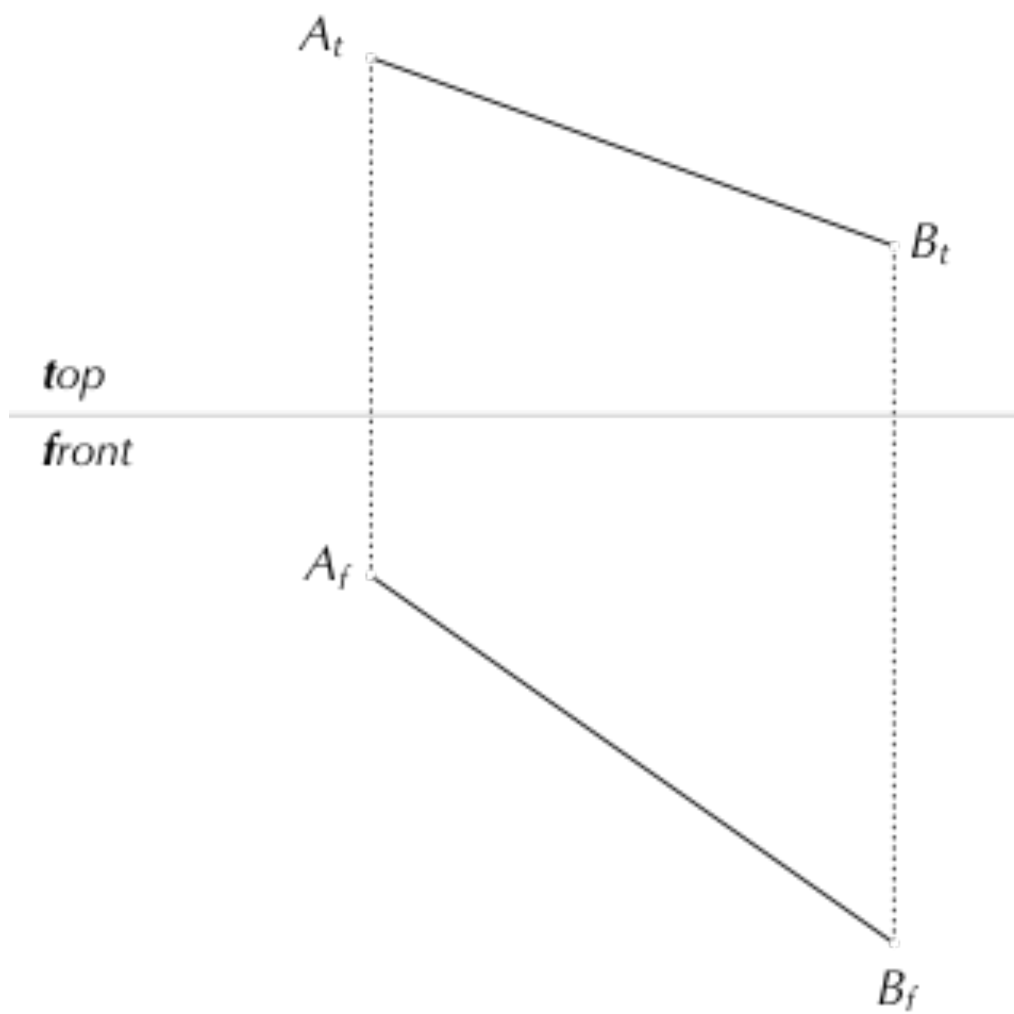
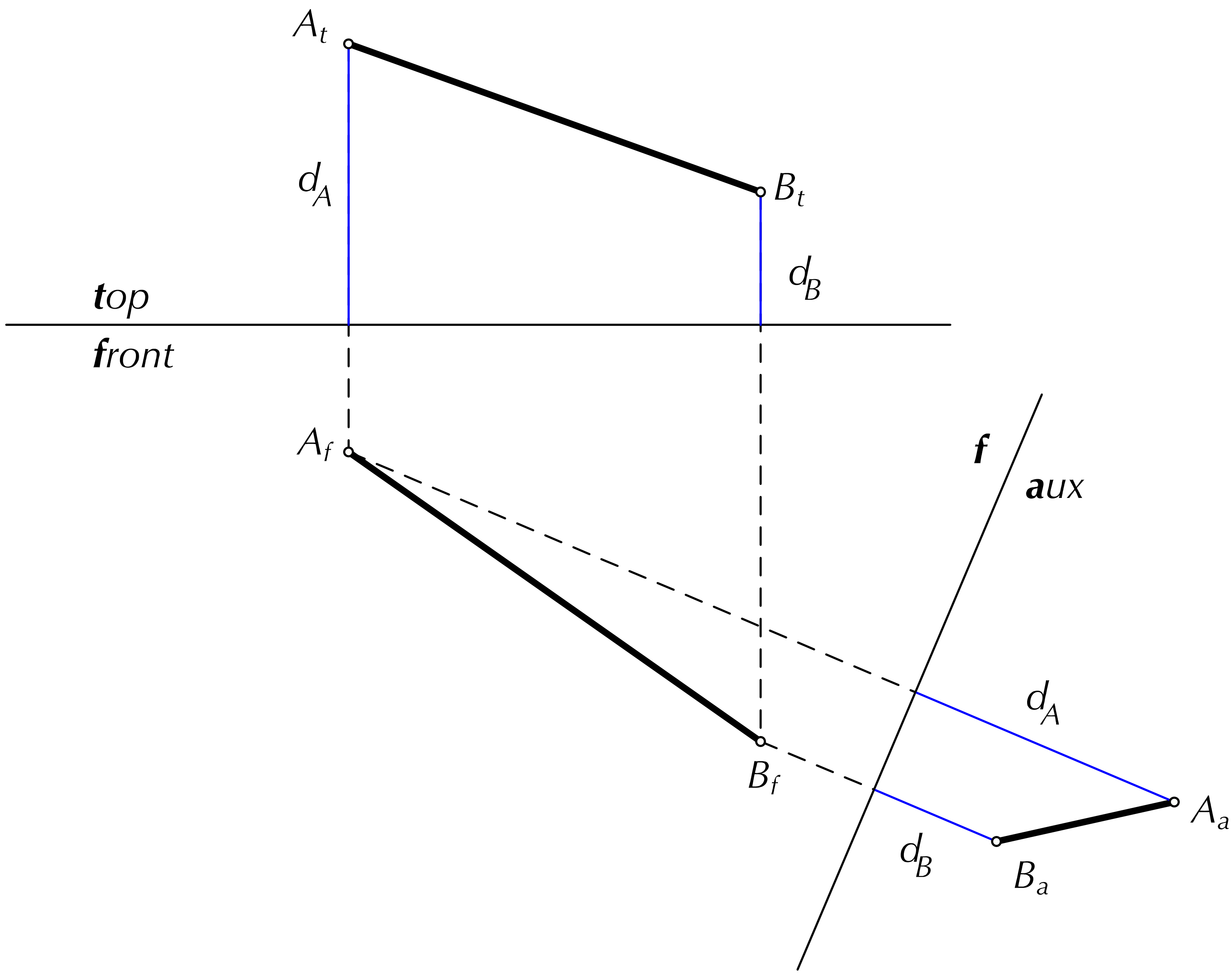
48-175
Descriptive Geometry

Lines in Descriptive Geometry

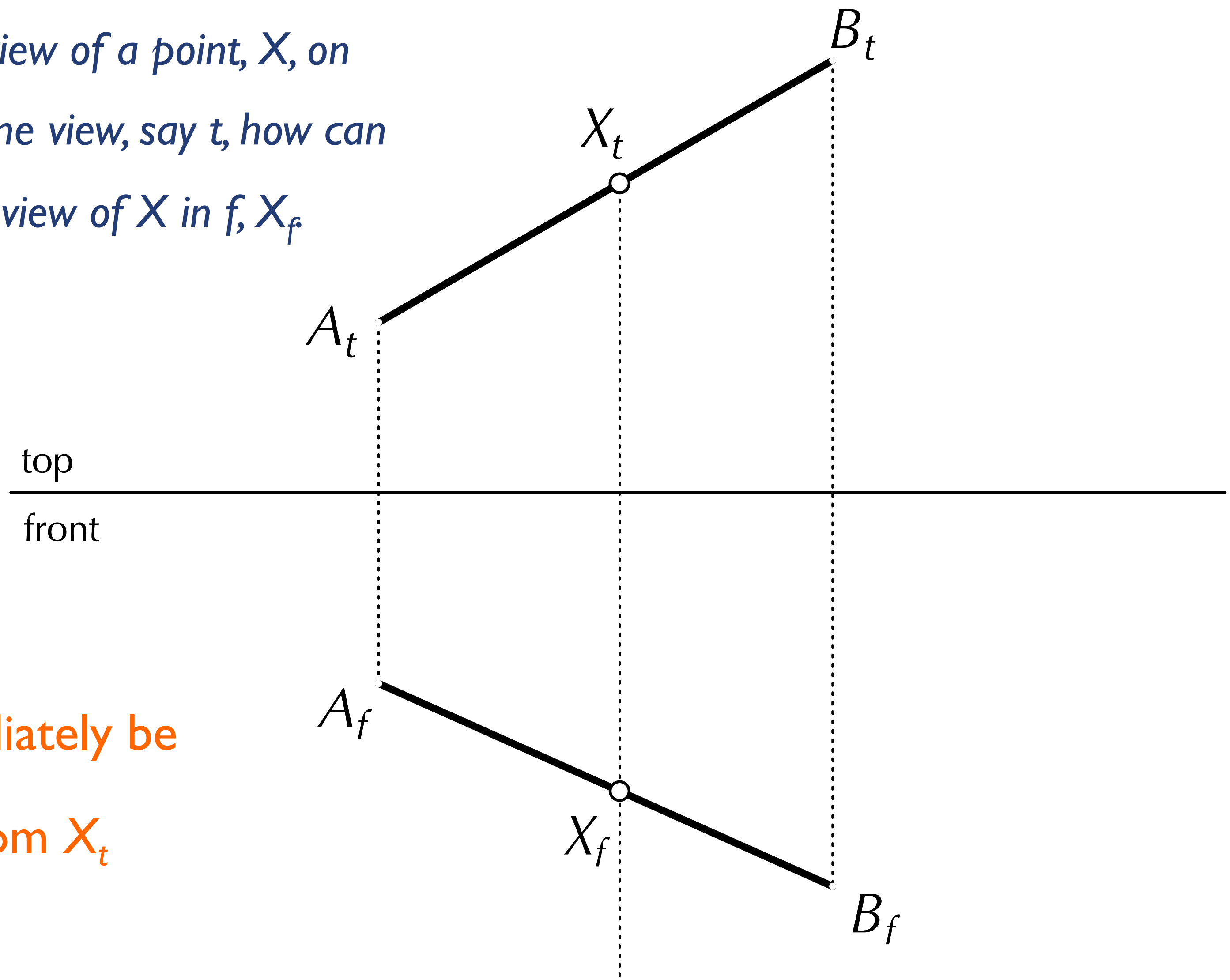


A_t
B_t
top
front
A_f
B_f



taking an auxiliary view of a line

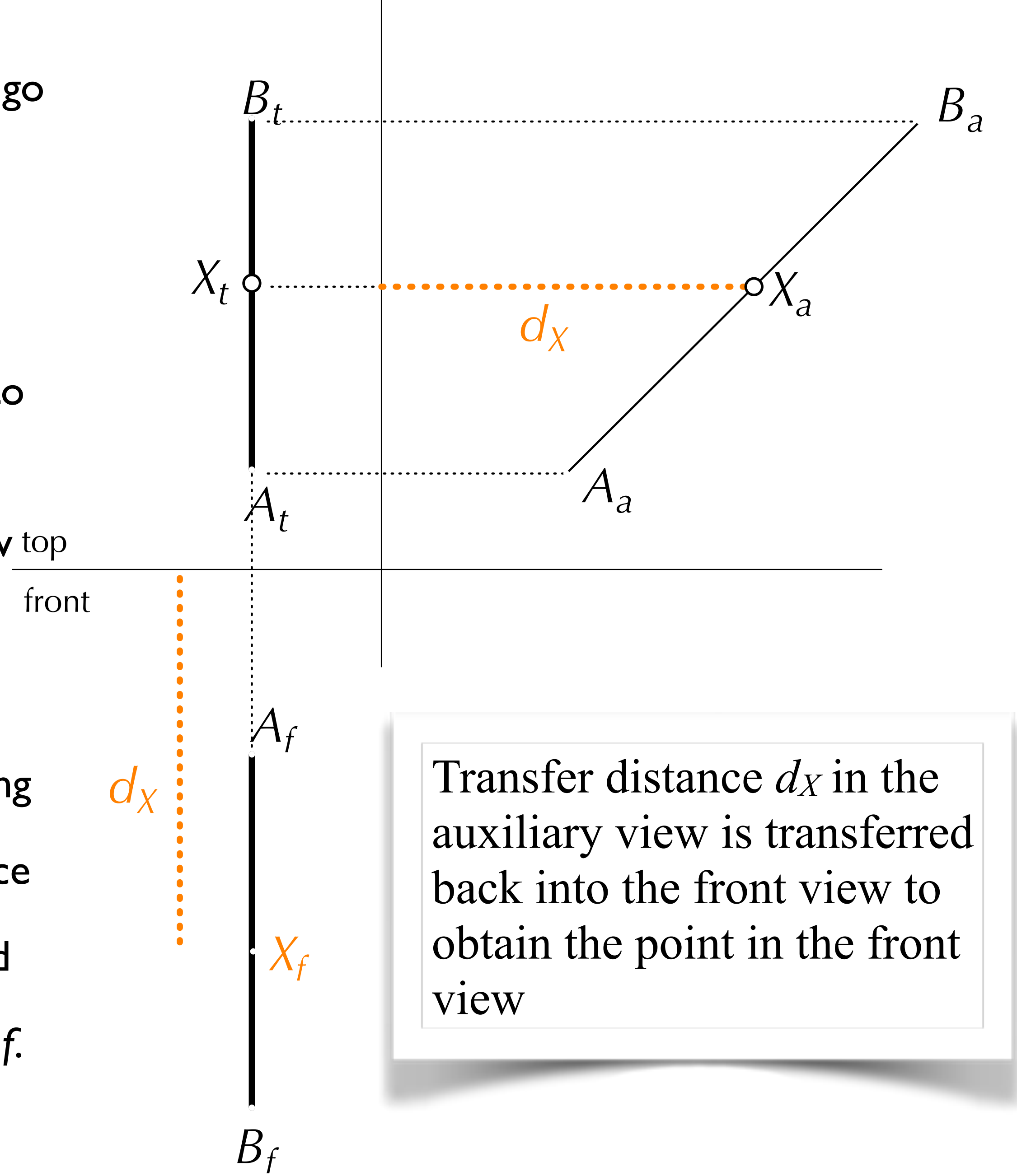
- *Given a segment in two adjacent views, t and f, and the view of a point, X, on the segment in one view, say t, how can we construct the view of X in f,* X_f



X_f can immediately be **projected** from X_t

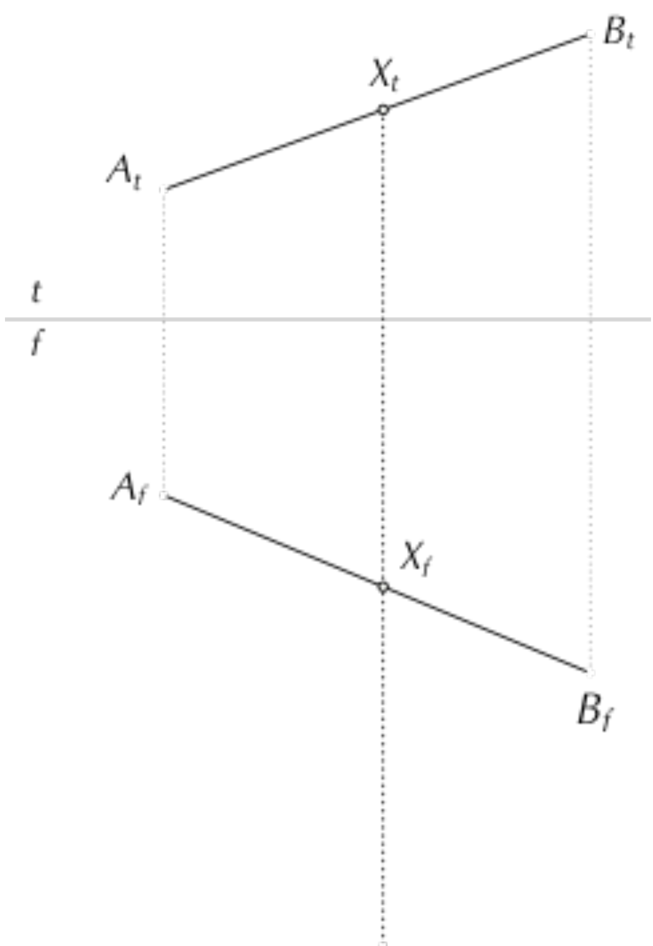
- *If the views are perpendicular,* we go through the following steps:

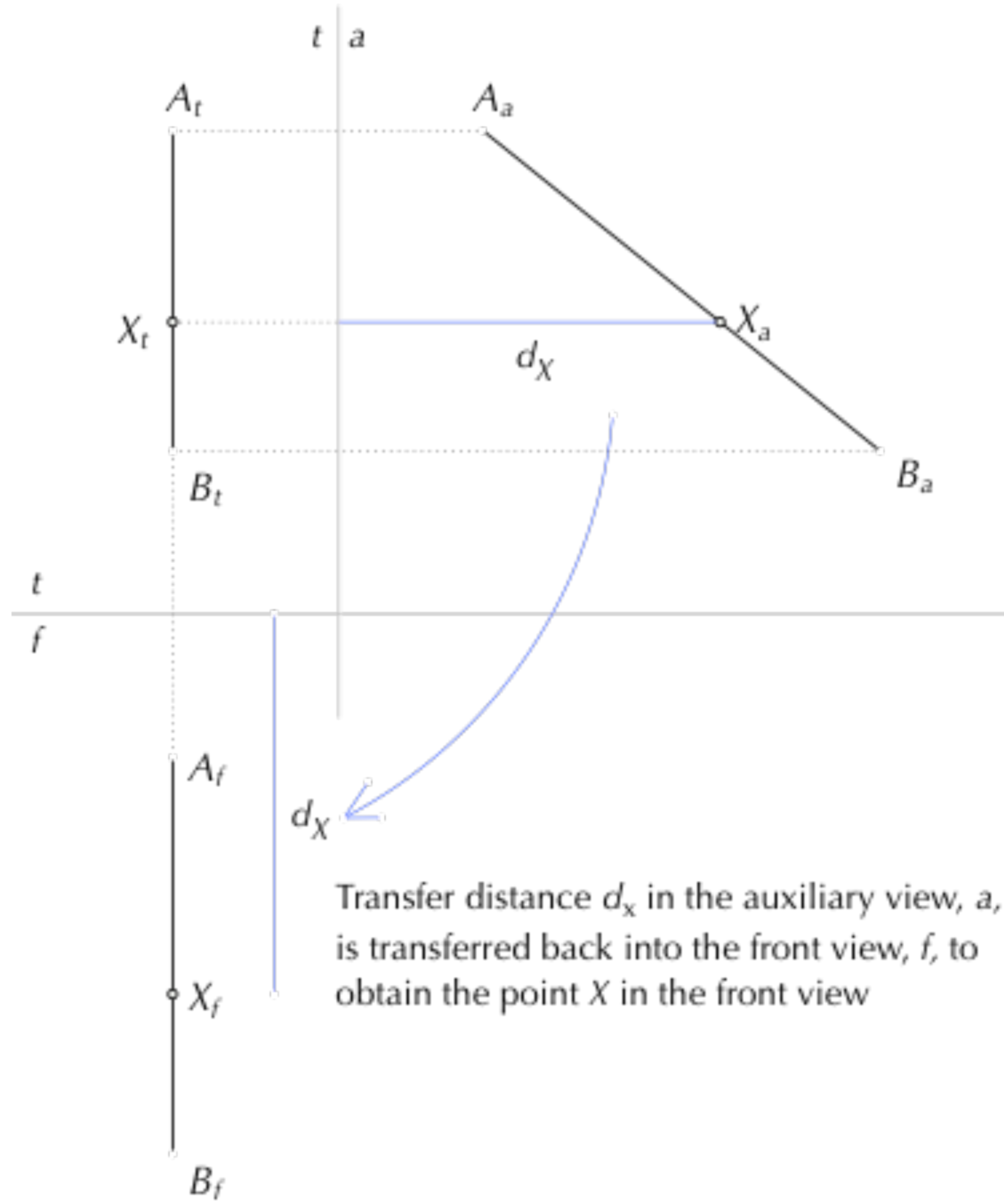
1. Use the auxiliary view construction to project the end-points of the segment into a view, *a*, adjacent to *p* and connect them to find the view of the segment.
2. Project X_t on the segment.
3. The distance of X_a from folding line t | *a*, d_X, is also the distance of X_q from folding line *t* | *f* and serves to locate that point in *f*.



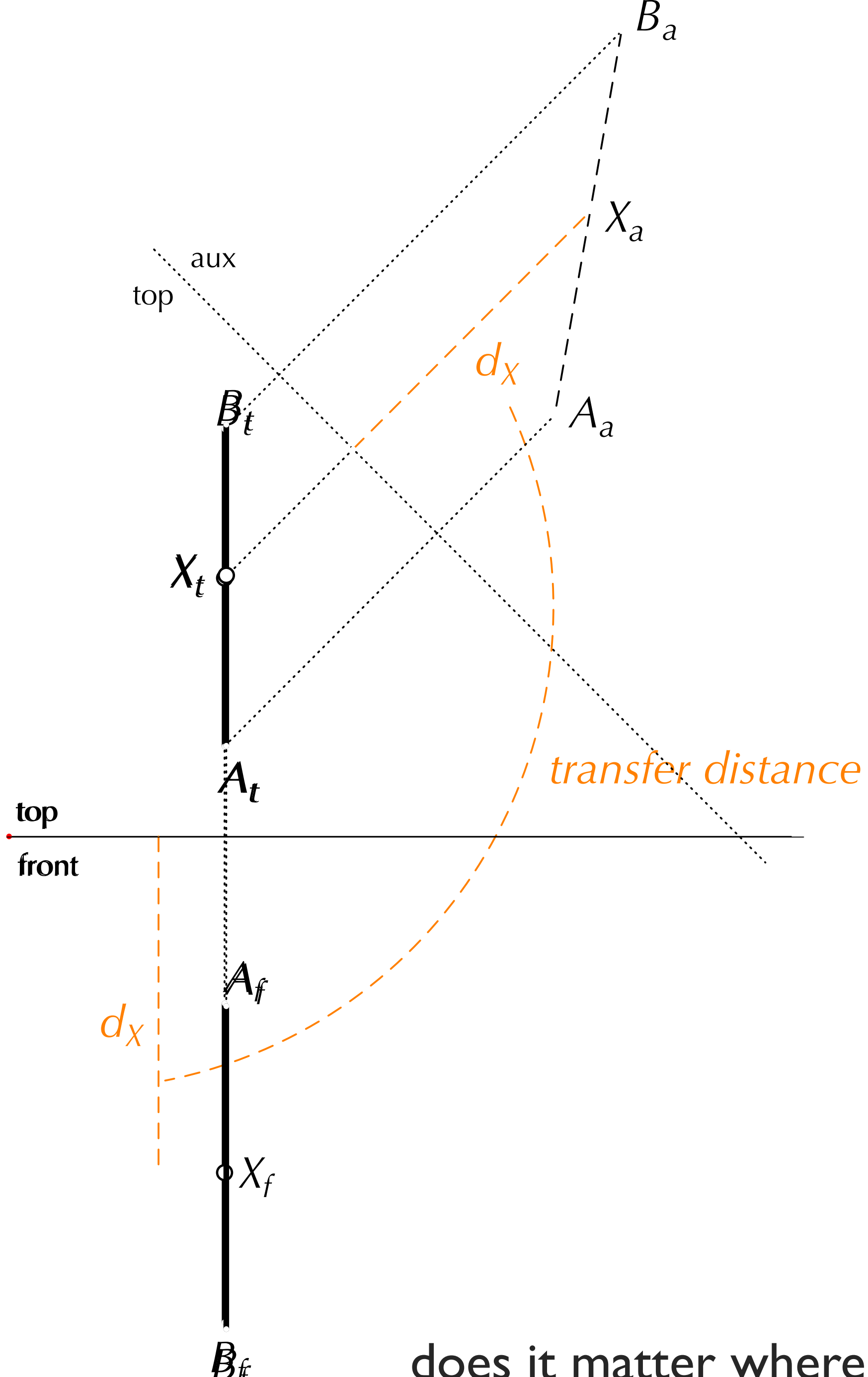
Transfer distance d_X in the auxiliary view is transferred back into the front view to obtain the point in the front view

construction: where is the point?

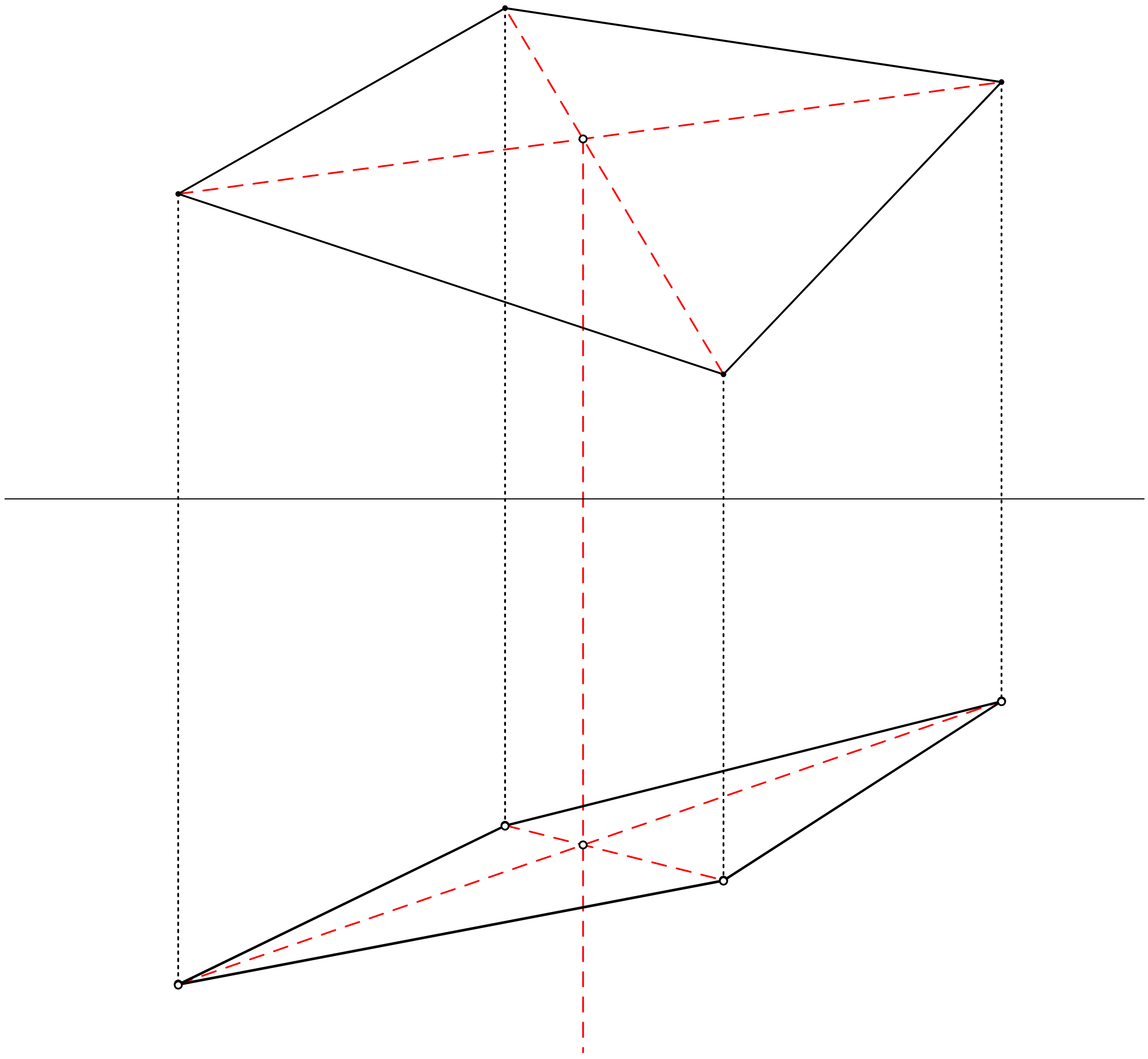




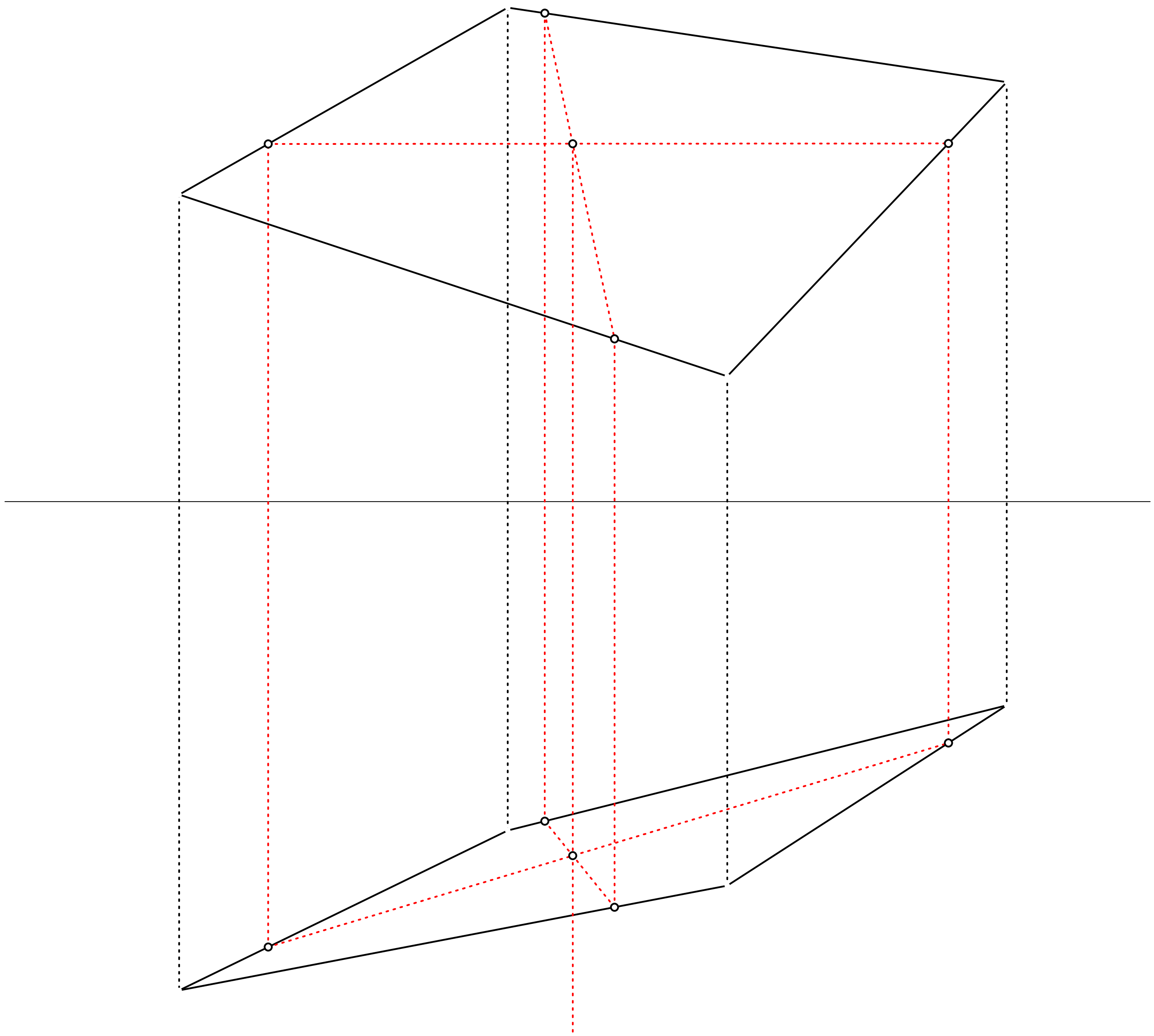
- summary – where is the point?



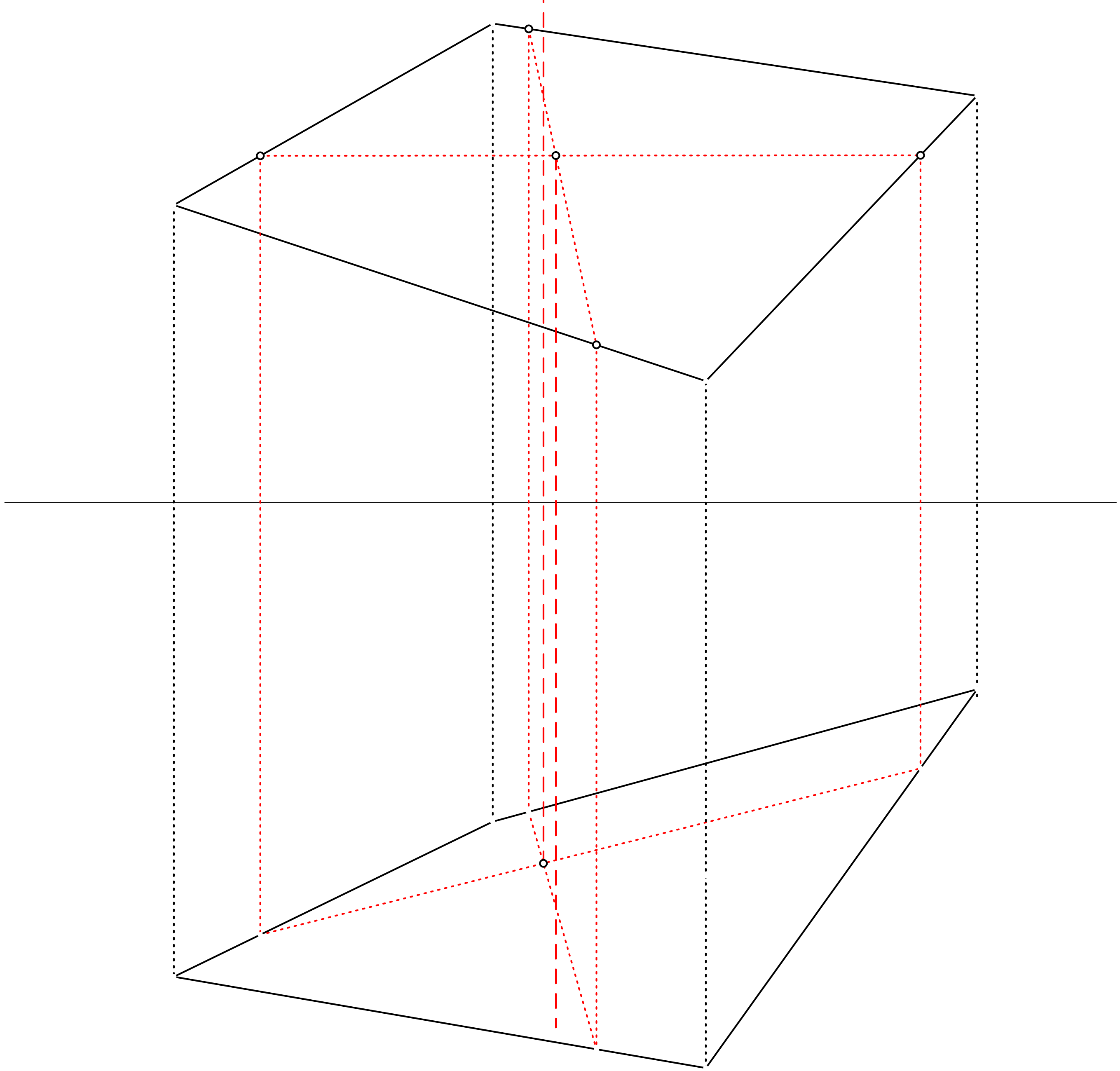
does it matter where I take the auxiliary view?



- Quiz-how do you know if a figure is planar



a variation

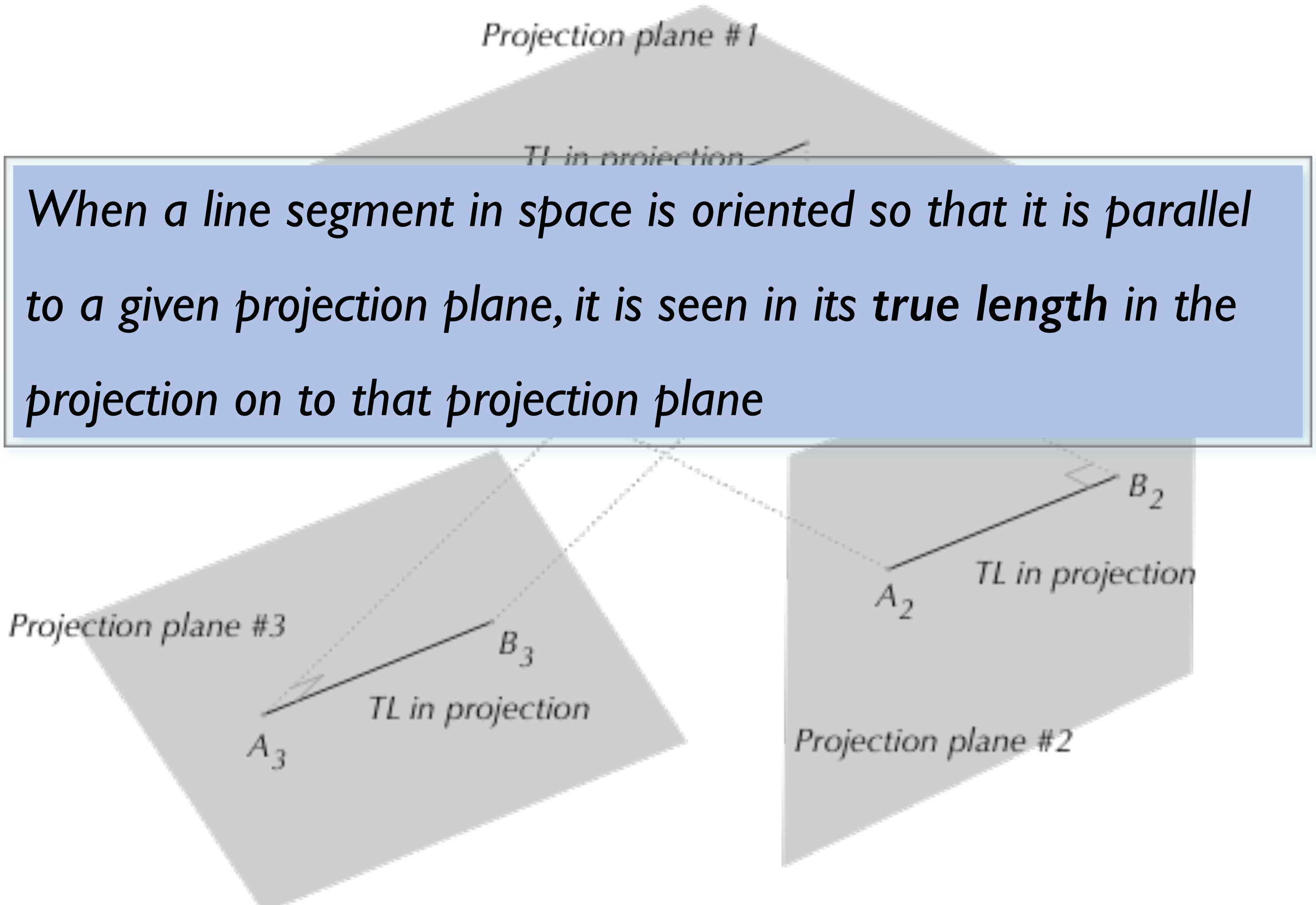


- here's one that is not planar

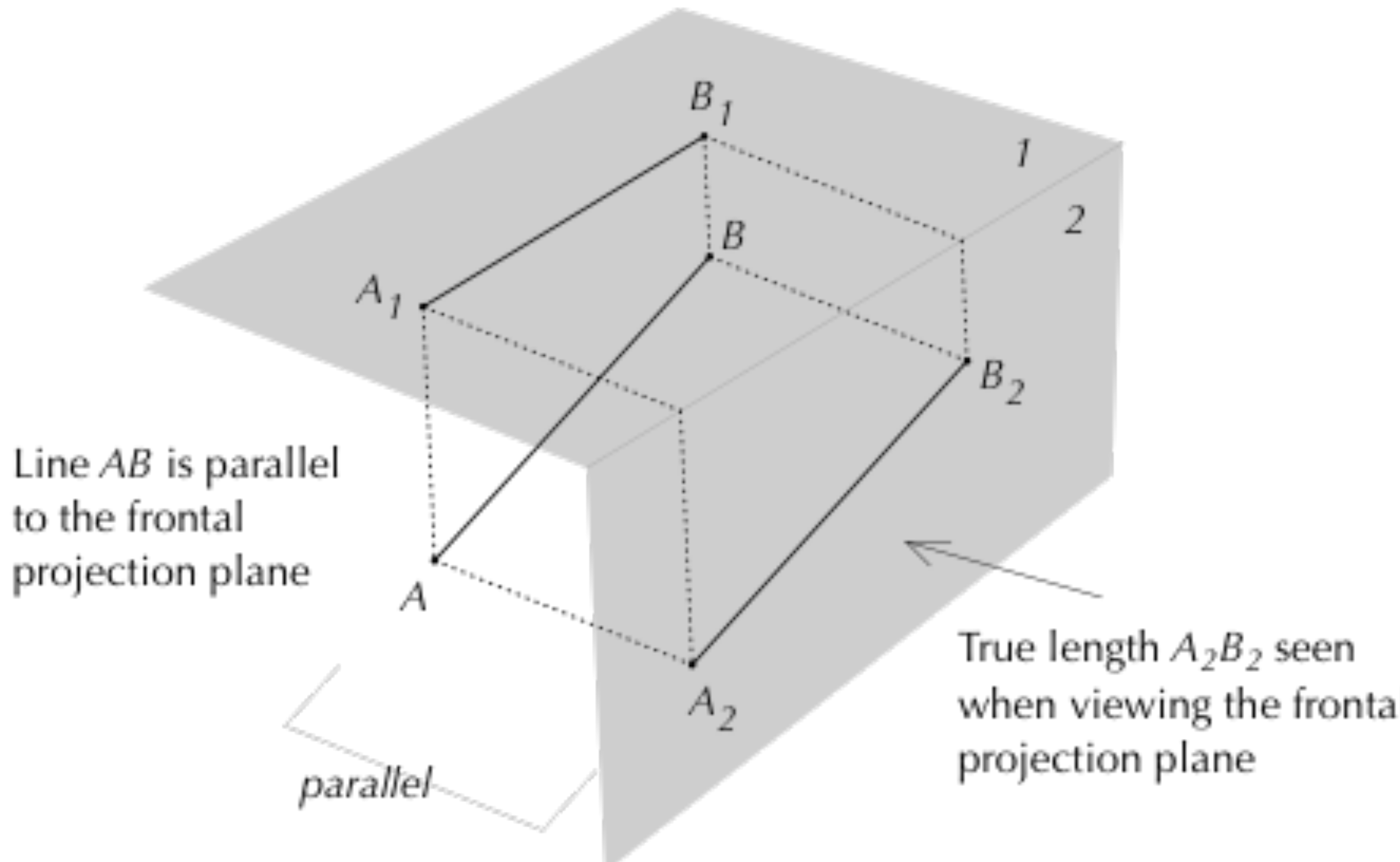
the first basic construction

true length of a segment

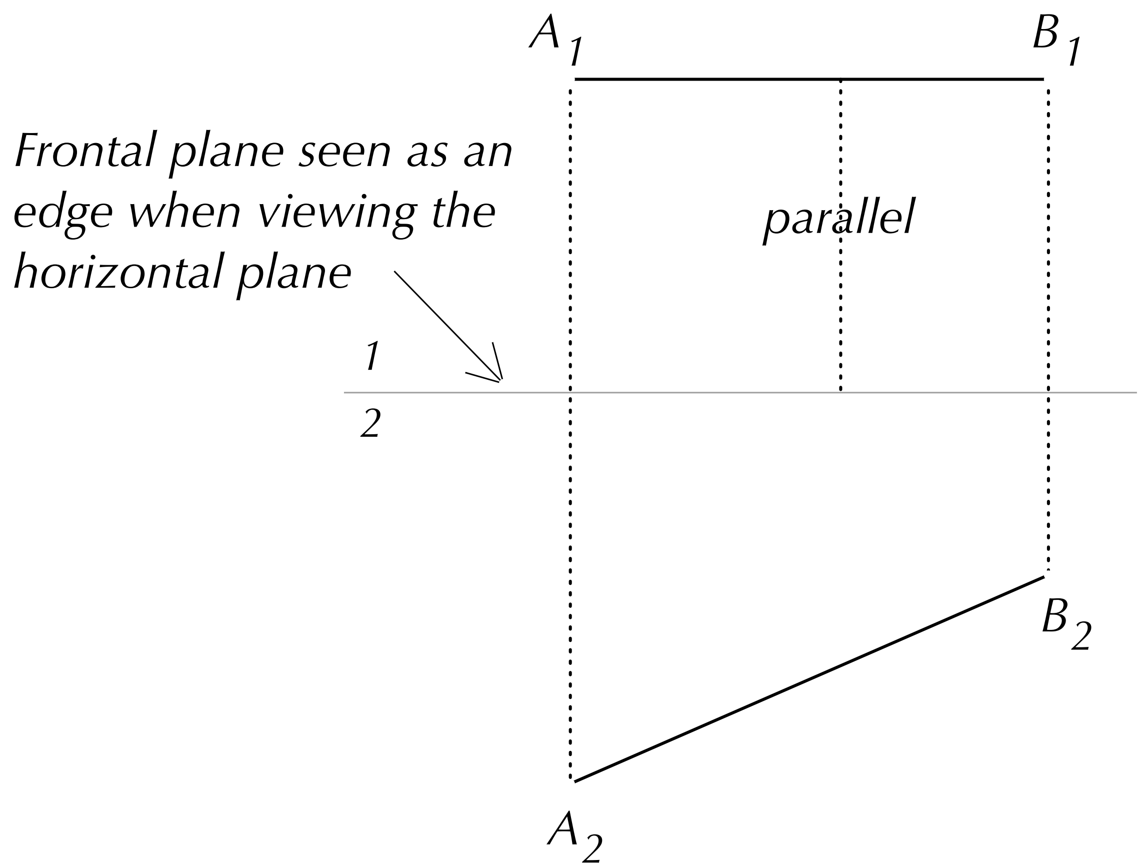
The ***true length*** (TL) of a segment is the distance between its end-points.



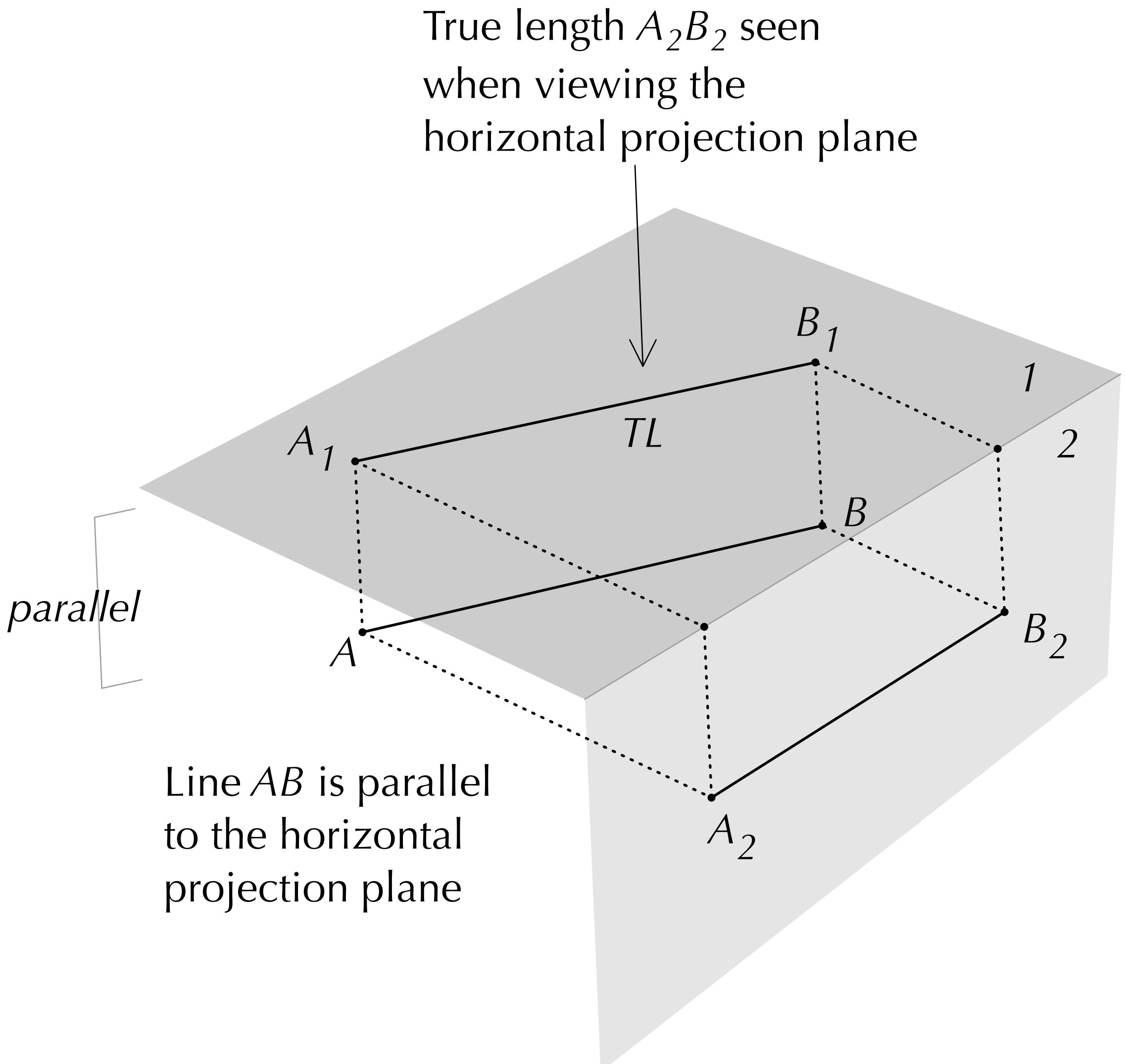
*When a line segment in space is oriented so that it is parallel to a given projection plane, it is seen in its **true length** in the projection on to that projection plane*



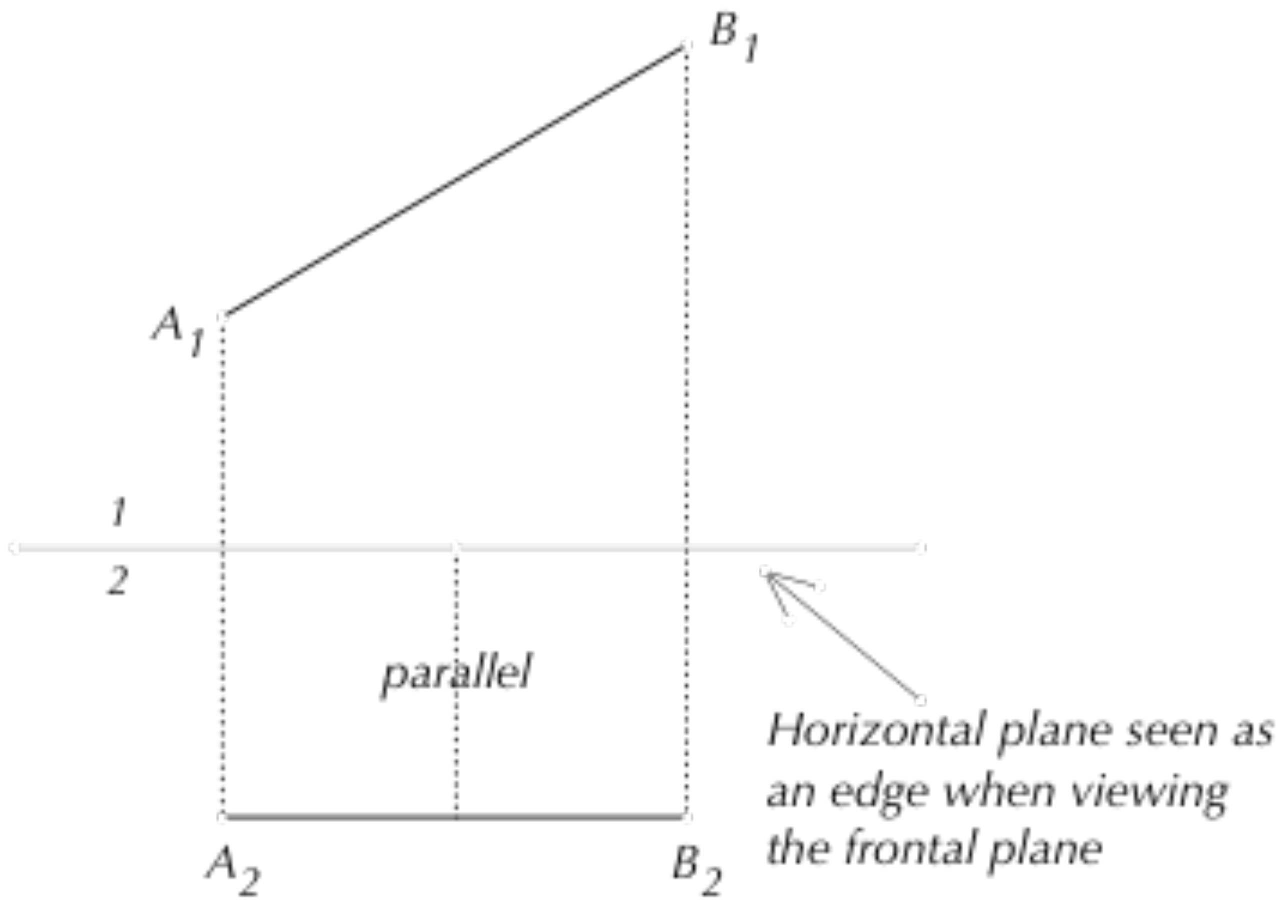
- segments seen in true length



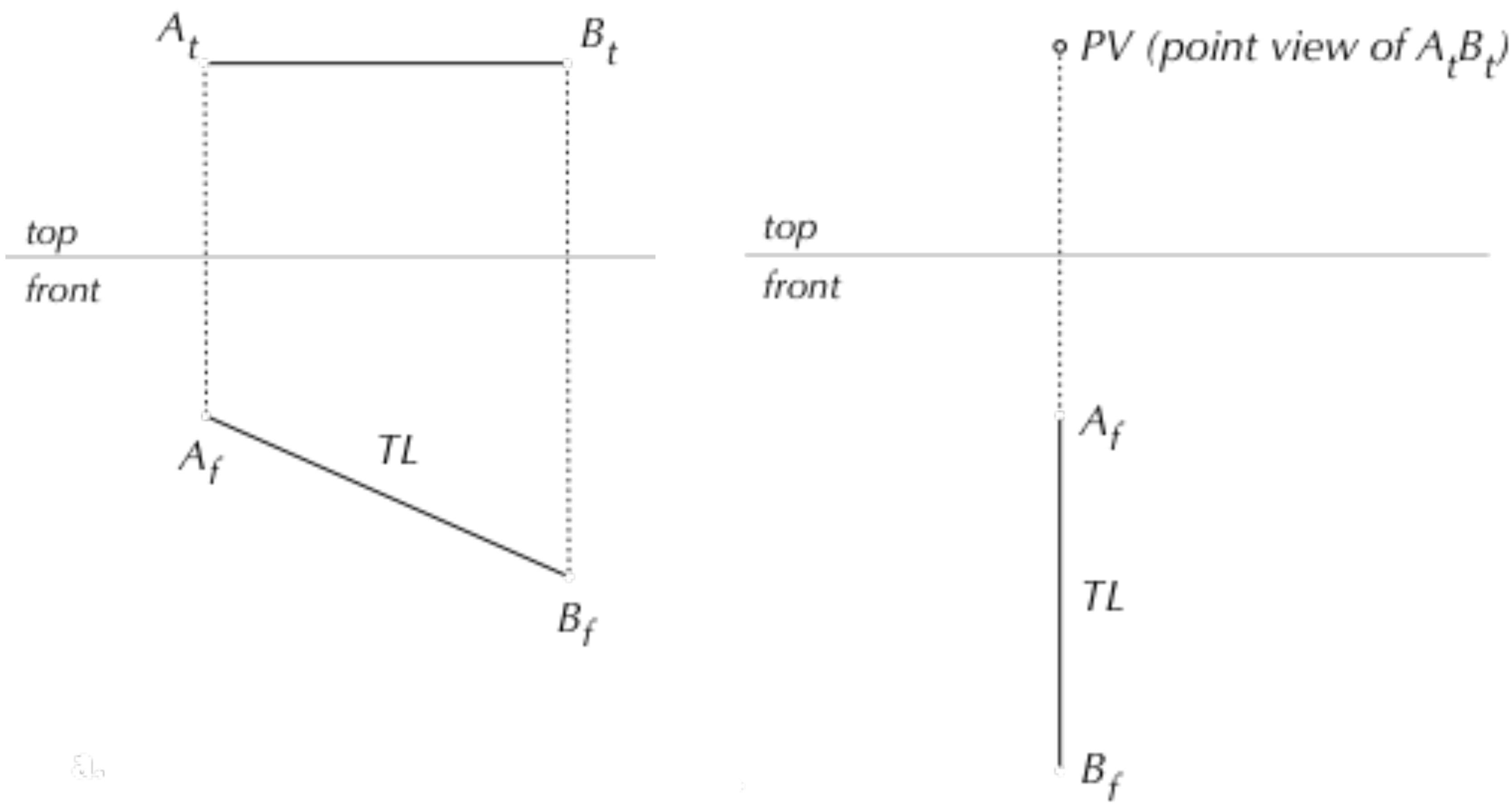
- segments seen in true length



segments seen in TL

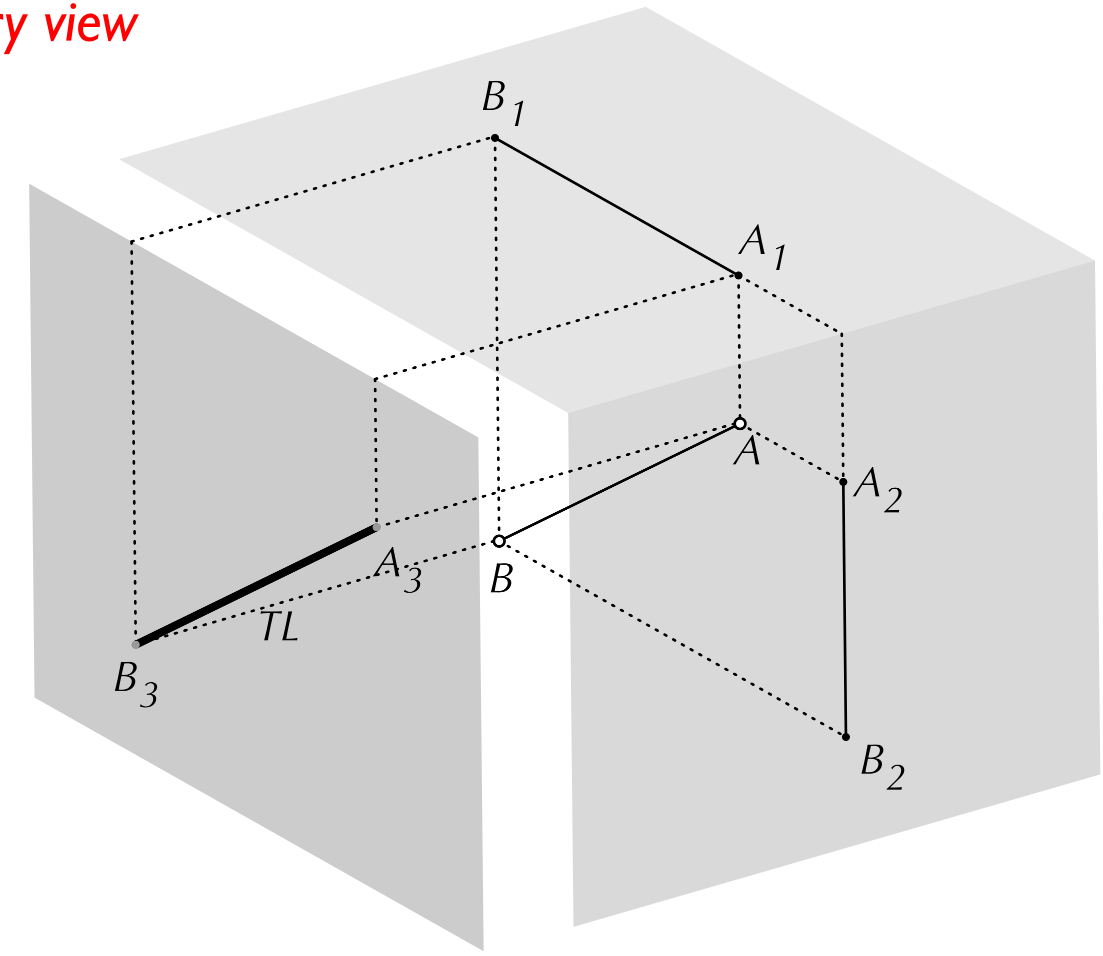


- segments seen in TL

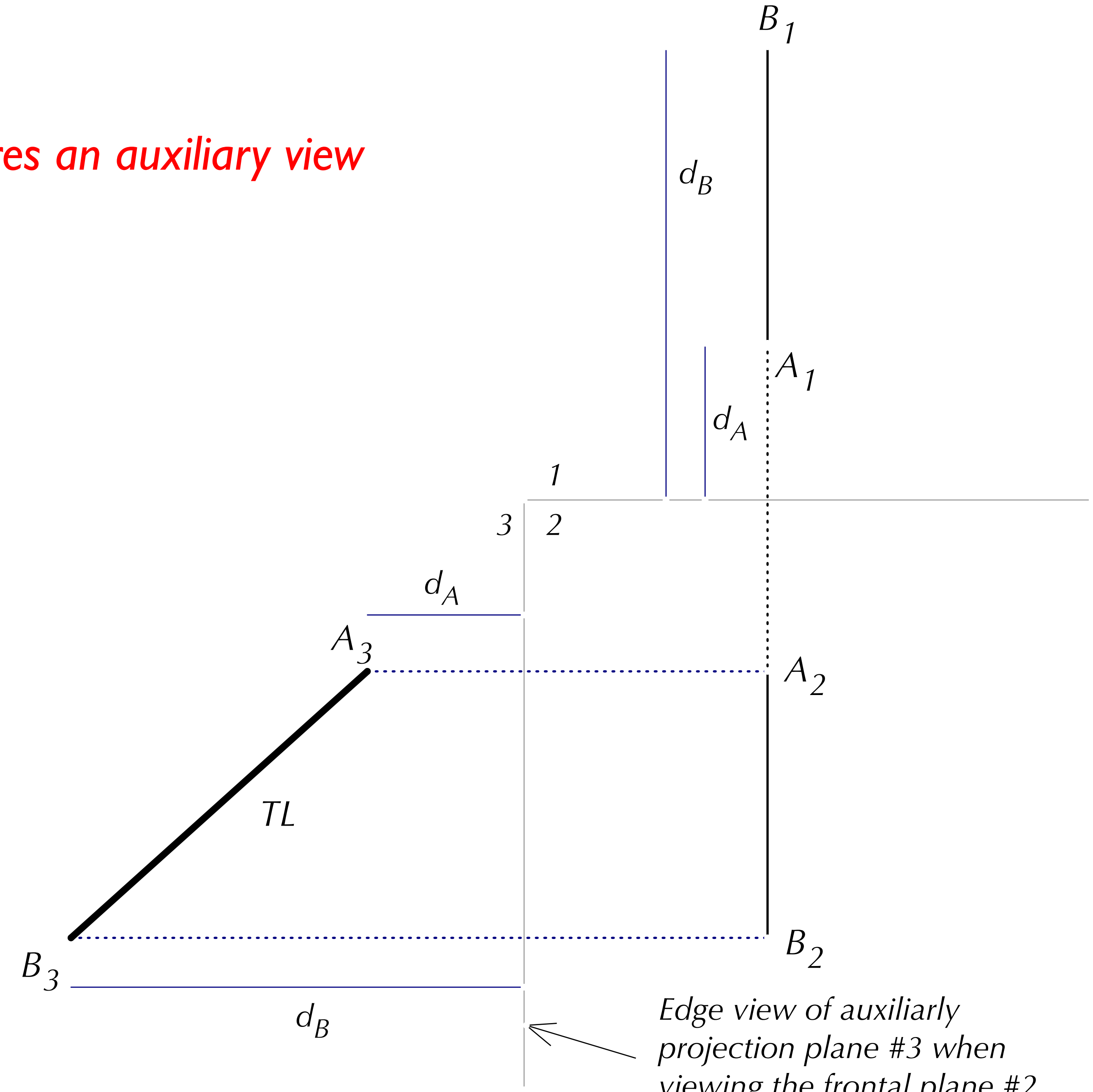


- two cases when segments seen in TL

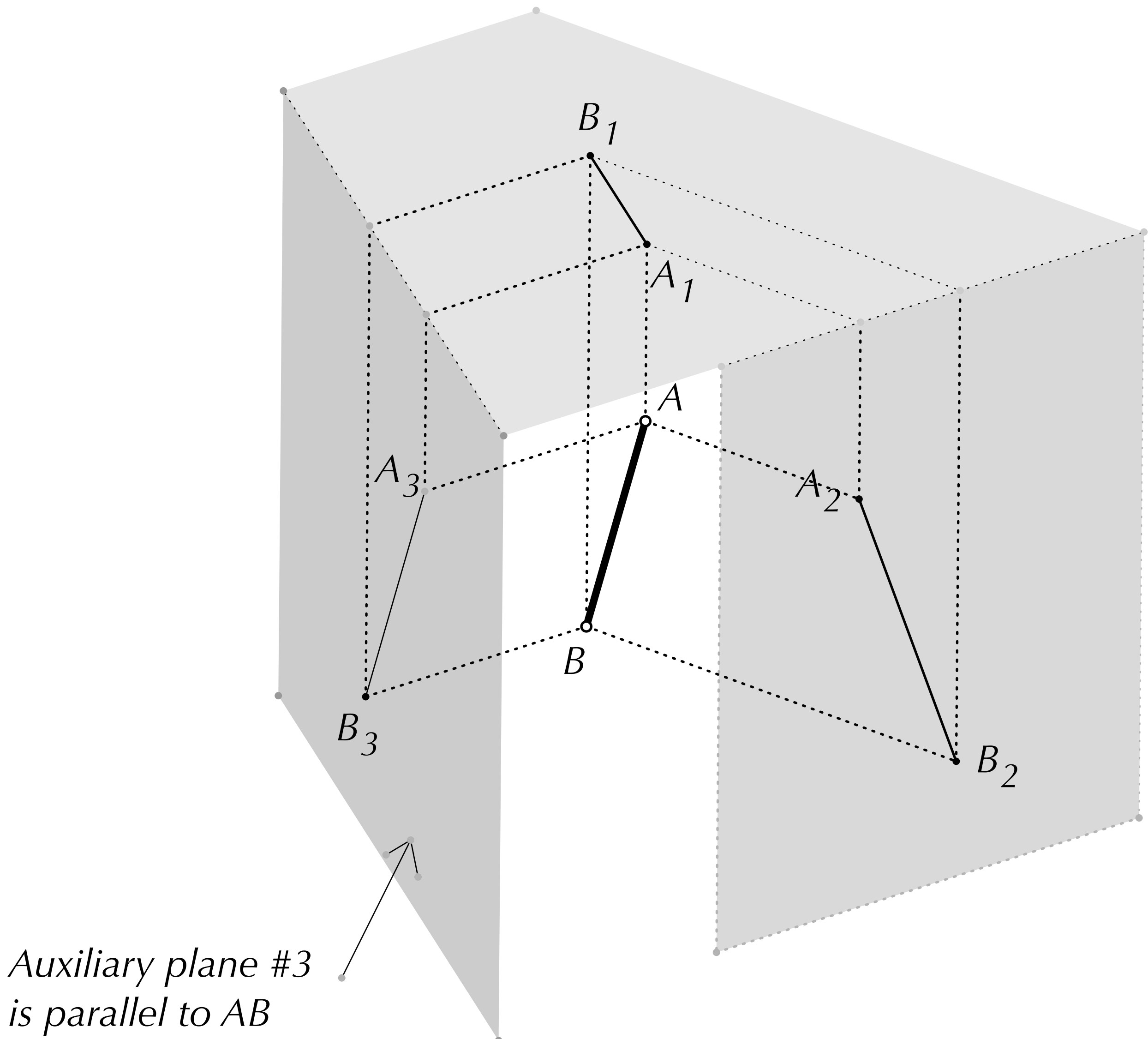
requires an auxiliary view



- when lines are perpendicular to the folding line *requires an auxiliary view*



- when lines are perpendicular to the folding line



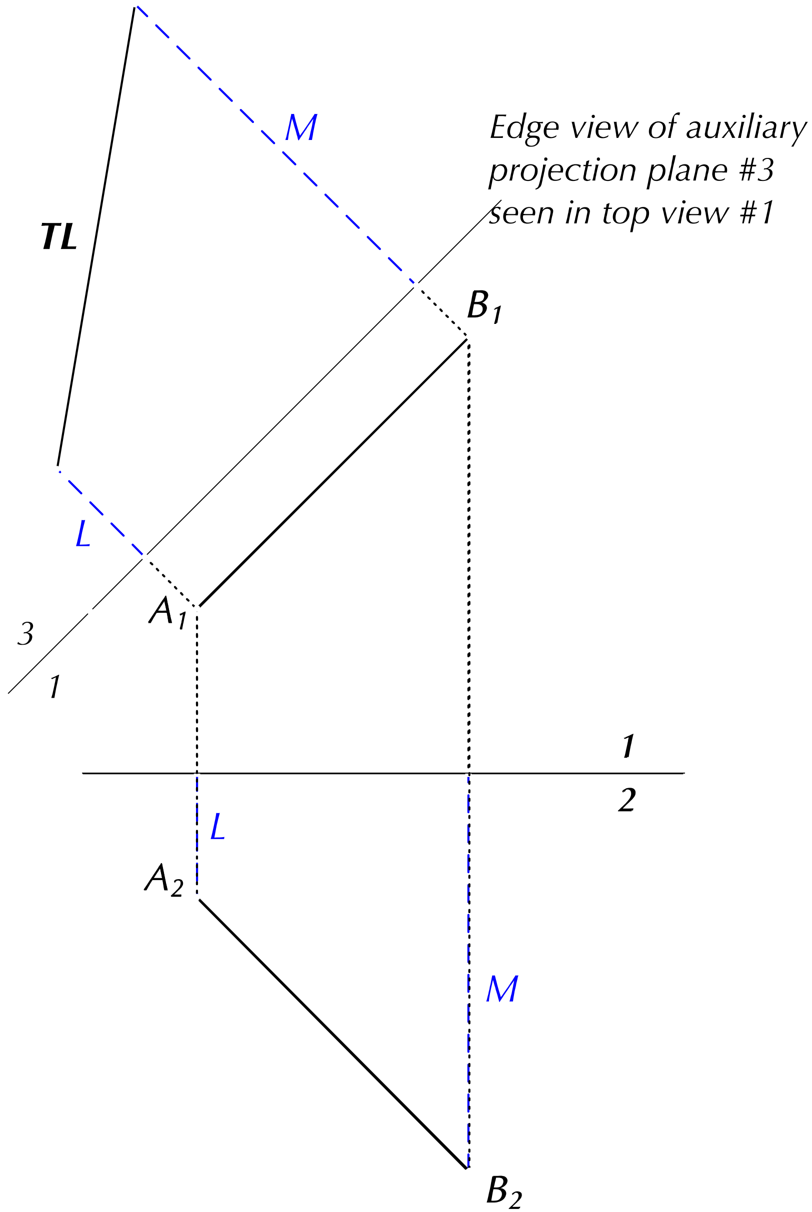
construction: TL of a segment

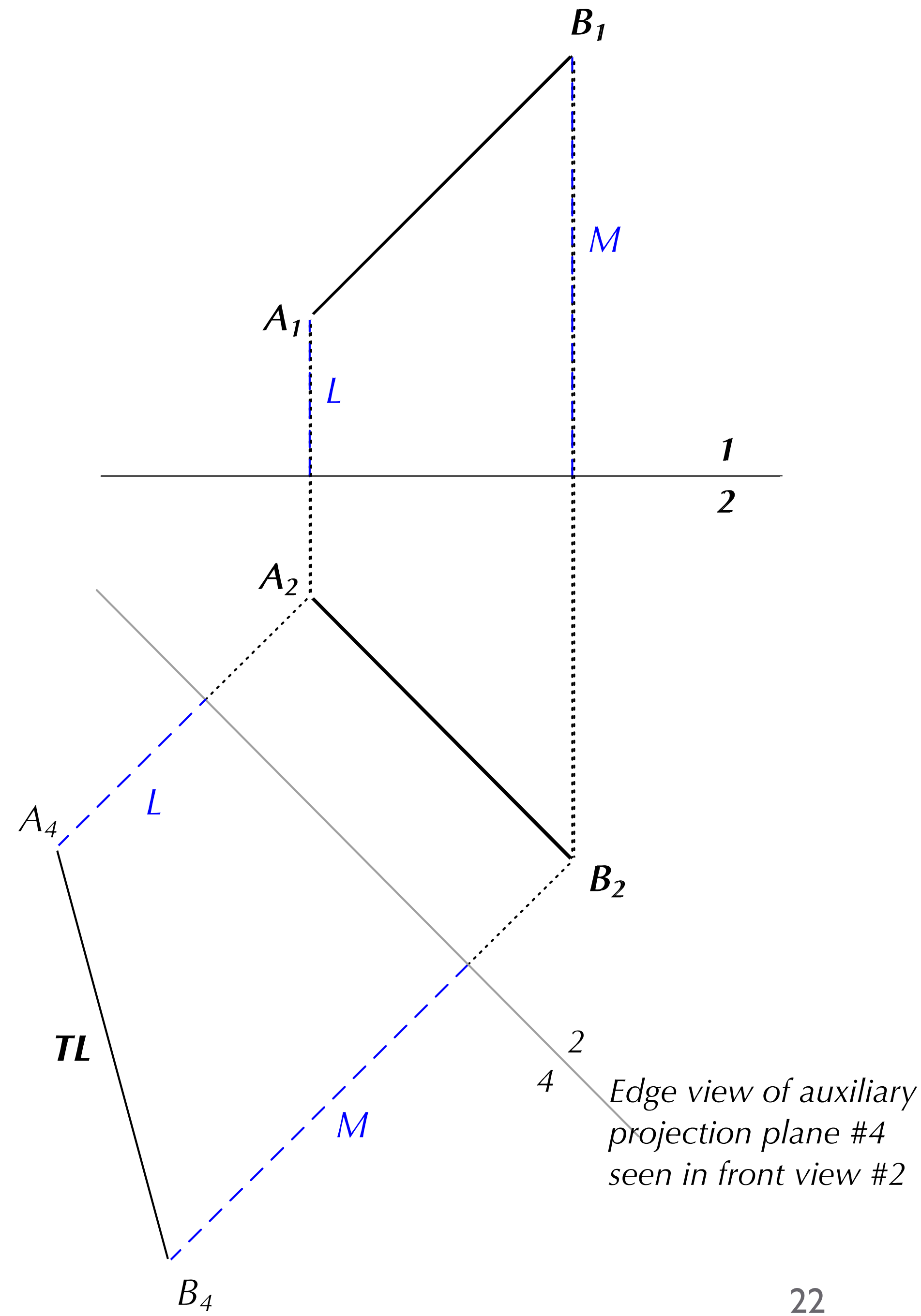
Given two adjacent views, 1 and 2, of an oblique segment, determine the TL of the segment.

There are three steps.

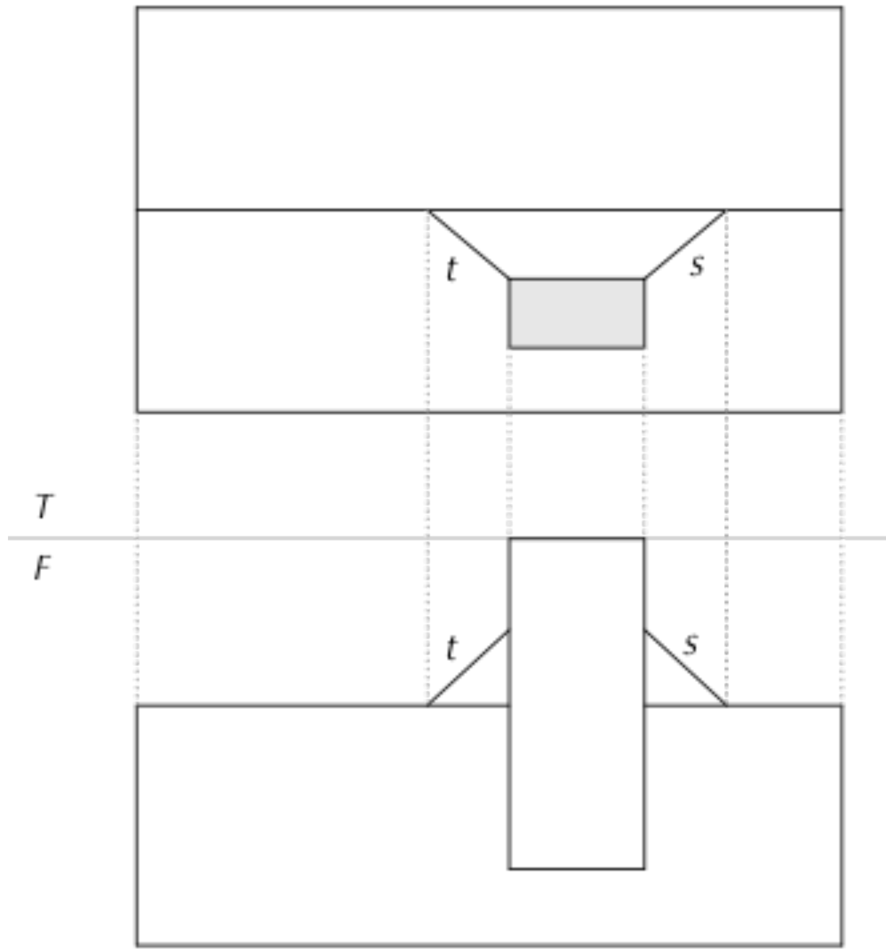
1. Select a view, say 1, and draw a folding line, 1 | 3, parallel to the segment for an auxiliary view 3
2. Project the endpoints of the segment into the auxiliary view
3. Connect the projected endpoints.

The resulting view shows the segment in TL.

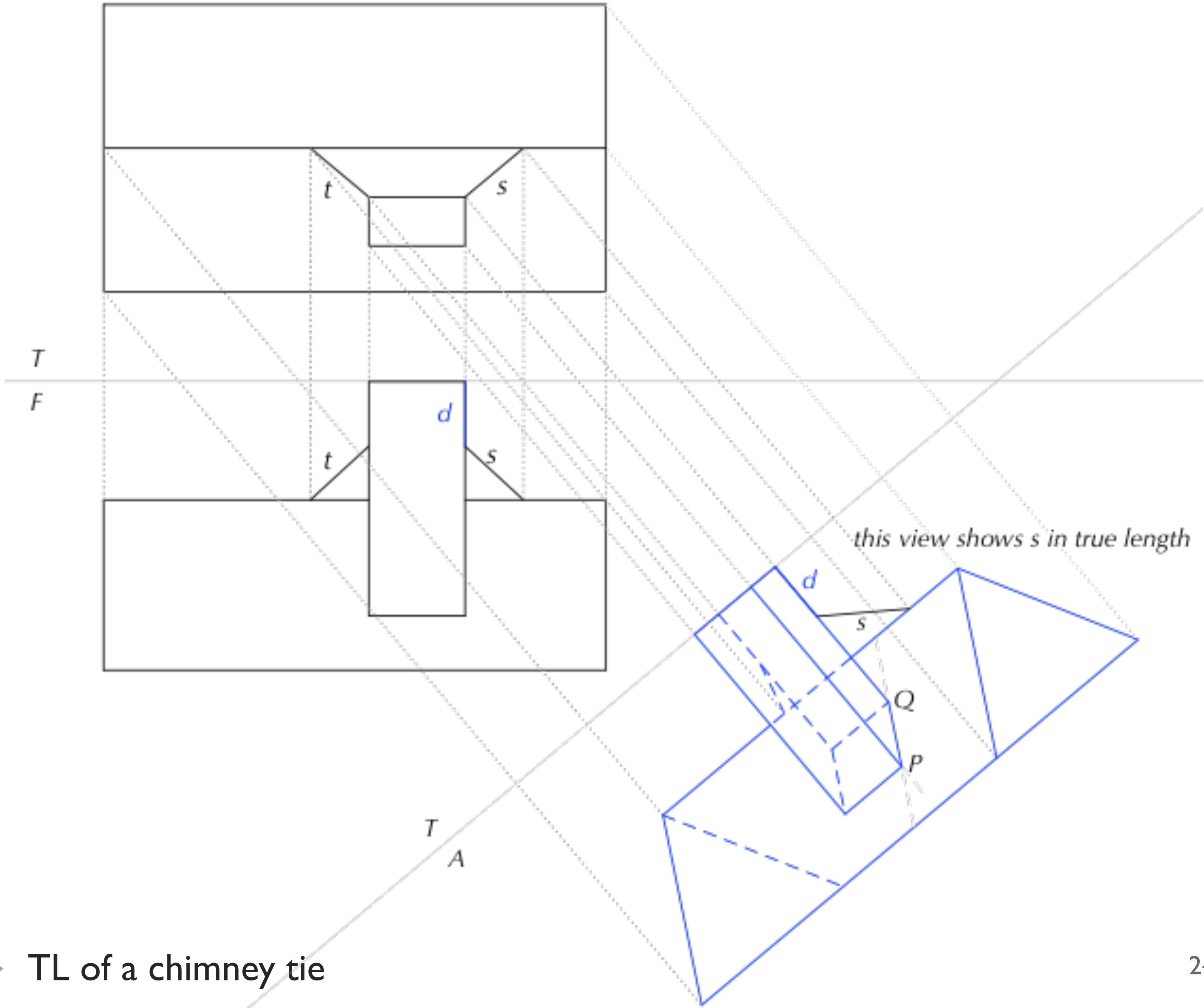




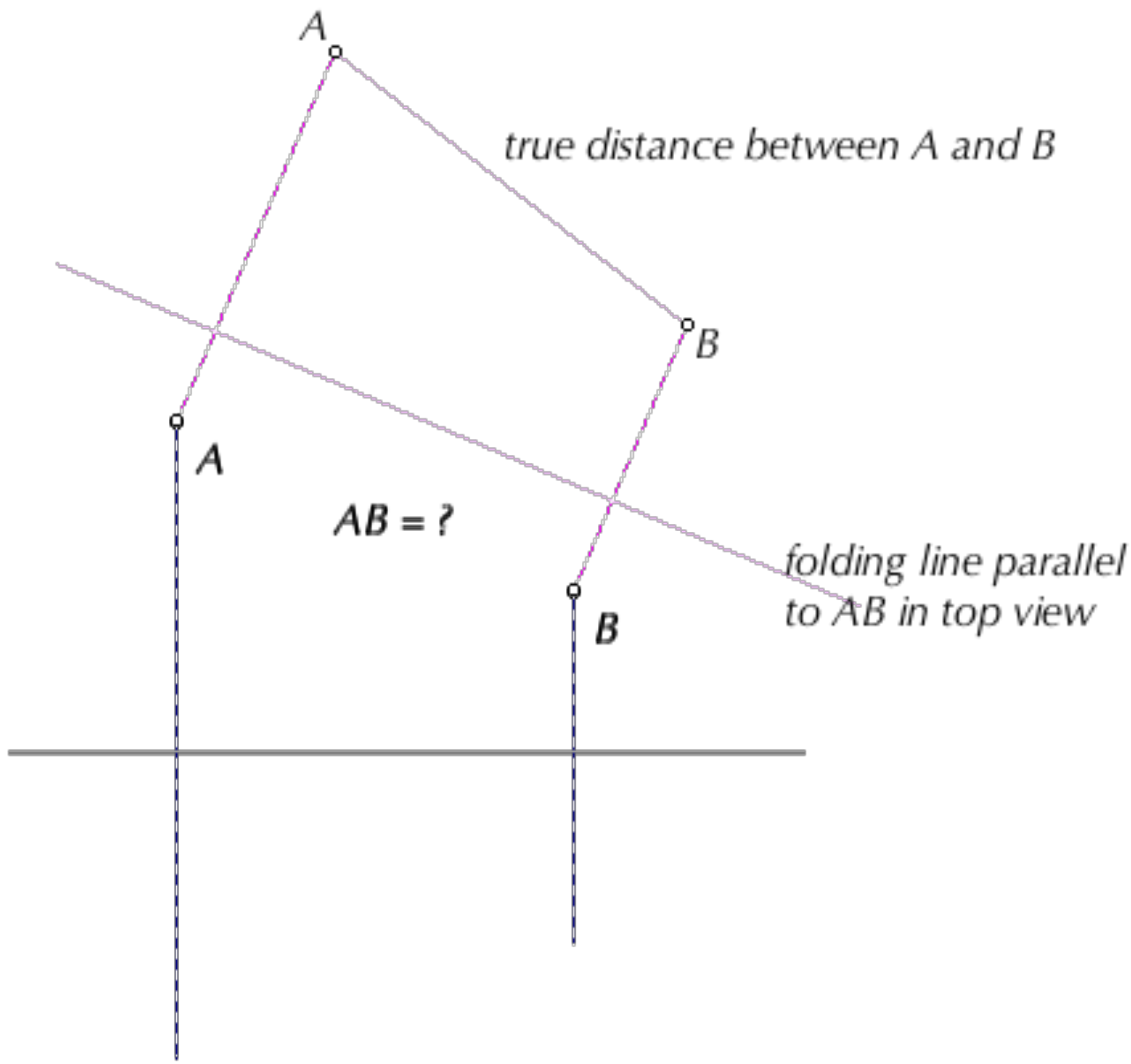
TL of a segment



- true length of a chimney tie



- TL of a chimney tie

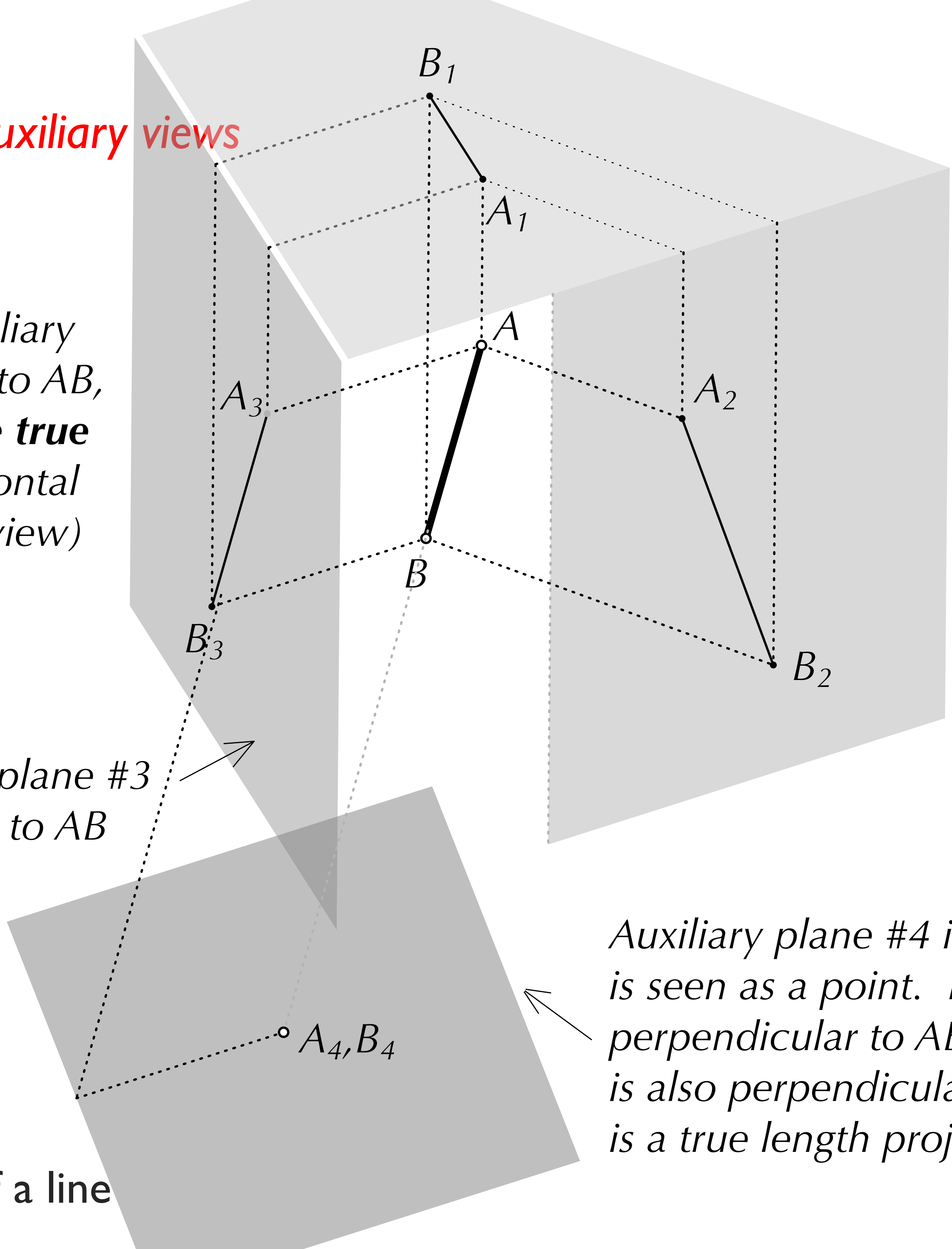


- how do you calculate the distance between two points?

point view of a segment

requires successive auxiliary views

With a line of sight perpendicular to an auxiliary elevation that is parallel to AB, the projection shows the ***true slope*** *of AB (since horizontal plane is shown in edge view)*

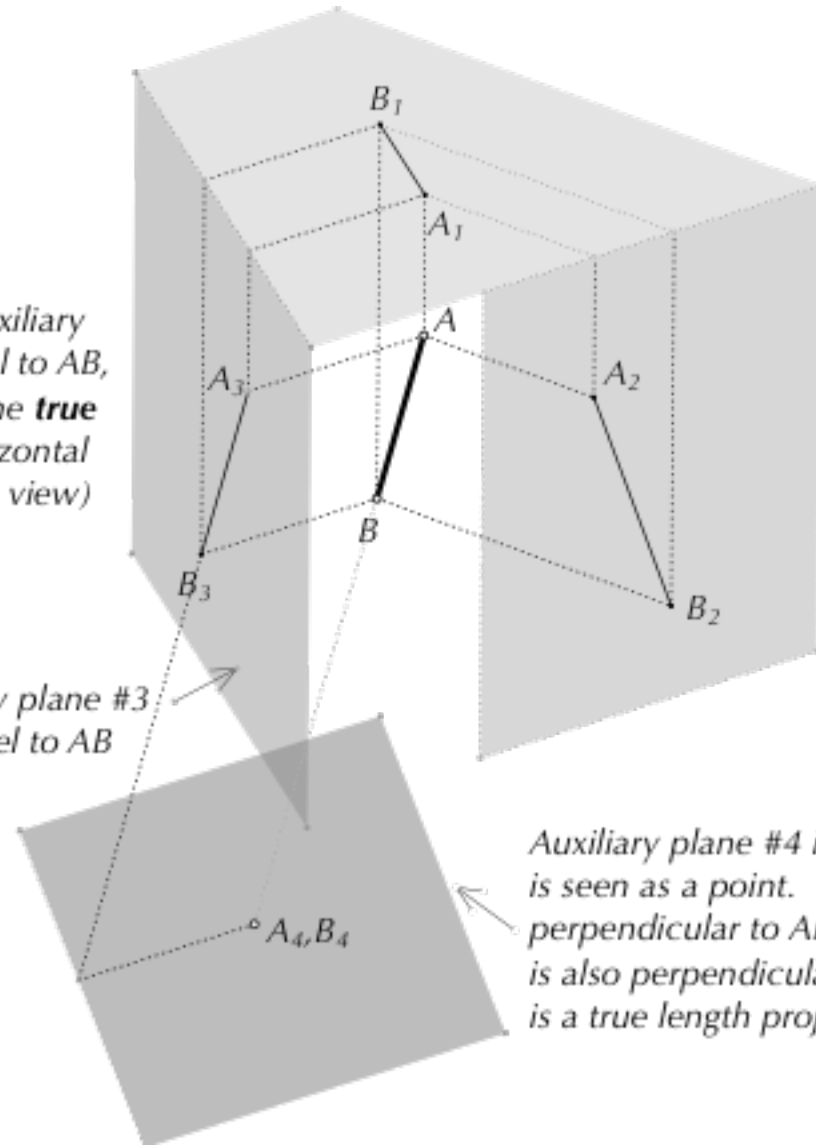


Auxiliary plane #3 is parallel to AB

Auxiliary plane #4 in which line
is seen as a point. Plane #4 is
perpendicular to AB (and therefo
is also perpendicular to A_3B_3 whi
is a true length projection of AB)

- point view (PV) of a line

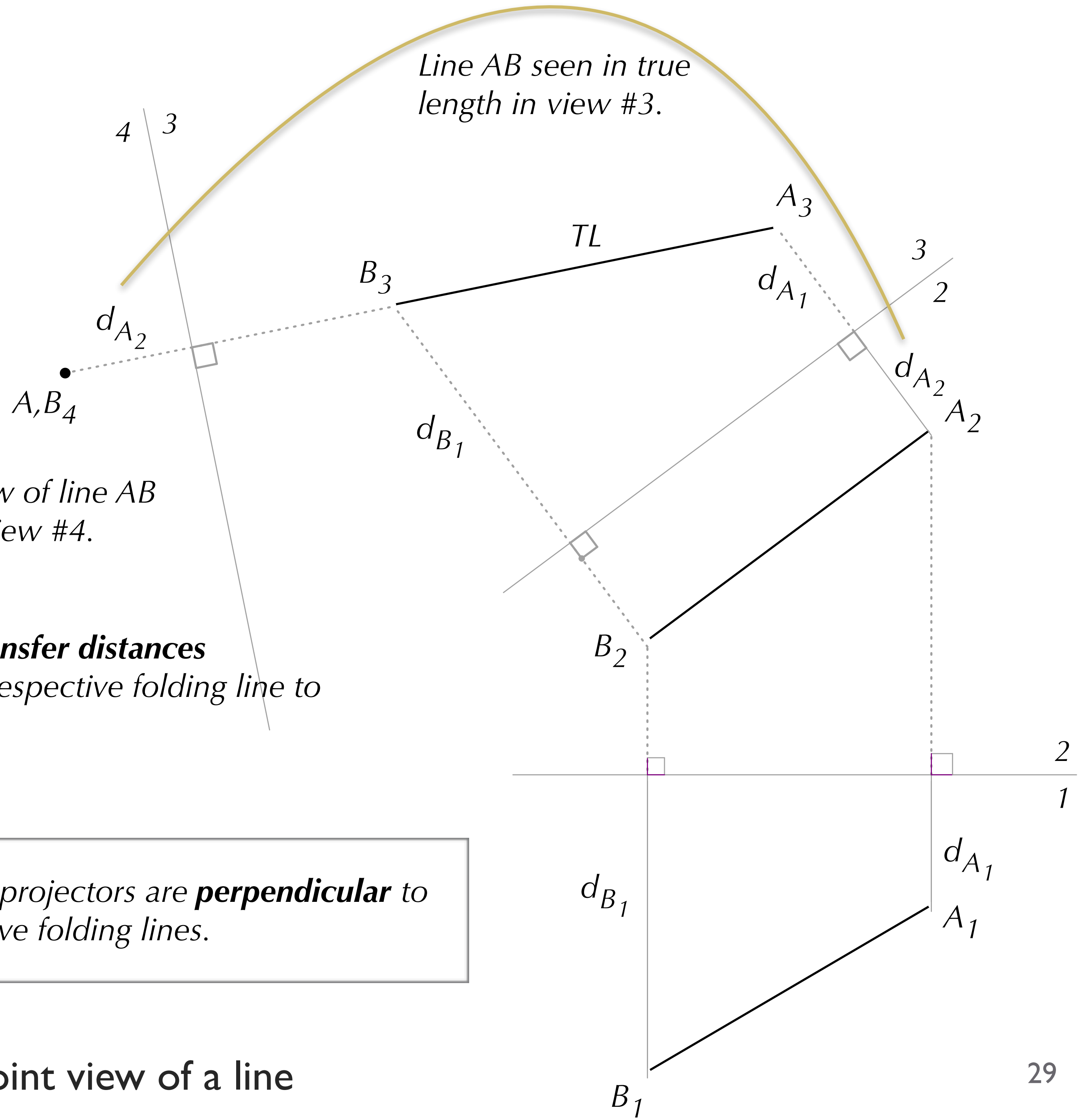
With a line of sight perpendicular to an auxiliary elevation that is parallel to AB, the projection shows the **true slope** of AB (since horizontal plane is shown in edge view)



Auxiliary plane #3 is parallel to AB

Auxiliary plane #4 in which line AB is seen as a point. Plane #4 is perpendicular to AB (and therefore is also perpendicular to A_3B_3 which is a true length projection of AB)

Line AB seen in true length in view #3.



Point view of line AB seen in view #4.

The d's represent ***transfer distances*** *measured from the respective folding line to the point.*

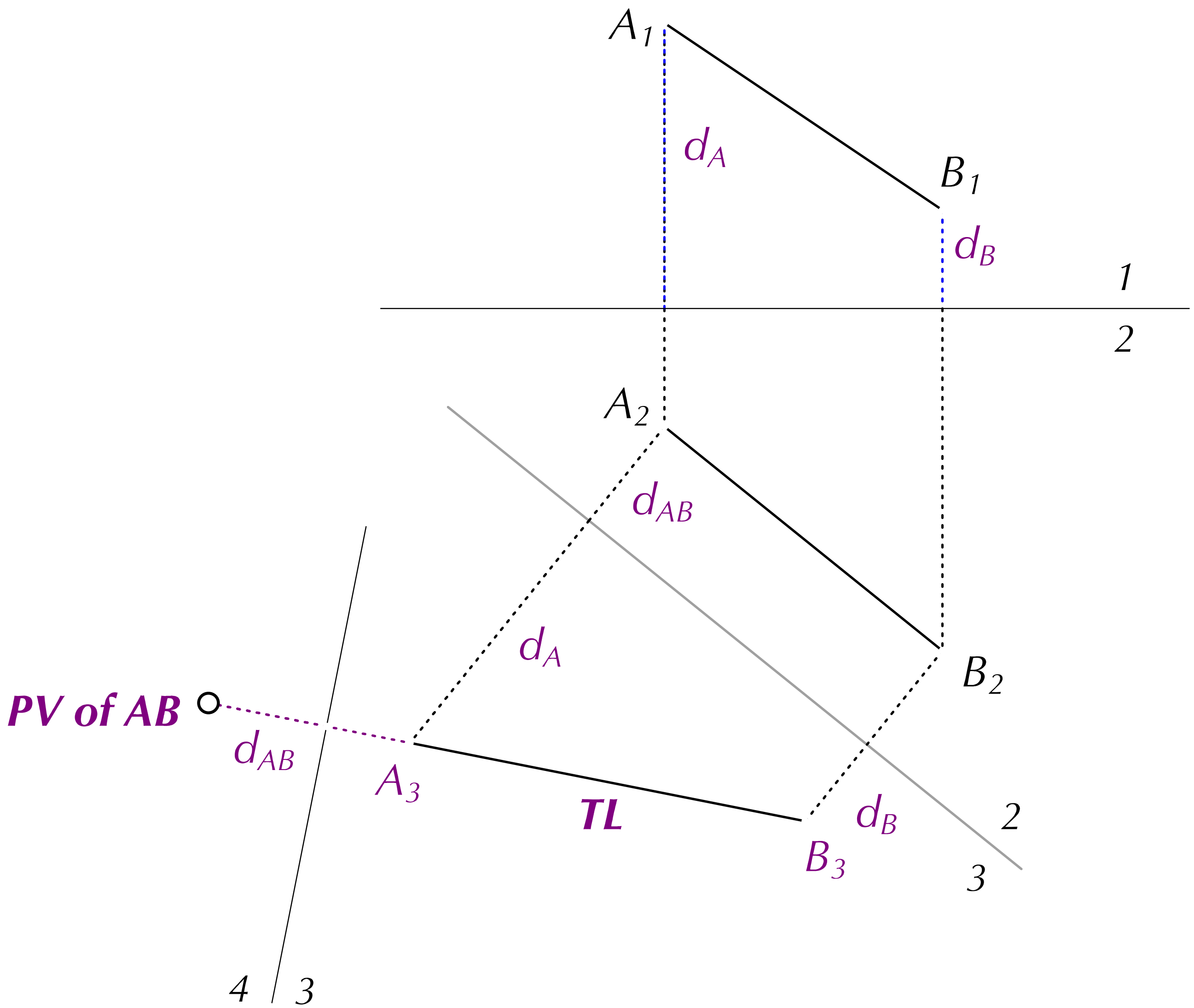
> *Note that all projectors are* ***perpendicular*** *to their respective folding lines.*

construction: point view of a line

Given an oblique segment in two adjacent views, 1 and 2, the steps to find a point view of the segment

1. Obtain a primary auxiliary view 3 showing the segment in TL
2. Place folding line 3 | 4 in view 3 perpendicular to the segment to define an auxiliary view 4
3. Project any point of the segment into view 4.

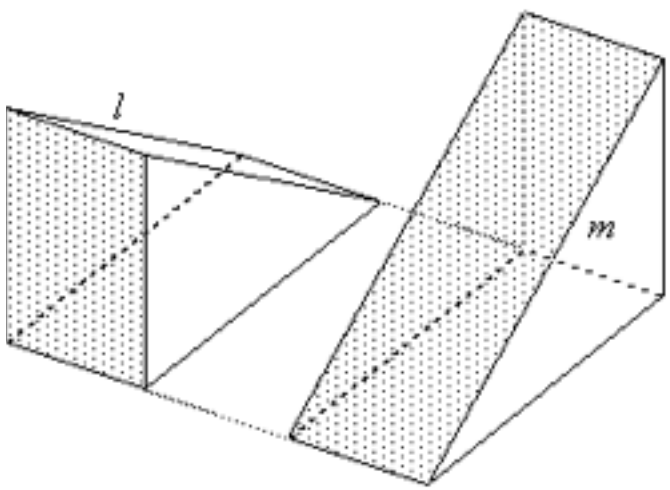
This is the **point view** of the entire segment

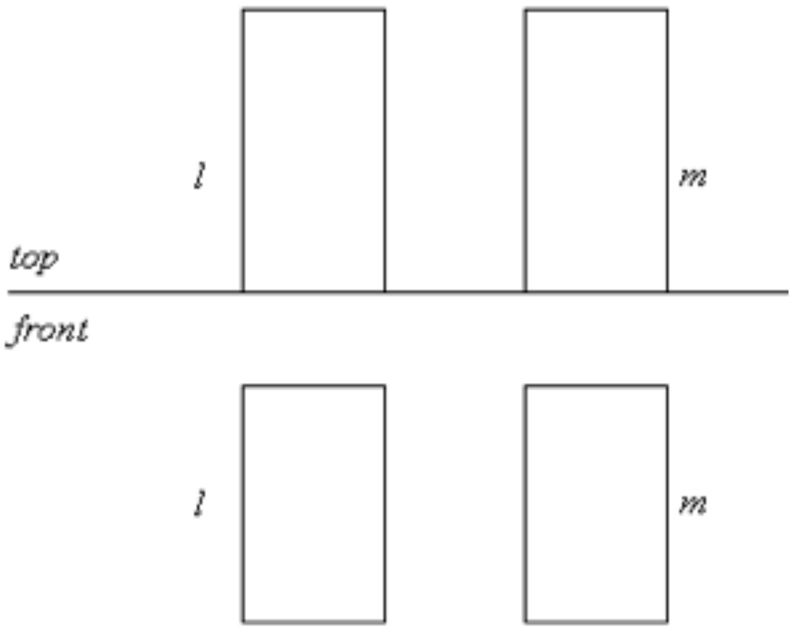


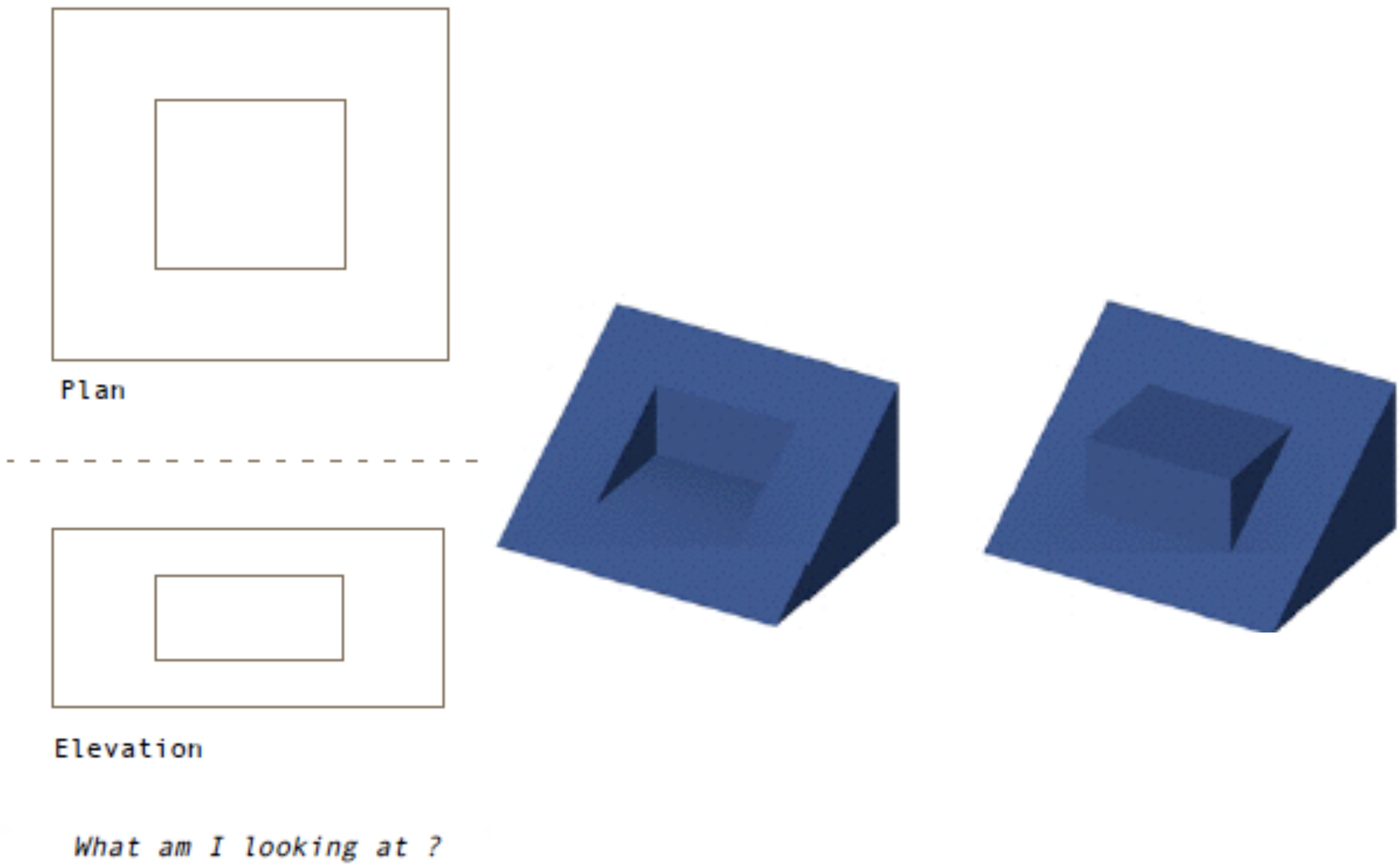
recap – pv of a line

parallel lines

- When two lines are truly parallel, they are parallel in any view, **except when they coincide or appear in point view**
- The **converse is not always true**: two lines that are parallel in a particular view or coincide might not be truly parallel

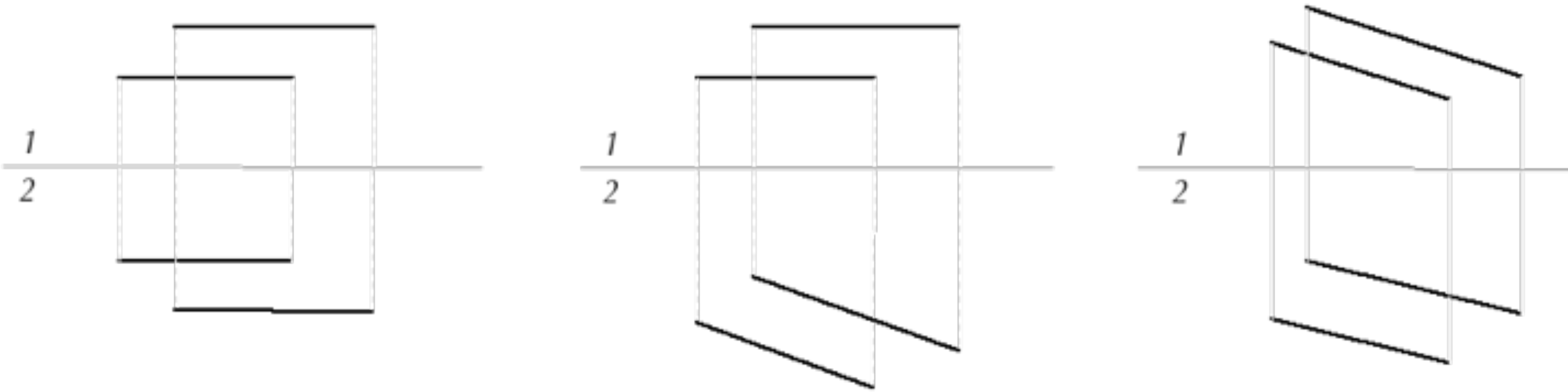






- parallel lines

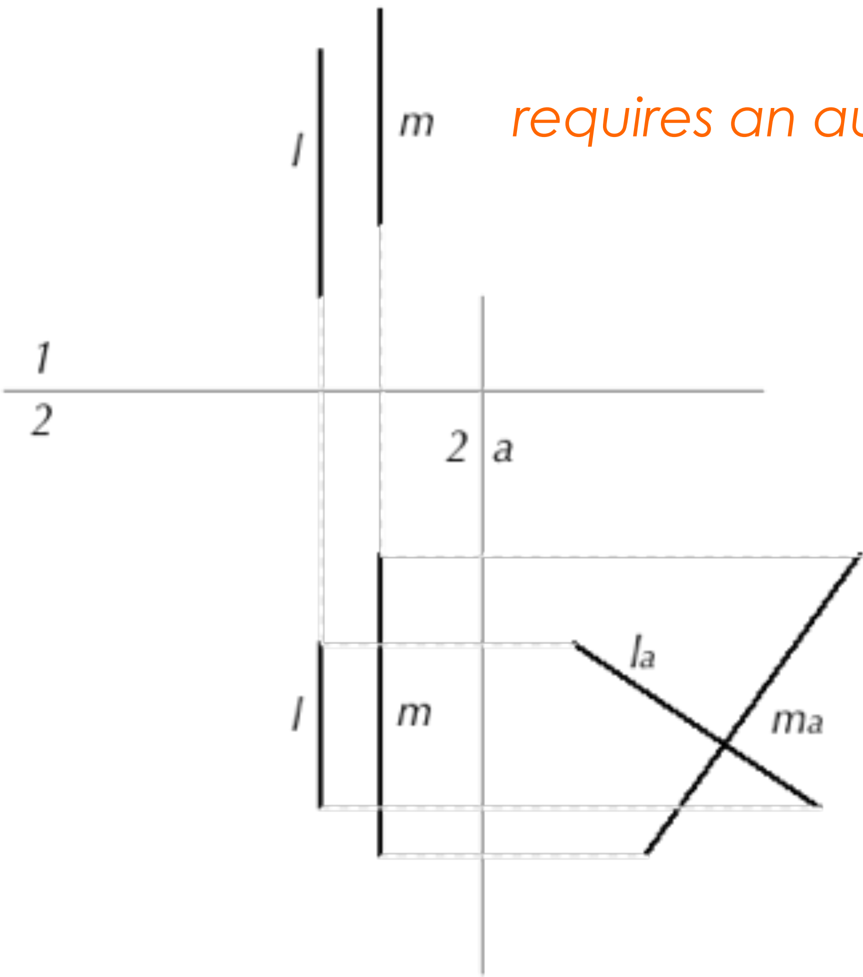
Lines are parallel in adjacent views



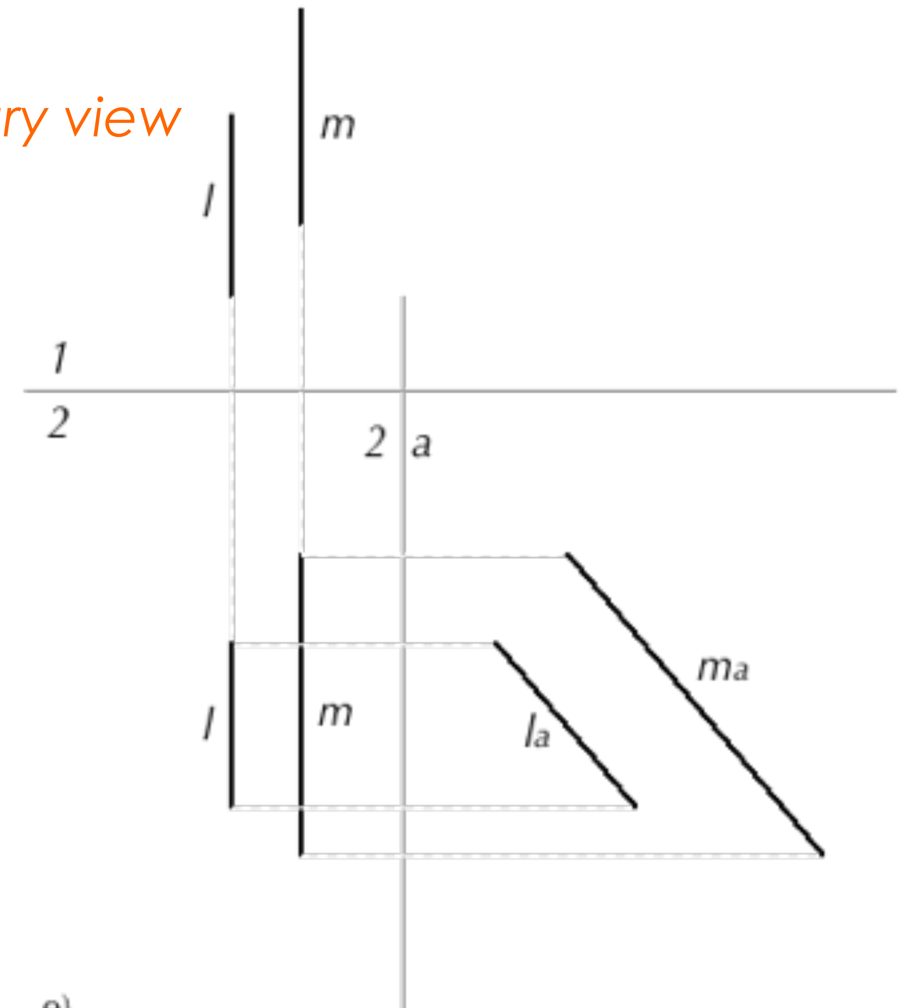
- testing for parallelism

Lines are perpendicular to the folding line

requires an auxiliary view

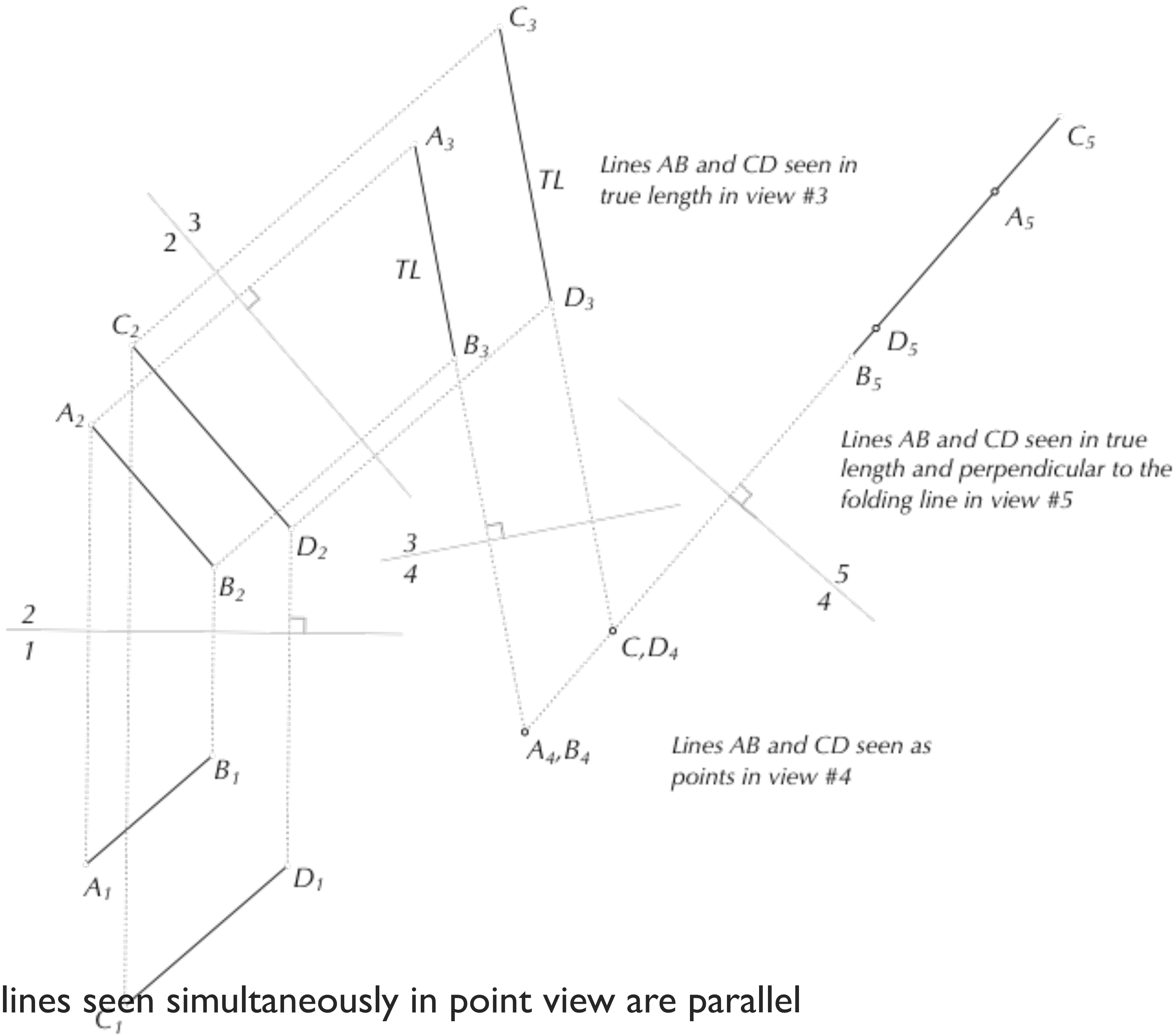


d)



e)

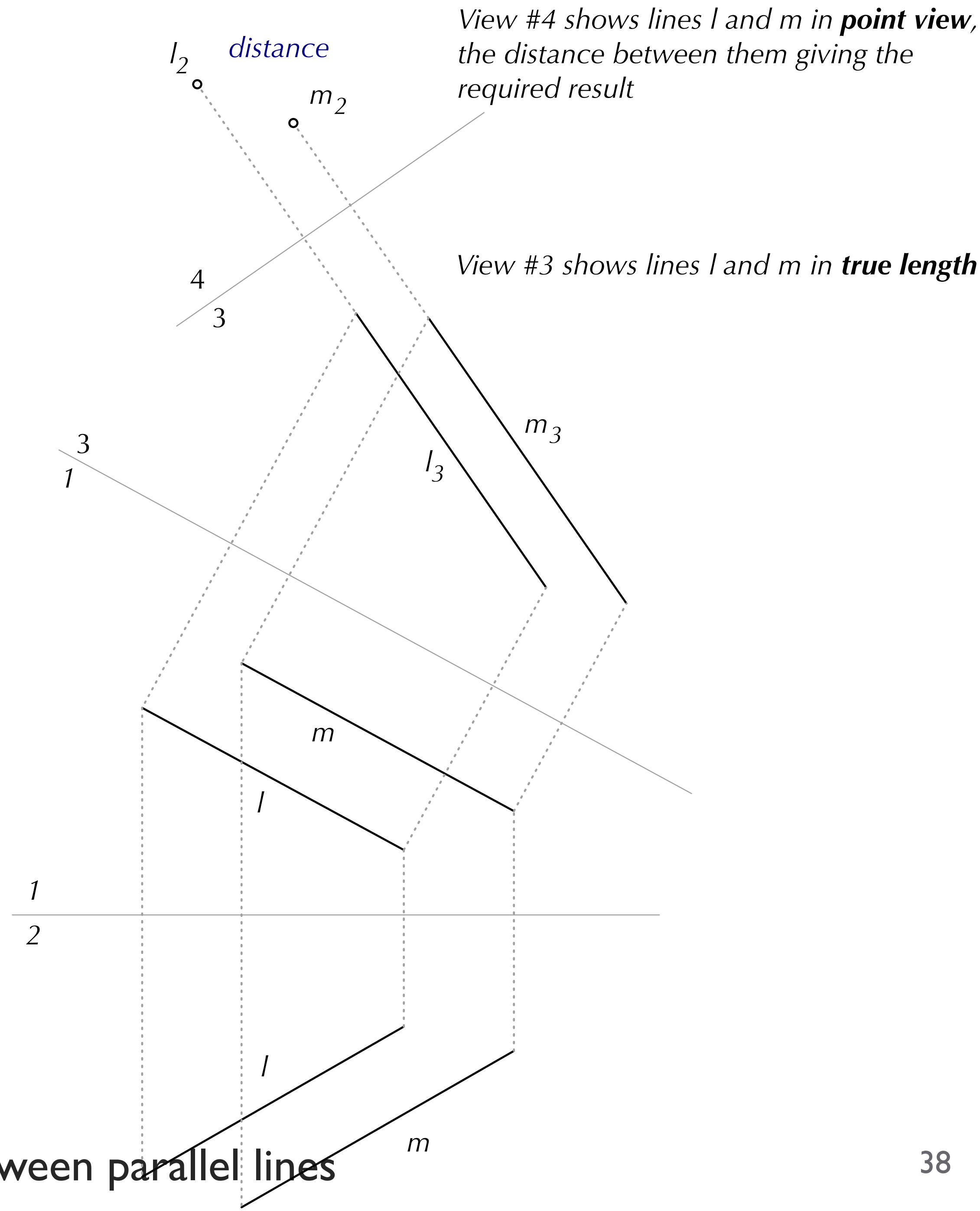
- testing for parallelism

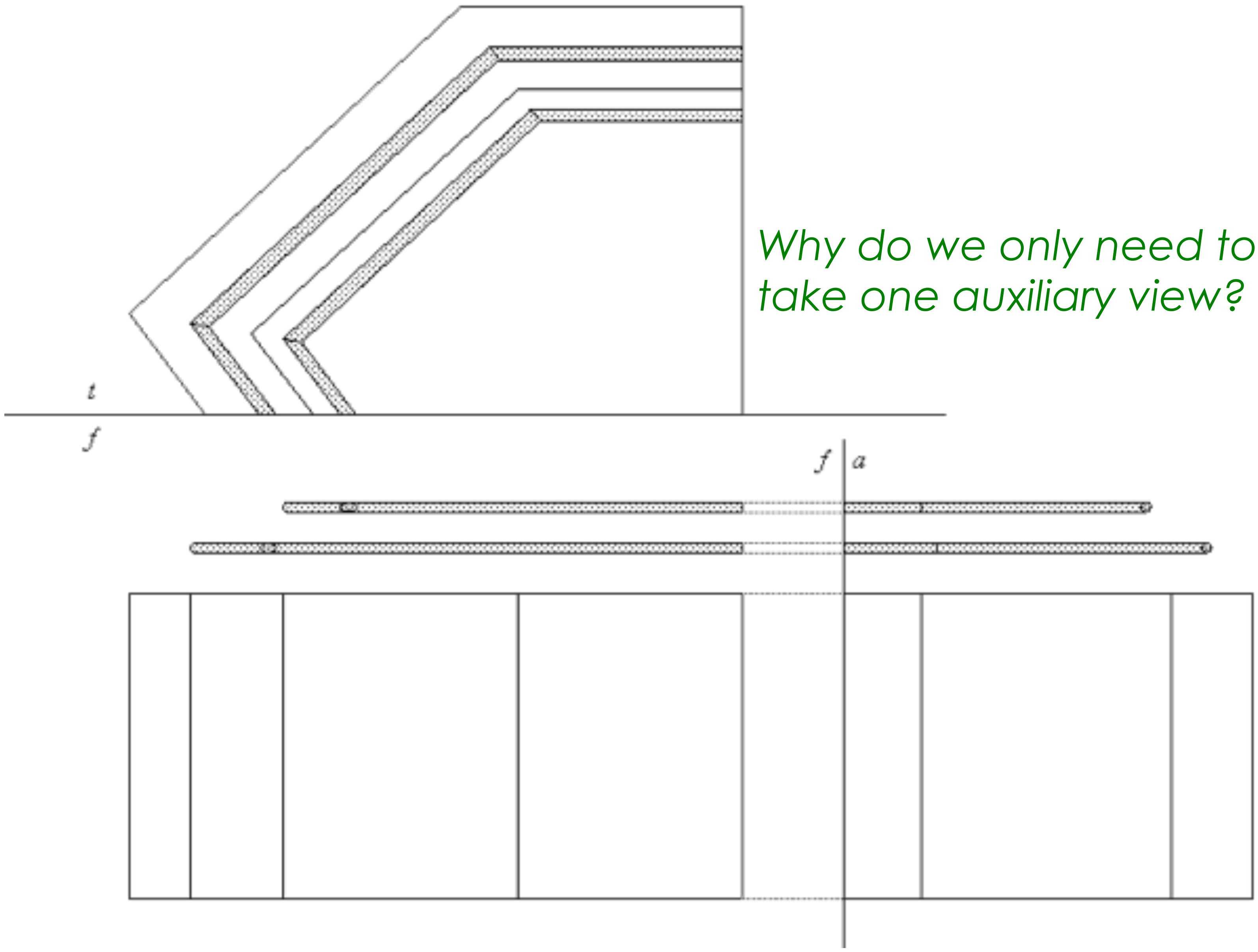


- lines seen simultaneously in point view are parallel

- Use two successive auxiliary views to show the lines in point view.

- The distance between the two point views is also the distance between the lines.





Why do we only need to take one auxiliary view?

- a practical example – distance between railings

- Constructions based on auxiliary views can be used flexibly to answer questions about the geometry of an evolving design as the design process unfolds.
- It is often sufficient to produce

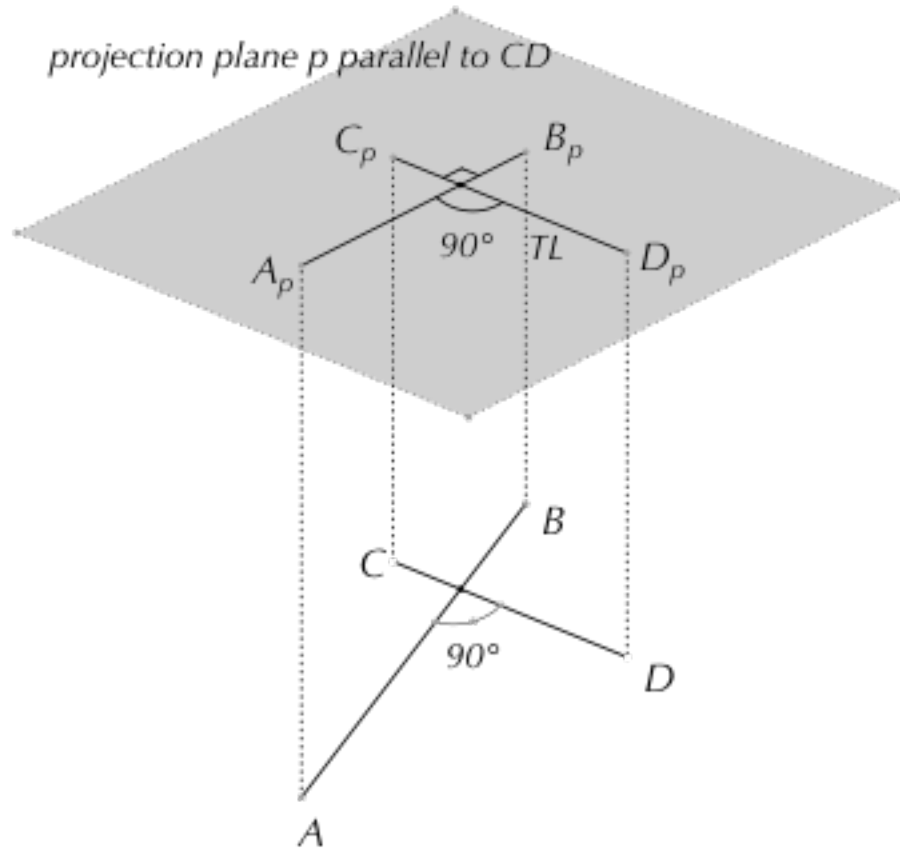
  auxiliary views only of a portion of the design,

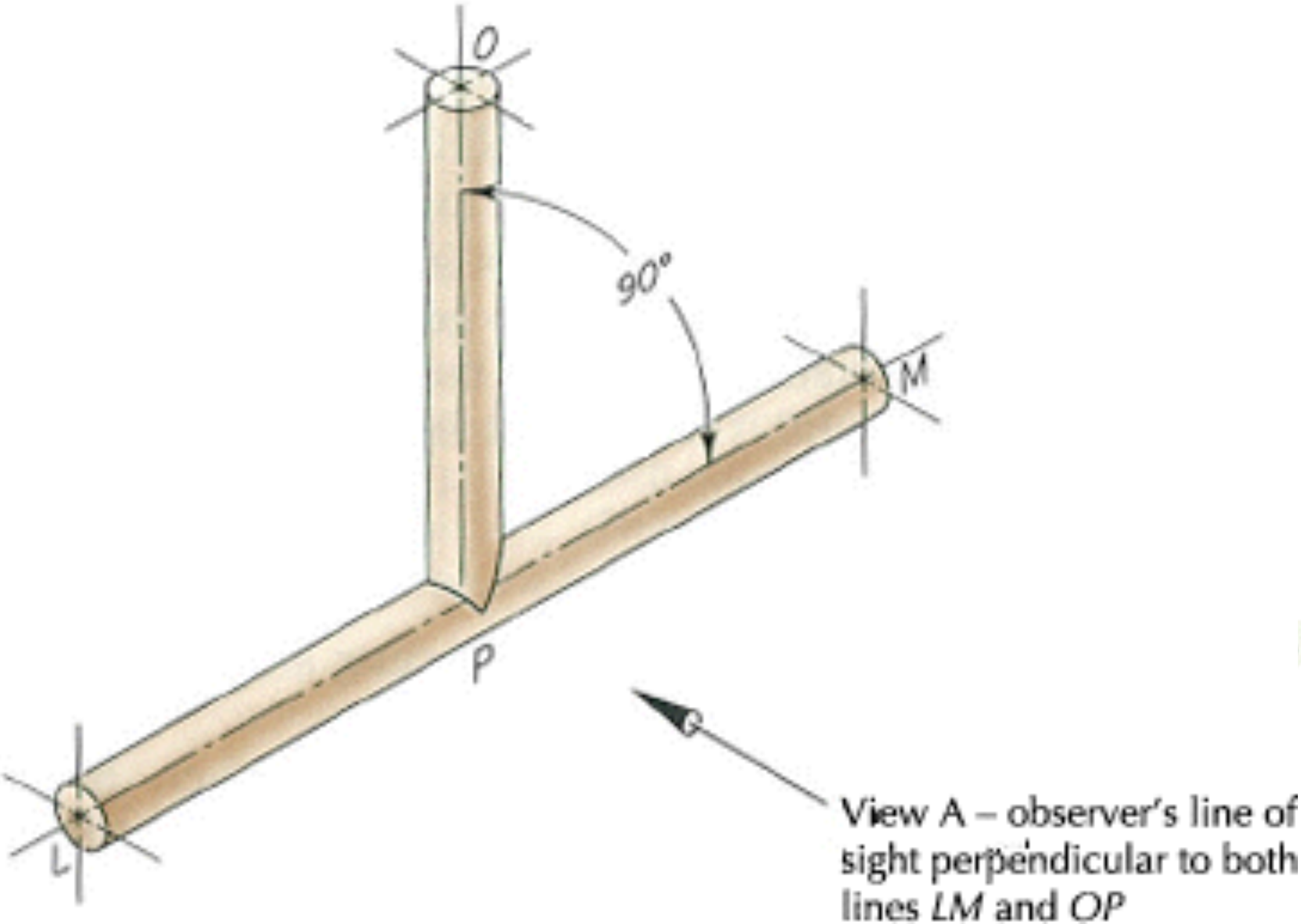
  which can often be done on-the-fly in some convenient region of the drawing sheet.
- Important to select an appropriate folding line (or picture plane)
- Pay particular attention to the way in which the constructions depend on properly selected folding lines

perpendicular lines

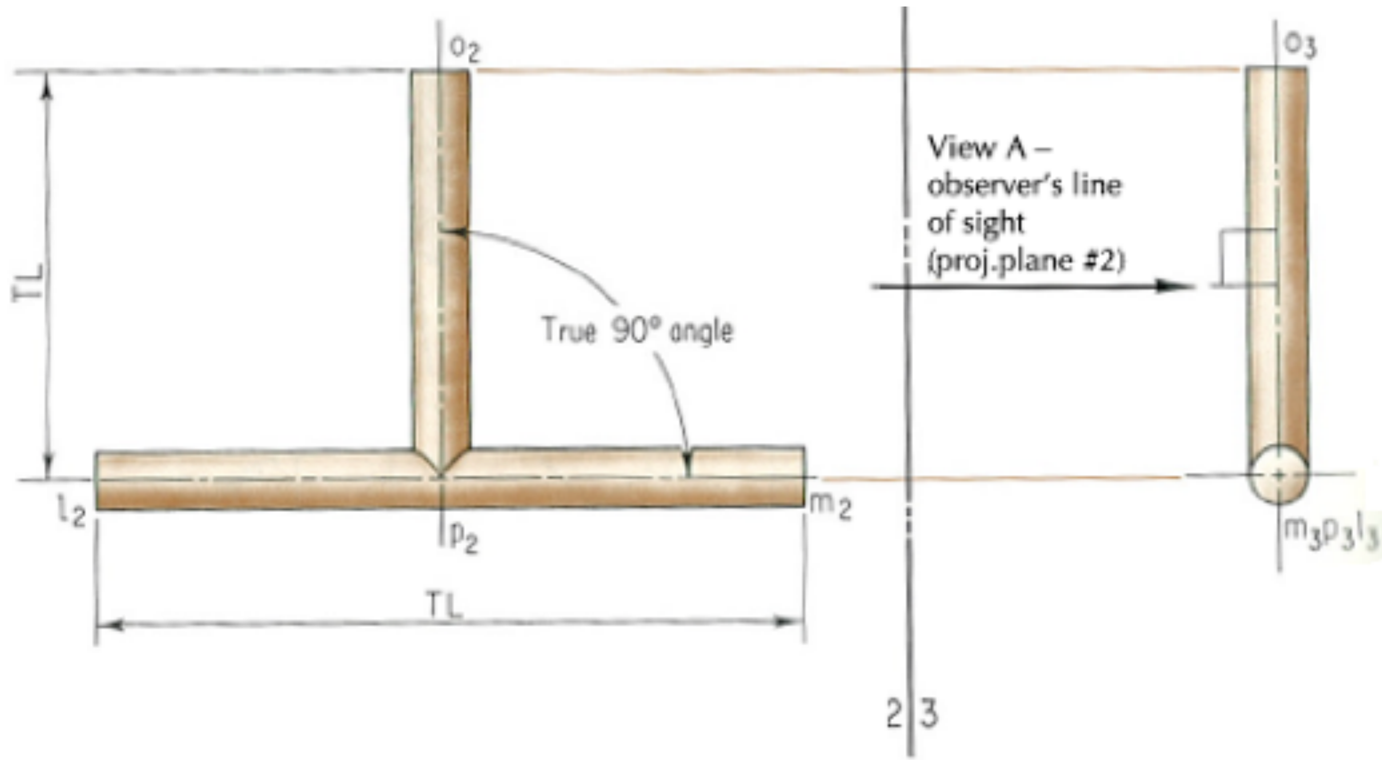
- two perpendicular lines appear perpendicular in any view that ***shows at least one line in TL***

- the ***converse*** is also true

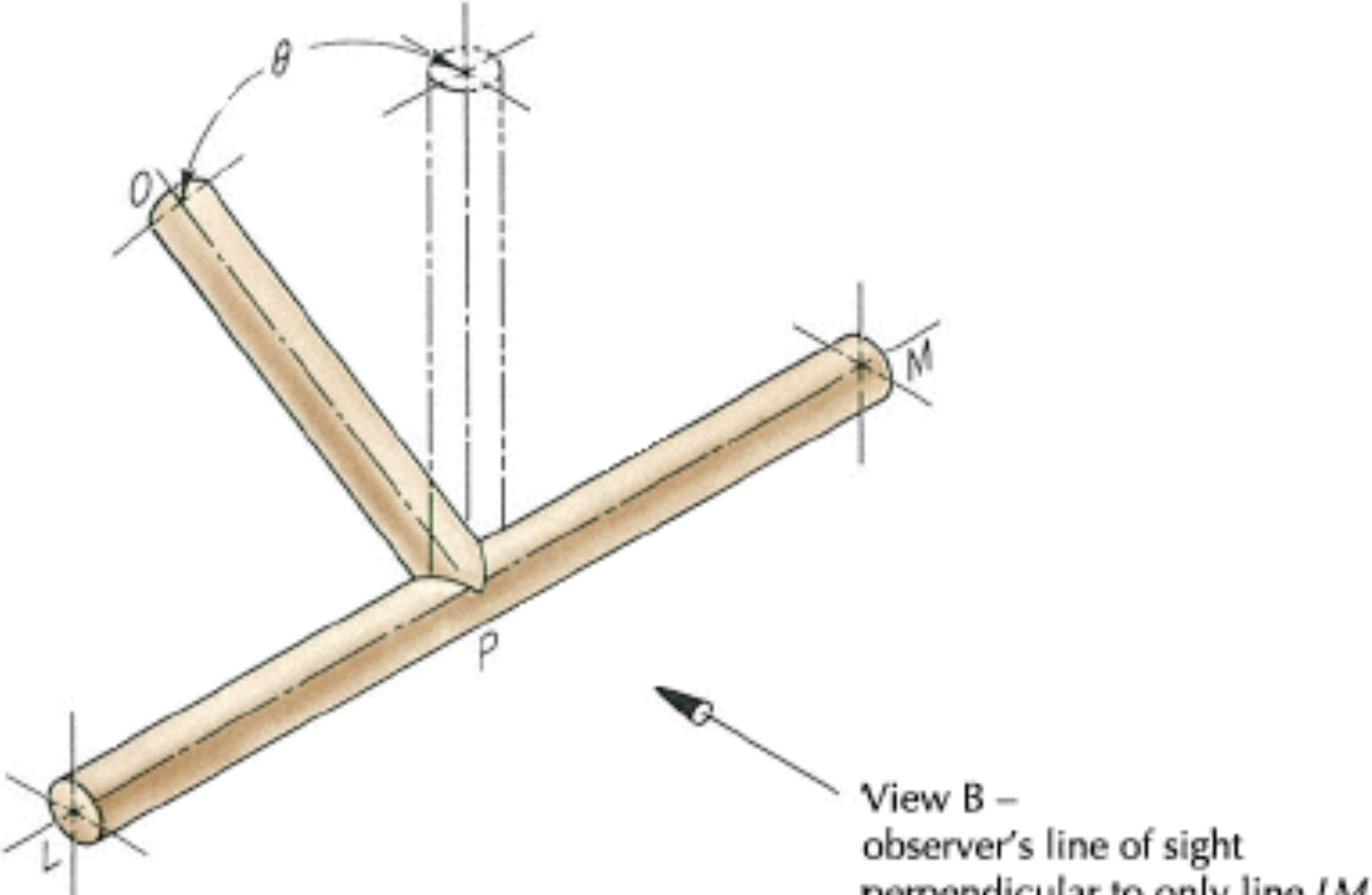




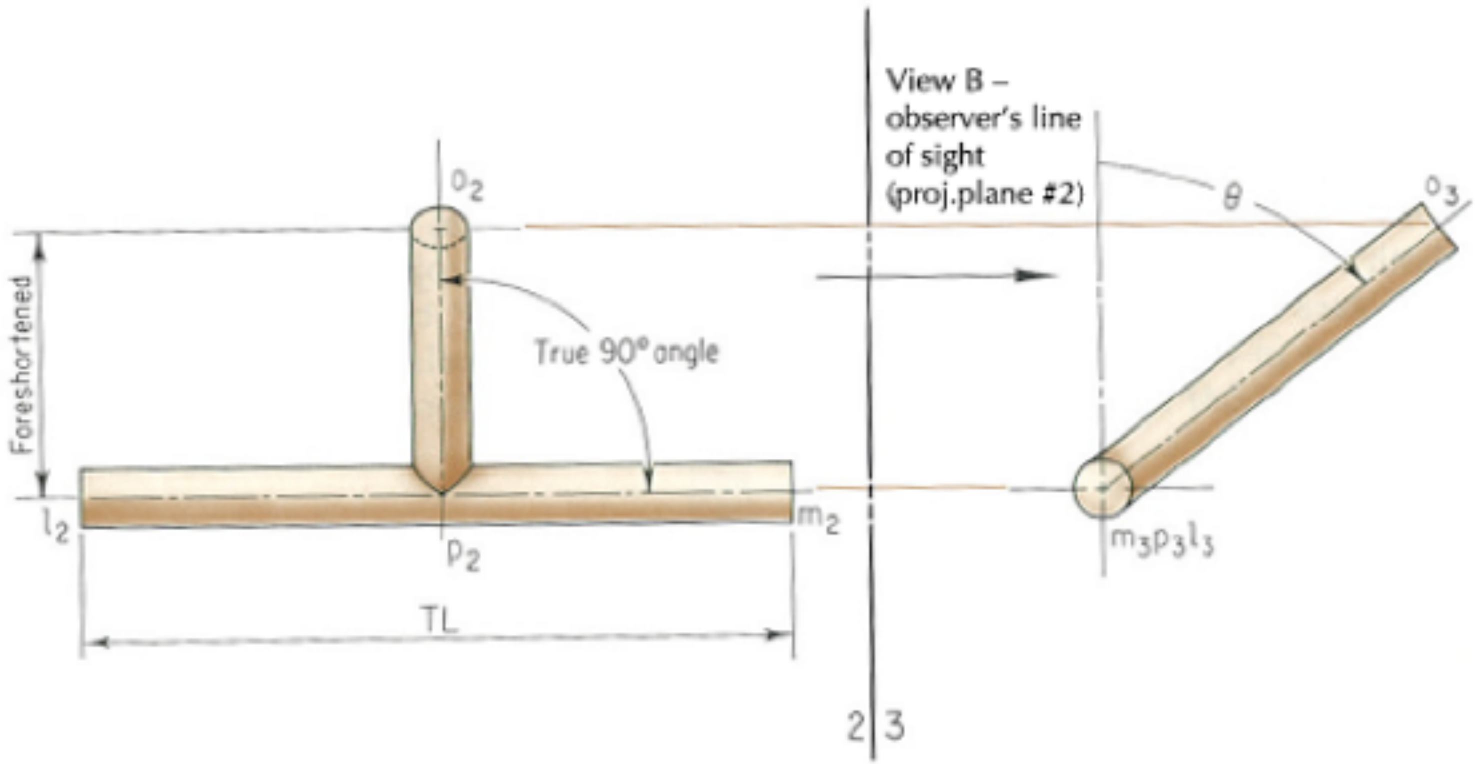
- perpendicular lines



- perpendicular lines

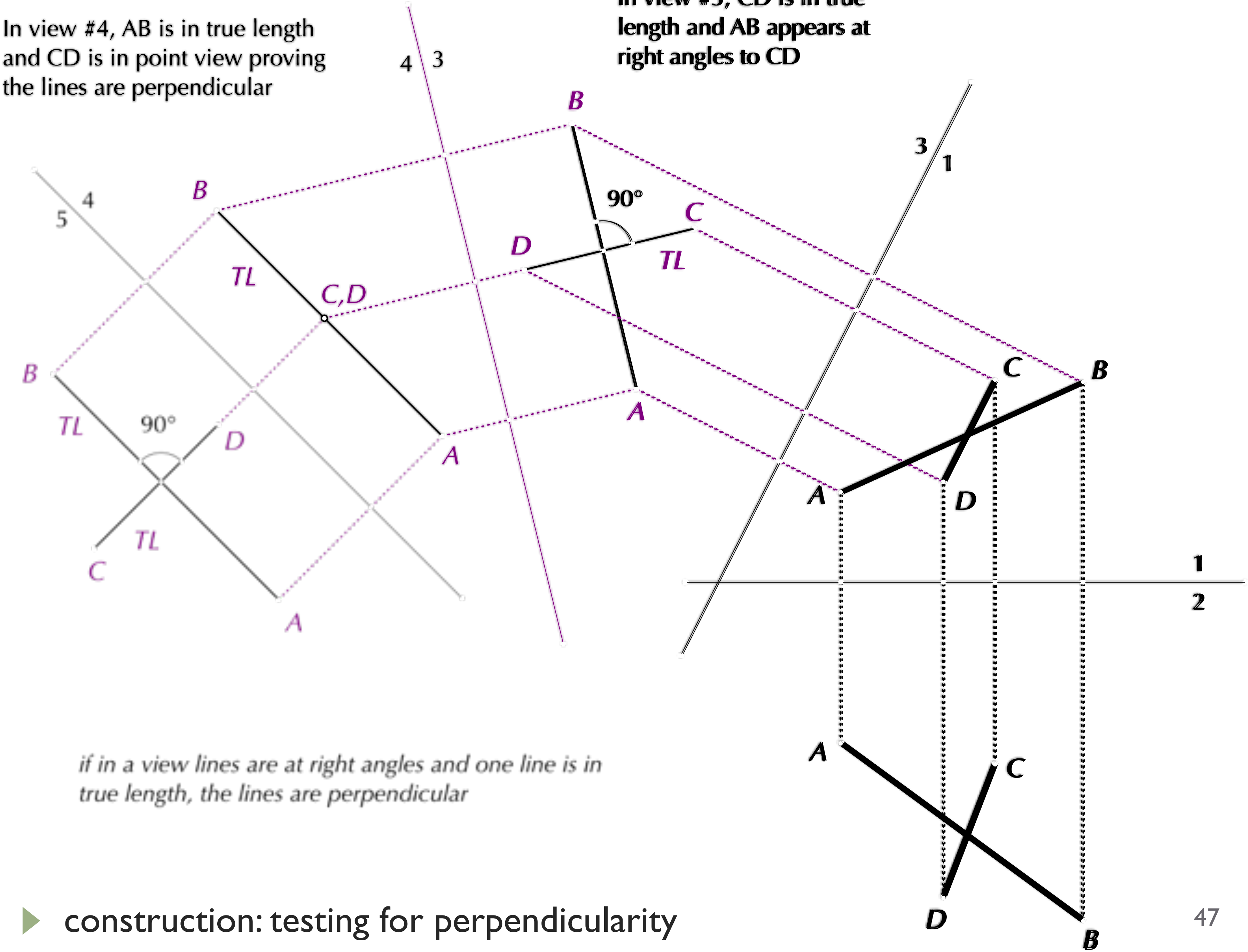


- perpendicular lines


View B –
observer's line
of sight
(proj.plane #2)
θ
o3
o2
Foreshortened
True 90° angle
l2
m2
p2
m3p3l3
TL
2
3

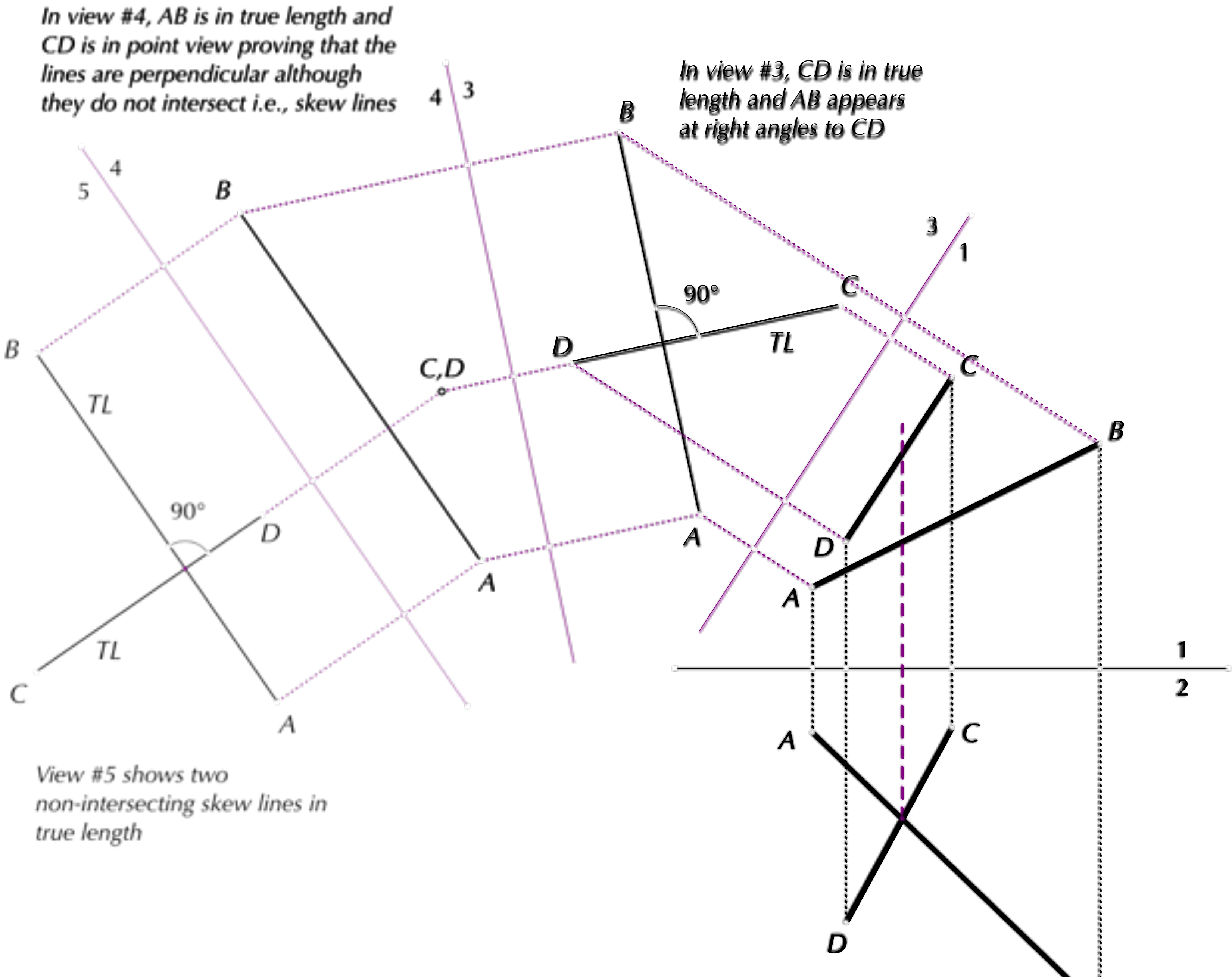
In view #4, AB is in true length and CD is in point view proving the lines are perpendicular

In view #3, CD is in true length and AB appears at right angles to CD

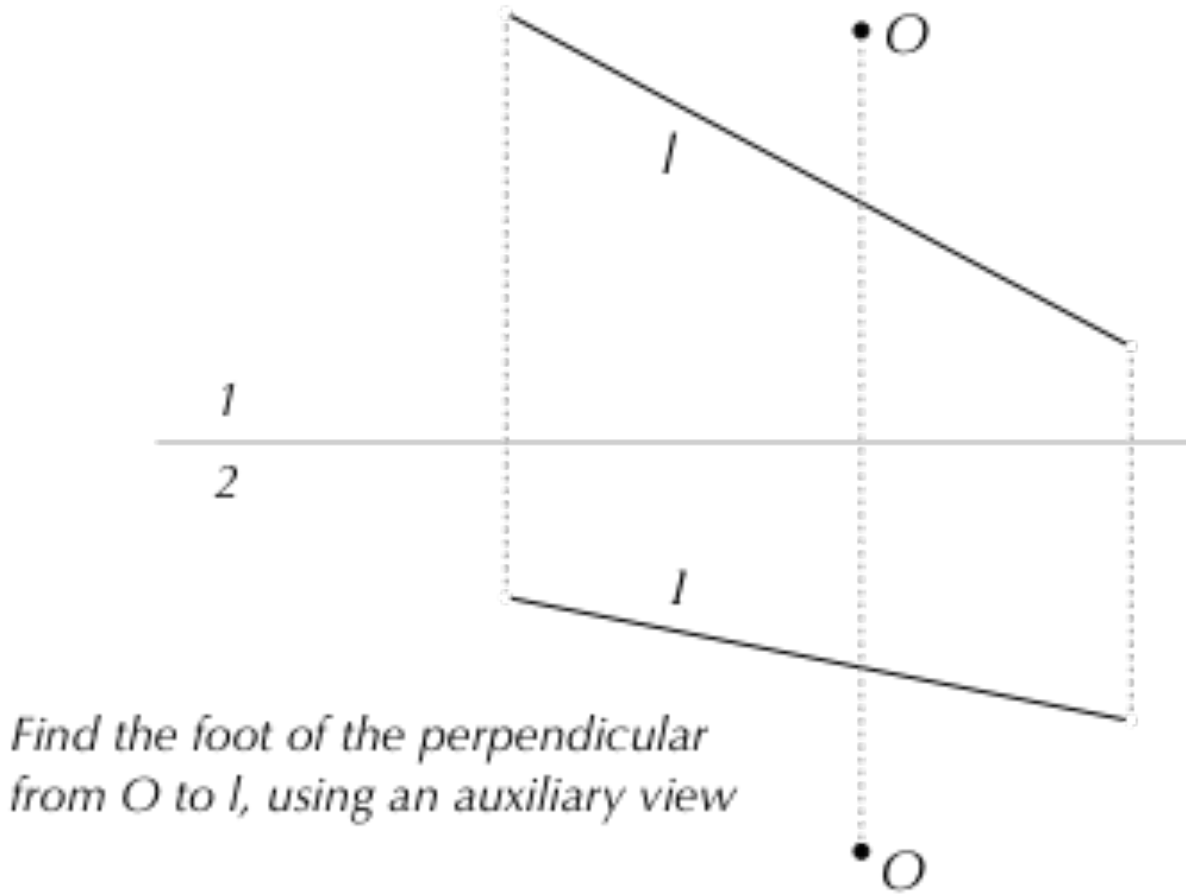


if in a view lines are at right angles and one line is in true length, the lines are perpendicular

- construction: testing for perpendicularity



- however, this condition can hold for (perpendicular?) skew lines

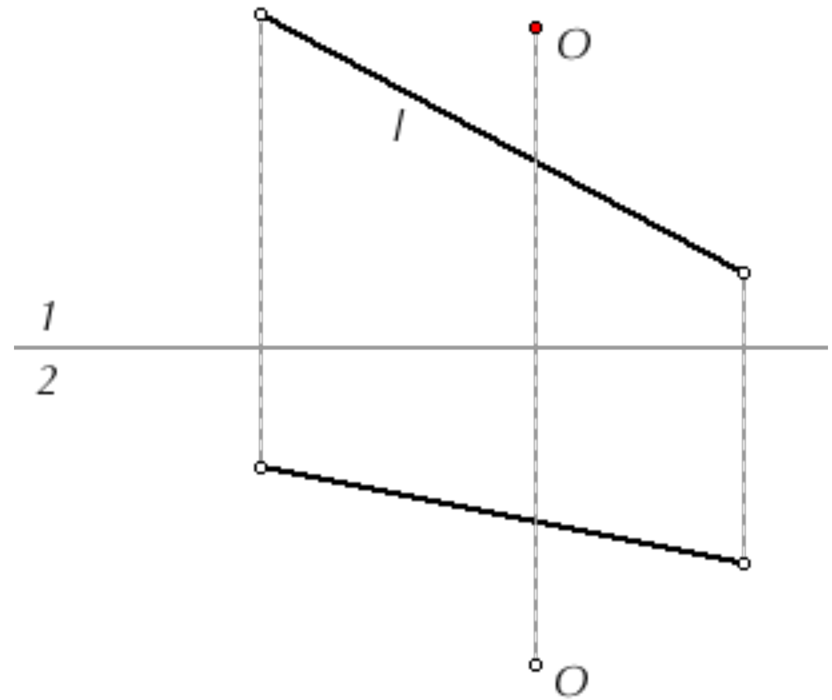


- construction: perpendicular to a line from a given point

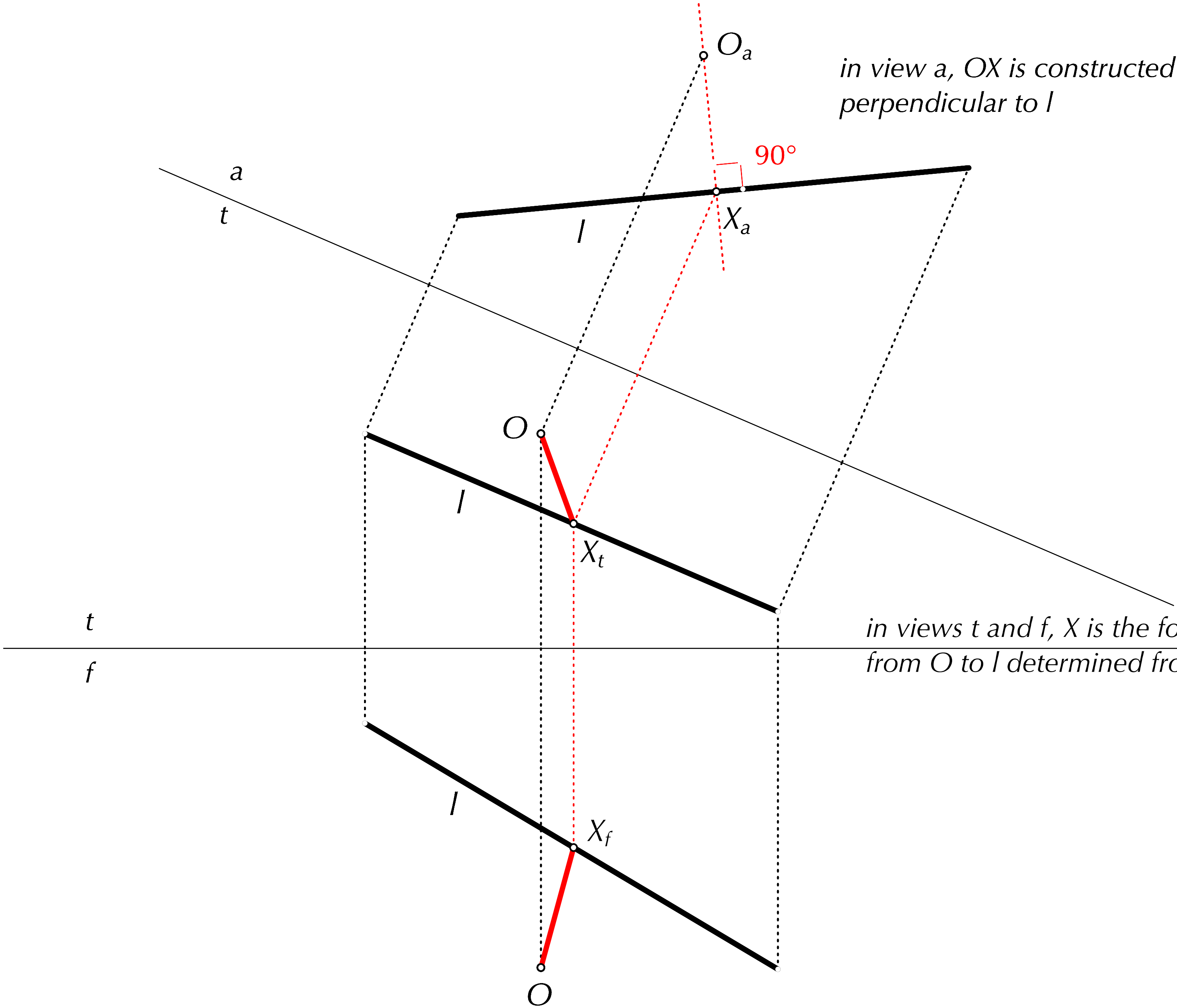
- Show *l* in TL in an auxiliary view *a*.

- In *a*, draw a line through *O* perpendicular to *l*. Call the intersection point *X*.
  This segment defines the desired line in *a*.

- Project back into the other views.



in view a, OX is constructed to be perpendicular to l

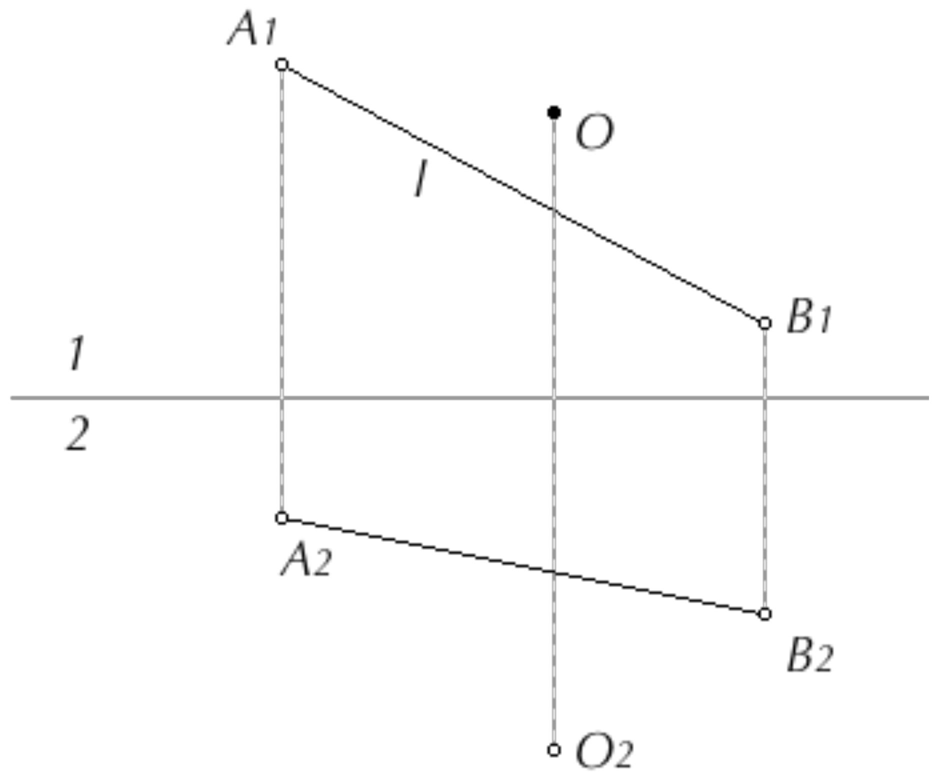


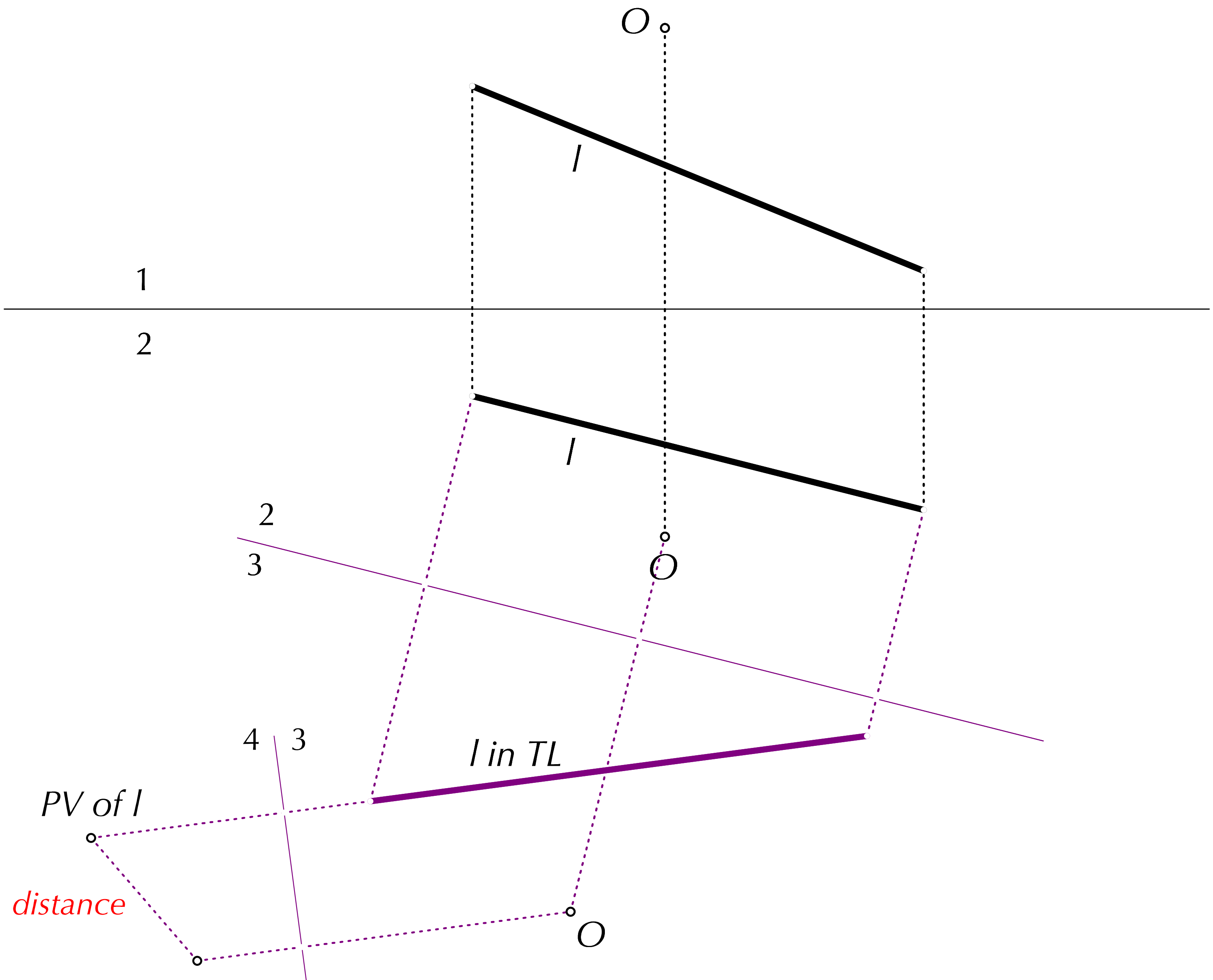
in views t and f, X is the foot of the perpendicular from O to l determined from the auxiliary view a

construction: perpendicular to a line

- *Given a line and a point in two adjacent views, find the true distance between the point and line*
- There are two steps:

1. Construct in a second auxiliary view, the PV of the line.
2. Project the point into this view The distance between the point and the PV of the line shows the true distance



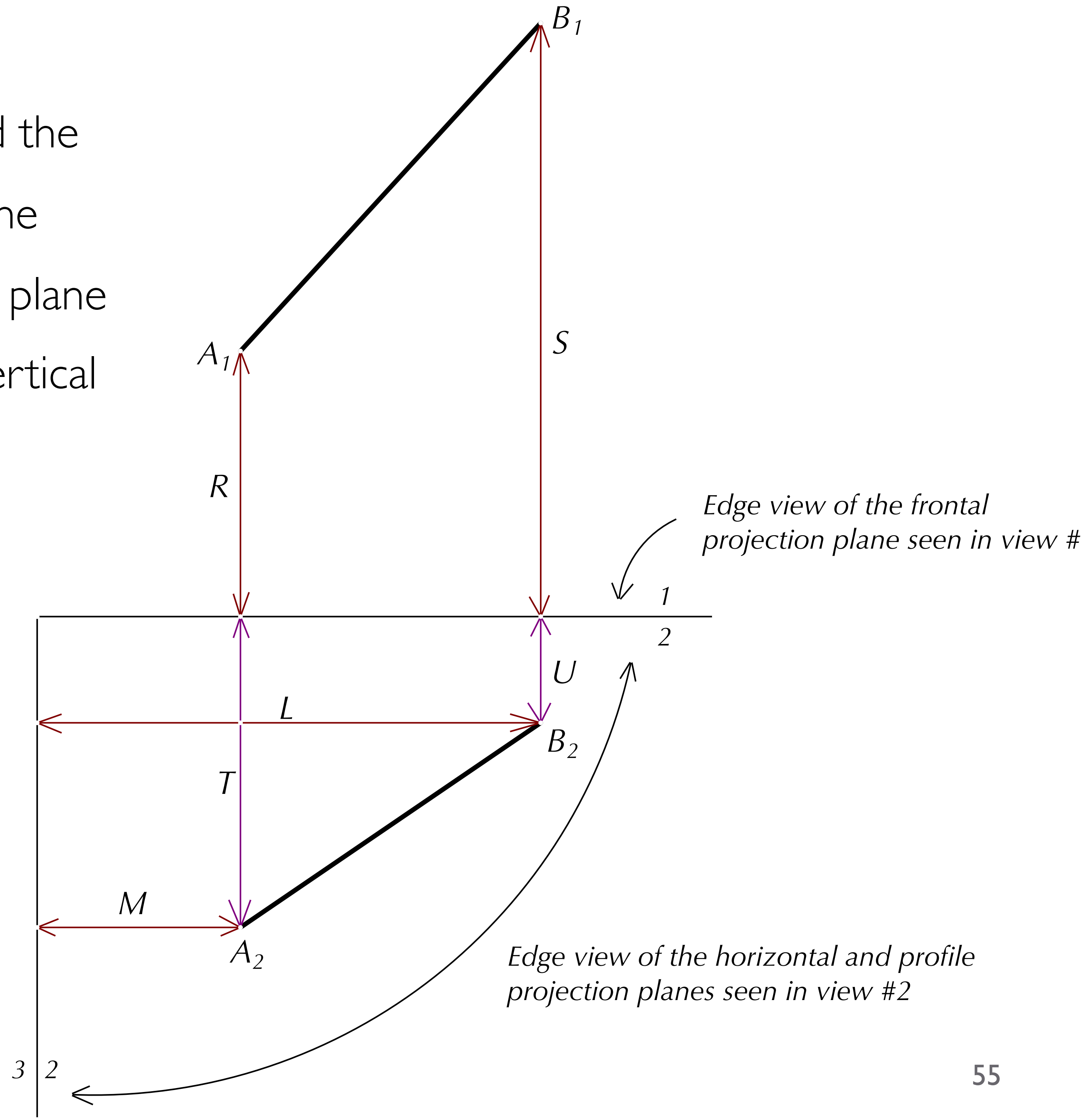


view #4 shows the line l in point view from which the shortest distance from O to l can be easily determined.

construction: shortest distance from point to line

specifying lines

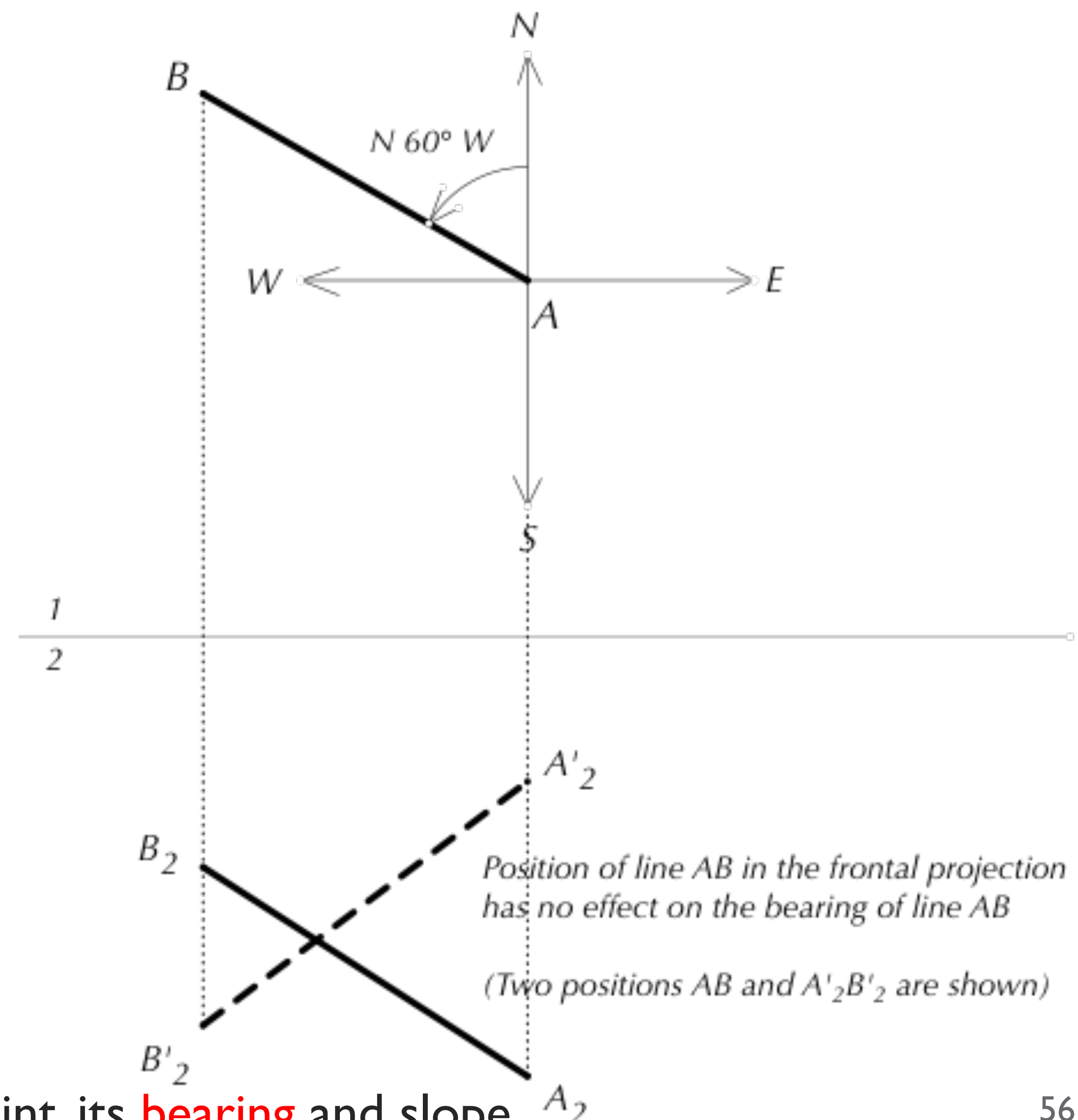
- By two points and the distances **below** the horizontal picture plane and **behind** the vertical picture plane



- The **bearing** is **always seen in a horizontal plane view** relative to the compass North

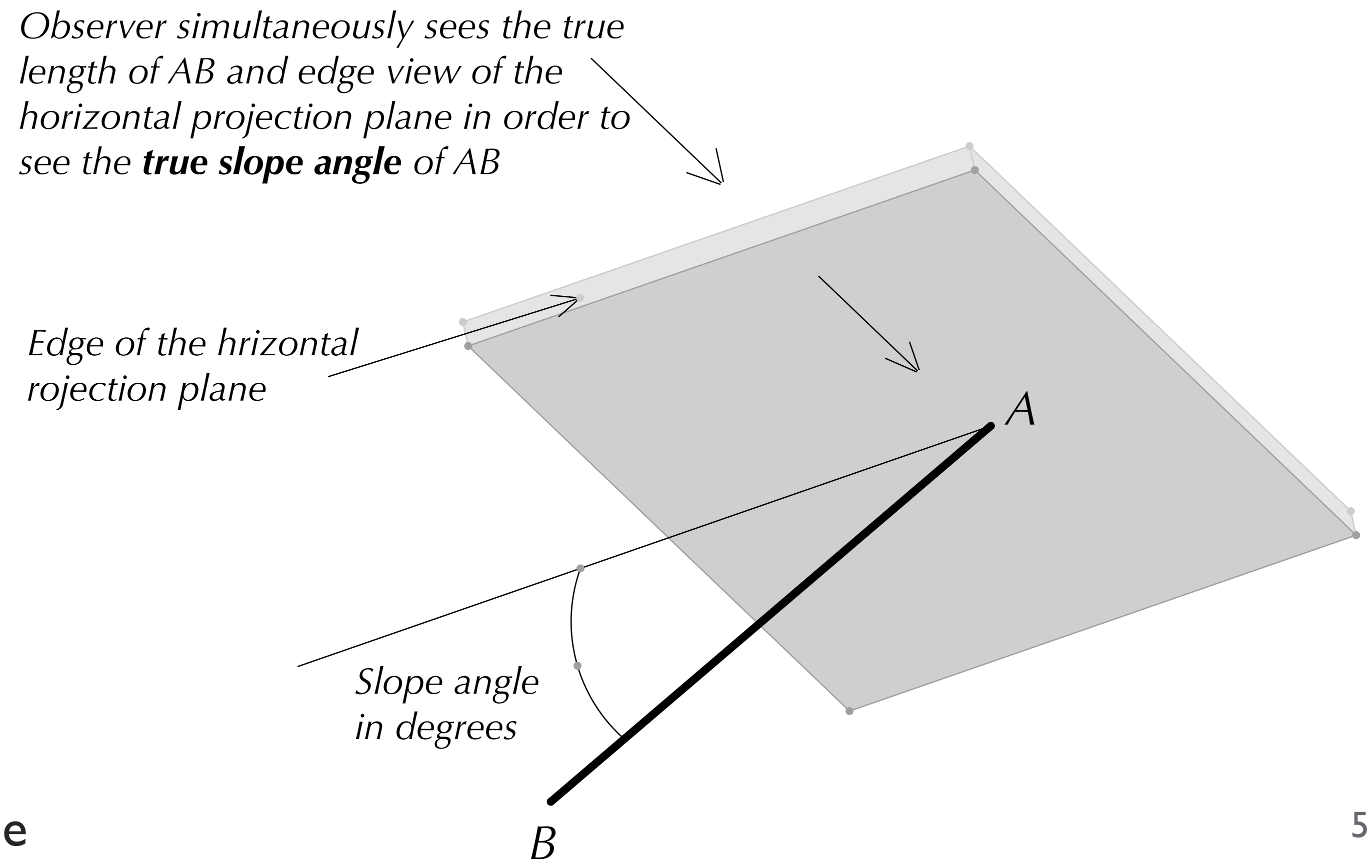
Bearing always measured from a compass direction (typically north or south) to a compass direction through a certain angle.

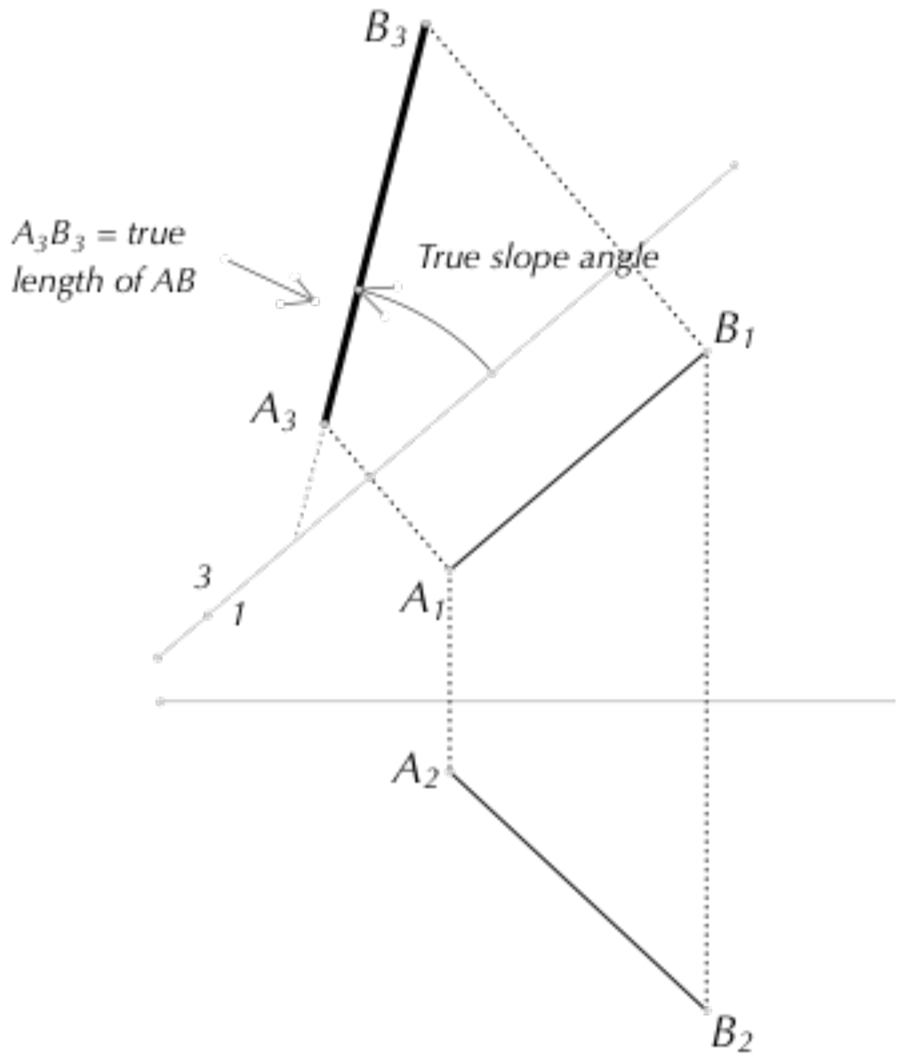
Here the bearing reads 60° from north towards west



specifying a line given a point, its **bearing** and slope

The *angle of inclination* of a line segment is the angle it makes with any horizontal plane It is the **slope angle** between the line and the horizontal projection plane and is seen only when — *the line is in true length and the horizontal plane is seen in edge view*

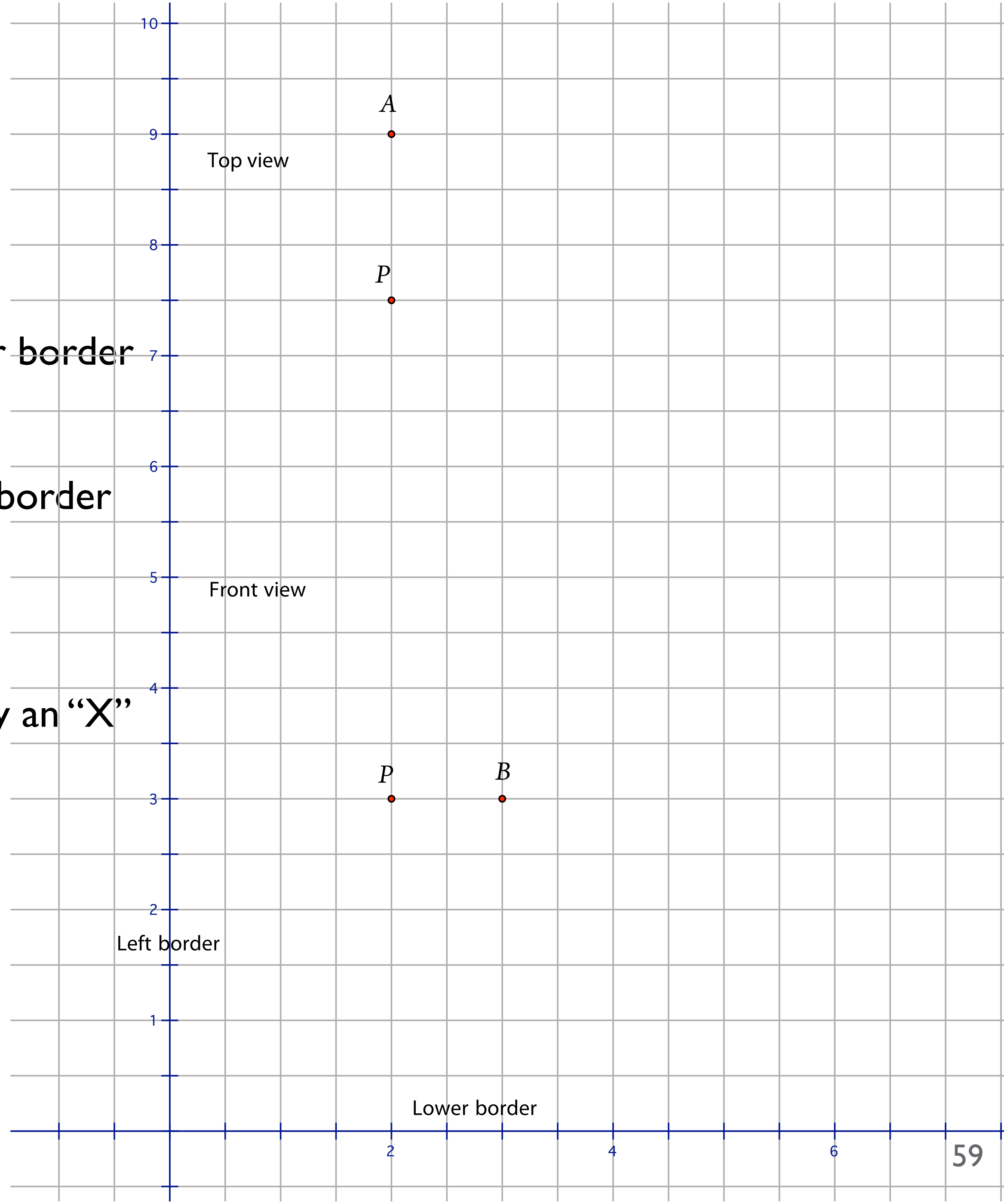




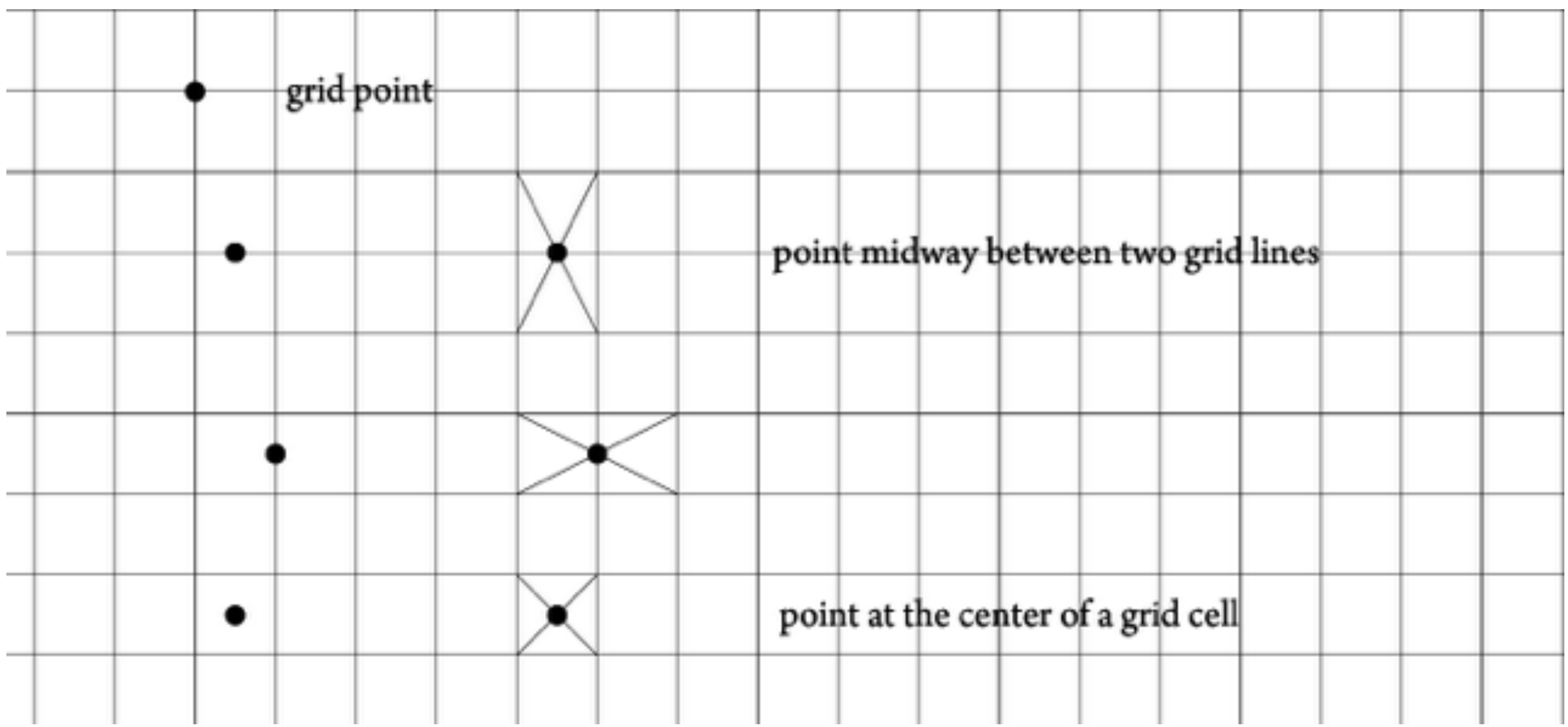
- specifying a line given a point, its bearing and slope

- *origin*: lower left corner
- *Point (x, Front y, Top y)*
- *x* distance from left margin
- *Front y* distance from lower border to front view
- *Top y* distance from lower border to top view

Unknown quantity marked by an "X"

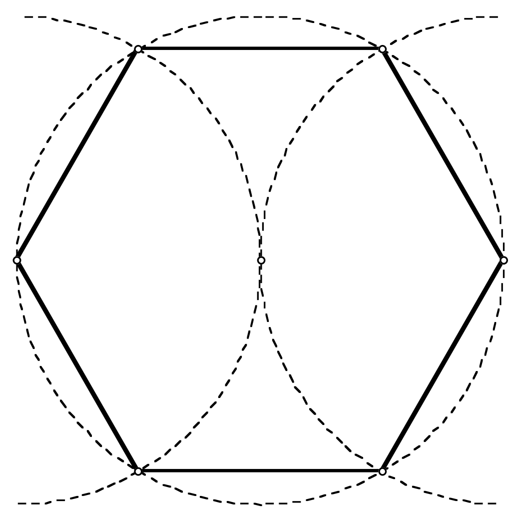


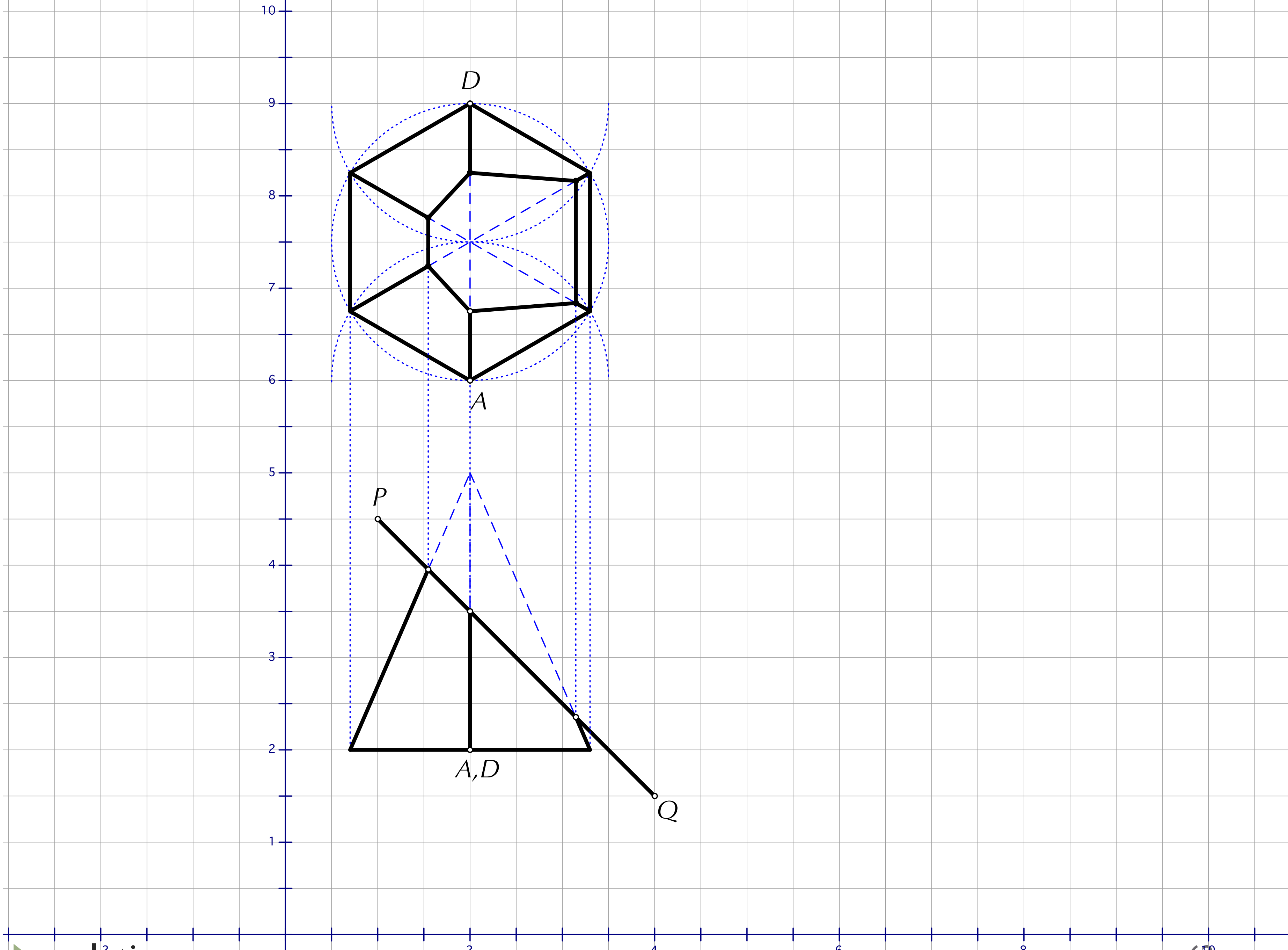
- talk about quad paper



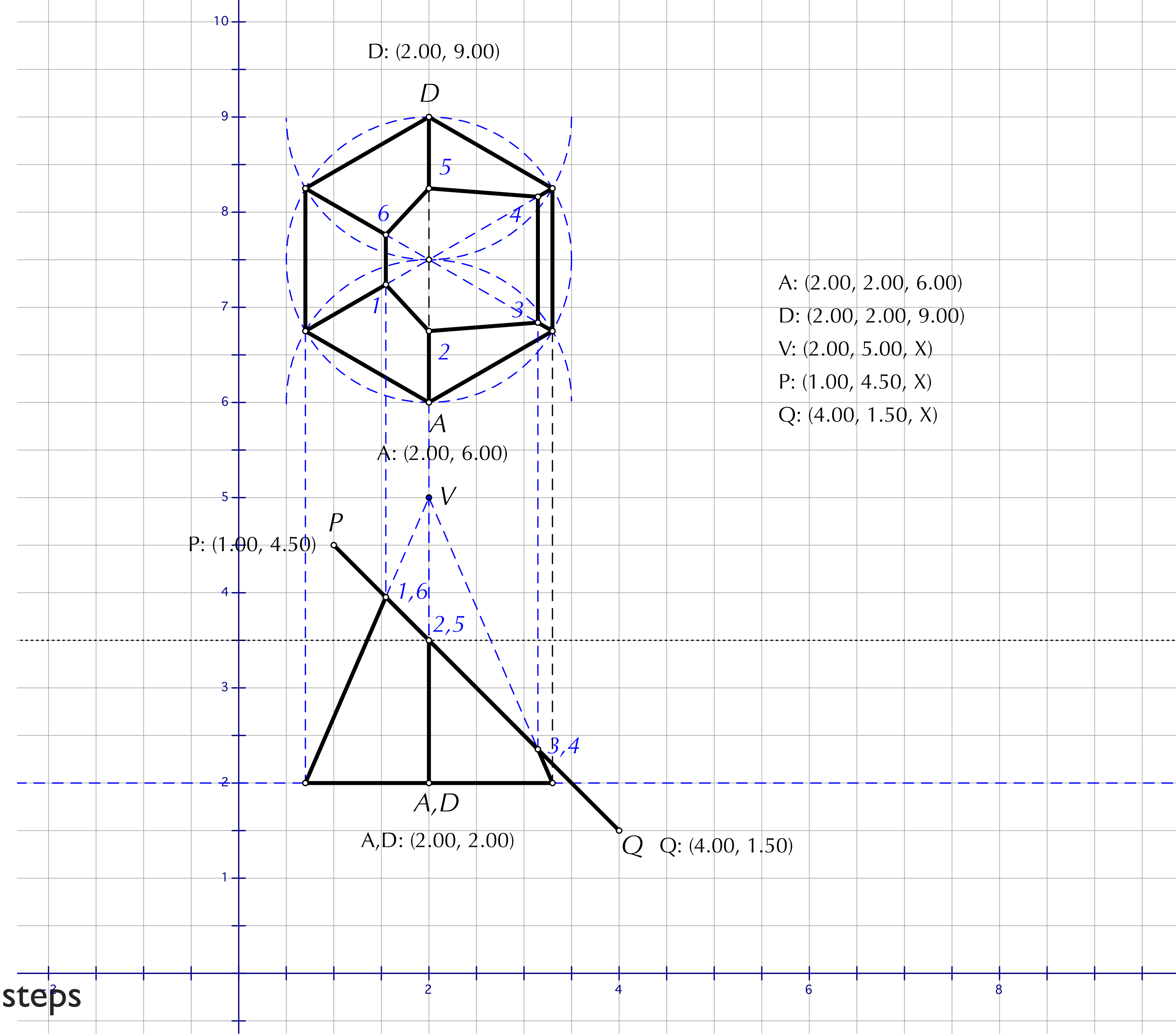
- adding precision

- On quad paper, line A: (2, 2, 6), D: (2, 2, 9) is a diagonal of a horizontal hexagonal base of a right pyramid. The vertex is 3" above the base. The pyramid is truncated by a plane that passes through points P: (1, 4 1/2, X) and Q: (4, 1 1/2, X) and projects edgewise in the front view. Draw top and front views of the truncated pyramid.

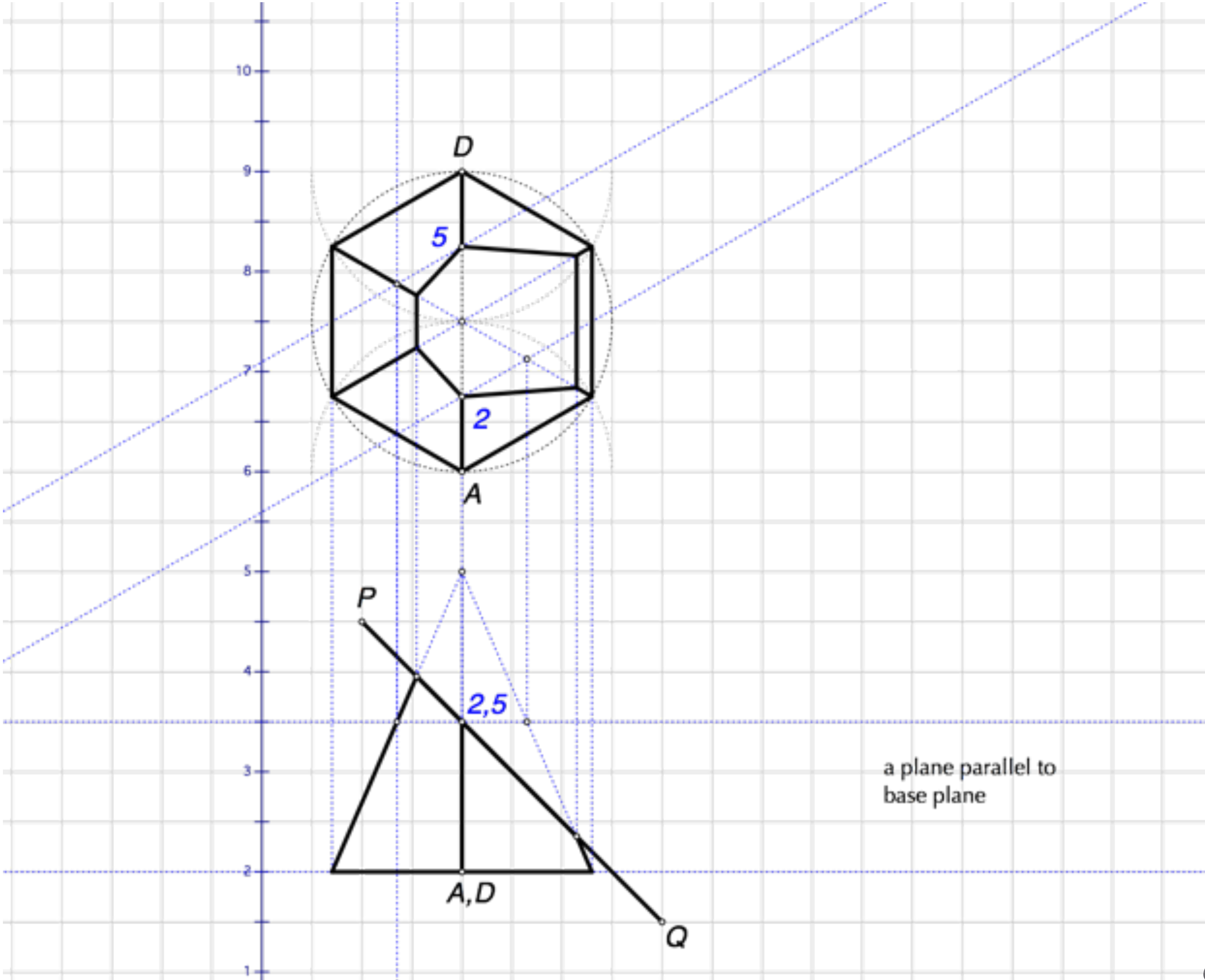




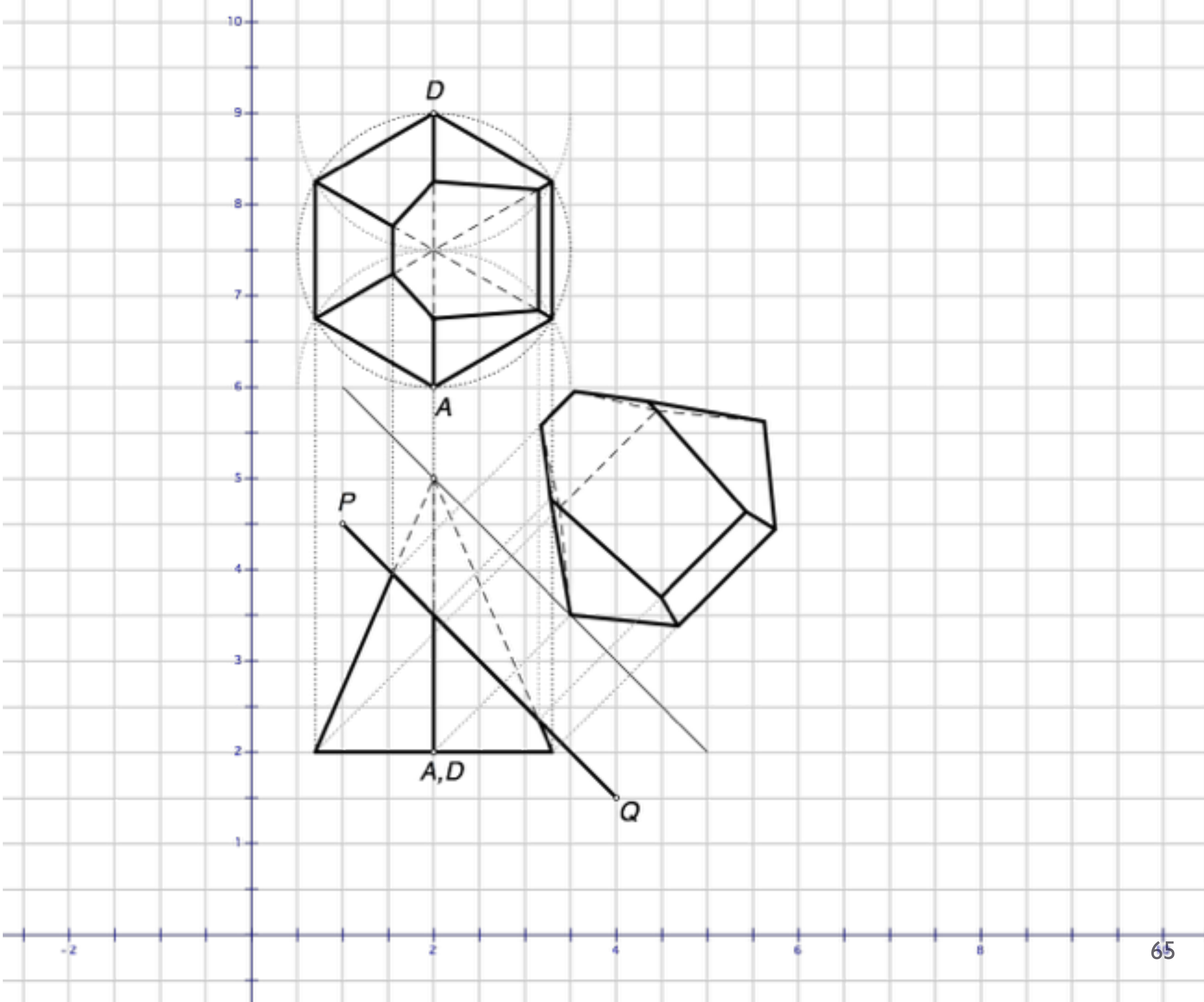
solution


D: (2.00, 9.00)
D
5
6
4
1
3
2
A
A: (2.00, 6.00)
A: (2.00, 2.00, 6.00)
D: (2.00, 2.00, 9.00)
V: (2.00, 5.00, X)
P: (1.00, 4.50, X)
Q: (4.00, 1.50, X)
V
P
P: (1.00, 4.50)
1,6
2,5
3,4
A,D
A,D: (2.00, 2.00)
Q
Q: (4.00, 1.50)
10
9
8
7
6
5
4
3
2
1
2
4
6
8

steps

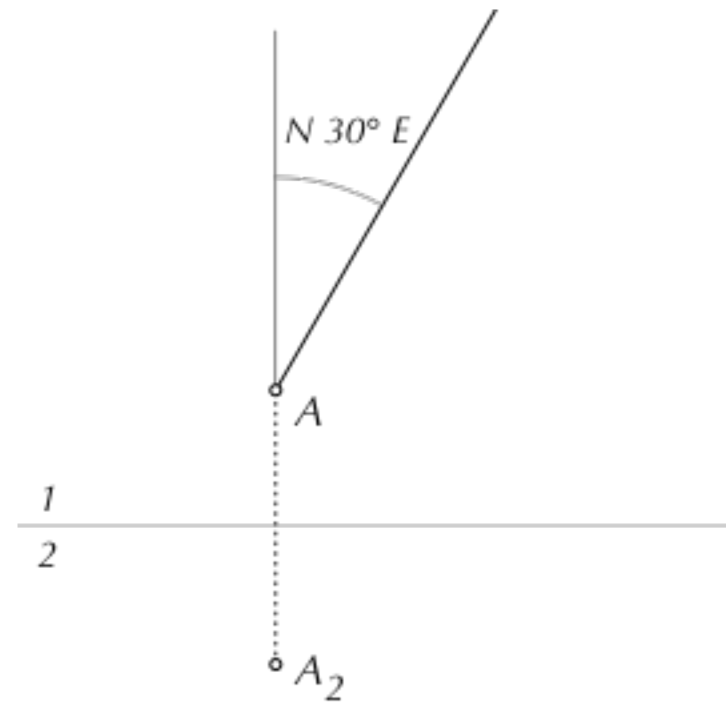


a plane parallel to
base plane

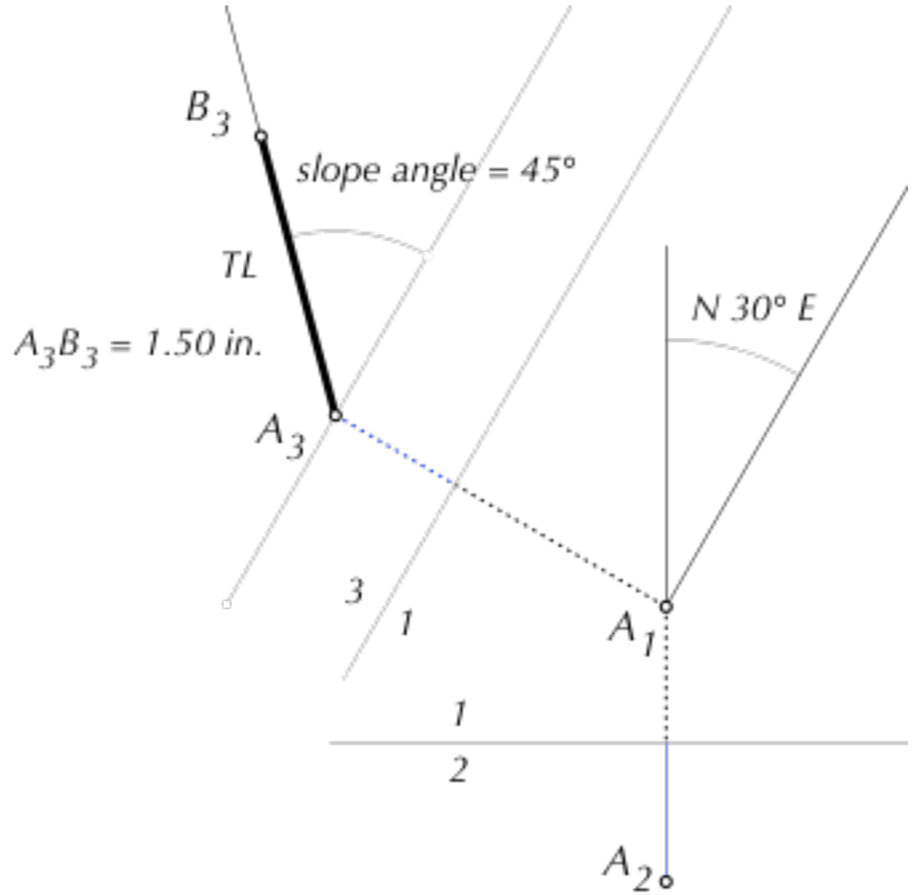

D
A
P
A,D
Q
10
9
8
7
6
5
4
3
2
1
-2
2
4
6
8

- **Given a point, the bearing, angle of inclination and true length of a line, construct the top and front views of the line**

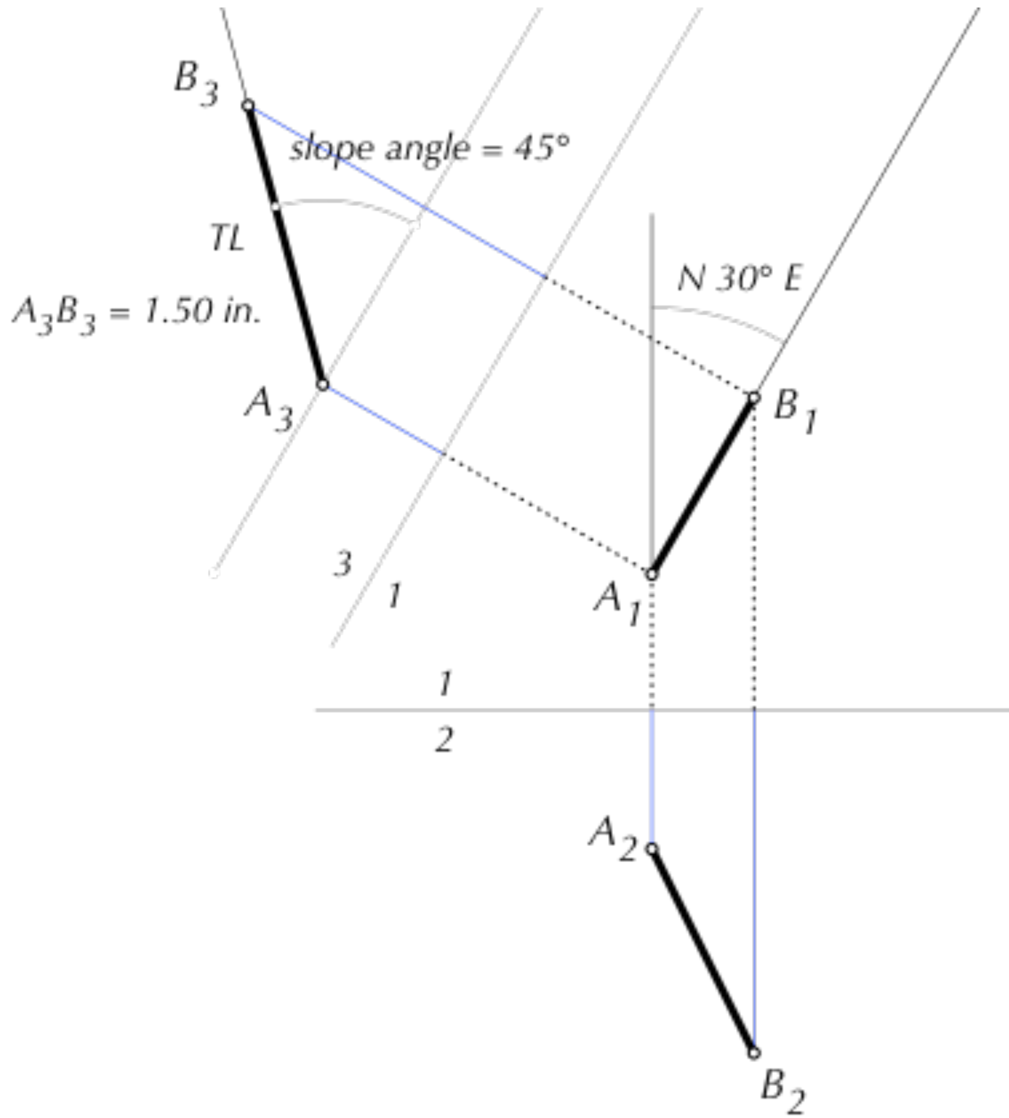
- Suppose we are given the top and front projections of the given point, A, bearing N30°E, slope 45° and true
- Assume North.
- Choose the point A in front view 2 arbitrarily



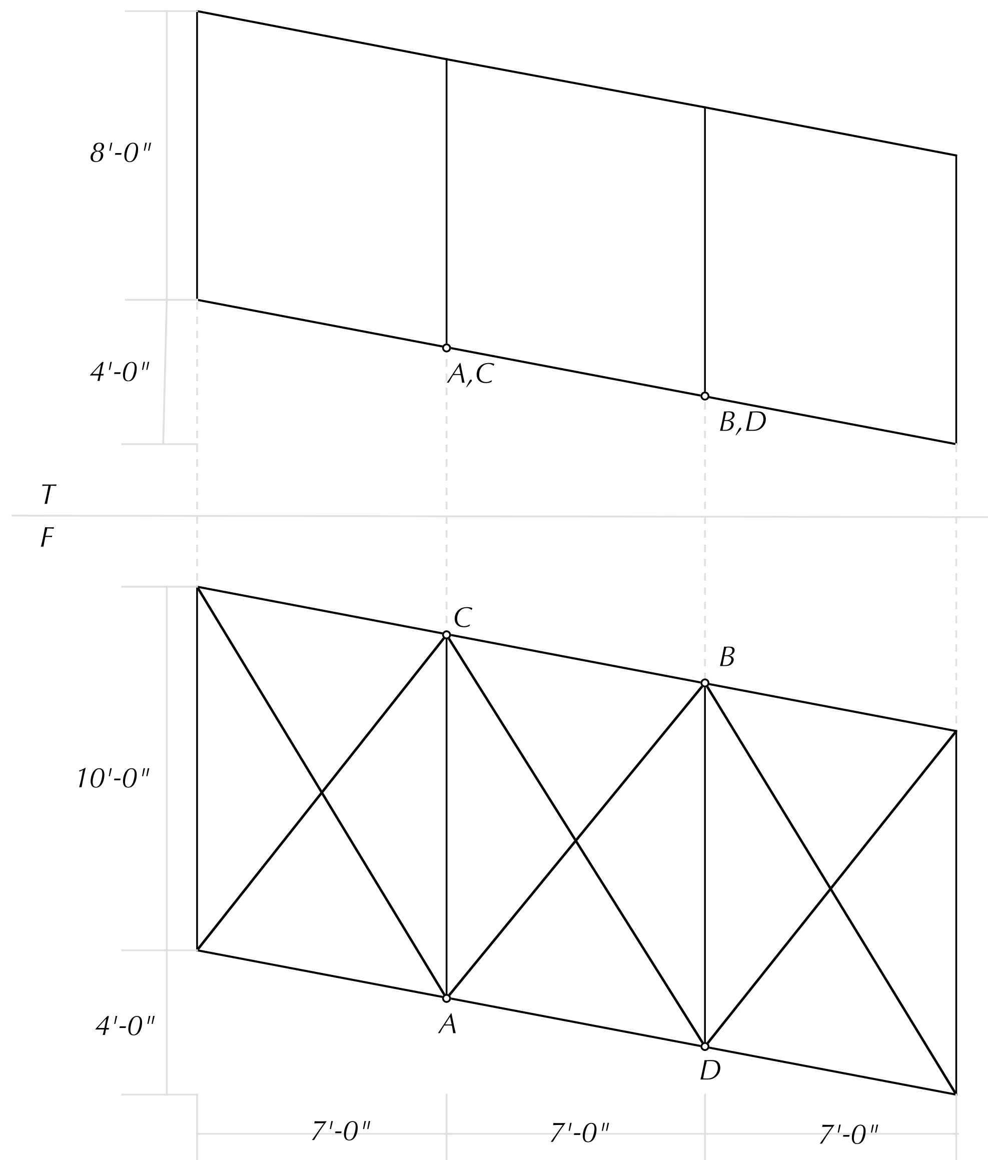
- Constructing an auxiliary view 3 using a folding line 3|1 parallel to the top view of the given line.
- Project A_1 to A_3 using the transfer distance from the front view 2.
- Draw a line from A_3 with given slope and measure off the supplied true length to construct point B_3

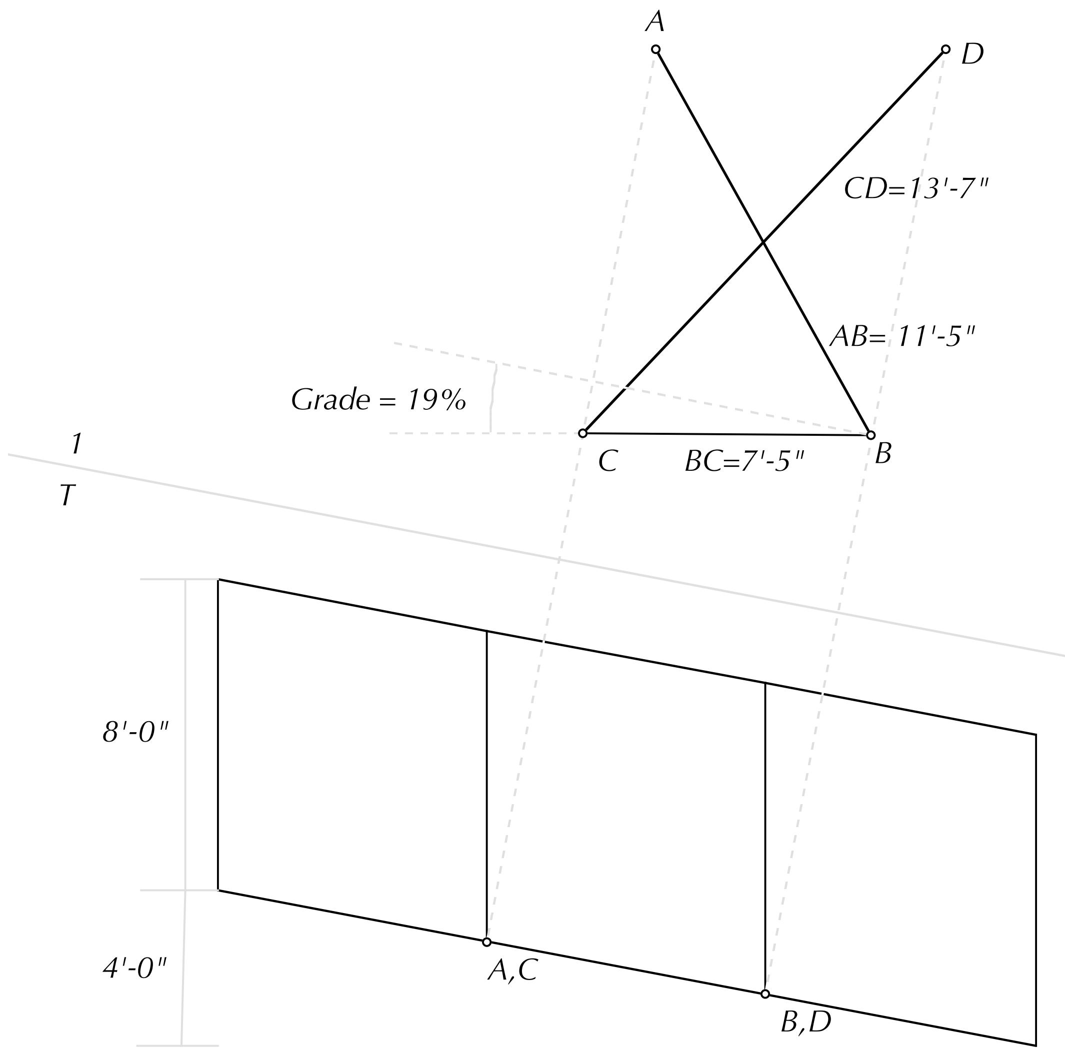


- Project B_3 to meet the line in top view at B_1. A_1B_1 is the required top view.
- Project B_1 to the front view and measure off the transfer distance from the auxiliary view 3 to get B_2. A_2B_2 is the required front view.



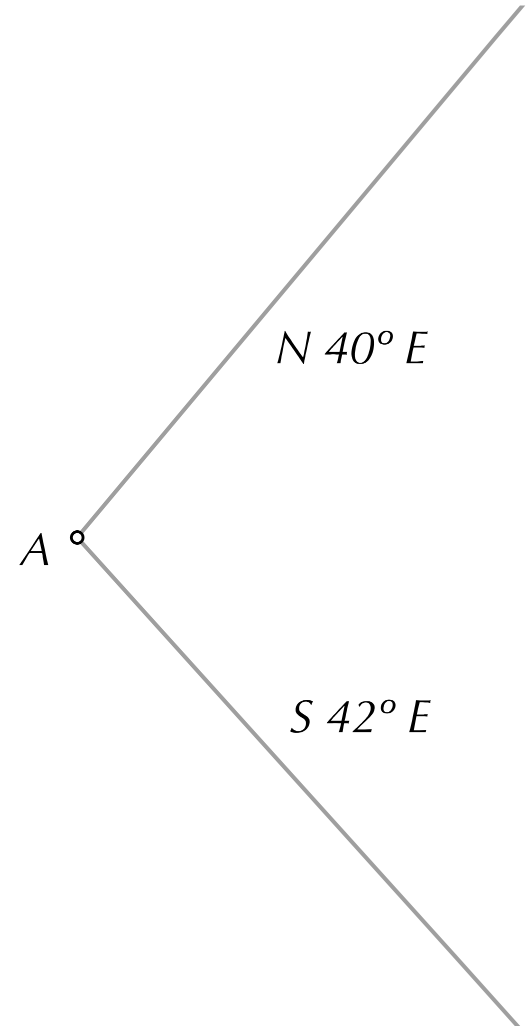
- The problem is to determine the true length of structural members *AB* and *CD* and the percentage grade of member *BC*.

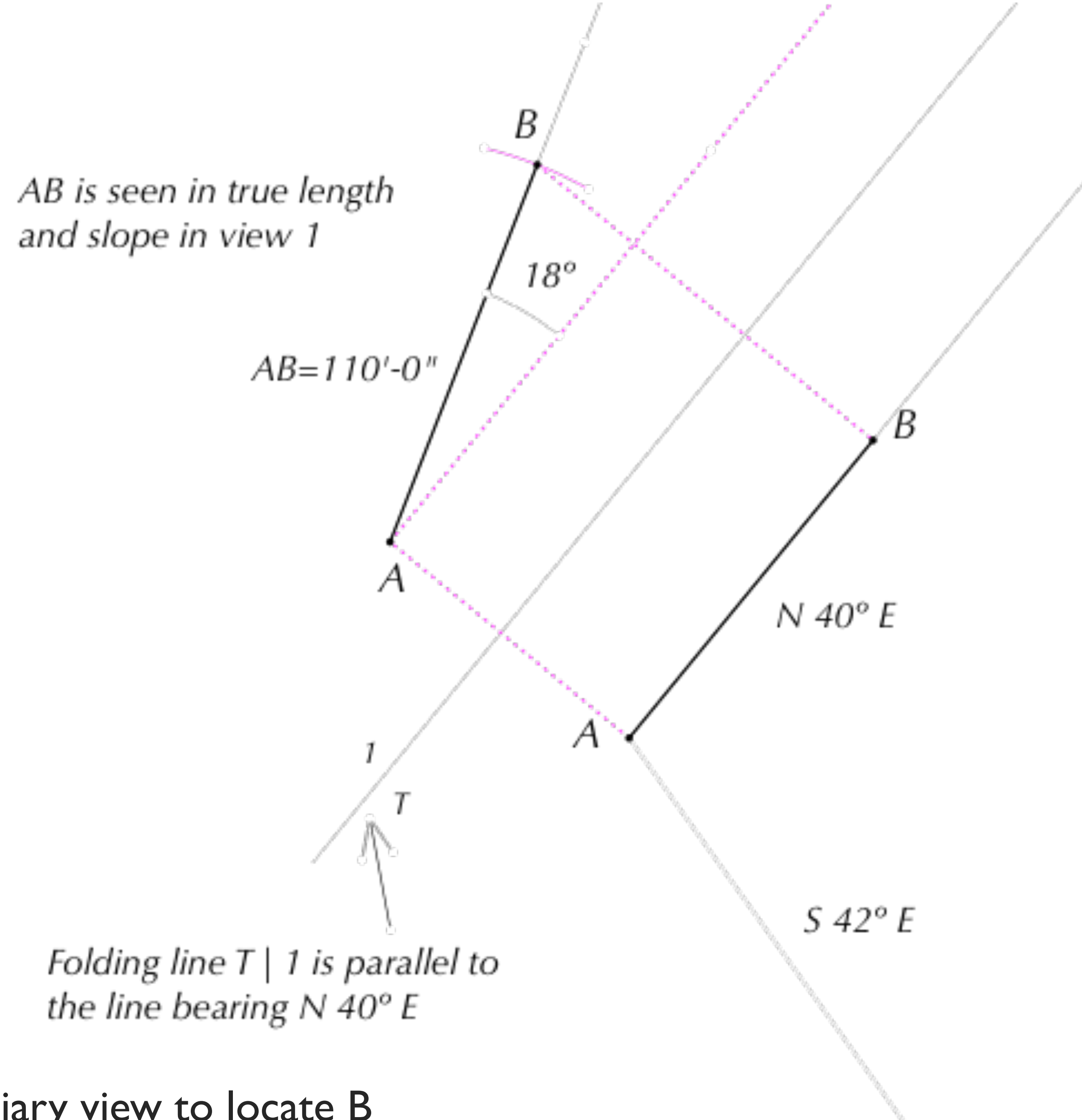




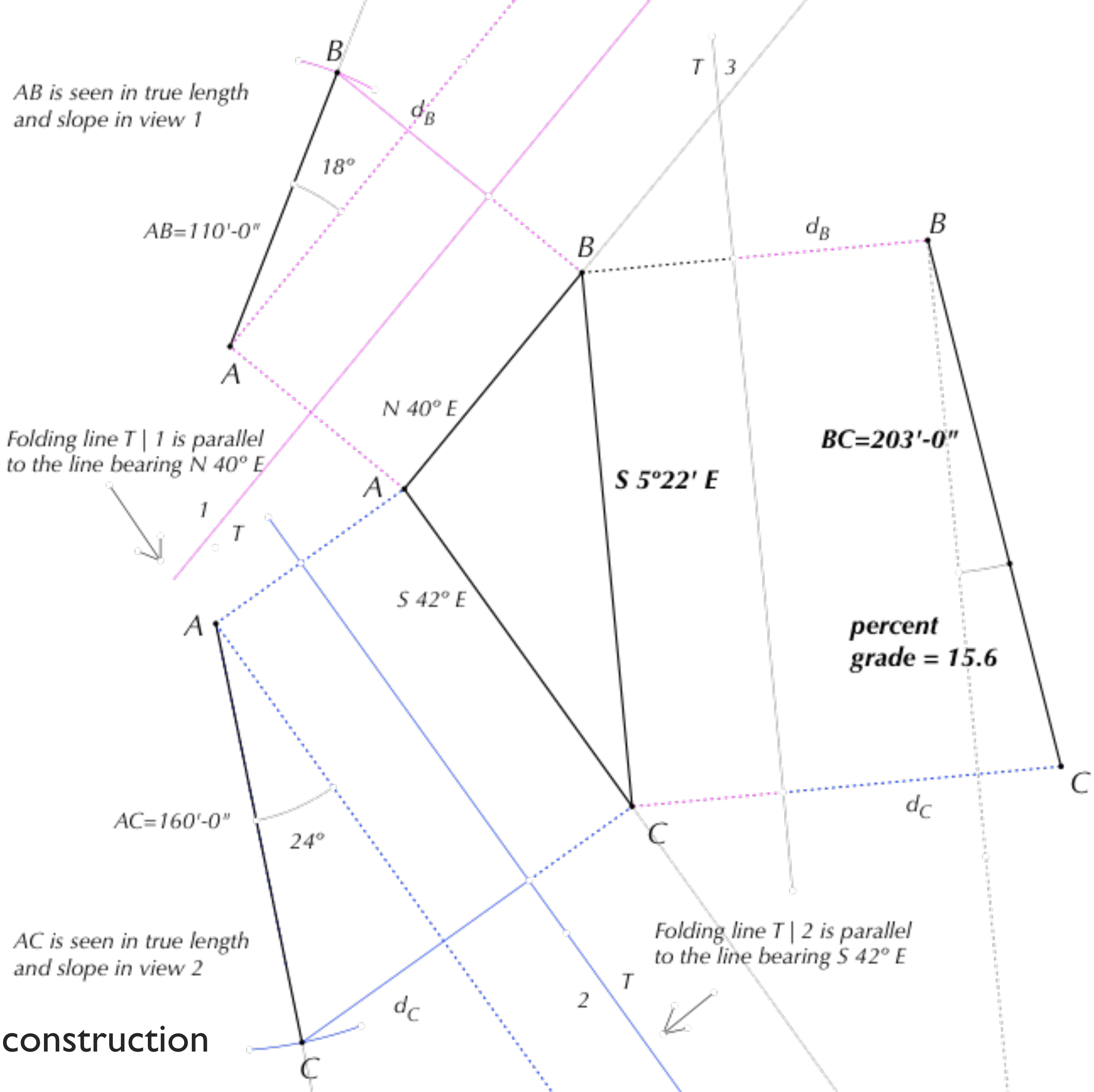
solving the structural framework problem

- Consider two such mine tunnels AB and AC, which start at a common point A. Tunnel AB is 110' long bearing N 40° E on a downward slope of 18°. Tunnel AC is 160' long bearing S 42° E on a downward slope of 24°.
- Suppose a new tunnel is dug between points B and C. *What would its length, bearing, and percent grade be?*





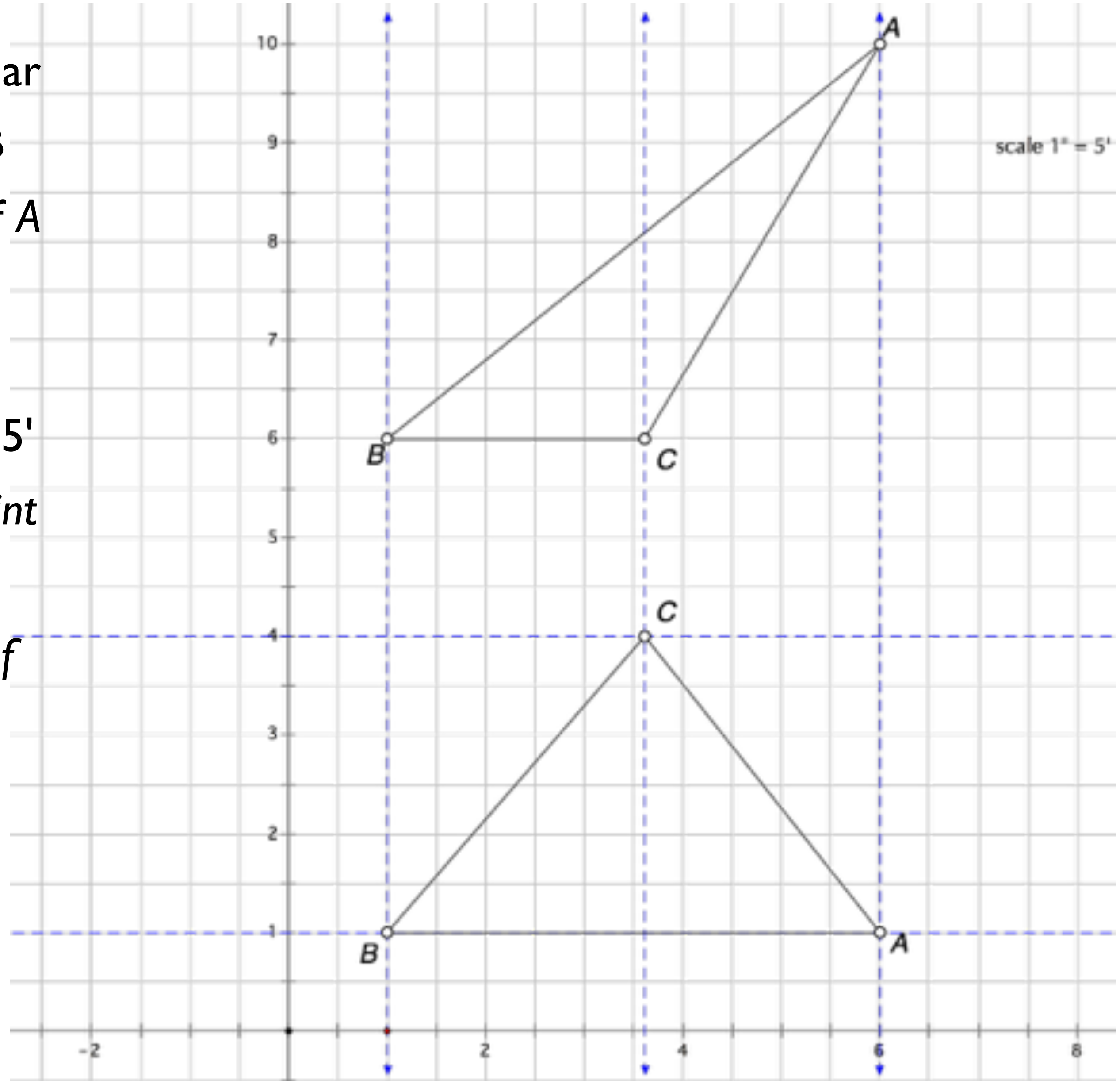
- an auxiliary view to locate B



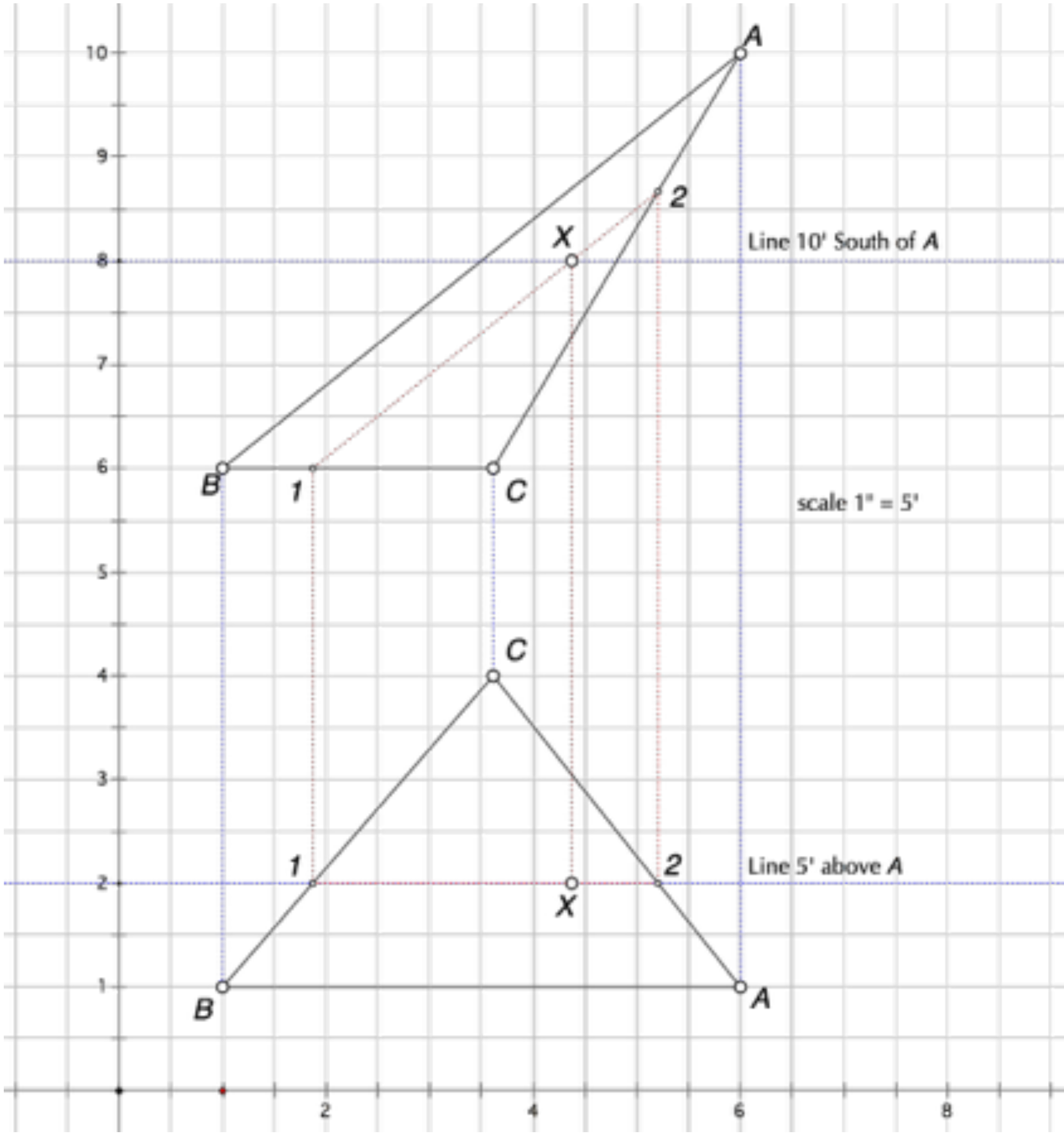
the construction

- in pittsburgh

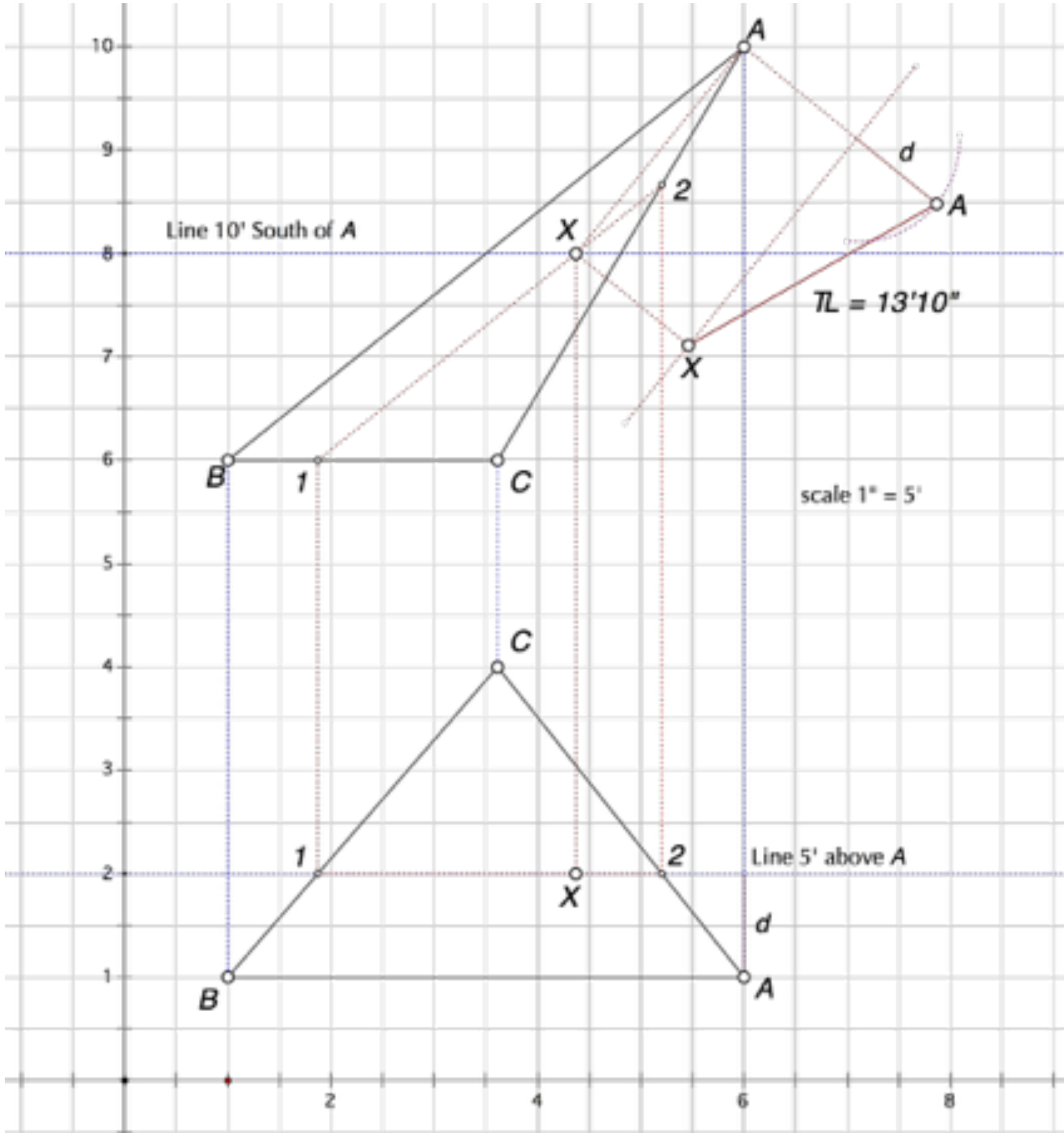
- Let *ABC* be a triangular planar surface with *B* 25' west 20' south of *A* and at the same elevation. *C* is 12' west 20' south and 15' above *A*. *Locate a point X on the triangle 5' above and 10' south of A. Determine the true distance from A to X.*



- step 1


A
2
X
Line 10' South of A
B
1
C
scale 1" = 5'
C
1
2
Line 5' above A
X
B
A
10
9
8
7
6
5
4
3
2
1
2
4
6
8

- step 2



- Step 3