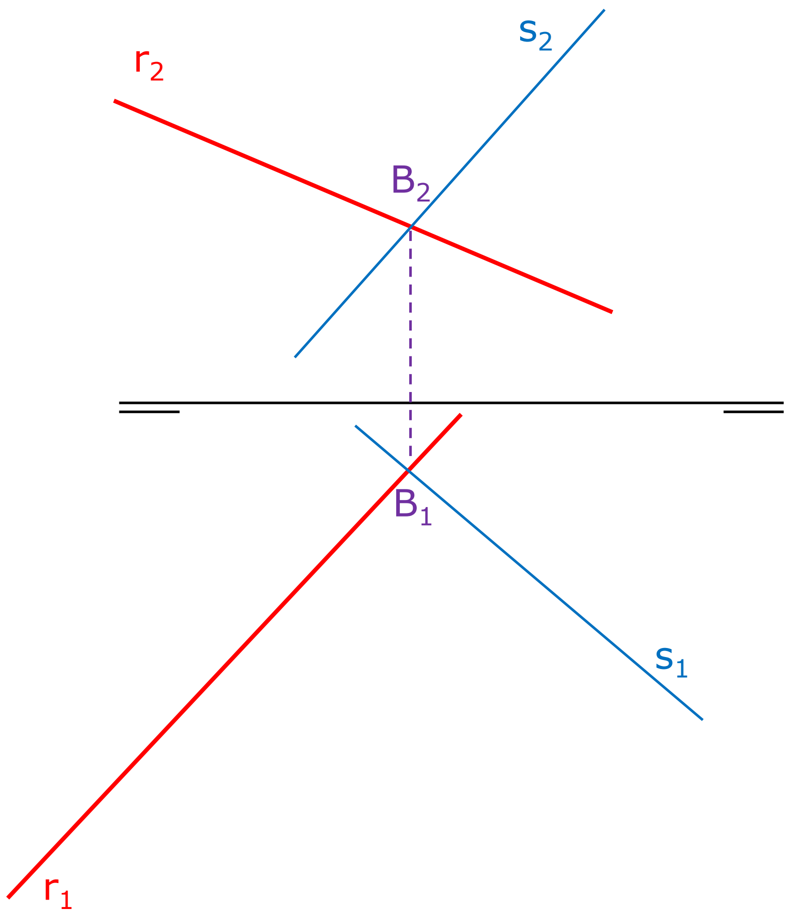
- A point *belongs* to a line if its **projections** are included in the line's **projections**.

- A line *belongs* to a plane if its **traces** are included in the **traces** of the plane.

- A point *belongs* to a plane, if it belongs to a line that is included in this plane.

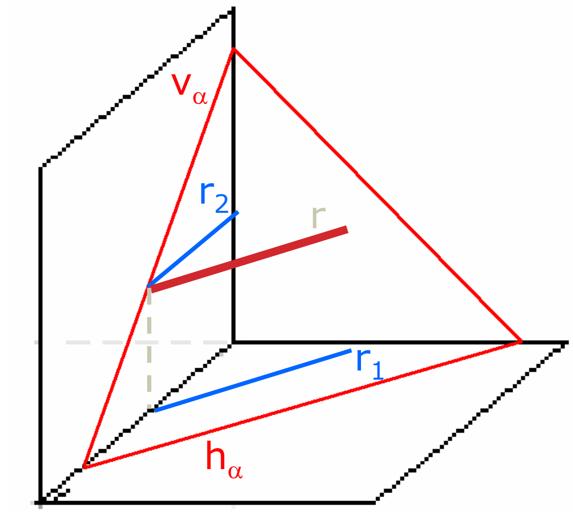
Intersection between lines

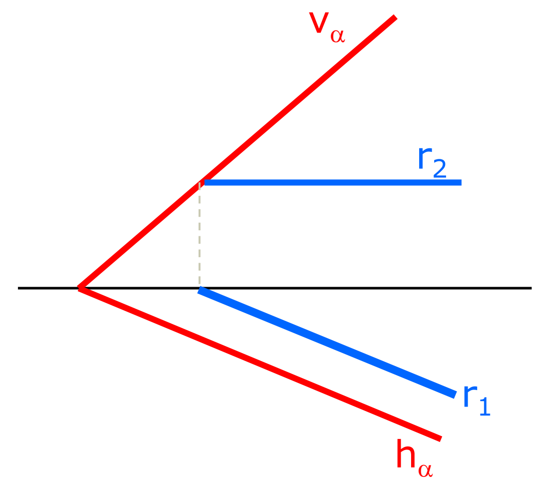




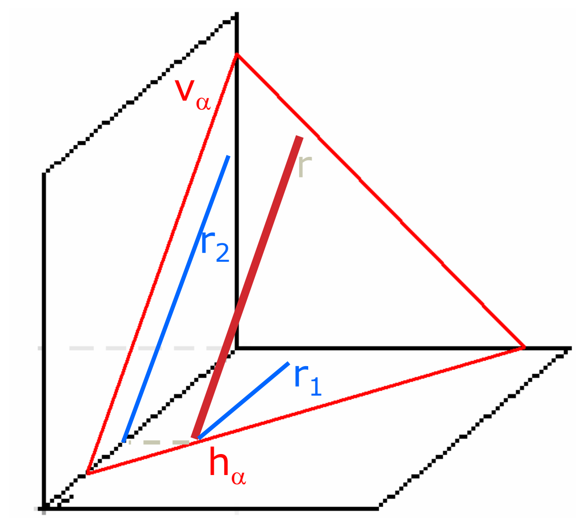
Special lines of a plane I

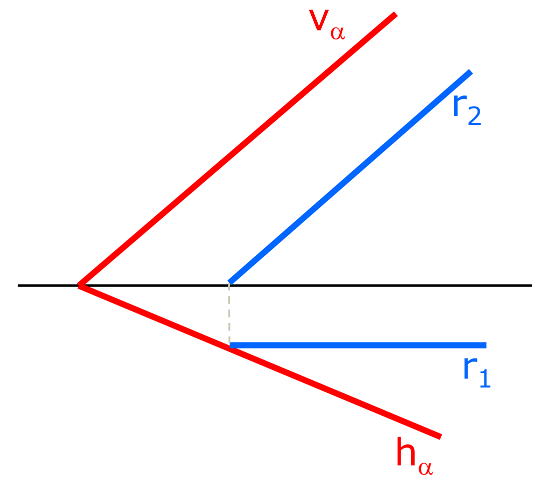
- Horizontal lines





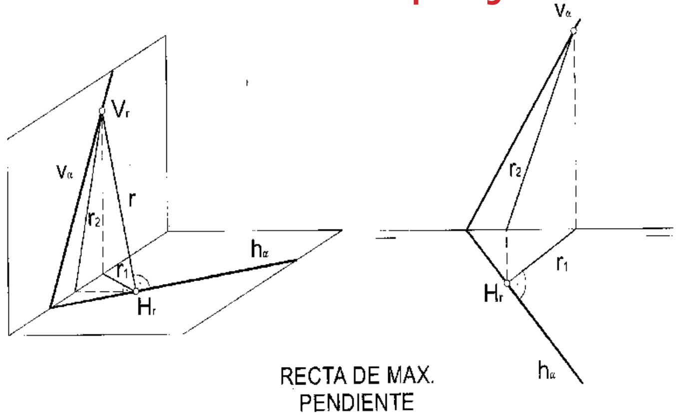
- Frontal lines



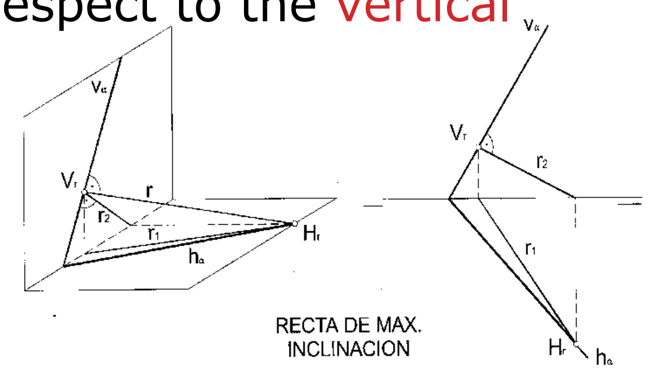


Special lines of a plane II

- **Lines of maximum slope:** Is a line that belongs to the plane and has the maximum angle with respect to the horizontal projection of the plane.
  - *Perpendicular to the horizontal projection of the plane.*

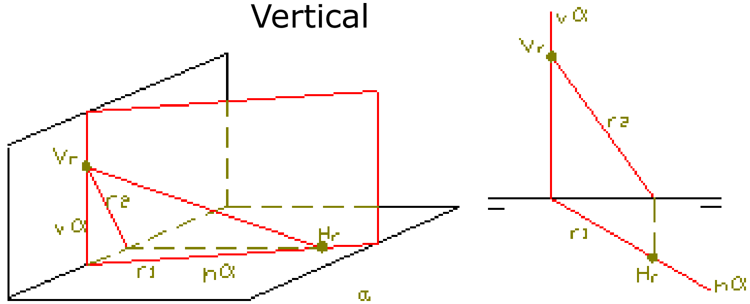


- **Lines of maximum inclination:** Is a line that belongs to the plane and has the maximum angle with respect to the vertical projection of the plane.
  - *Perpendicular to the vertical projection of the plane.*

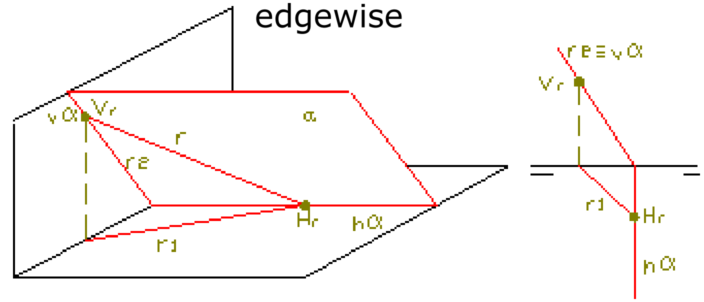


Special planes and their lines

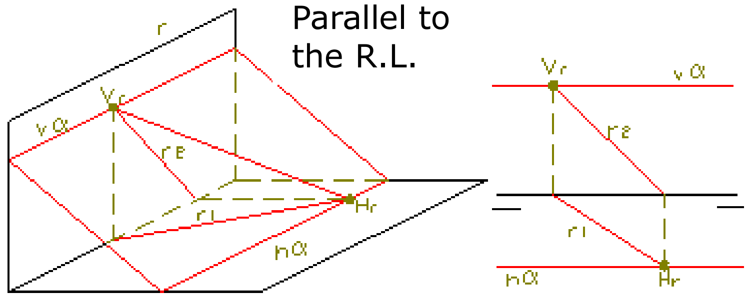
Vertical



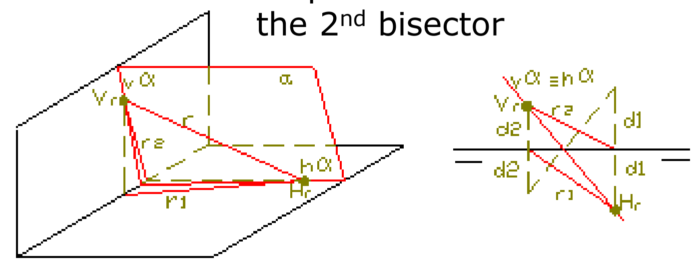
edgewise



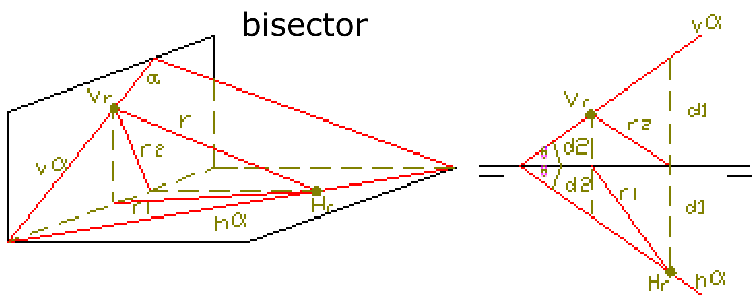
Parallel to
the R.L.



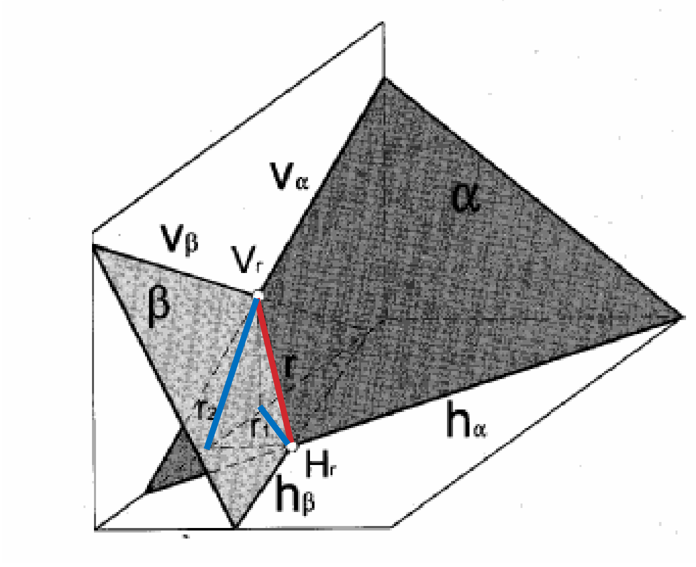
Perpendicular to
the 2nd bisector

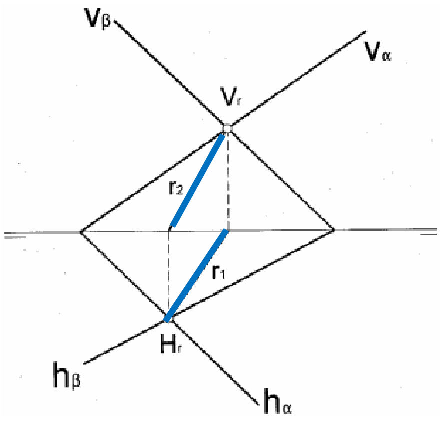


Parallel to the 1st
bisector



Intersection of planes I



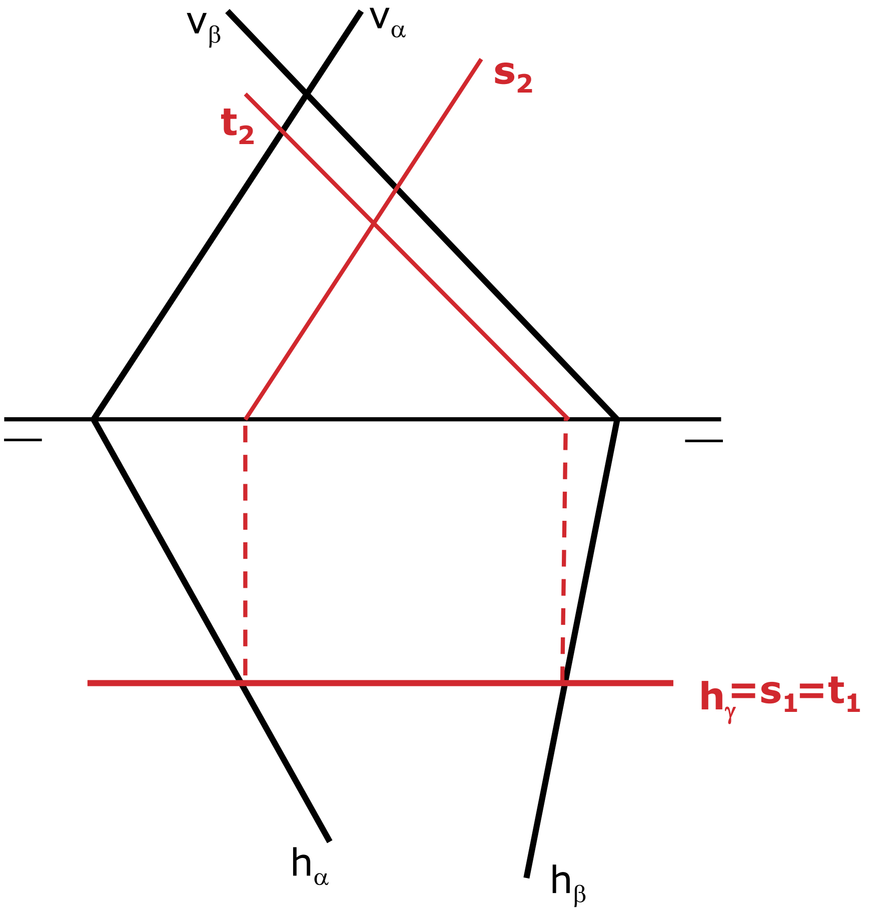


If the intersection of the projections of the planes is out of the paper

Use auxiliary plane

Intersection of planes II

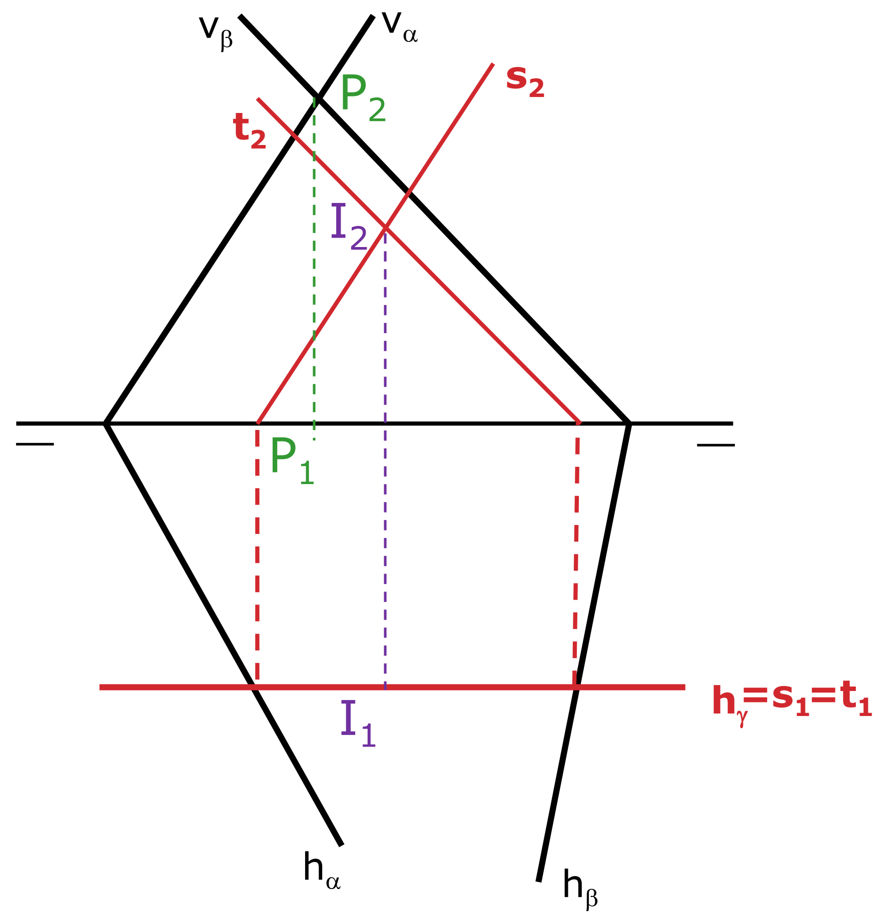
- Draw a frontal plane γ
- Find the intersection of γ with α and β (s&t)



If both intersections of the plans projections are out of the paper, see video: *http://www.youtube.com/watch?v=9r-nWoubXec*

Intersection of plans II

- Draw a frontal plane γ
- Find the intersection of γ with α and β (s&t)
- Projections of s&t would meet at point I
- And α&β at point P



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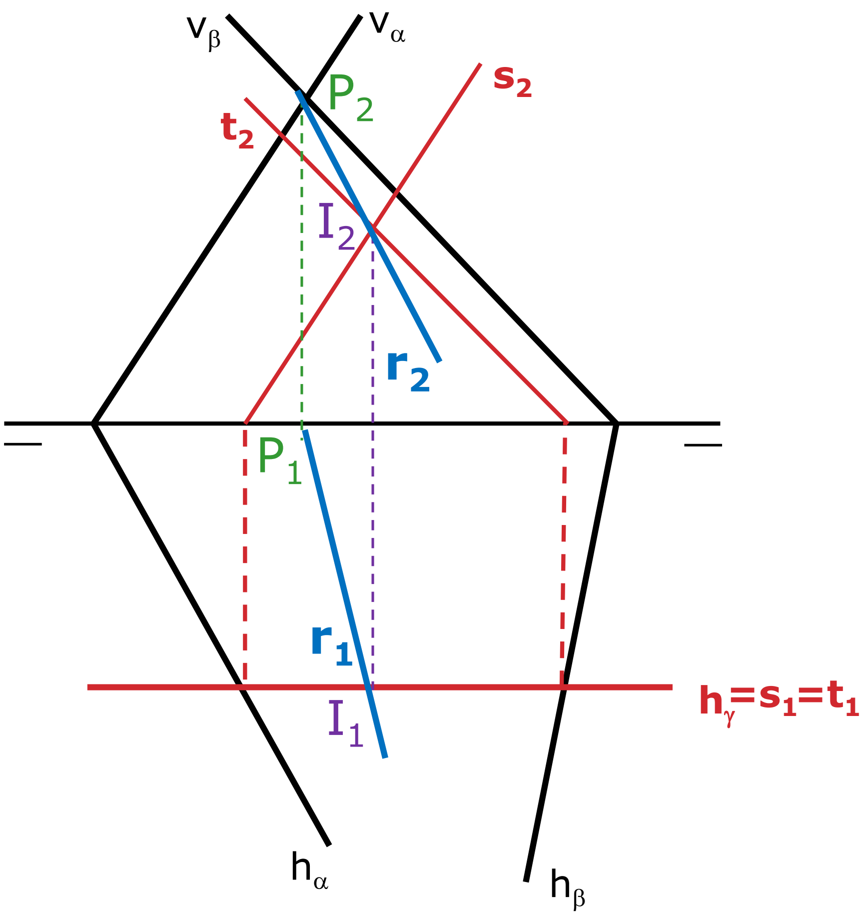
Intersection of plans II

- Draw a frontal plane γ
- Find the intersection of γ with α and β (s&t)
- Projections of s&t would meet at point I
- And α&β at point P
- Joining I & P we get r (the line where both plans intersect)



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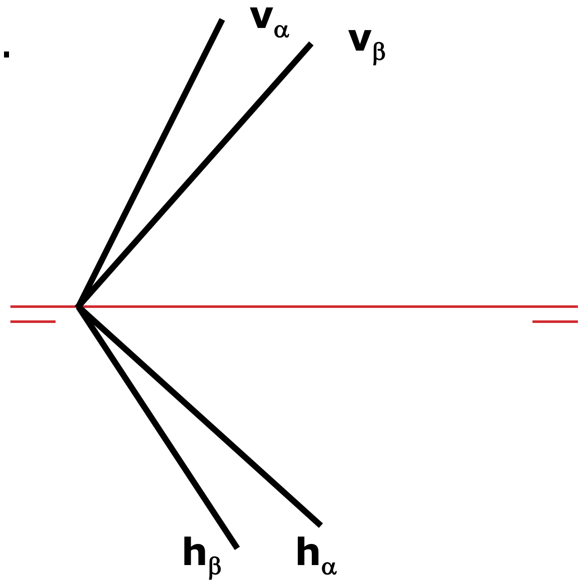
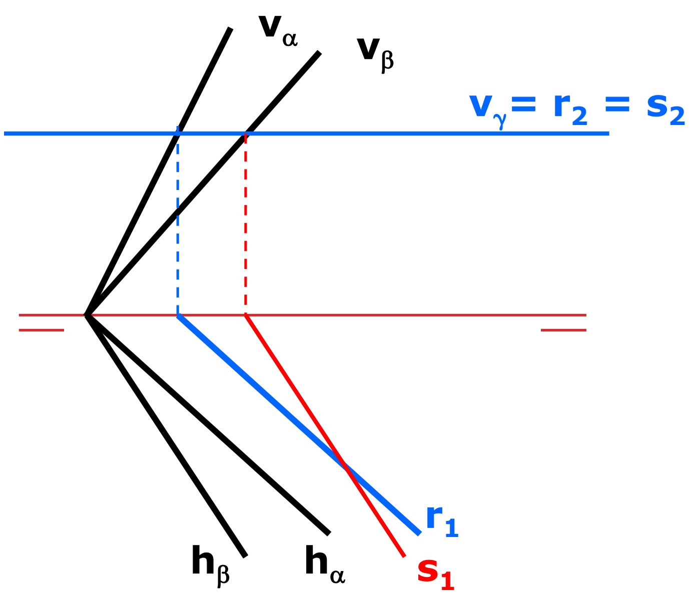
Intersection of planes III

Coinciding planes in the same point on the R.L.



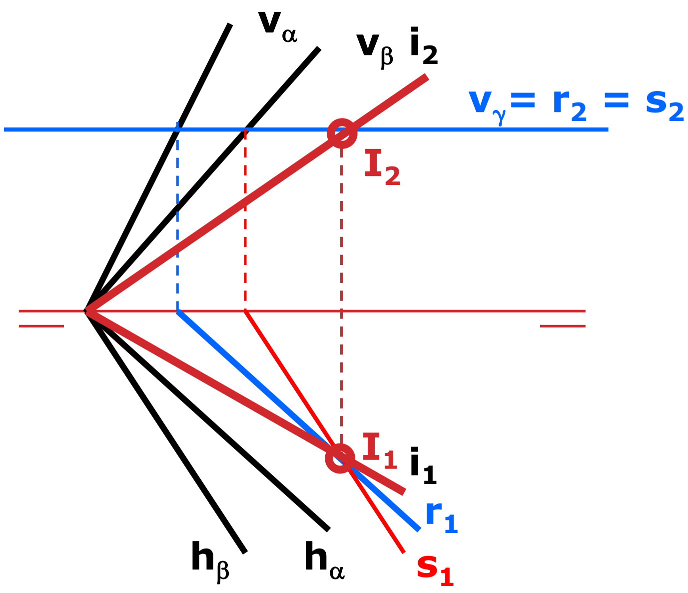
Intersection of planes III

Coinciding planes in the same point on the R.L.



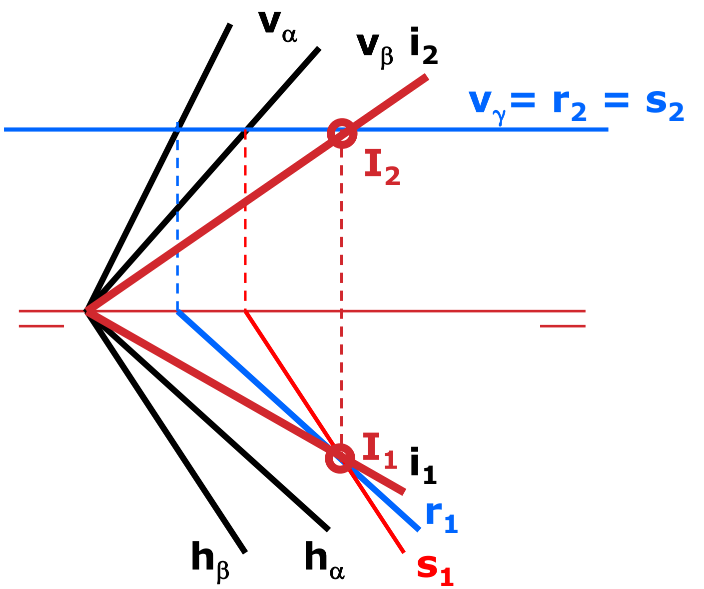
Intersection of planes III

Coinciding planes in the same point on the R.L.

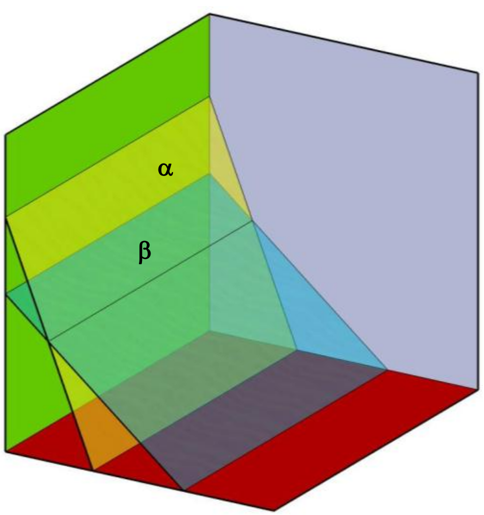


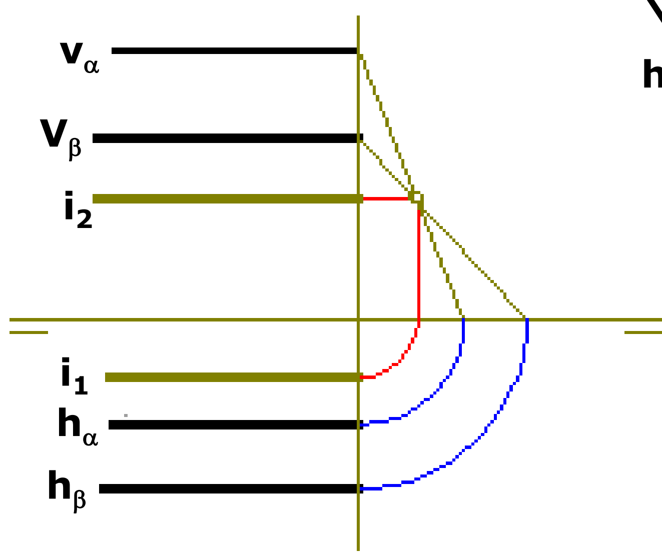
Intersection of planes III

Coinciding planes in the same point on the R.L.

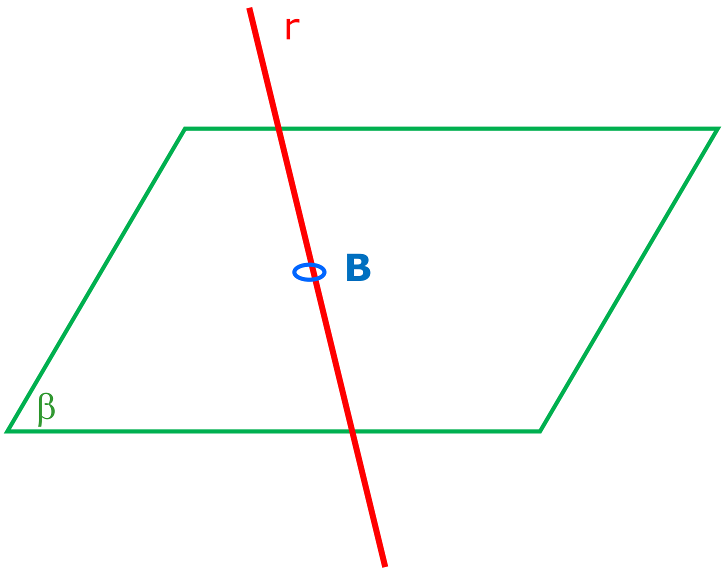


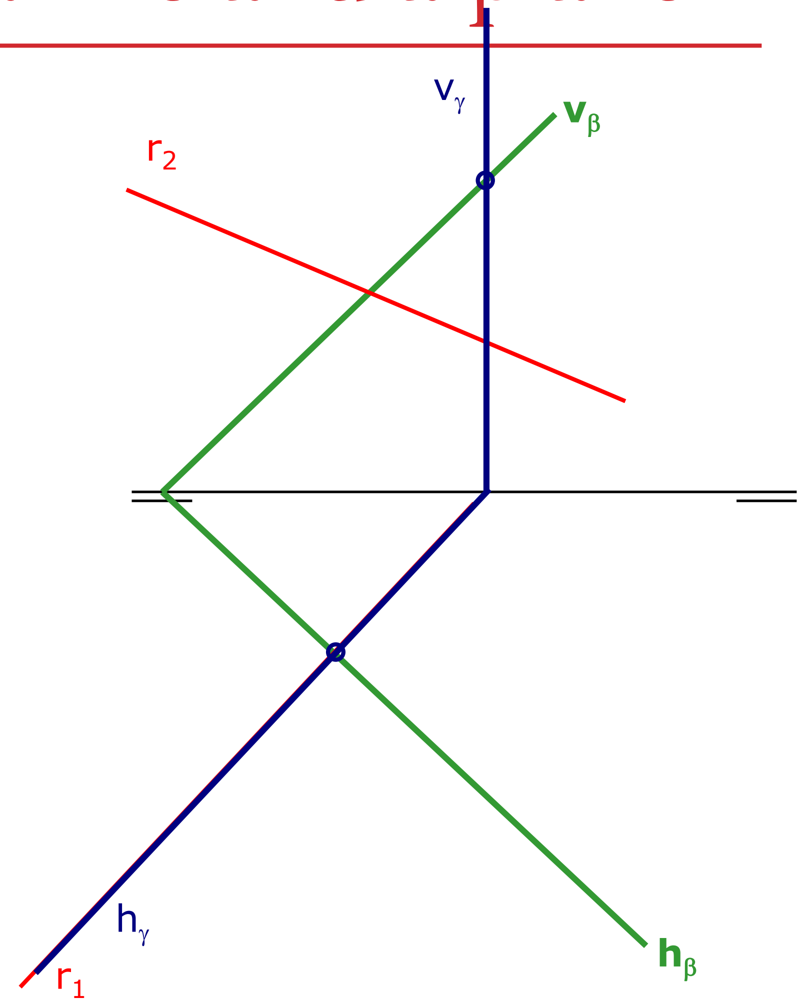
Planes parallel to the R.L.





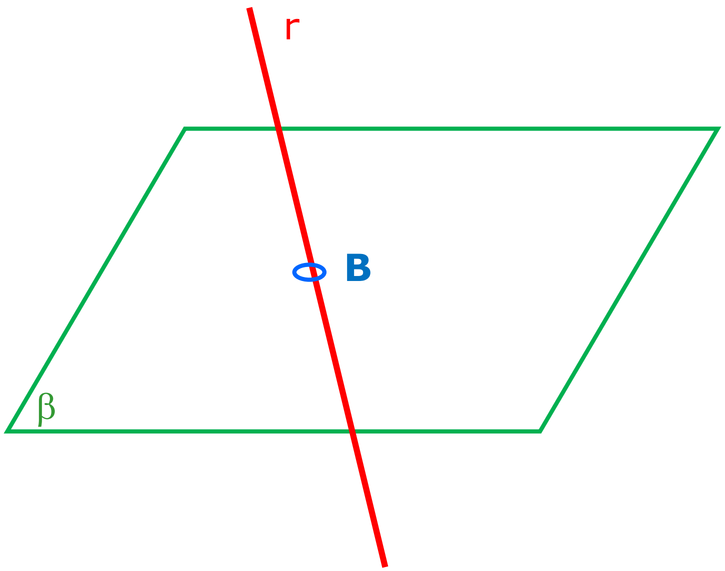
Intersection between a line and a plane

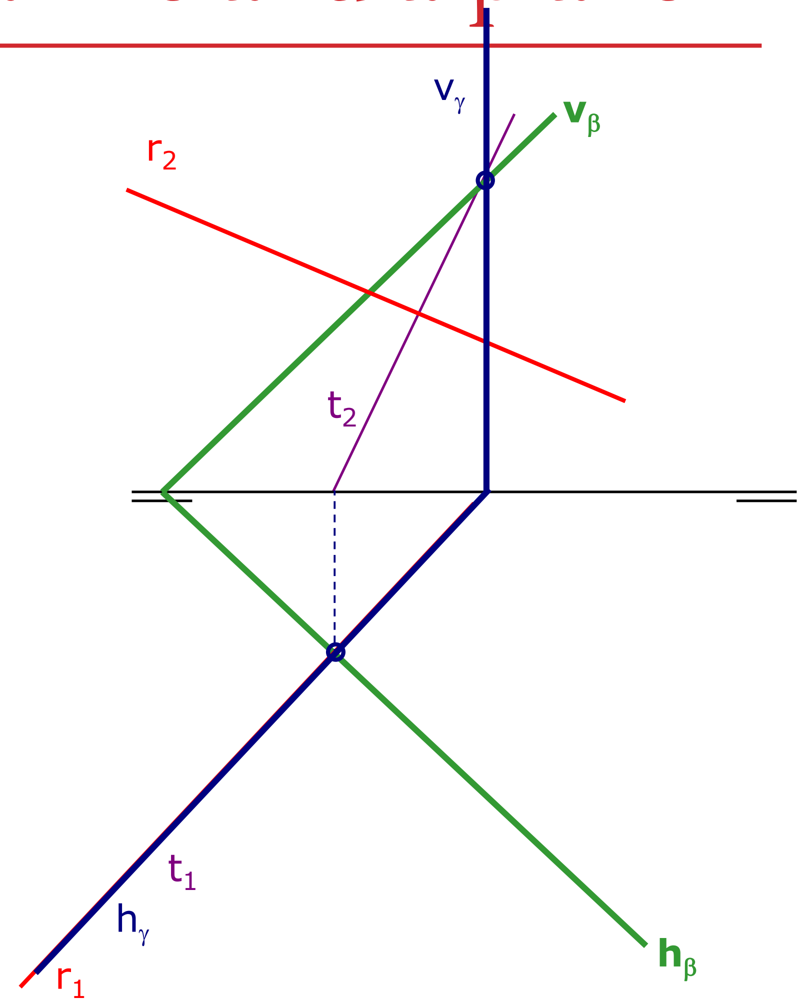




1. Create a plane γ that includes the line r. (easiest option vertical plane)

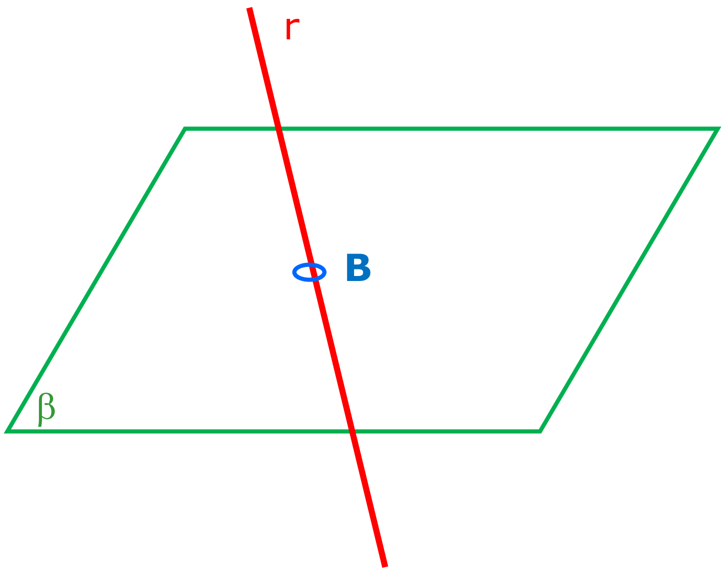
Intersection between a line and a plane

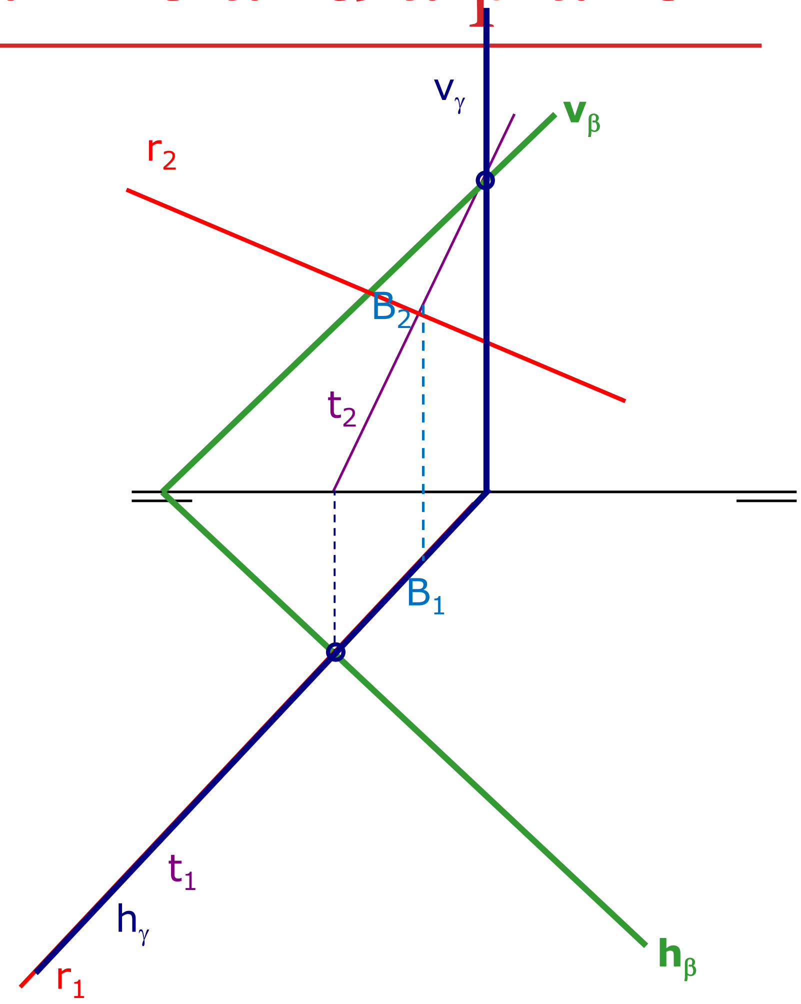




1. Create a plane γ that includes the line r. (easiest option vertical plane)
2. Calculate the intersection between plane γ and plane β -> Line t

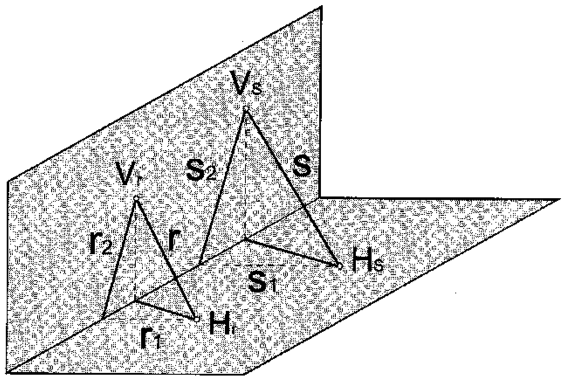
Intersection between a line and a plane

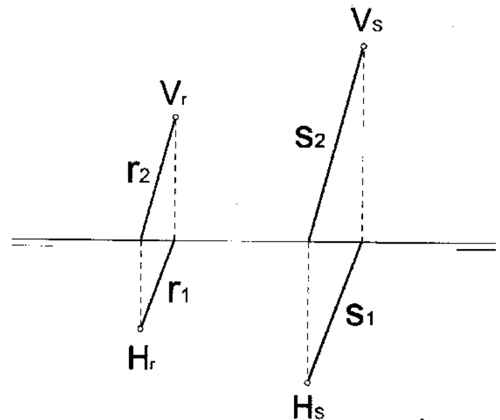




1. Create a plane γ that includes the line r. (easiest option vertical plane)
2. Calculate the intersection between plane γ and plane β -> Line t
3. Calculate the intersection of line t with given line r -> Point B

Relative positions: Parallelism I

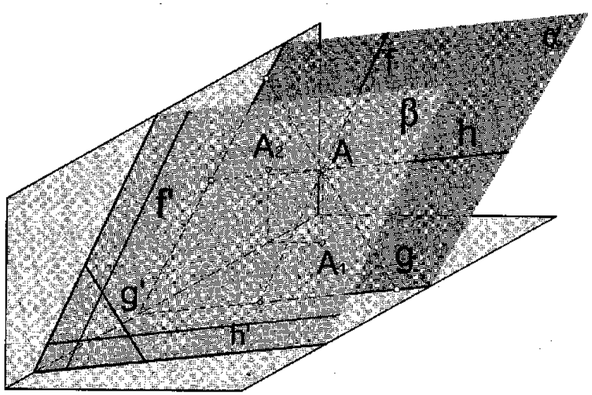


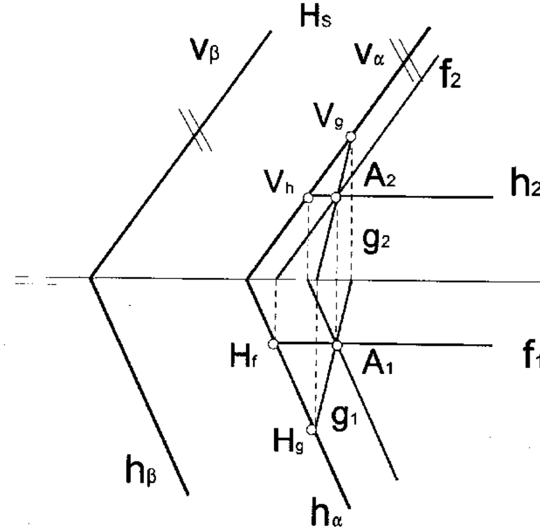


(1)

LINE WITH LINE:

2 lines are parallel if their projections are also parallel





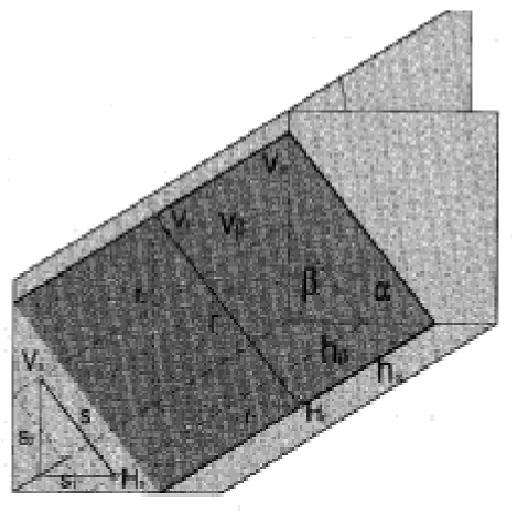
(2)

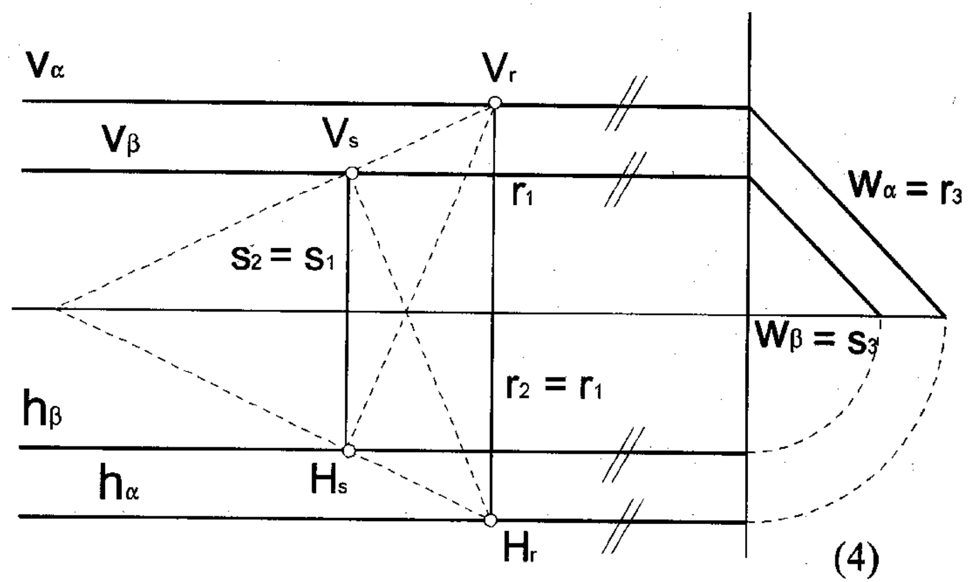
PLANE WITH PLANE:

their traces are parallel as well

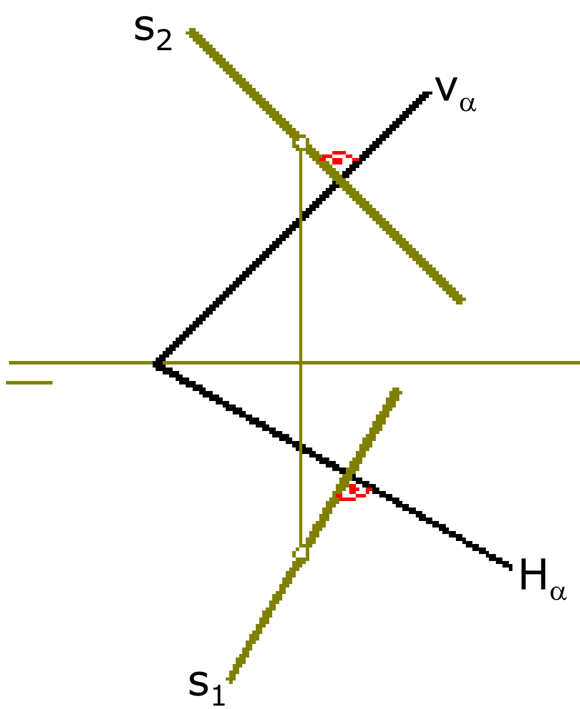
Relative positions. Parallelism II

PLANES PARALLELS TO THE R.L.: their profile traces should be parallel as well





Relative positions. Perpendicularity



- A line and a plane are perpendicular when the projections of the line are perpendicular to the plane traces. The perpendicularity line-line and plane-plane is not visible in the vertical or horizontal projection.
- If a line is perpendicular to a plane it is perpendicular to all the lines r, s, t ,etc. that belong to the plane.
- A plane is perpendicular to another plane if a line of one of the planes is perpendicular to the other plane.
- If a line (plane) is perpendicular to a plane (line) it is also perpendicular to all of its parallel plans (lines).