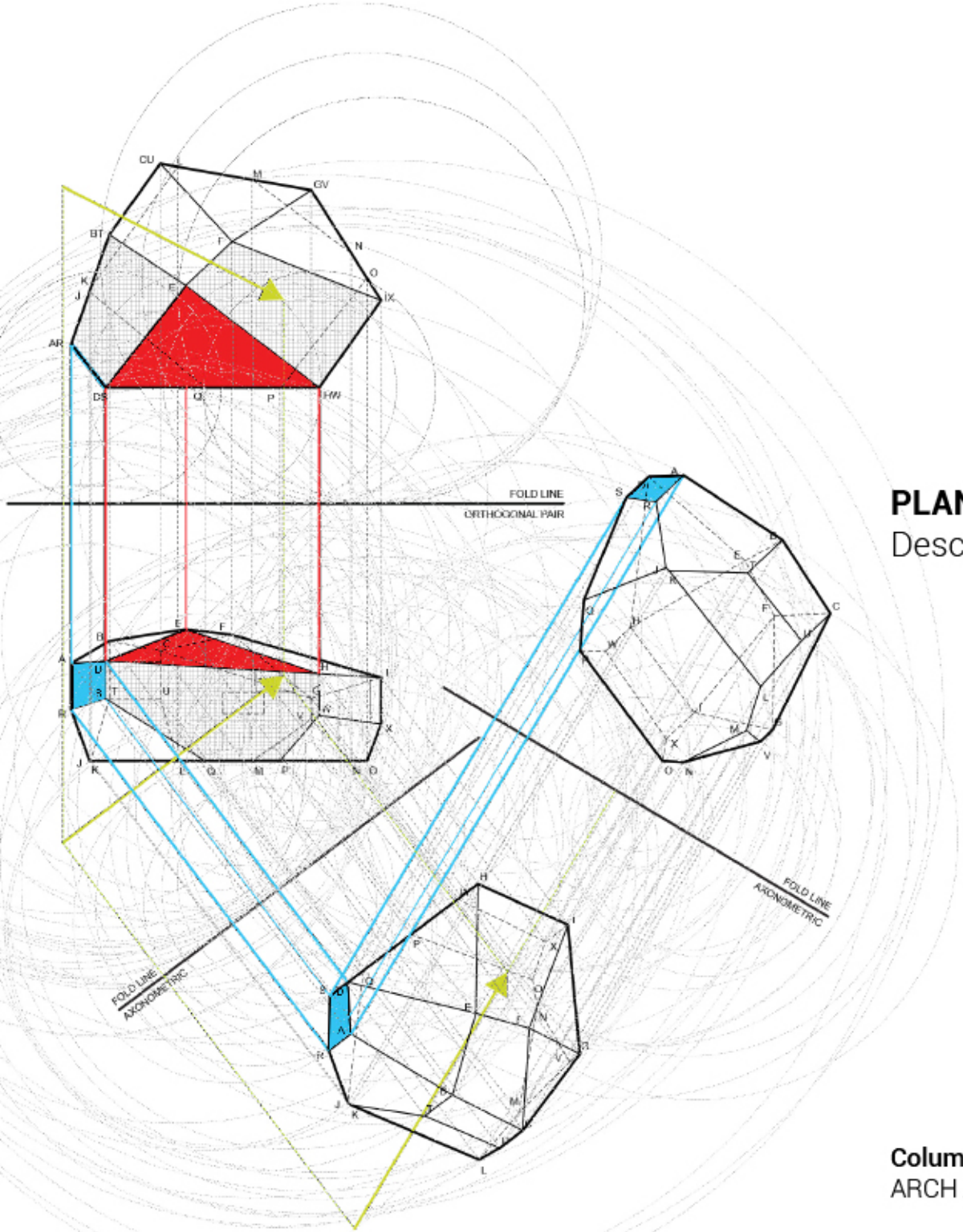
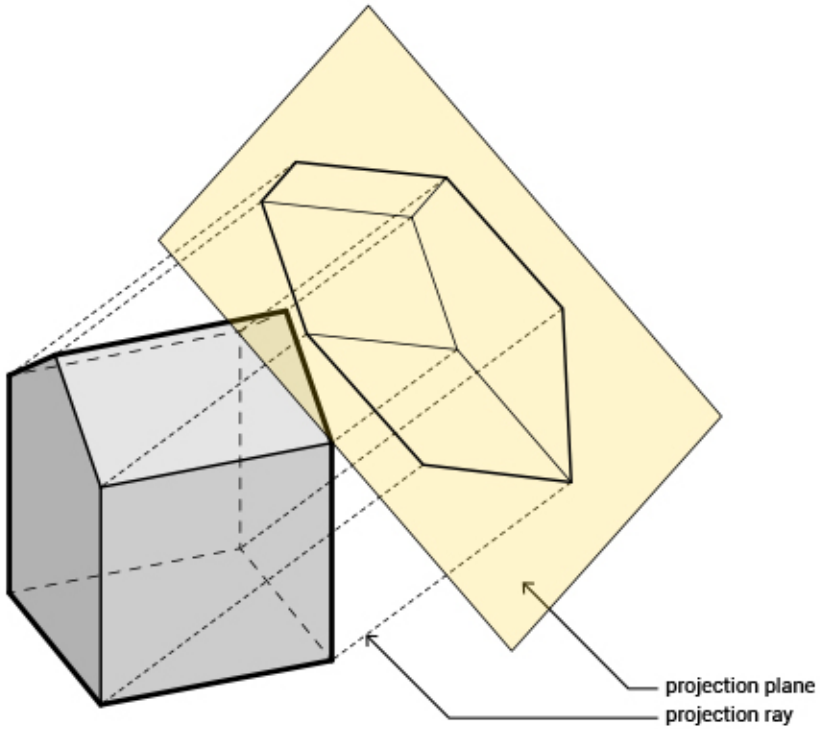


PLAN AS GENERATOR

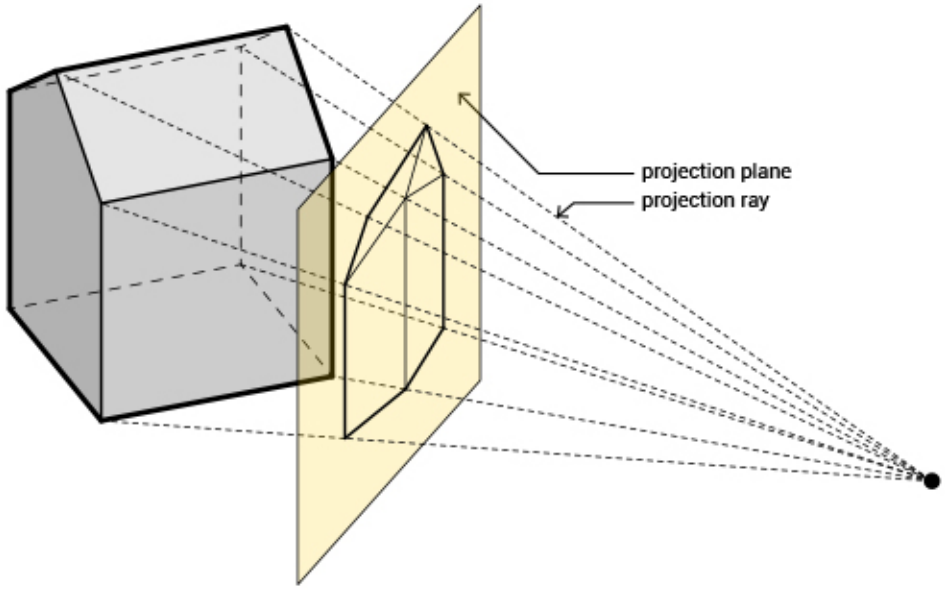
Descriptive Geometry And Parallel Projection

Columbia University GSAPP
ARCH A4570: Drawing with Data

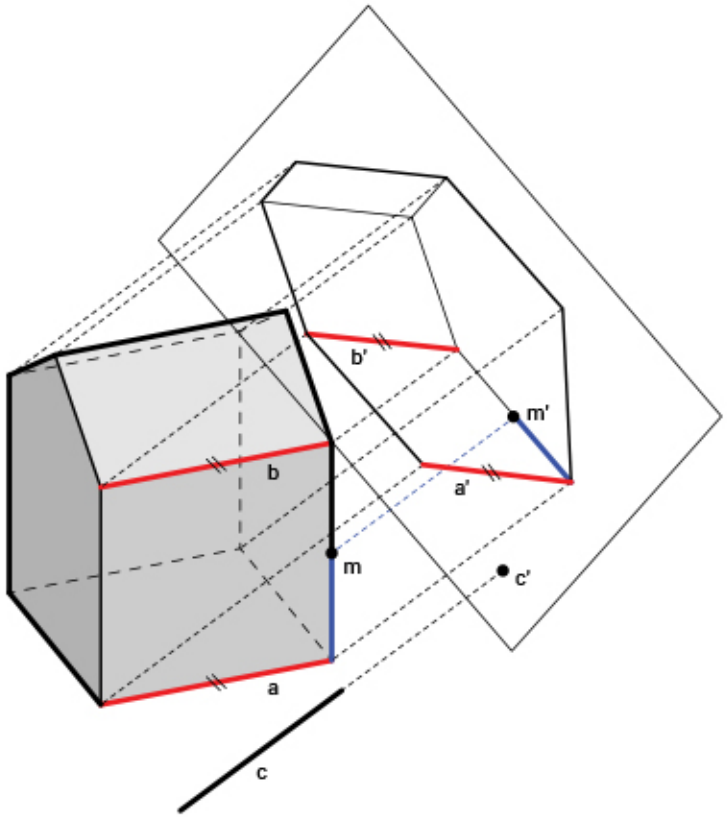
PROJECTION - Perspective vs. Parallel Projection



Parallel Projection



Perspective Projection

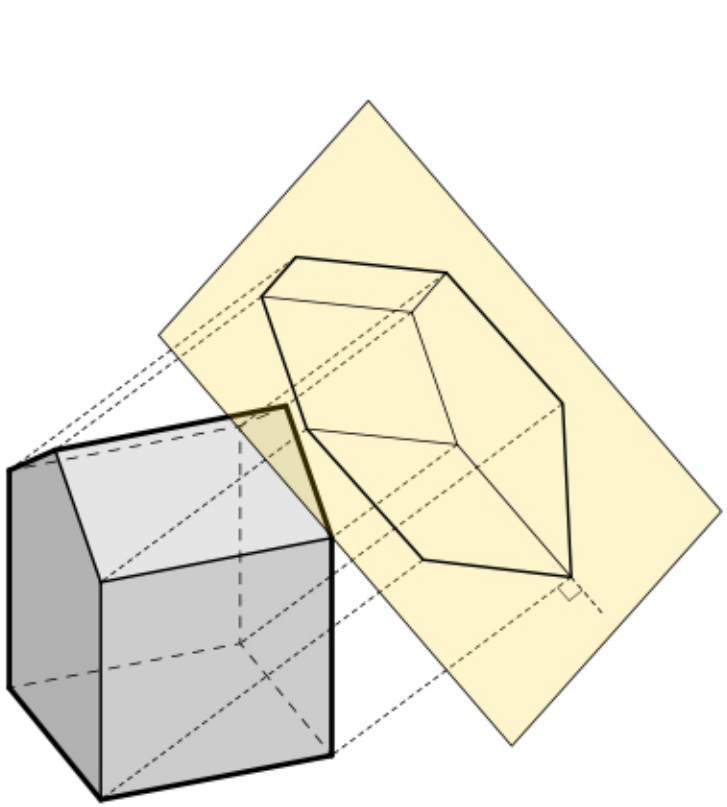


Parallel Projection

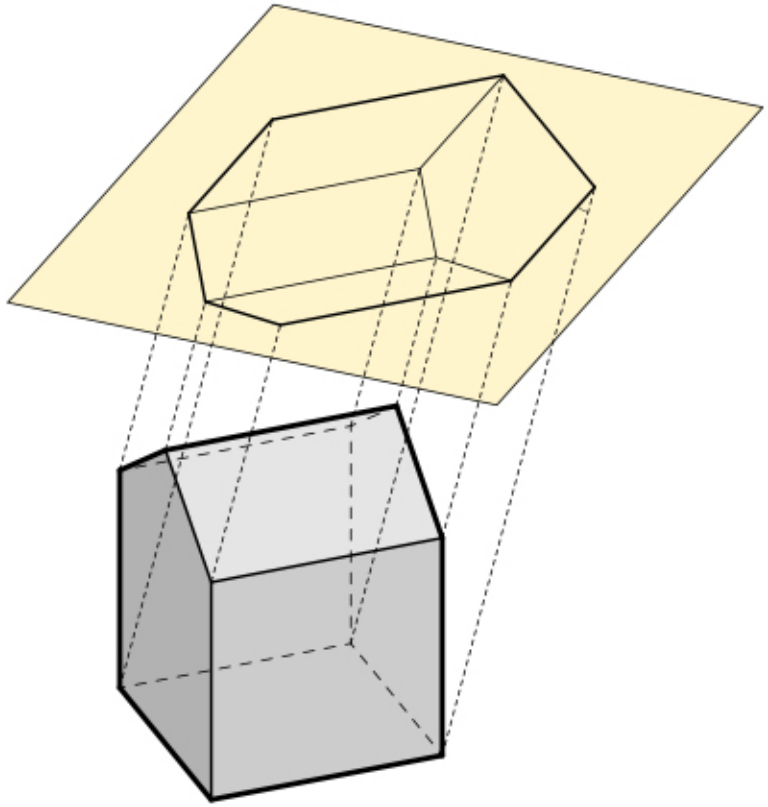
Properties of Parallel Projection

- In general, the parallel projection of a spatial line a is a line a', In the special case, when a line c is parallel to the projection rays the parallel projection degenerates to a point c'.
- The parallel projections a', b' of parallel lines a, b (not parallel to the projection rays) are parallel.
- The ratio of distances is preserved under parallel projection. This means that if a point divides a spatial line in a certain ratio the point divides the projected line in the same ratio. For example, the midpoint m of a line is projected into the midpoint m'.
- Parallel line segments of equal length in space are projected onto parallel line segments of equal length in the plane.

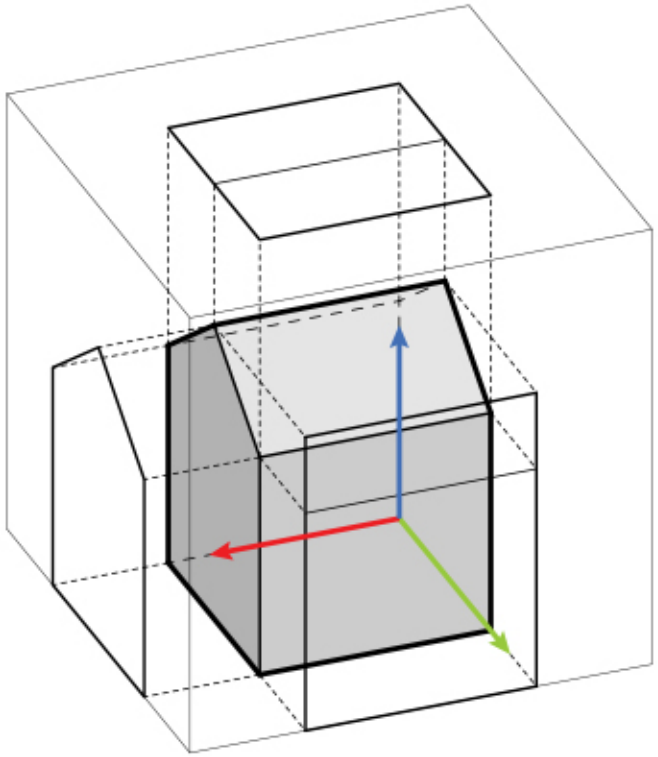
PROJECTION - Normal vs. Oblique Projection



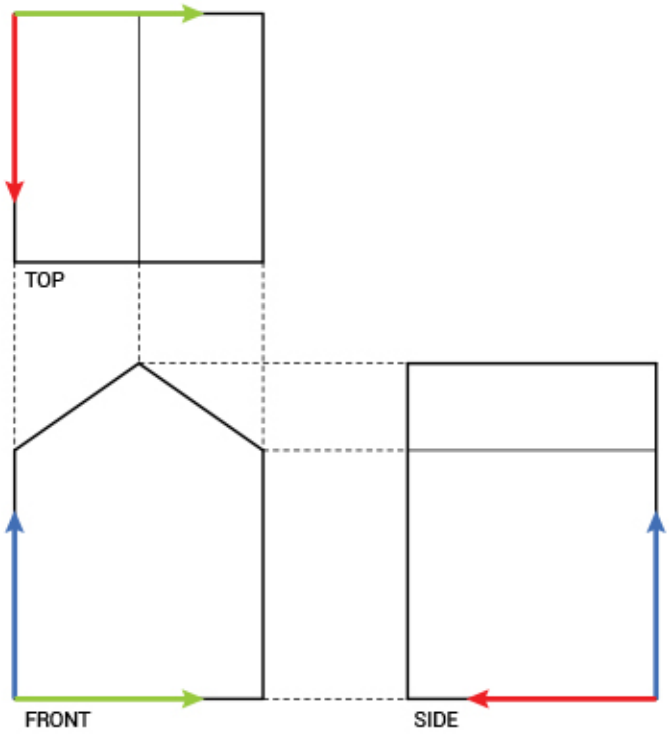
Normal Projection
- projection rays normal to projection plane



Oblique Projection
- projection rays oblique to projection plane

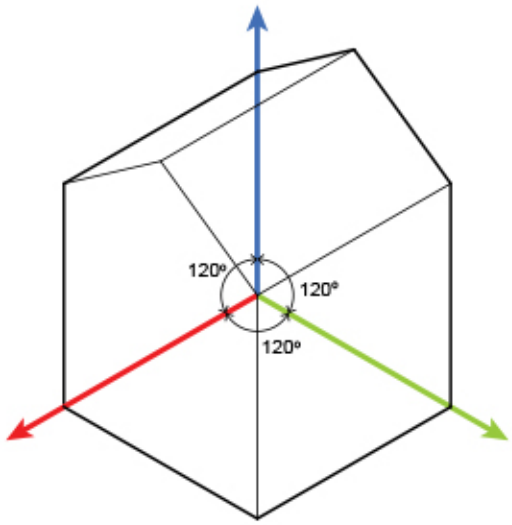


Projection onto a 'projection cuboid'

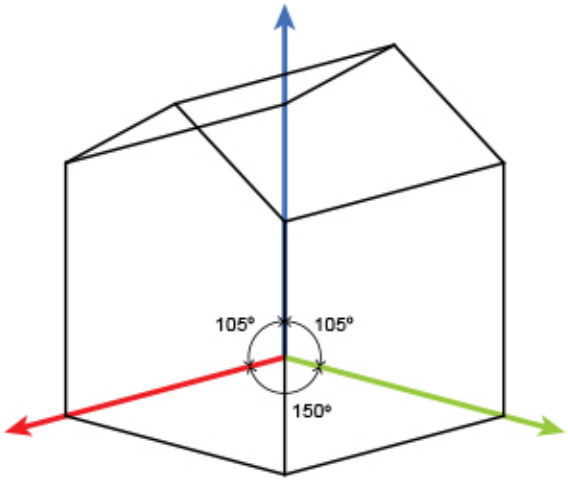


Three primary orthographic projections linked to cartesian coordinate frame

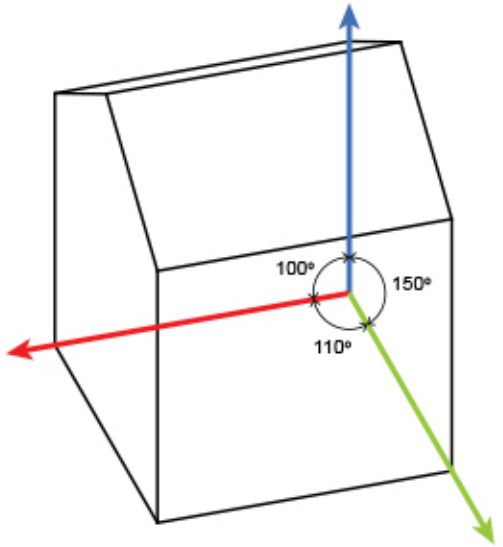
PROJECTION - Axonometric Projection



Isometric

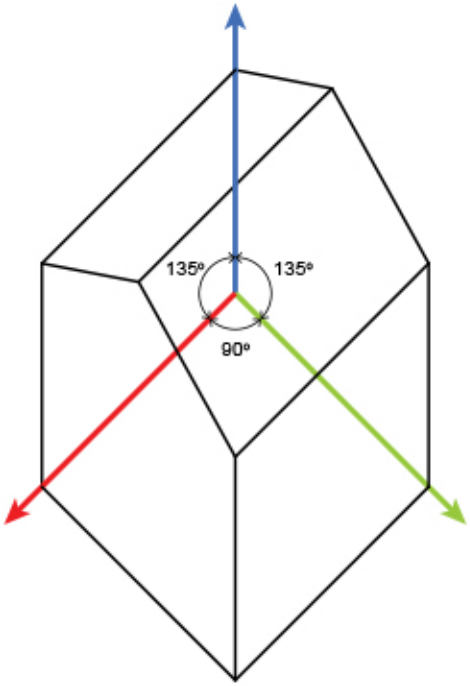


Dimetric

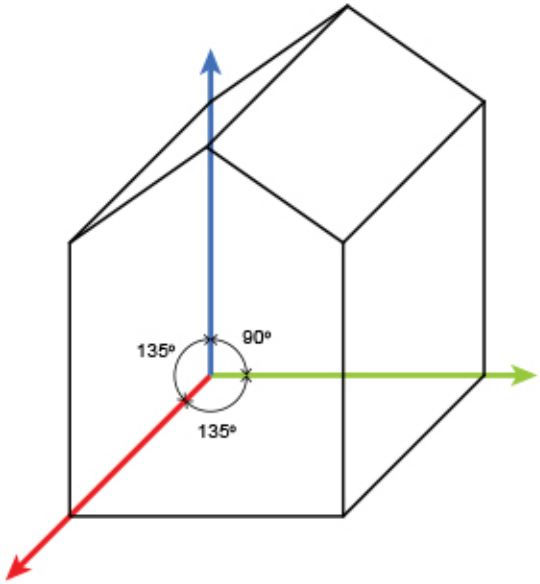


Trimetric

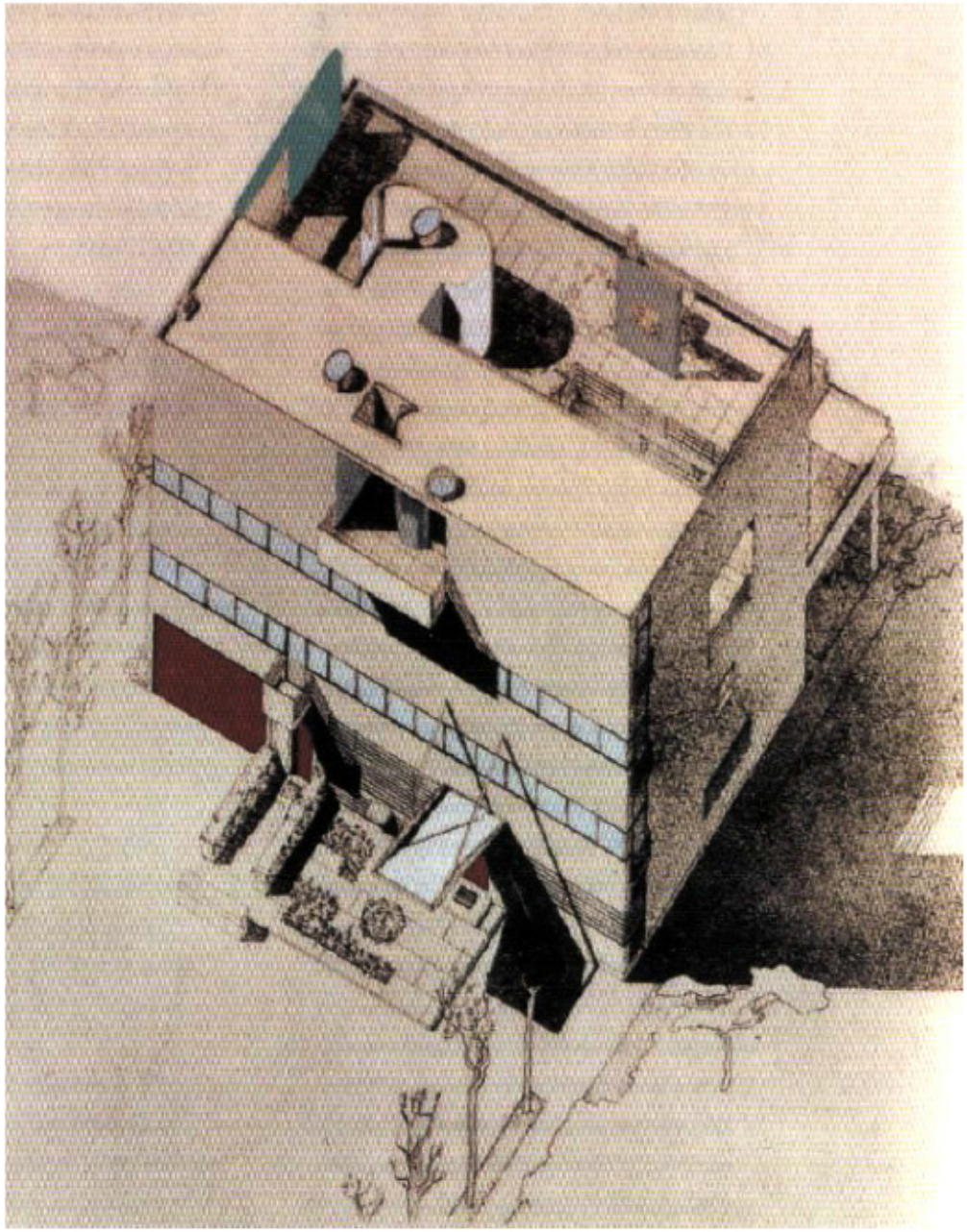
PROJECTION - Oblique Projection



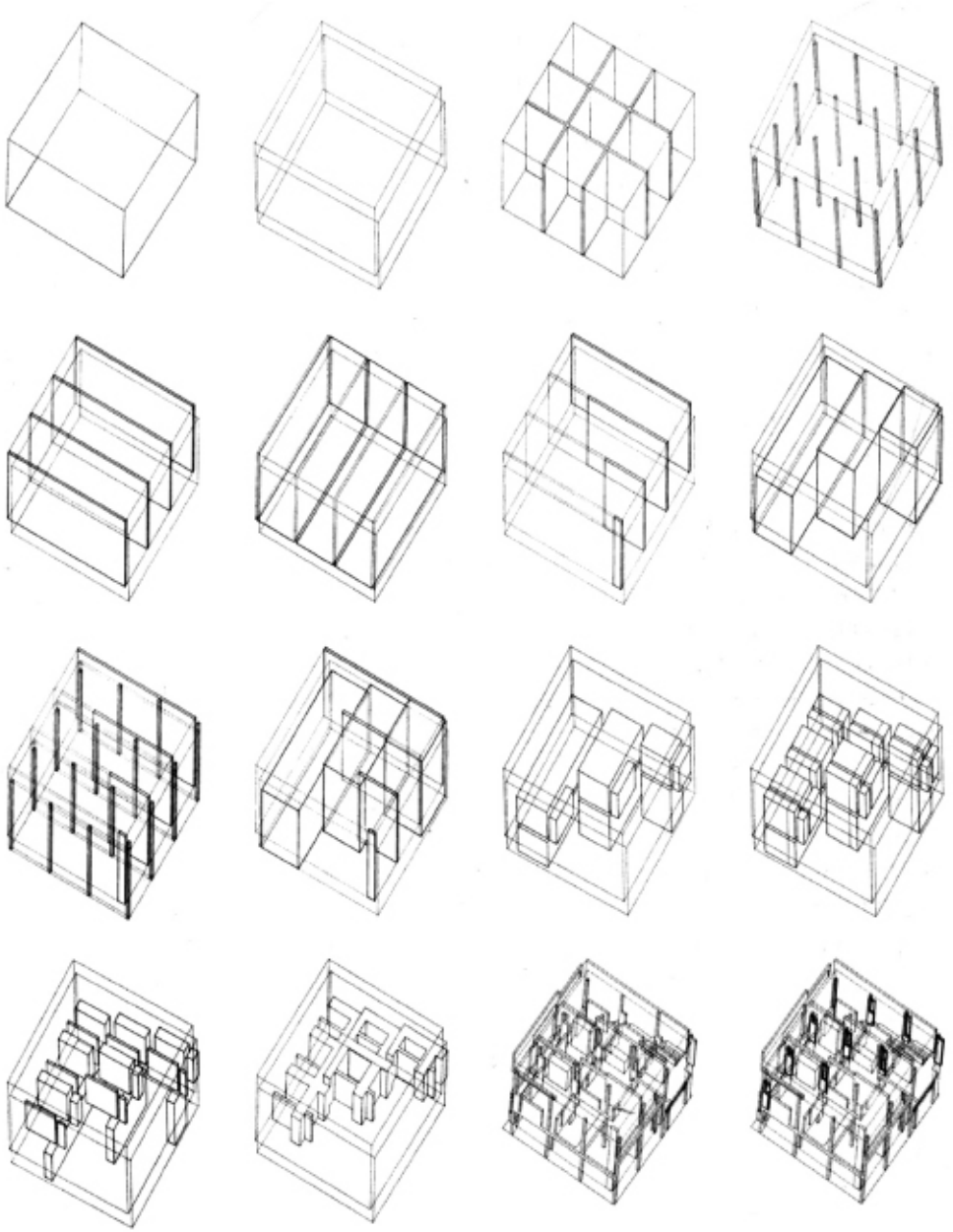
Plan Oblique



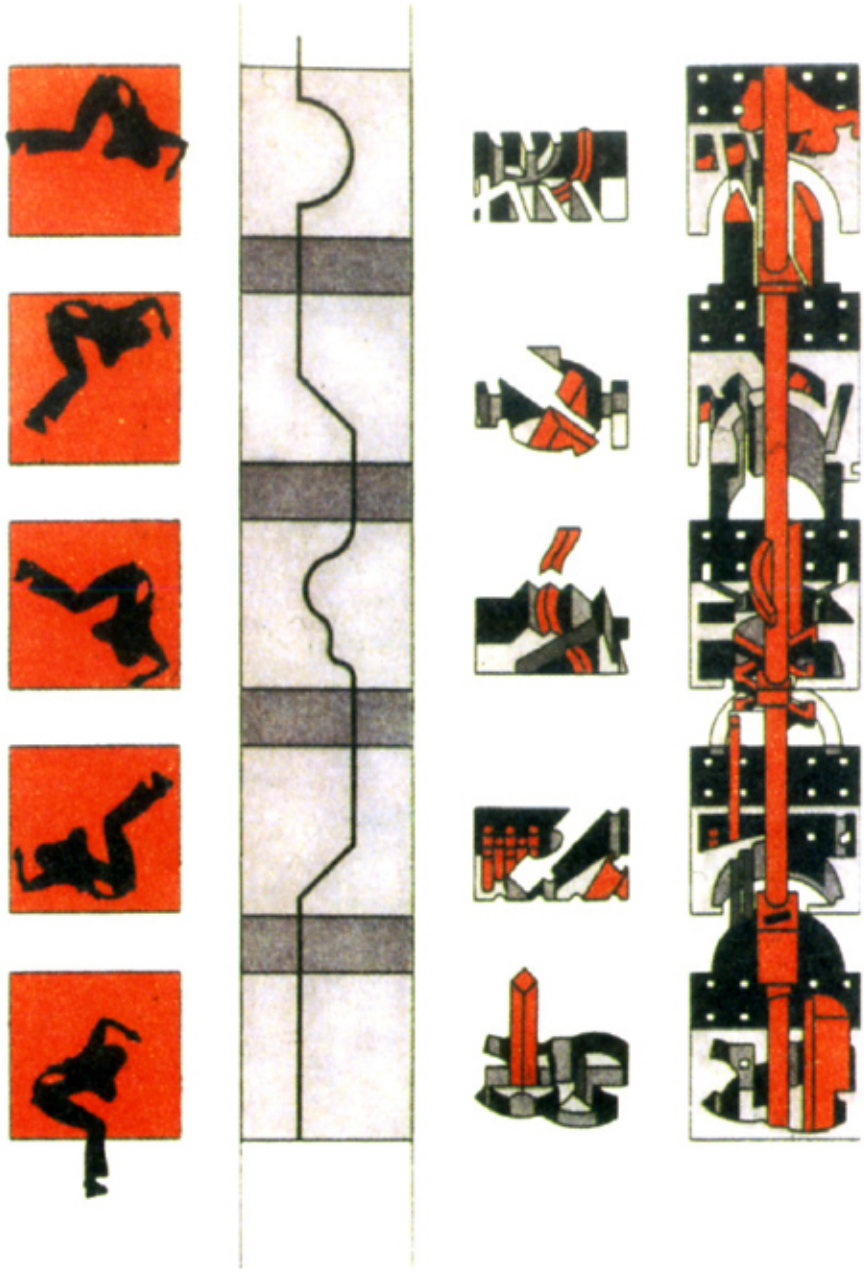
Elevation Oblique



Le Corbusier painting and axonometric projection of *Villa at Garches*

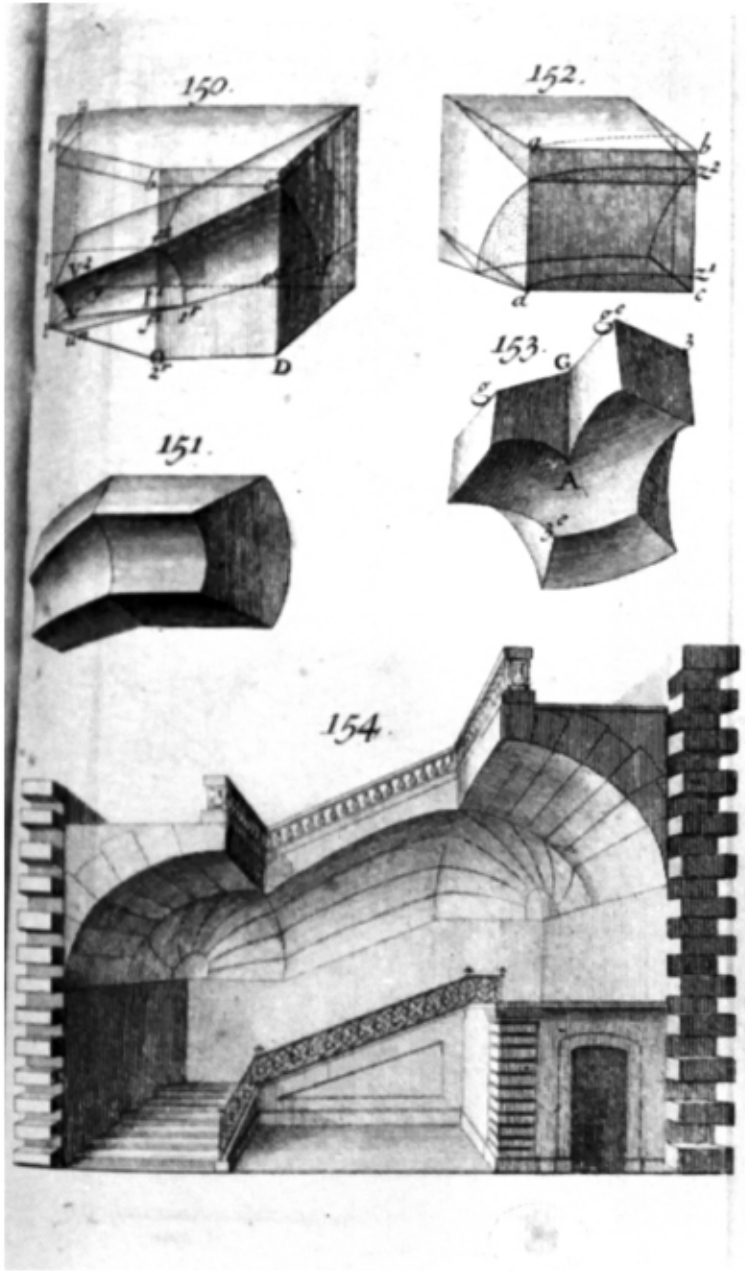


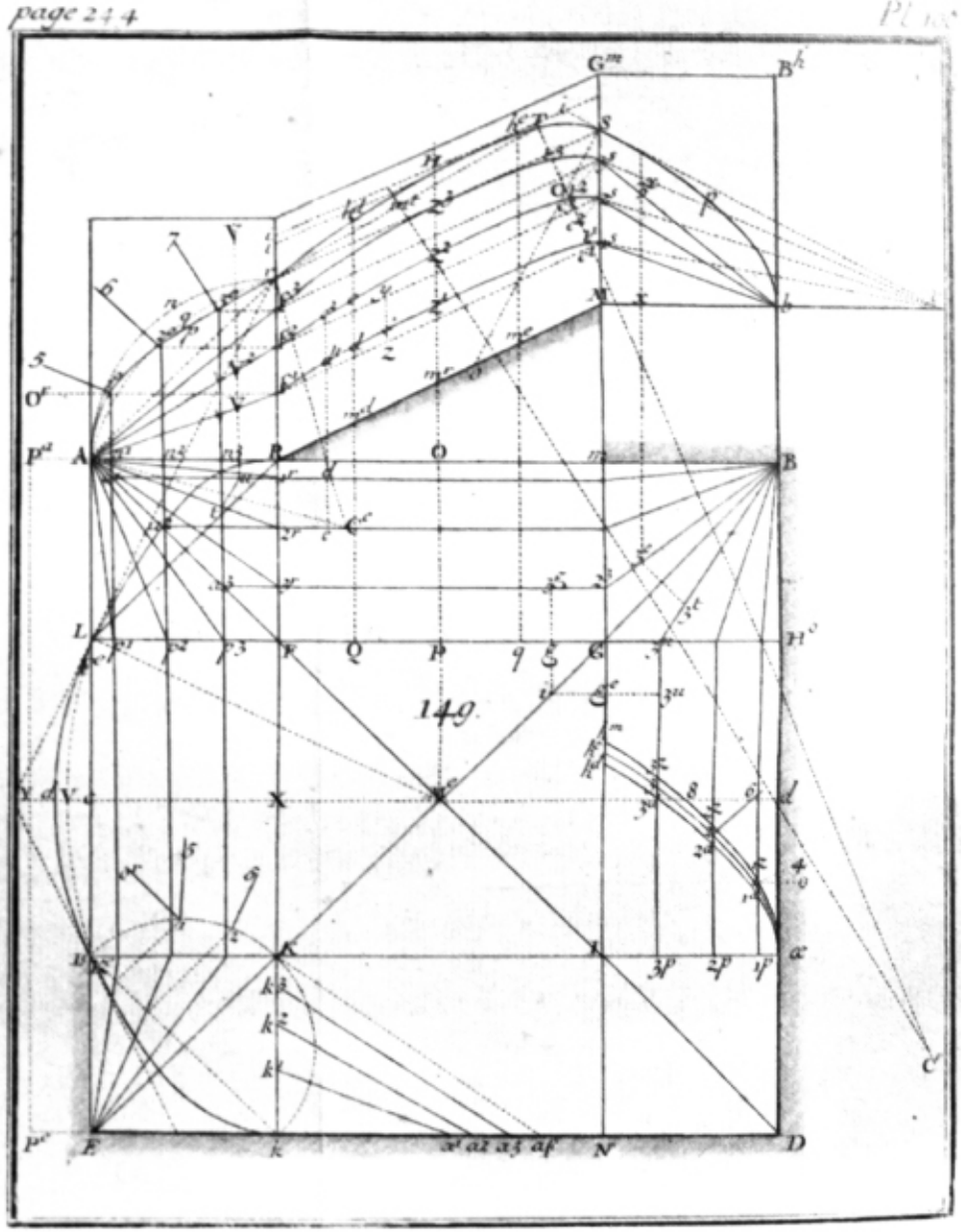
Peter Eisenman, *House II*



Bernard Tschumi, *The Tower* from *The Manhattan Transcripts*

STEREOTOMY





Evans, Robin, The Projective Cast

G.ard Monge, Comte de Peluse.
Gaspard

1746 - 1818

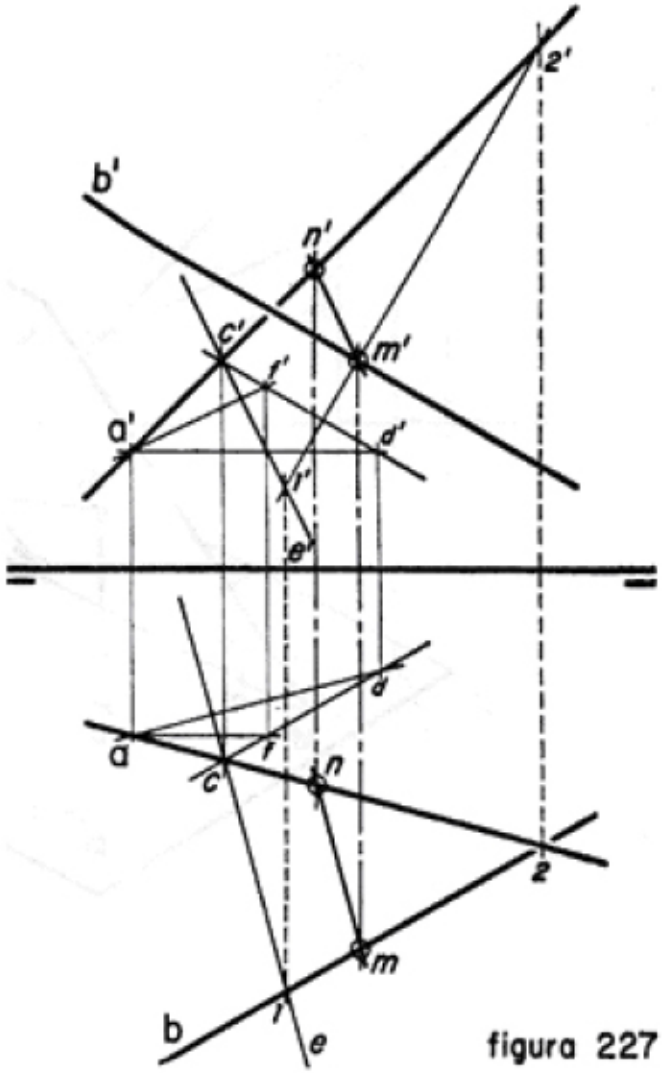


figura 227

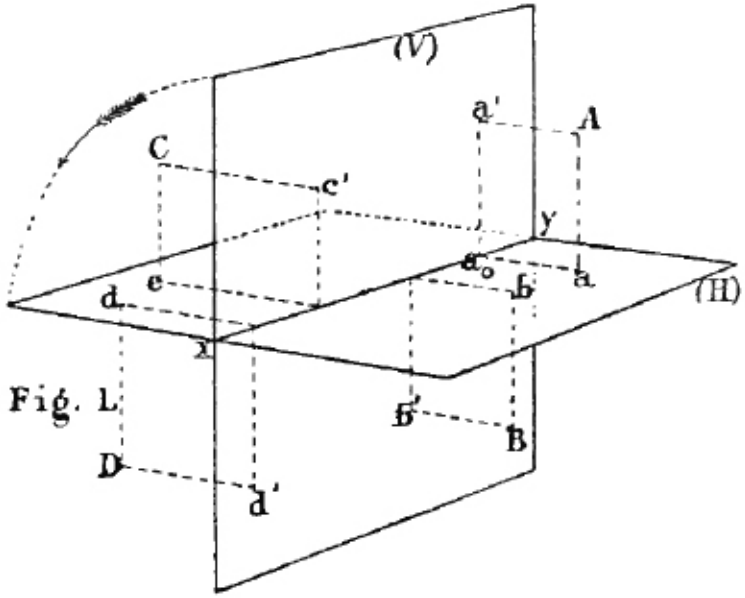


Fig. 1.

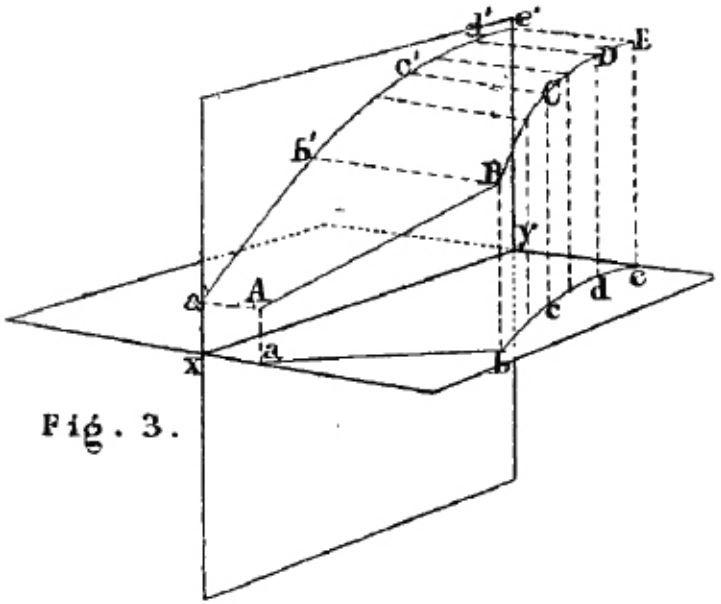


Fig. 3.

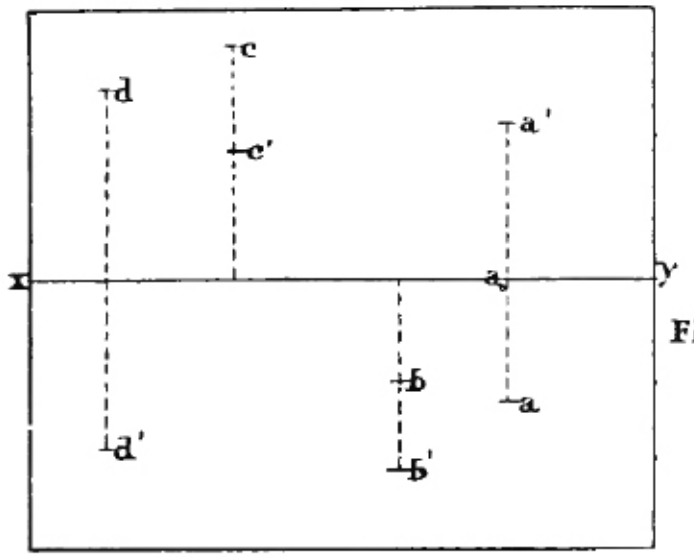


Fig. 2.

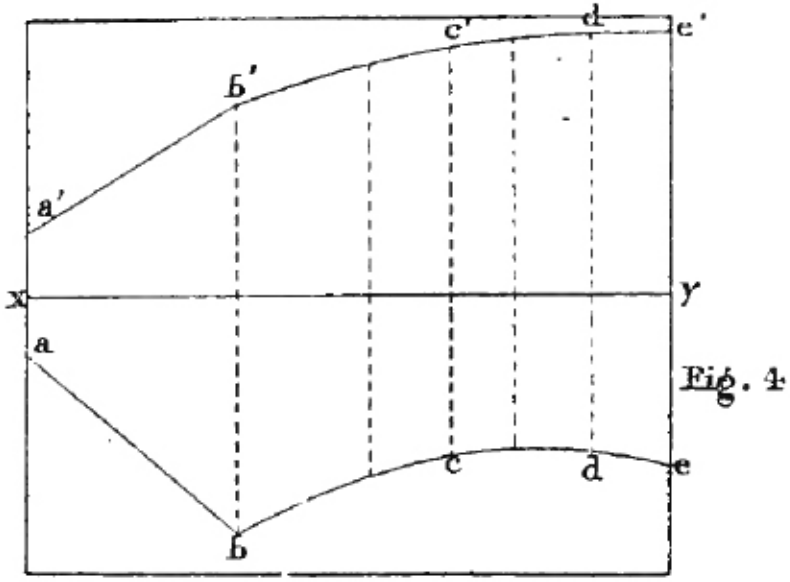


Fig. 4.

Representation of Points

Representation of Lines

Millar, J. B., Elements of Descriptive Geometry

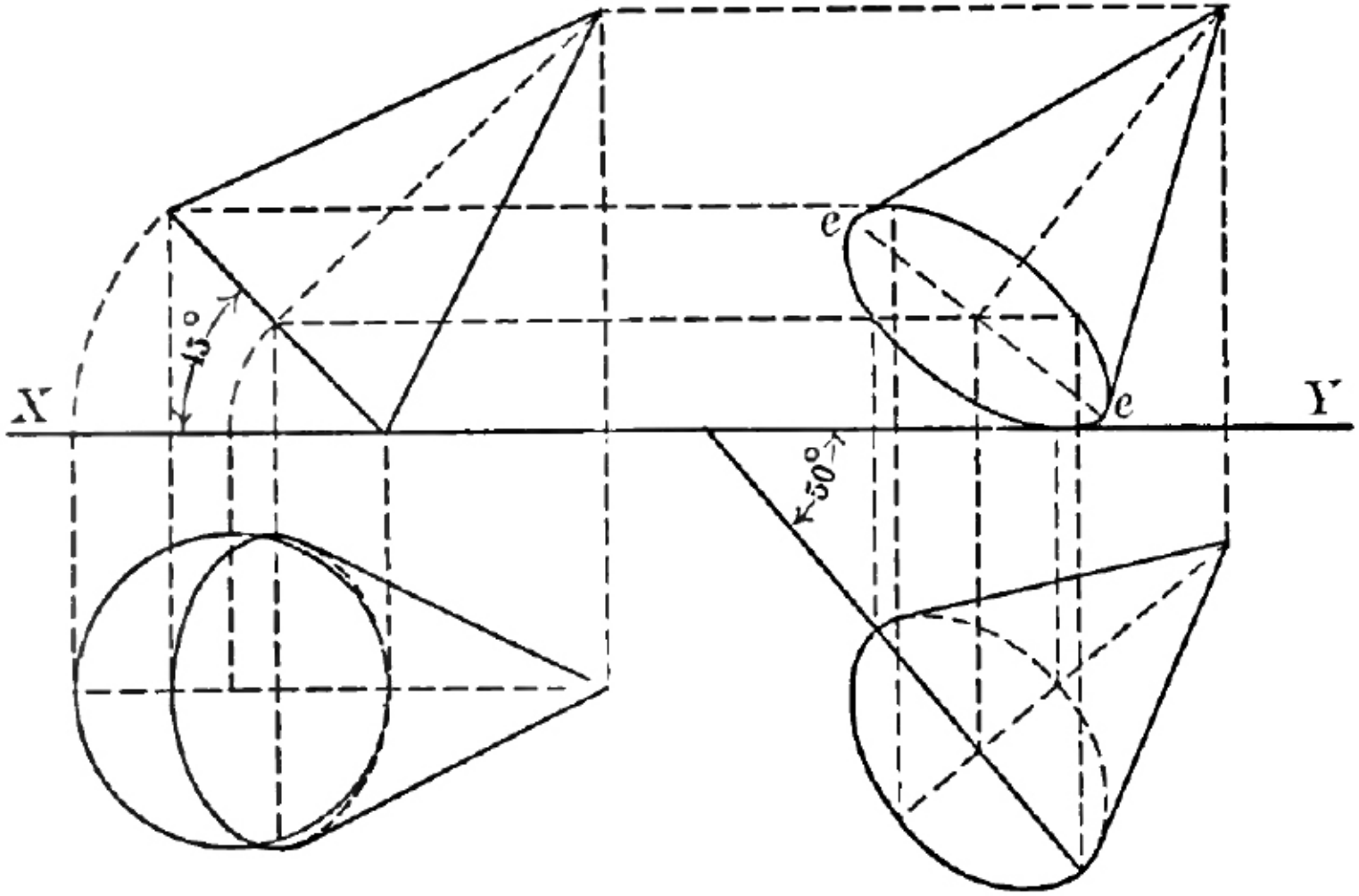
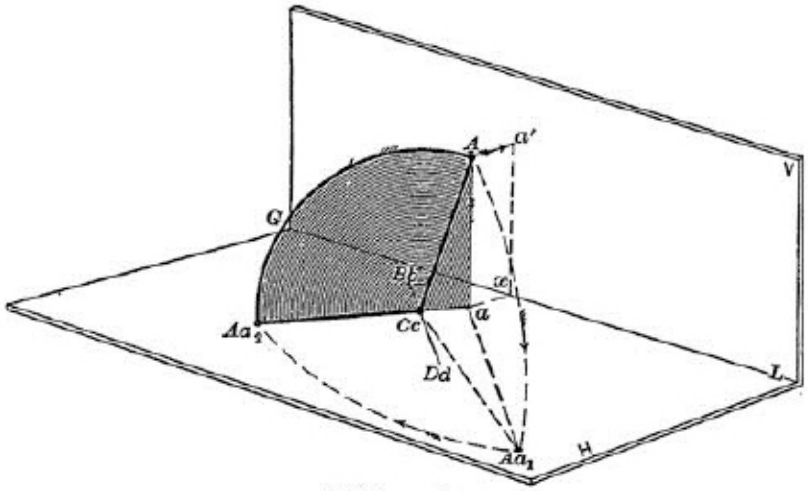
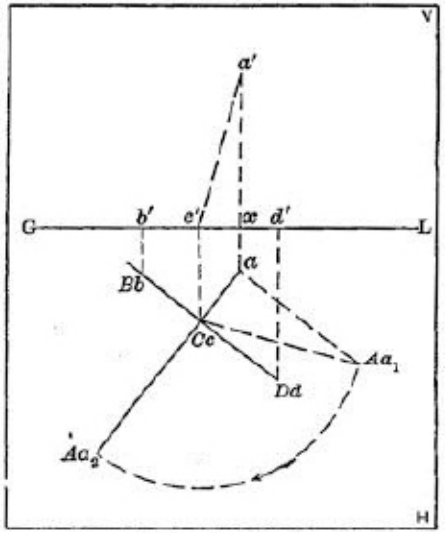


FIG. 34.

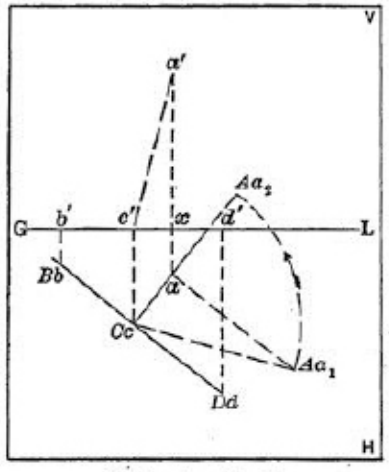
Armstrong, Henry F., Descriptive Geometry



(a) Perspective.



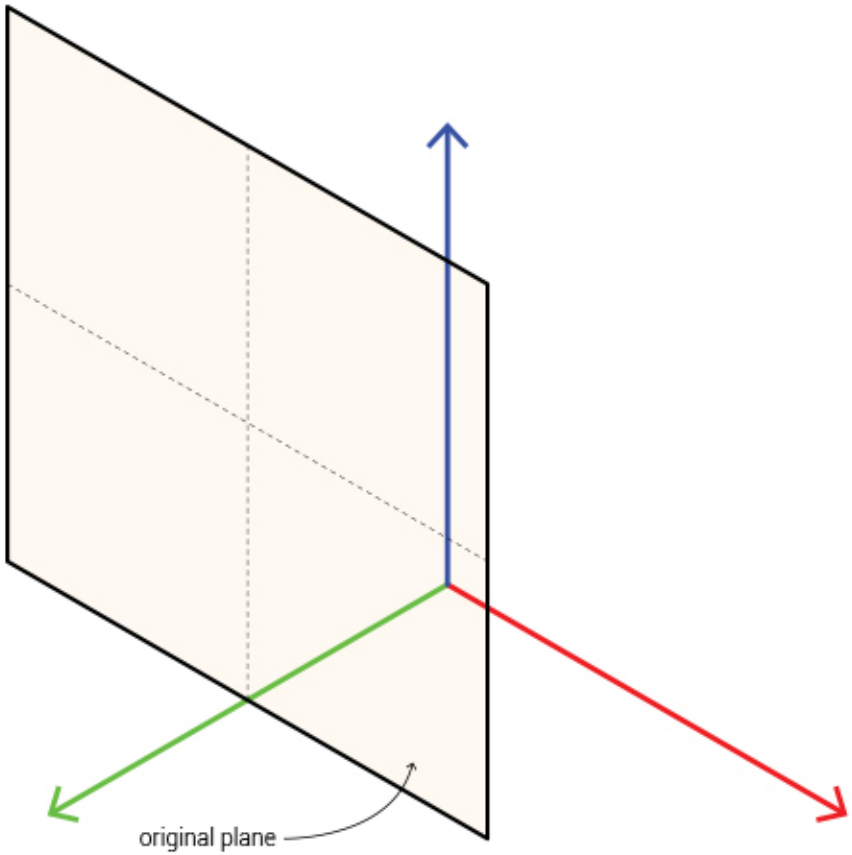
(b) Construction I.



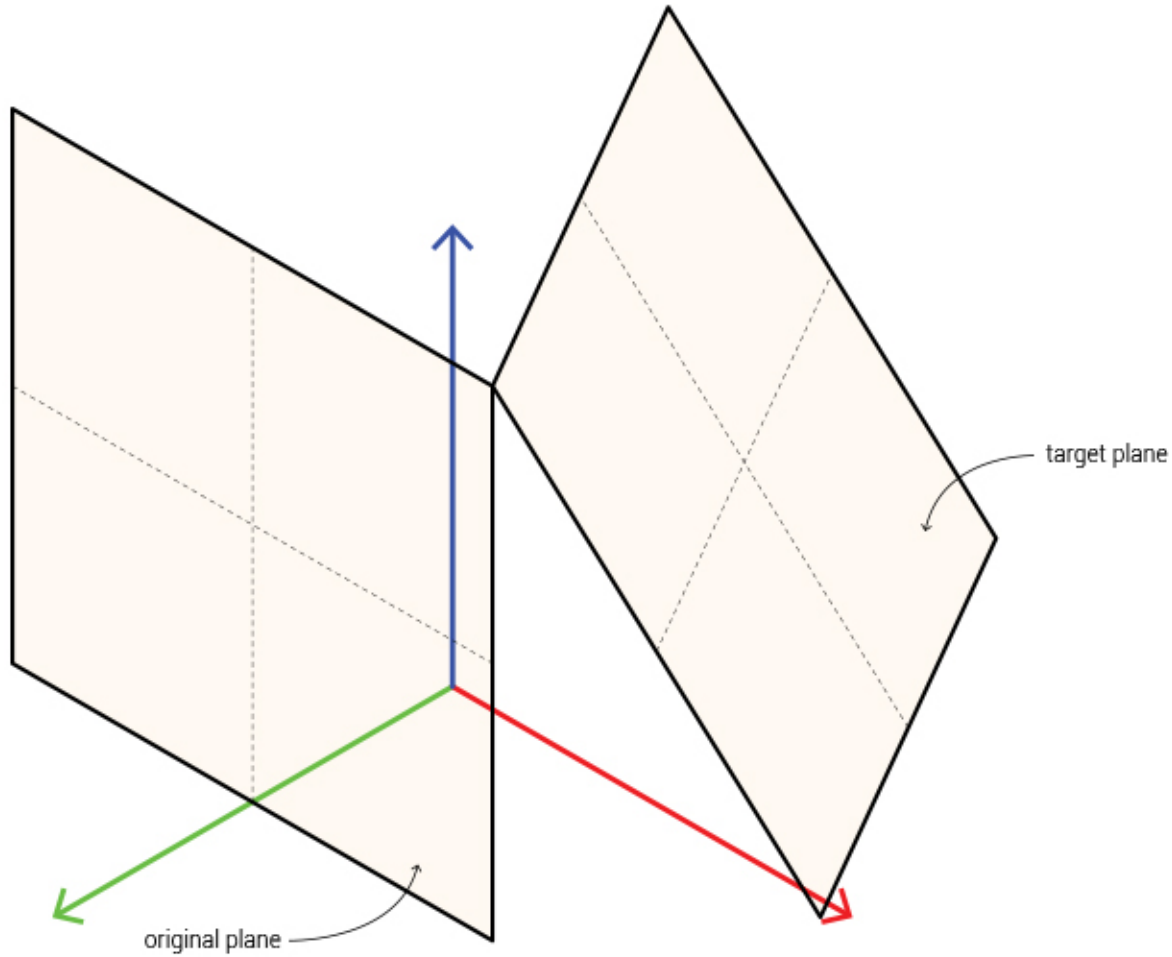
(c) Construction II.

Fig. 33. —Revolution of a Point about Any Line lying in a Plane of Projection.

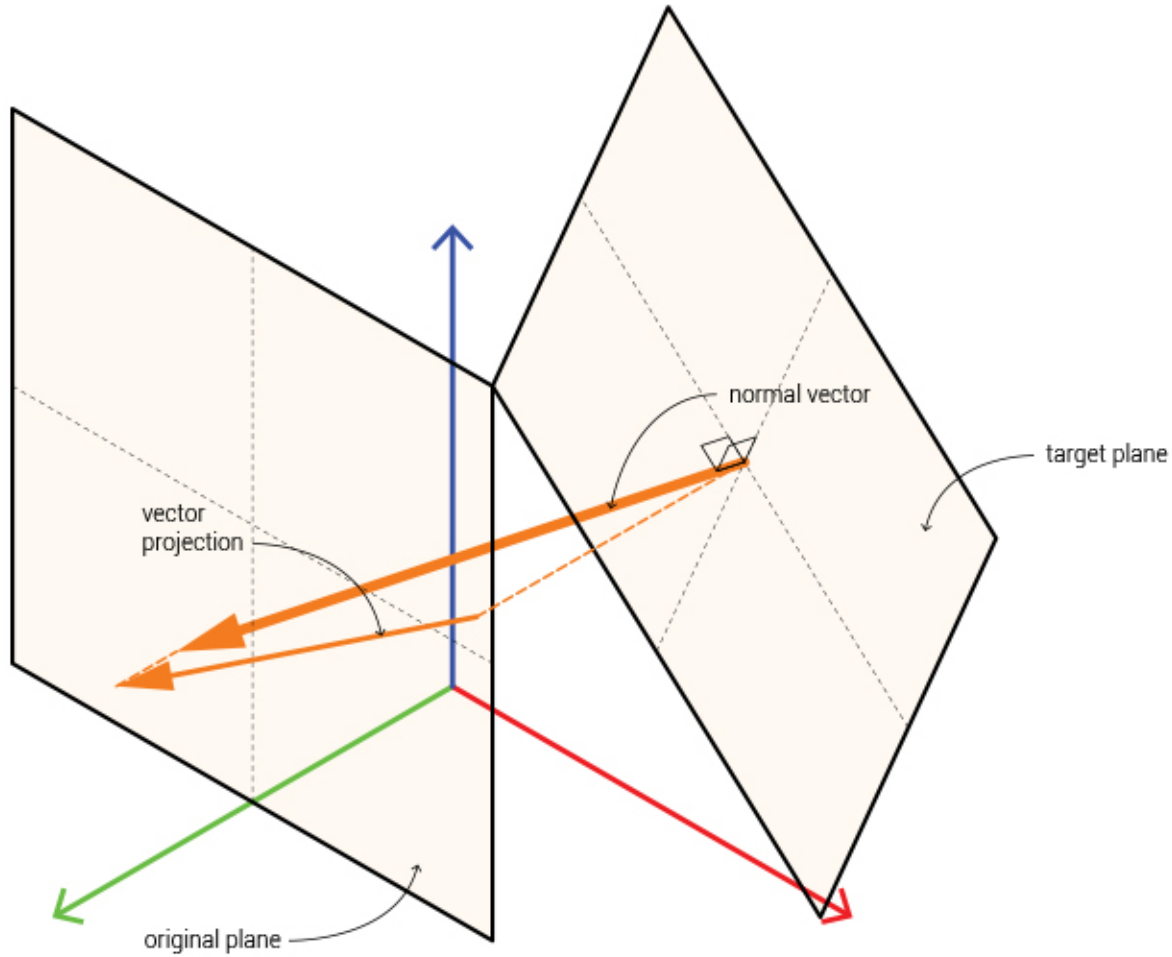
48. **PROBLEM 6. To revolve a point in space into H about an axis which lies in H and is oblique to V.**


original plane

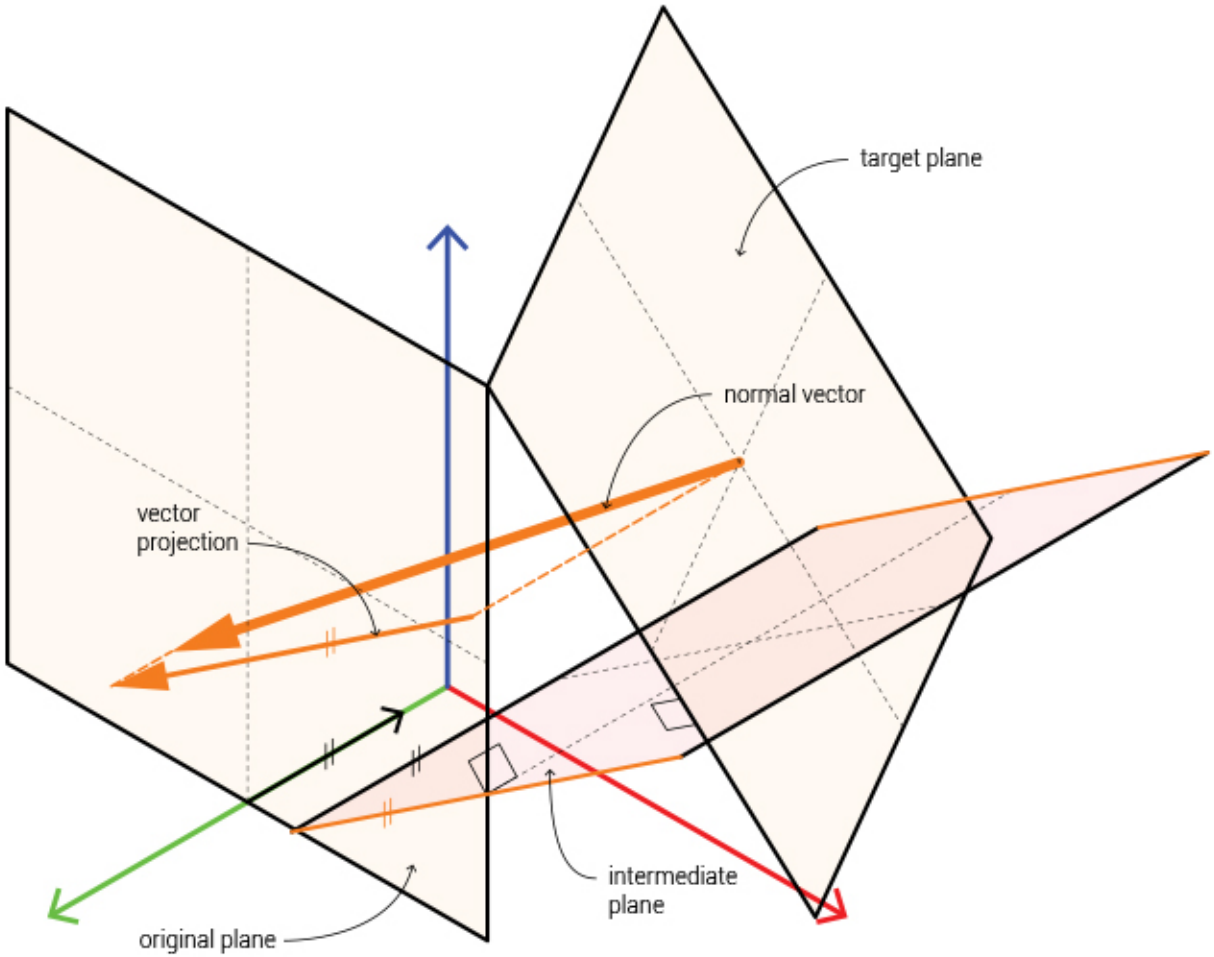
DESCRIPTIVE GEOMETRY - Law of orthogonal planes



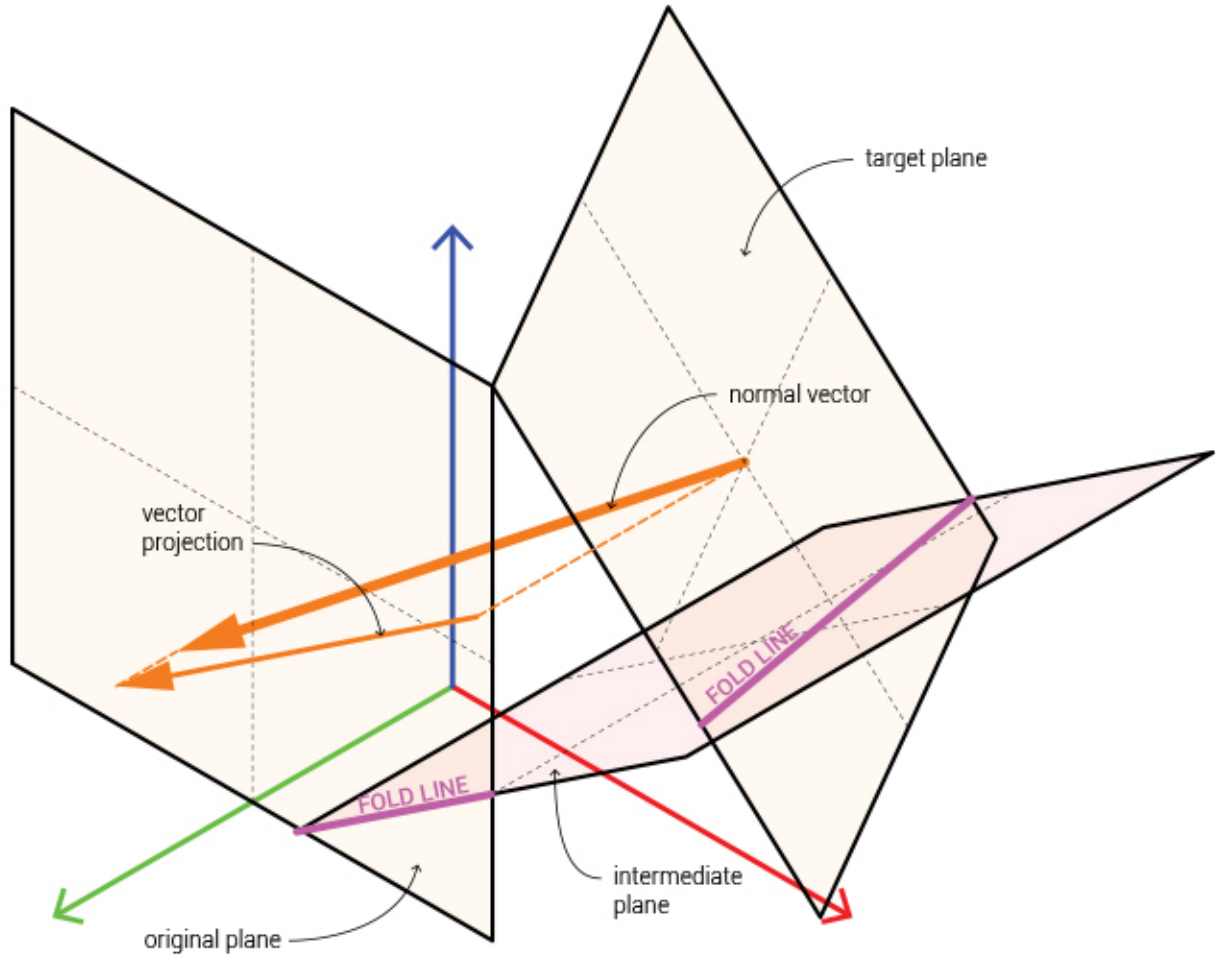
DESCRIPTIVE GEOMETRY - Law of orthogonal planes



DESCRIPTIVE GEOMETRY - Law of orthogonal planes



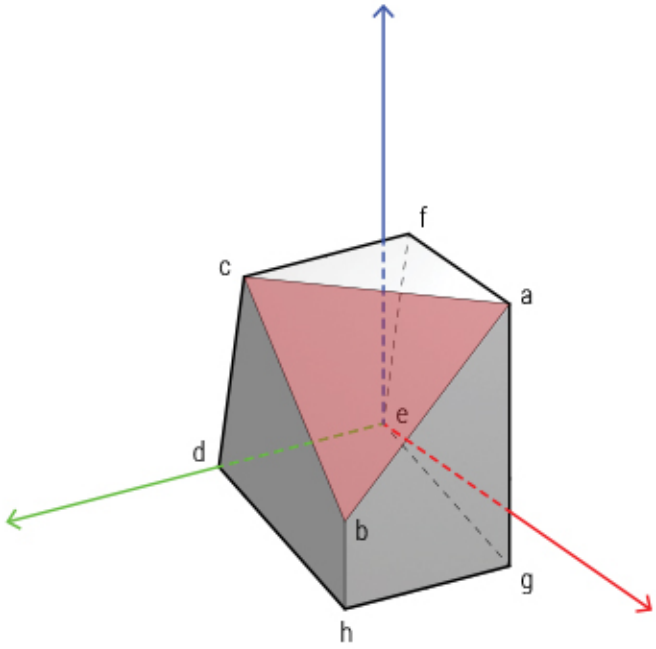
DESCRIPTIVE GEOMETRY - Law of orthogonal planes



TECHNIQUE 1:
ORIENT TO VIEW

TECHNIQUE 2:
ORIENT TO FACE

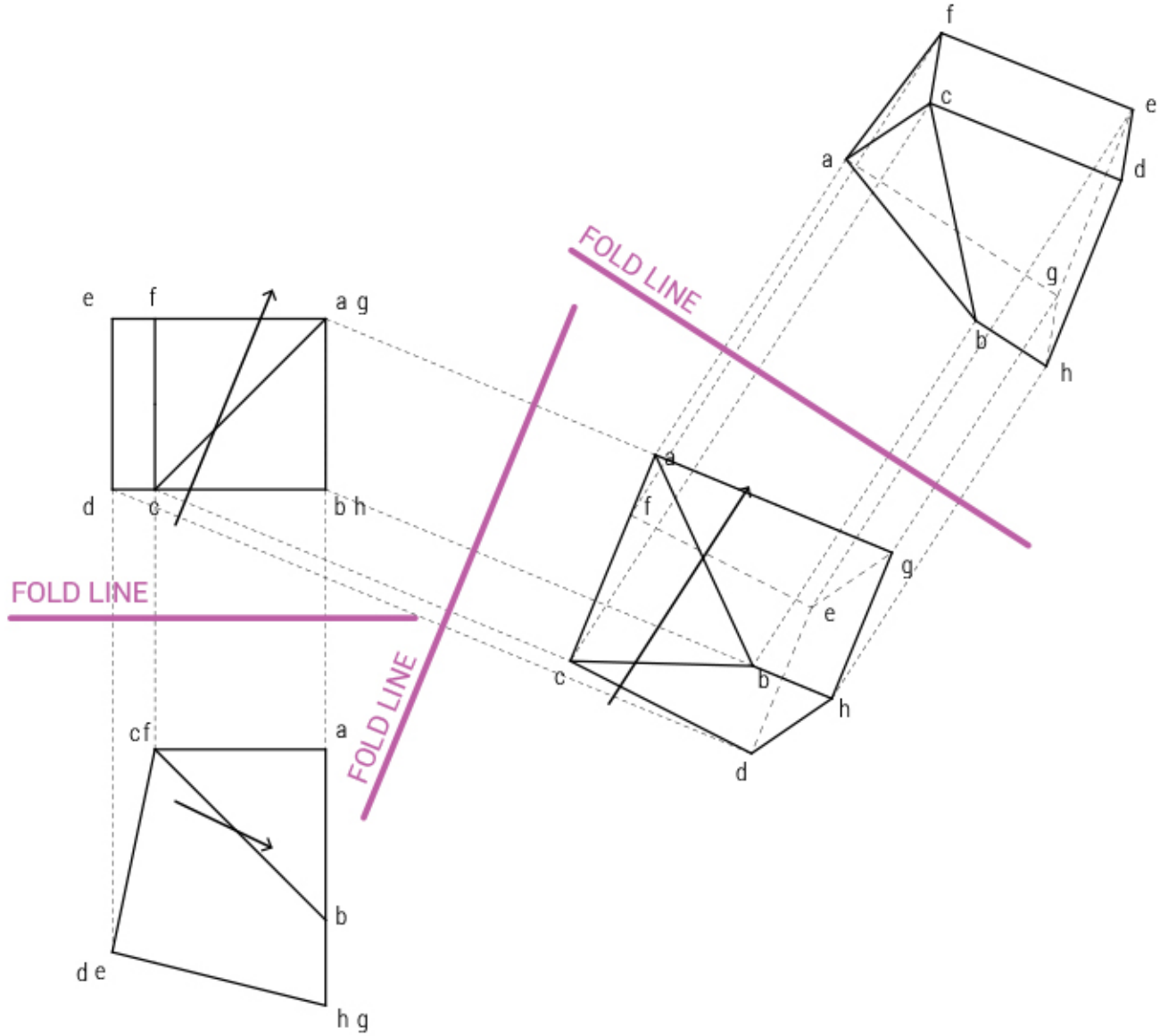
TECHNIQUE 3:
UNFOLD FACES



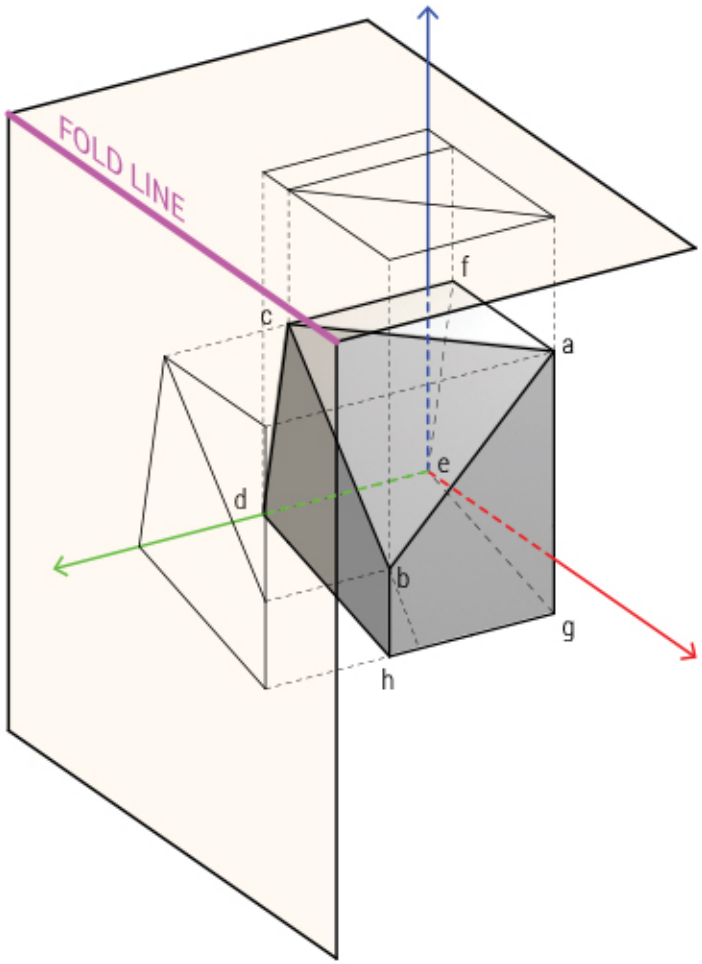
TECHNIQUE 1:
ORIENT TO VIEW

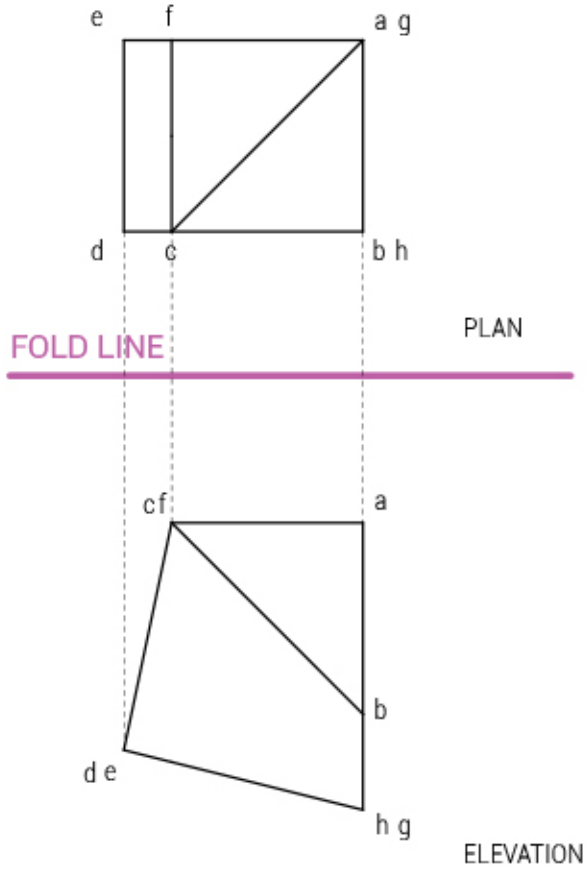
TECHNIQUE 2:
ORIENT TO FACE

TECHNIQUE 3:
UNFOLD FACES

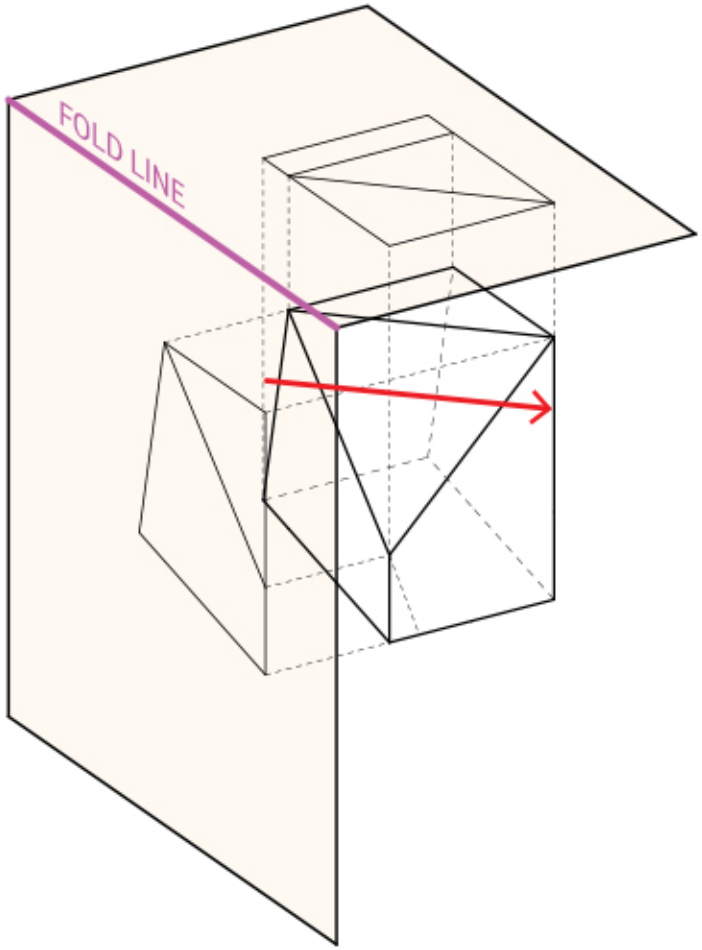


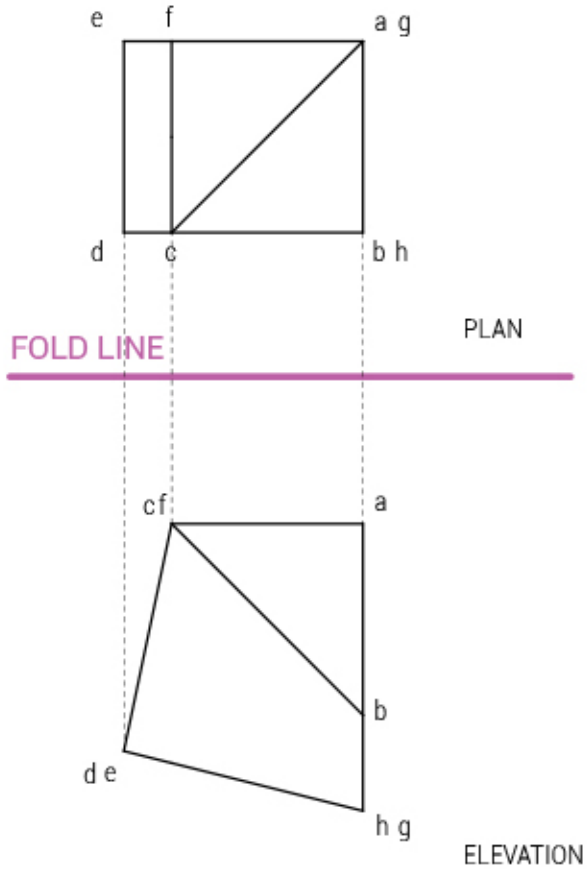
1. Set up base orthogonal pair



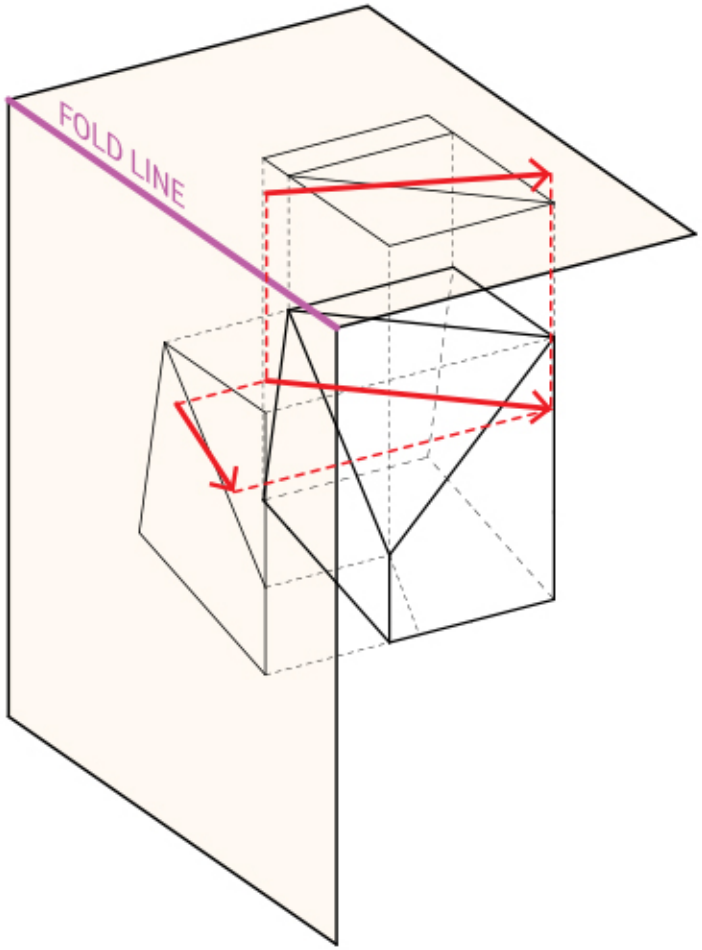


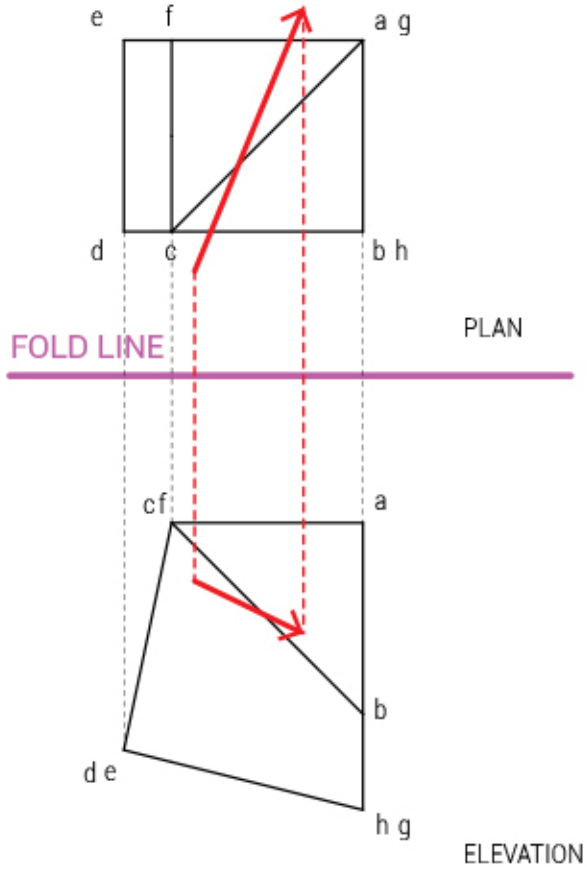
2. Establish a view vector



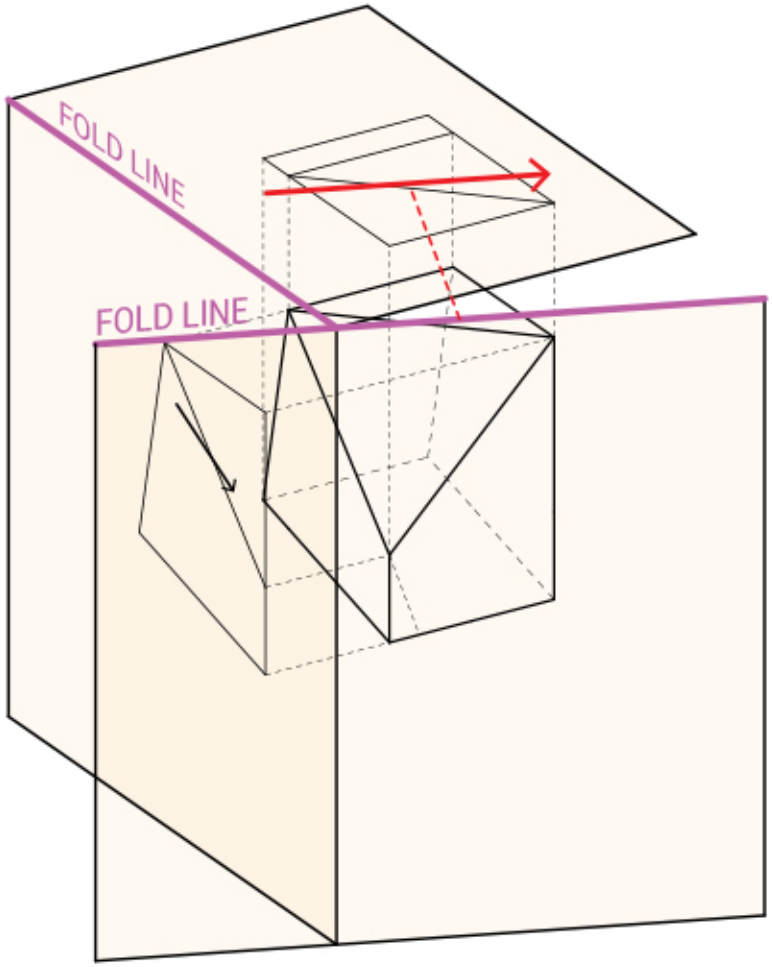


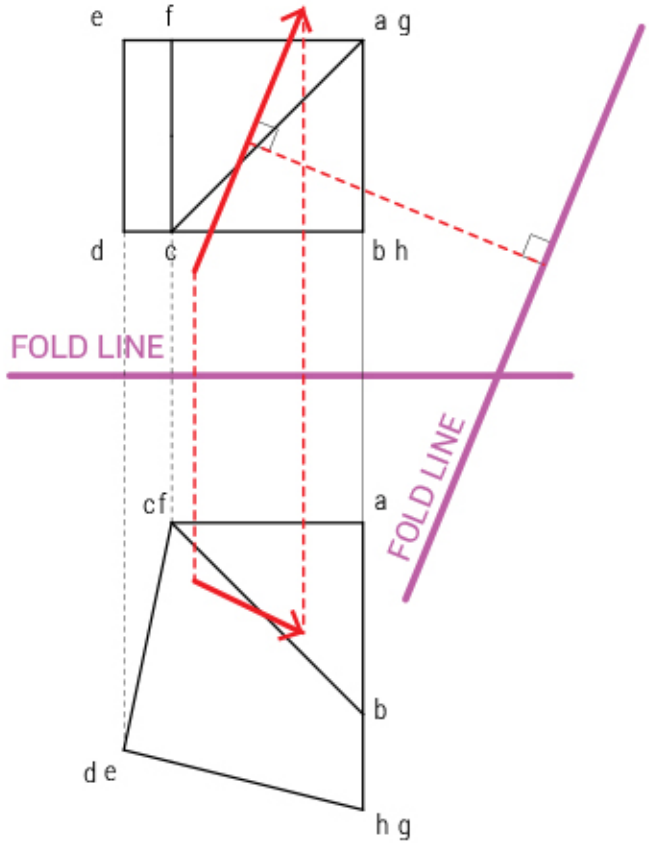
3. Project view vector onto orthogonal pair



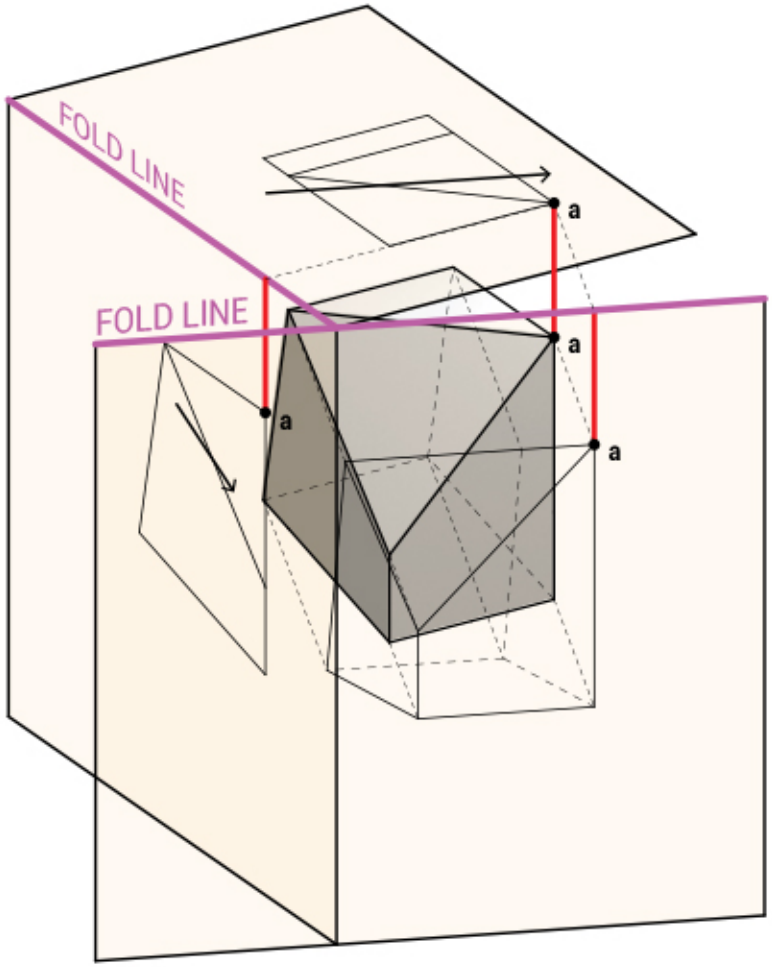


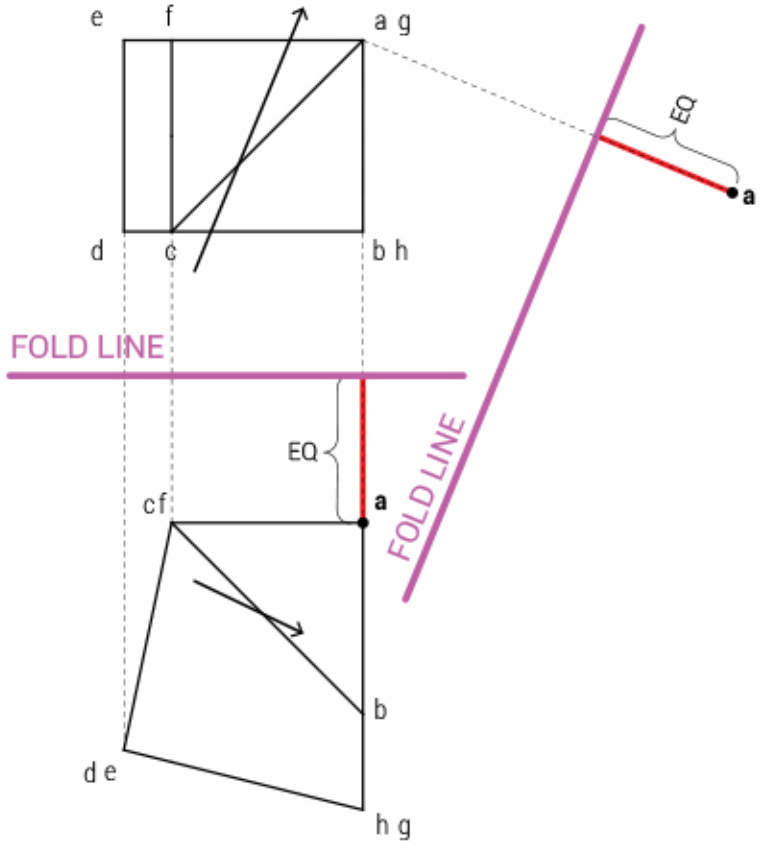
4. Construct first fold line parallel to one of the view vector's projections



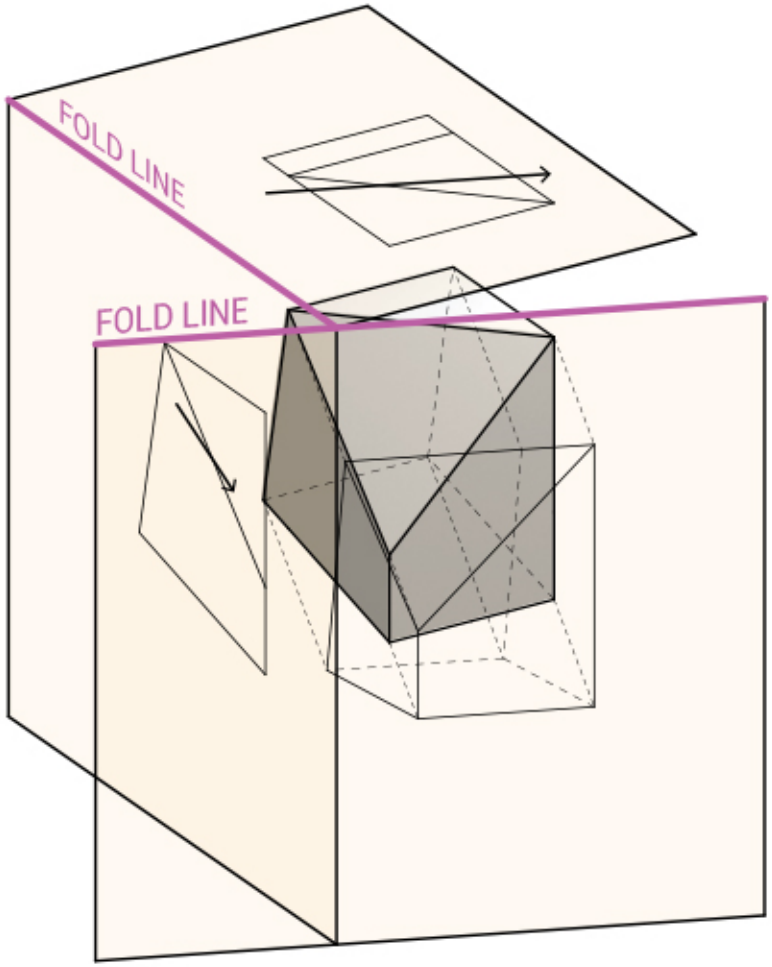


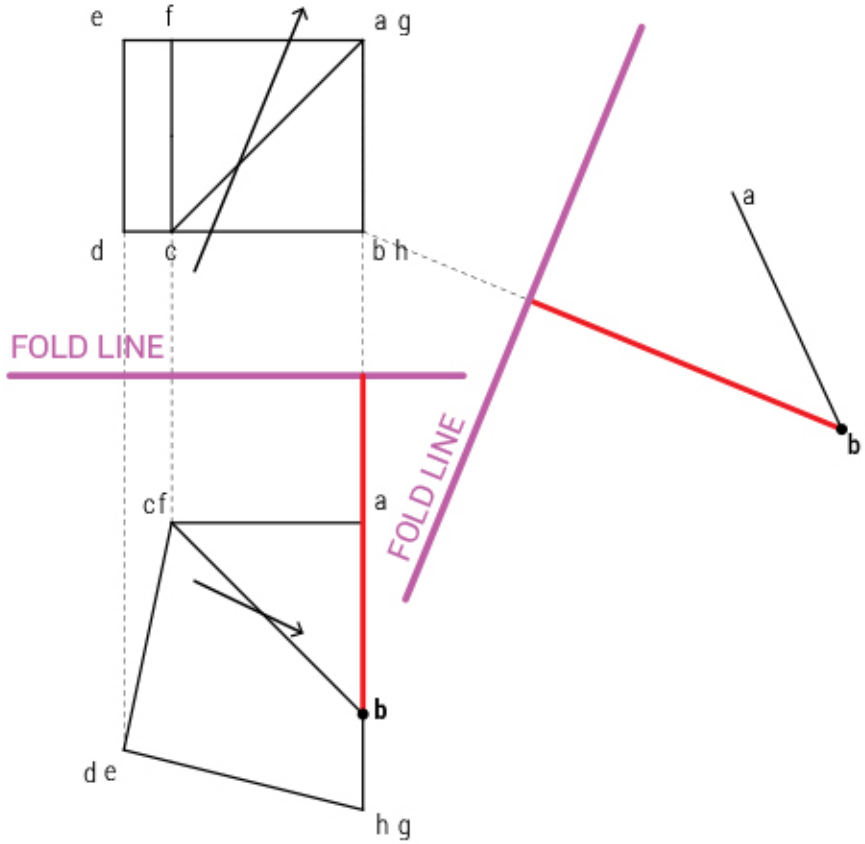
5. Construct intermediate projection using new fold line



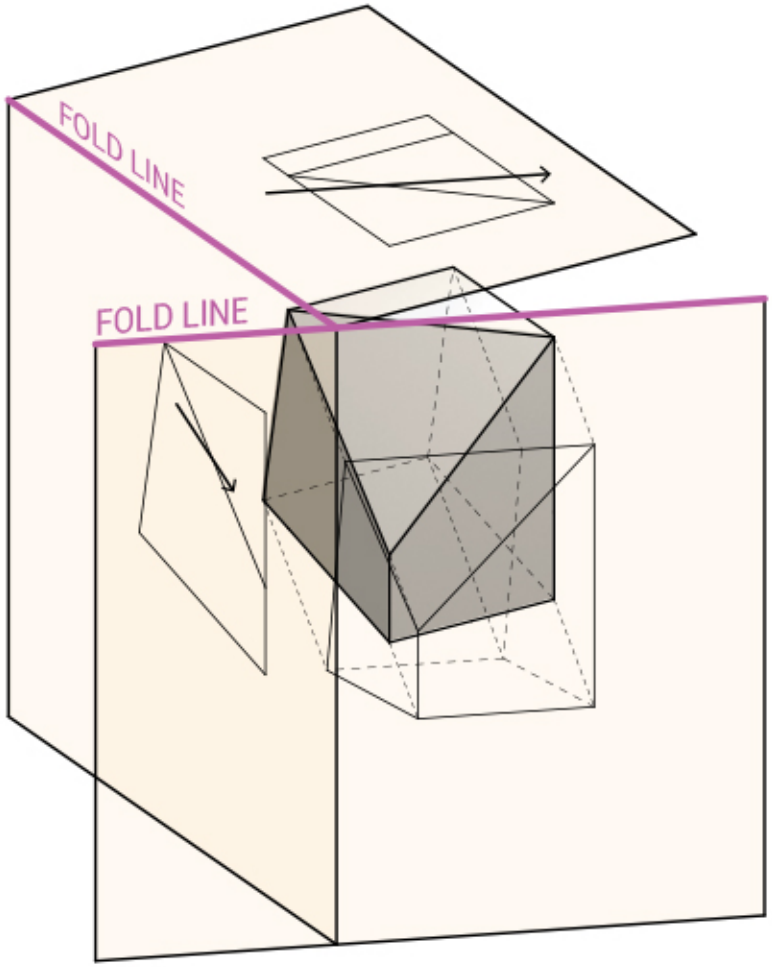


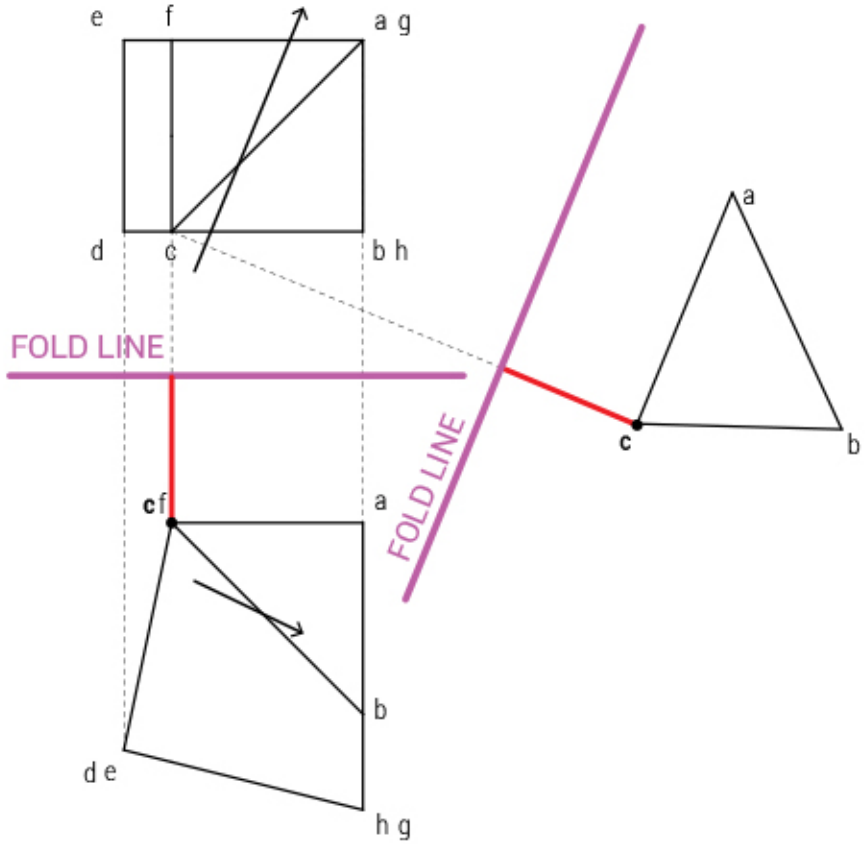
5. Construct intermediate projection using new fold line



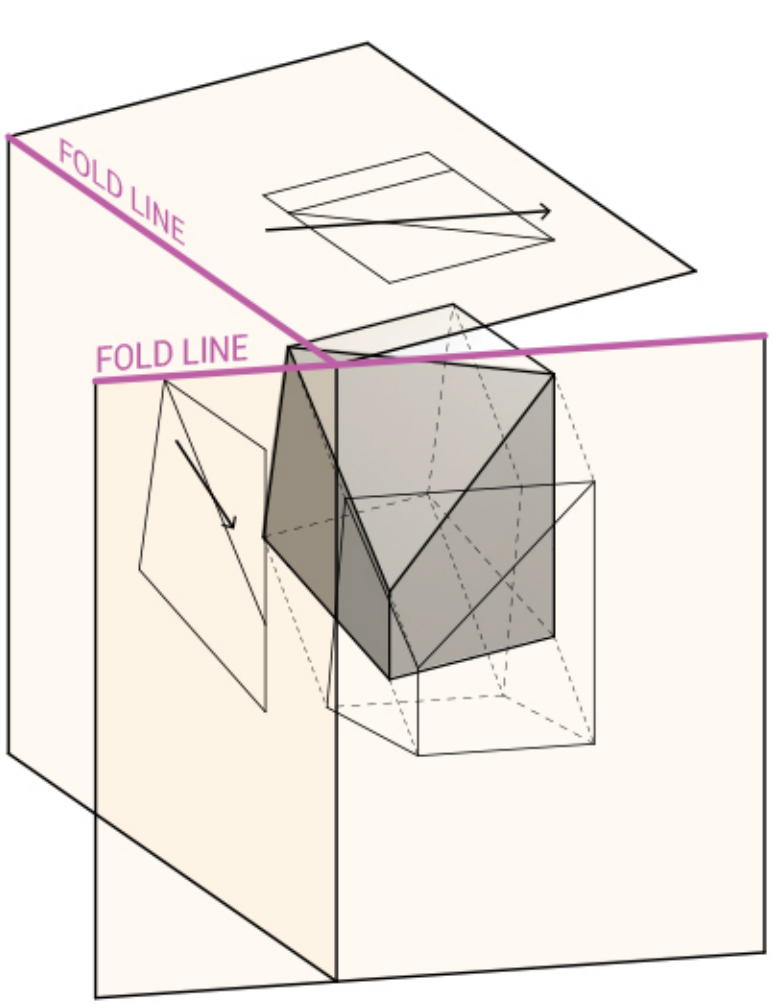


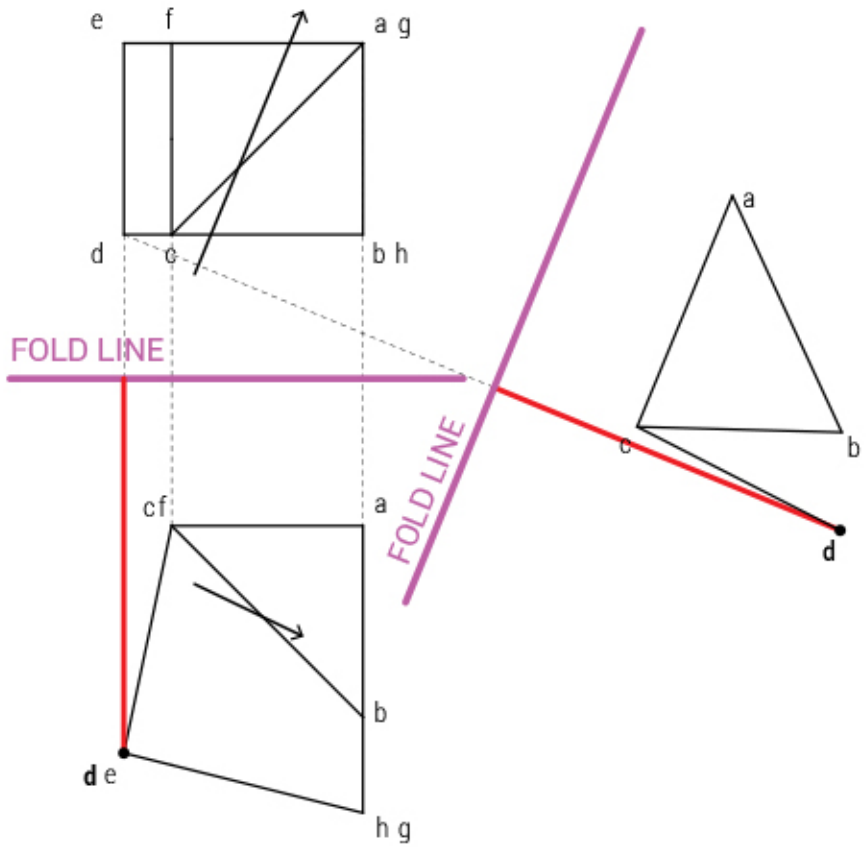
5. Construct intermediate projection using new fold line



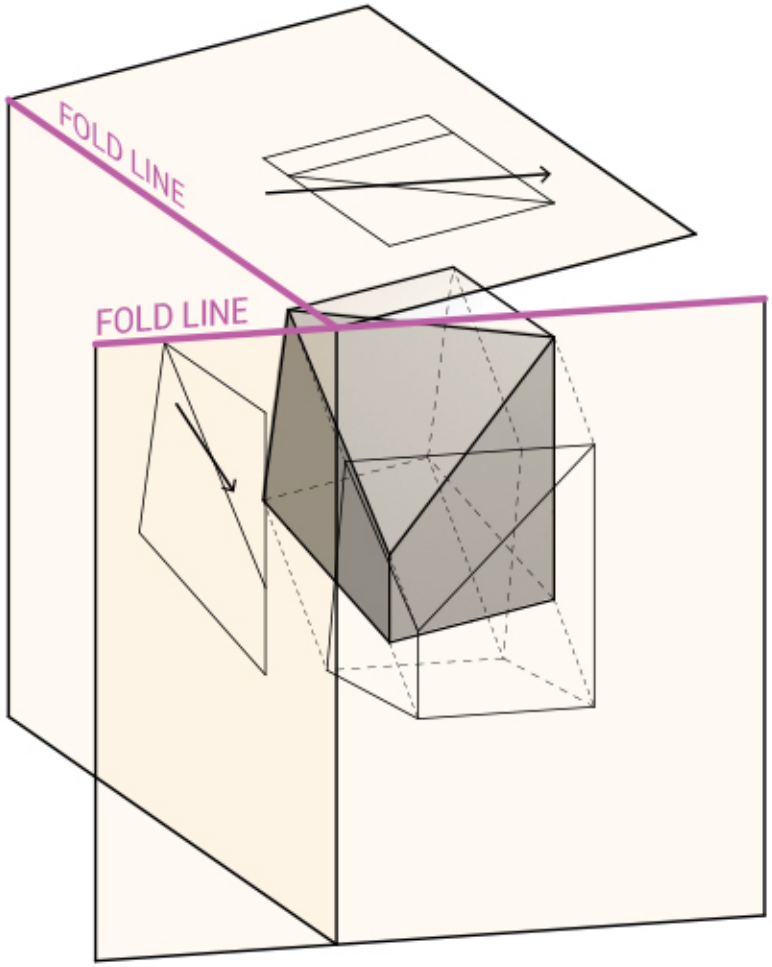


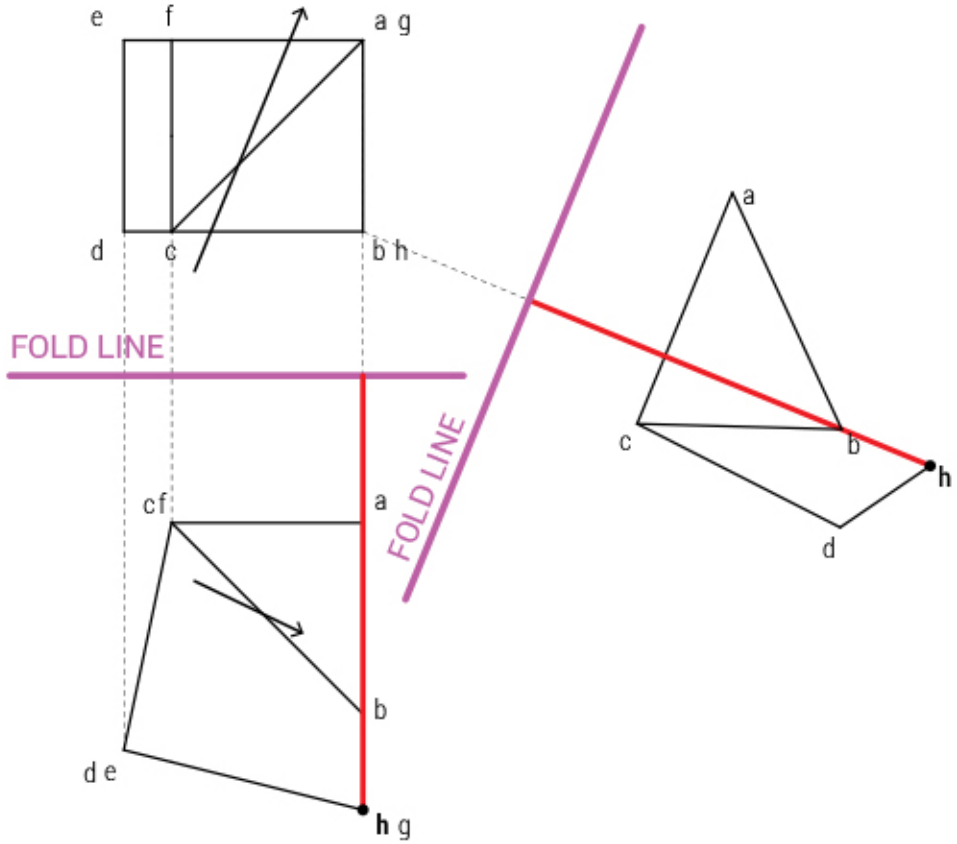
5. Construct intermediate projection using new fold line



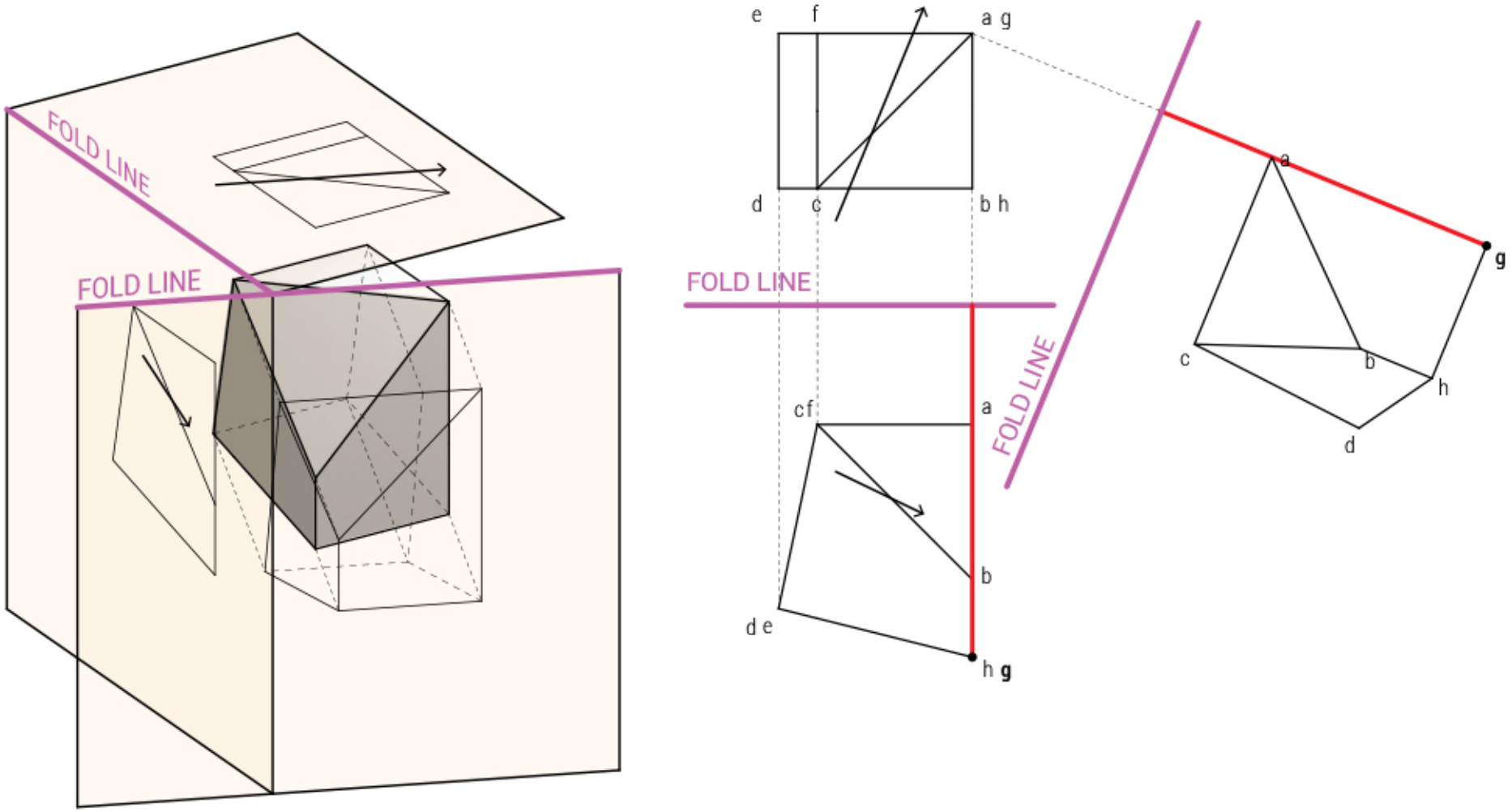


5. Construct intermediate projection using new fold line

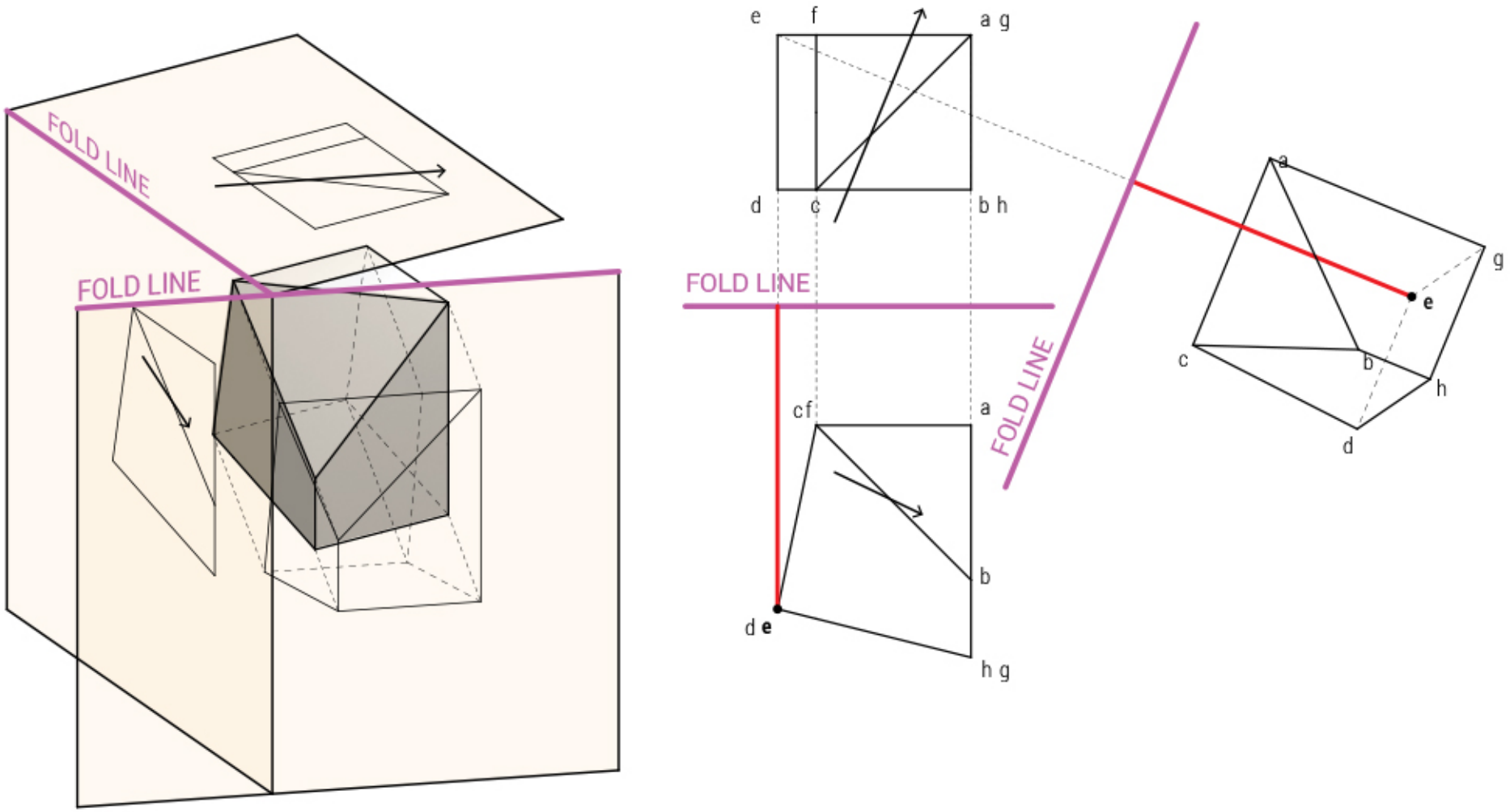




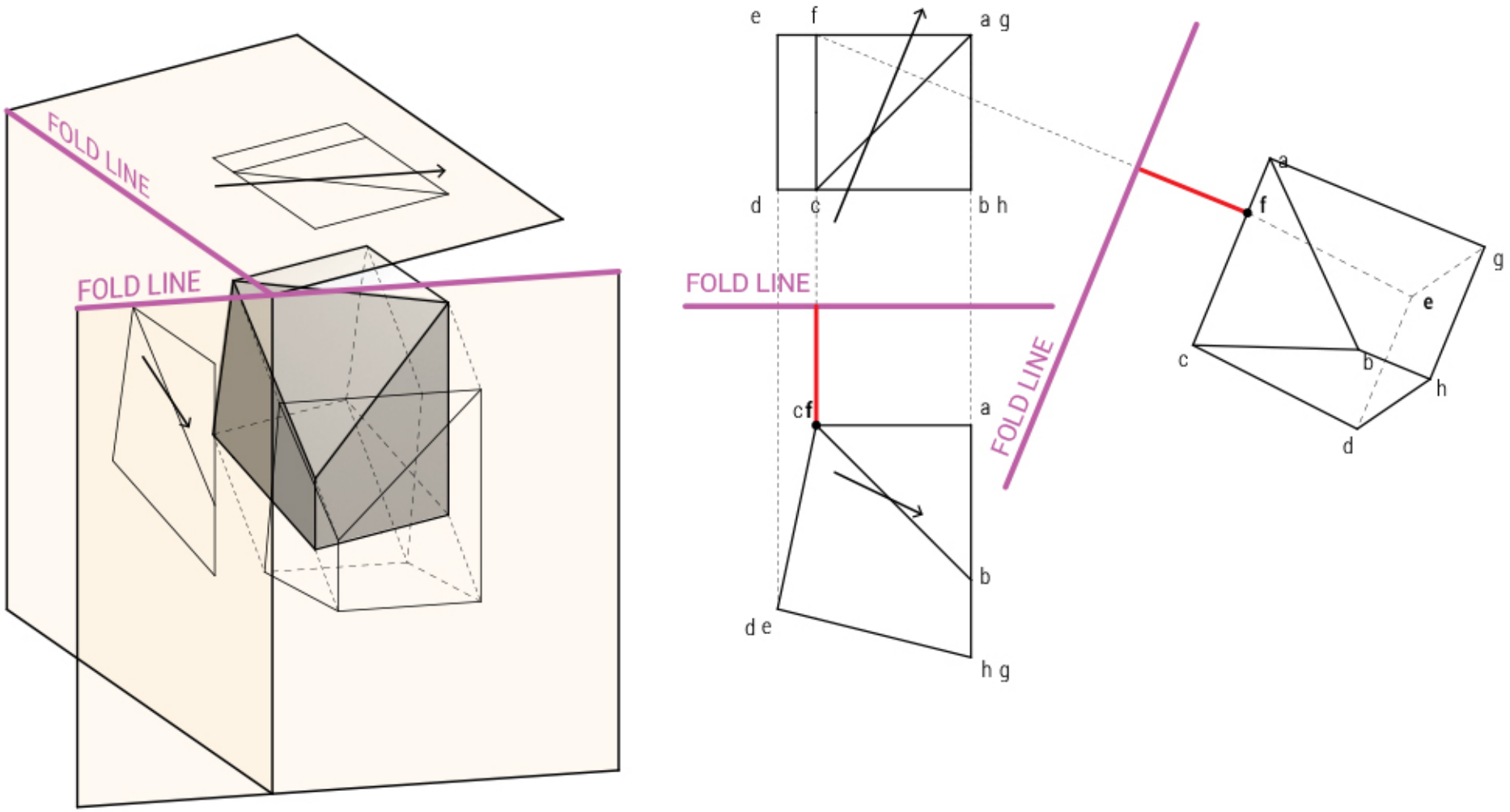
5. Construct intermediate projection using new fold line



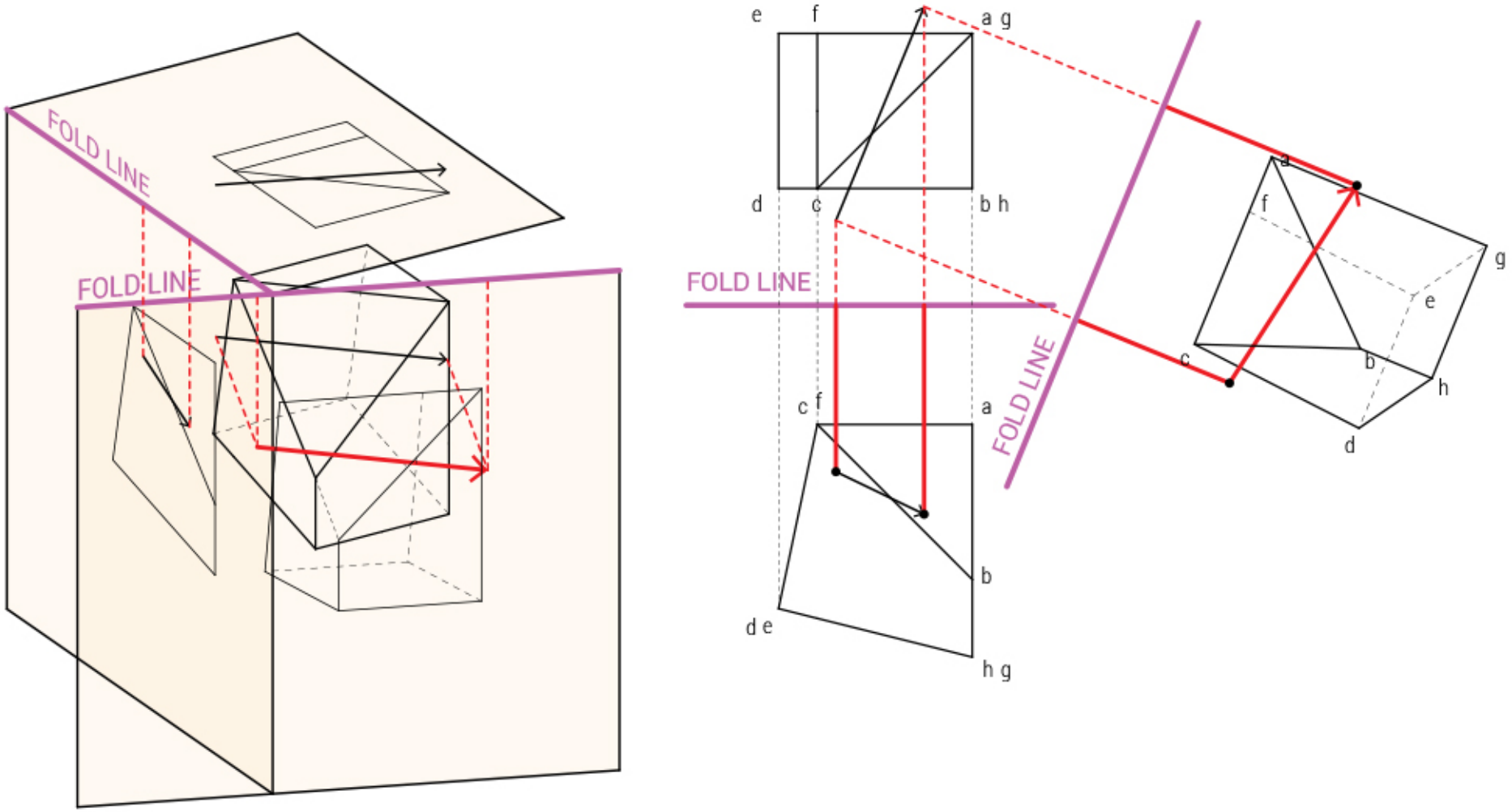
5. Construct intermediate projection using new fold line



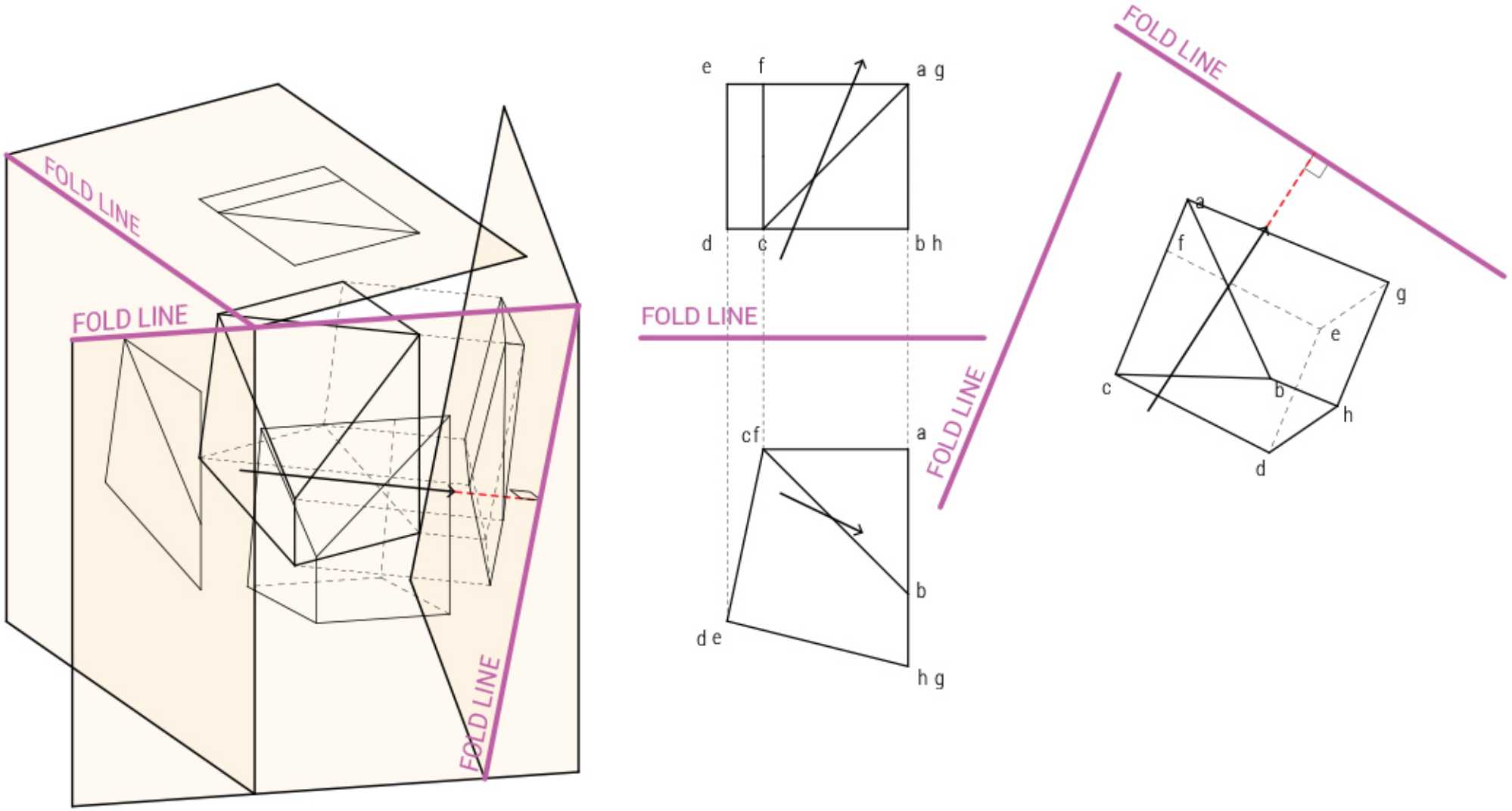
5. Construct intermediate projection using new fold line



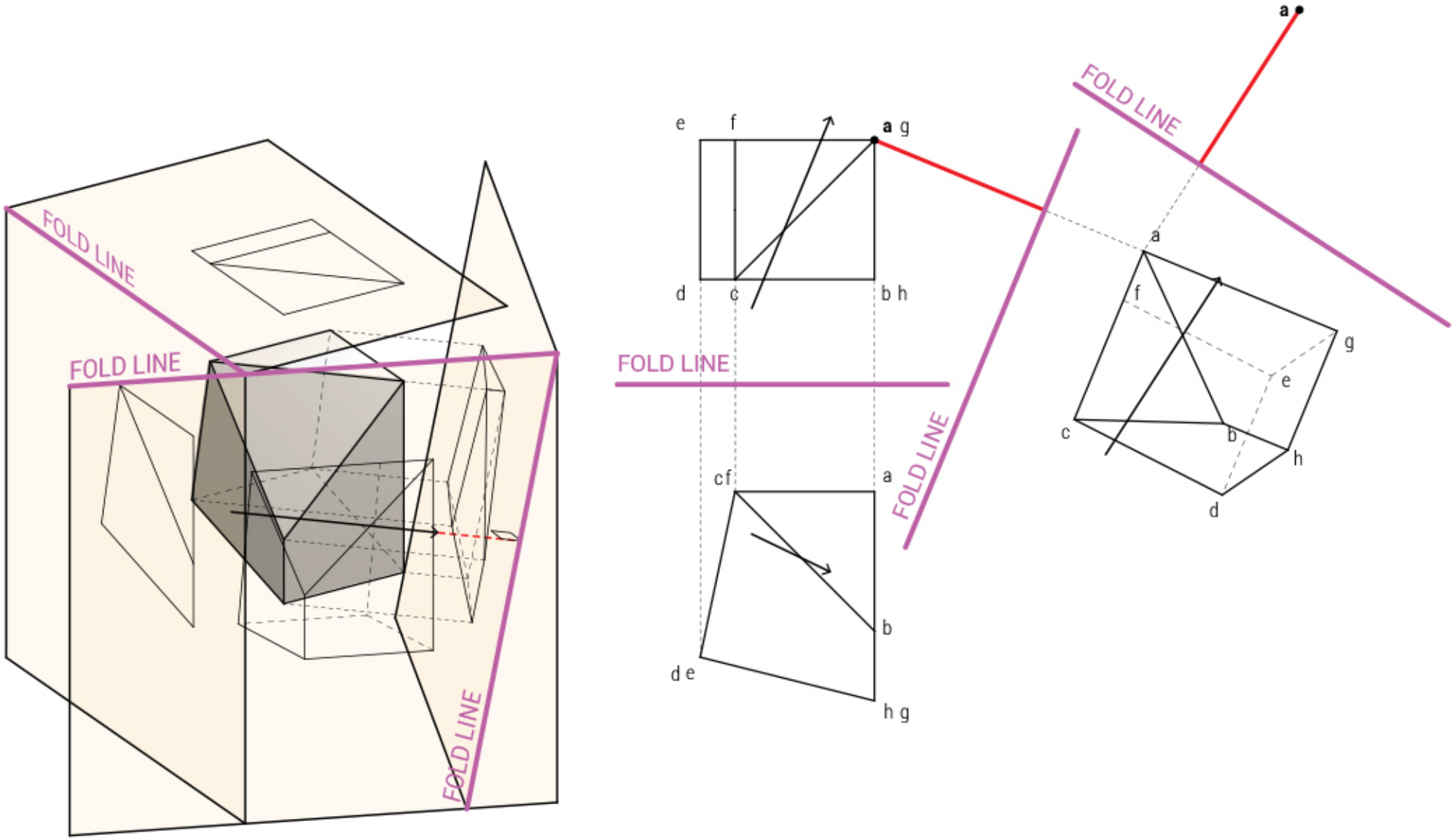
6. Project view vector into intermediate projection



7. Construct second fold line perpendicular to projected view vector



8. Construct final projection using new fold line



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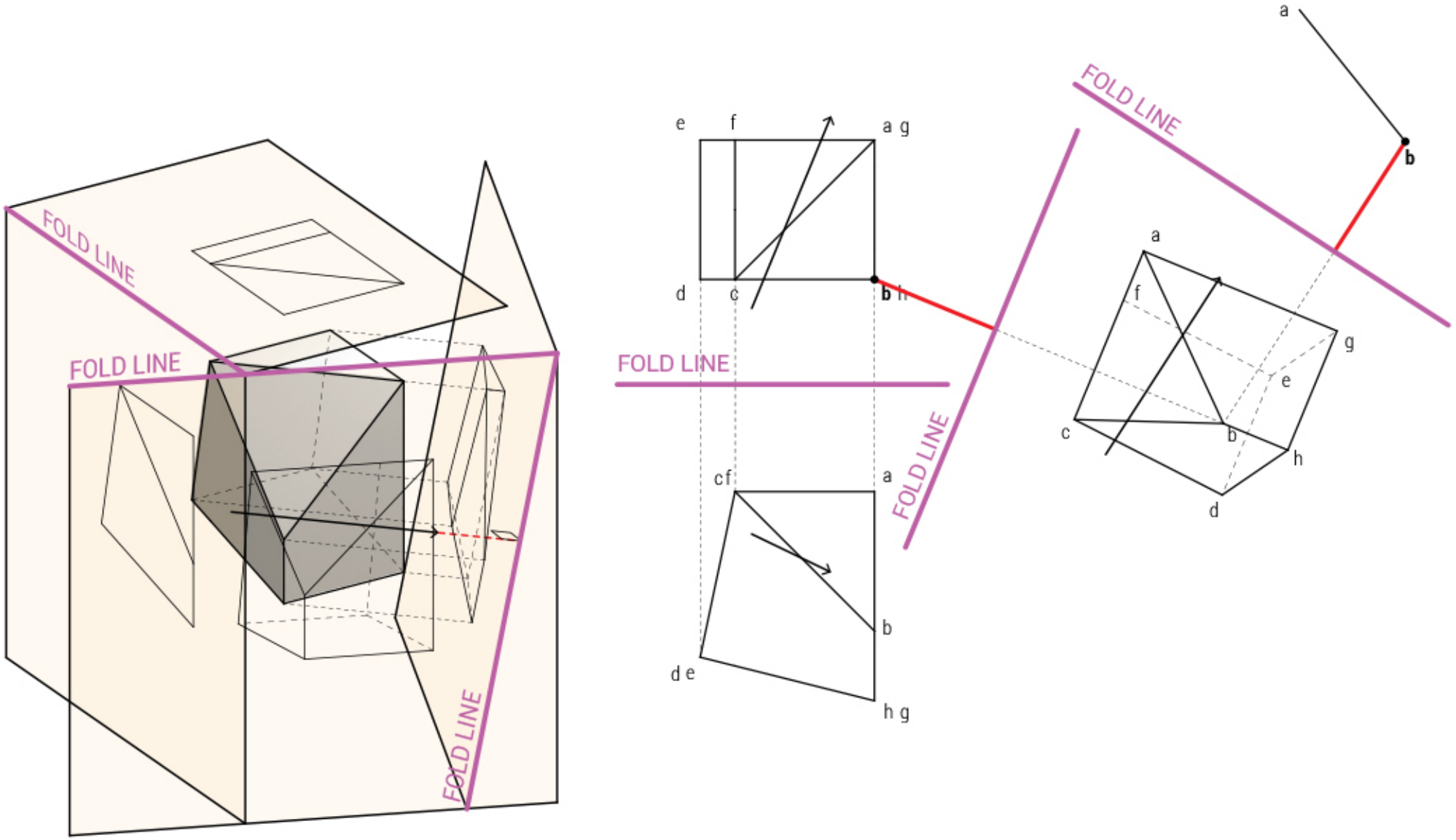

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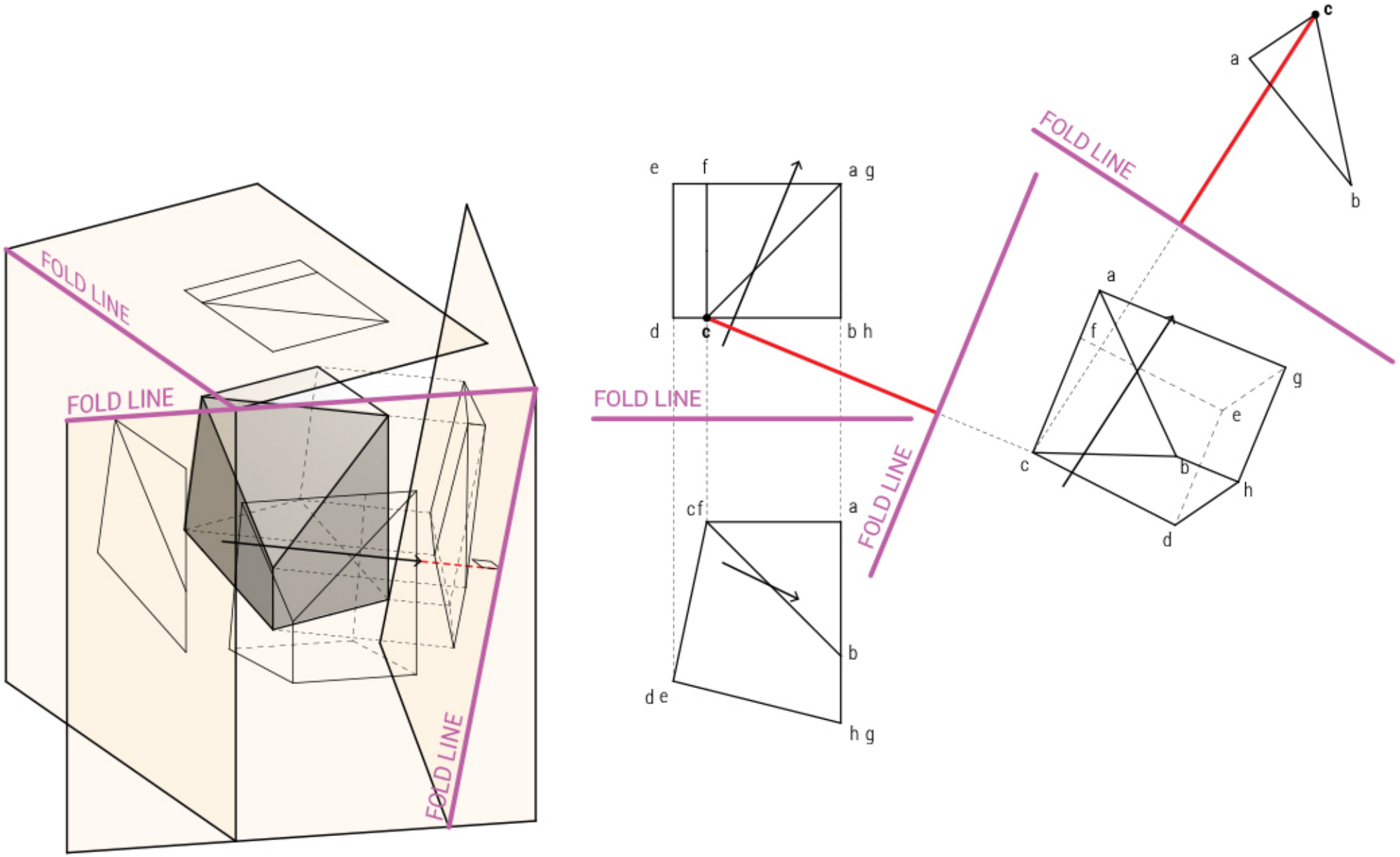
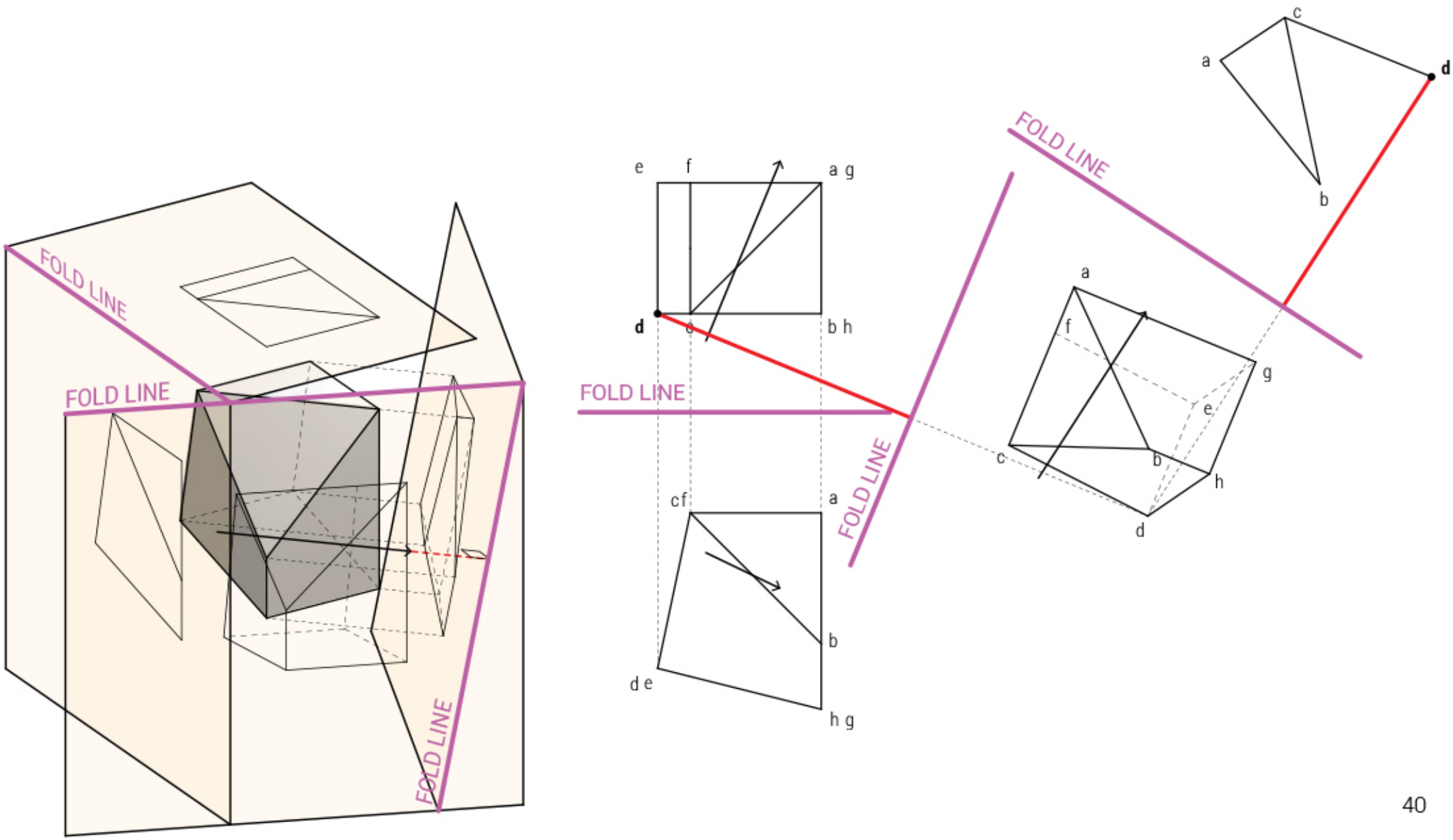


8. Construct final projection using new fold line



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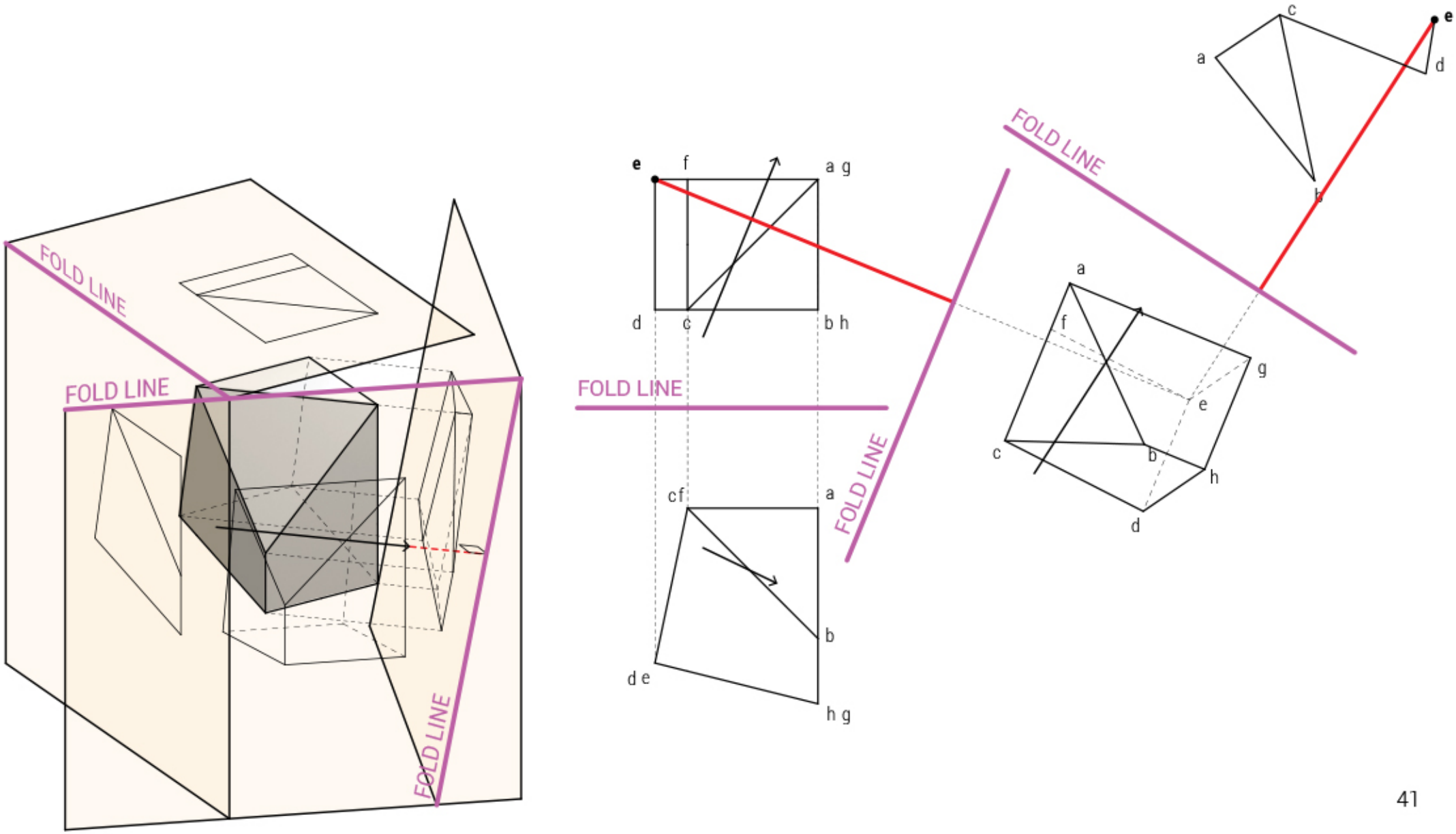

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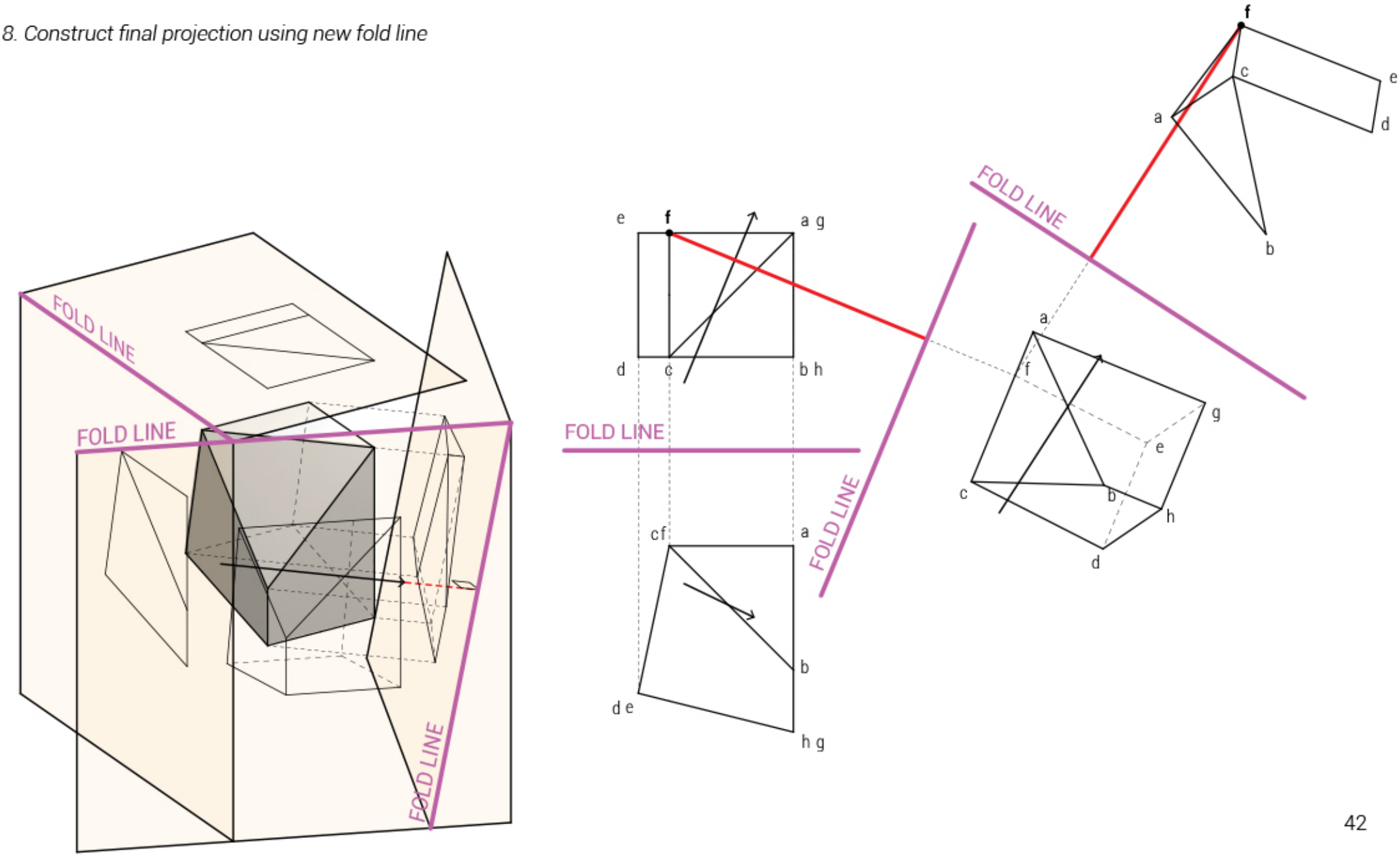

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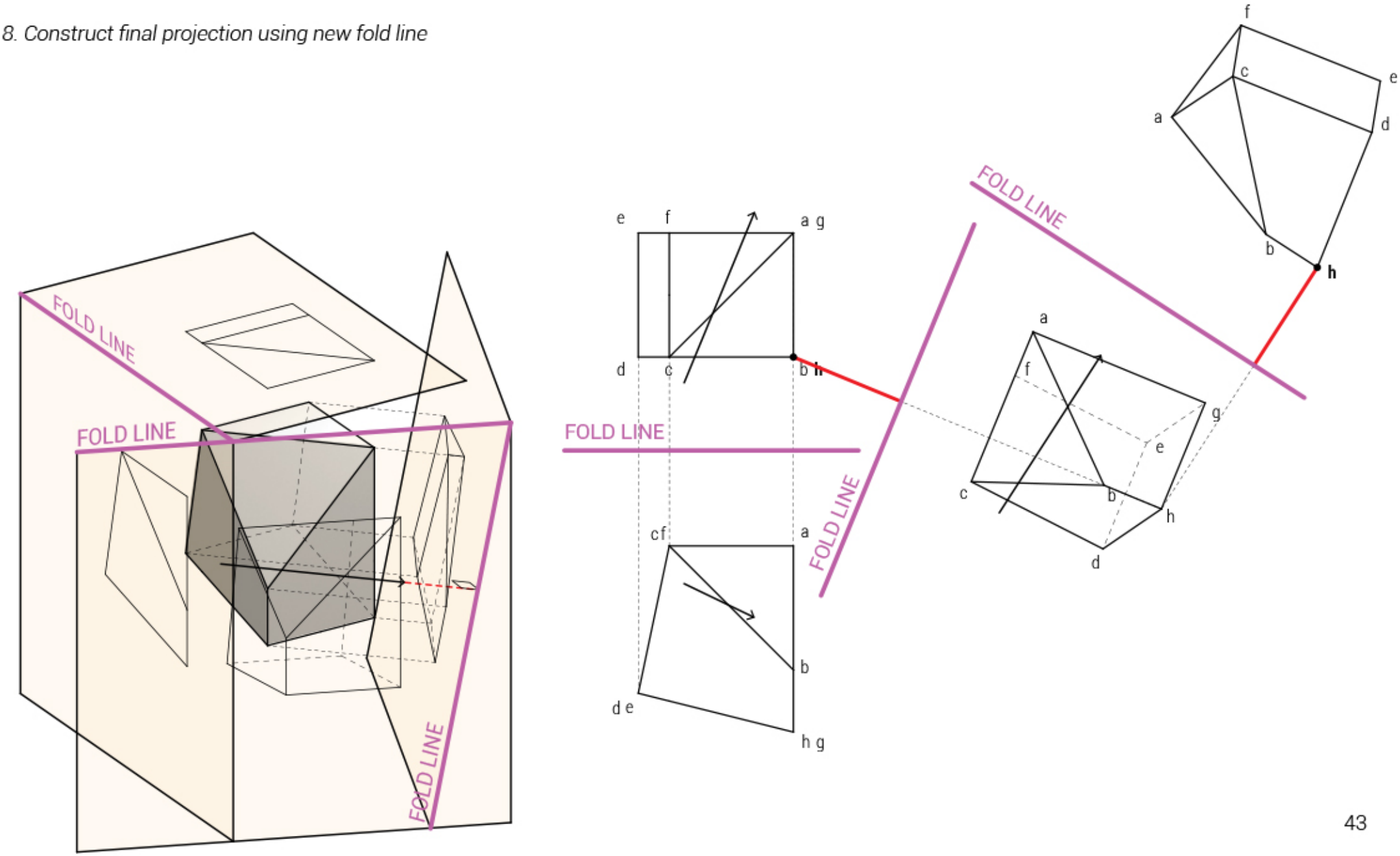

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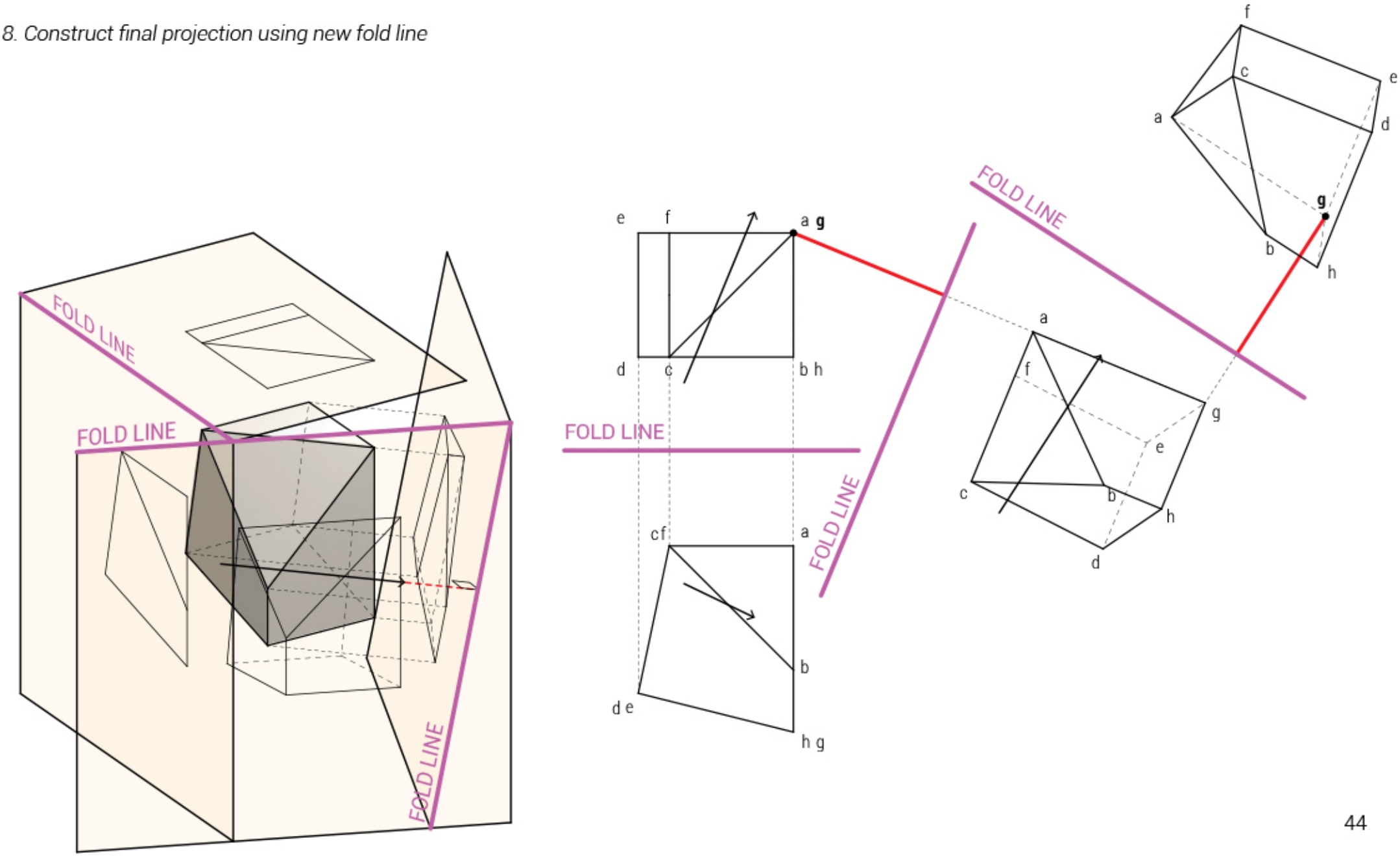

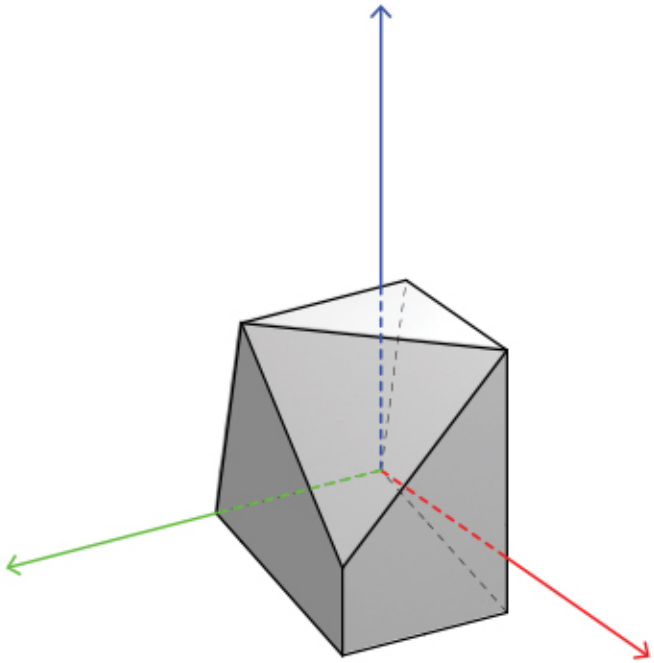

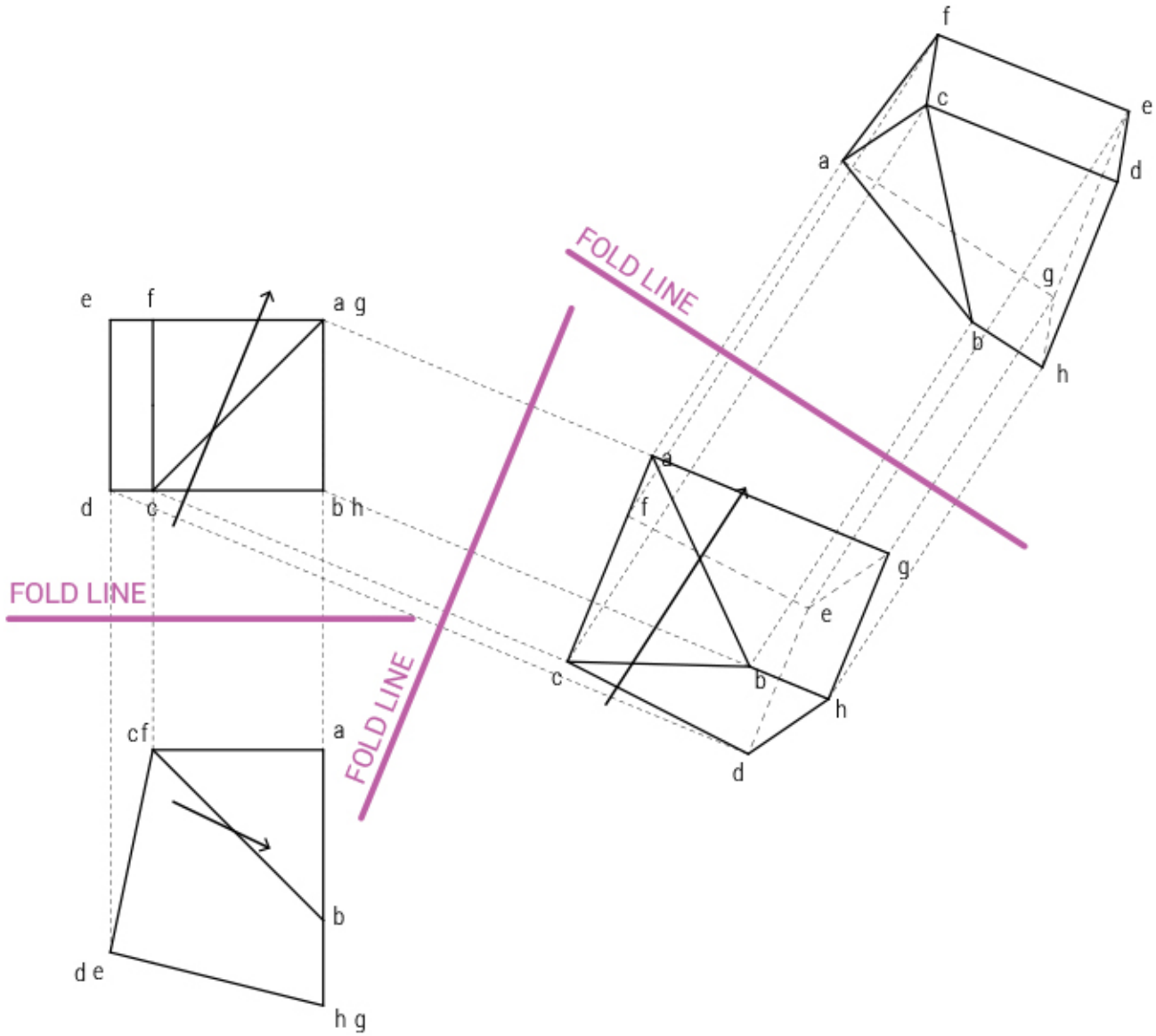
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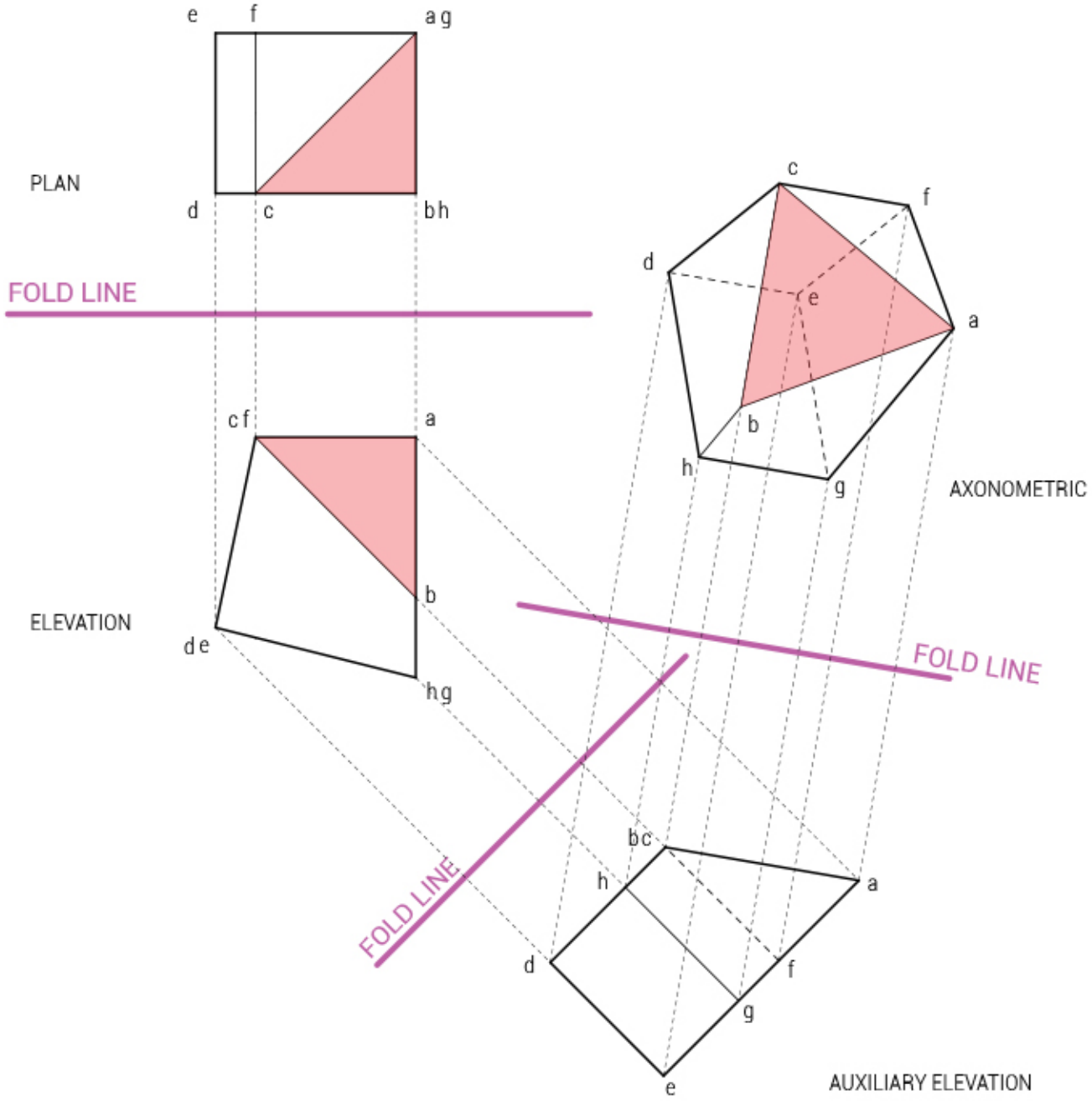
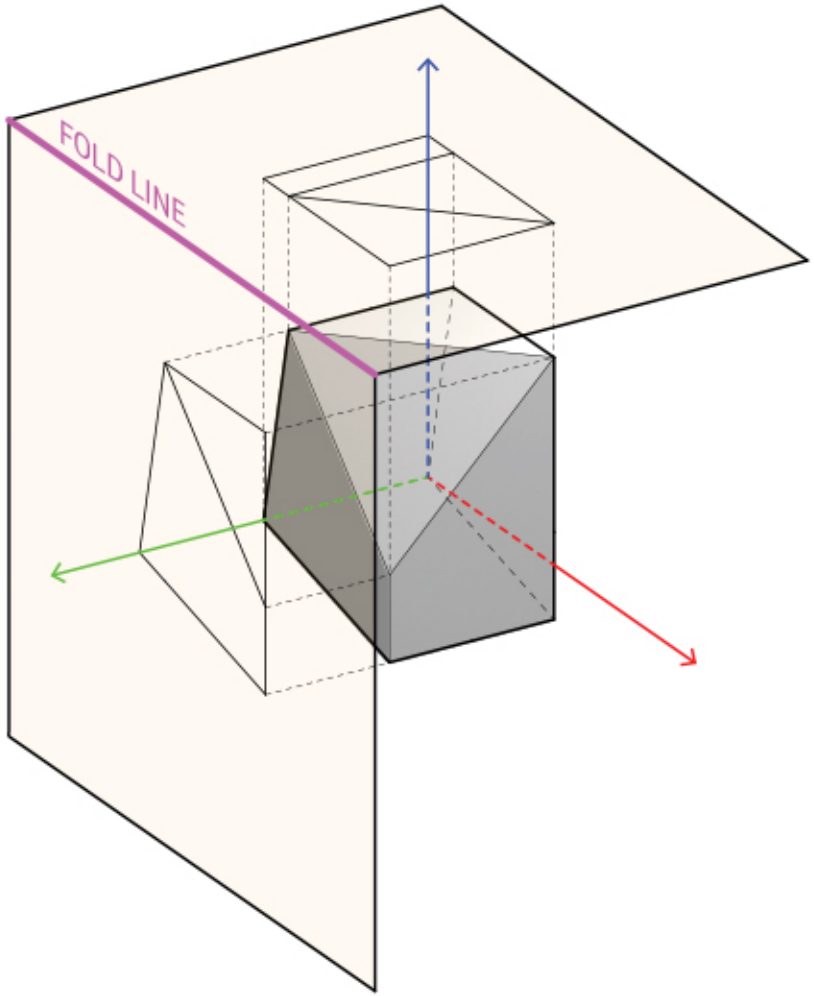
TECHNIQUE 1:
ORIENT TO VIEW

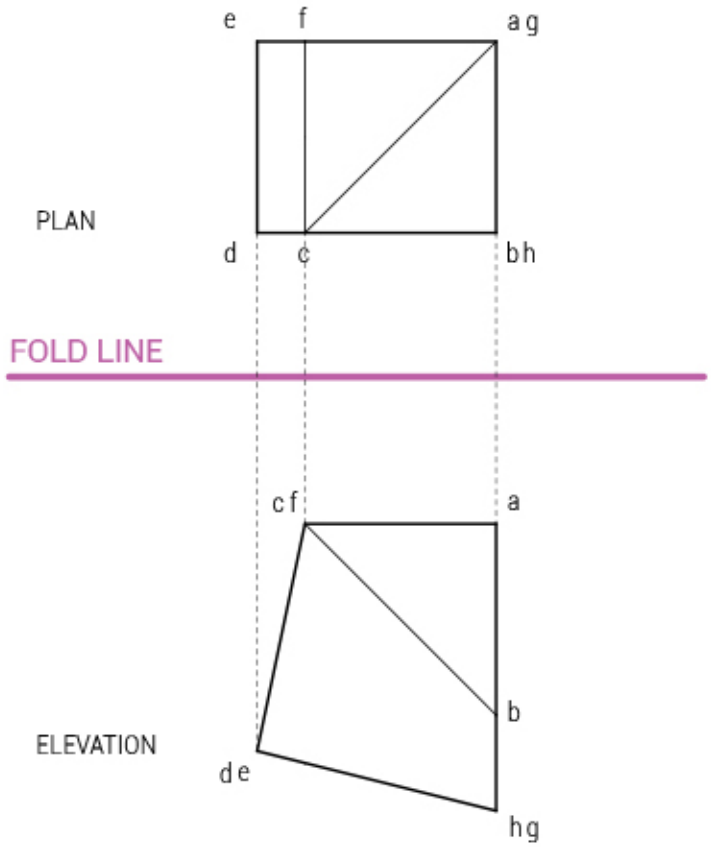
TECHNIQUE 2:
ORIENT TO FACE

TECHNIQUE 3:
UNFOLD FACES

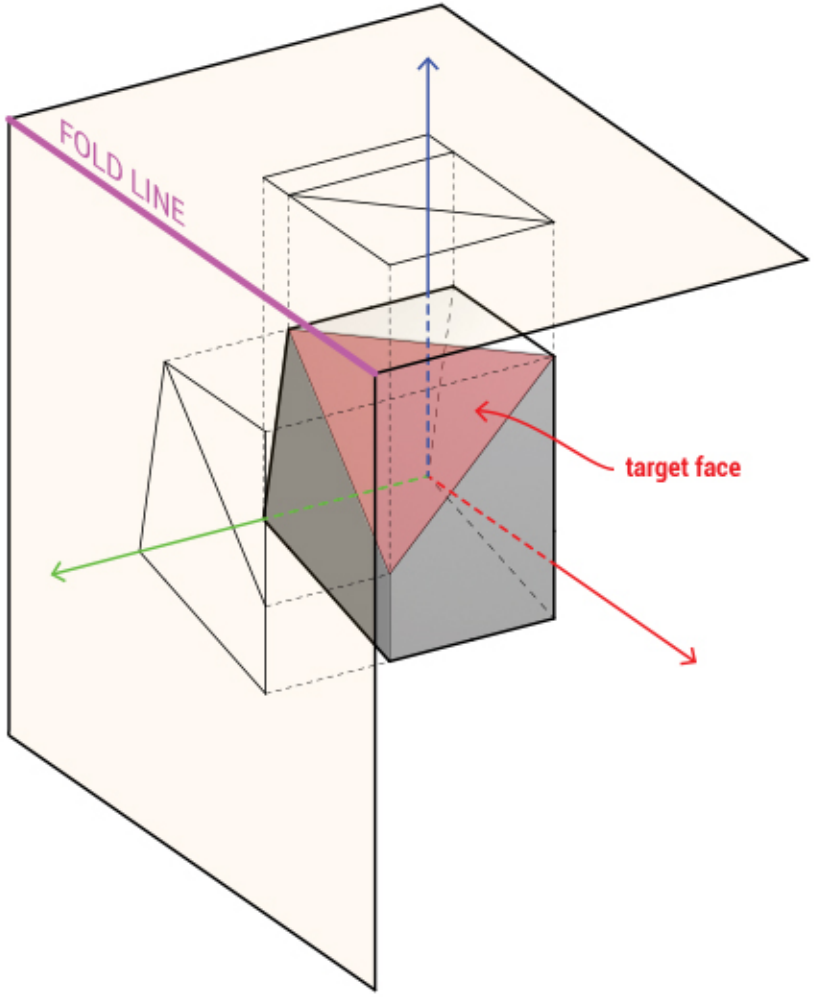


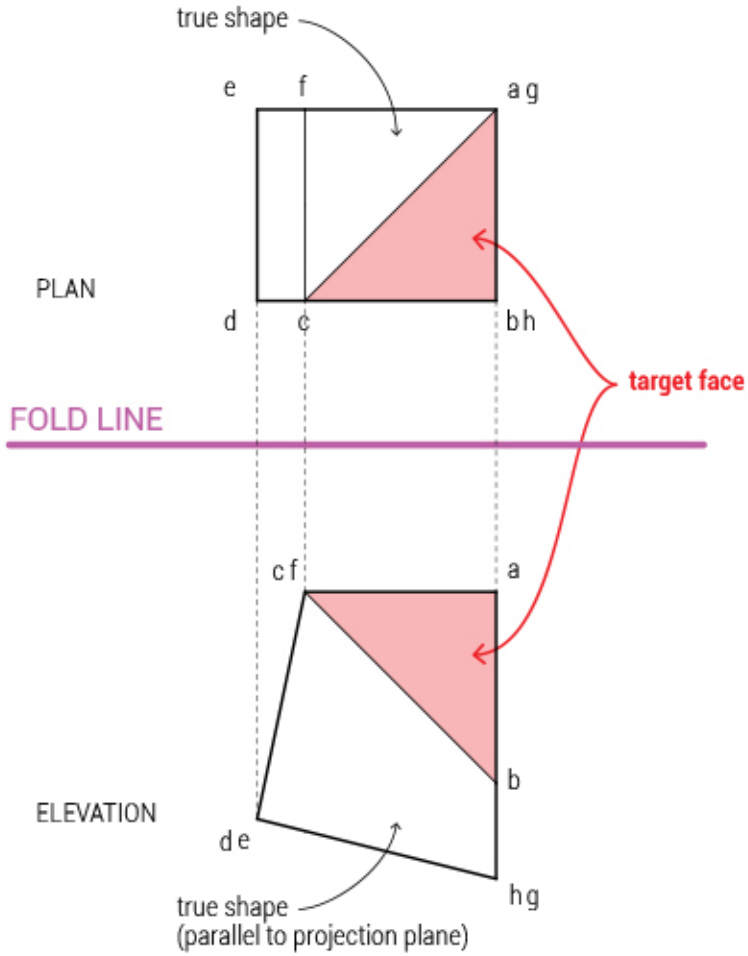
1. Set up base orthogonal pair



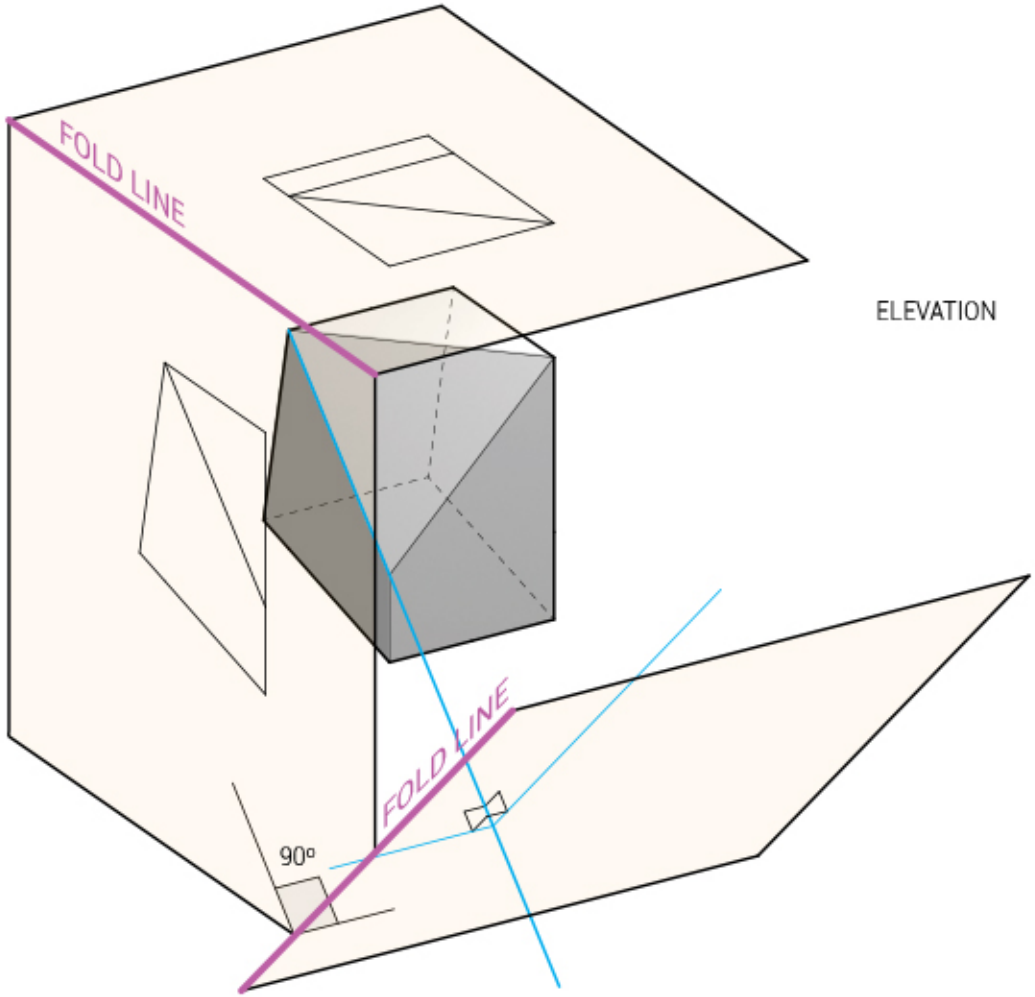


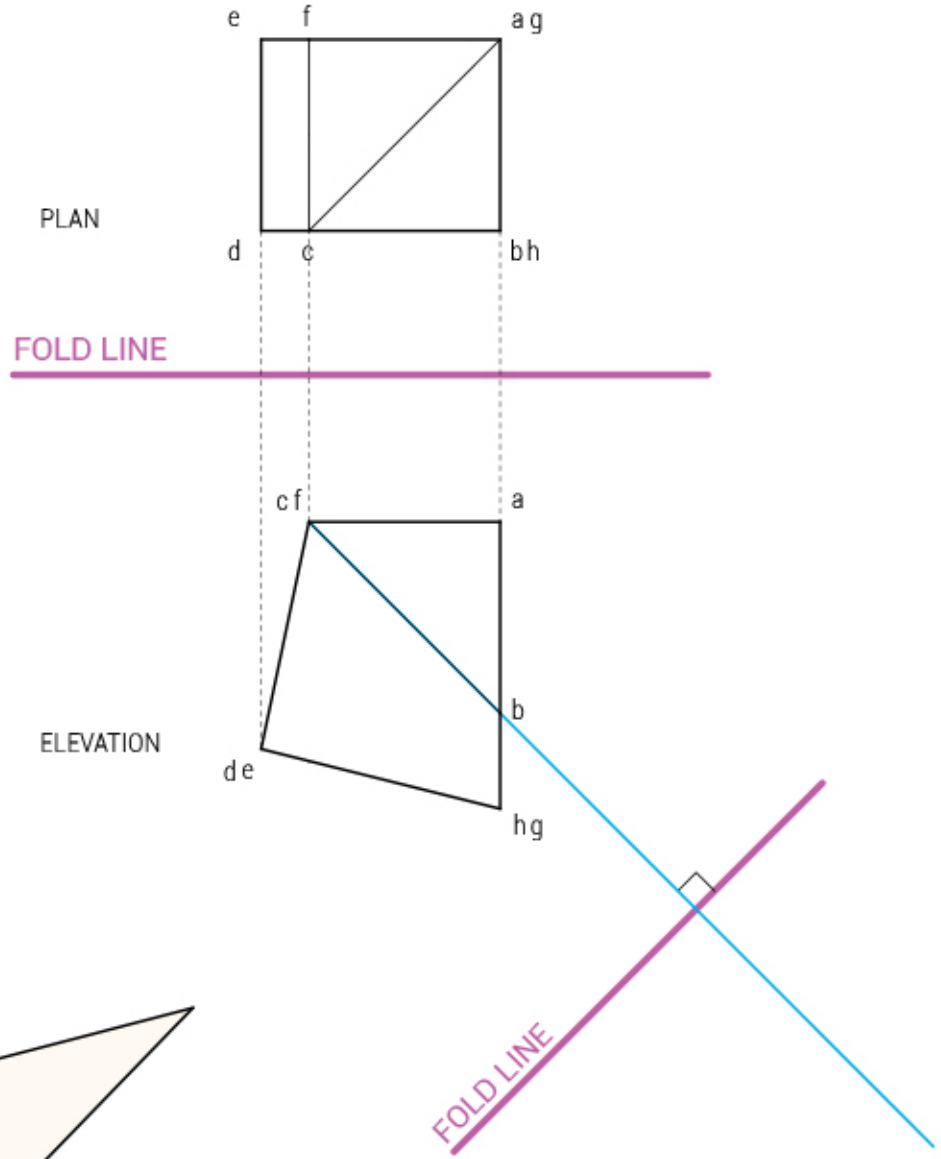
2. Choose target face for orienting the projection plane





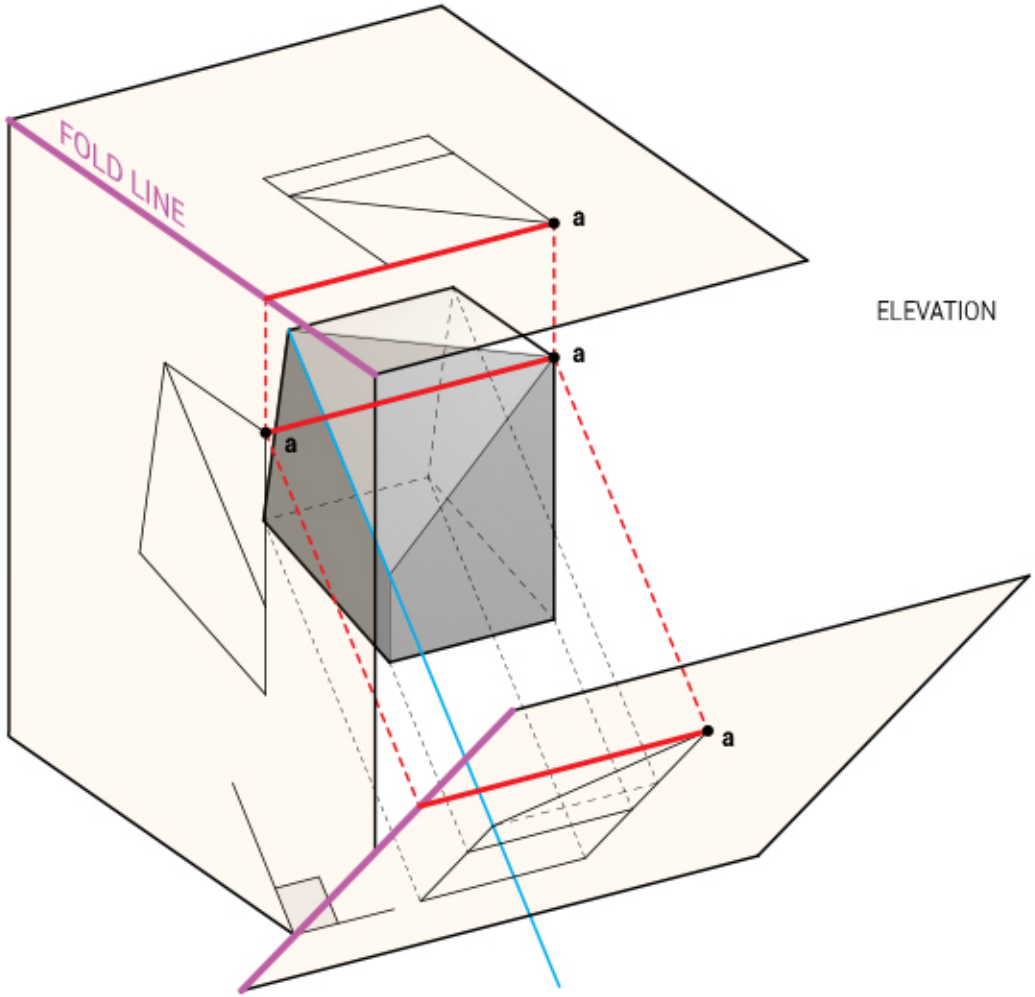
3. Construct intermediate projection plane as the plane perpendicular to the intersection line of the previous plane and the target plane

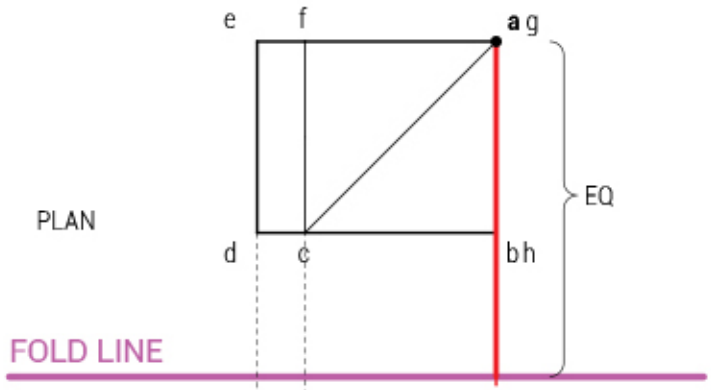


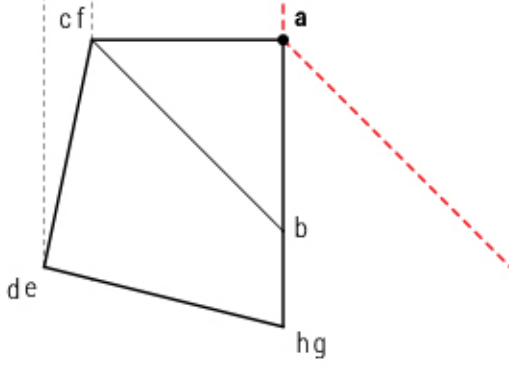


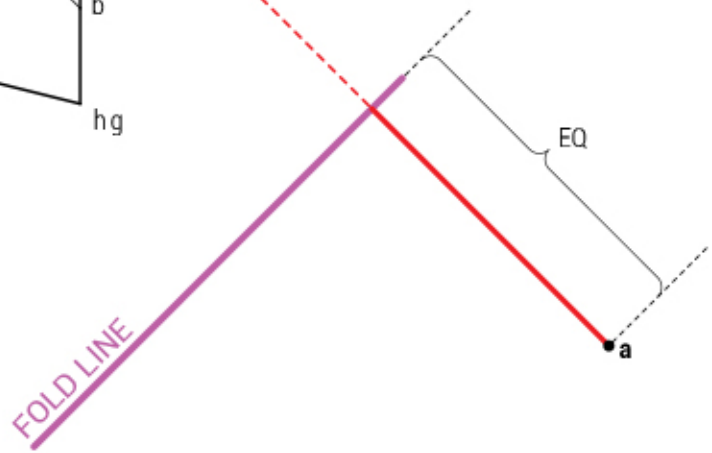
Derive first projection plane

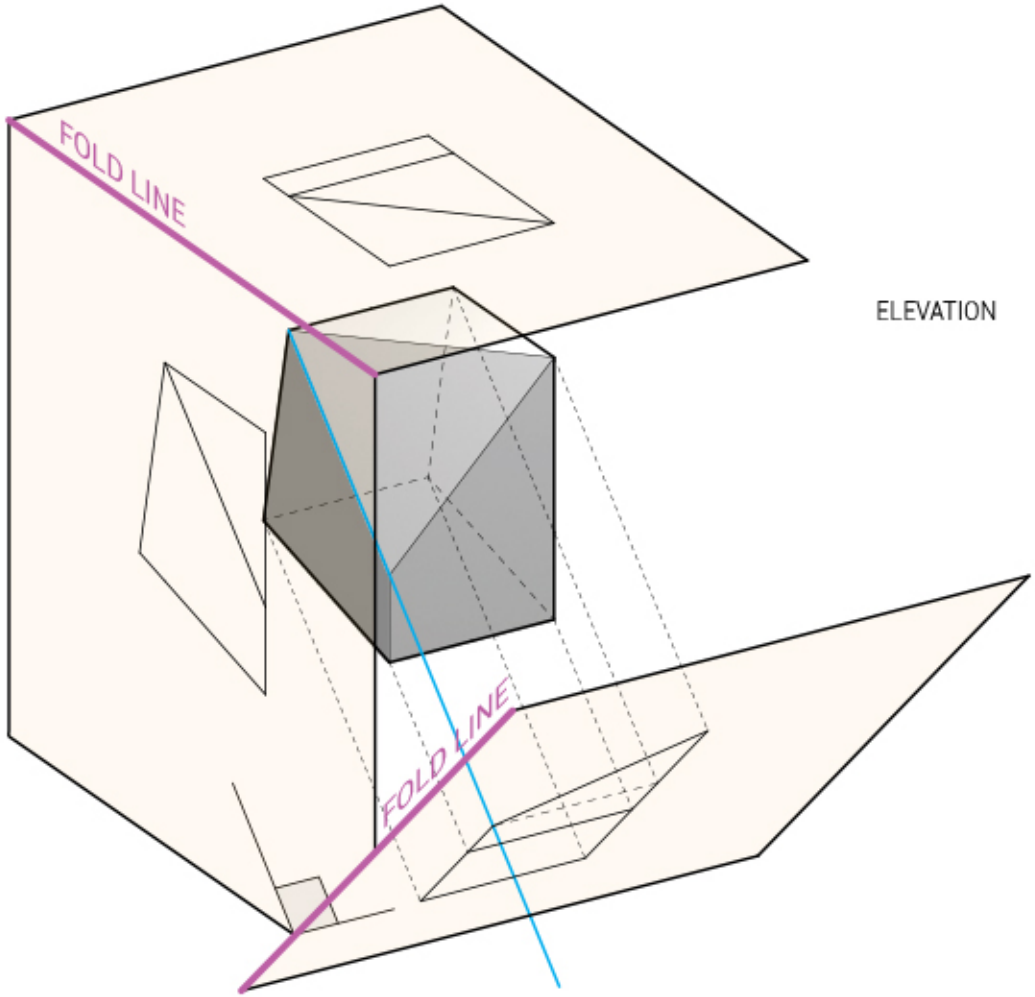
4. Construct intermediate projection using new projection plane







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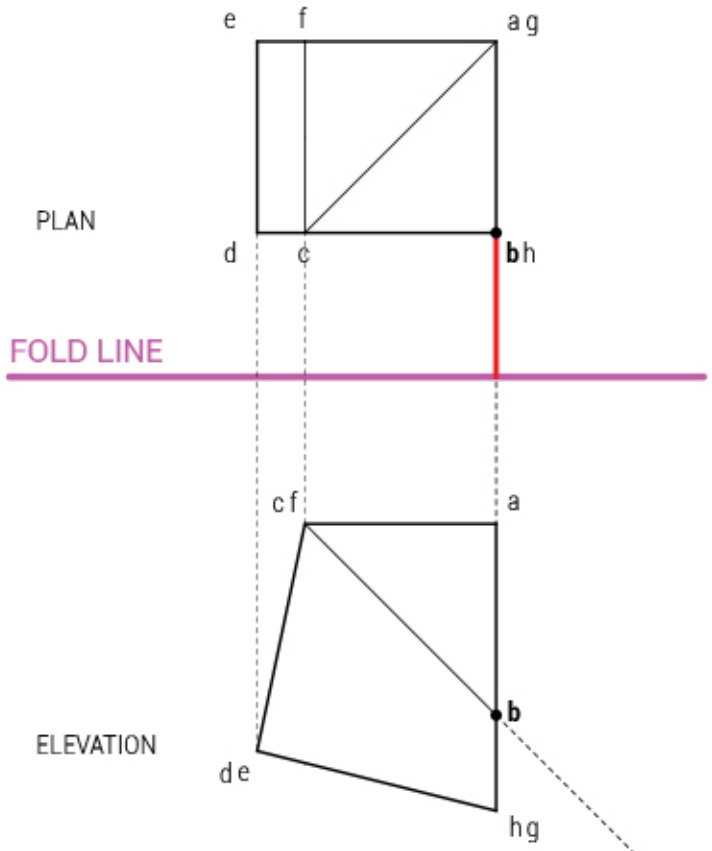
FOLD LINE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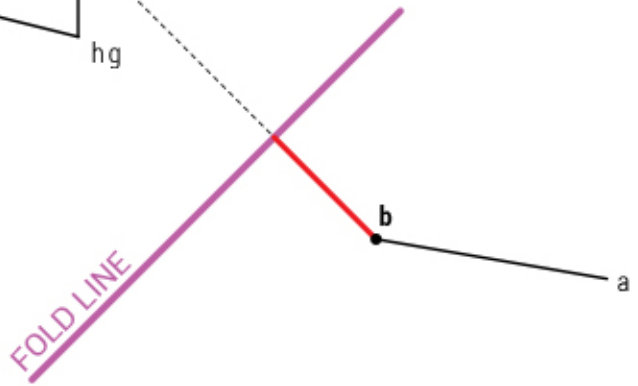
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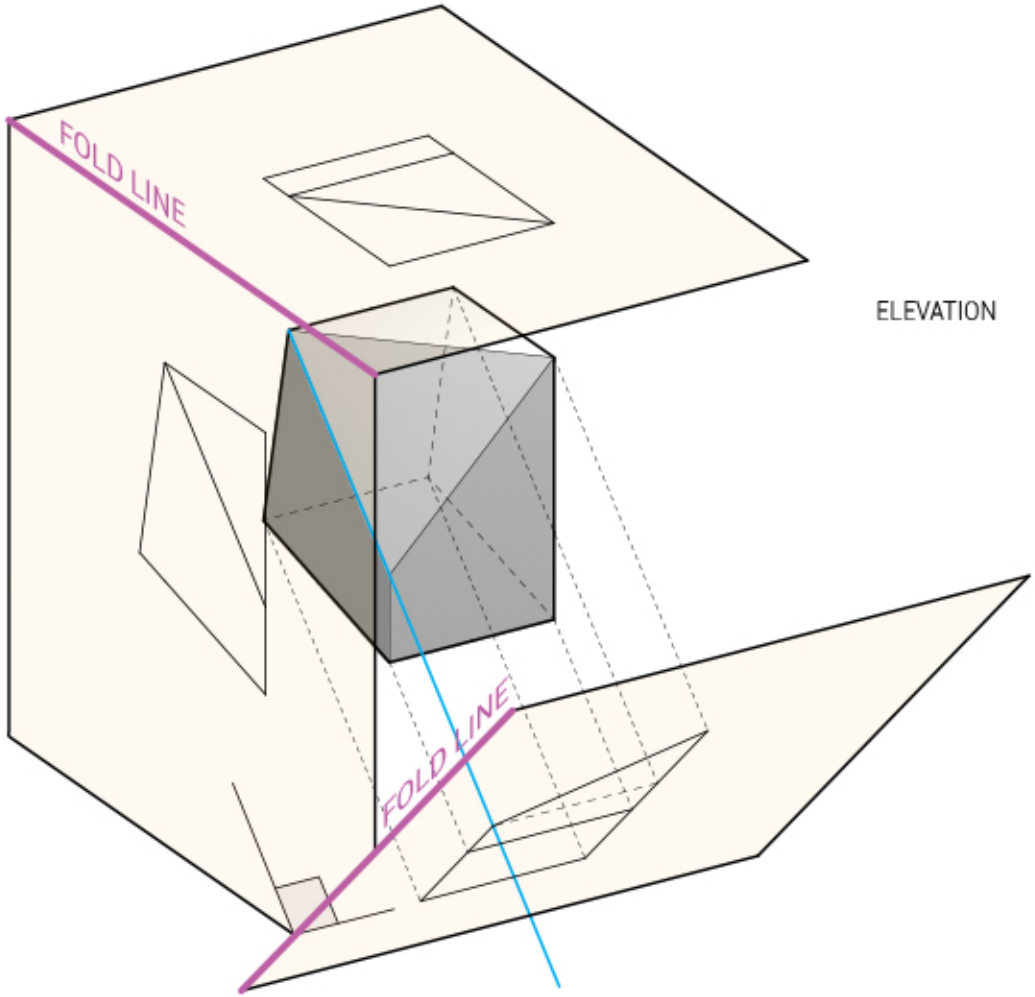
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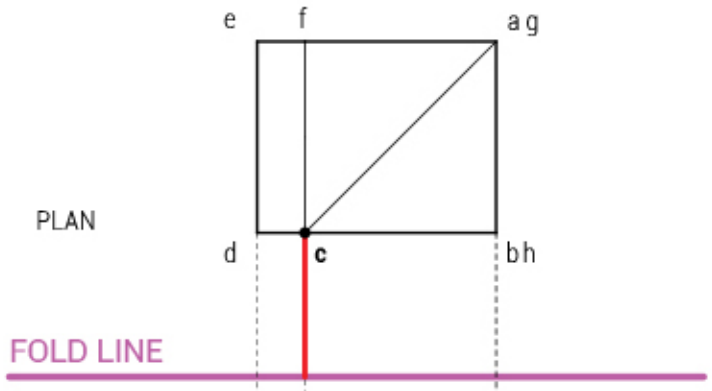
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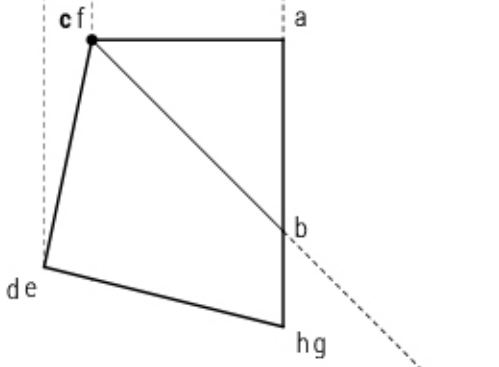
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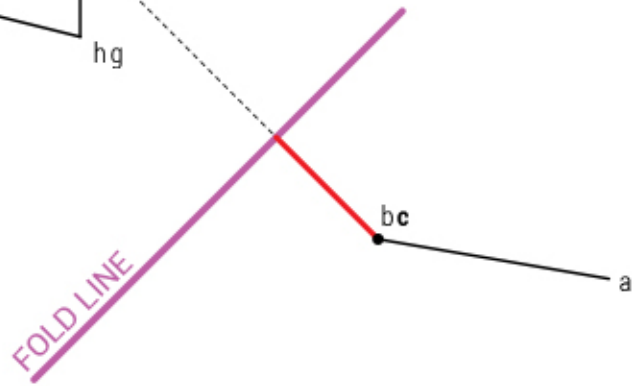
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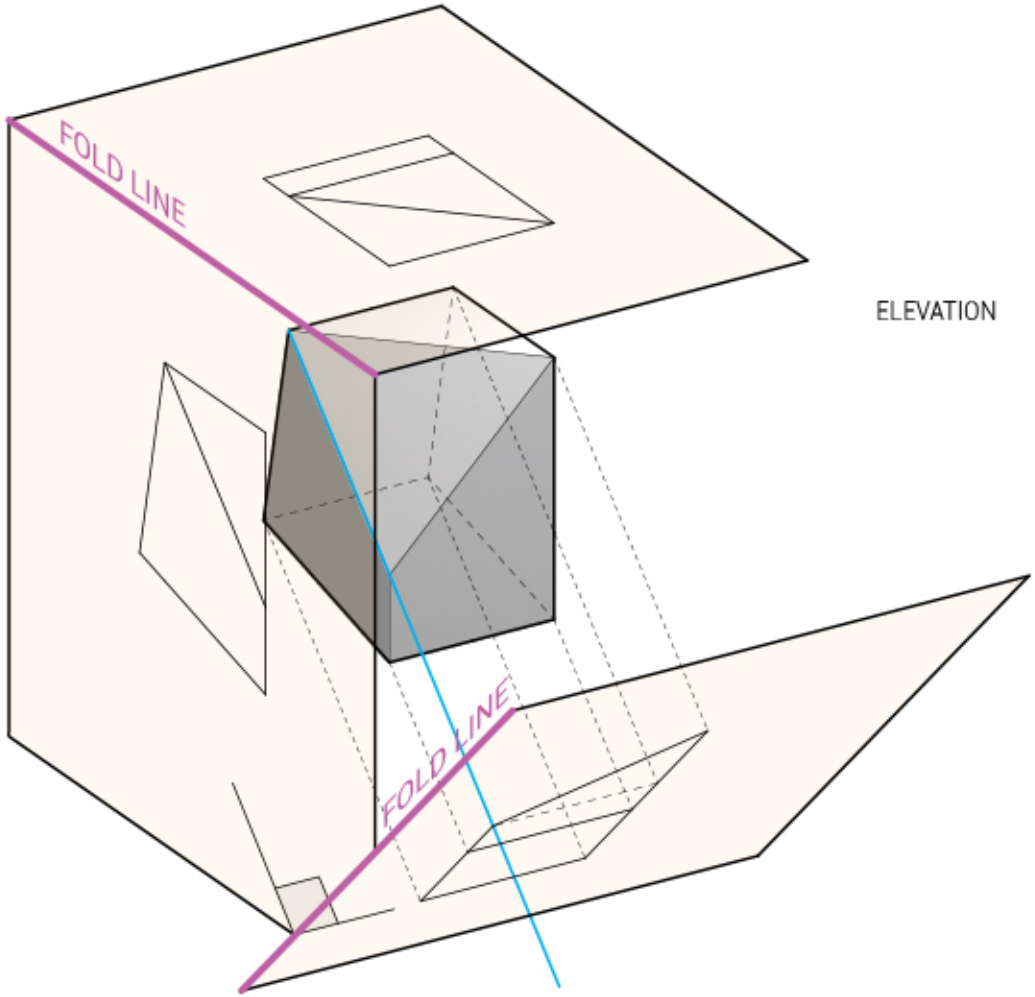
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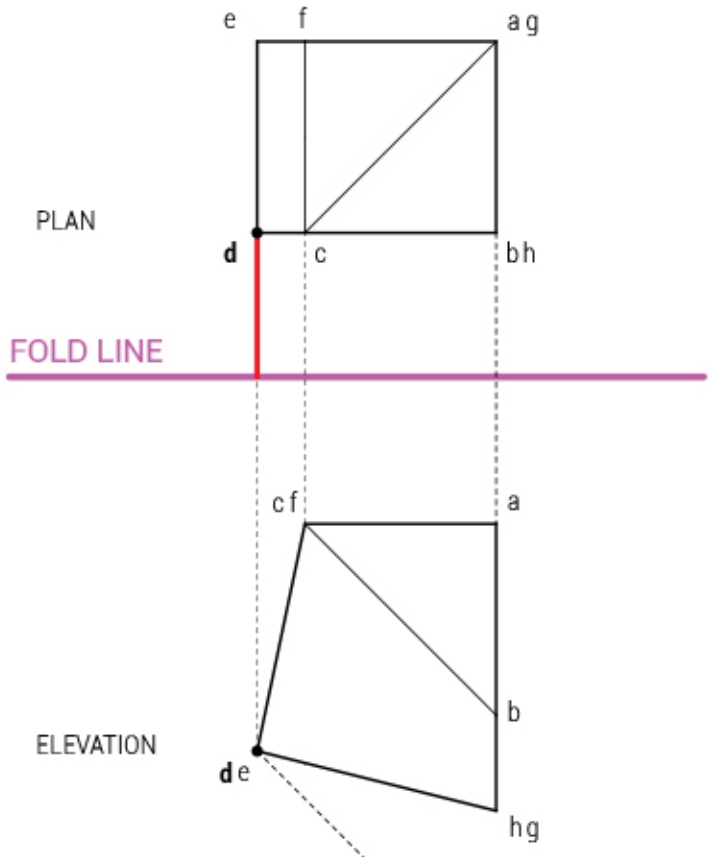
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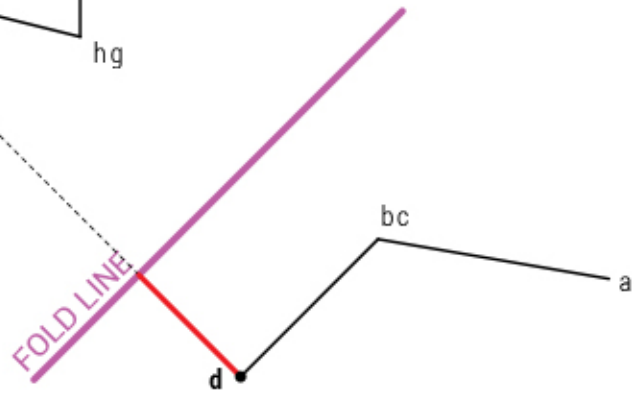
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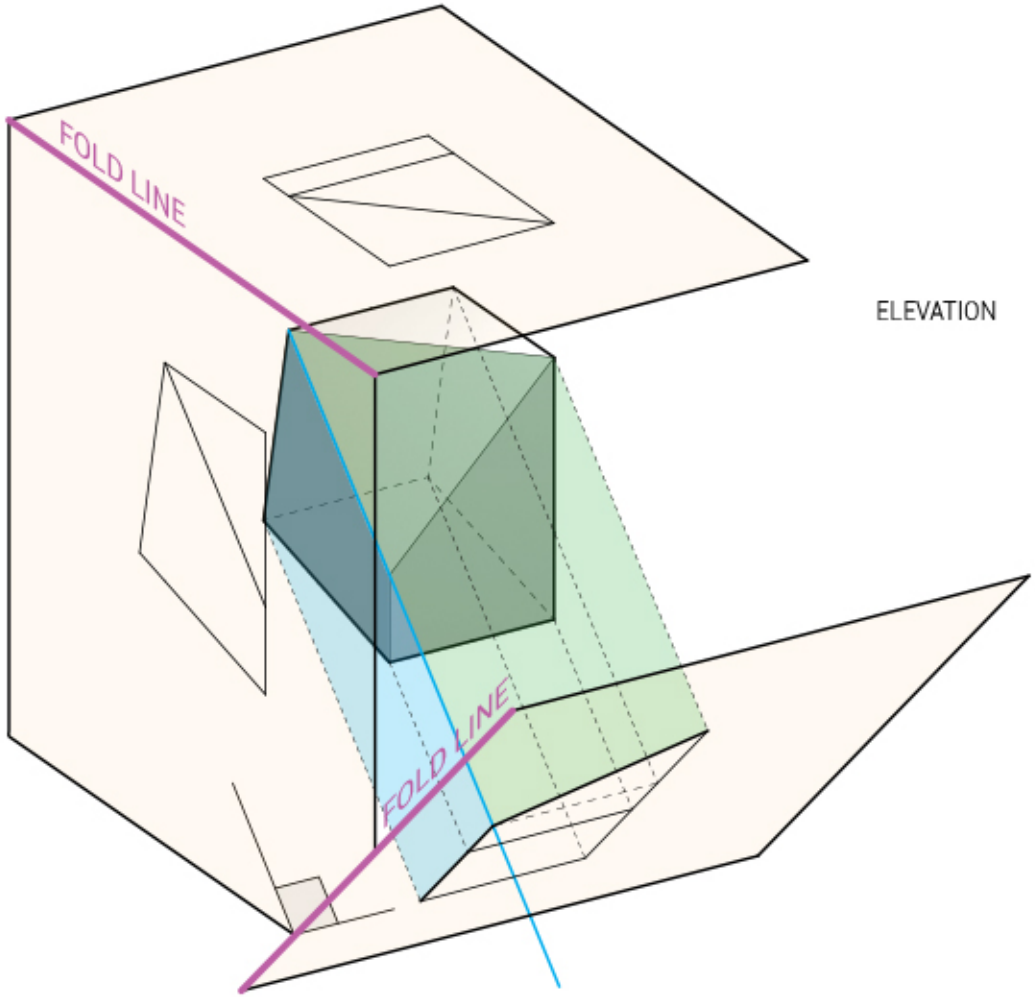
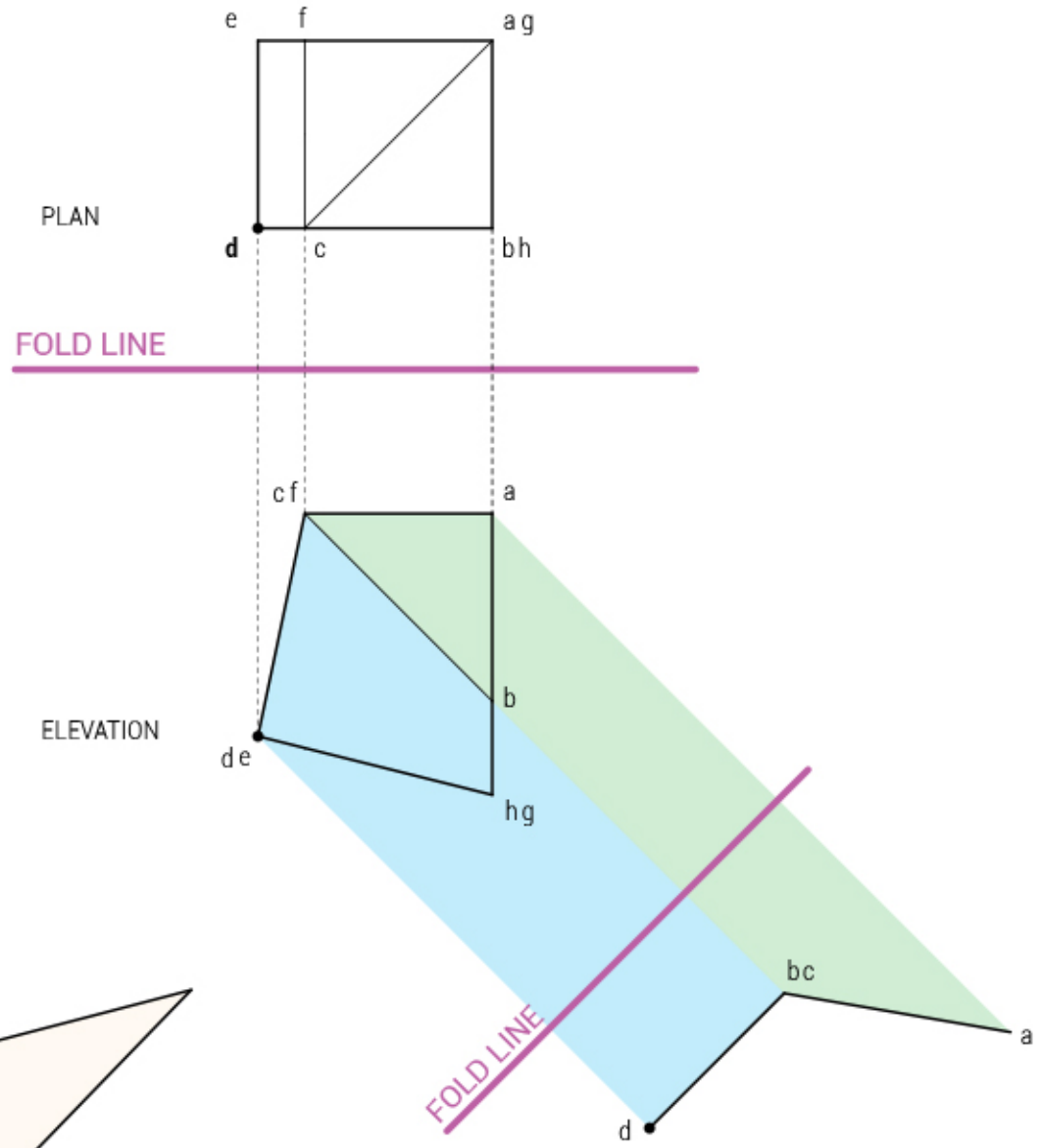
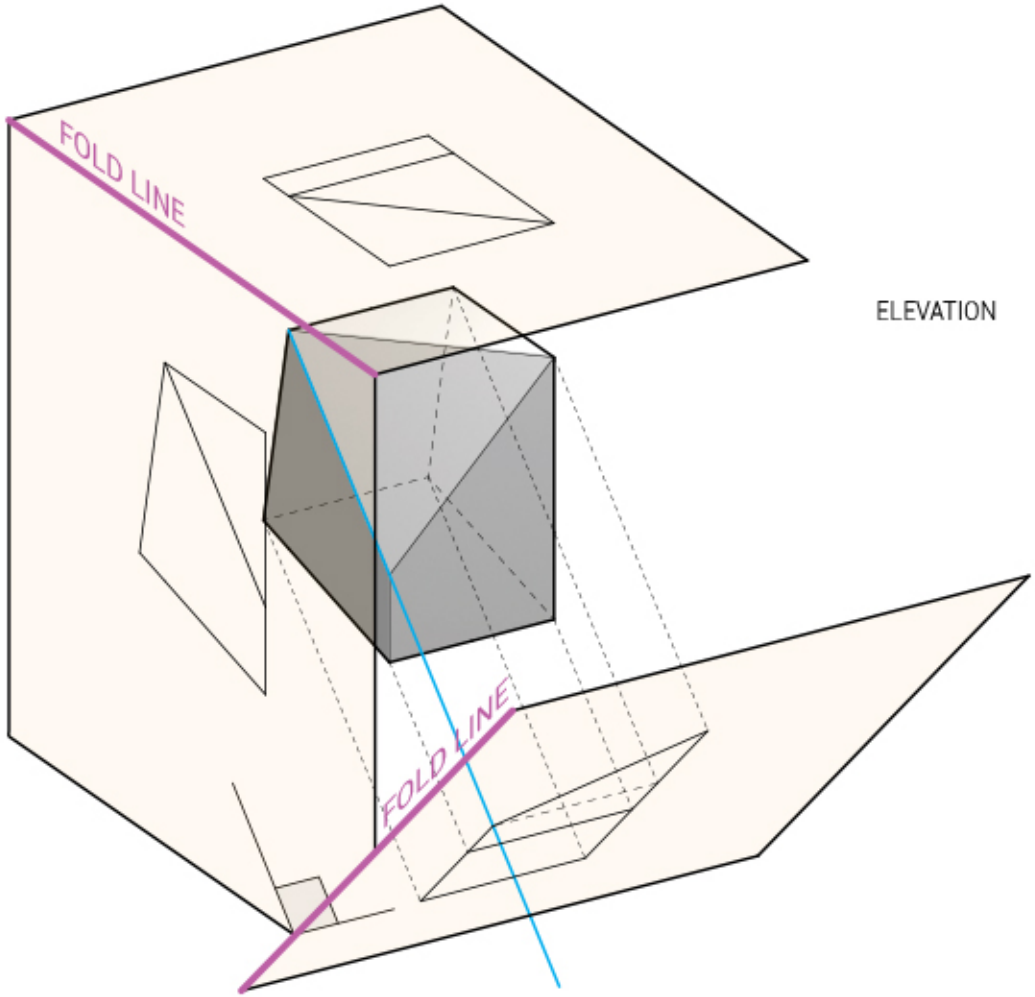
Note that any surface in the previous and target projection plane become lines in the intermediate projection



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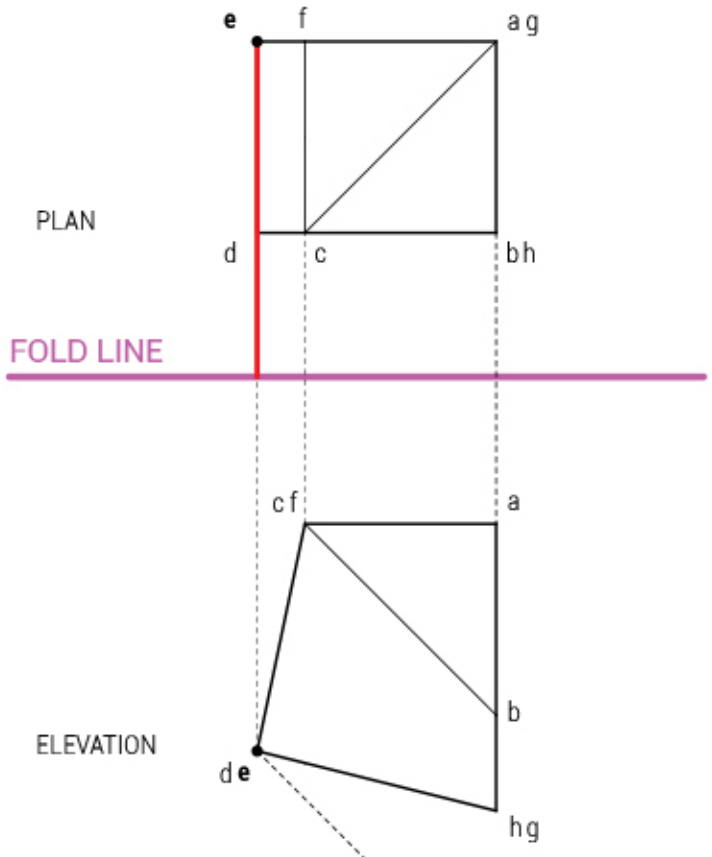
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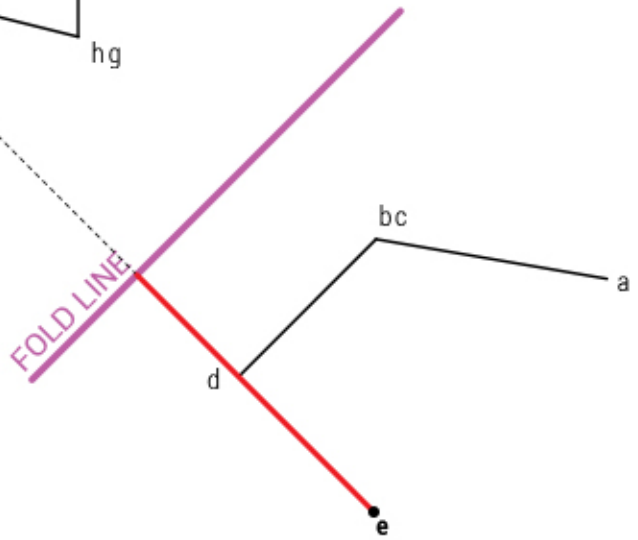
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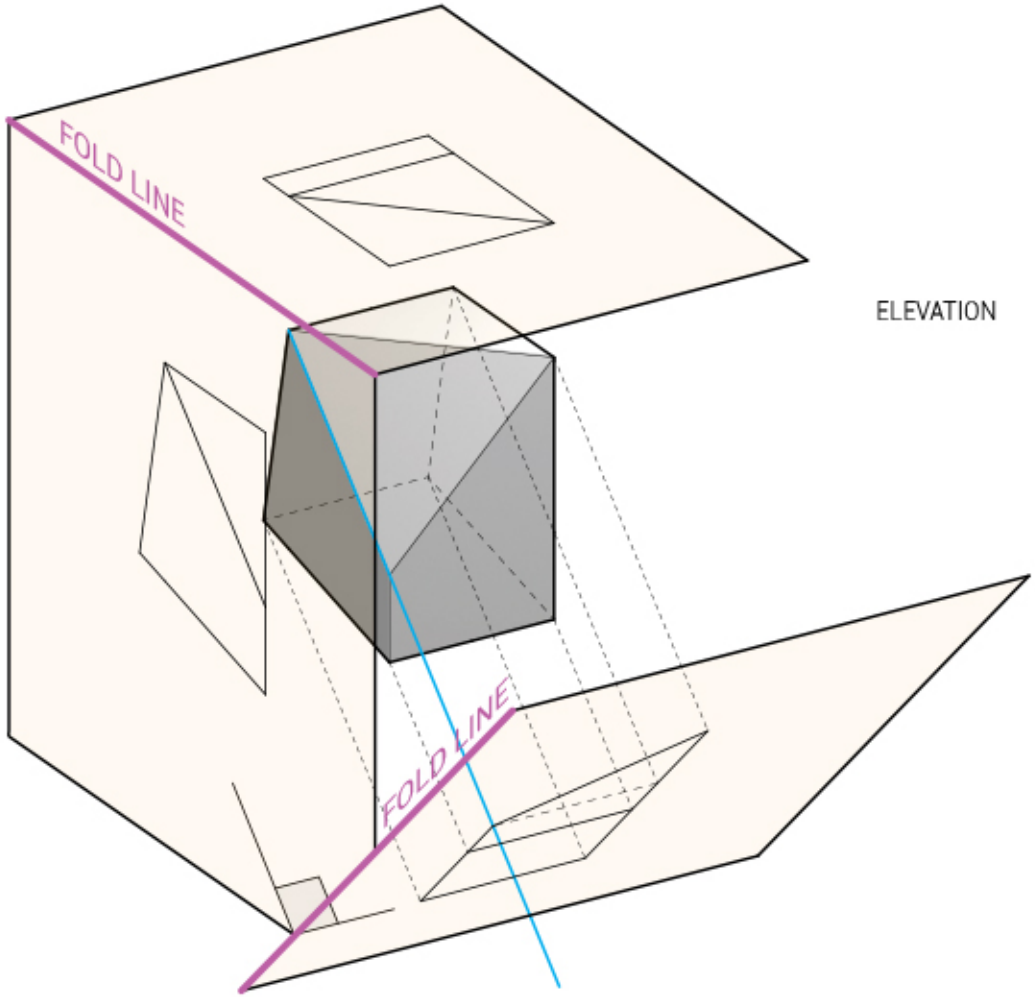
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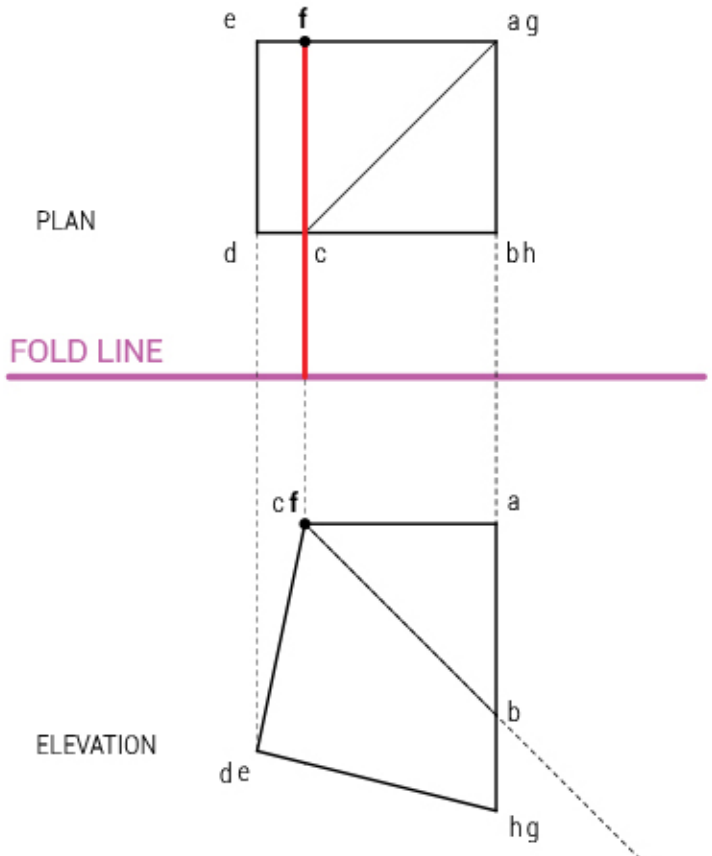
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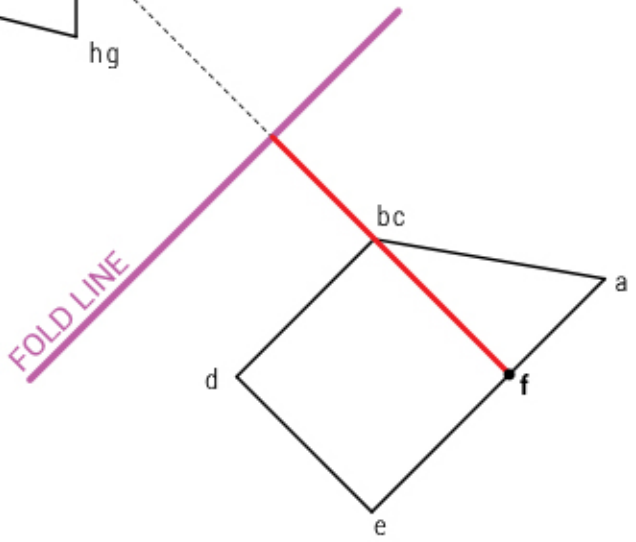
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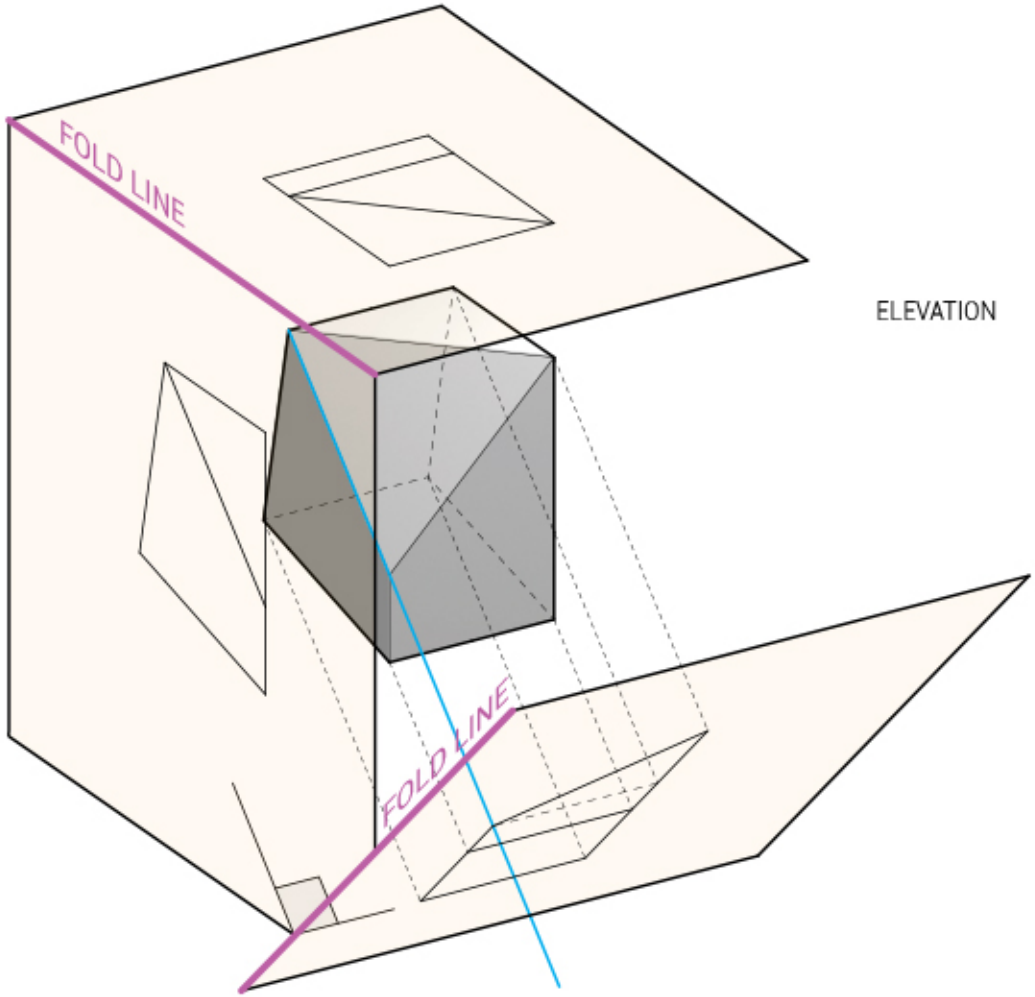
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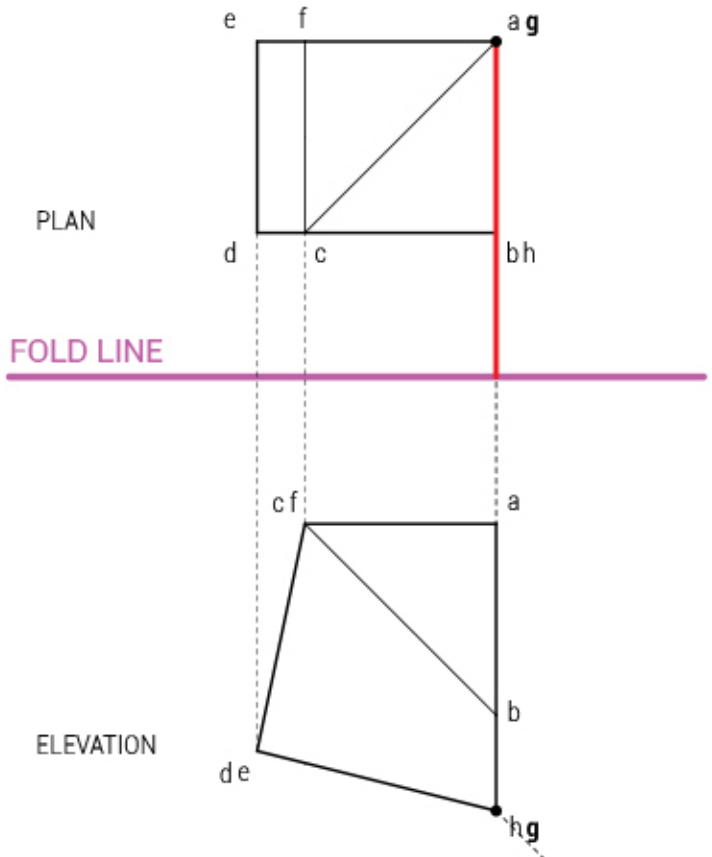
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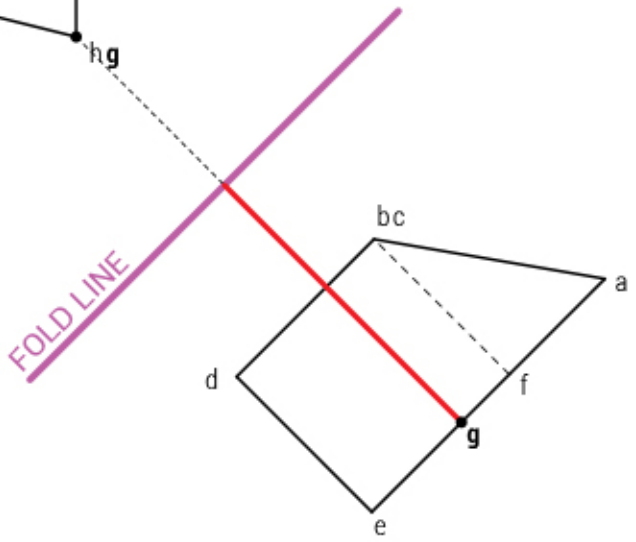
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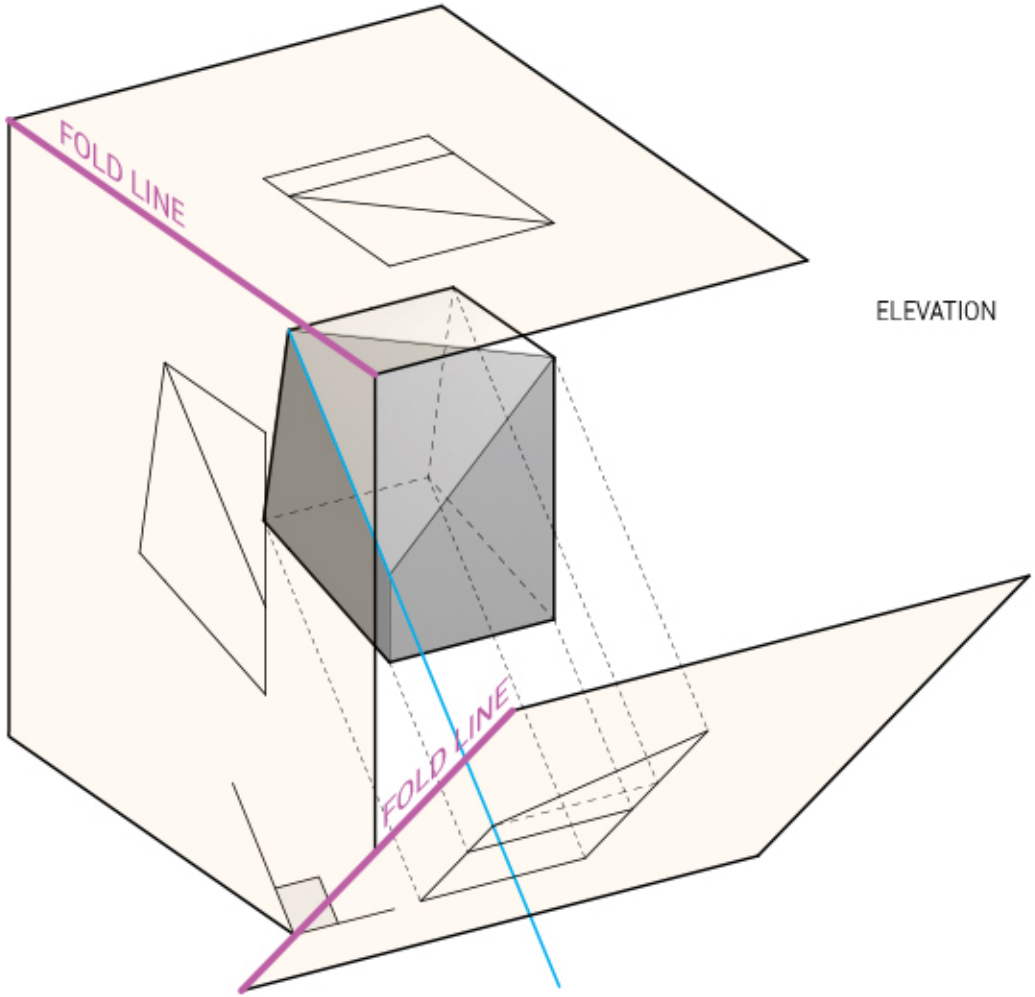
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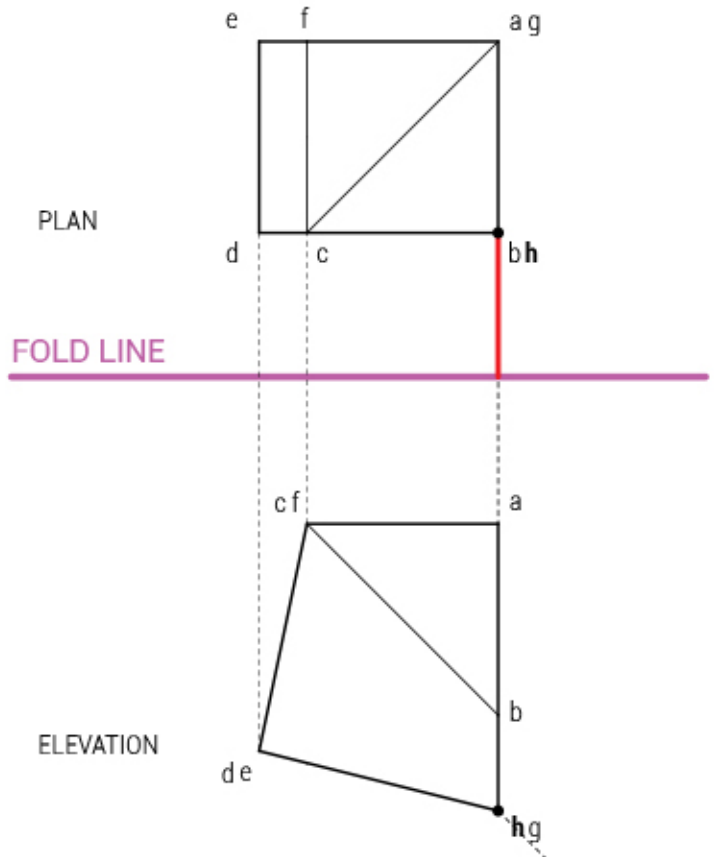
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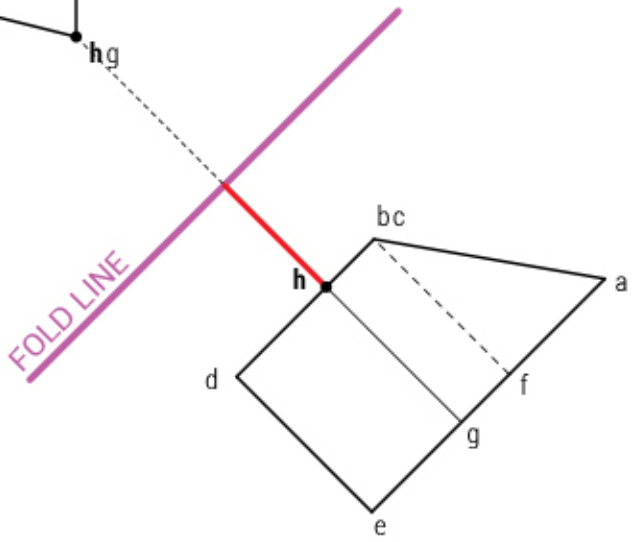
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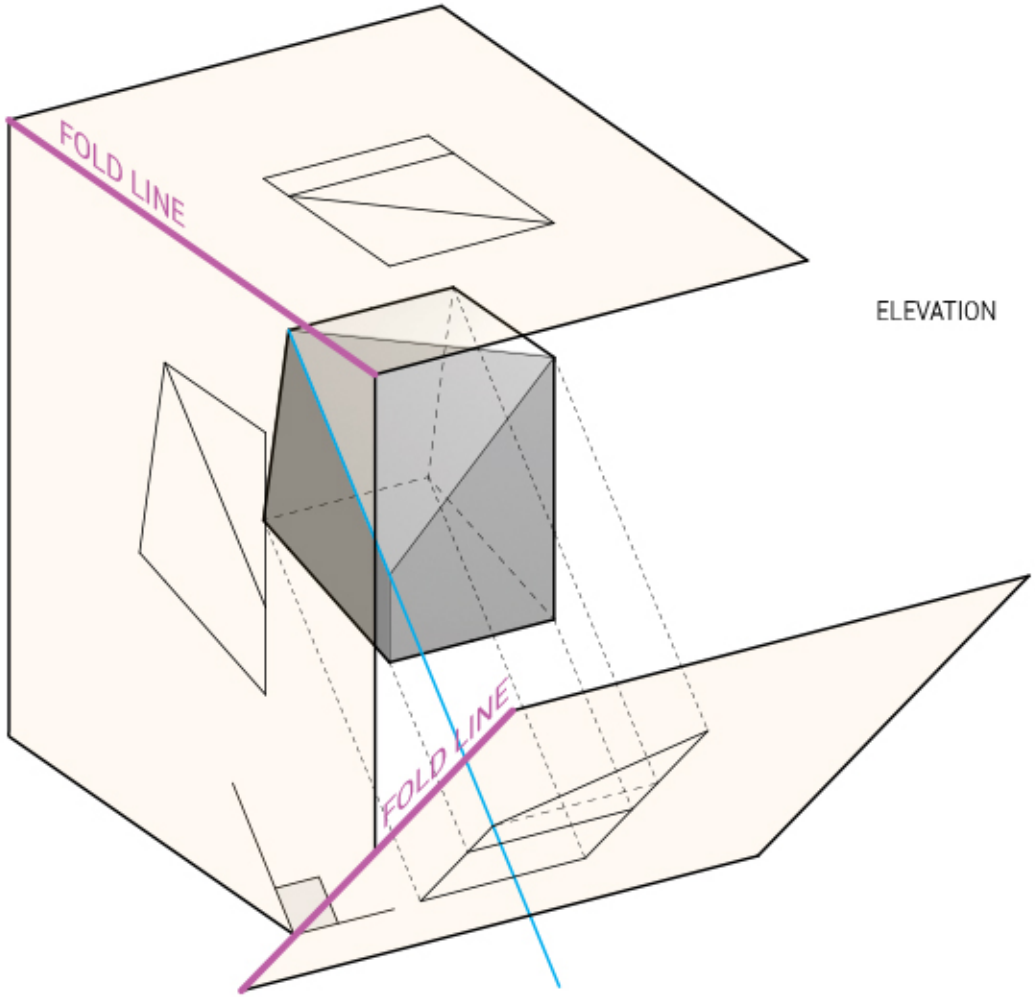
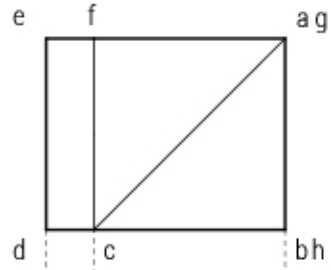


PLAN



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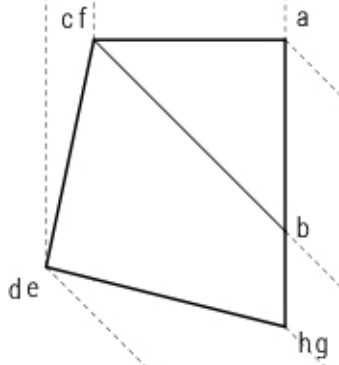
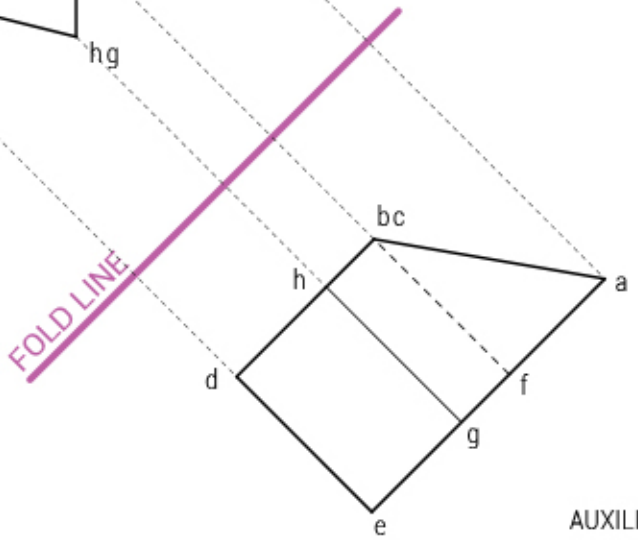
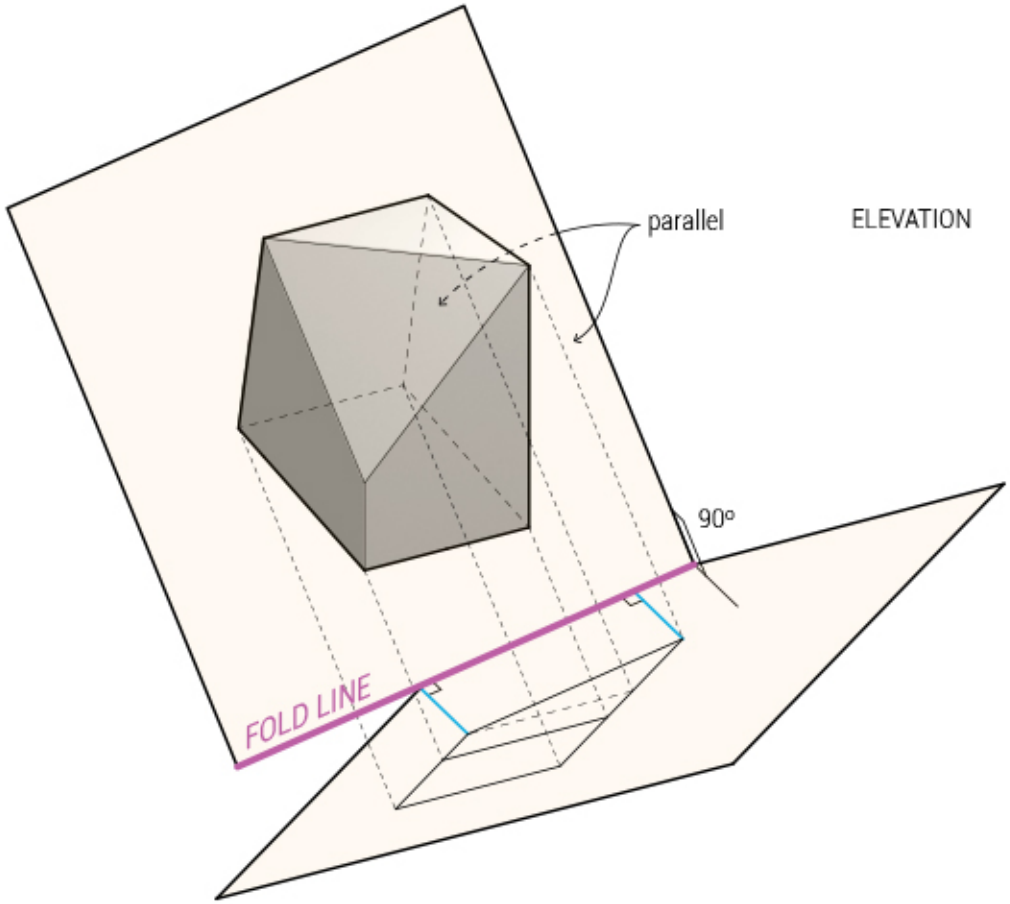
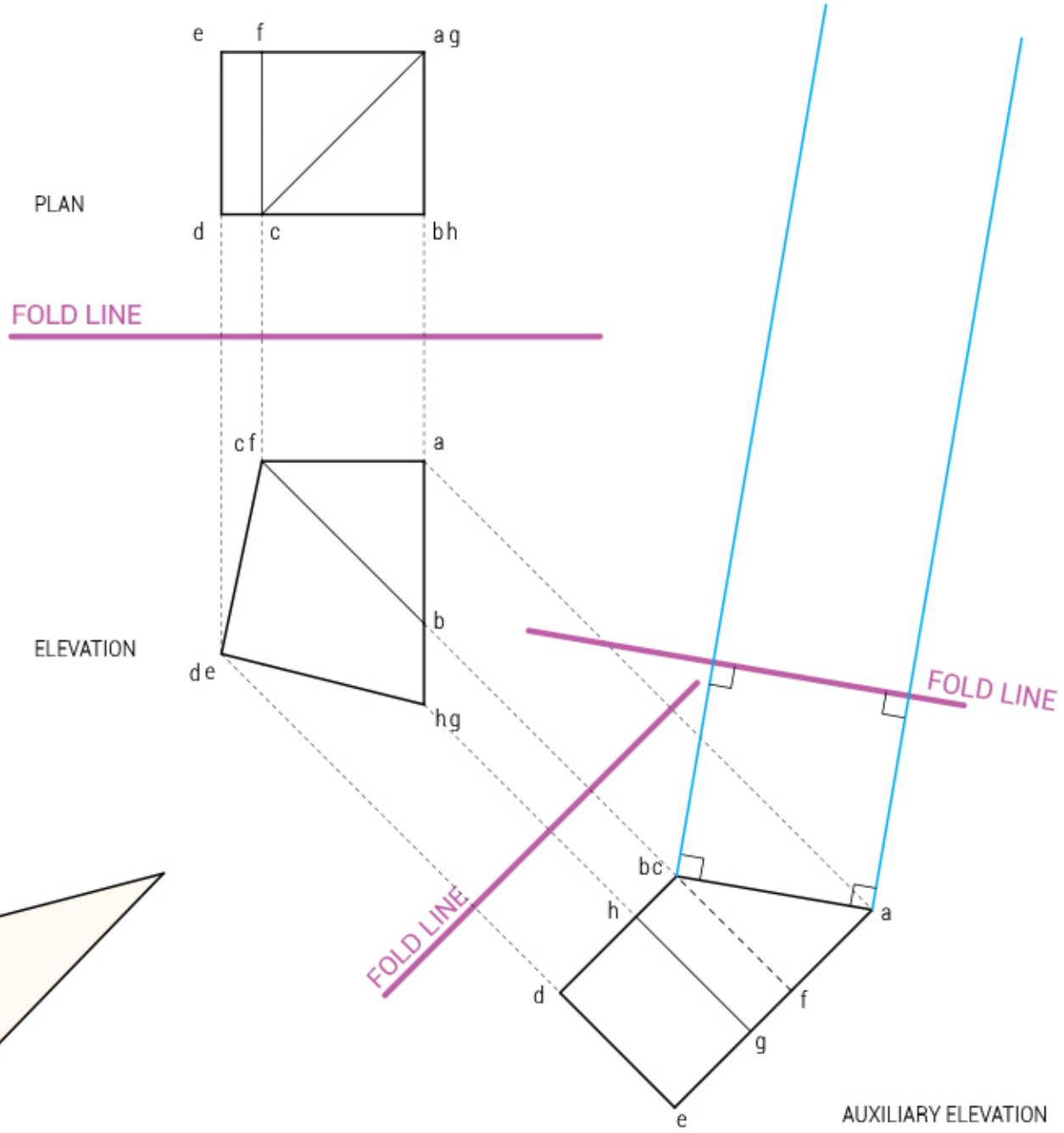




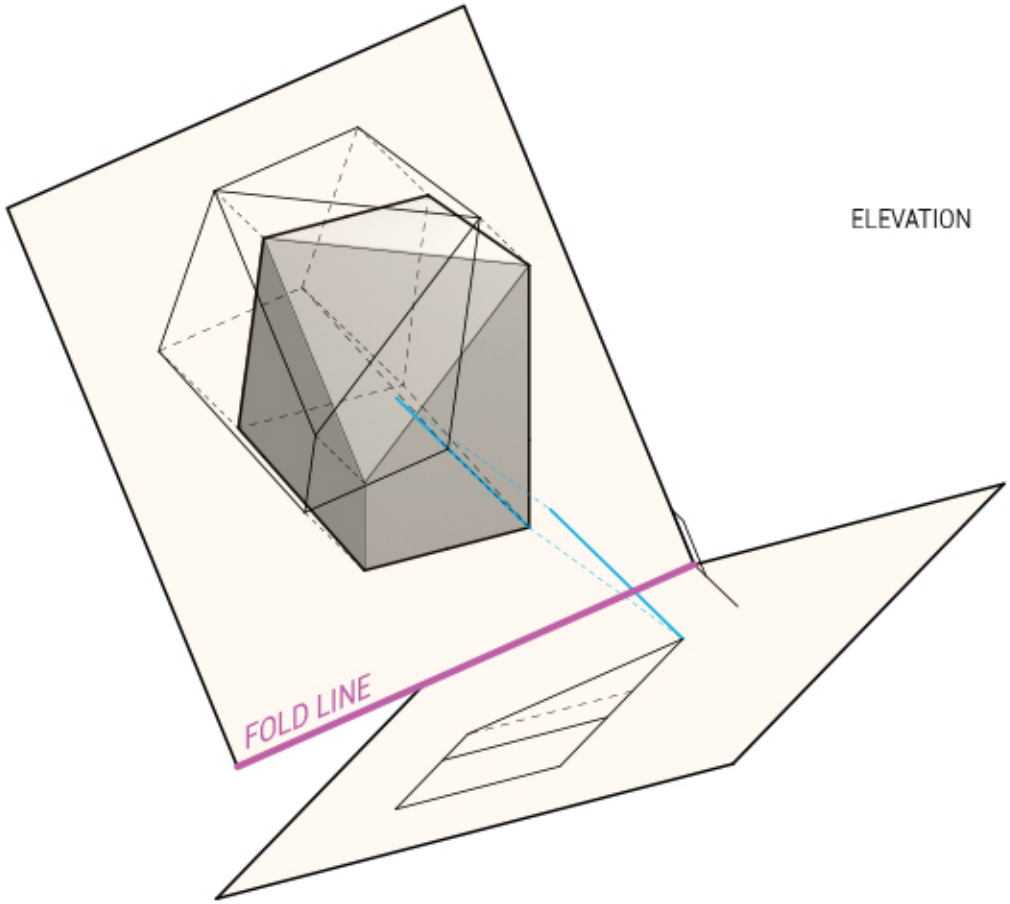
AUXILIARY ELEVATION

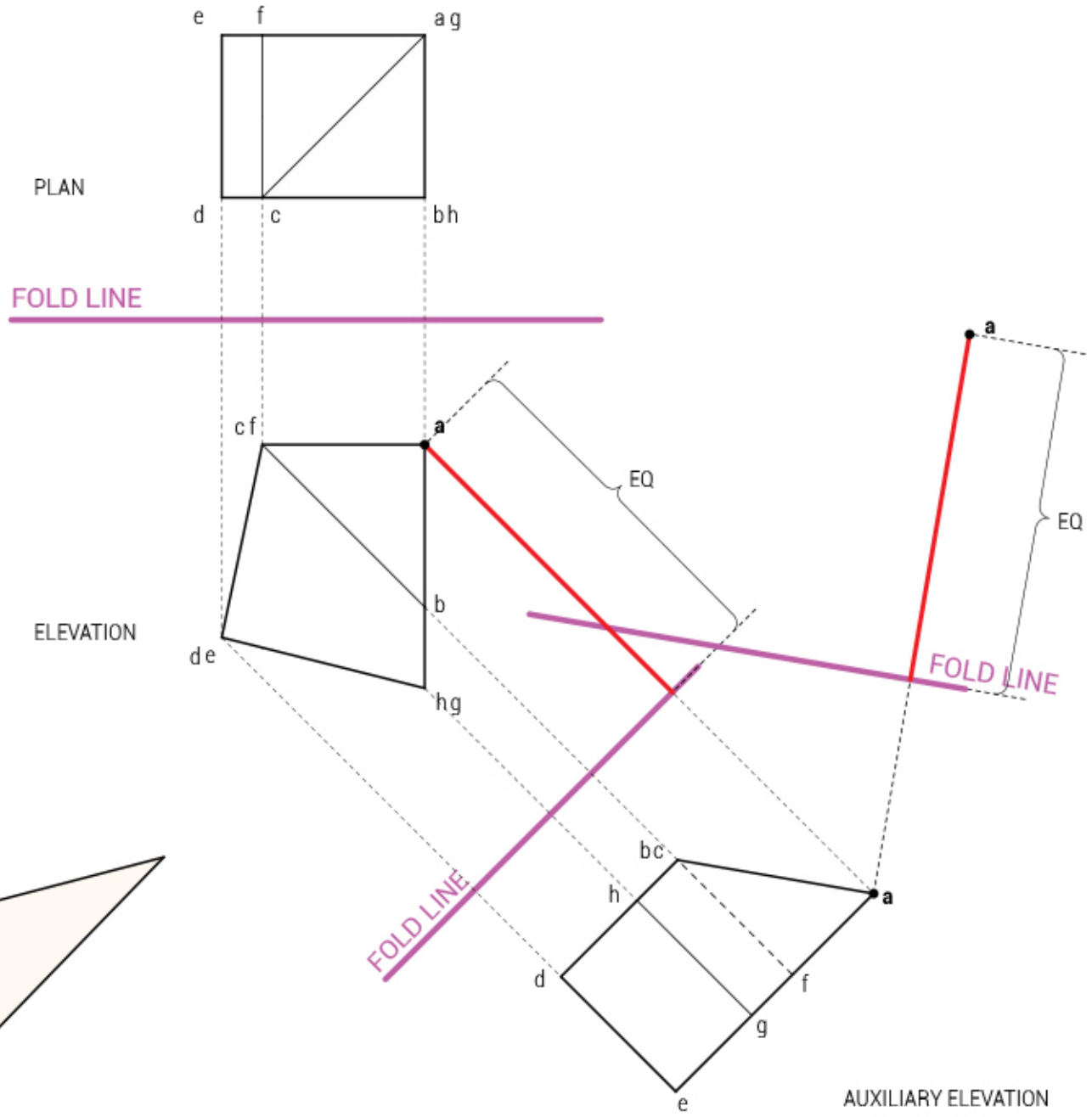
5. Construct target projection plane as parallel to the target face

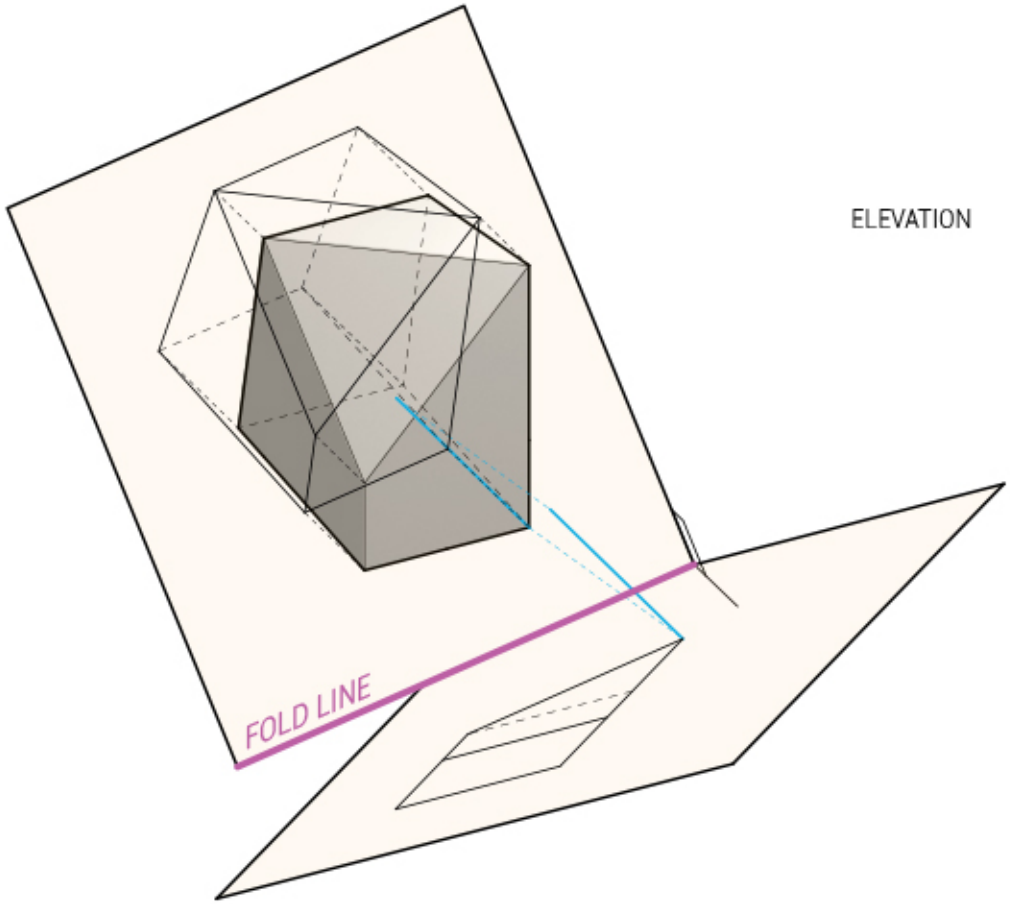


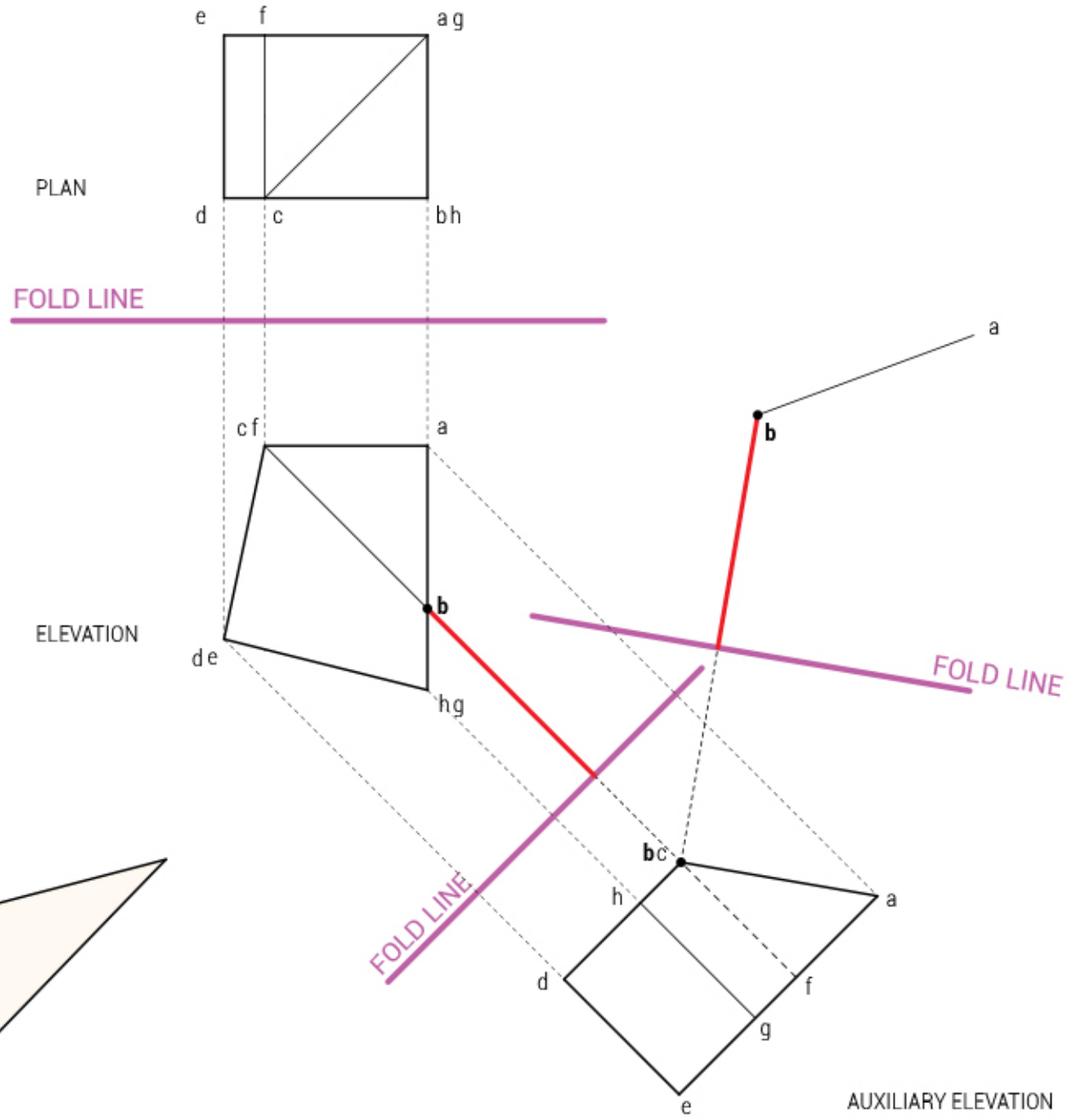


6. Construct target projection using target projection plane






FOLD LINE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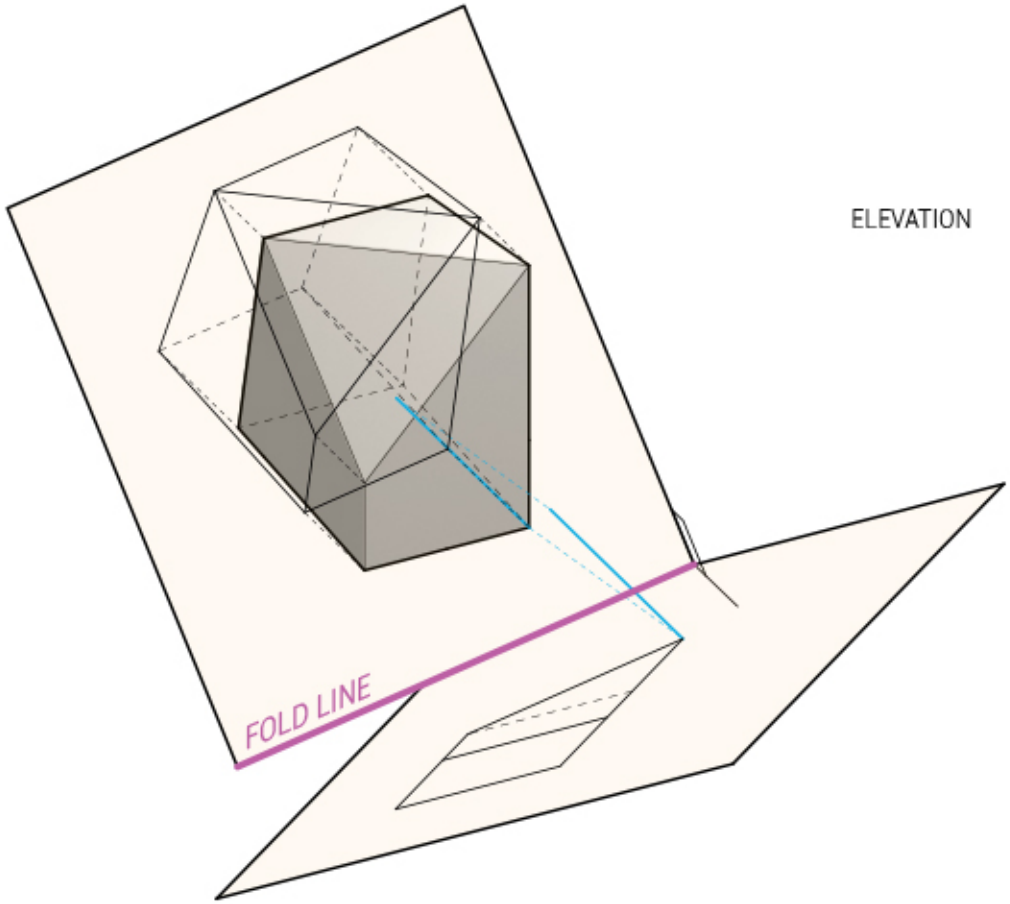
AUXILIARY ELEVATION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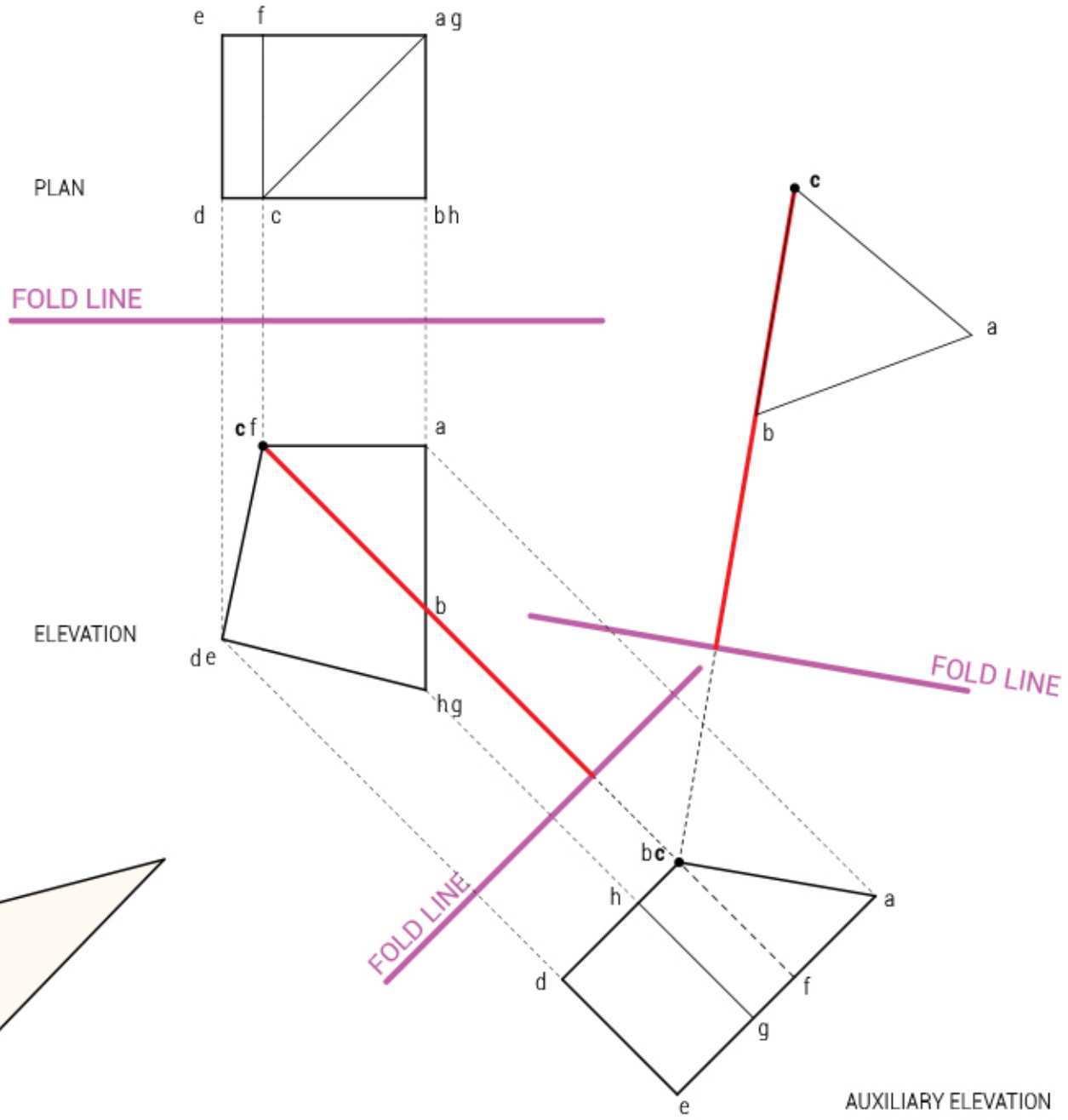
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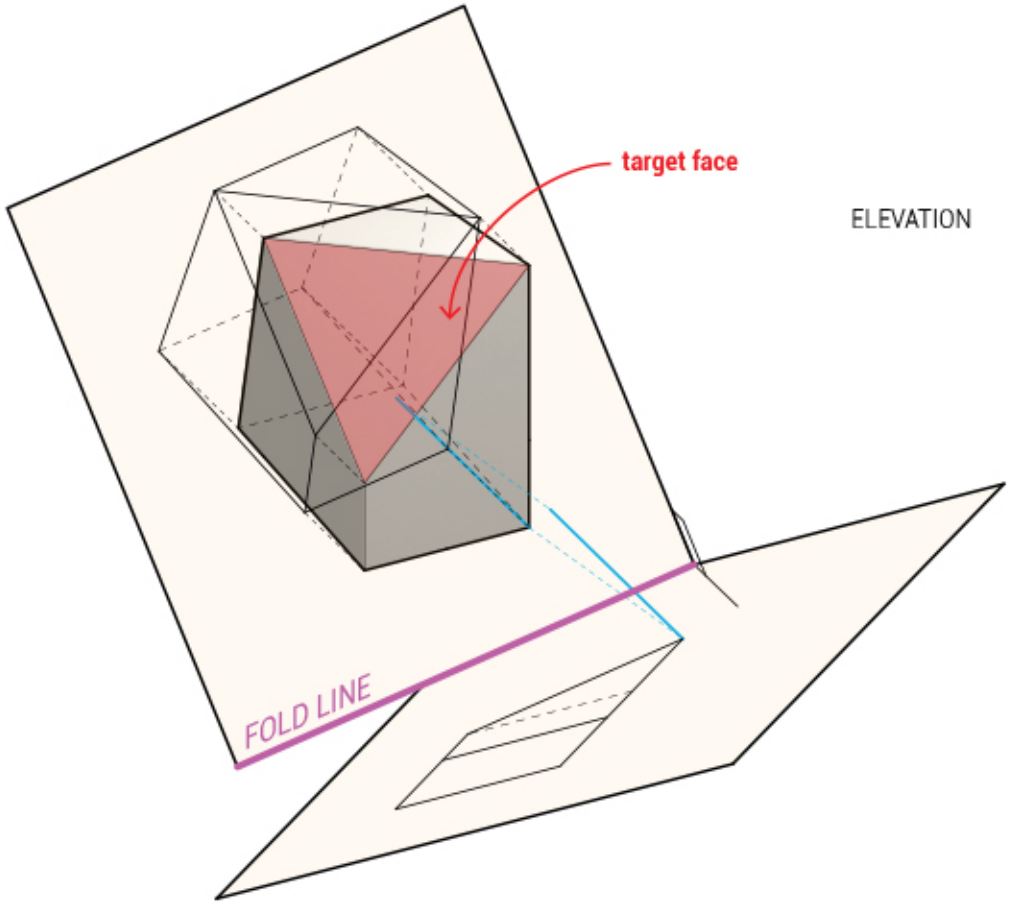
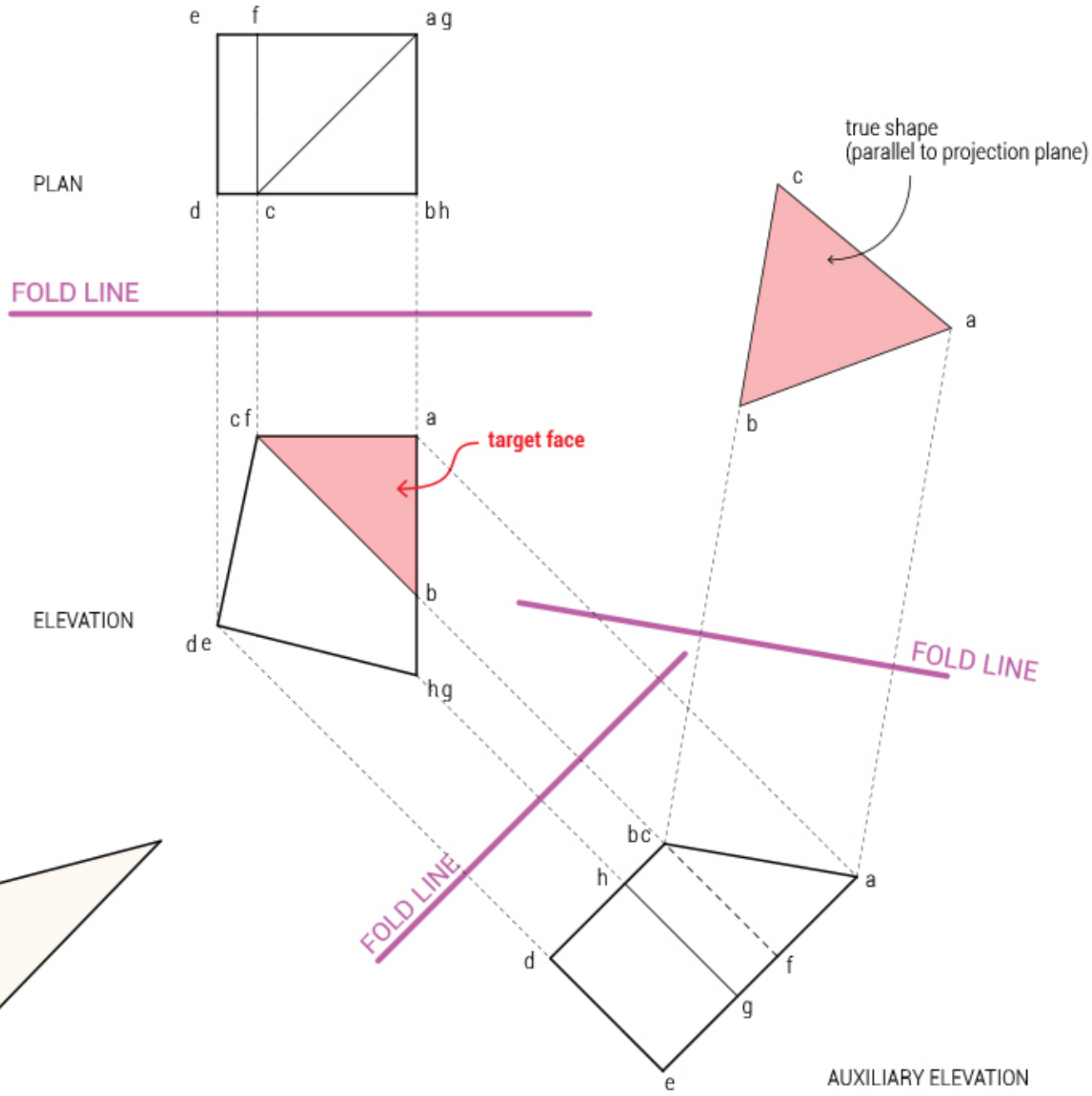
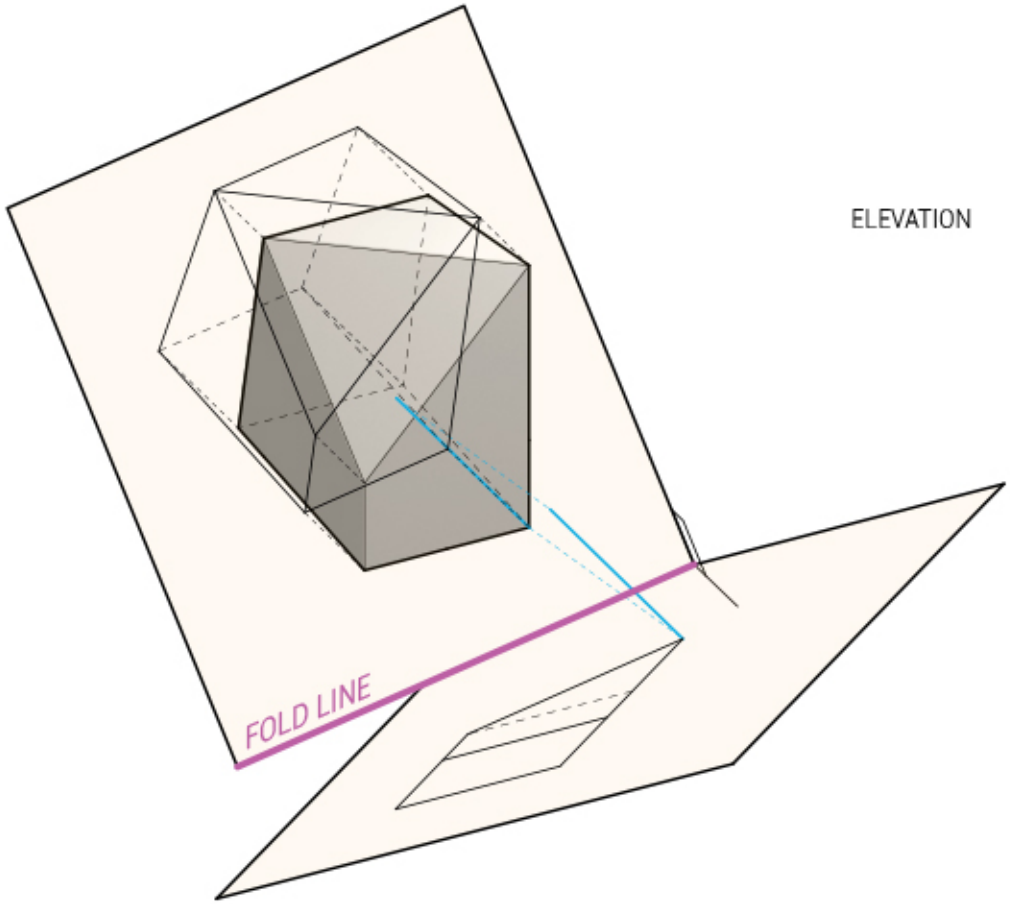
AUXILIARY ELEVATION

7. Construction of target face in true shape



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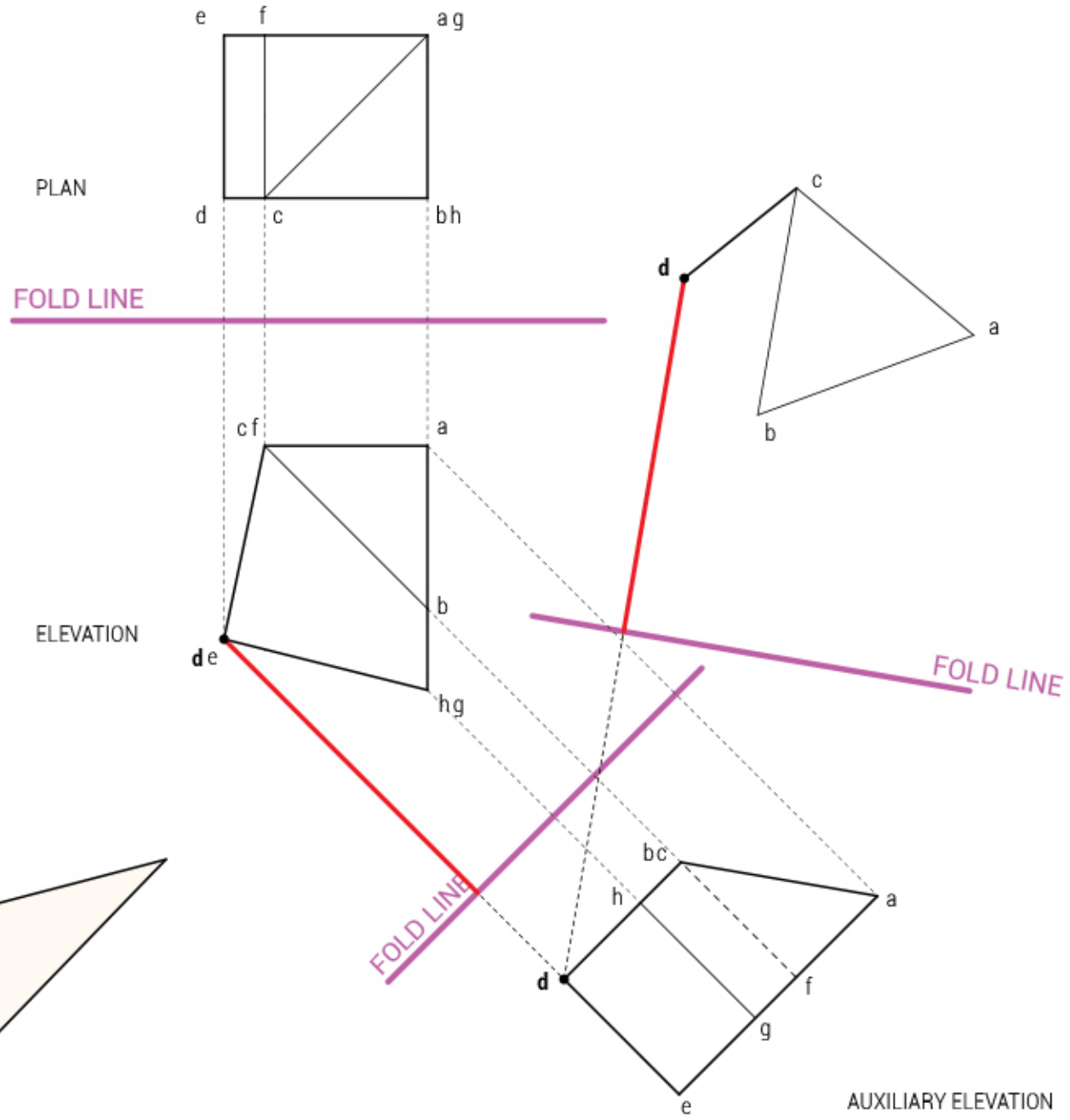
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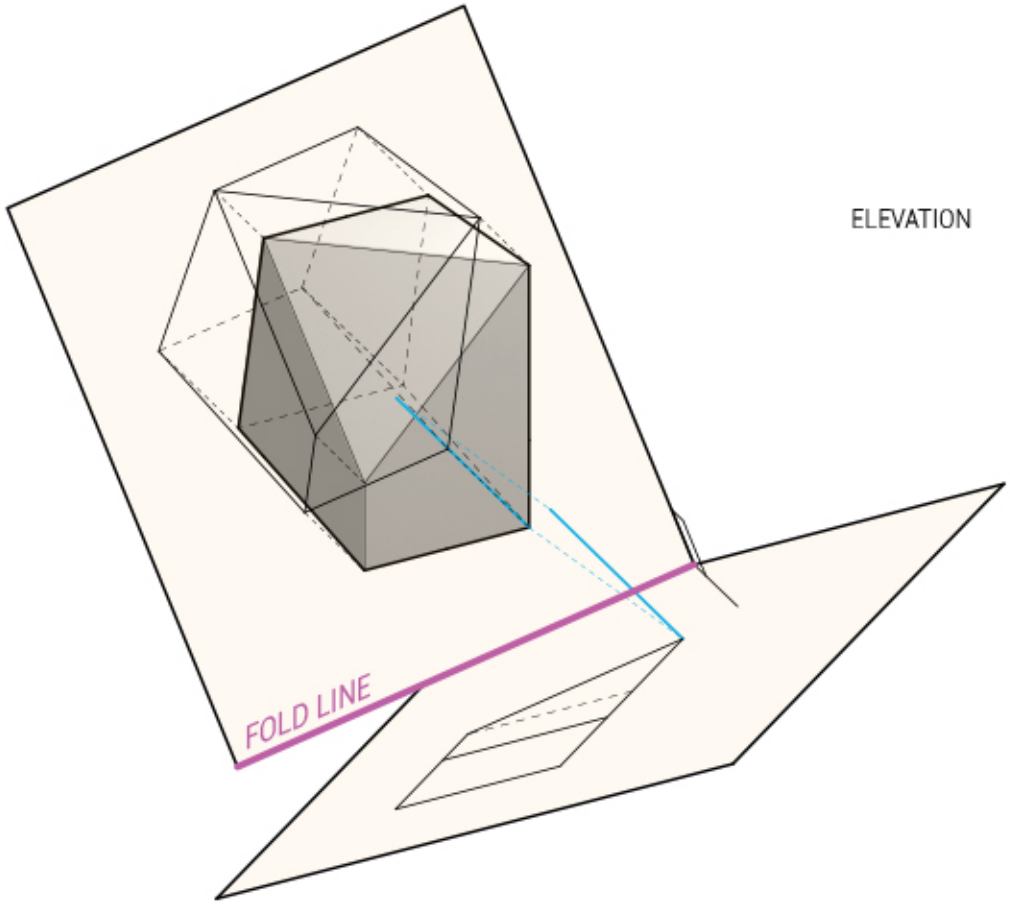
AUXILIARY ELEVATION



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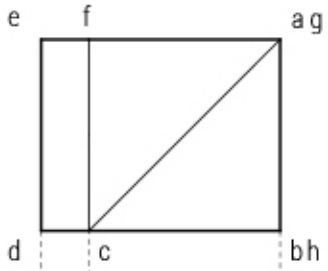

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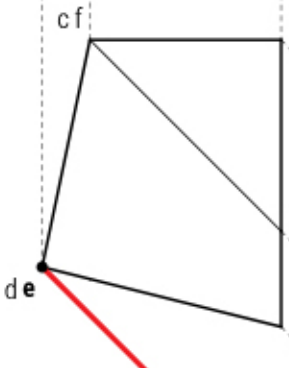

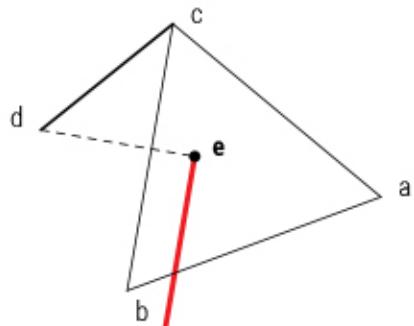

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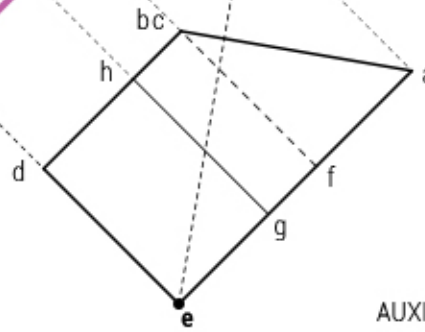
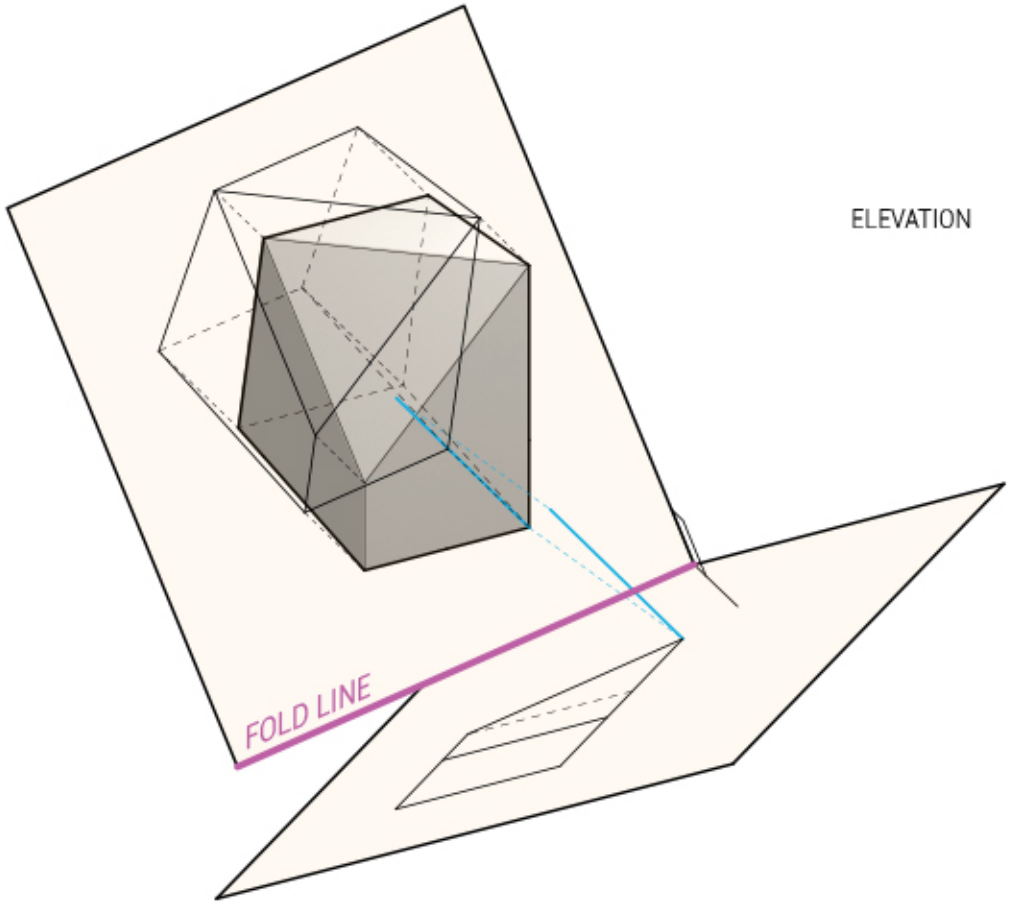


AUXILIARY ELEVATION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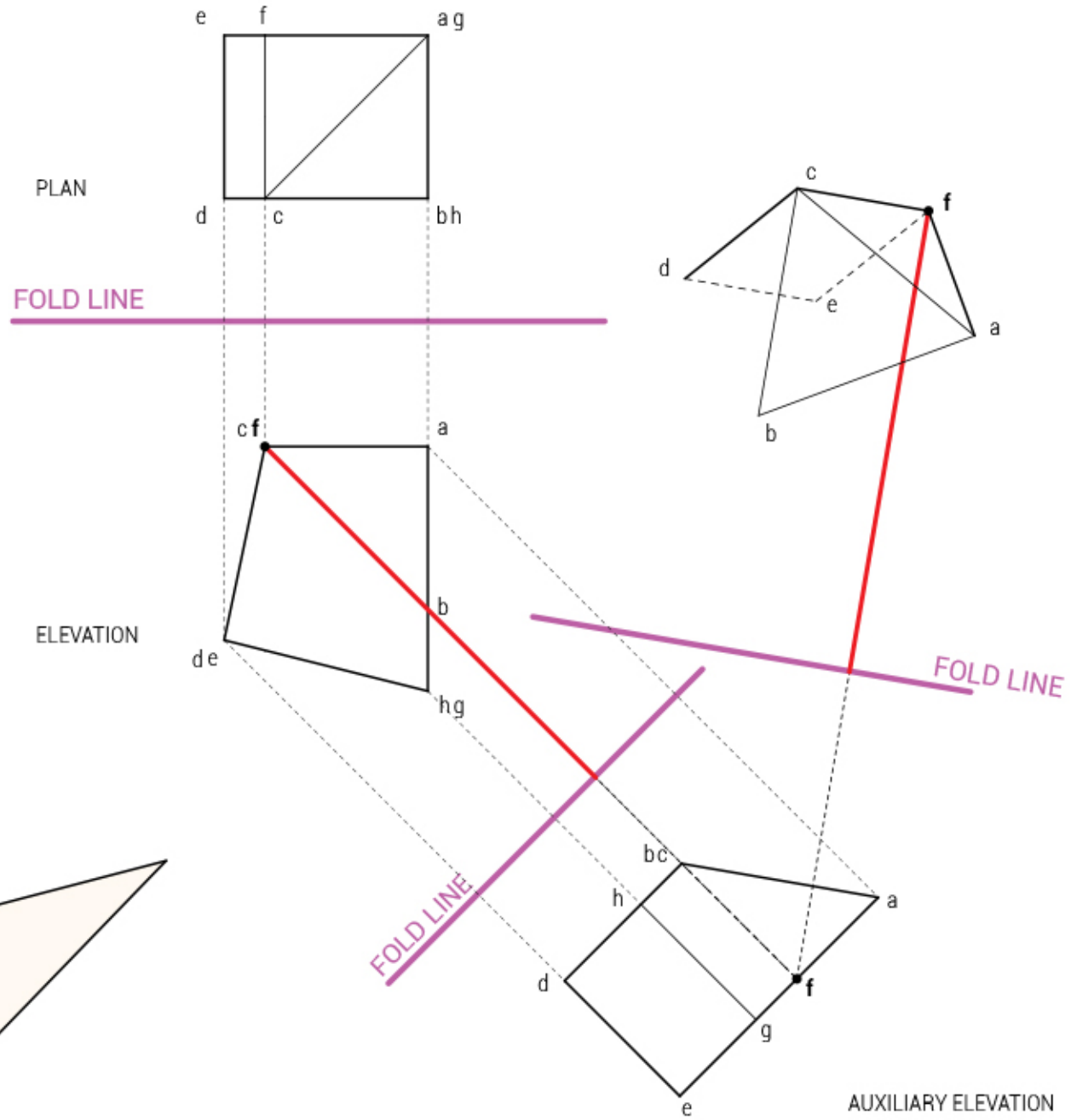
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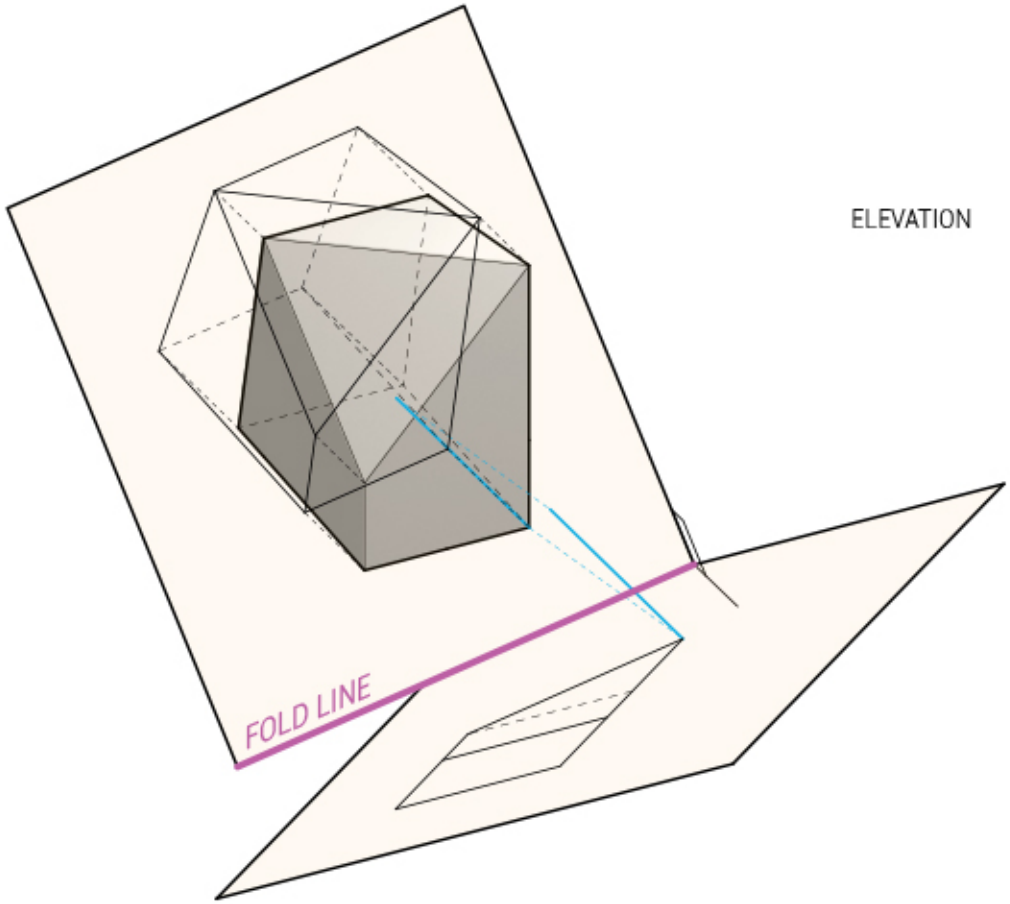
AUXILIARY ELEVATION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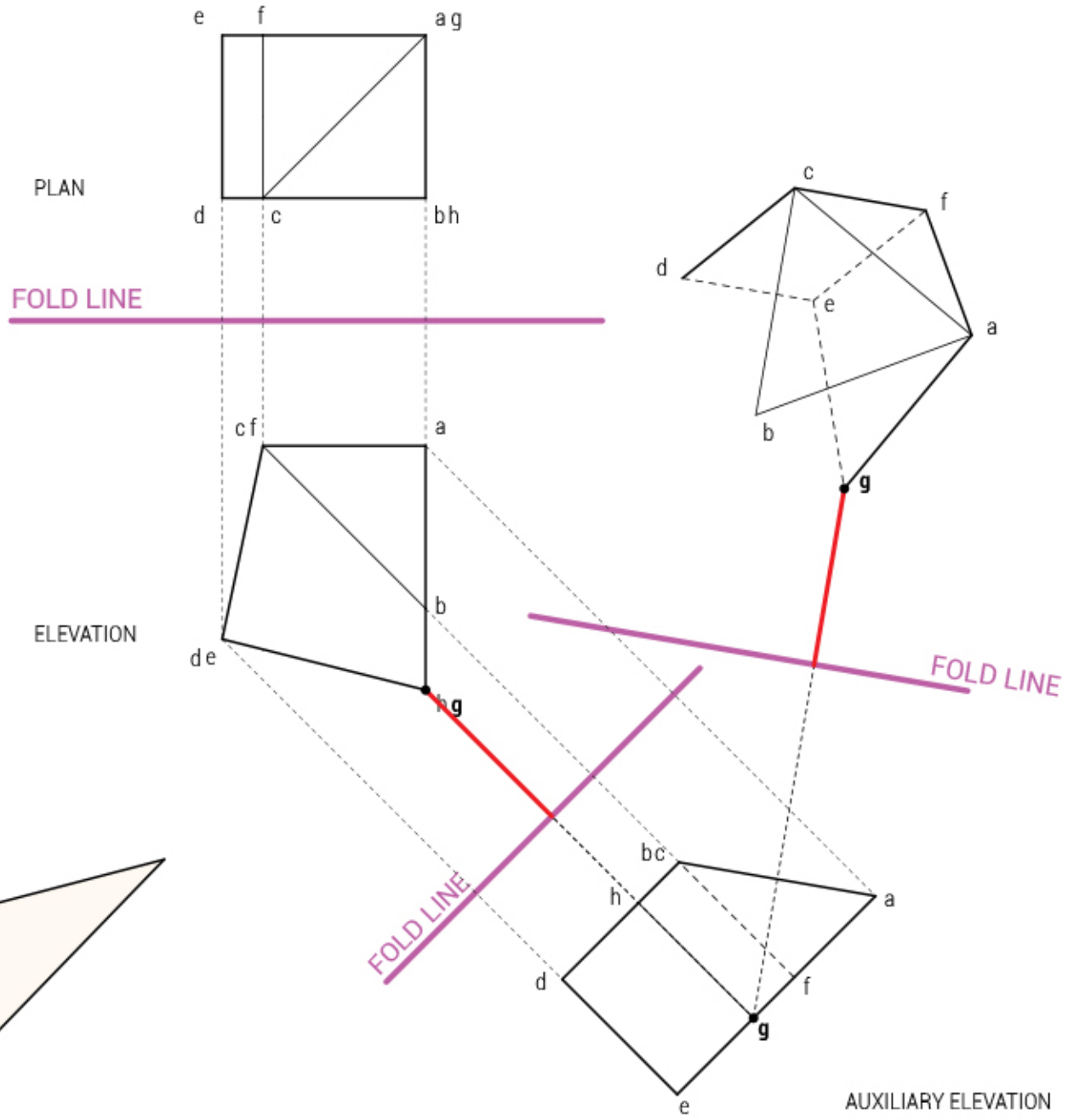
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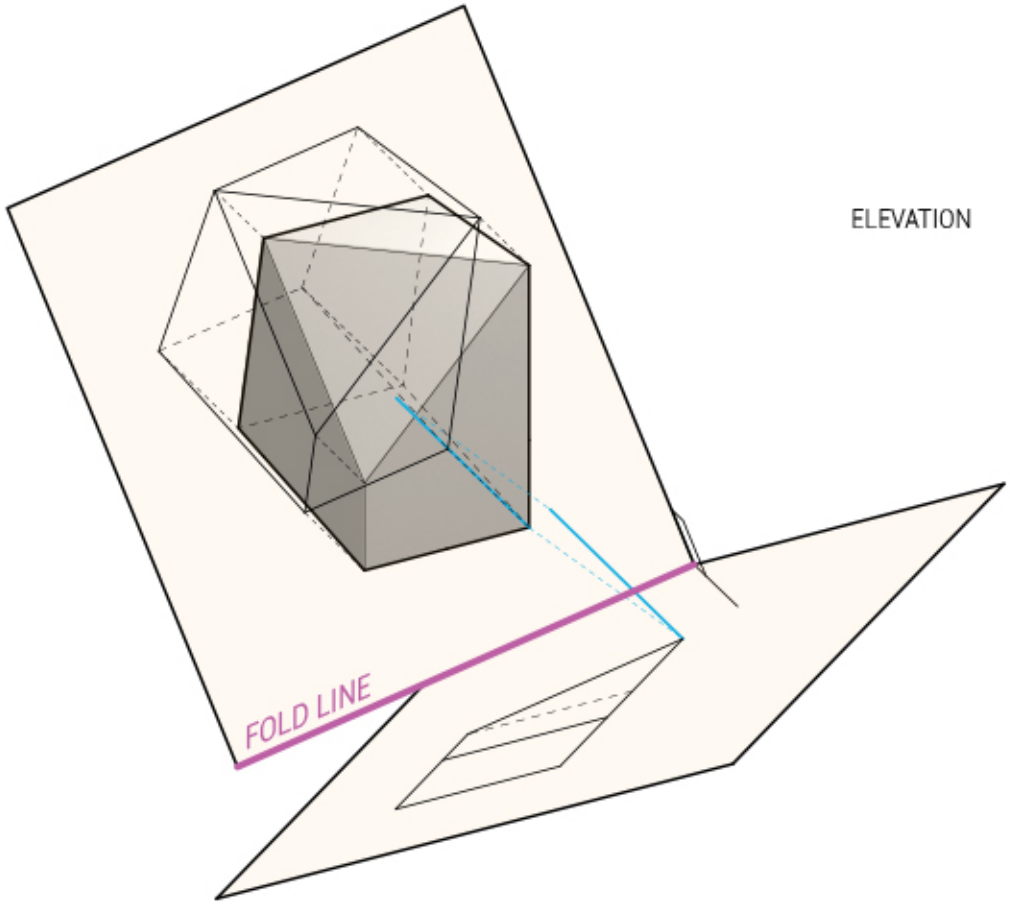
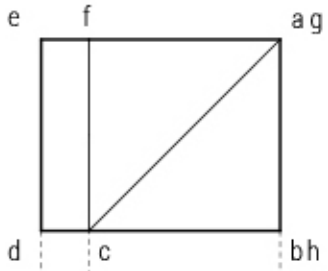
AUXILIARY ELEVATION



PLAN



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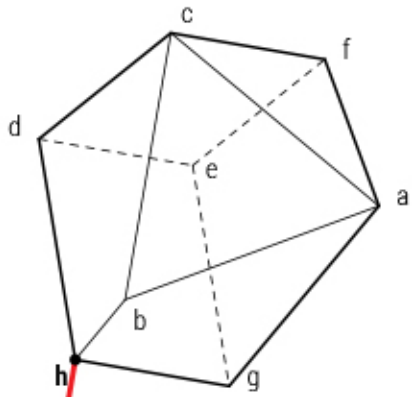
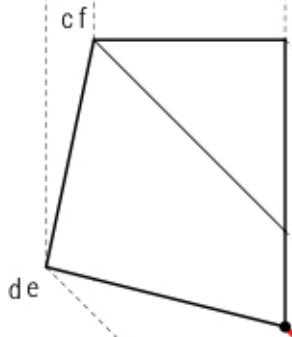
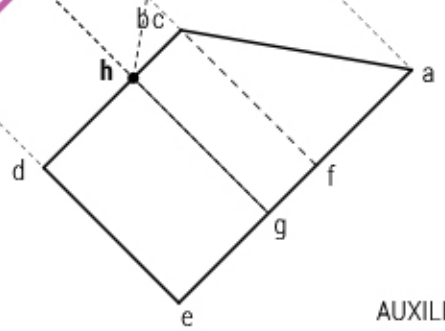


ELEVATION



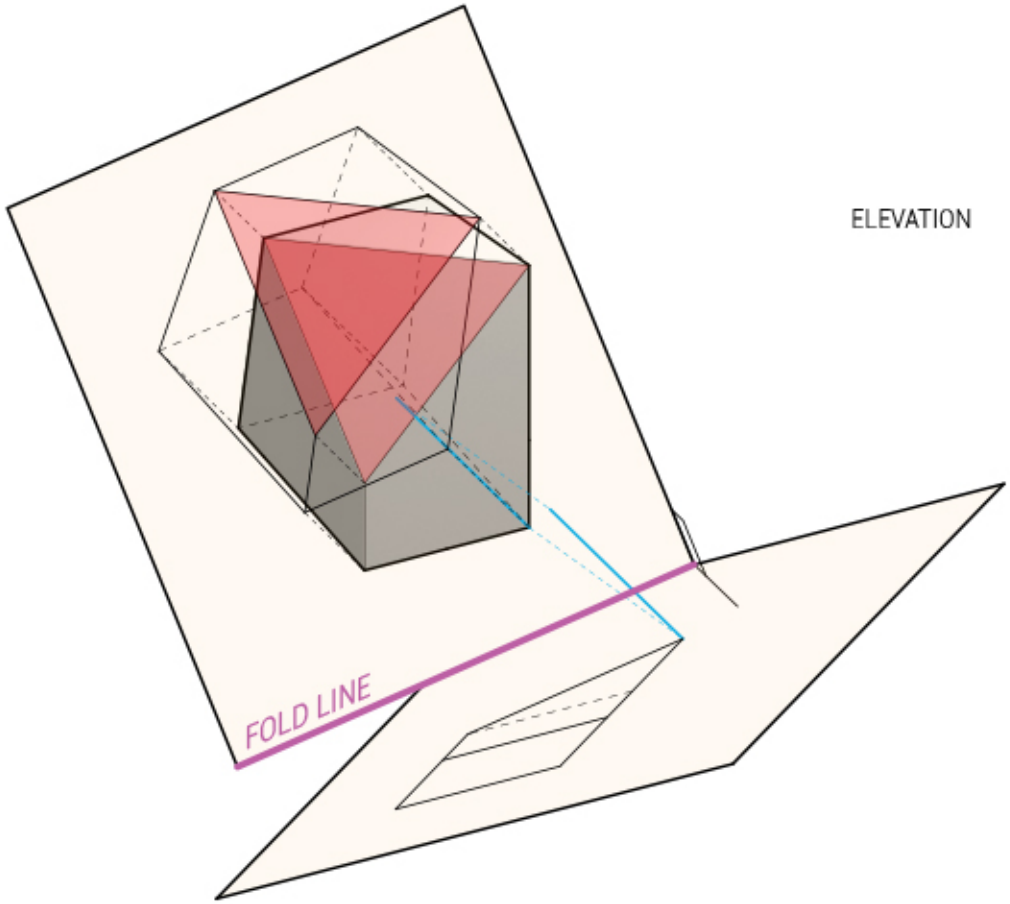
FOLD LINE

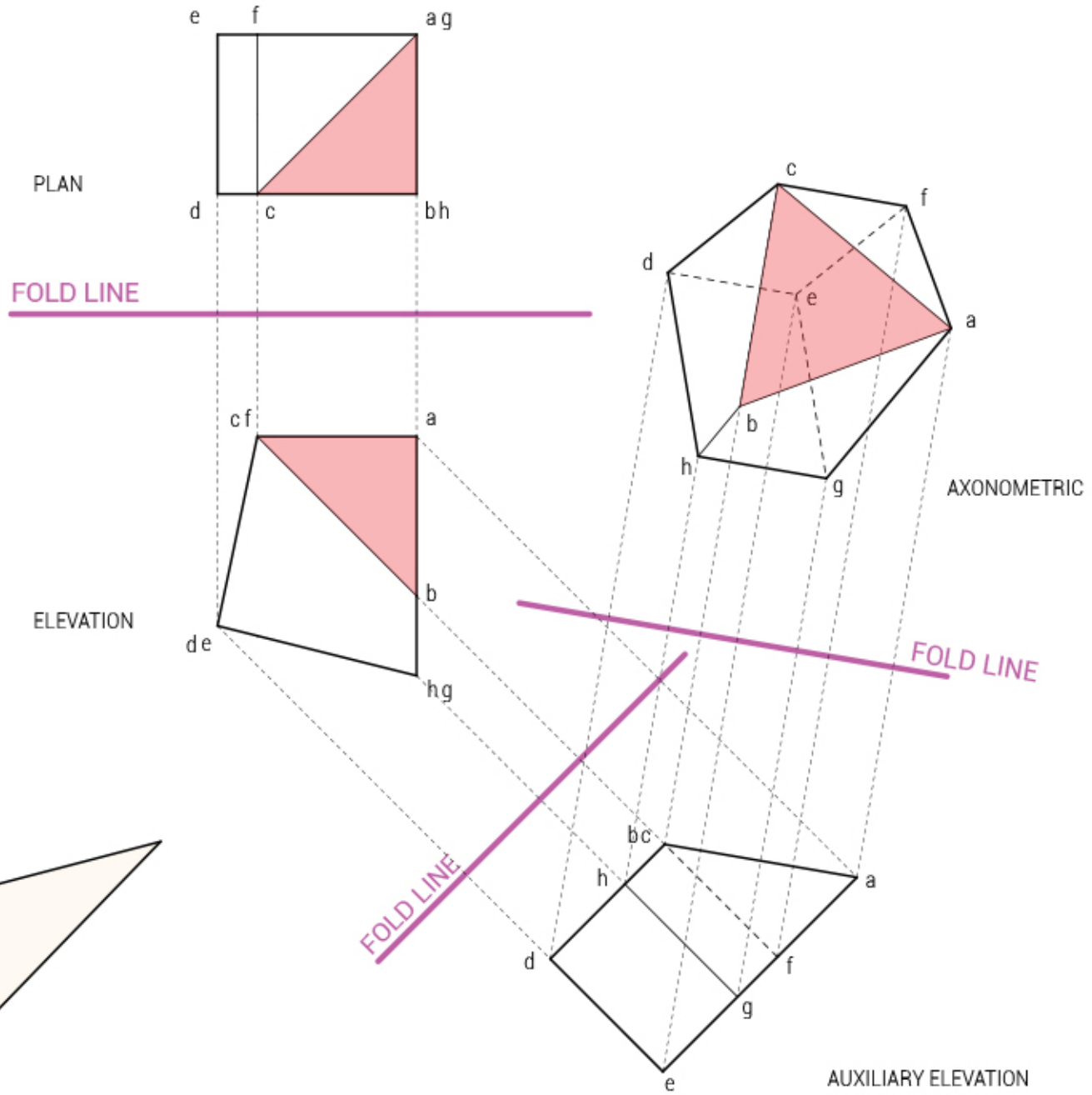
FOLD LINE



AUXILIARY ELEVATION

8. Construction of final axonometric projection with target face in true shape

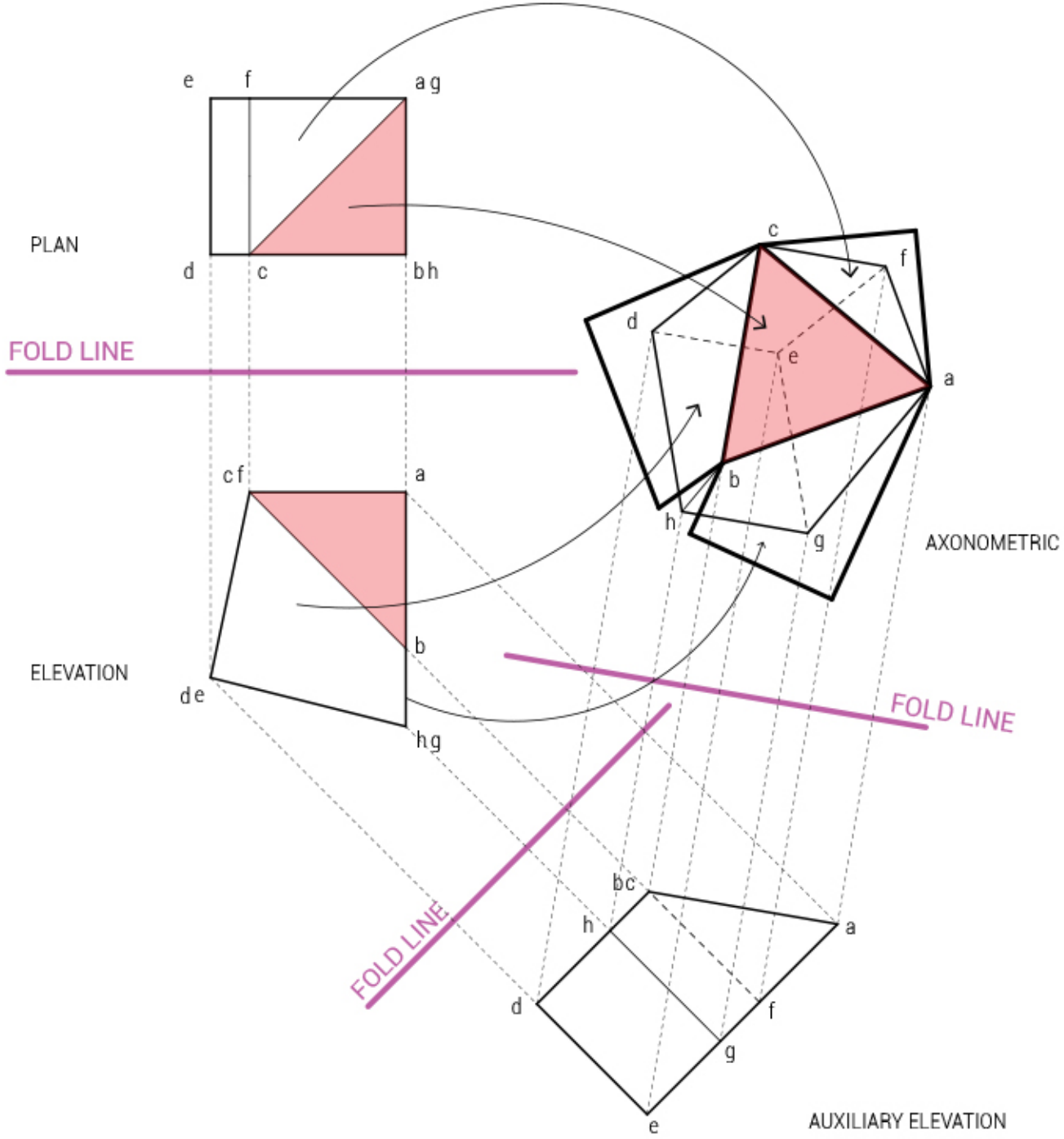




TECHNIQUE 1:
ORIENT TO VIEW

TECHNIQUE 2:
ORIENT TO FACE

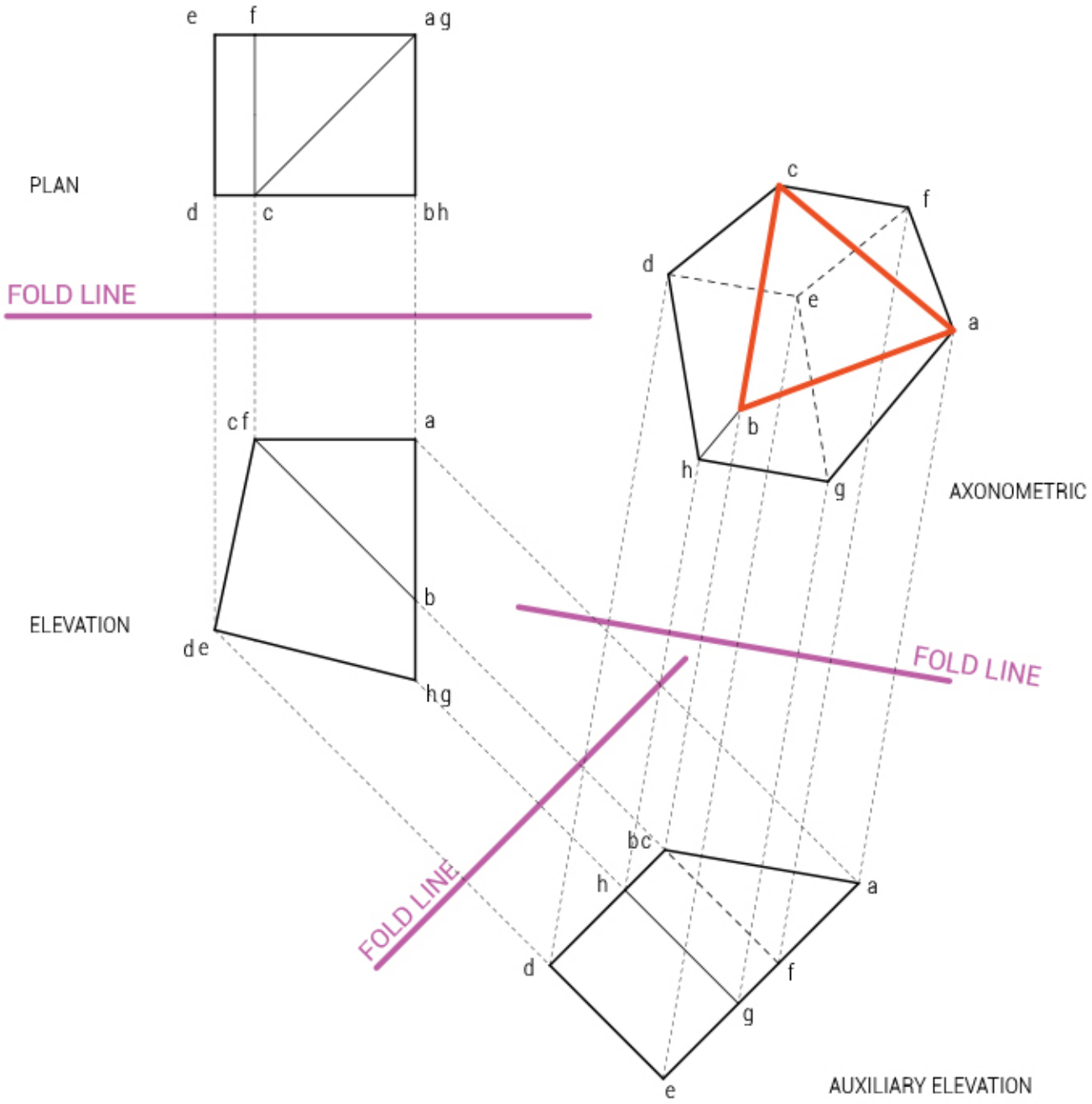
TECHNIQUE 3:
UNFOLD FACES



DRAWING 3:
UNFOLD FACES

Faces can be unfolded into the plane of projection by rotating them around edges that lie parallel to the plane of projection.

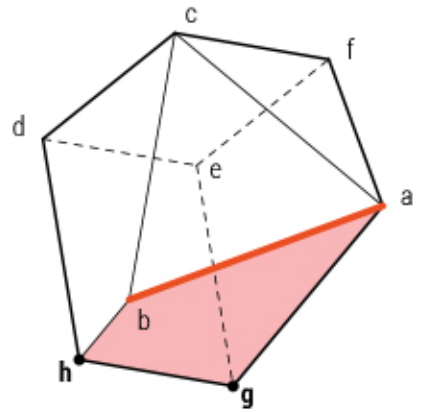
Once a face is unfolded into the plane of projection, it is represented in true shape with accurate distance and angle measures.

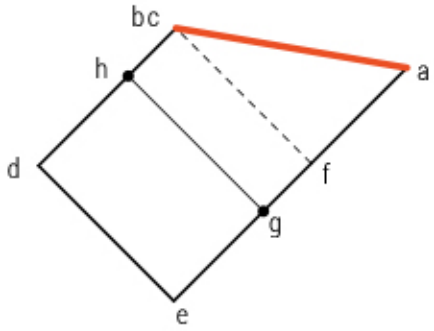


DRAWING 3:
UNFOLD FACES

A face is unfolded by rotating its points (g and h) around the parallel edge (ab) until it also lies in the projection plane.

Once all points are rotated, they can be reconnected to form the unfolded face.

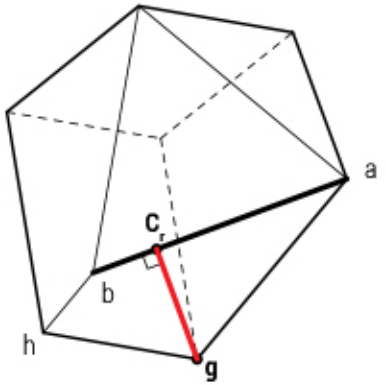


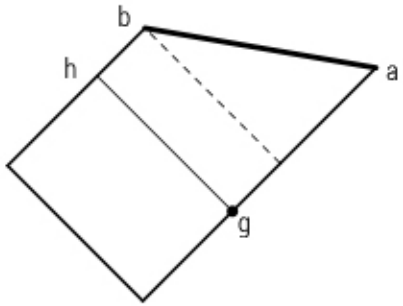


DRAWING 3:
UNFOLD FACES

Steps to rotate a point (g) around a line (ab)parallel to the plane of projection:

1. Construct a line from g to ab that is perpendicular to ab. Where the two lines intersect is the center of rotation (C).



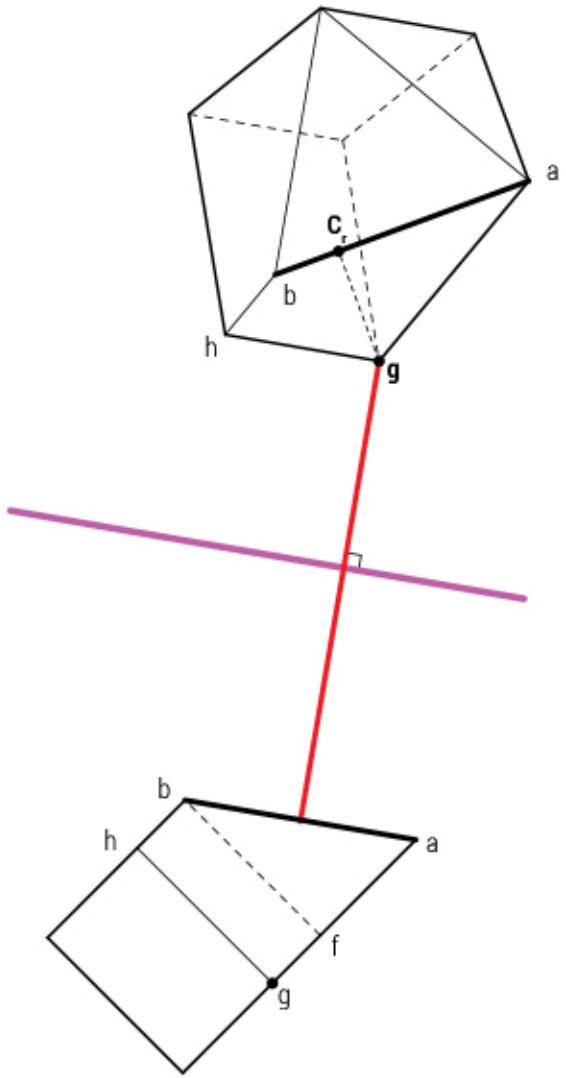


DRAWING 3:
UNFOLD FACES

Steps to rotate a point (g) around a line (ab)parallel to the plane of projection:

1. Construct a line from g to ab that is perpendicular to ab. Where the two lines intersect is the center of rotation (C).

2. Construct a line perpendicular to the fold line from g to the projection of ab.



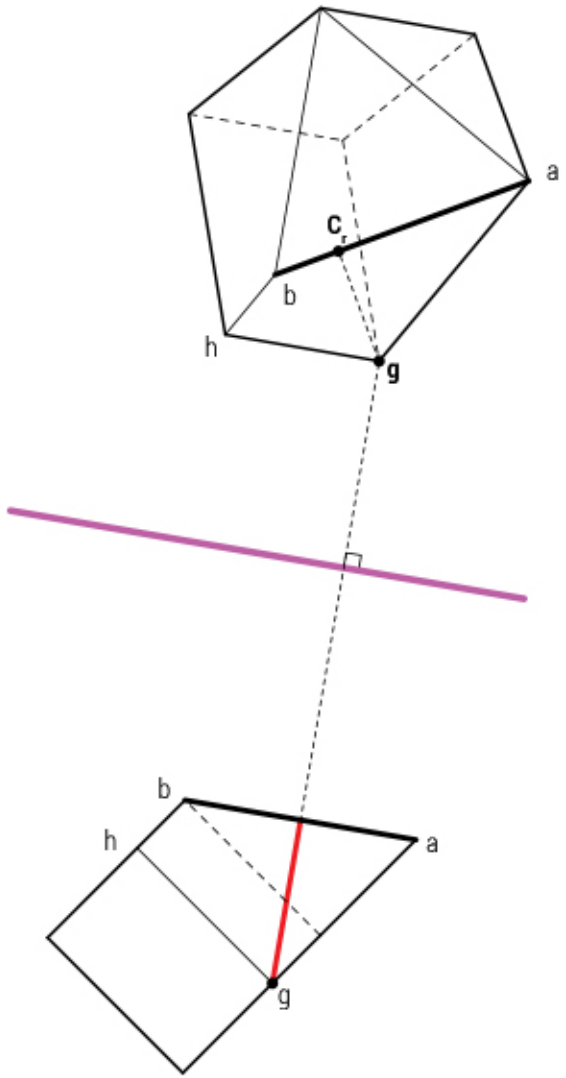
DRAWING 3:
UNFOLD FACES

Steps to rotate a point (g) around a line (ab)parallel to the plane of projection:

1. Construct a line from g to ab that is perpendicular to ab. Where the two lines intersect is the center of rotation (C).

2. Construct a line perpendicular to the fold line from g to the projection of ab.

3. Construct a line from the end of the previous line to the projection of g.



DRAWING 3:
UNFOLD FACES

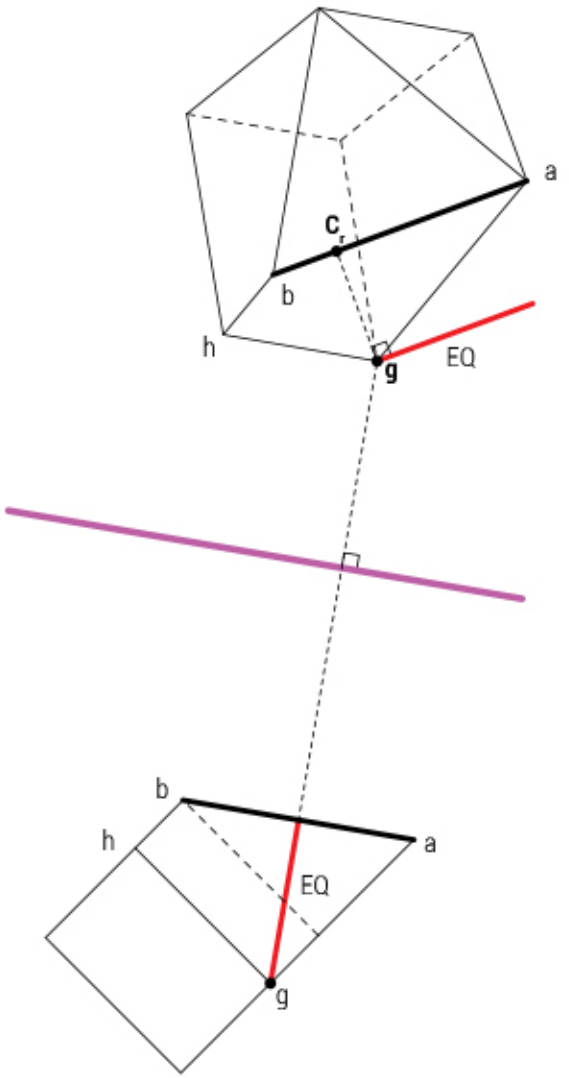
Steps to rotate a point (g) around a line (ab)parallel to the plane of projection:

1. Construct a line from g to ab that is perpendicular to ab. Where the two lines intersect is the center of rotation (C).

2. Construct a line perpendicular to the fold line from g to the projection of ab.

3. Construct a line from the end of the previous line to the projection of g.

4. Construct a line from g that is parallel to ab and of equal length to the previous line.



DRAWING 3:
UNFOLD FACES

Steps to rotate a point (g) around a line (ab)parallel to the plane of projection:

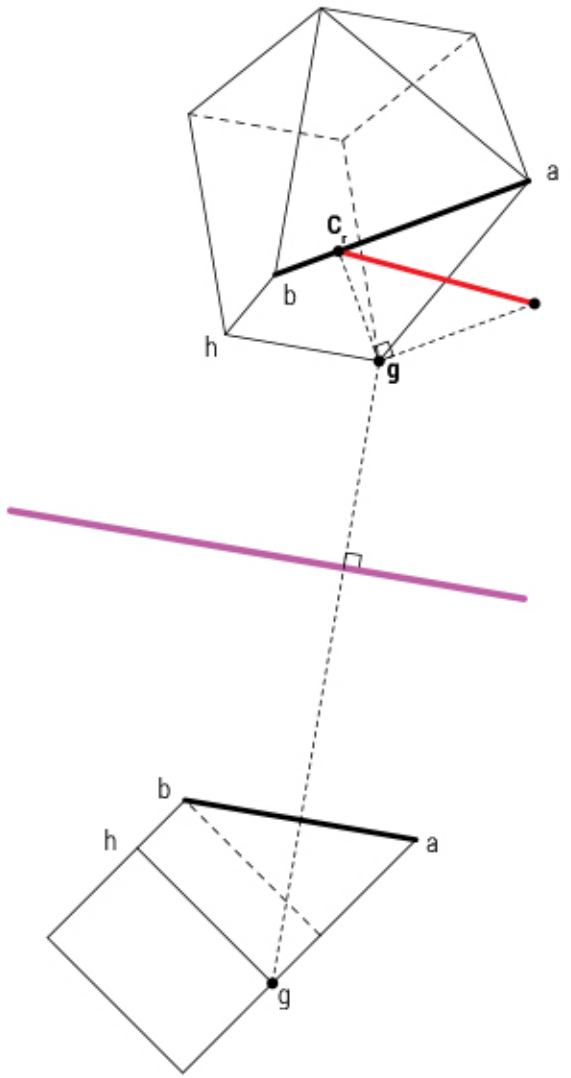
1. Construct a line from g to ab that is perpendicular to ab. Where the two lines intersect is the center of rotation (C_r).

2. Construct a line perpendicular to the fold line from g to the projection of ab.

3. Construct a line from the end of the previous line to the projection of g.

4. Construct a line from g that is parallel to ab and of equal length to the previous line.

5. Construct a line from C_r to the end of the previous line.



DRAWING 3:
UNFOLD FACES

Steps to rotate a point (g) around a line (ab)parallel to the plane of projection:

1. Construct a line from g to ab that is perpendicular to ab. Where the two lines intersect is the center of rotation (C_r).

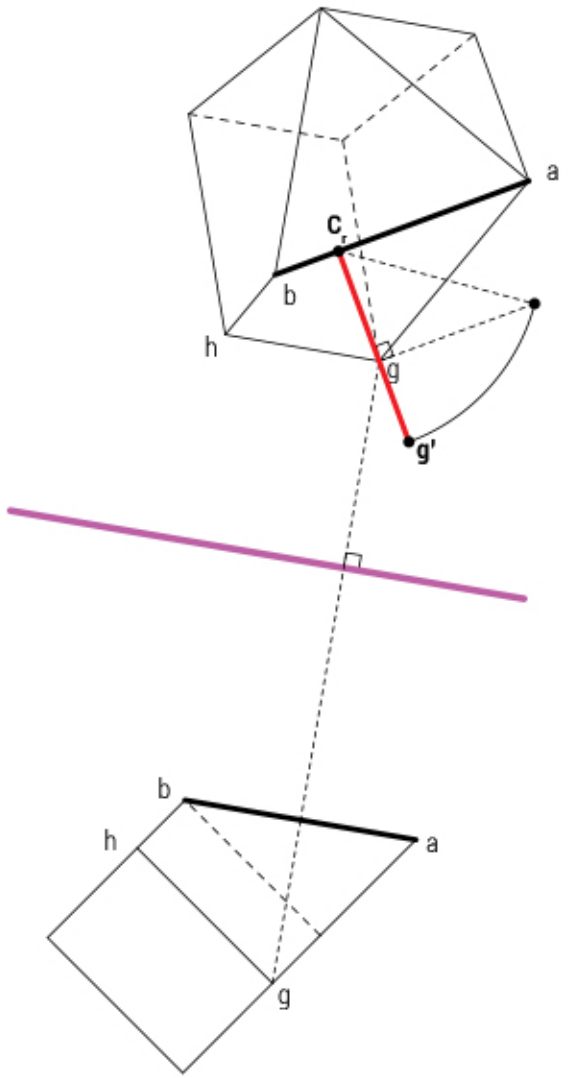
2. Construct a line perpendicular to the fold line from g to the projection of ab.

3. Construct a line from the end of the previous line to the projection of g.

4. Construct a line from g that is parallel to ab and of equal length to the previous line.

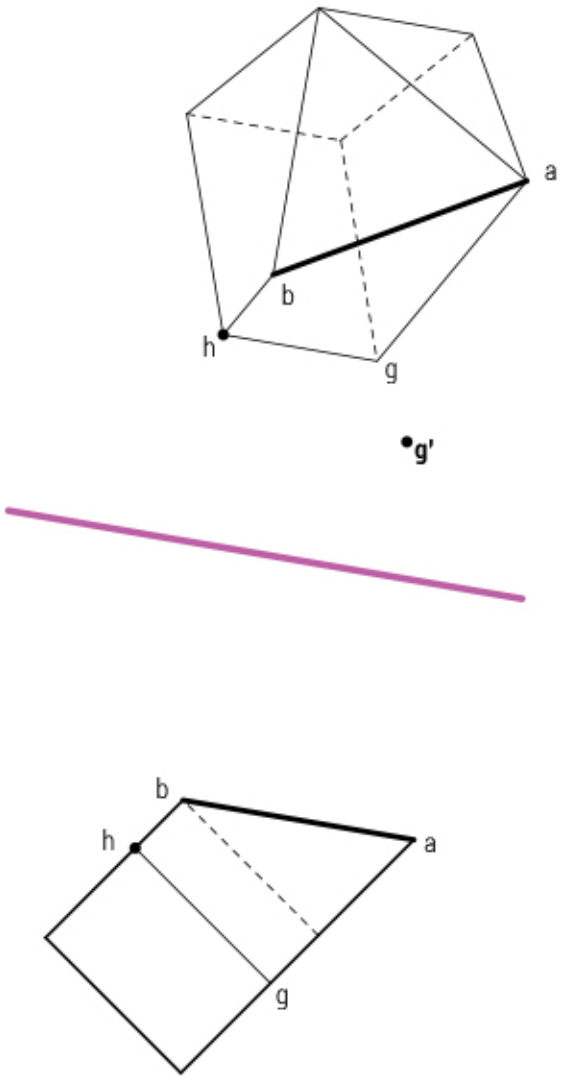
5. Construct a line from C_r to the end of the previous line.

6. Construct a line that goes through Cr and g and is the same length as the previous line.



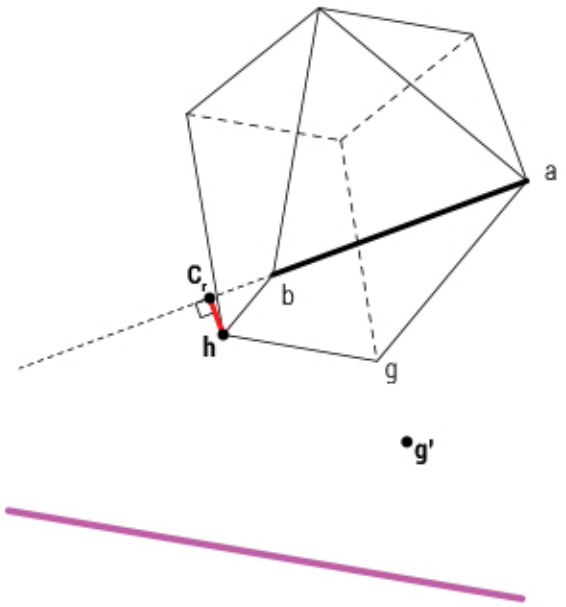
DRAWING 3:
UNFOLD FACES

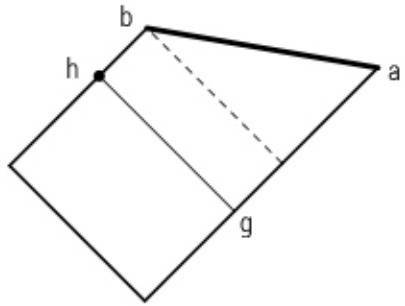
Final location of g rotated into the plane of projection



DRAWING 3:
UNFOLD FACES

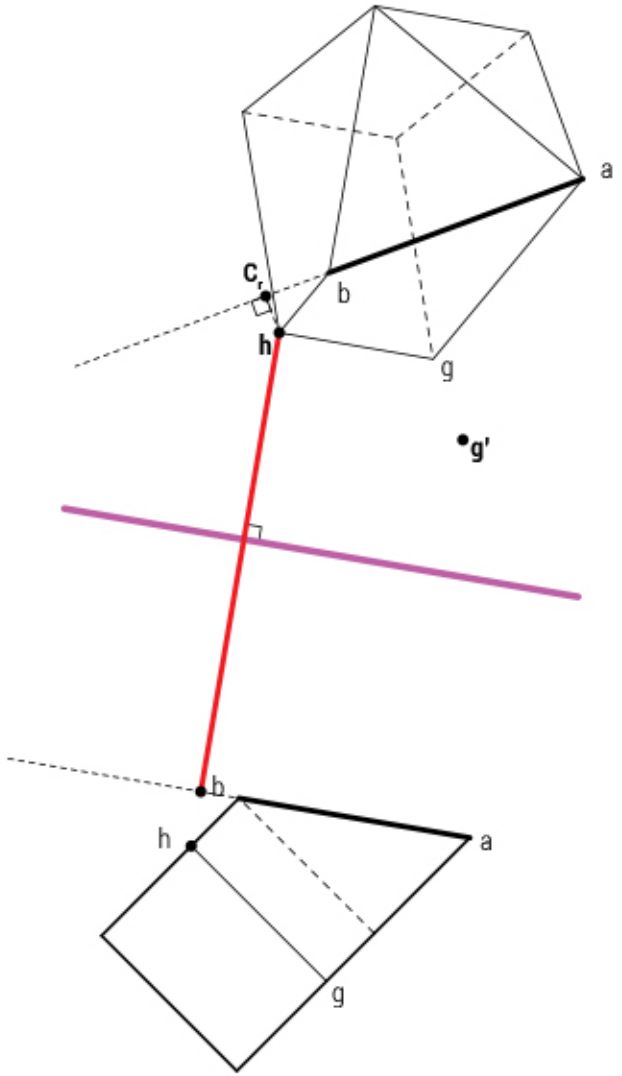
Repeat steps for point h





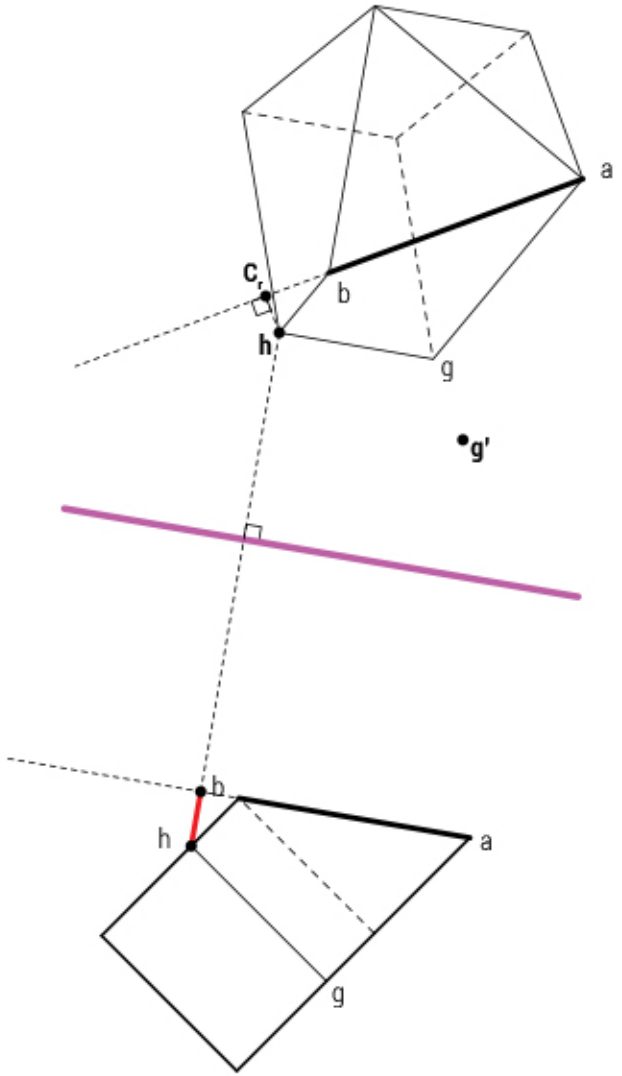
DRAWING 3:
UNFOLD FACES

Repeat steps for point h



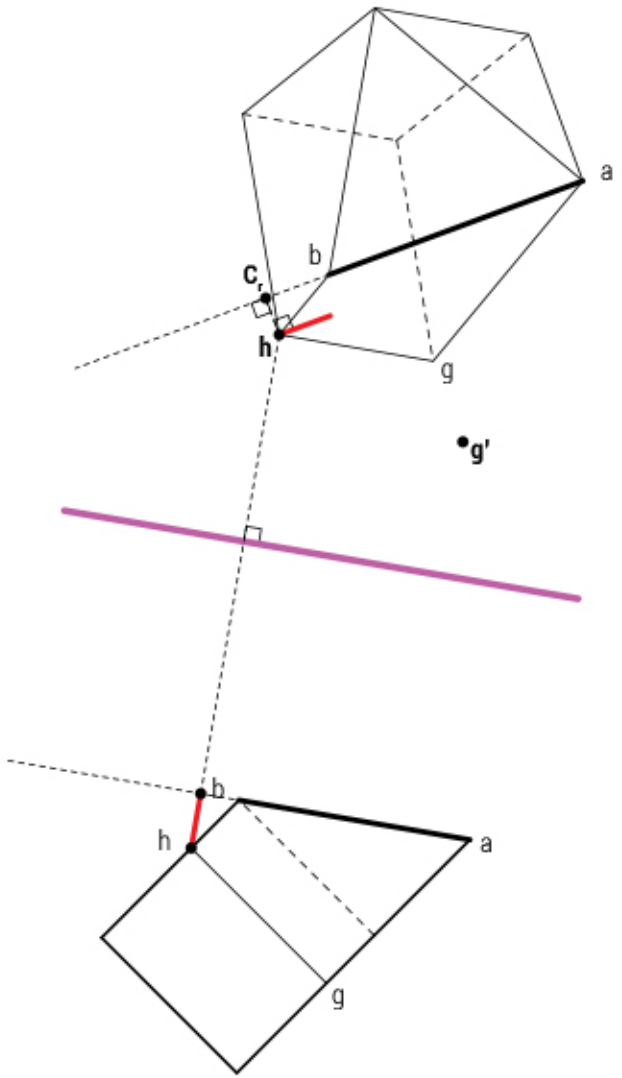
DRAWING 3:
UNFOLD FACES

Repeat steps for point h



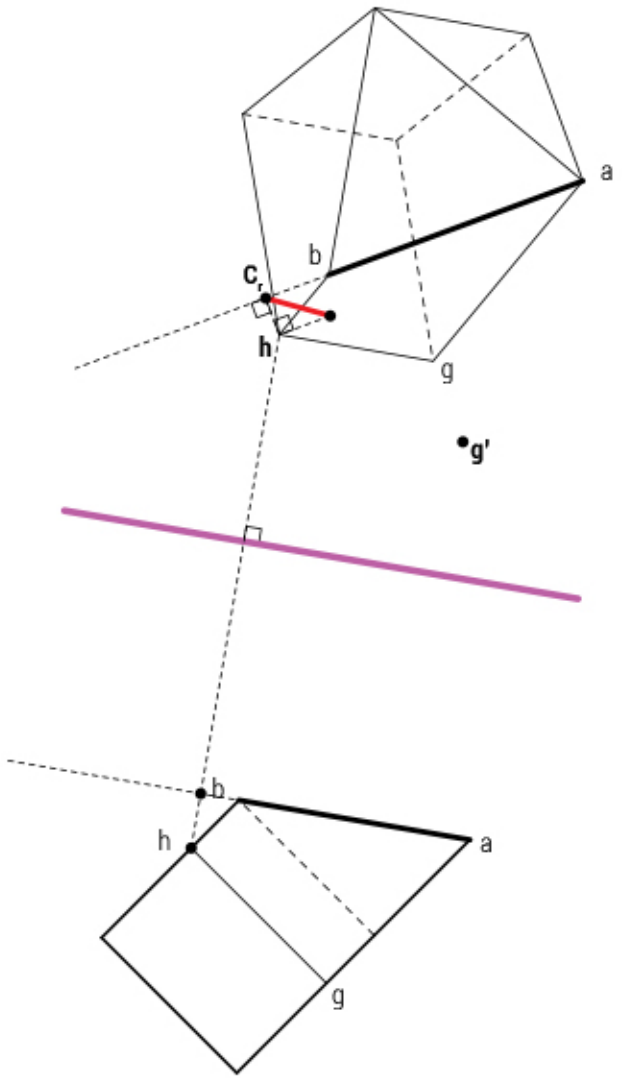
DRAWING 3:
UNFOLD FACES

Repeat steps for point h



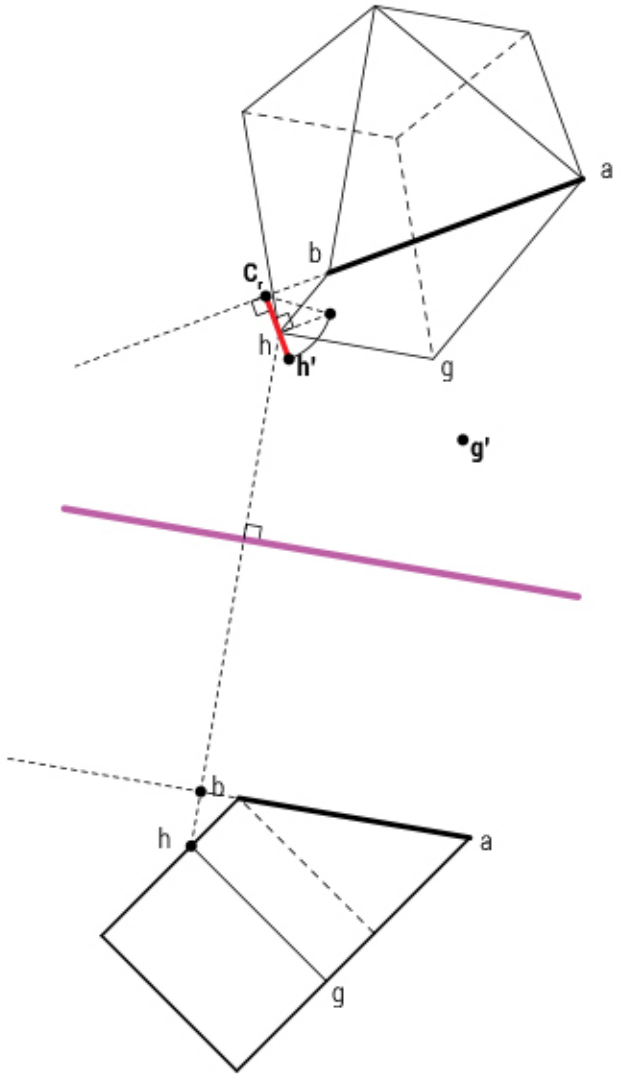
DRAWING 3:
UNFOLD FACES

Repeat steps for point h



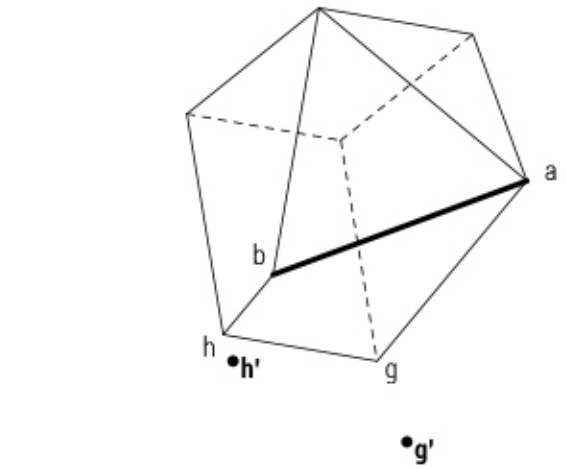
DRAWING 3:
UNFOLD FACES

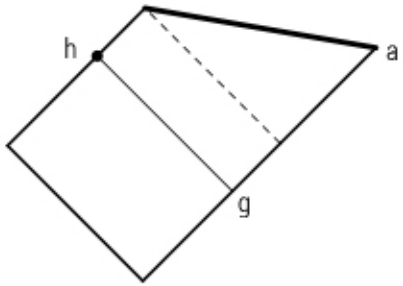
Repeat steps for point h



DRAWING 3:
UNFOLD FACES

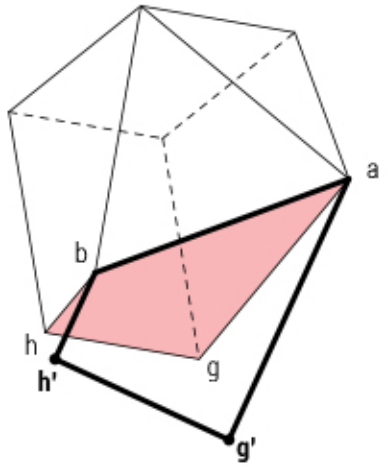
Final location of h rotated into the plane of projection

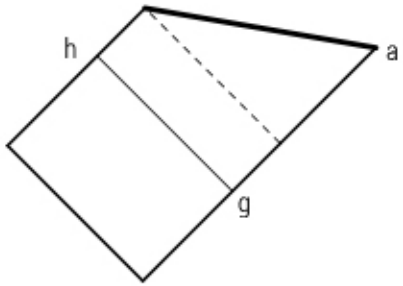




DRAWING 3:
UNFOLD FACES

Reconnect points to form face unfolded into projection plane. This face is now in true shape and can be used to derive exact dimensions and angles of the face.

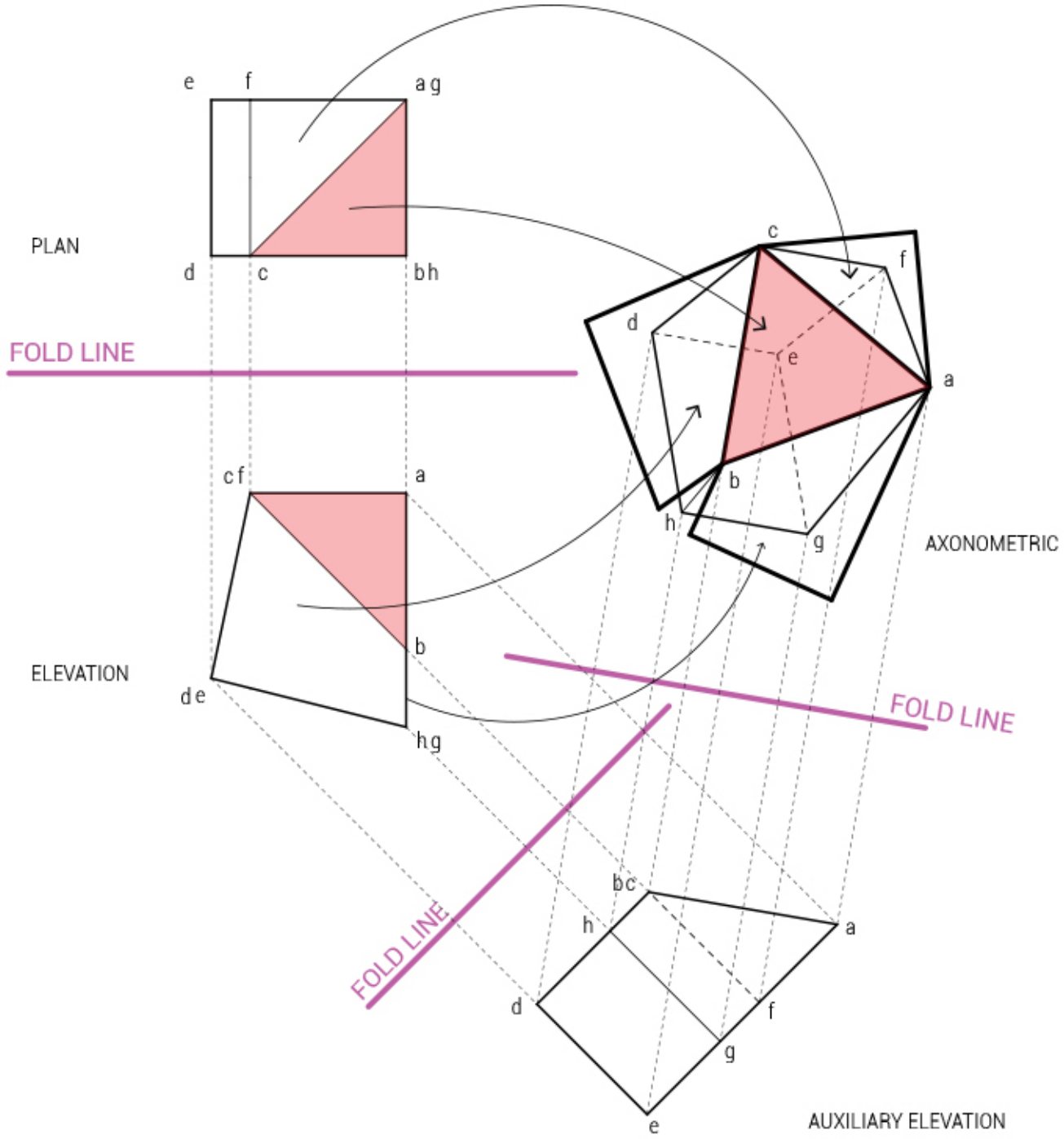


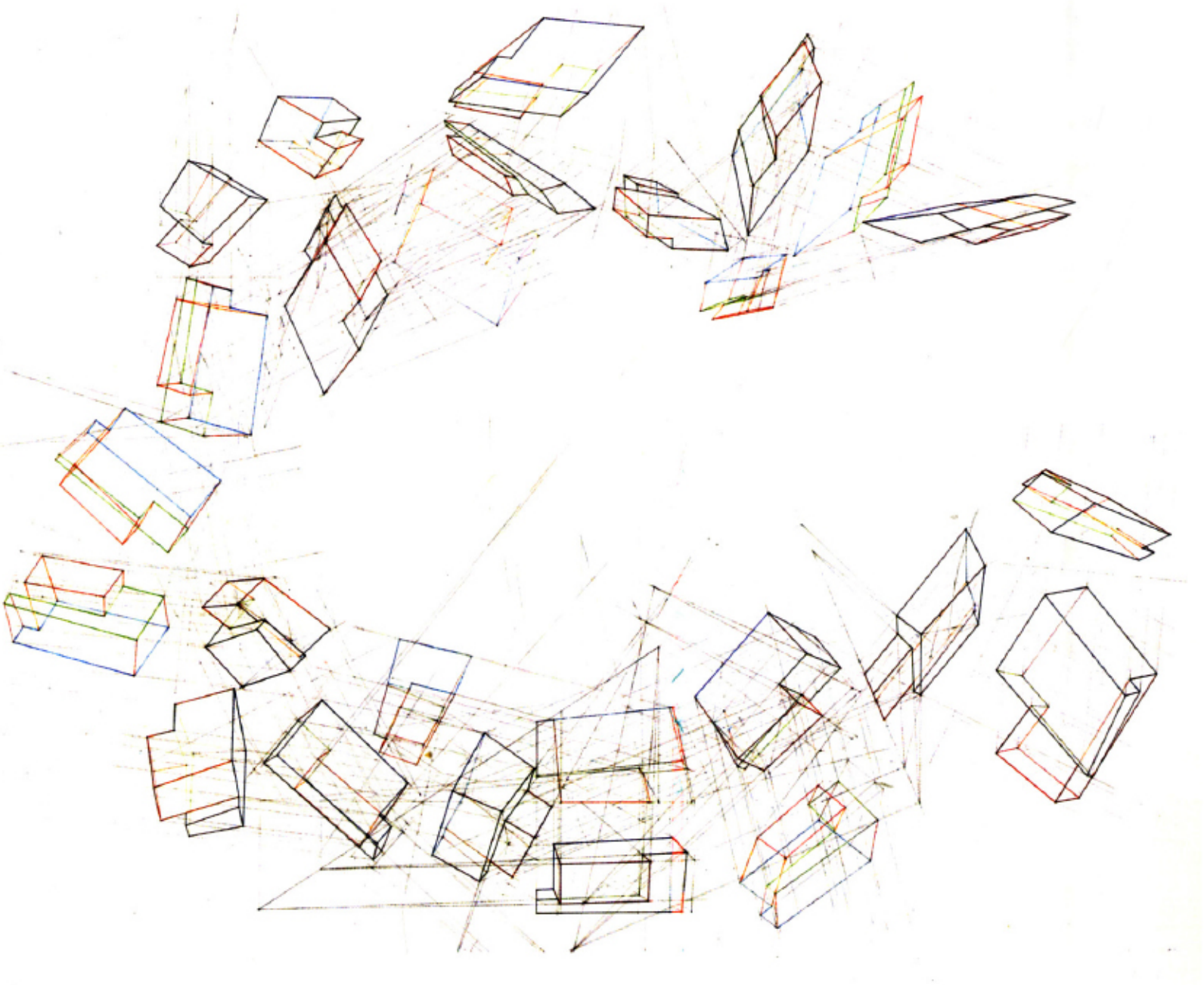


TECHNIQUE 1:
ORIENT TO VIEW

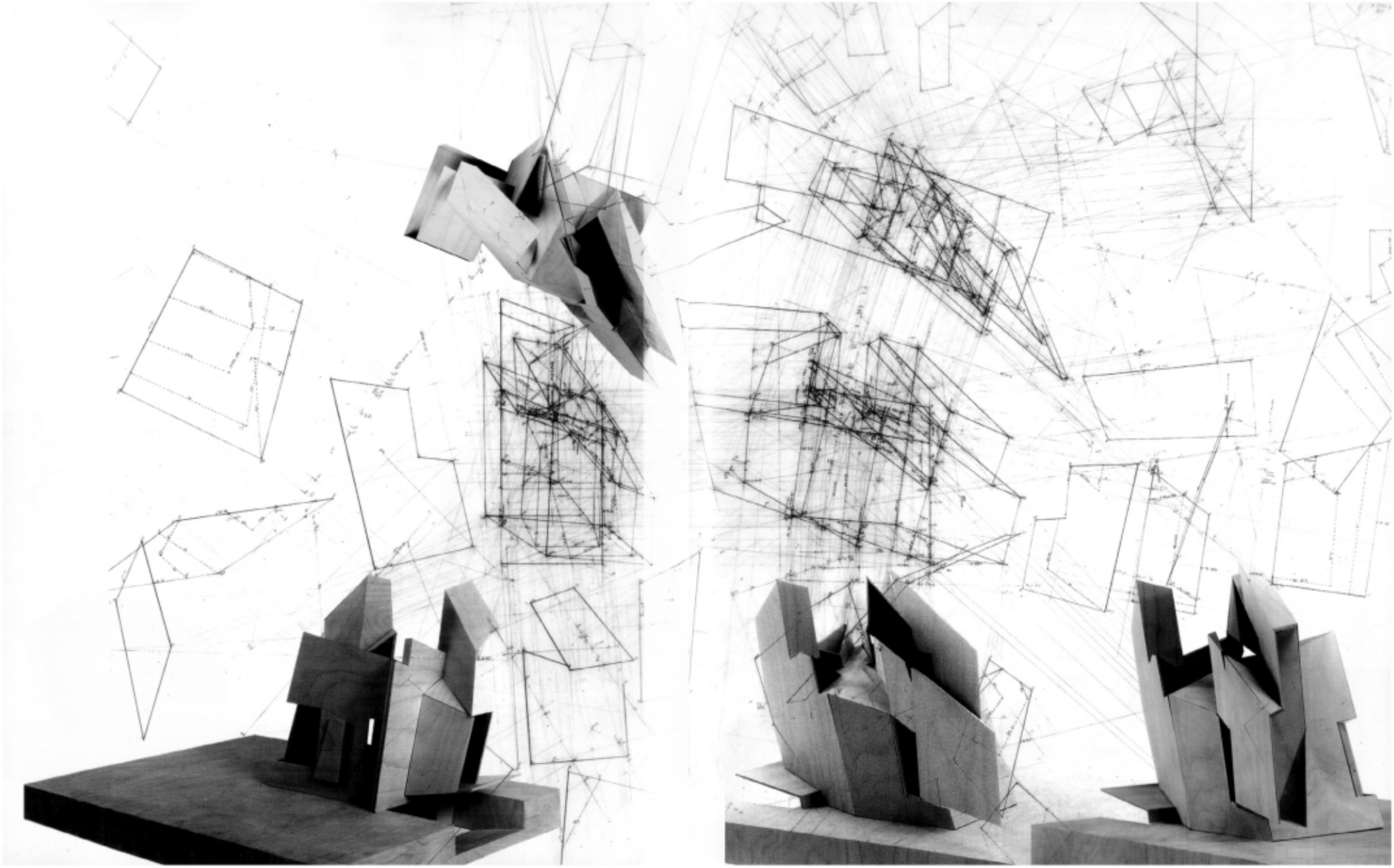
TECHNIQUE 2:
ORIENT TO FACE

TECHNIQUE 3:
UNFOLD FACES





Cohen, Preston Scott, Contested Symmetries



Cohen, Preston Scott, Contested Symmetries

DESCRIPTIVE GEOMETRY DEMO