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**48-175**  
**Descriptive Geometry**

Spatial Relations on Lines

A line is *parallel* to a plane if it has no common point with the plane.

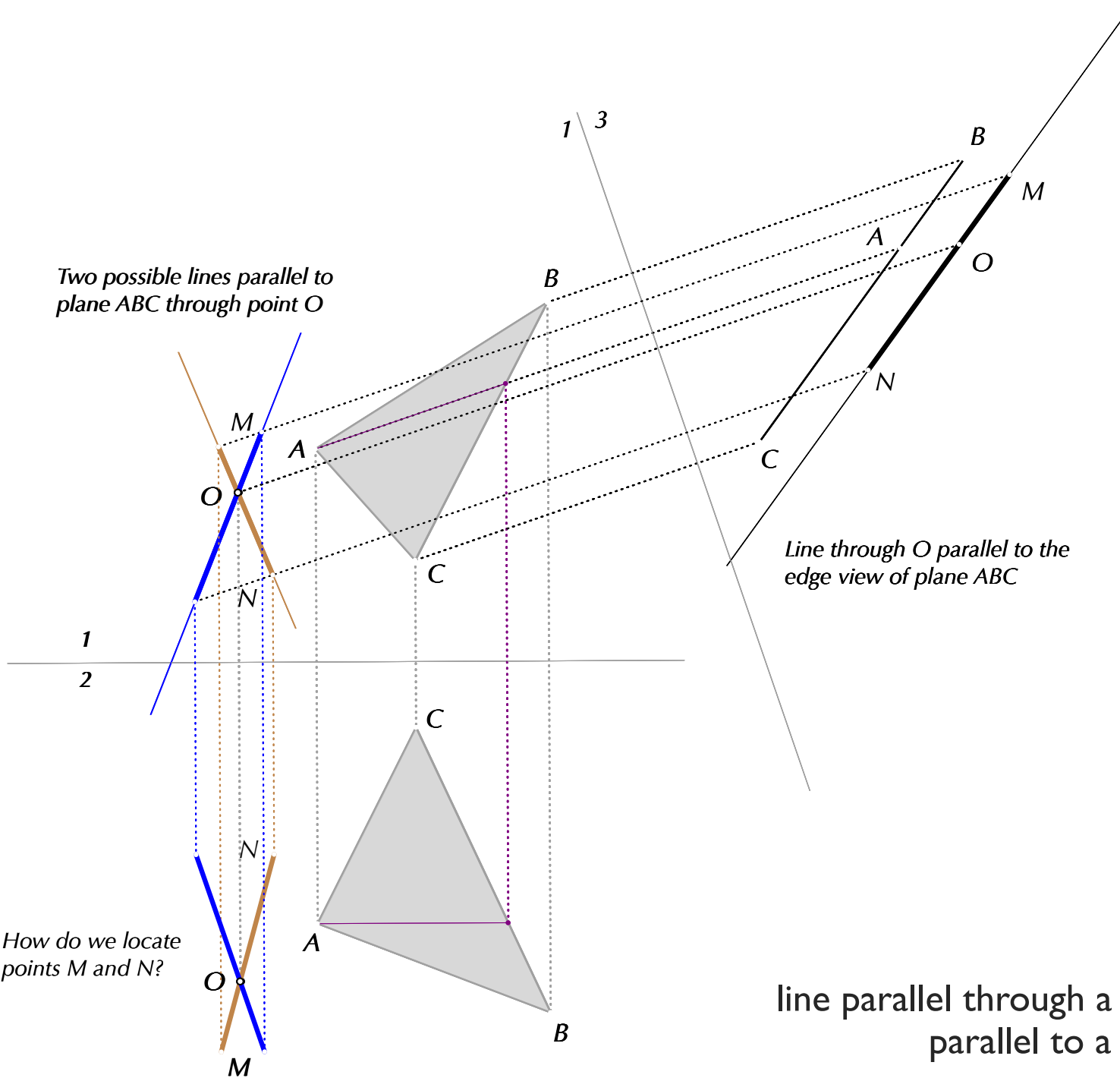
To **test** whether a given line and plane **are parallel**:

simply, construct an edge view of the plane and project the line into the same view; if the *line appears in point view or parallel to the edge view*, then it cannot meet the plane in a point, and is therefore parallel to the plane

This fact can be used to construct a plane parallel to a given line or a line parallel to a given plane.

## ► Lines parallel to a plane

Two possible lines parallel to plane ABC through point O



Line through O parallel to the edge view of plane ABC

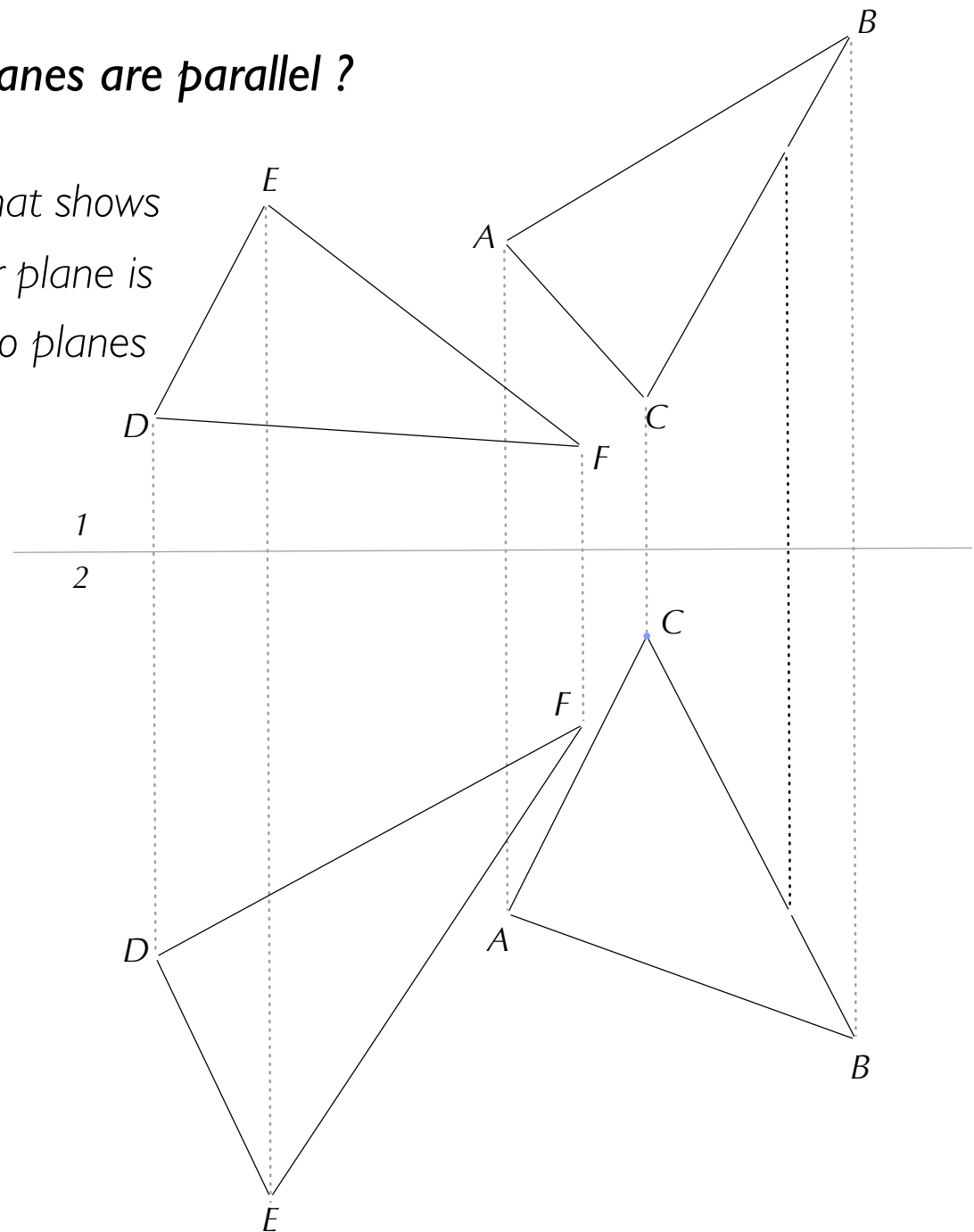
How do we locate points M and N?

line parallel through a point parallel to a plane

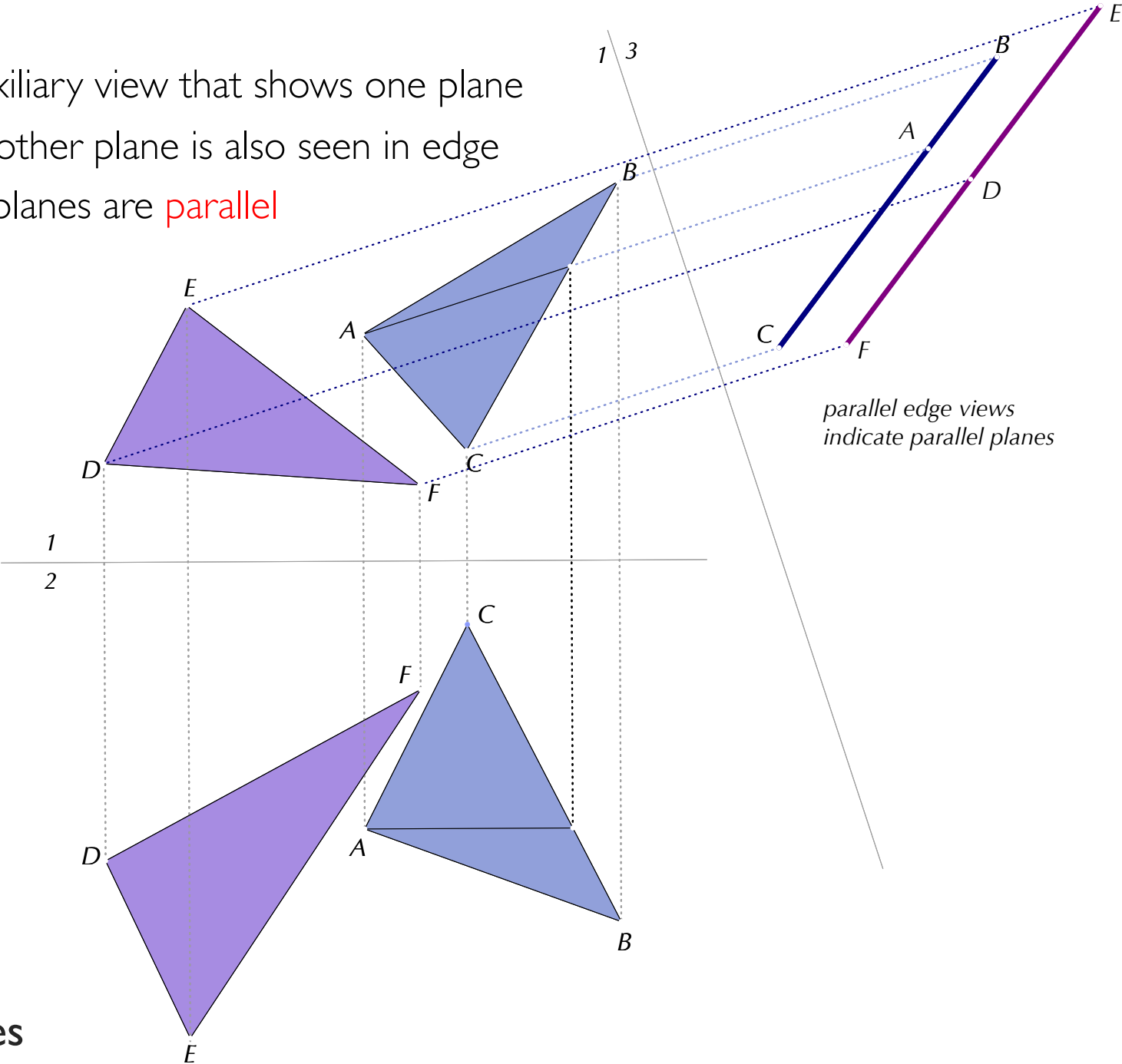


## How do we determine if two planes are parallel ?

by constructing an auxiliary view that shows one plane in edge view; if the other plane is also seen in edge view then the two planes are *parallel*

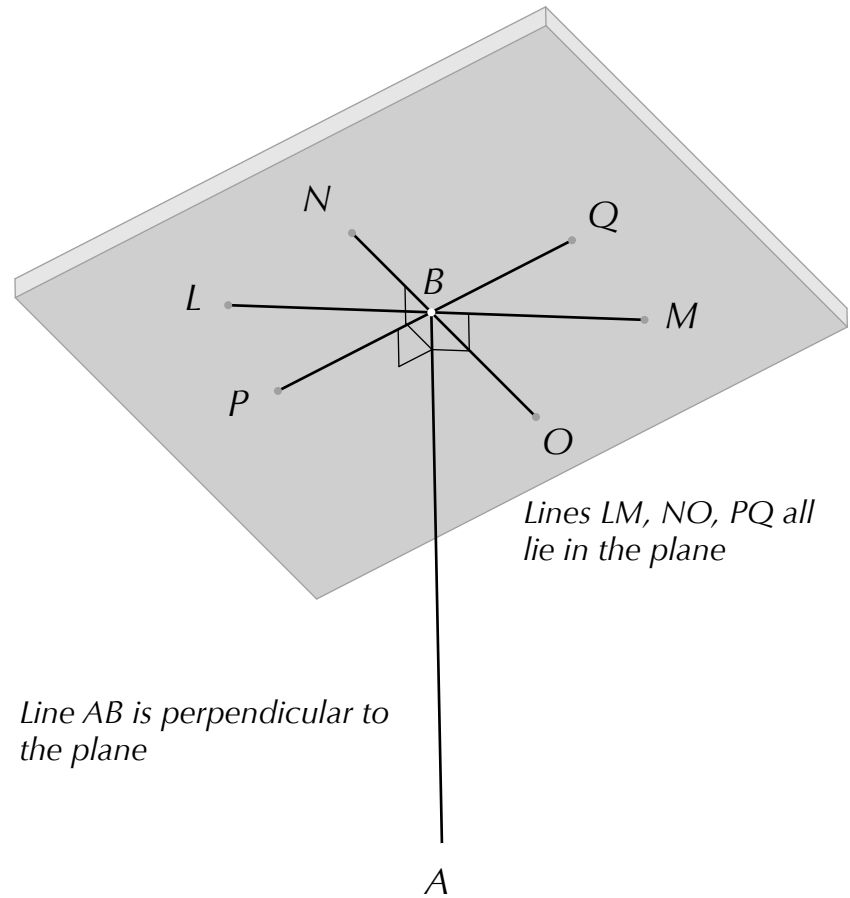


Constructing an auxiliary view that shows one plane in edge view; if the other plane is also seen in edge view then the two planes are **parallel**

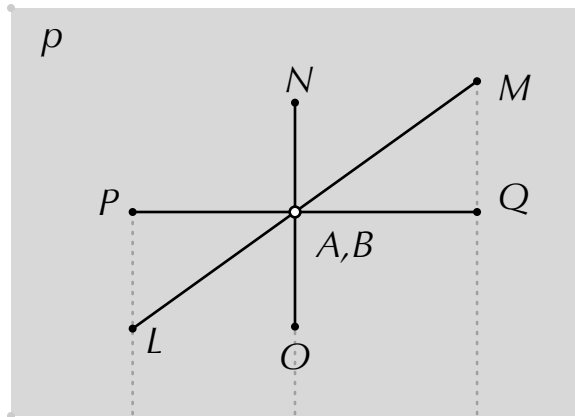


► parallel planes

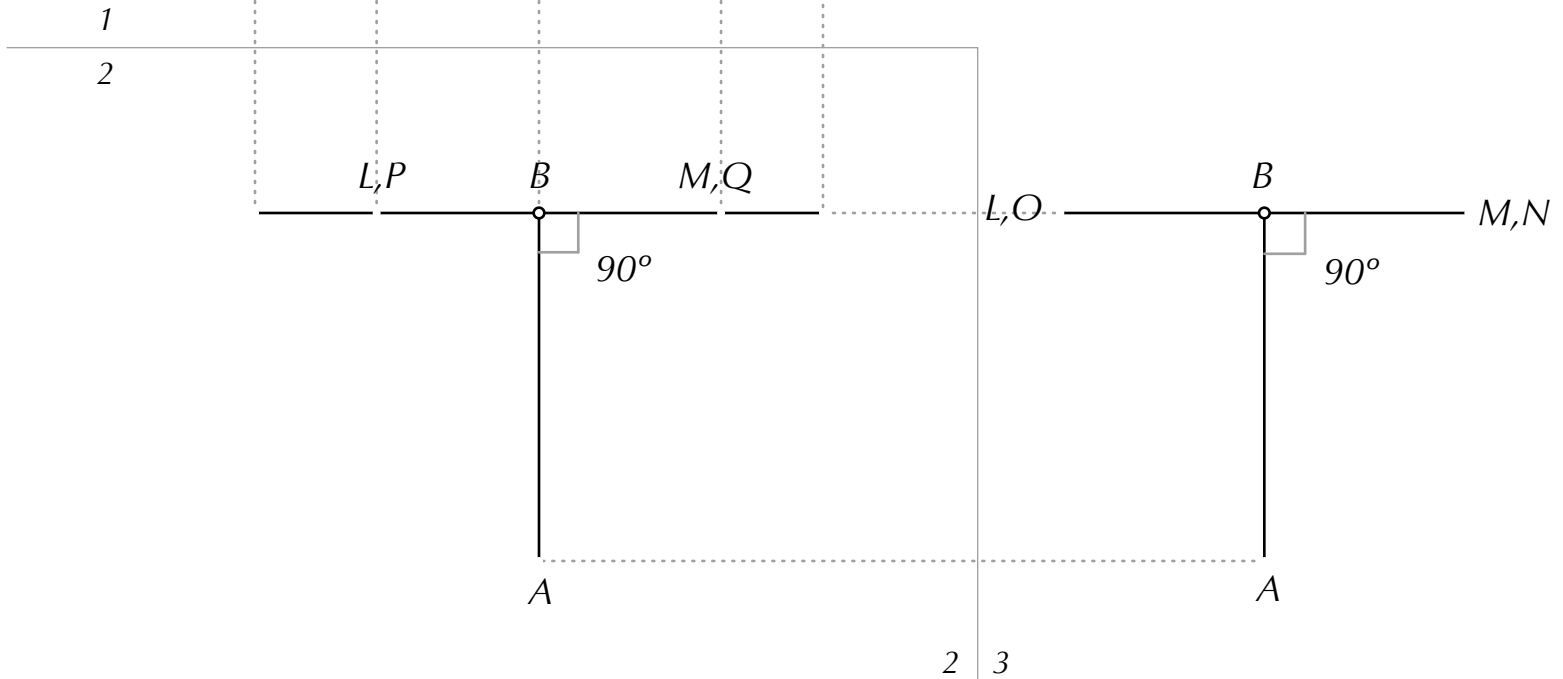
A line is **perpendicular** to a plane if every line in the plane that passes through the point of intersection of the given line and the plane makes a right angle with the given line



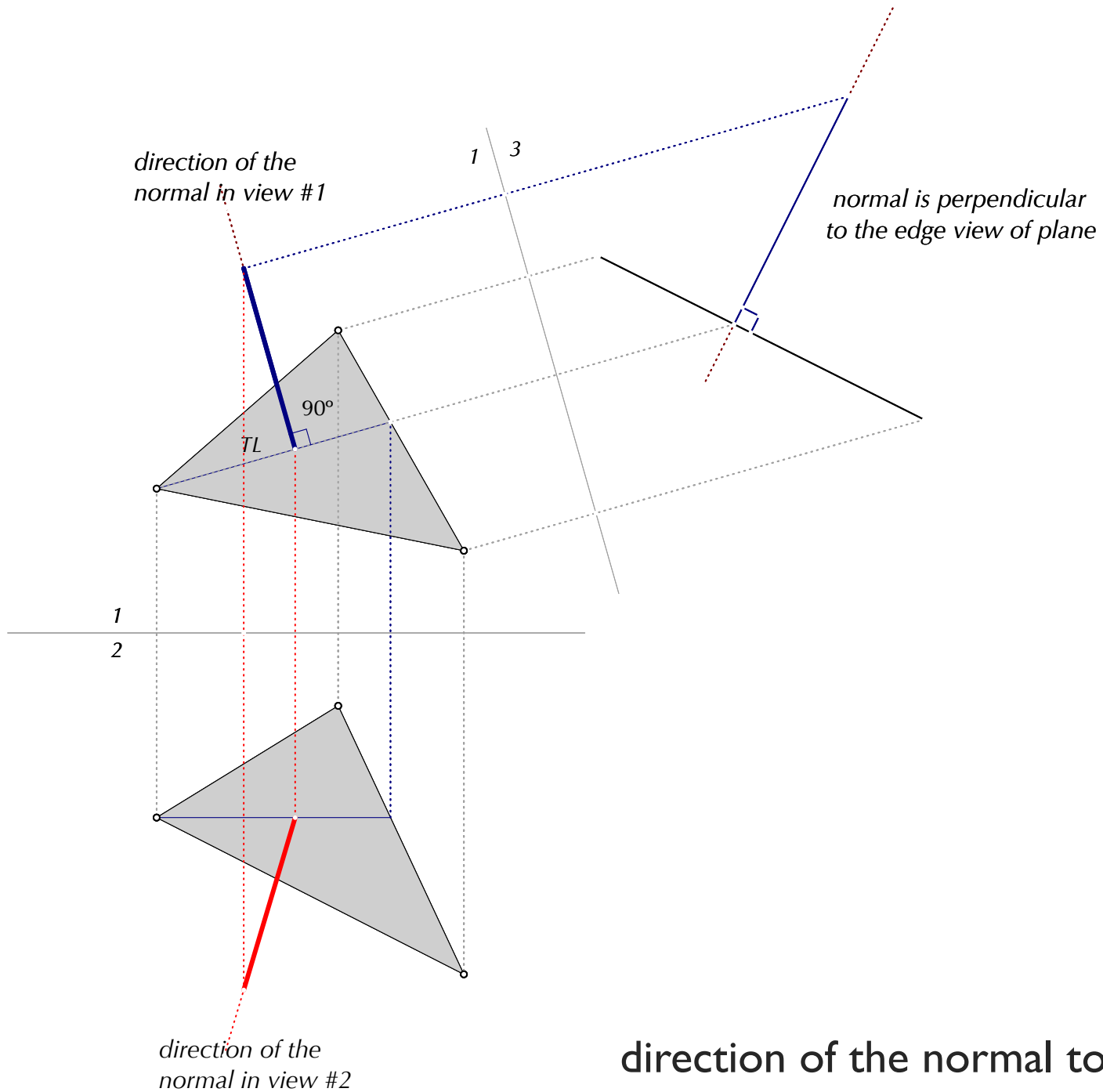
► line perpendicular to plane (**normal**)



$p$  is a plane  
 Line  $AB$  is a normal to it  
 Lines  $LM$ ,  $NO$  and  $PQ$  lie in the plane



► perpendicular line to plane (normal)



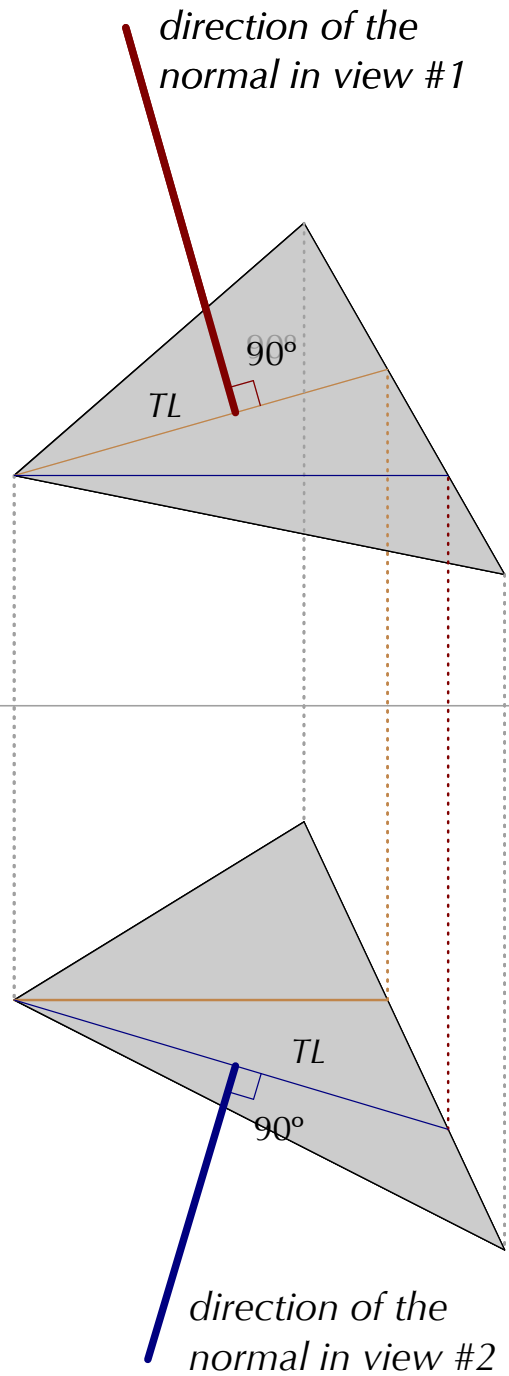
direction of the normal to a plane





Two-view method to find direction (**bearing**)

1  
2



*direction of the normal in view #1*

90°

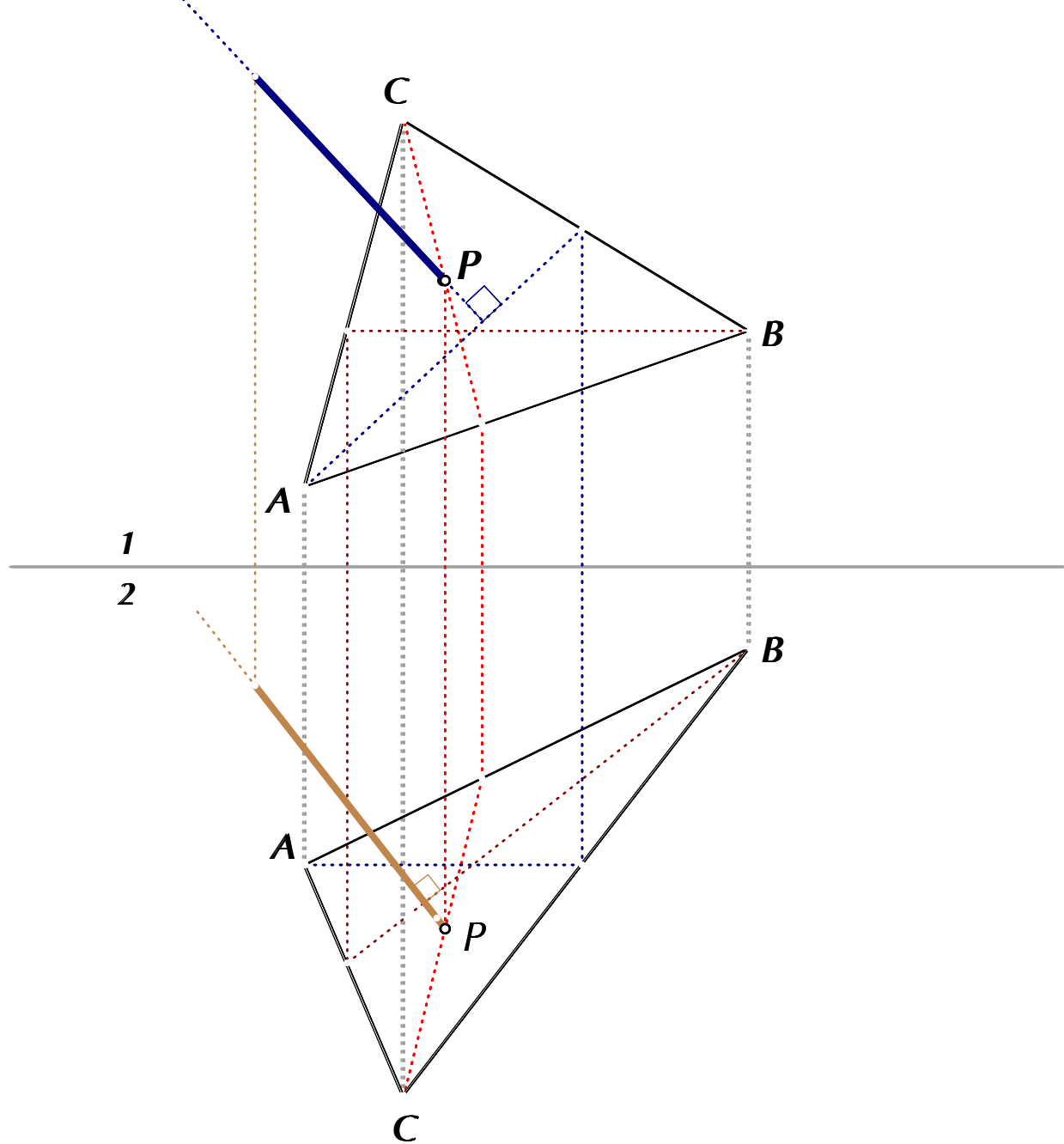
TL

TL

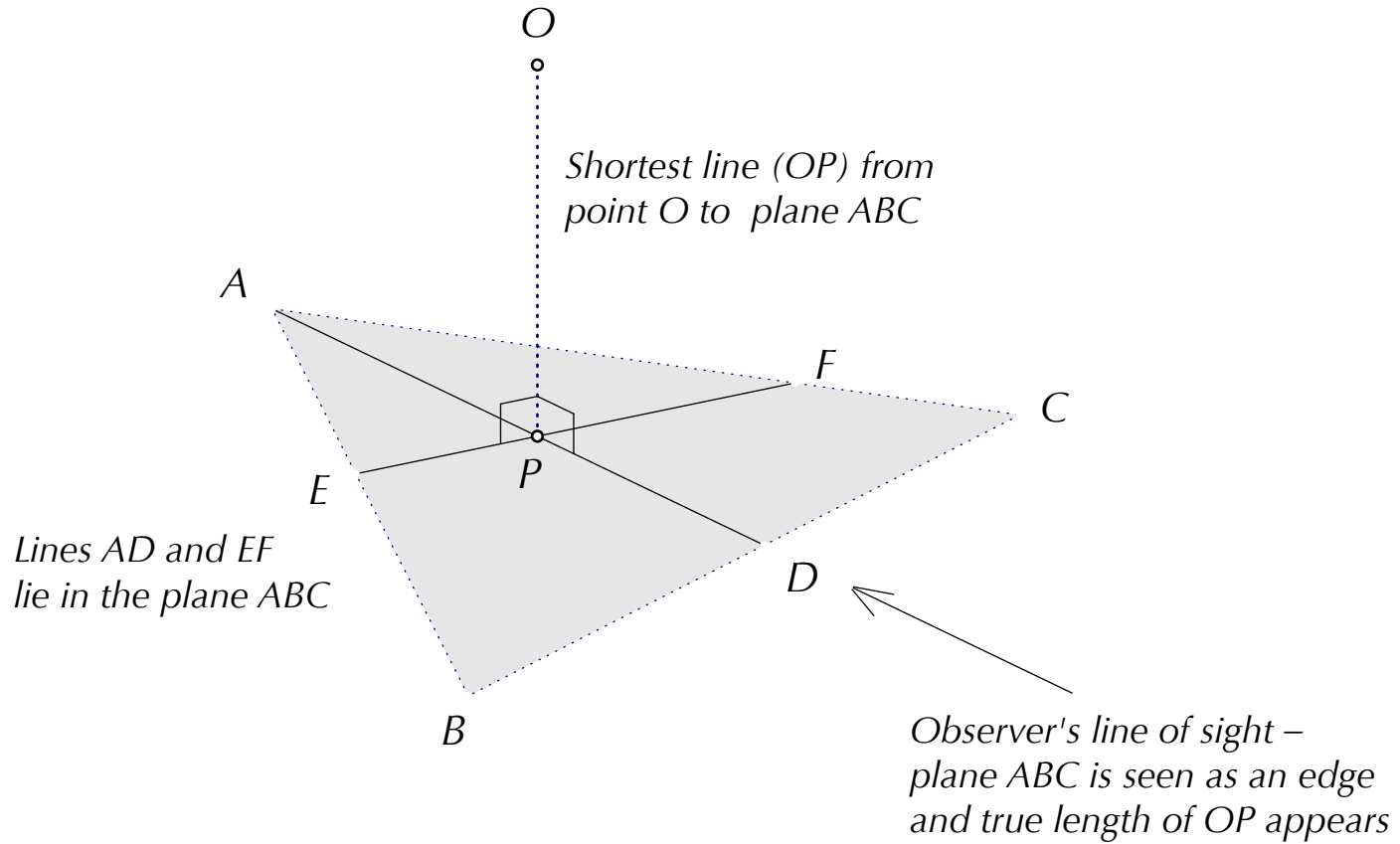
90°

*direction of the normal in view #2*

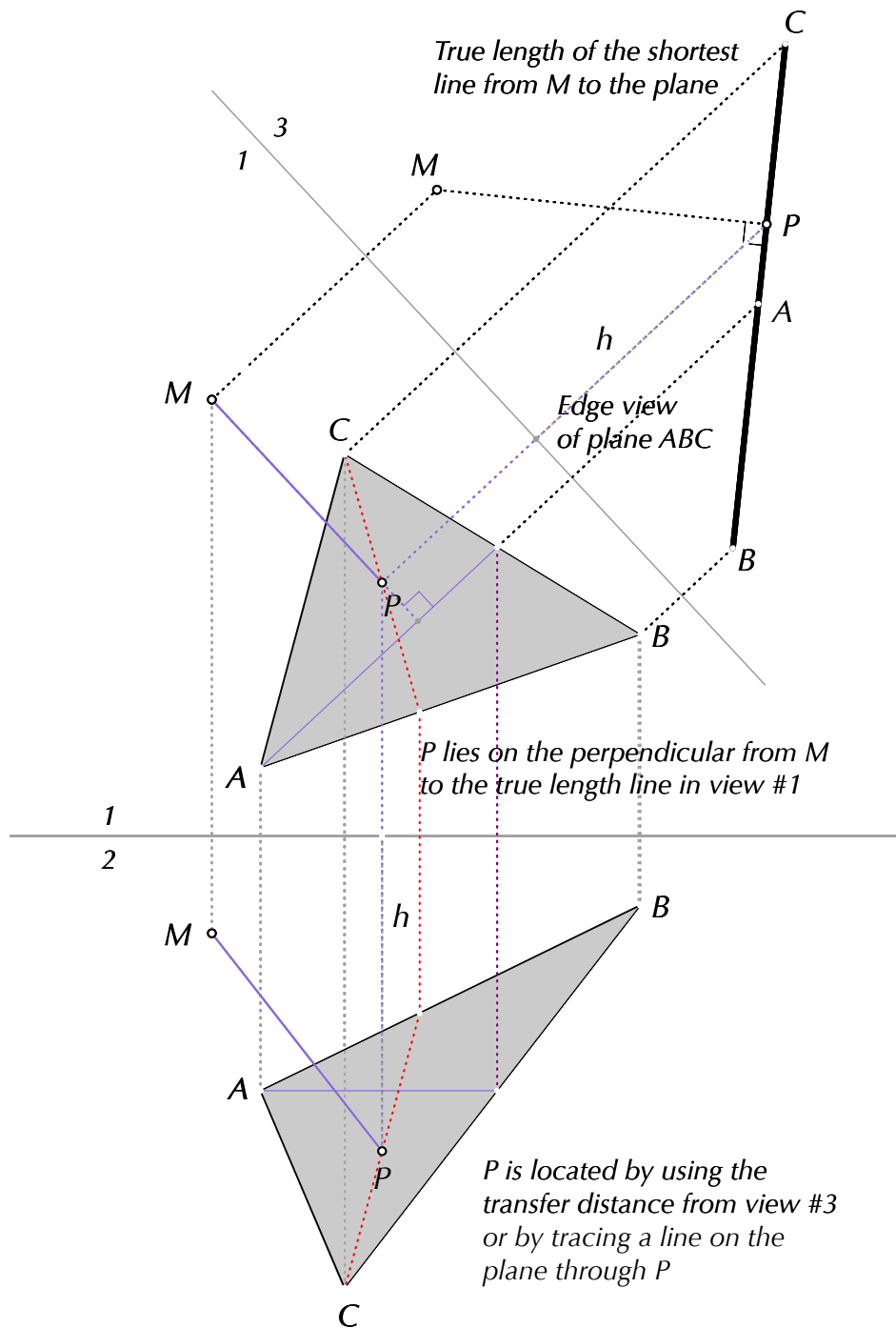
► direction of the normal to a plane



► quiz: perpendicular to the plane at point  $P$



► shortest distance from a point and a plane



**how do we determine if a plane is perpendicular to a given plane ?**

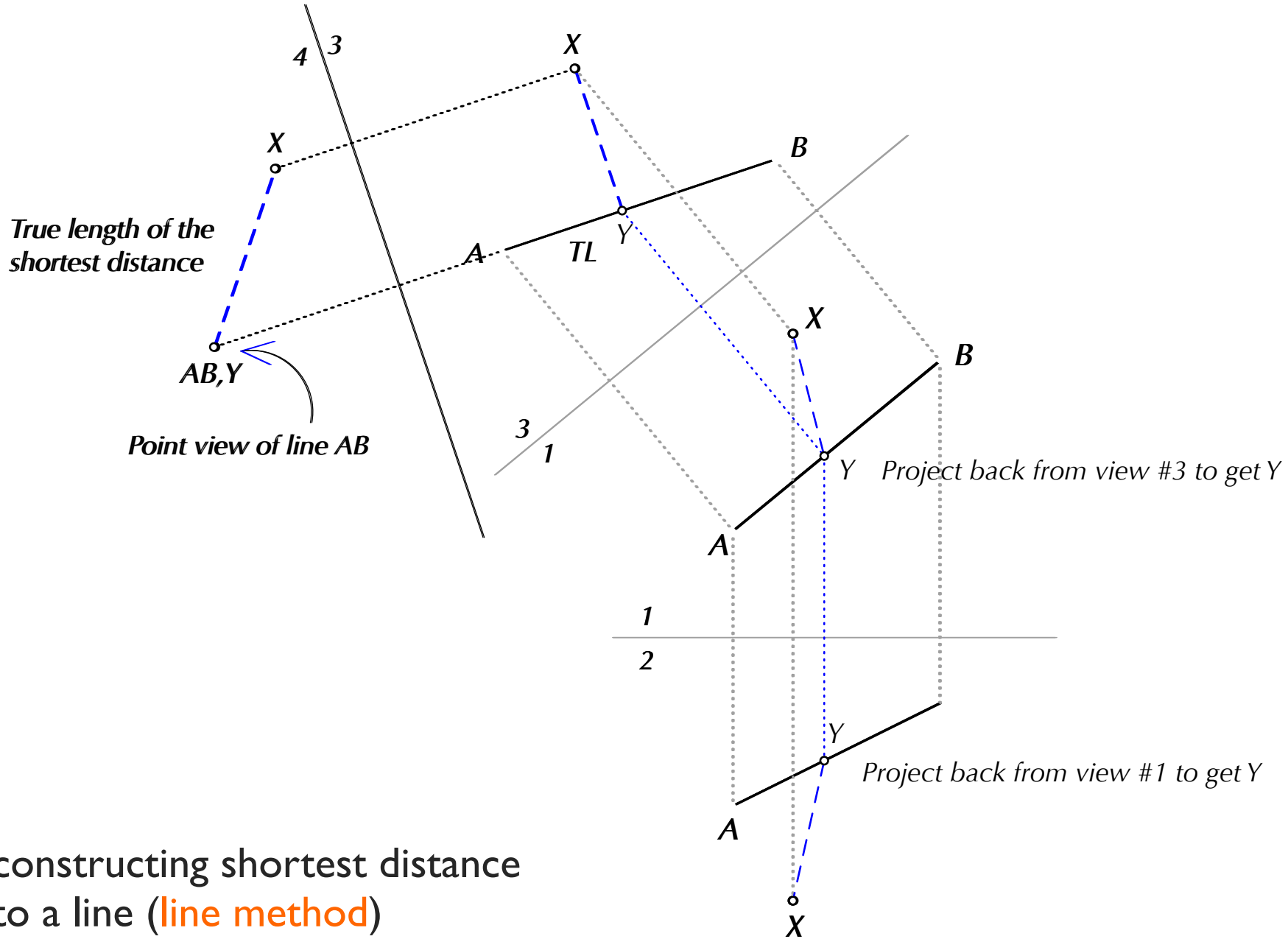
this requires finding edge views of the plane and seeing if they are perpendicular to each other – which we will consider it later when we consider lines of intersection

► perpendicular planes

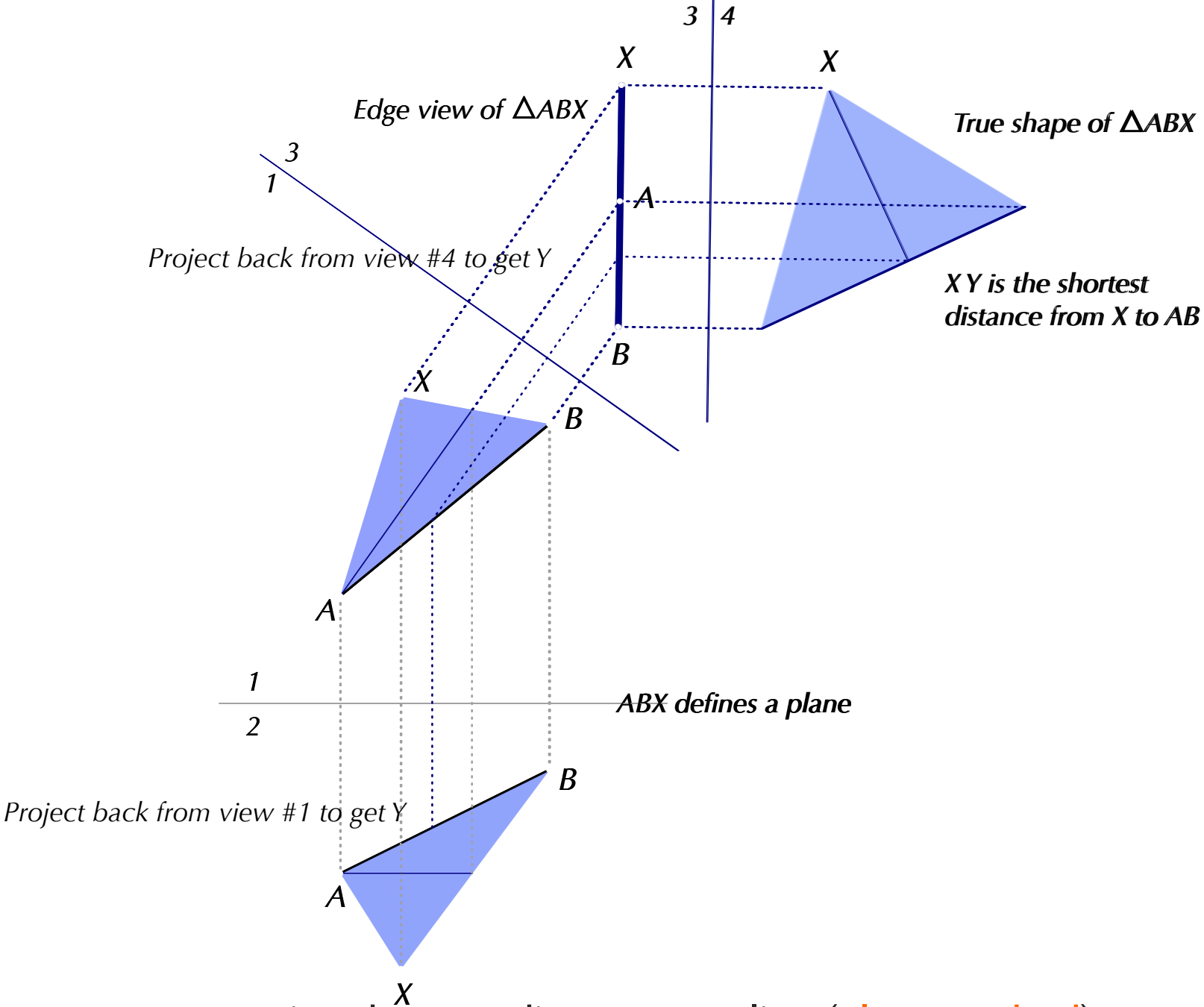
revisiting an old problem – shortest distance to a line



As line AB is in true length, the constructed perpendicular from X to AB produces point Y

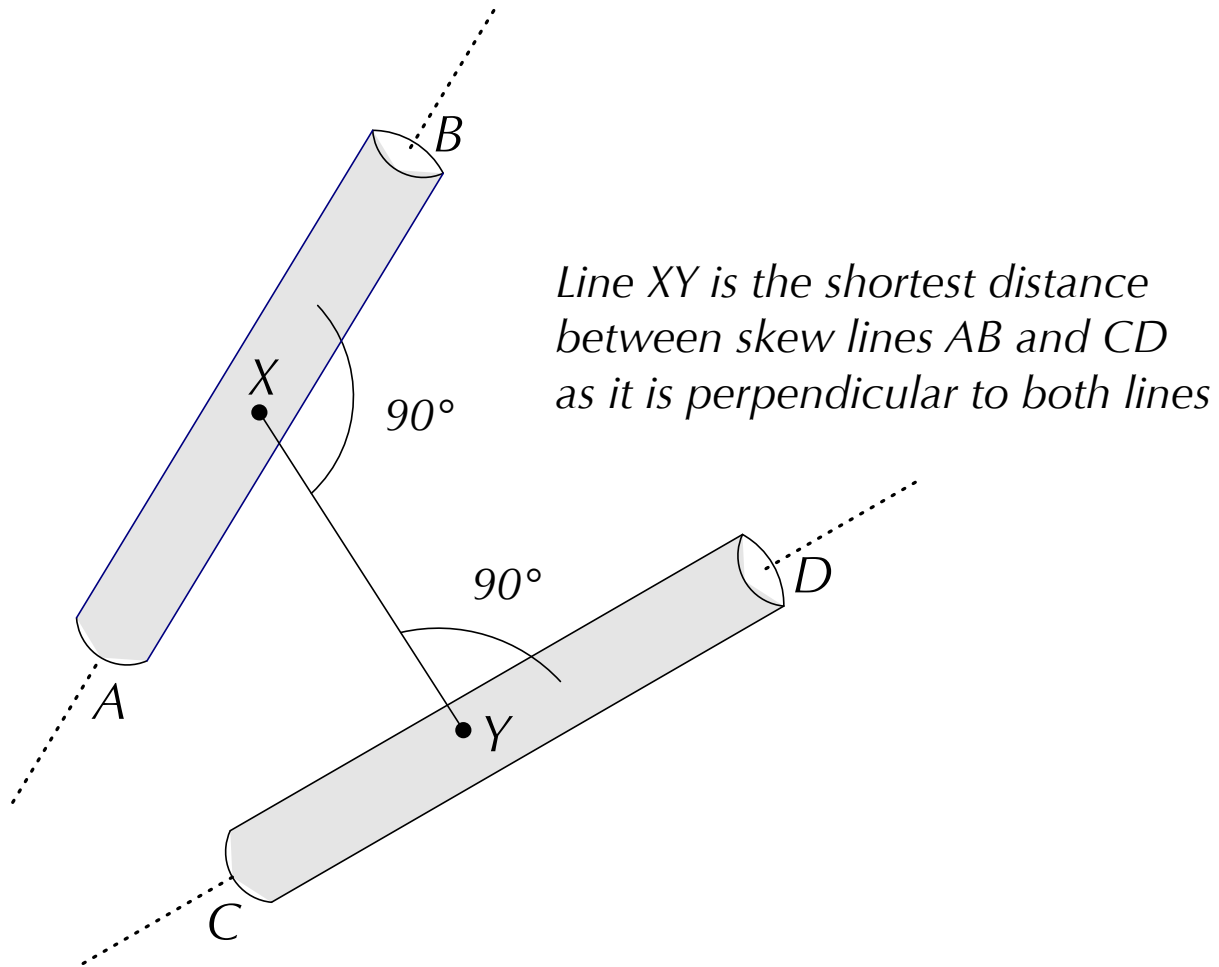


constructing shortest distance  
▶ to a line (line method)

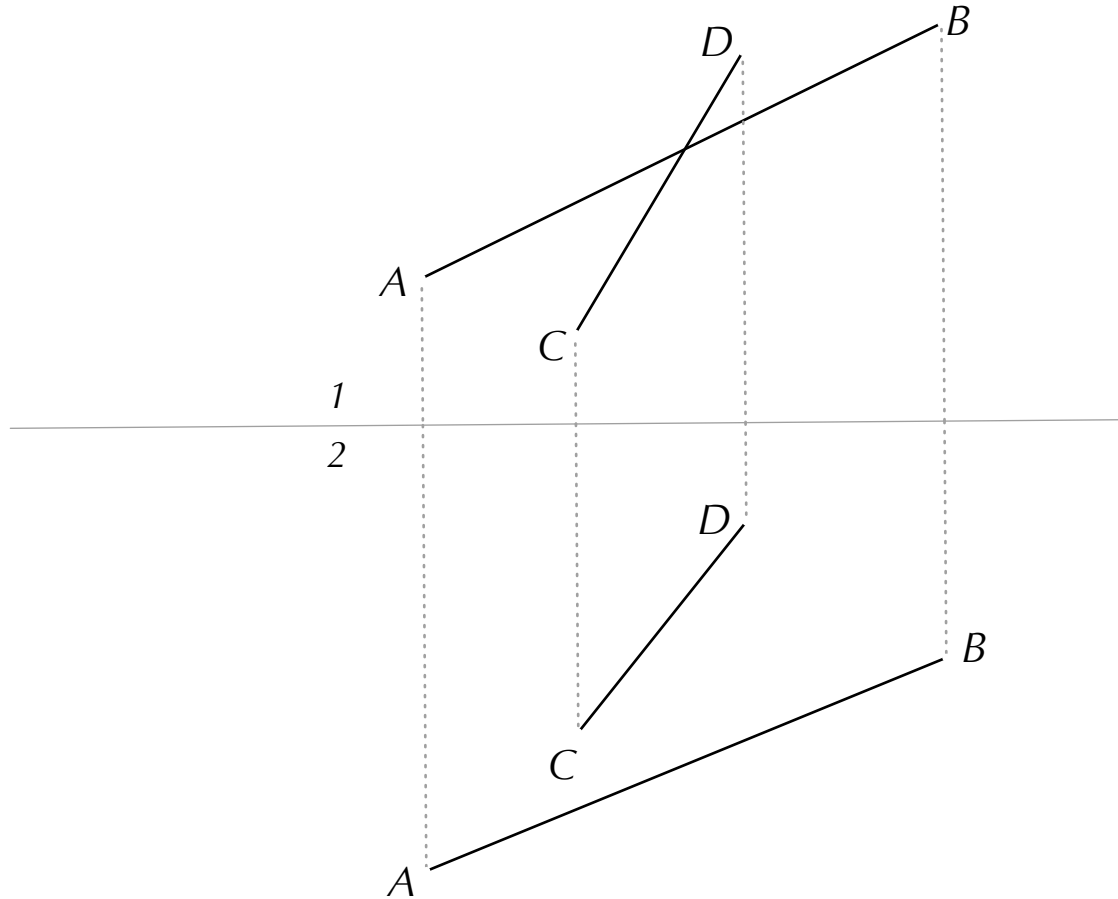


► constructing shortest distance to a line (plane method)

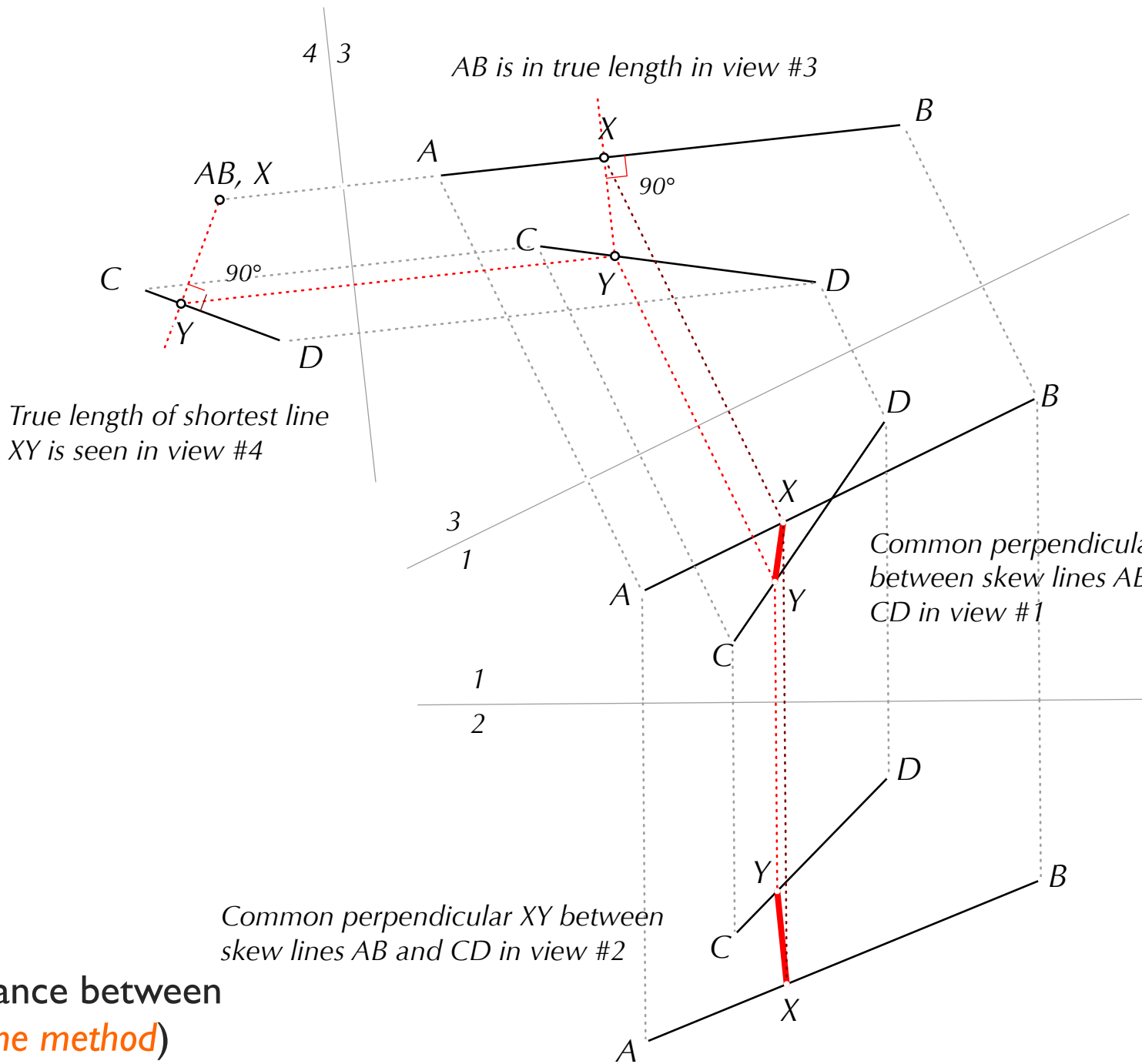




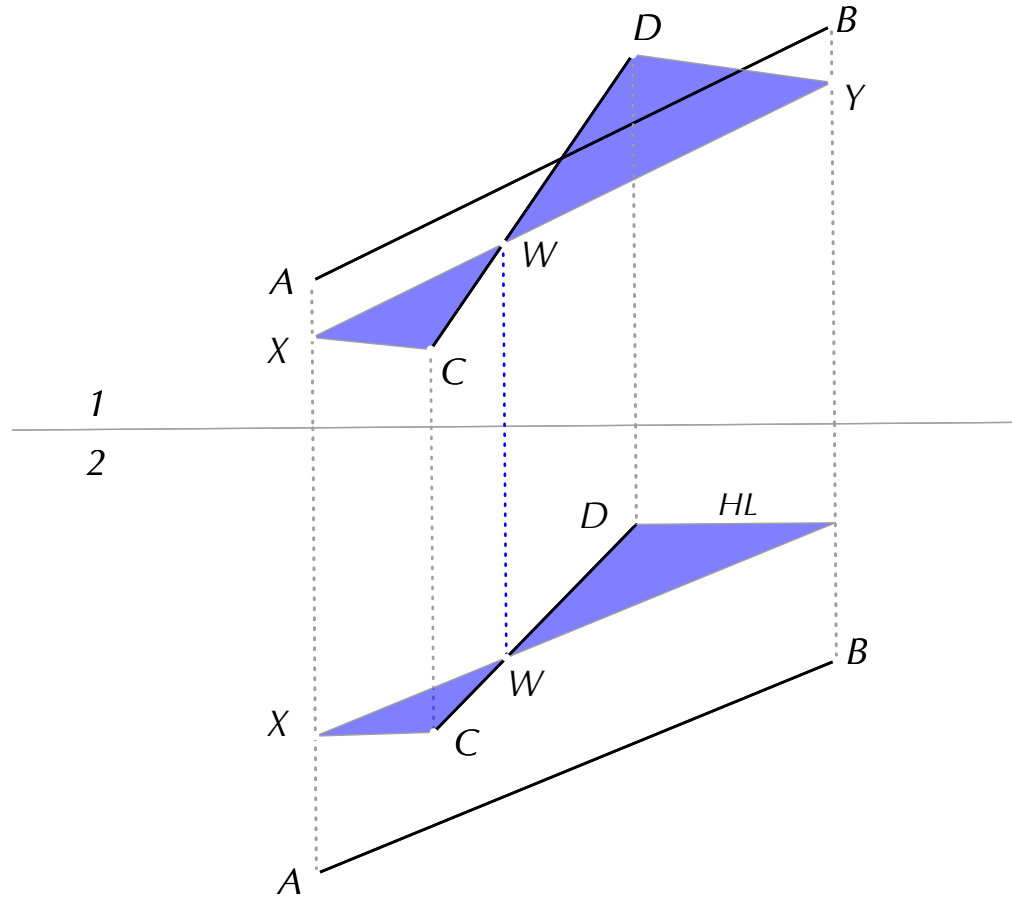
► shortest distance between skew lines



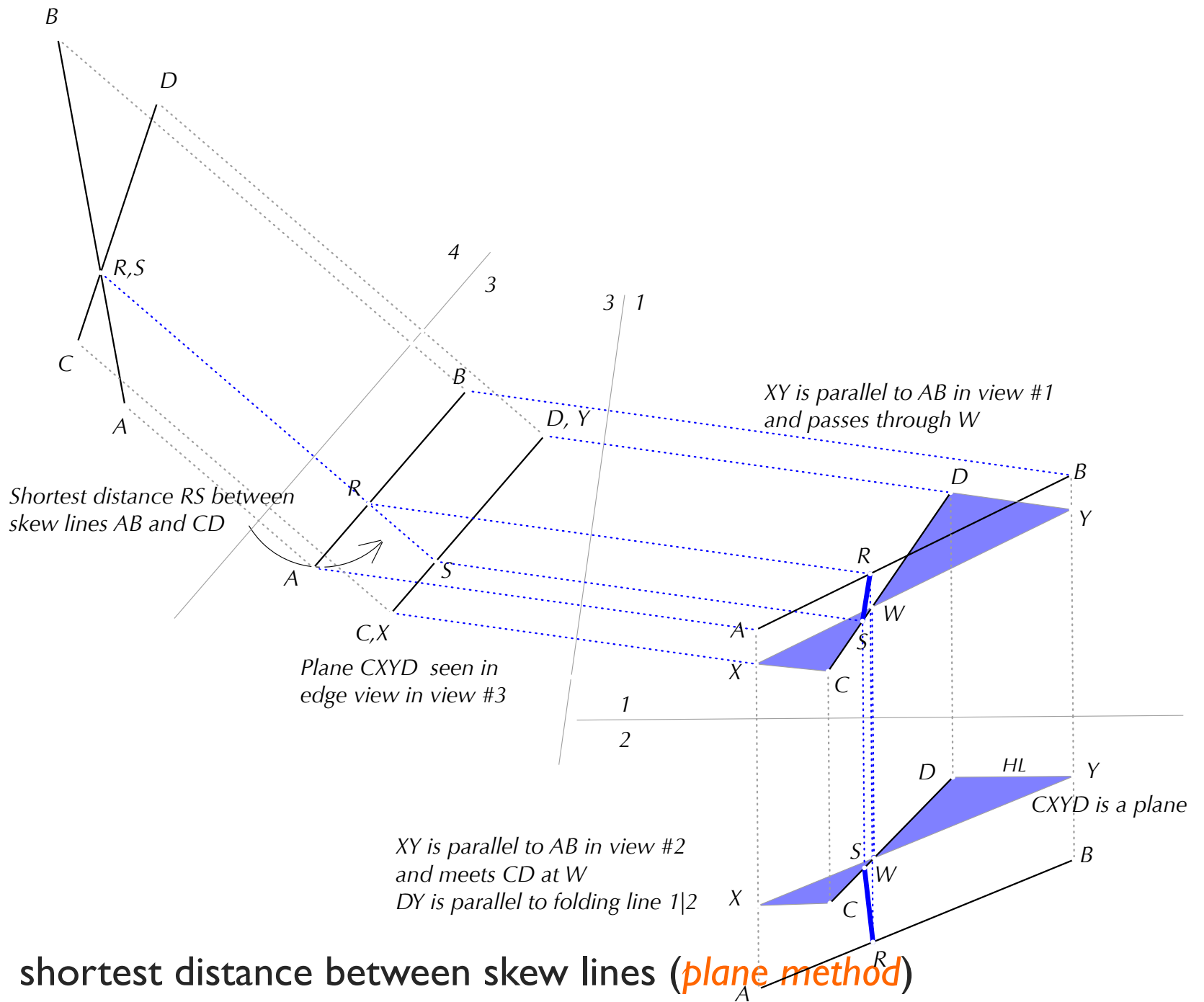
► shortest distance between skew lines

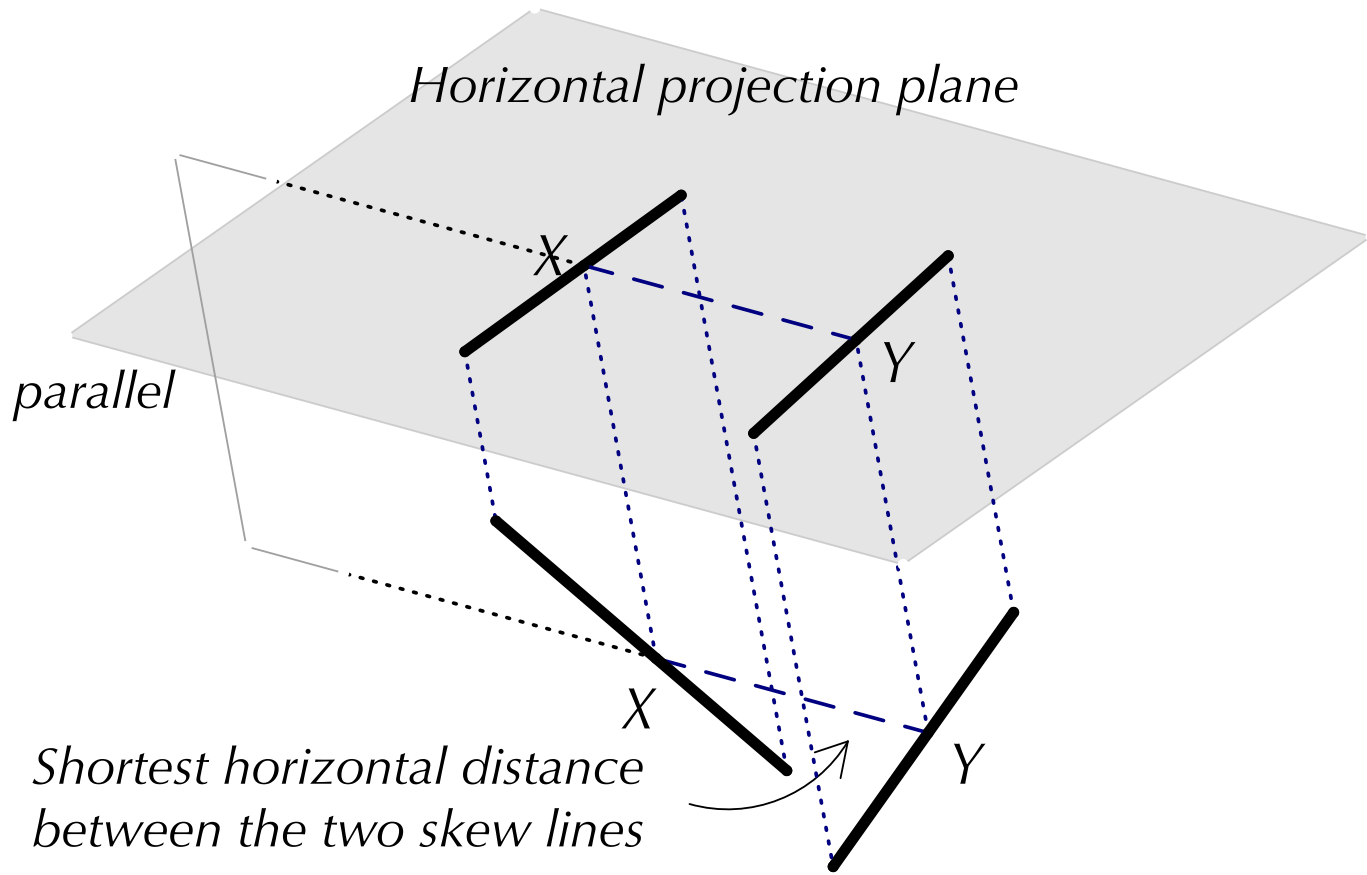


shortest distance between  
 ► skew lines (*line method*)

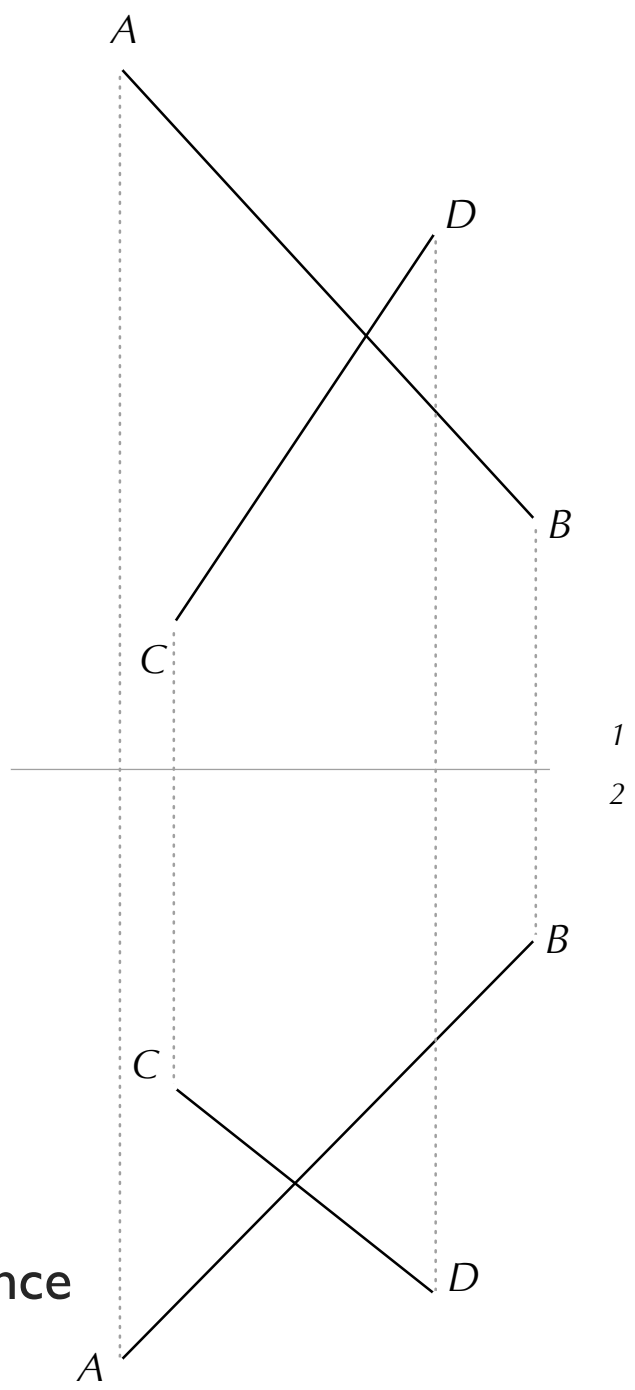


► shortest distance between skew lines (*plane method*)

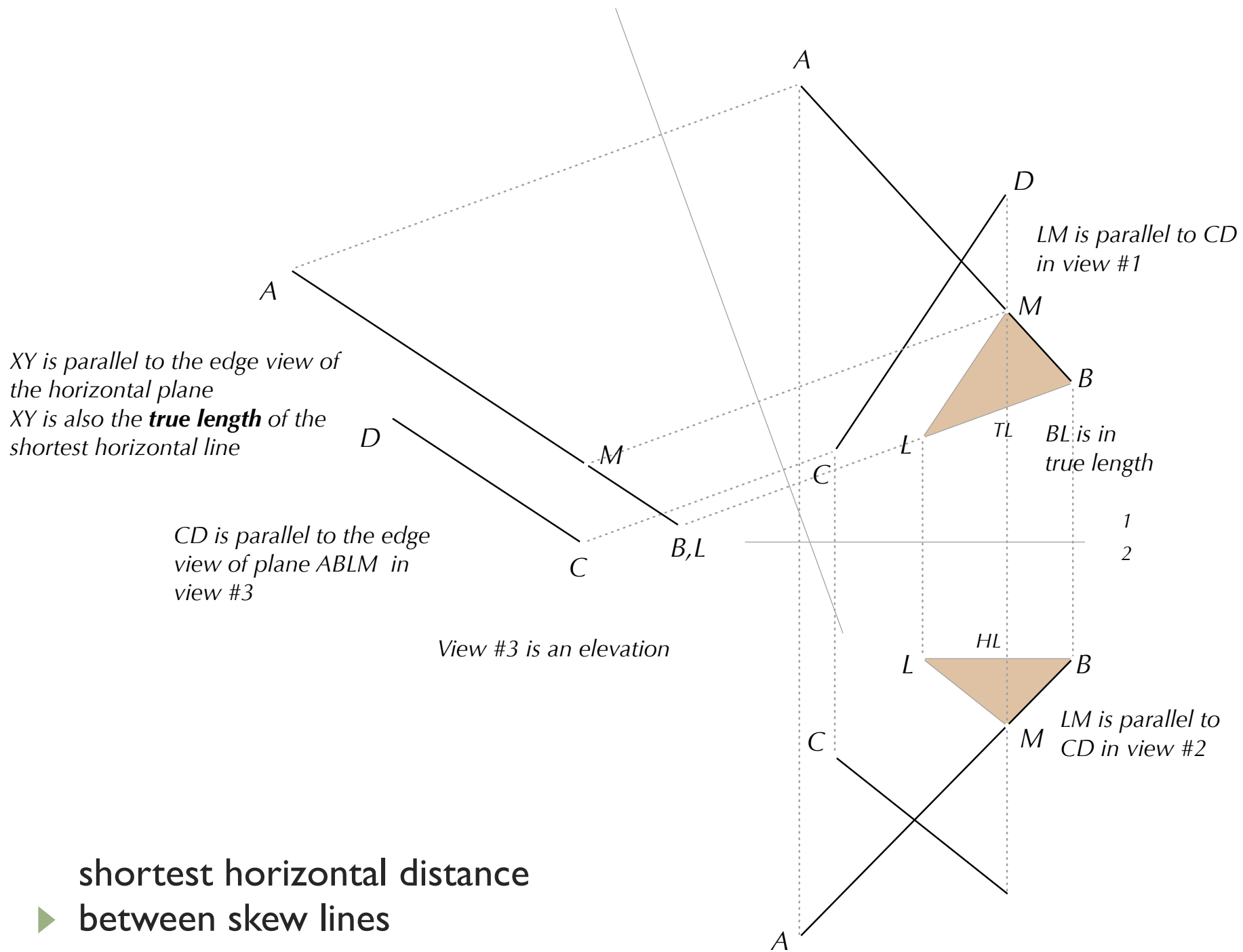




- shortest horizontal distance between skew lines

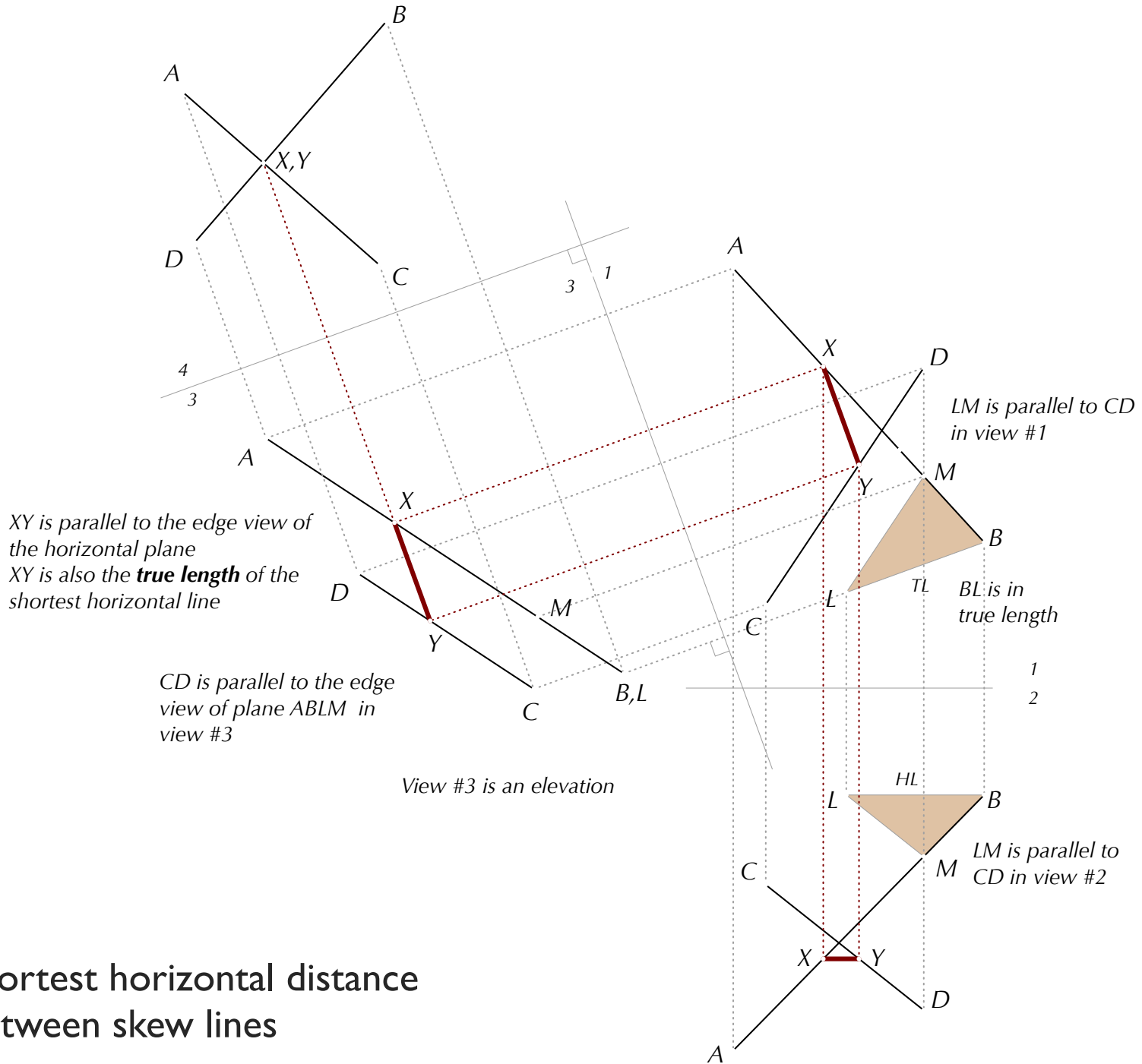


▶ shortest horizontal distance  
between skew lines

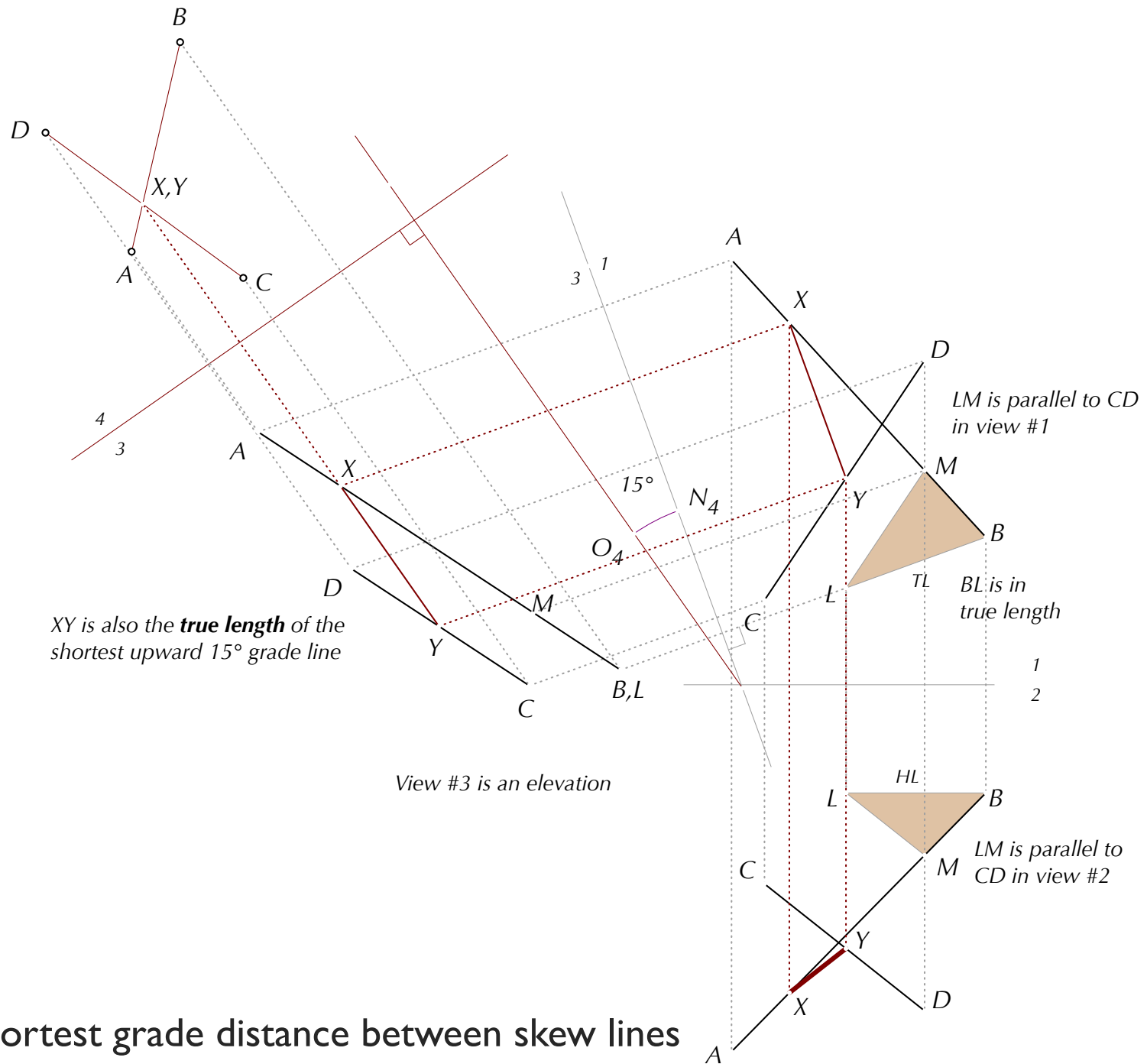


shortest horizontal distance  
 ► between skew lines

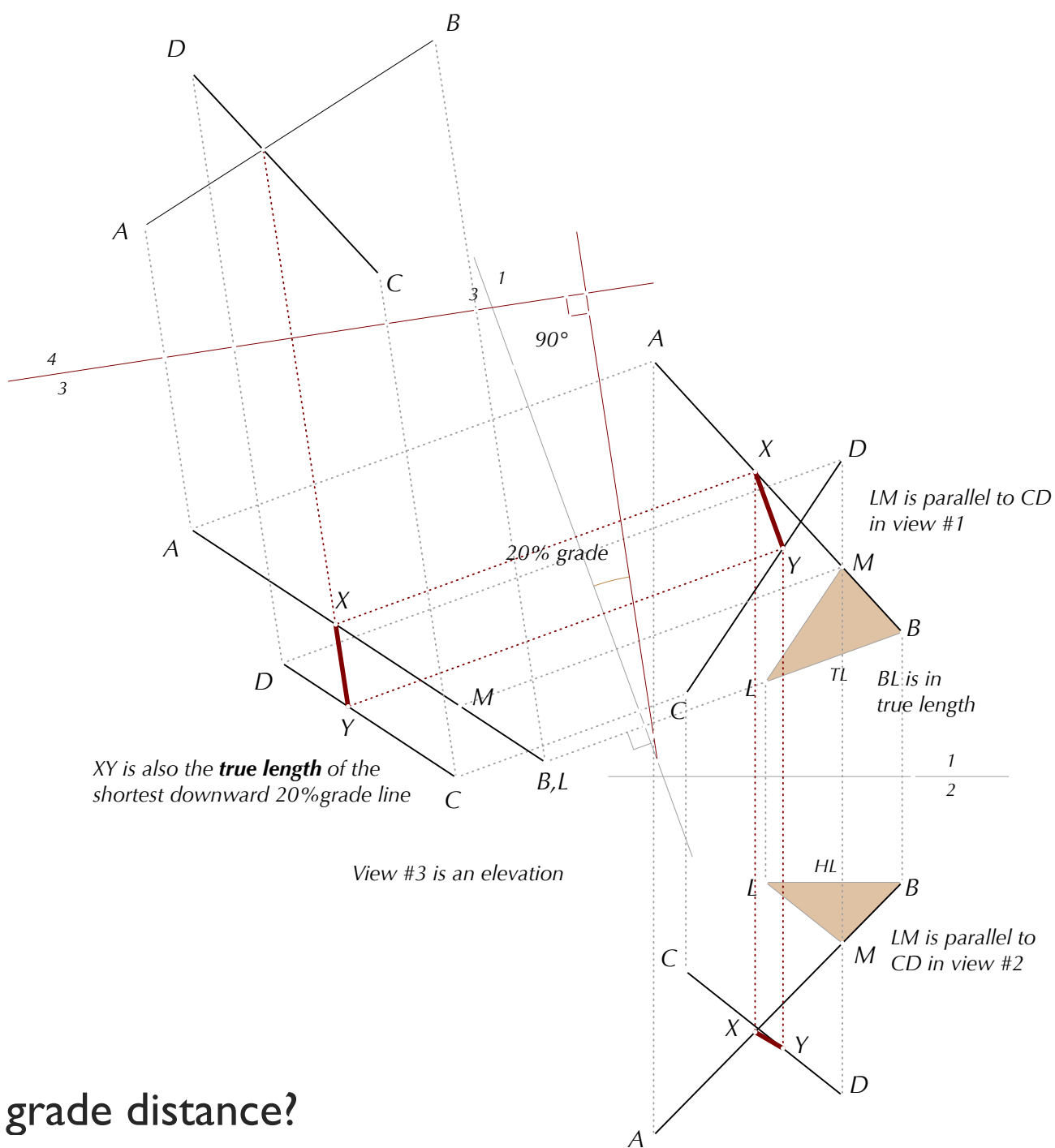




▶ shortest horizontal distance between skew lines

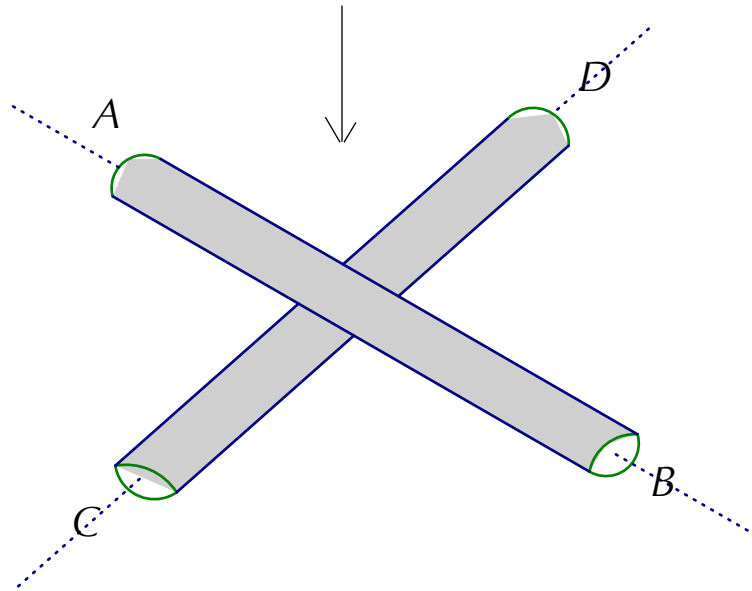


► shortest grade distance between skew lines

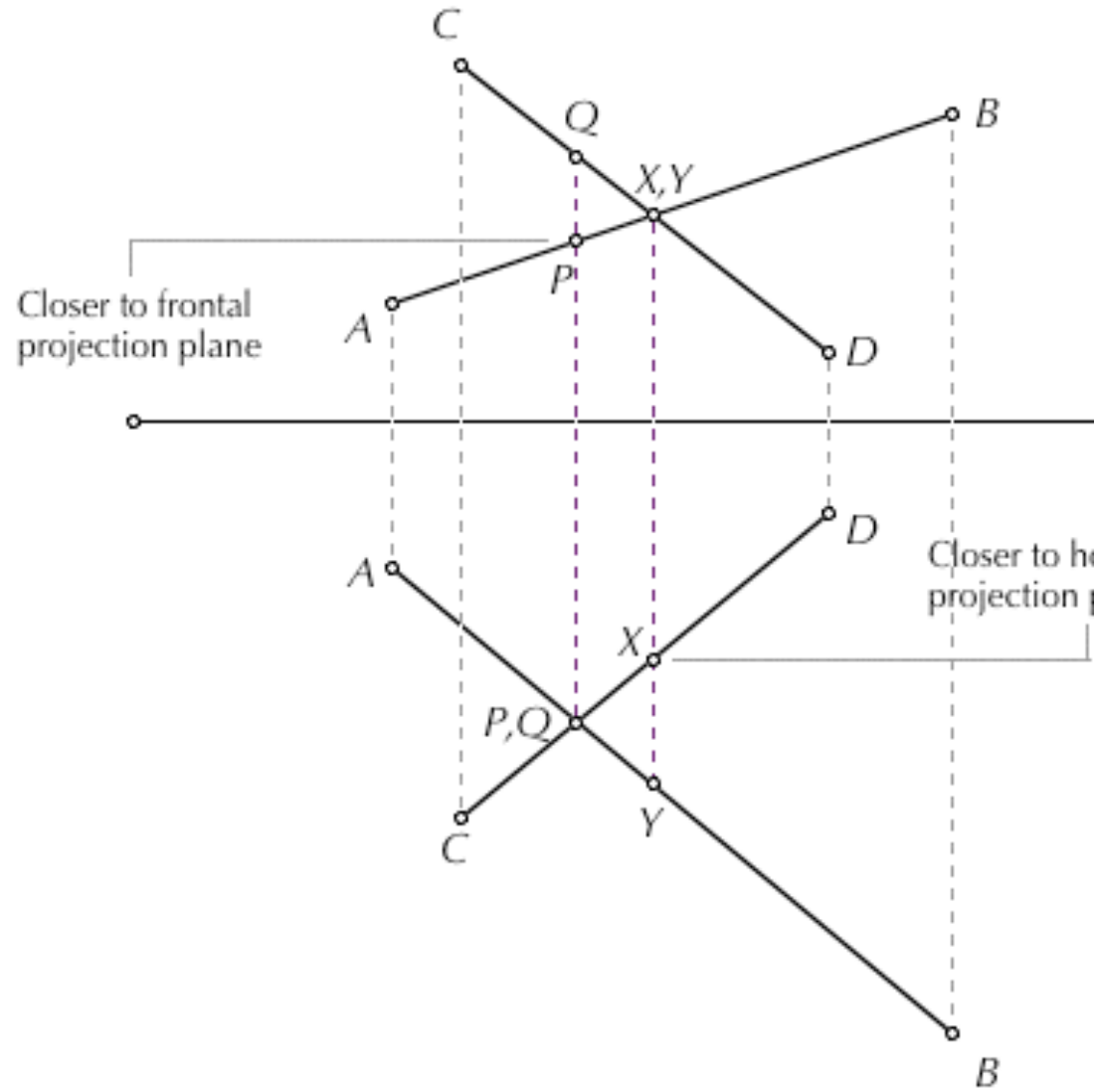


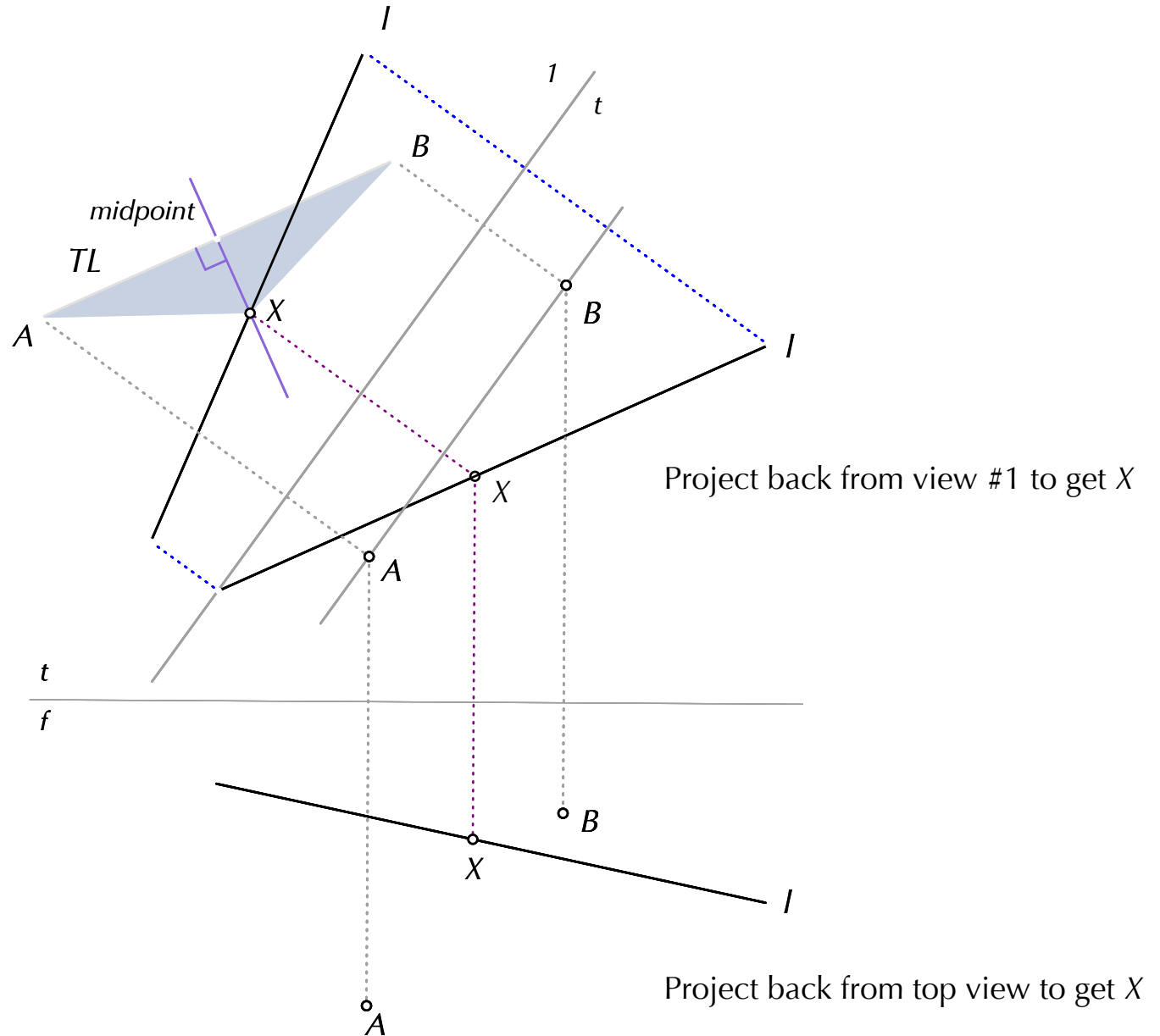
► which grade distance?

*Observers line of sight in which  
line AB is above line CD*

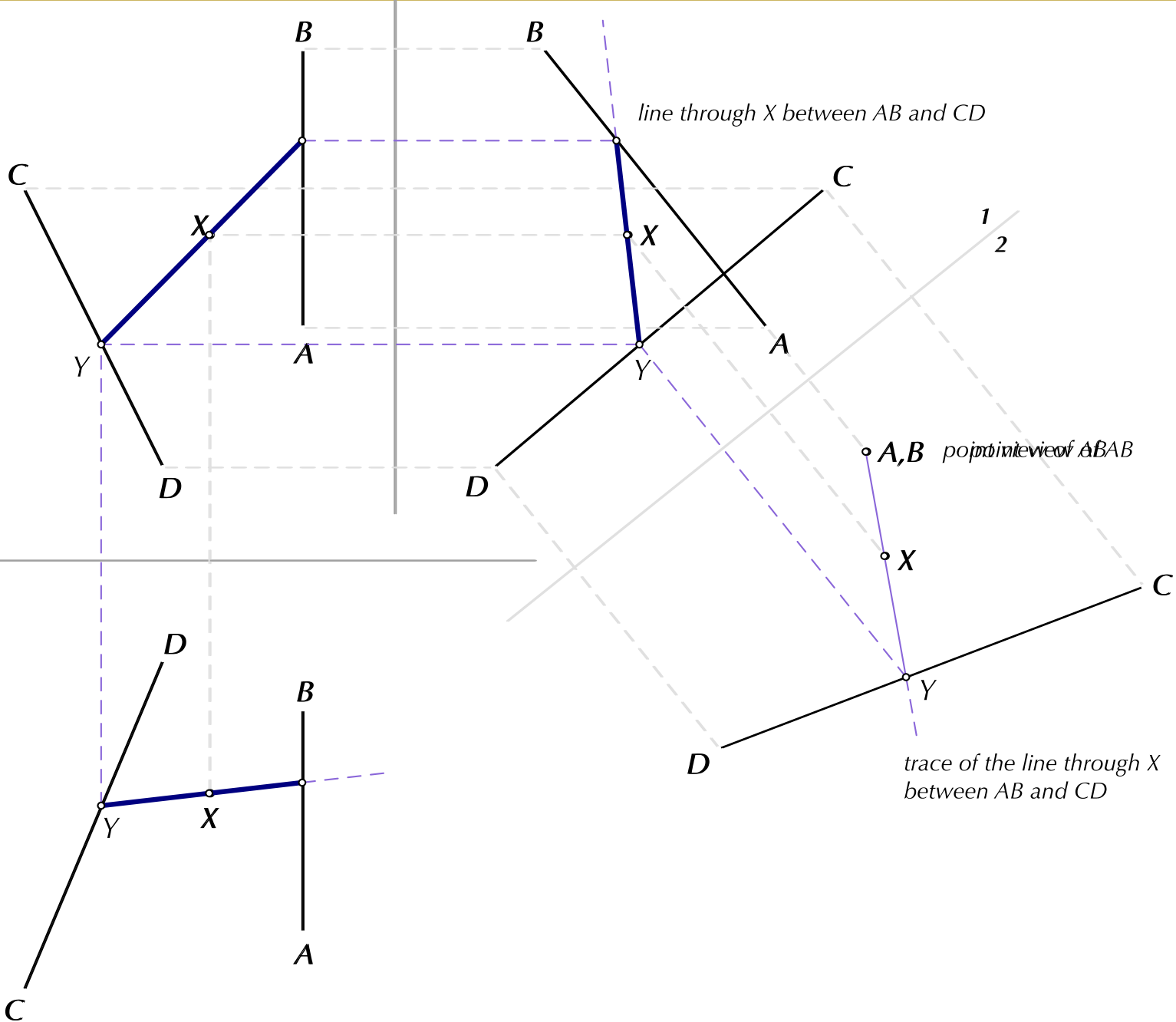


► visibility

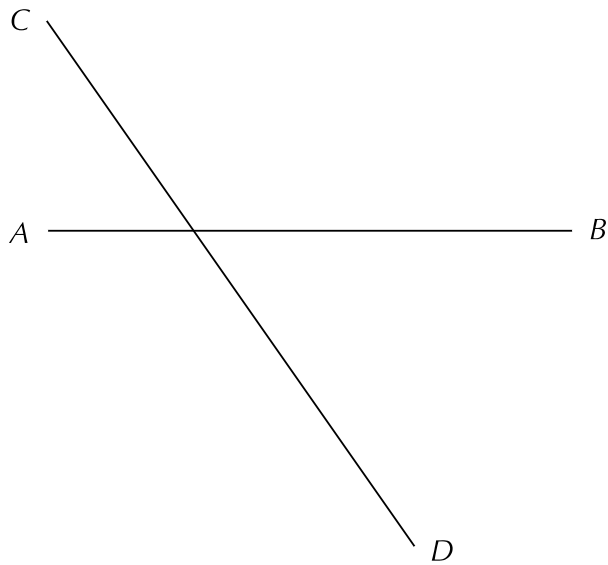




► quiz: find a point on a line equidistant to two points



quiz: locating a line between two skew lines through a point

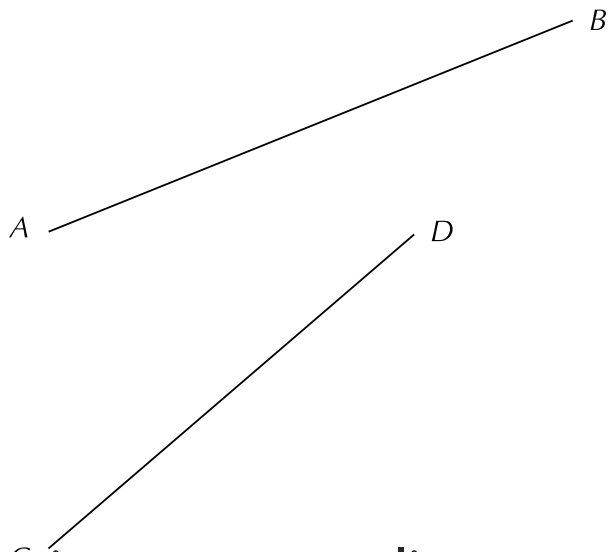


Lines AB and CD specify centerlines of two existing sewers as shown in the figure.

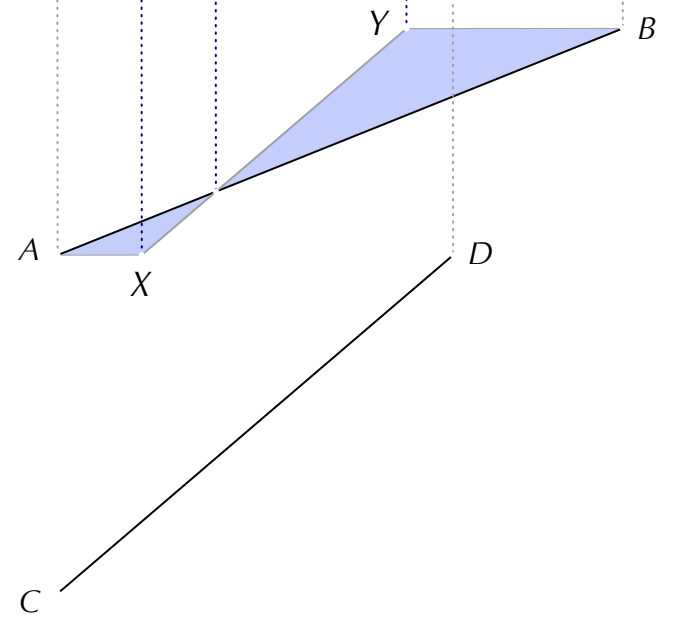
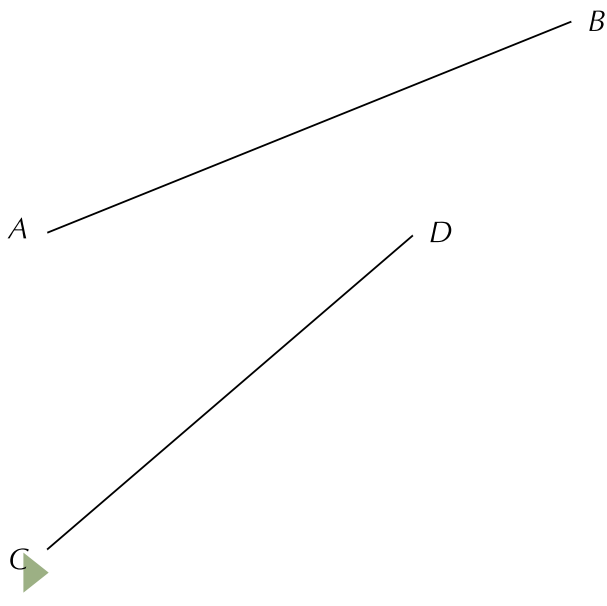
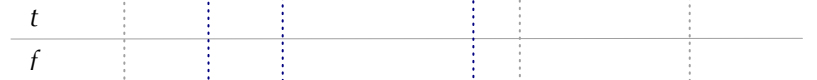
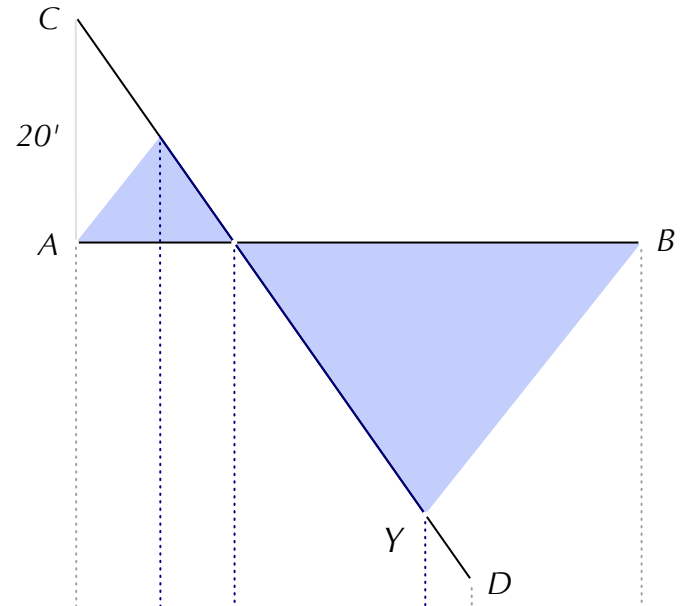
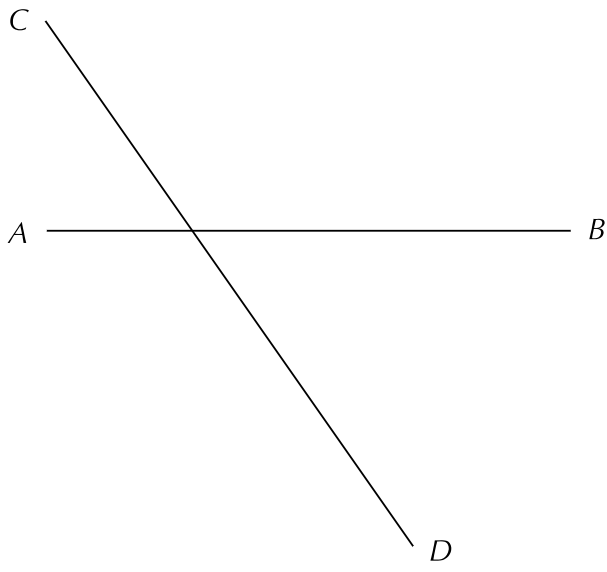
The sewer pipes are to be **connected by a branch pipe** having a **downward grade of 2:7** from the higher to the lower pipe.

Given that point C is 20' North of point A, the problem is to determine the true length\_and bearing of the branch pipe and show this pipe in all views.

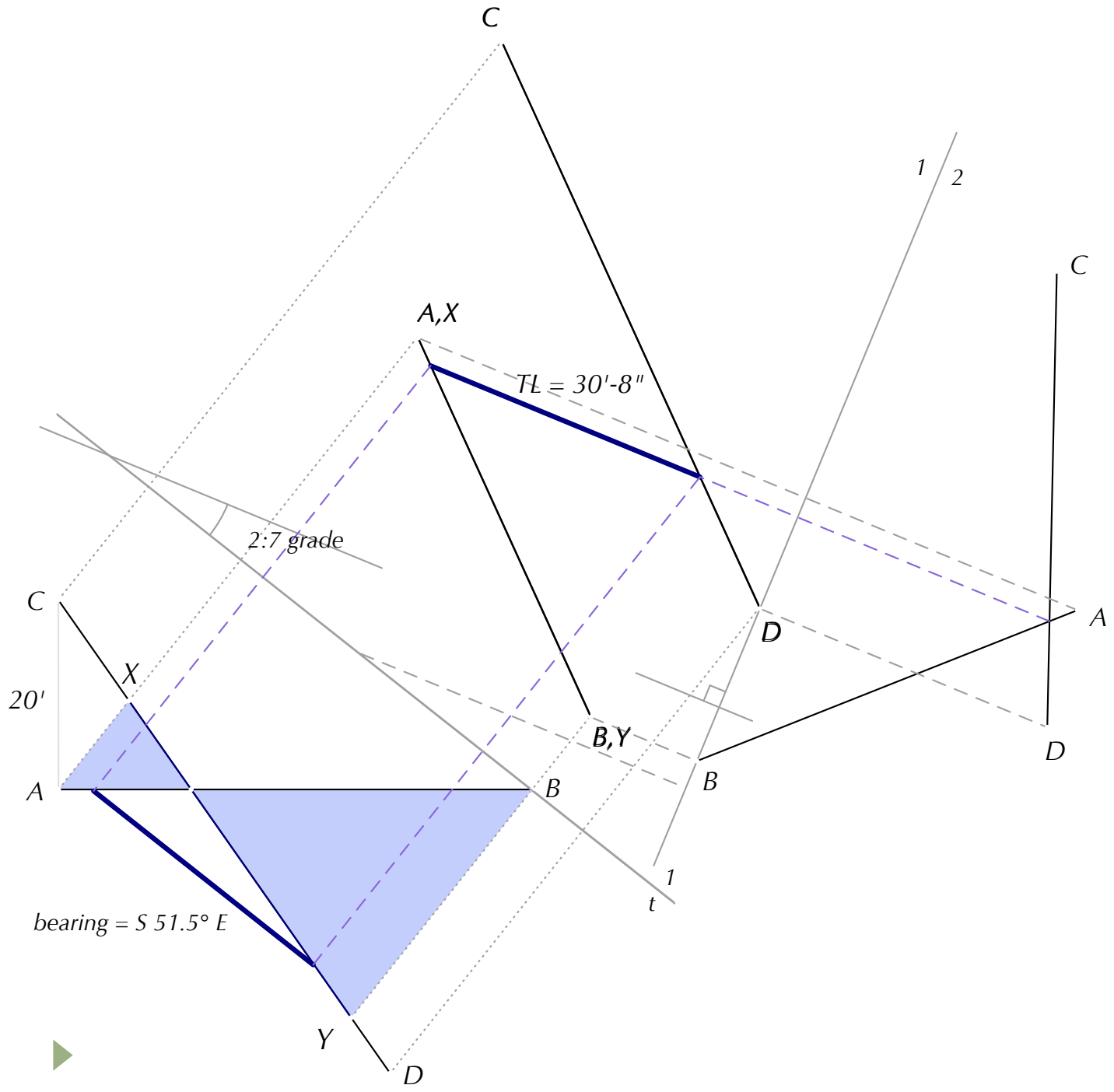
Line AC (in plan) measures 20'.

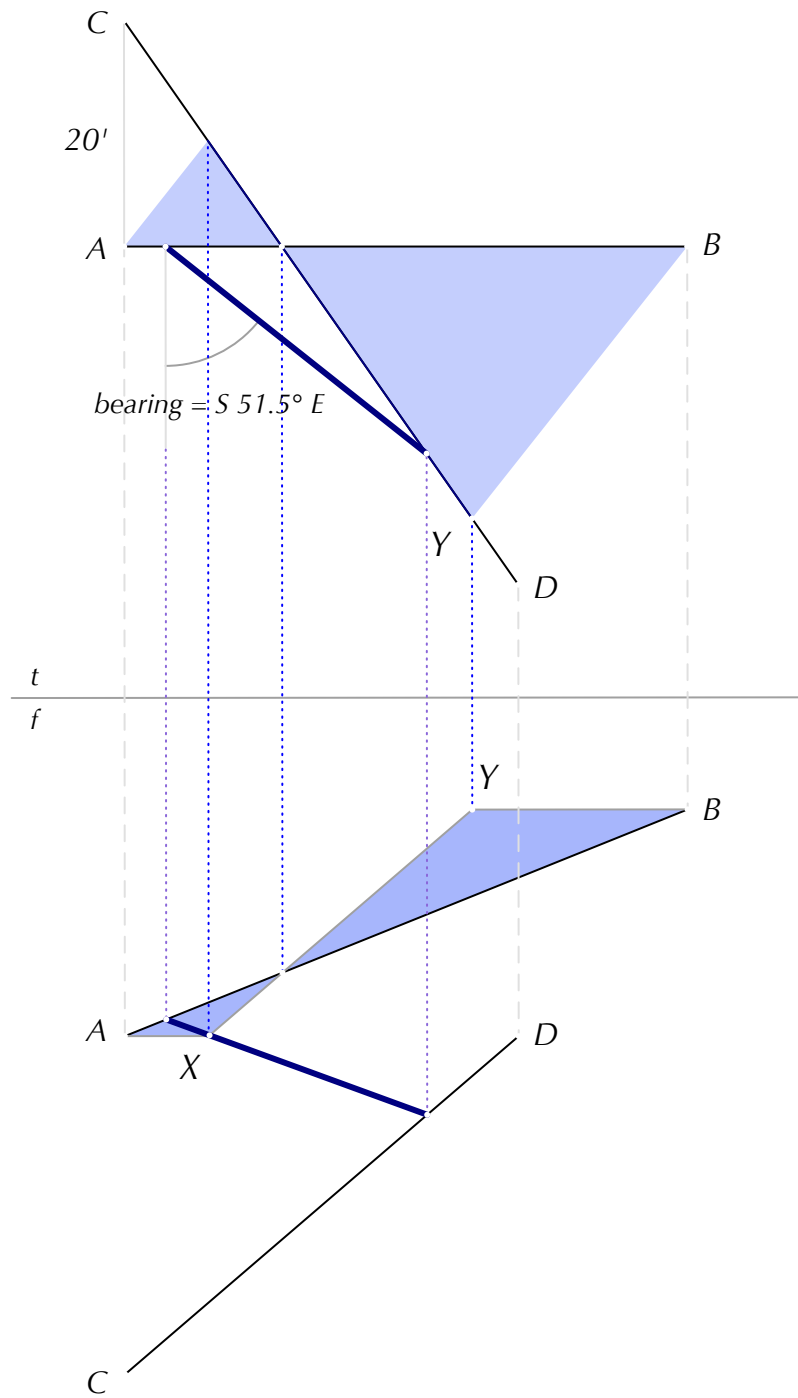


► **quiz: construct a line at a certain grade**

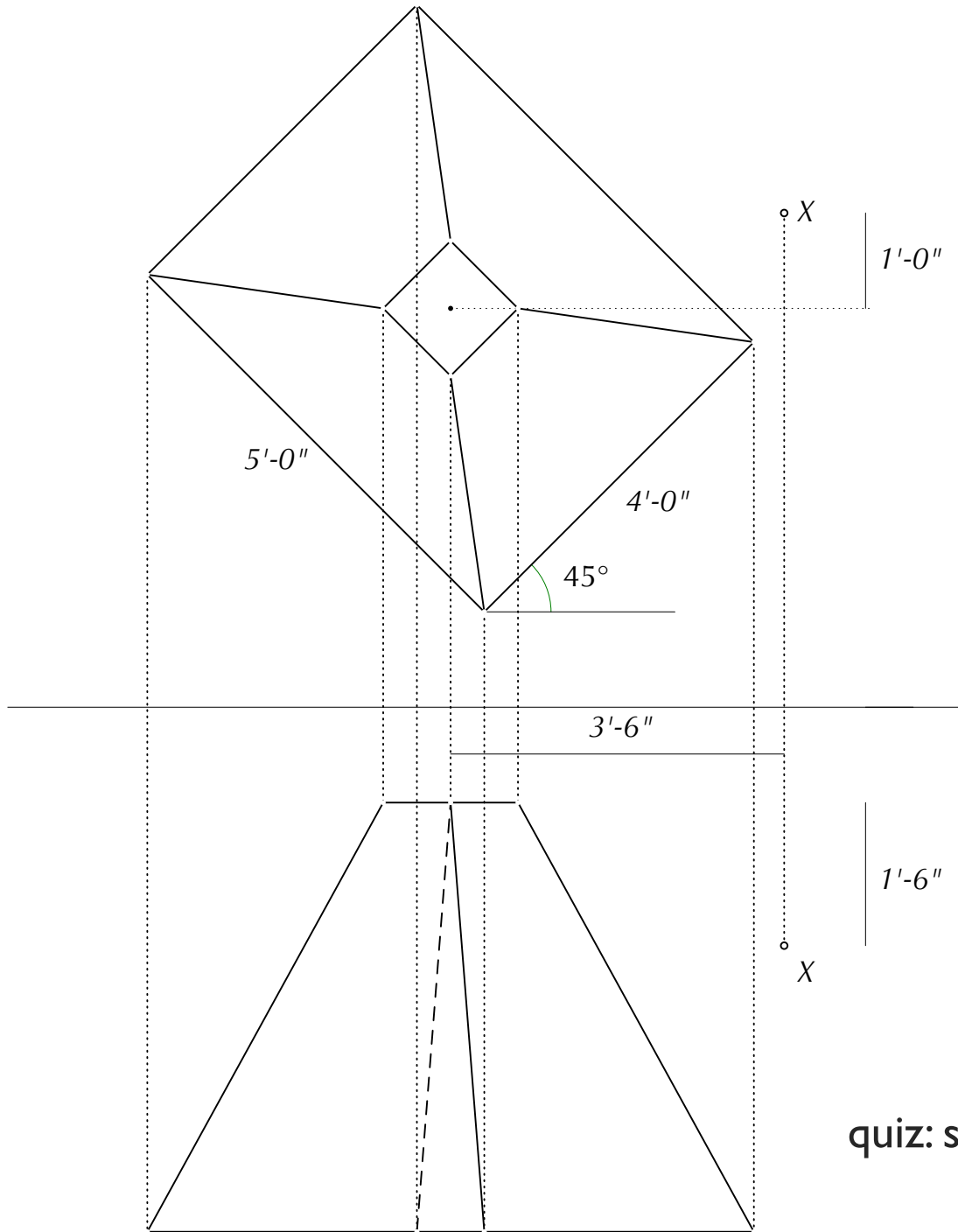






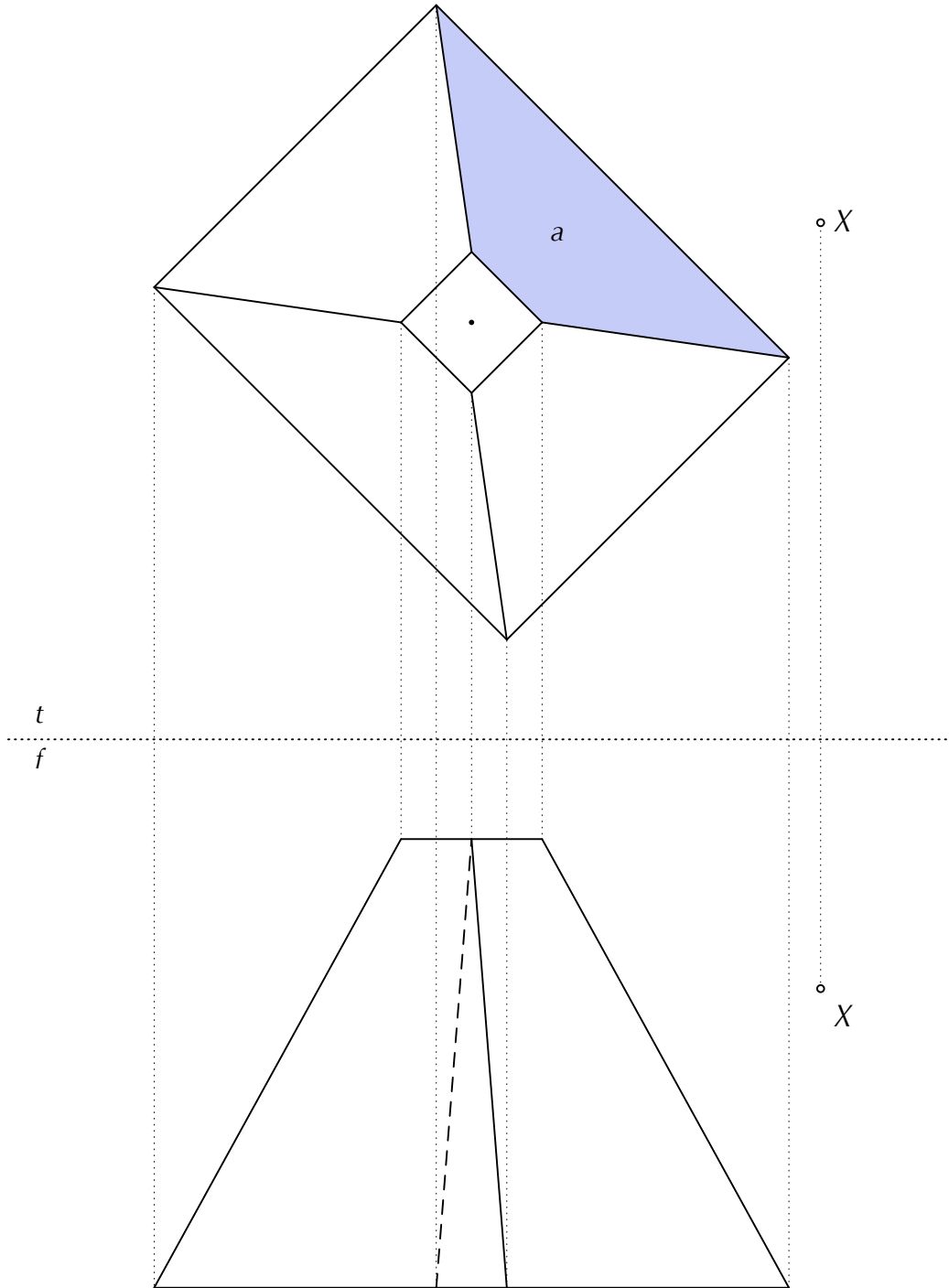


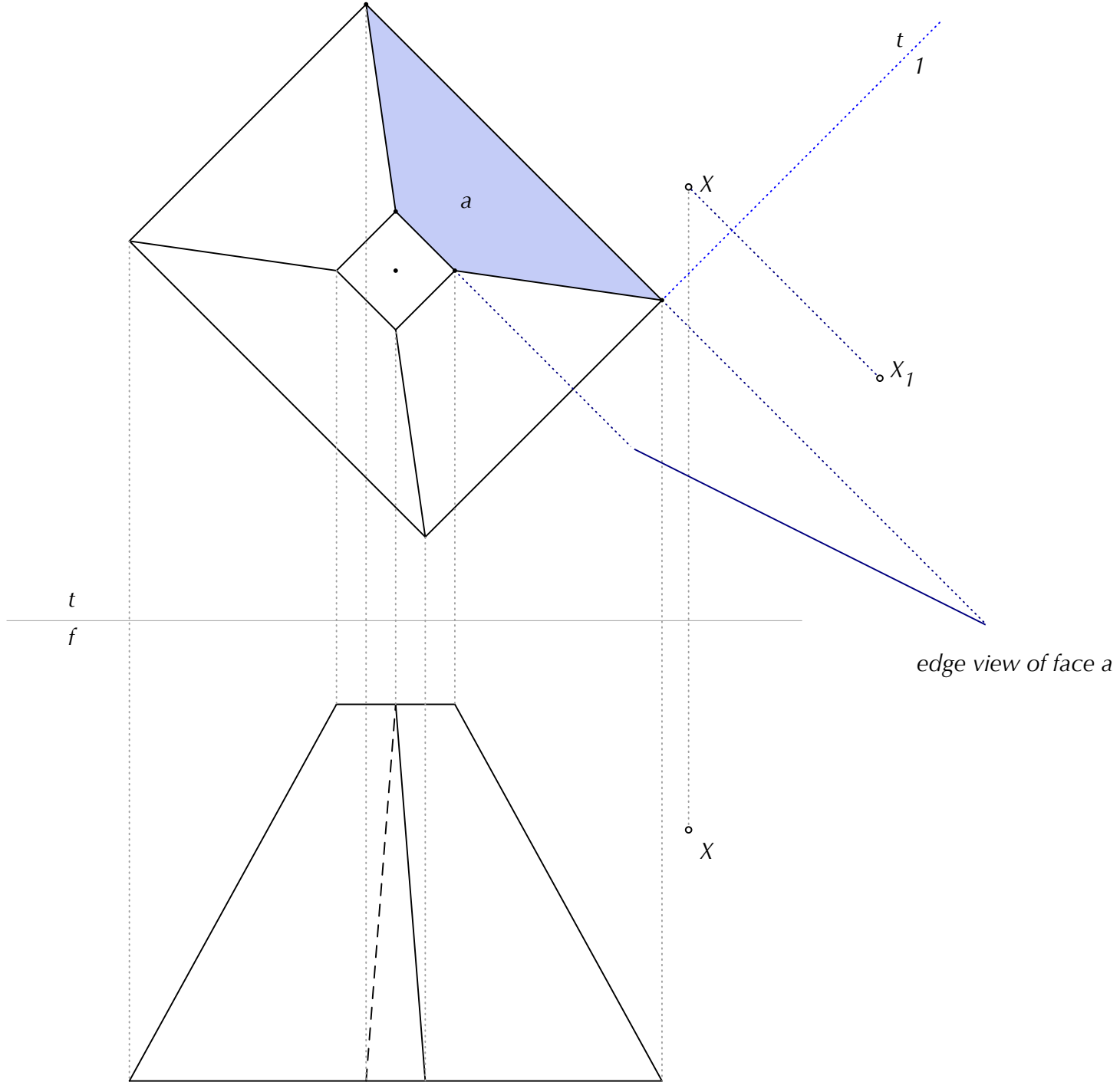


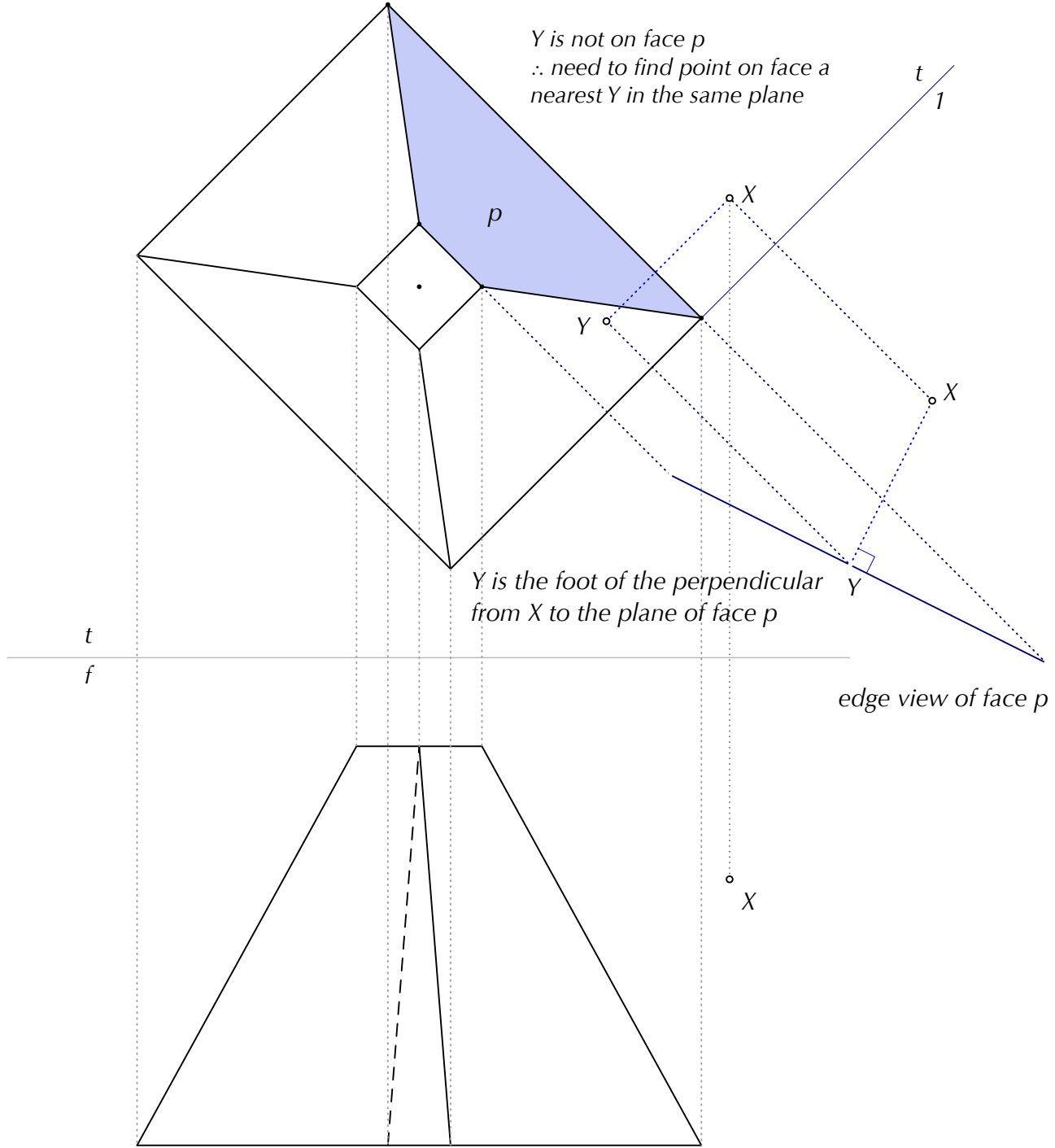


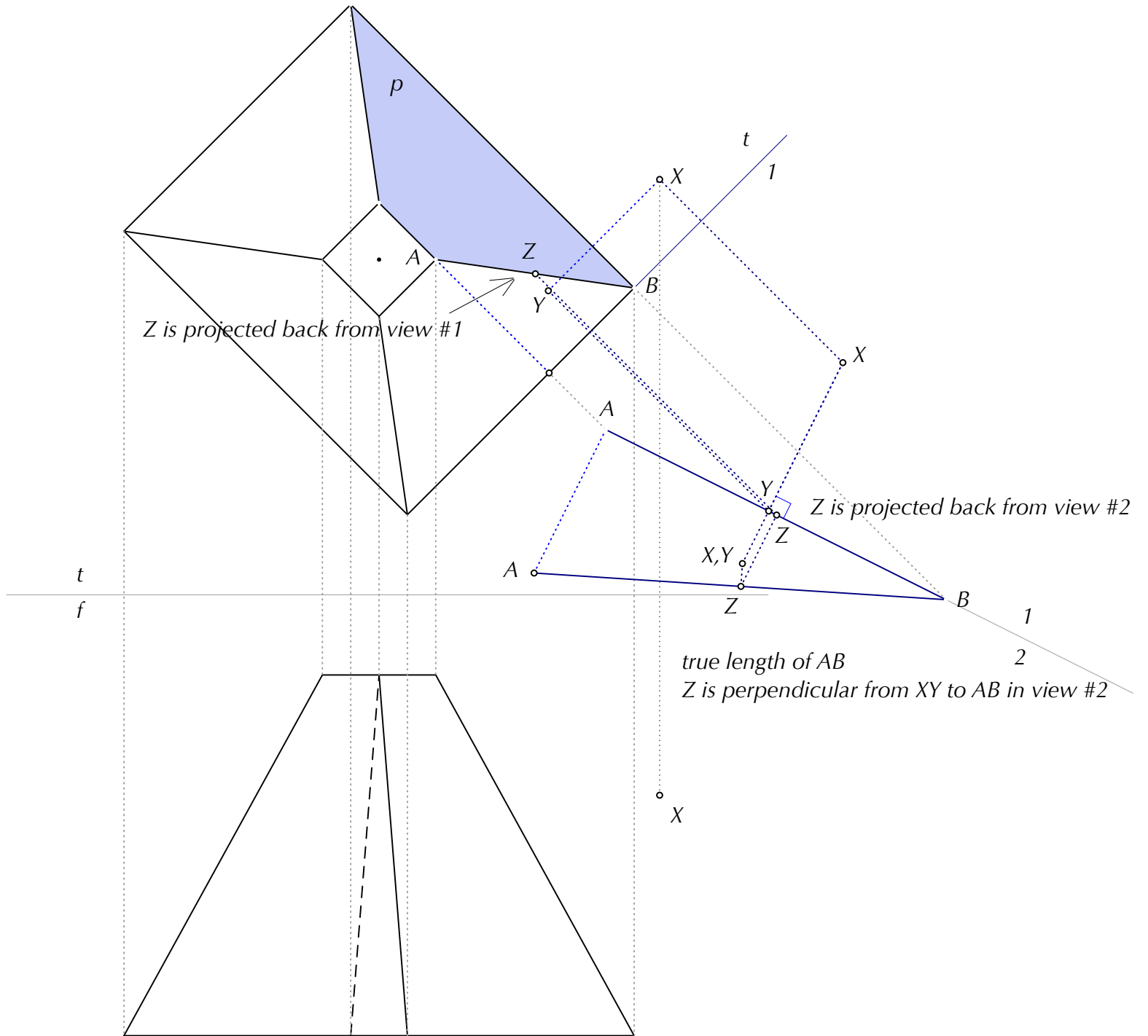
quiz: shortest distance from X to nearest face















Three equal legs of a surveyor's tripod are located in their relationship to the plumb line.

Leg A bears  $N30^\circ W$  and has a slope of  $30^\circ$

Leg B is 3'-3" due east of the plumb line and at the same elevation as the plumb line

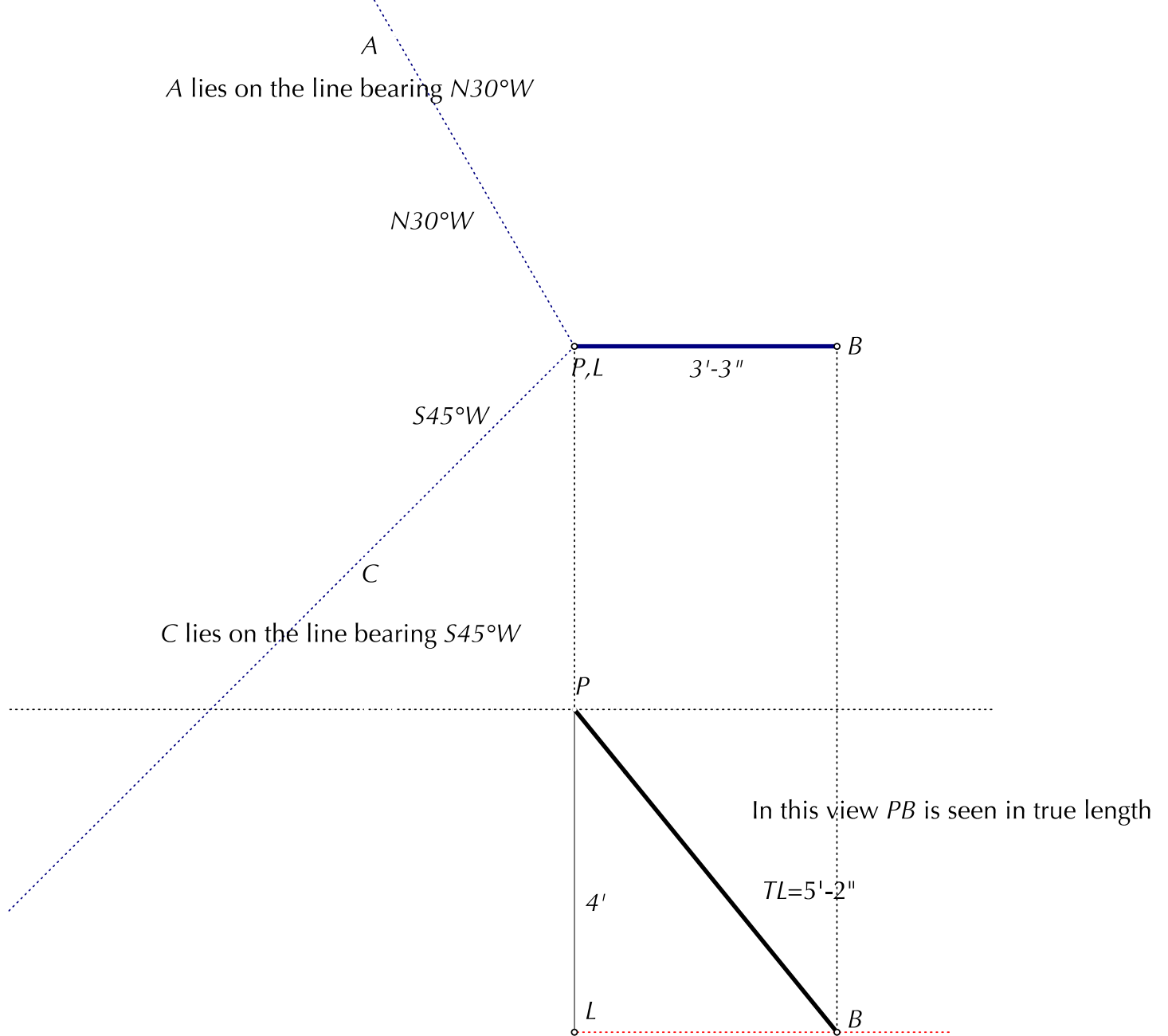
Leg C bears  $S45^\circ W$  and has a slope of  $45^\circ$

The plumb bob touches the bench mark at a vertical distance of 4' below the top of the line

**Determine TL of legs A, B and C ?**

**What is the angle B makes with plumb line?**

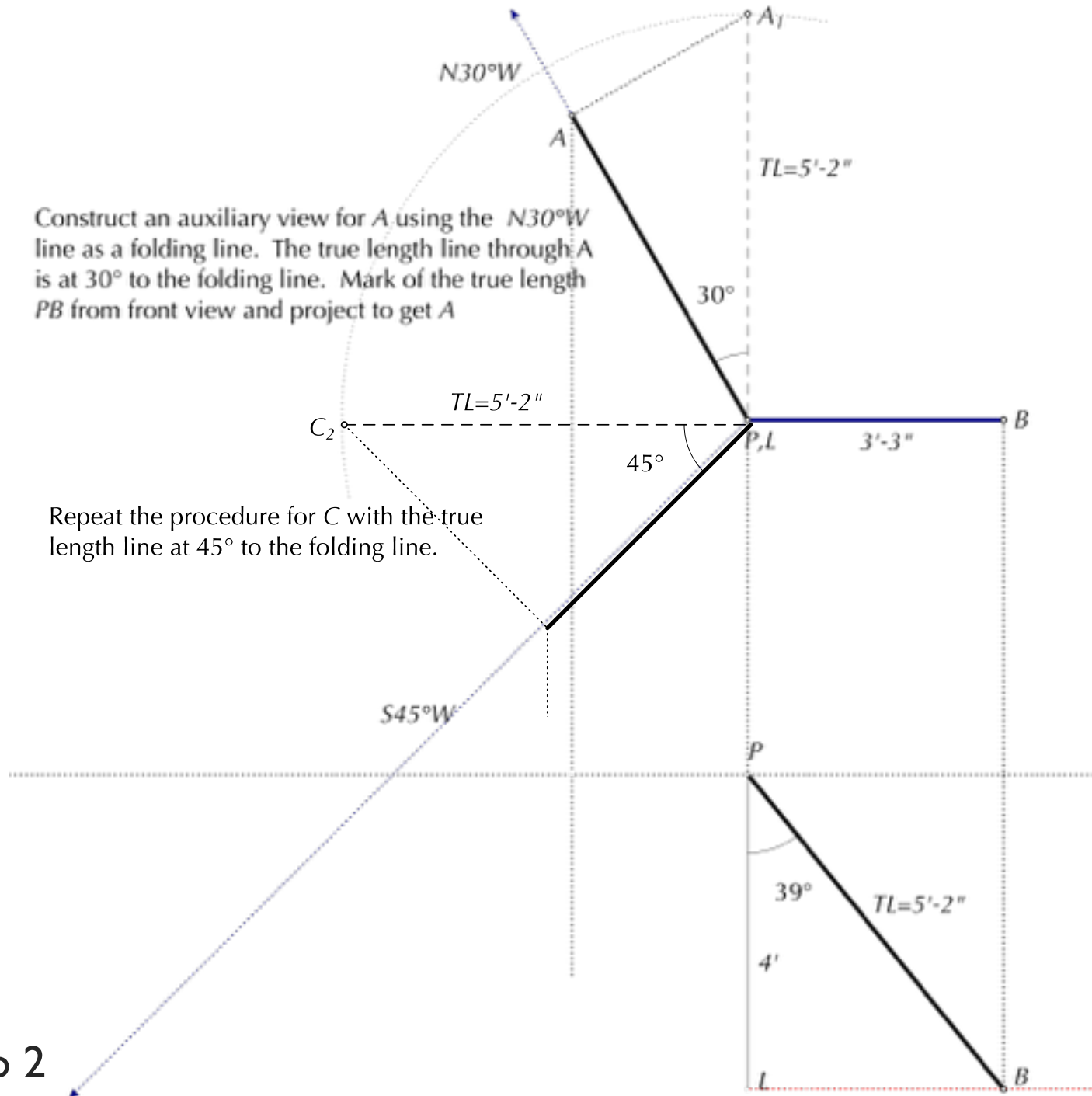
**Show legs in front and top views.**



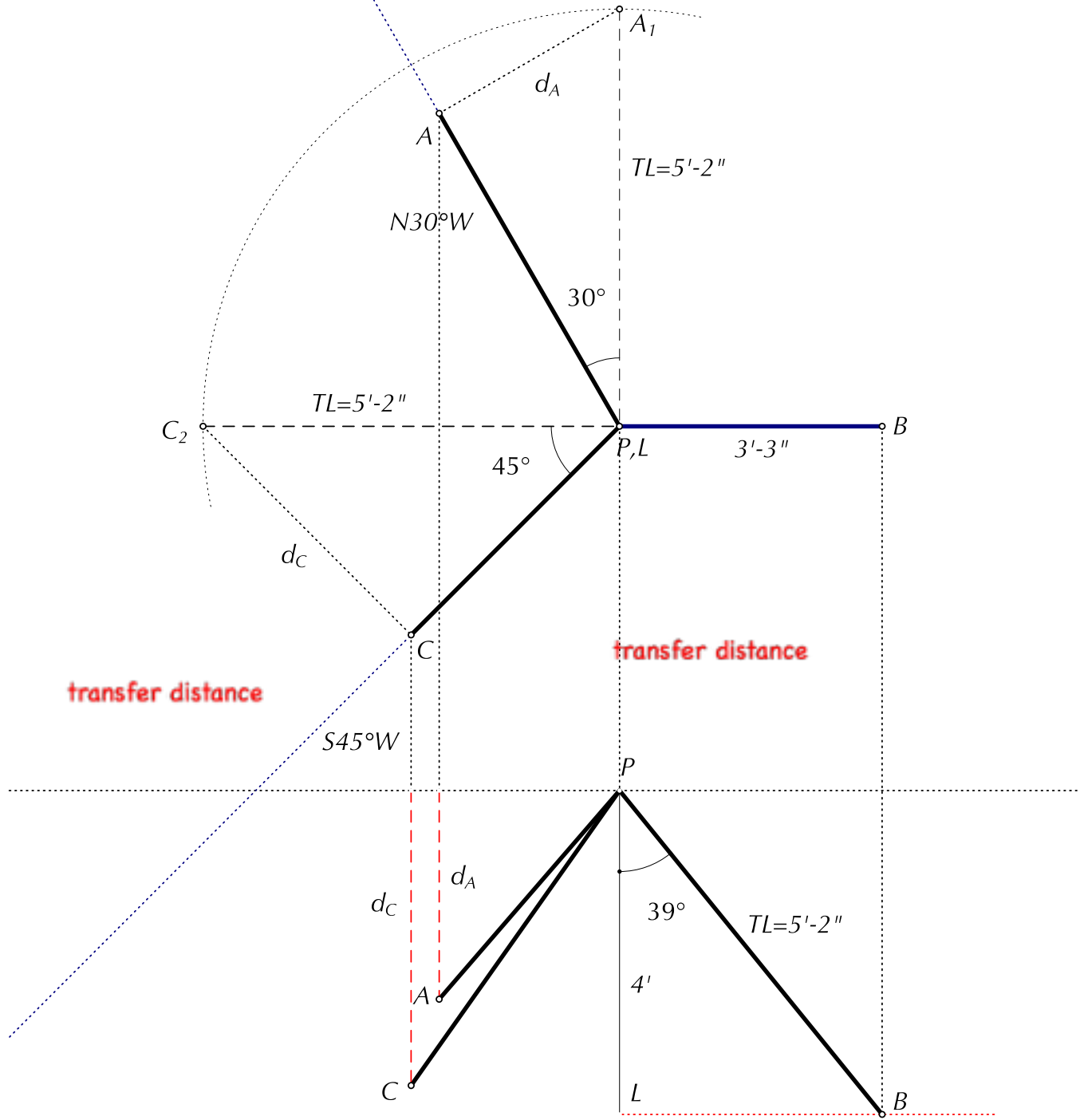
► Step I

Construct an auxiliary view for A using the  $N30^\circ W$  line as a folding line. The true length line through A is at  $30^\circ$  to the folding line. Mark of the true length  $PB$  from front view and project to get A

Repeat the procedure for C with the true length line at  $45^\circ$  to the folding line.



► Step 2



Two sewer lines AB and CB converge at manhole B

A is 35' north 10' east of B and 30' above B

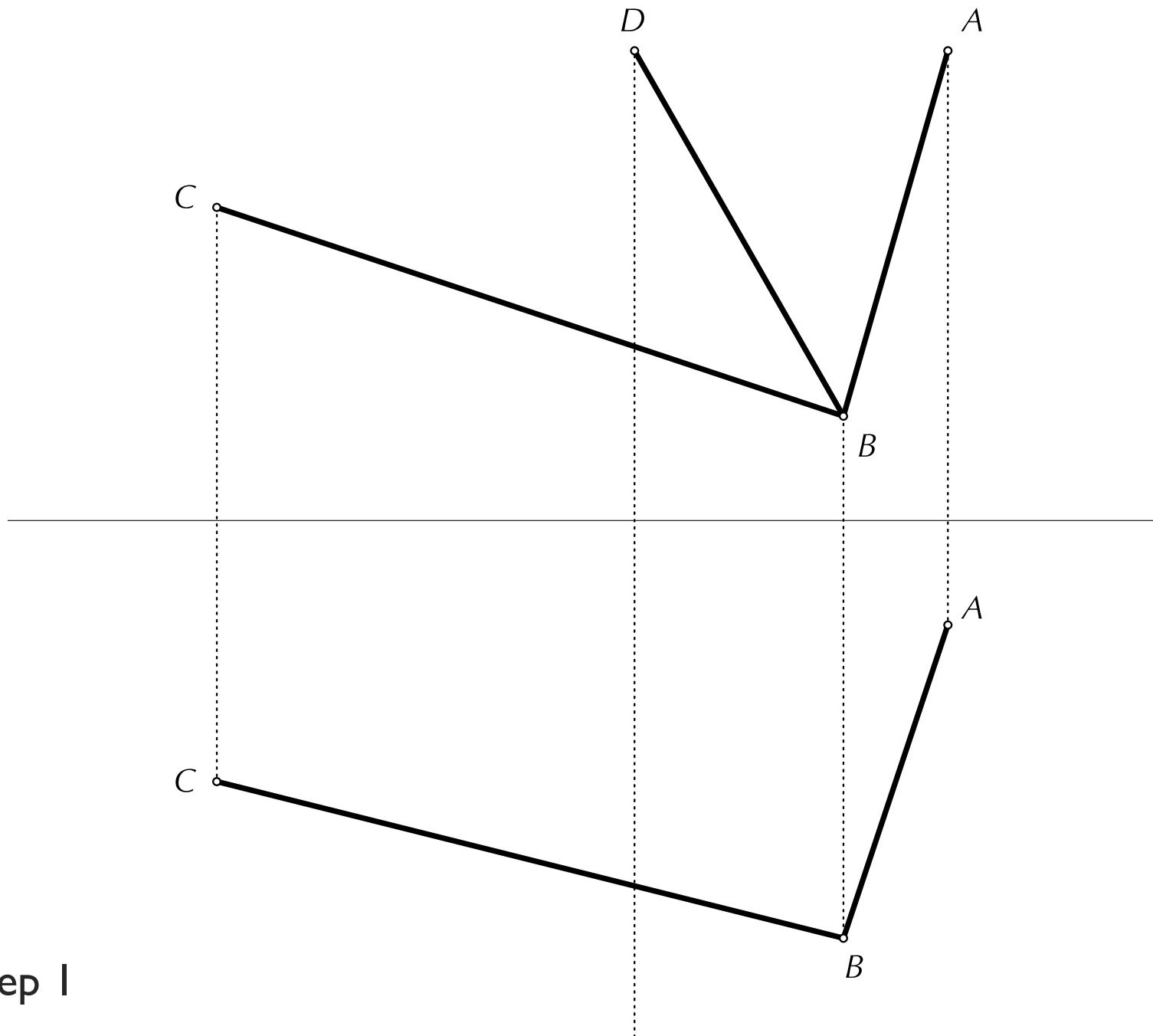
C is 20' north 60' west of B and 15' above B

A new line DB is located in the plane of ABC at a point 30' due west of A

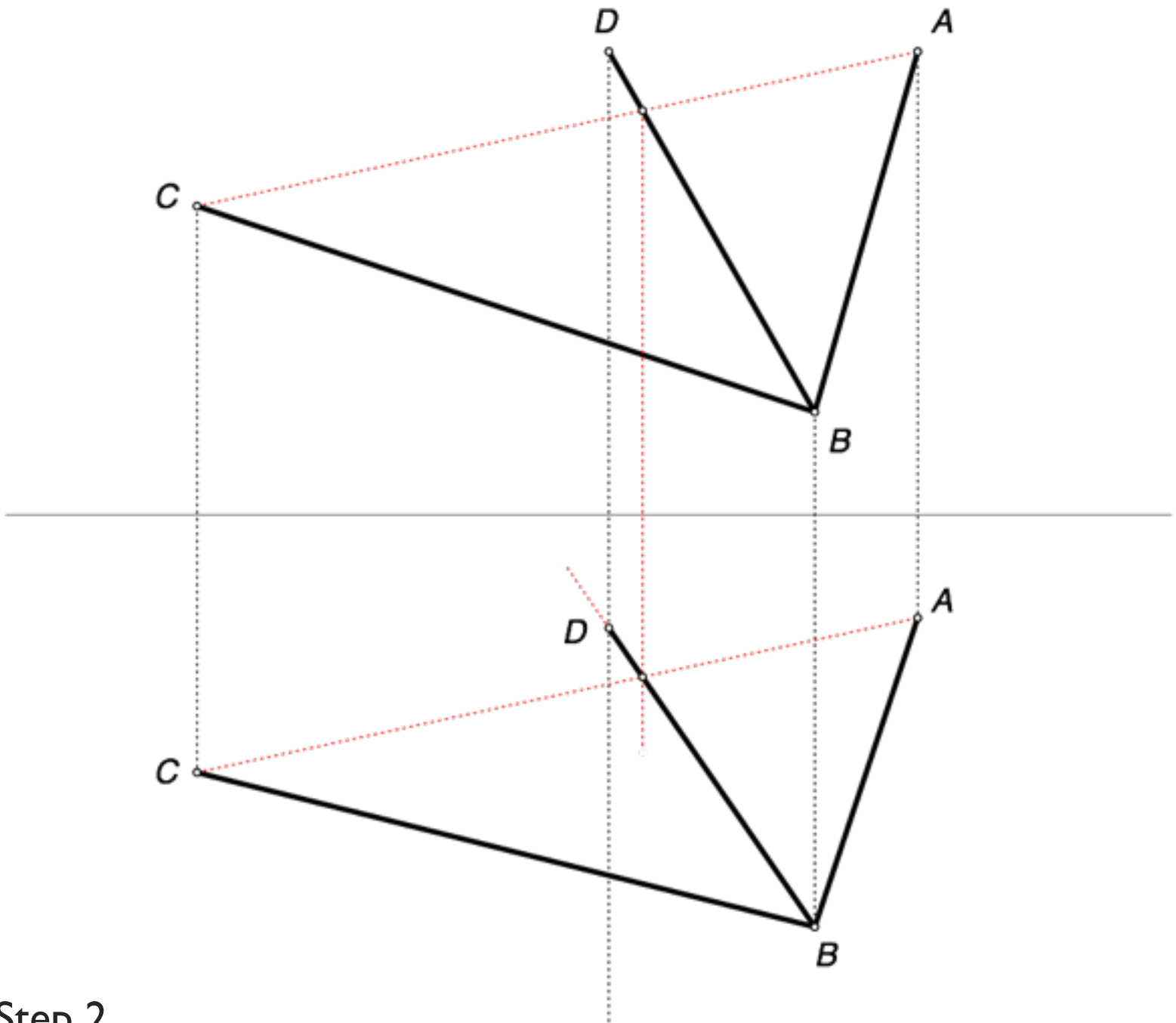
**Using only two views locate D**

**What is the TL of each sewer line?**

**What is the angle of the plane ABC**

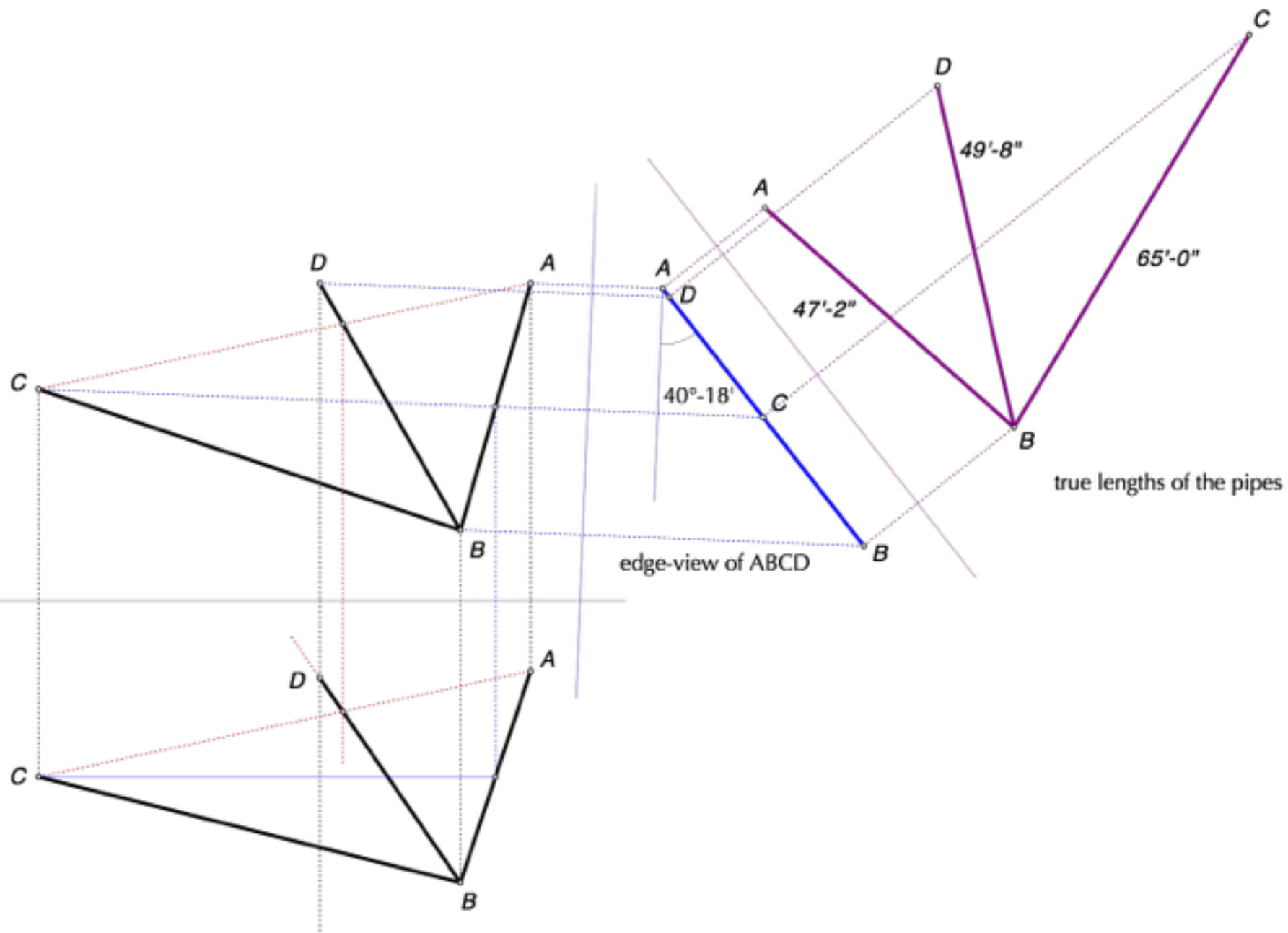


► Step I

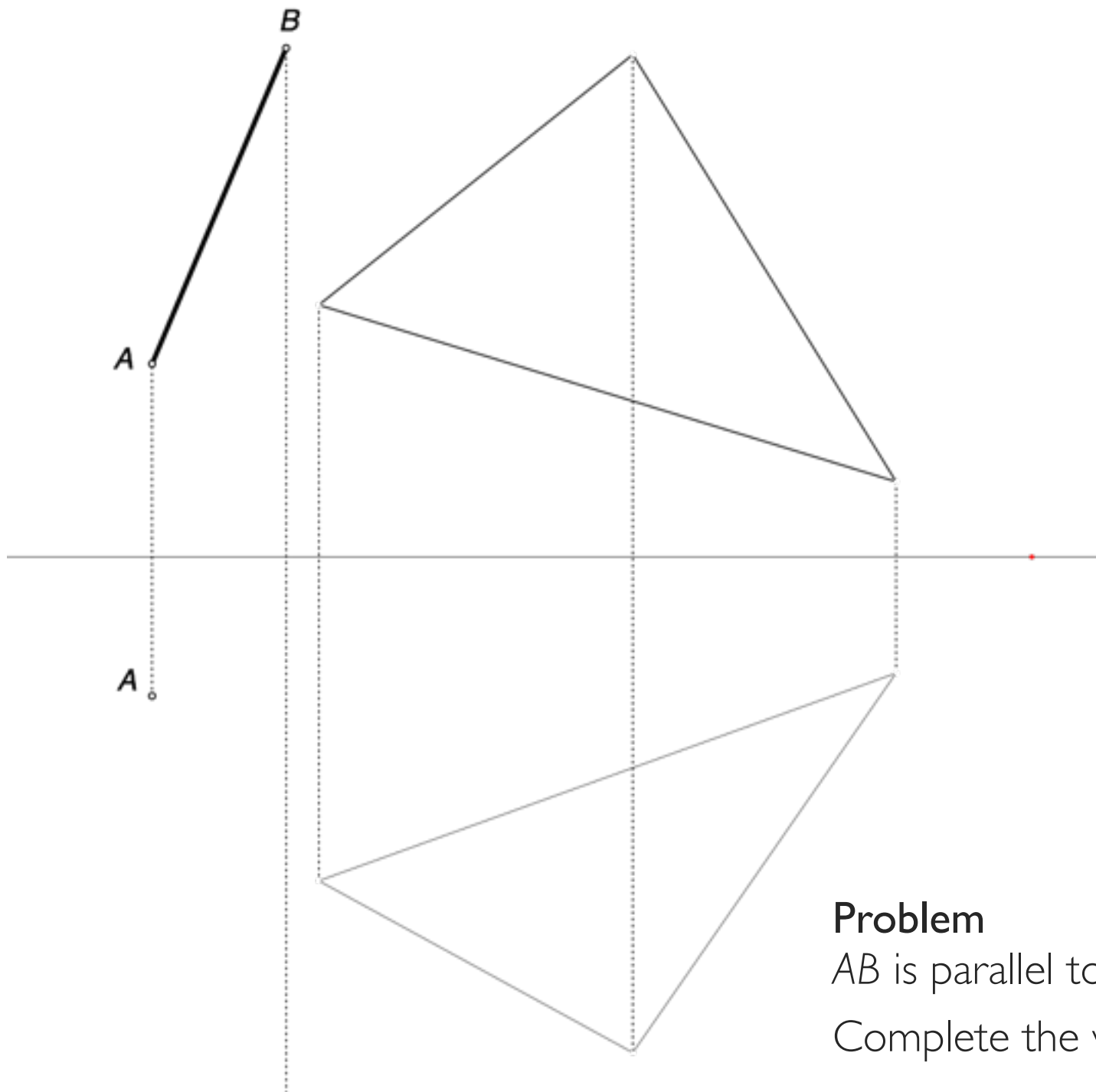


► Step 2





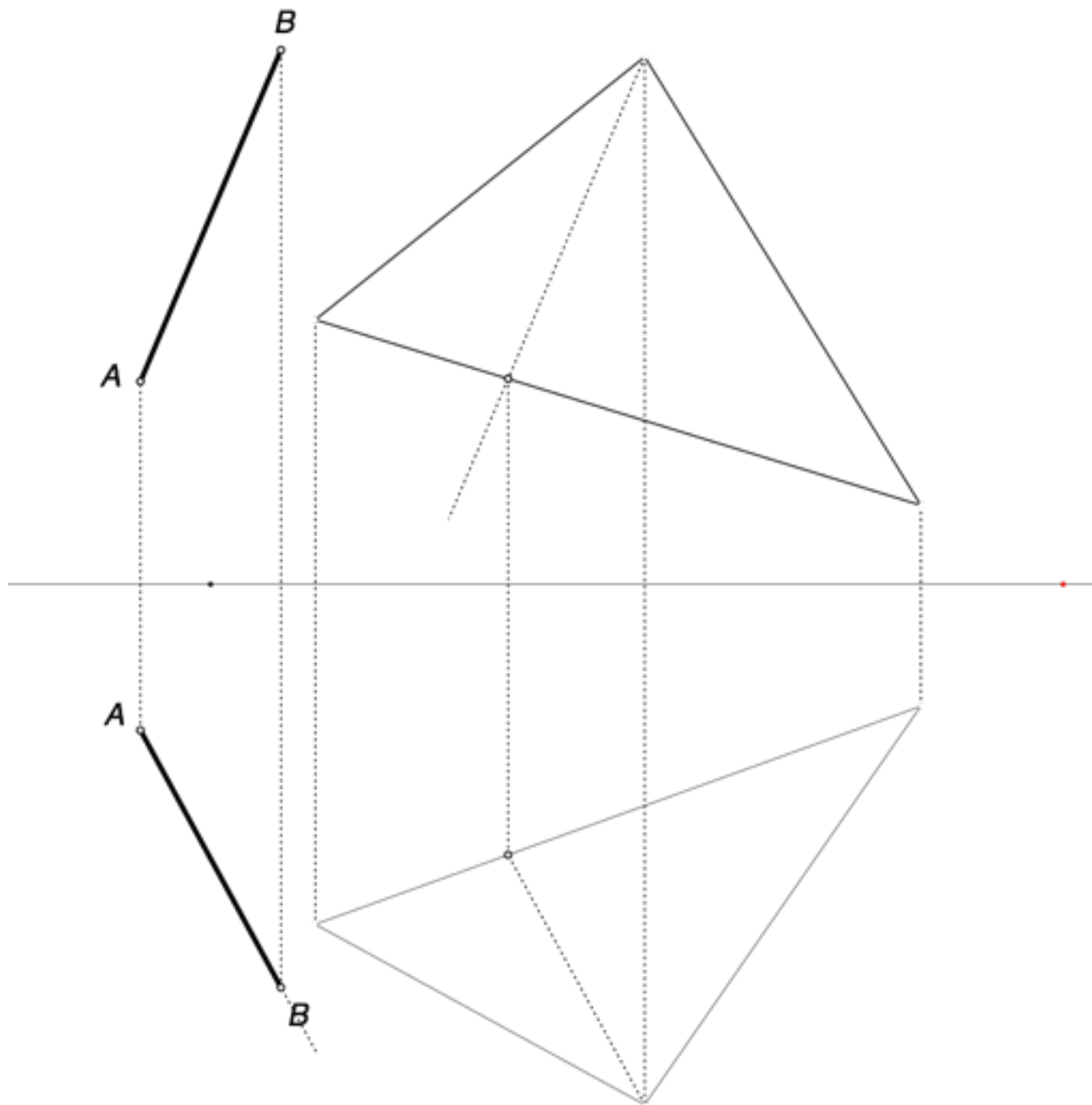
► Step 3



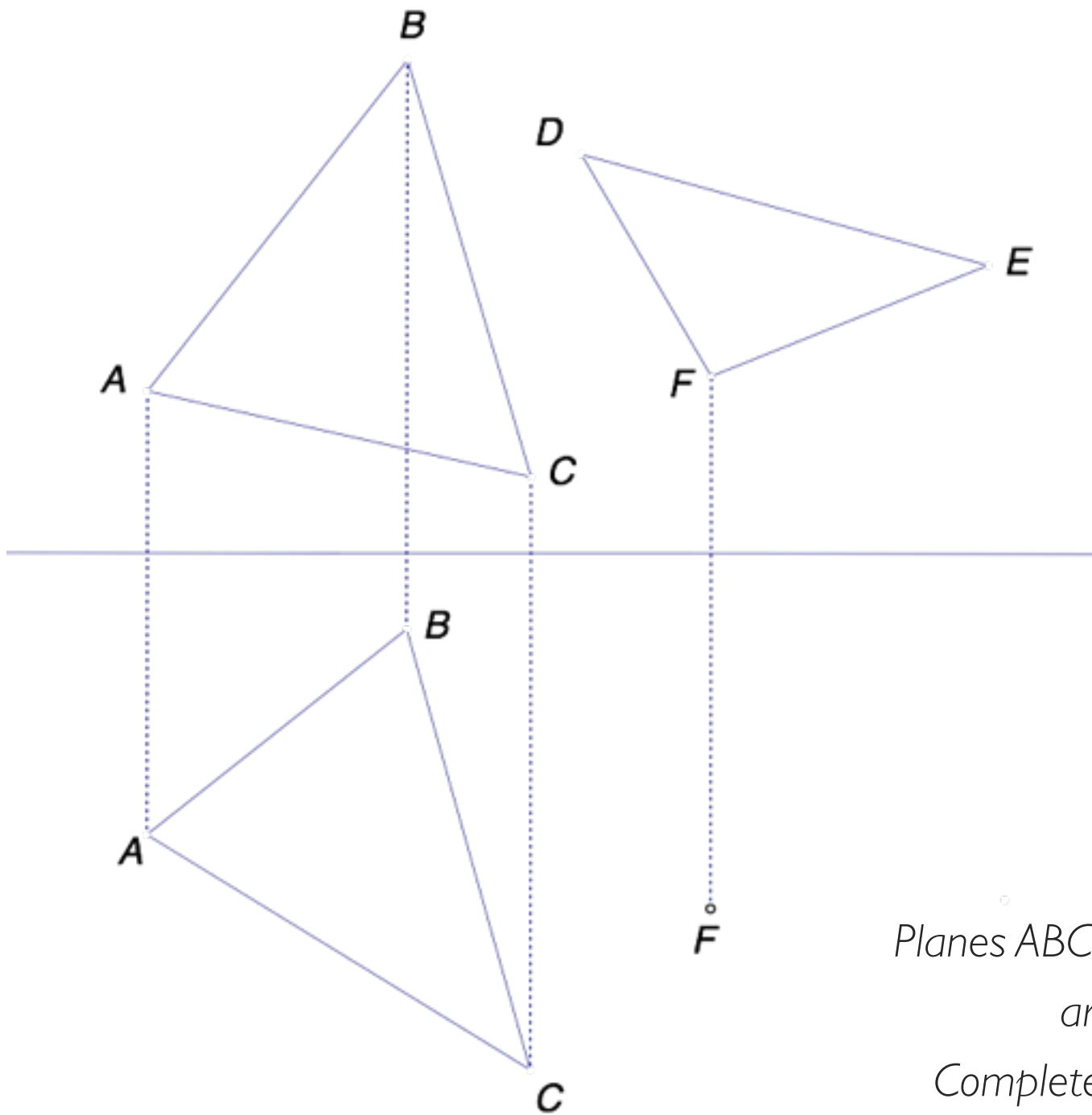
### Problem

$AB$  is parallel to plane.  
Complete the view.





► Step

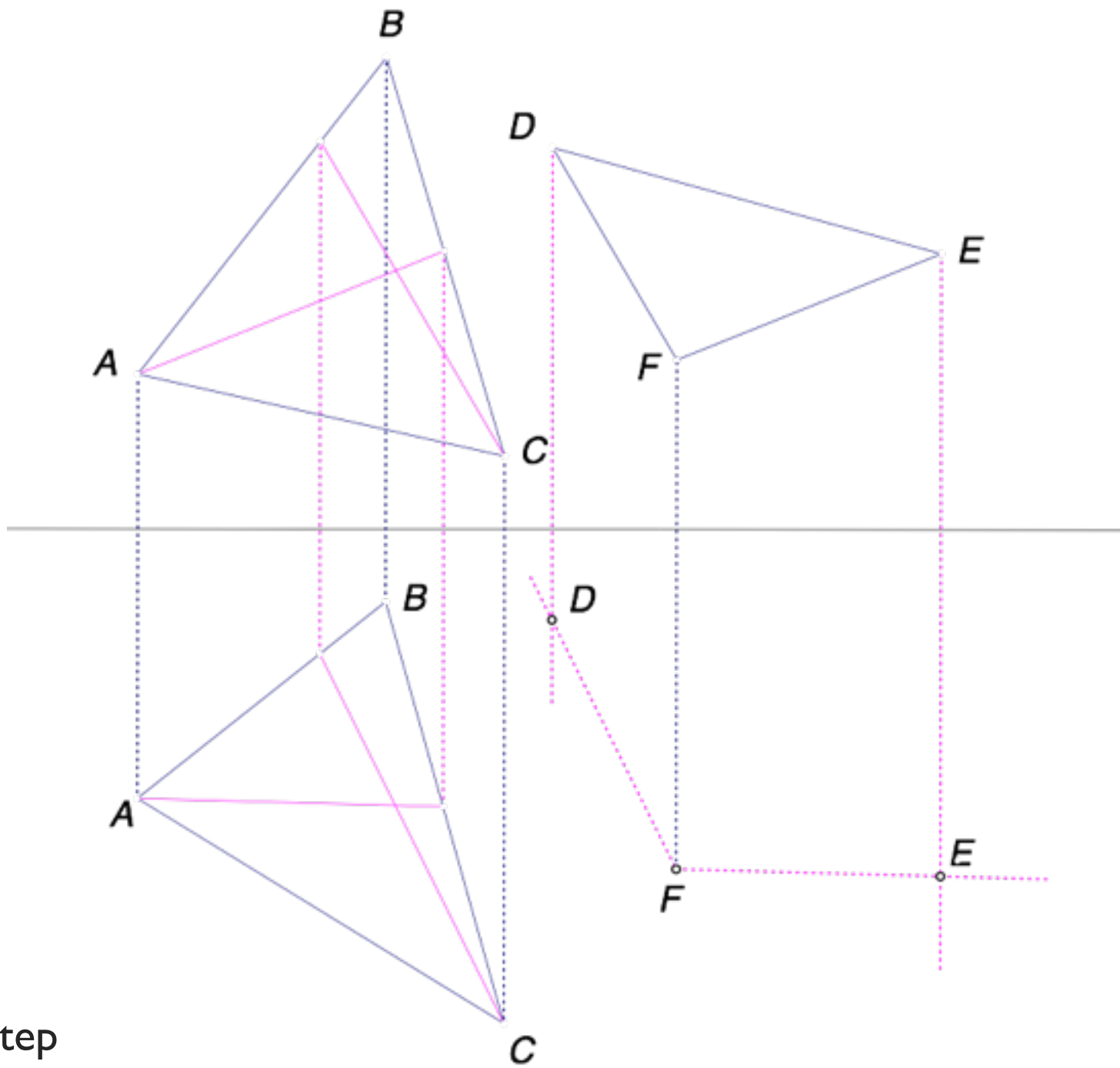


**Problem**

*Planes ABC and DEF  
are parallel.*

*Complete the view*

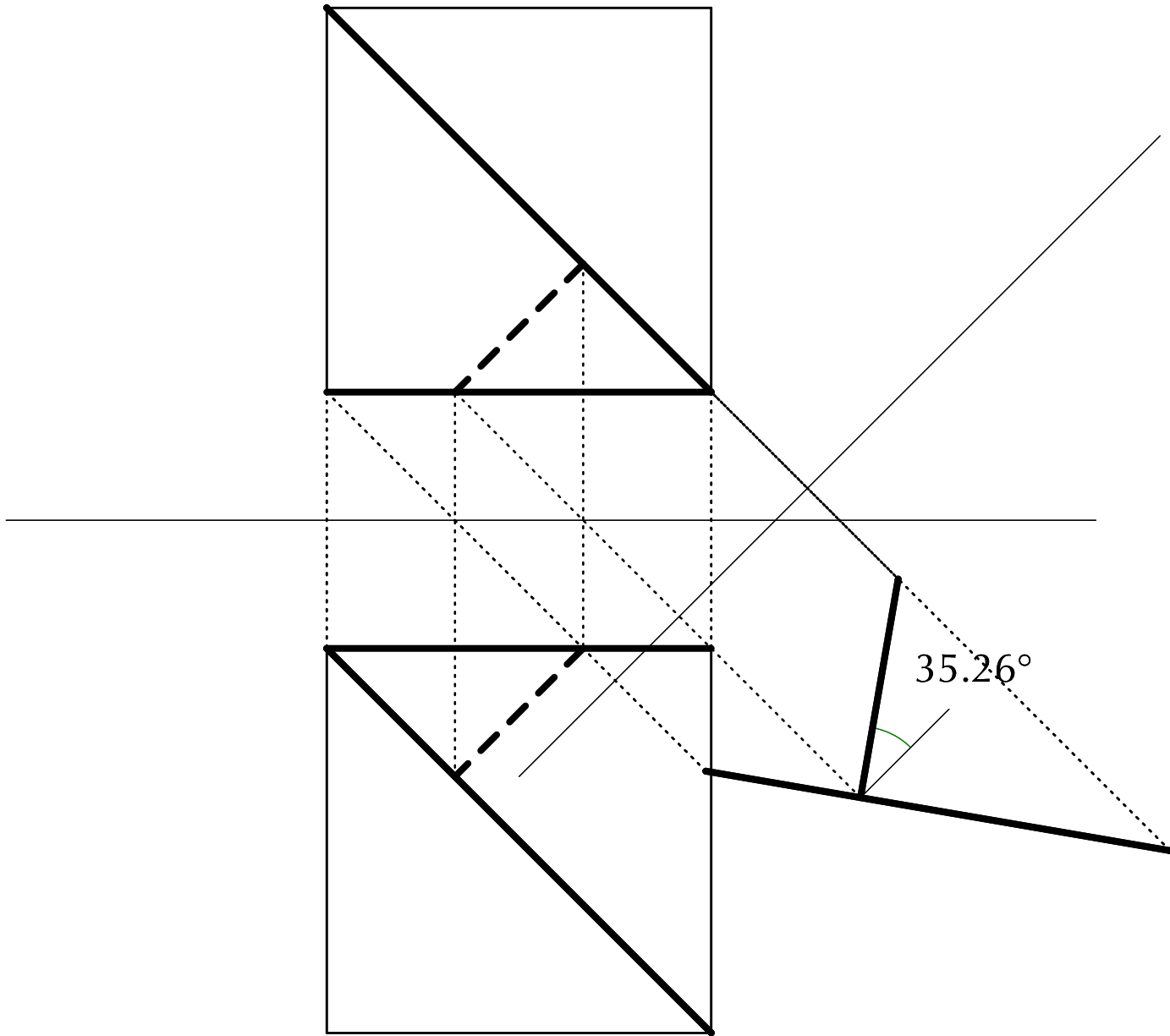




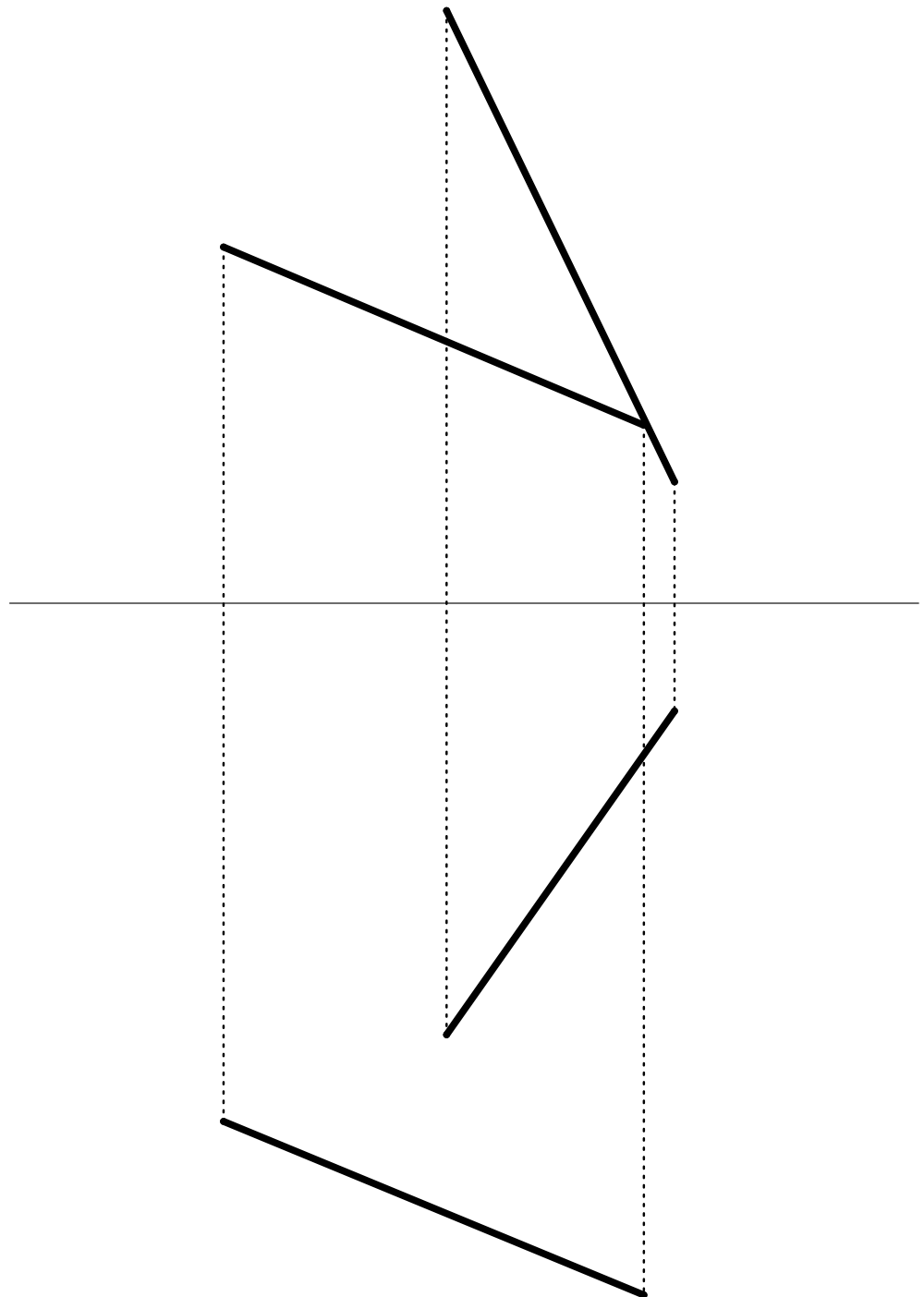
► Step

*What is the shortest length between non-intersecting diagonals of adjacent faces of a cube?*



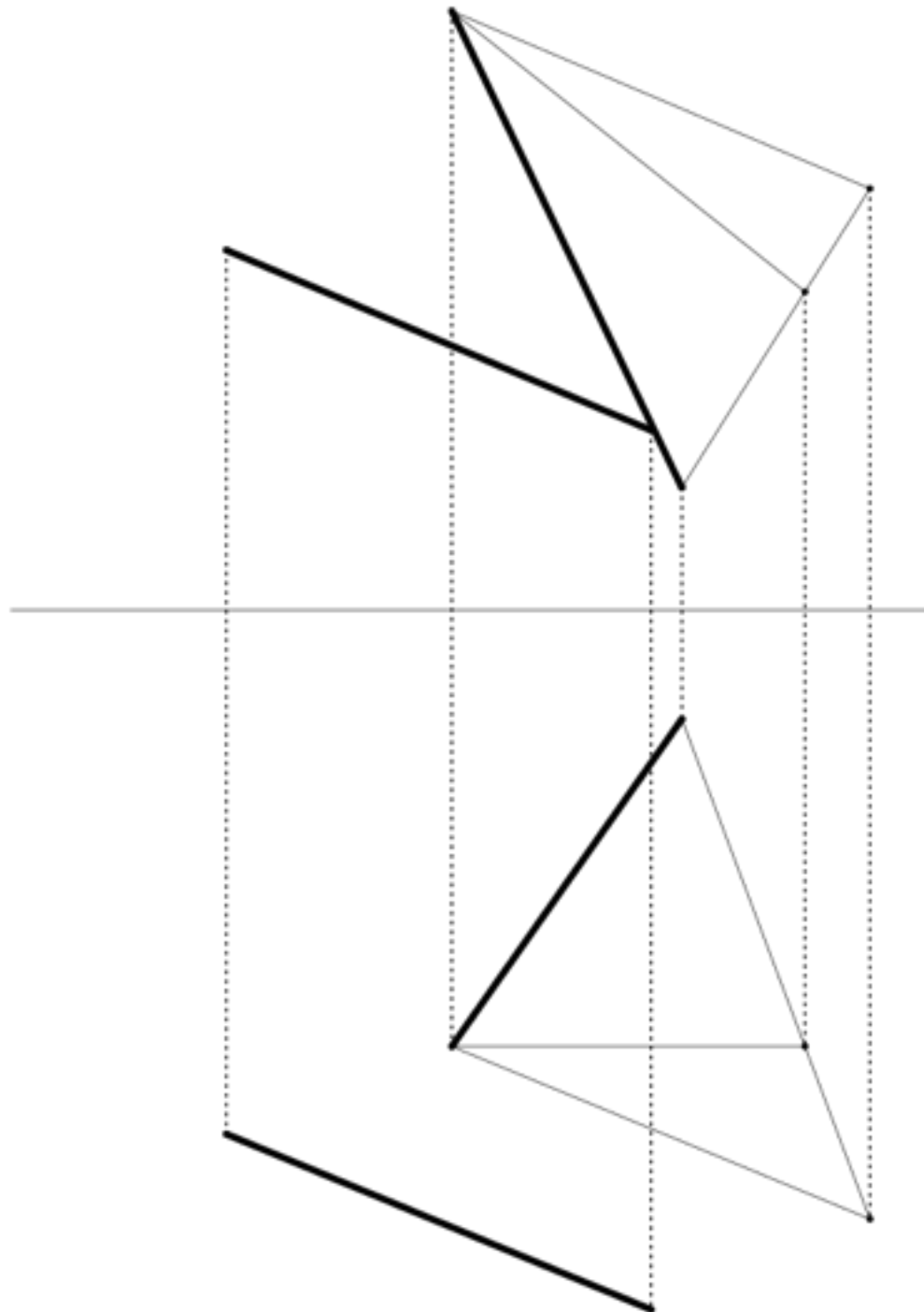


Given two partial pipelines –  
construct the shortest level  
pipeline to connect them.  
These pipelines may be  
extended

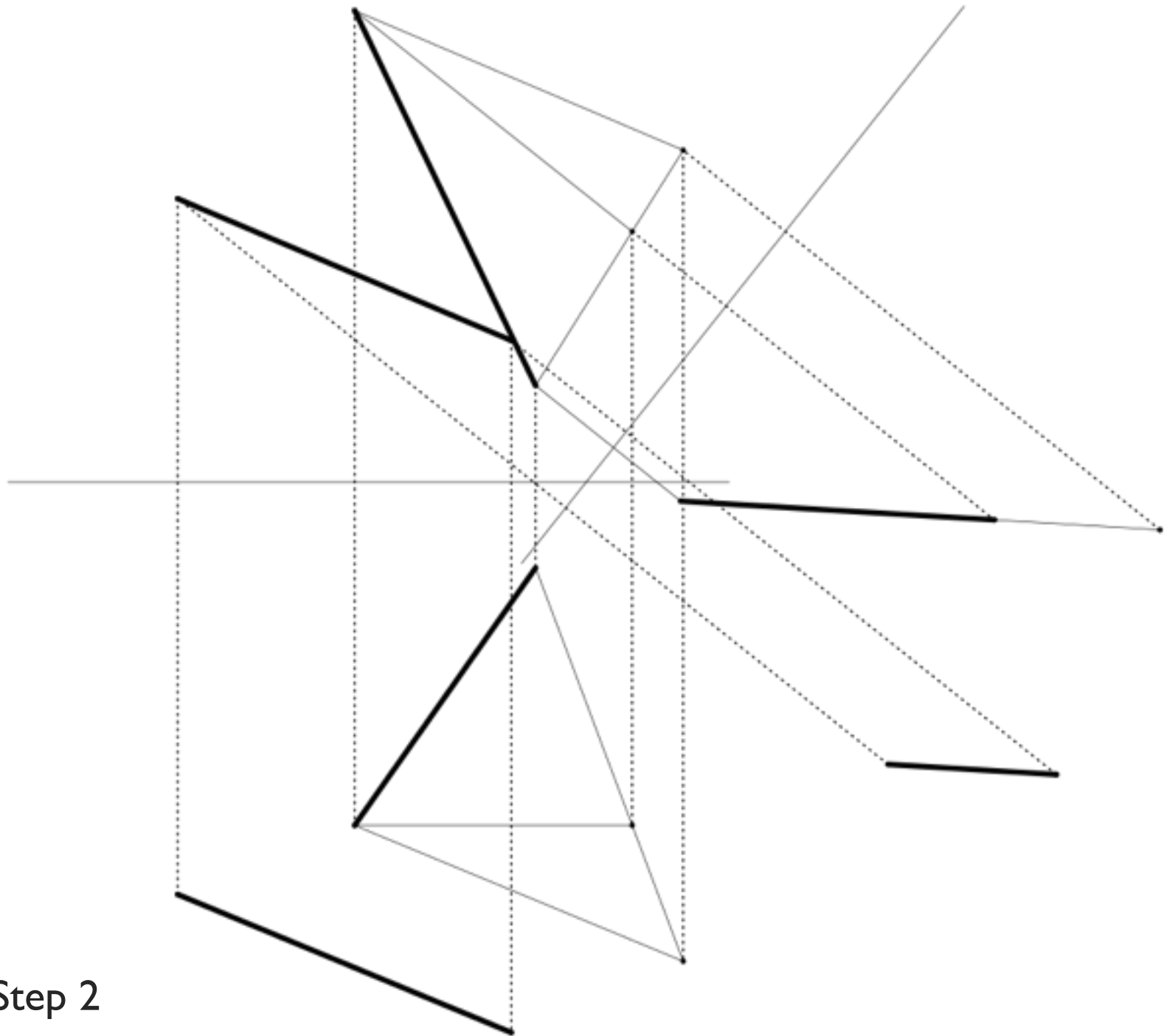


► Problem

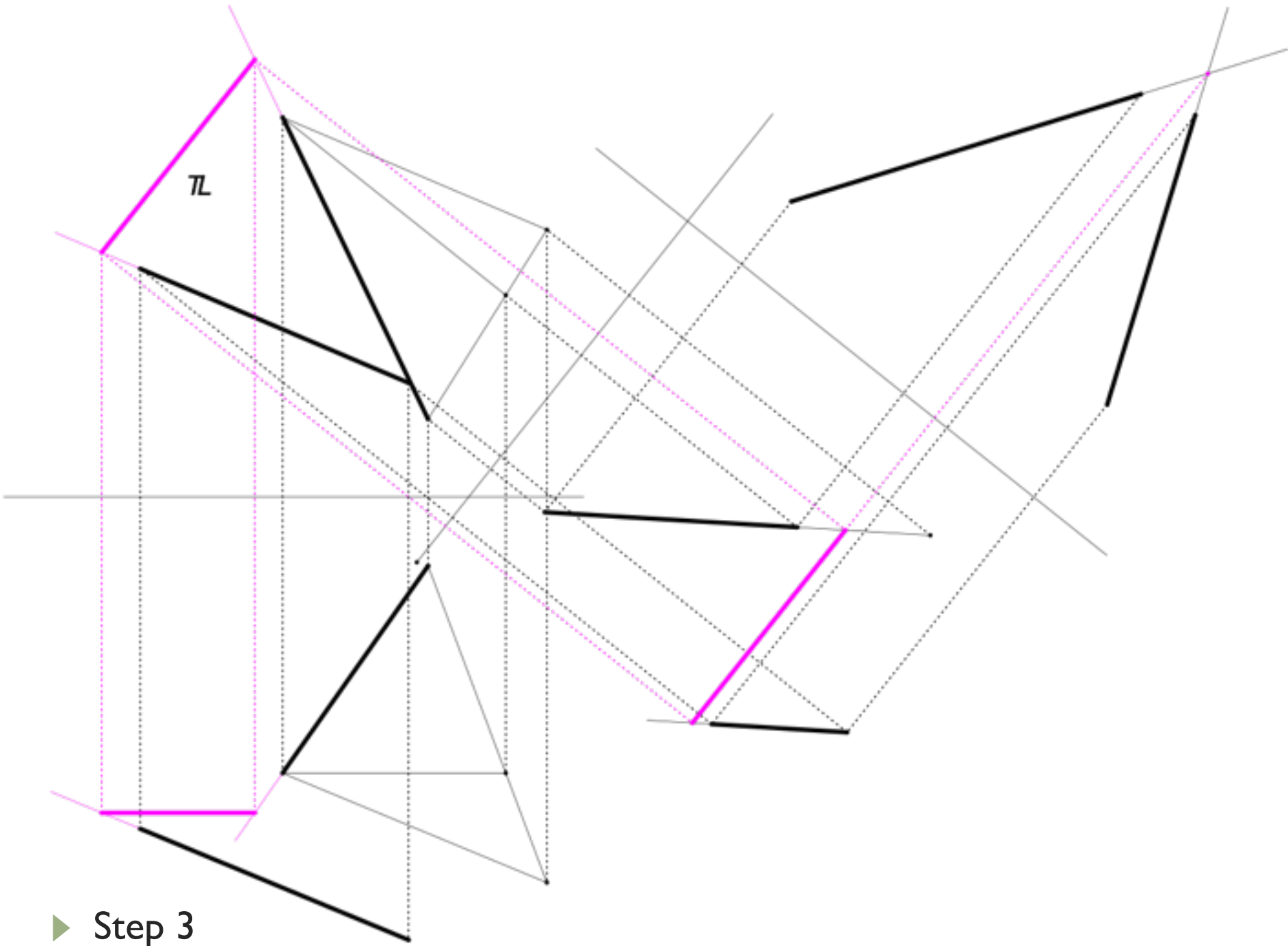




► Step 1



► Step 2



► Step 3

Construct the pyramid with

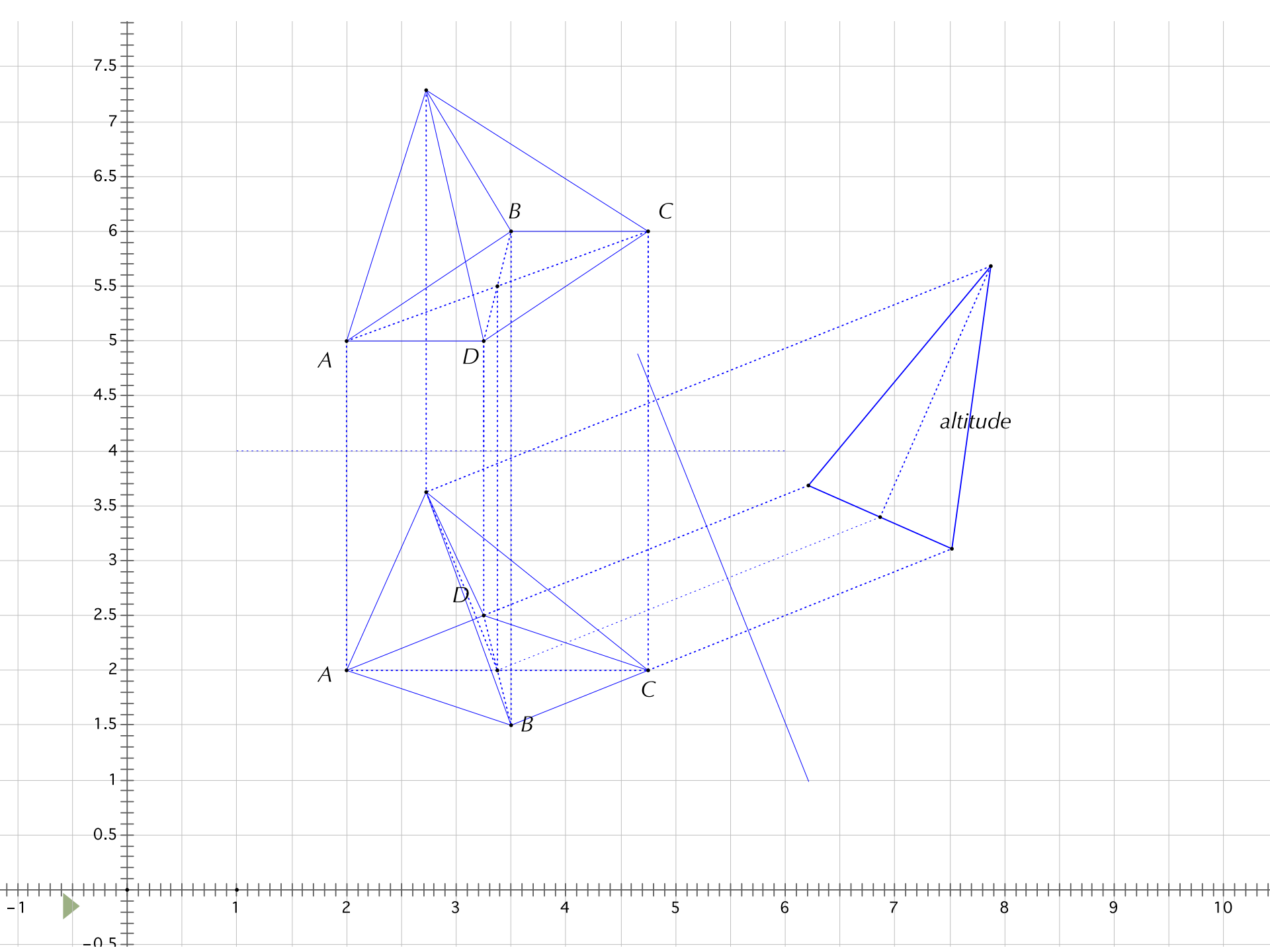
base  $A(2, 2, 5)$ ,  $B(3.5, 1.5, 6)$ ,  $C(4.75, 2, 6)$   $D(3.25, 2.5, 5)$

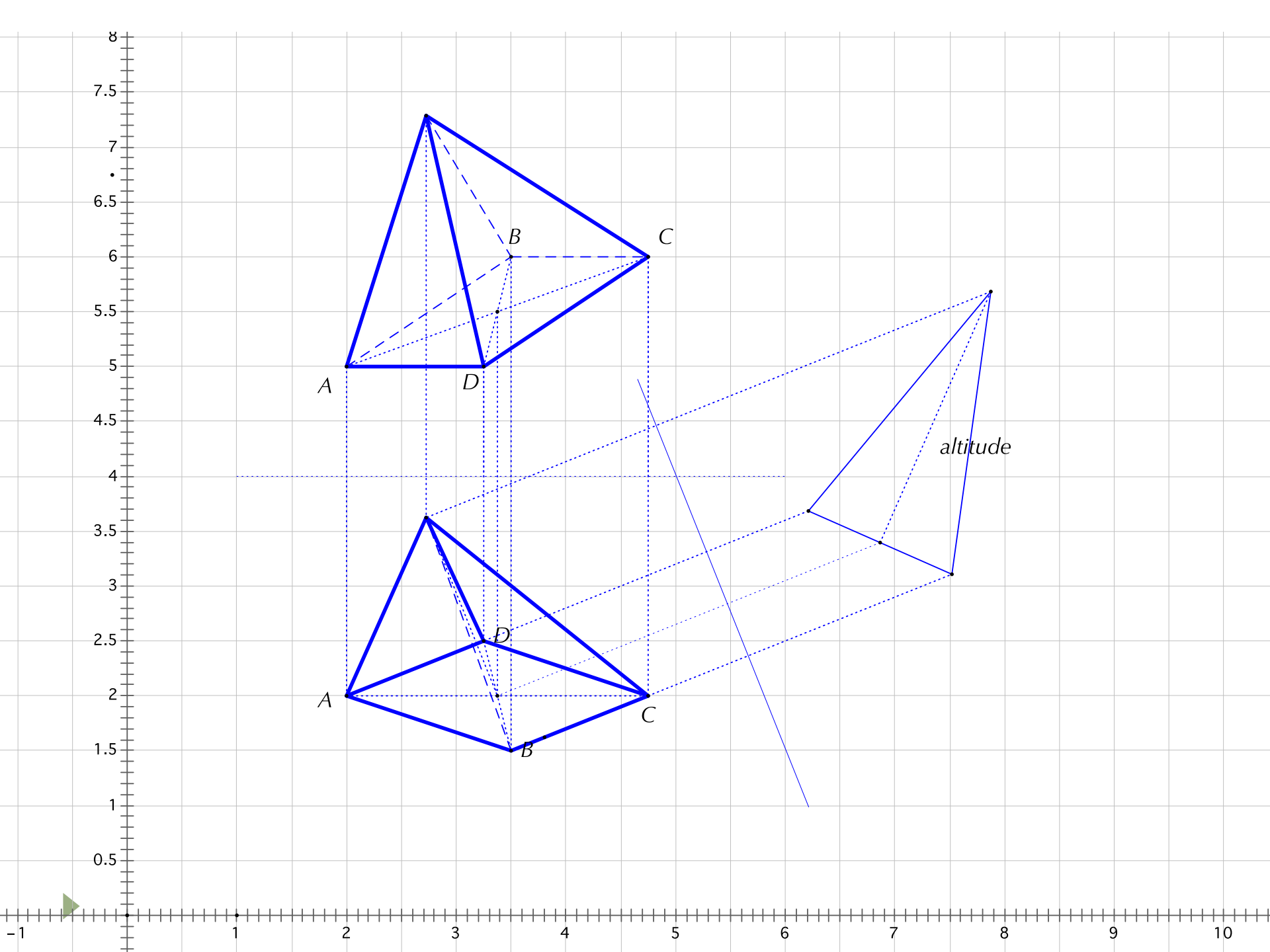
height 2.5

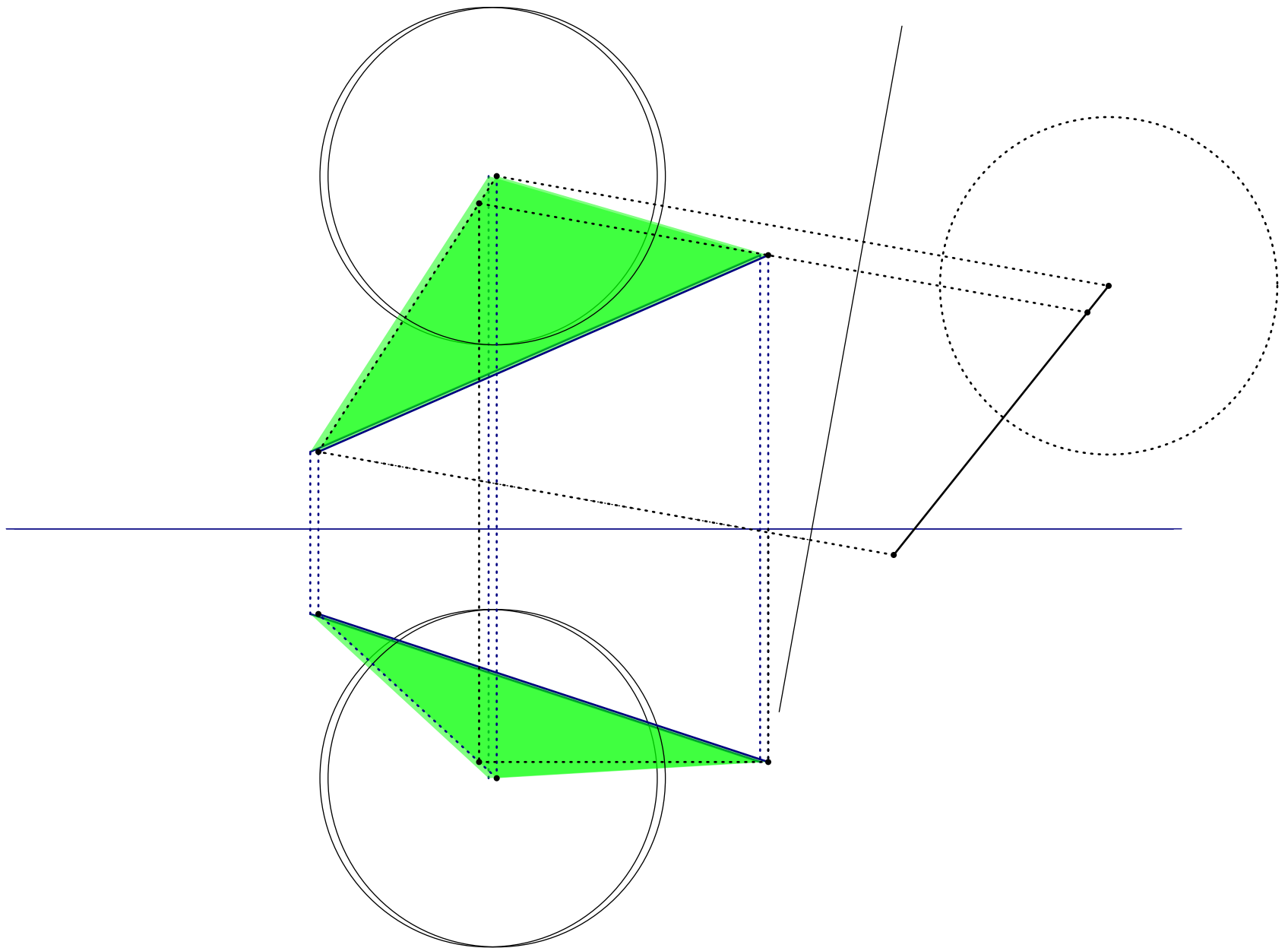
All measurements in inches

Complete top and front views with proper visibility i.e., visible lines are solid and not visible lines shown dashed.

► **Problem involving perpendicular lines**







► What is the clearance between a pipe and the ball?

