Lecture 6
# Development of Surfaces
(Ch. 15, ND Bhatt)
ME 119

Introduction

- **Geometric surface** – surface generated by a motion of a straight line (ruled surface) or by a motion of a curve (doubly curved surface)

- **Types of Geometric Solids**
    1. Solids bounded by plane surfaces (prism, pyramid, etc)
    2. Solids bounded by single-curved surfaces (cone, cylinder)
    3. Solids bounded by doubly-curved surfaces (sphere, torus, etc) .

- **Development**:A development is the un-folded / unrolled flat / plane figure of a 3-D object. It is also called a pattern where the plane may show the true size of each area of the object. When the pattern is cut, it can be rolled or folded back into the original object
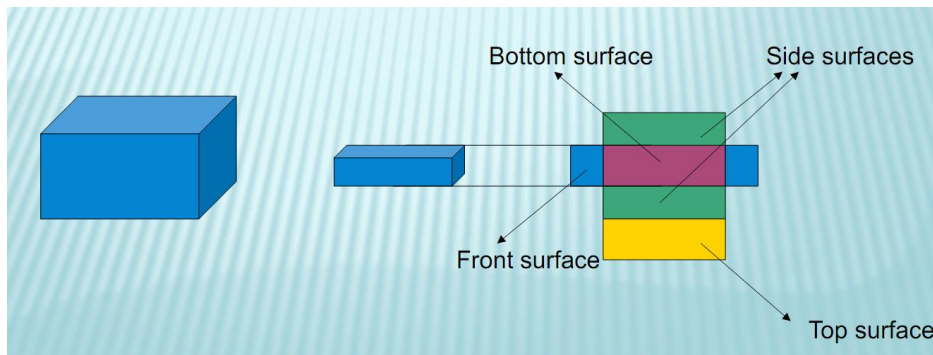
Motivation

Sheet metal components/thin plates are widely used in wide variety of industry – automobile, aerospace, home appliances, ship building, oil and gas

Components have to be fabricated with good degree of accuracy

The fabrication is usually done by bending sheet metal flat plates
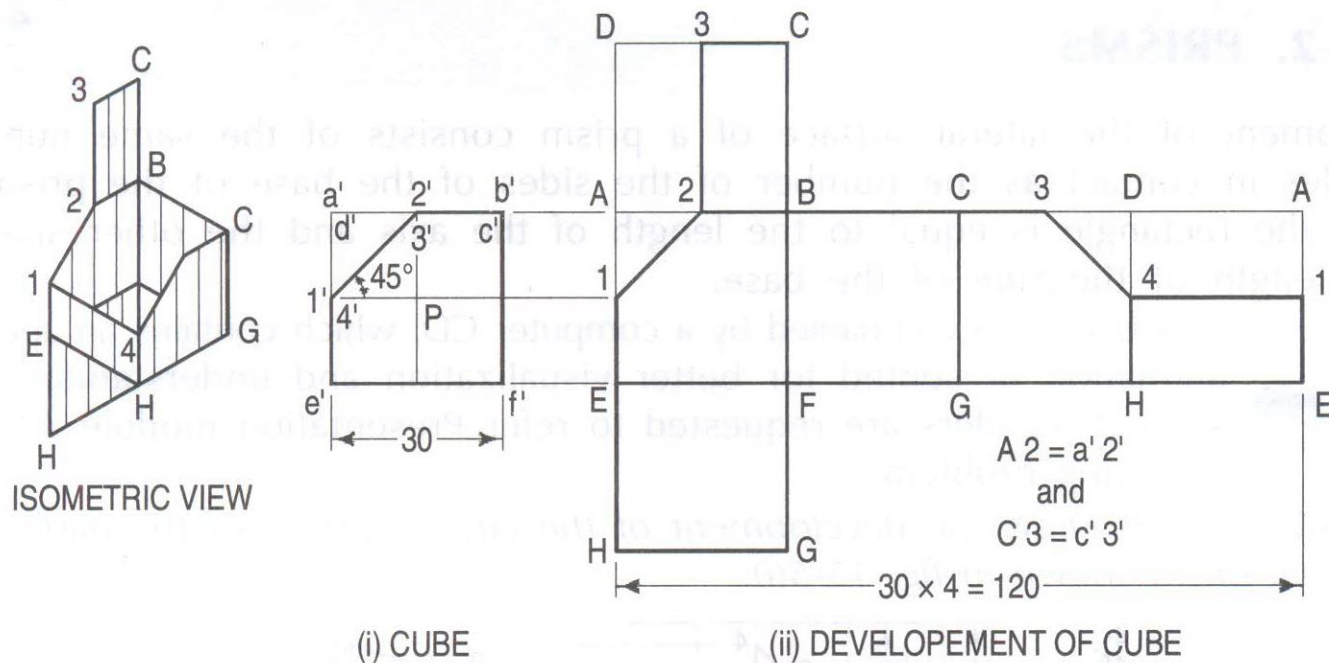
Therefore essential to know what size and shape of flat plates to start with

Most Important Point to Remember

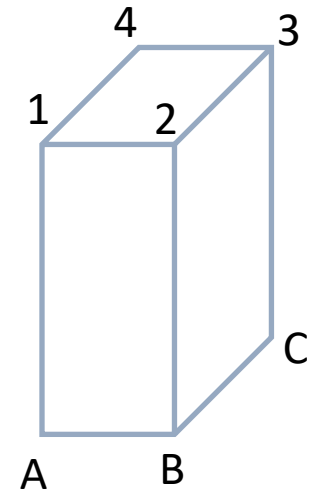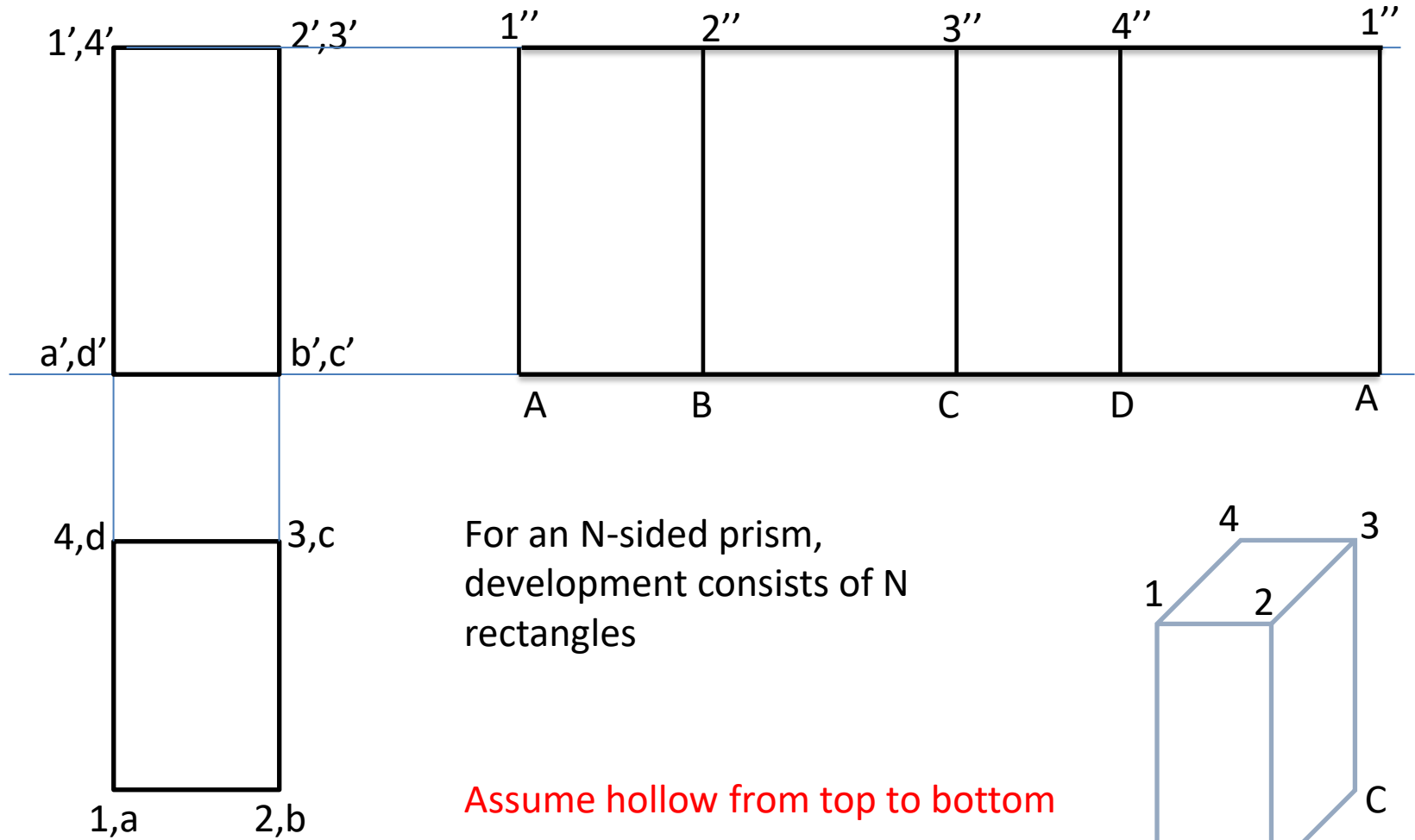In the development, all the lengths must be true lengths

Identify the correct size and shape of the base

Identify the true length of the edges/generators

ISOMETRIC VIEW

(i) CUBE

$A\,2 = a'\,2'$
and
$C\,3 = c'\,3'$

$30 \times 4 = 120$

(ii) DEVELOPEMENT OF CUBE

Development of Rectangle Prism

Axis is perpendicular to the base

1',4' 2',3' 1'' 2'' 3'' 4'' 1''

a',d' b',c'

A B C D A

4,d 3,c

For an N-sided prism,
development consists of N
rectangles

1,a 2,b

Assume hollow from top to bottom
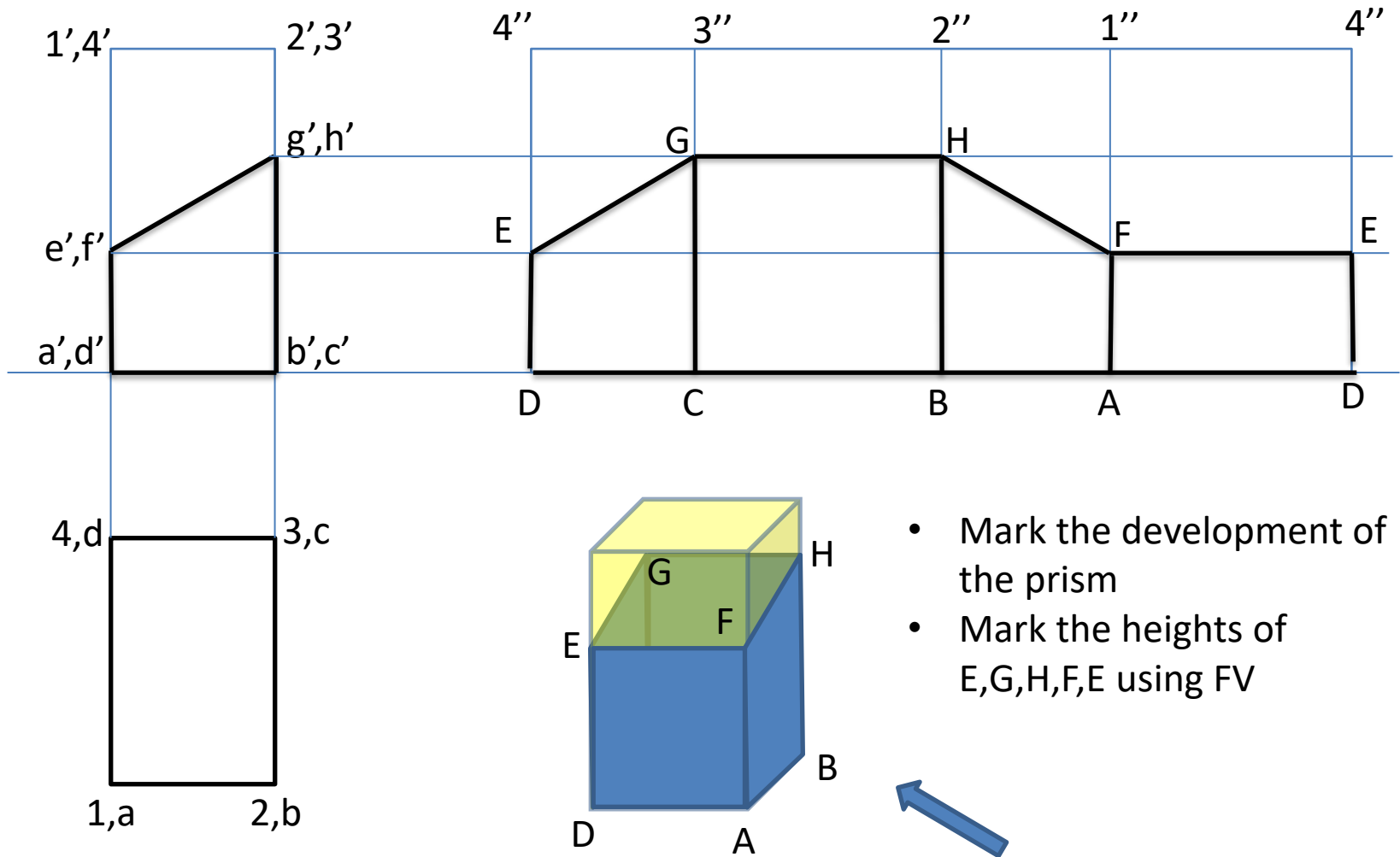
4 3

1 2

C

A B

Important Point to Note

In the development, all the lengths must be **true lengths**

Development involves finding true shape of all surfaces, _and attaching them along their edges: you have some freedom on where you make the cut(s)._
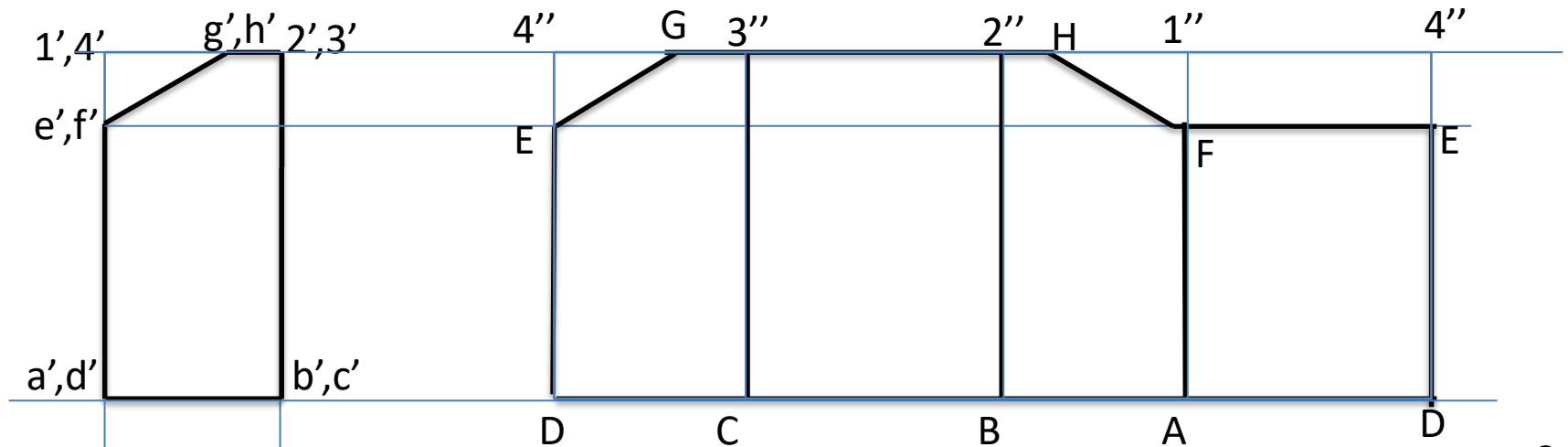
Development of Truncated Right Prism

- Mark the development of the prism
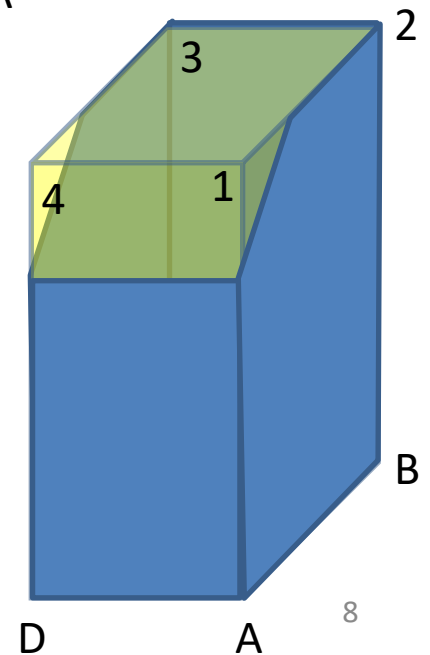- Mark the heights of E,G,H,F,E using FV

Assume hollow from top to bottom
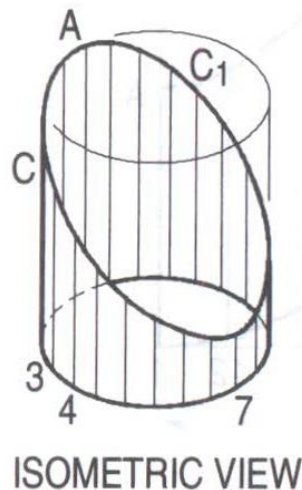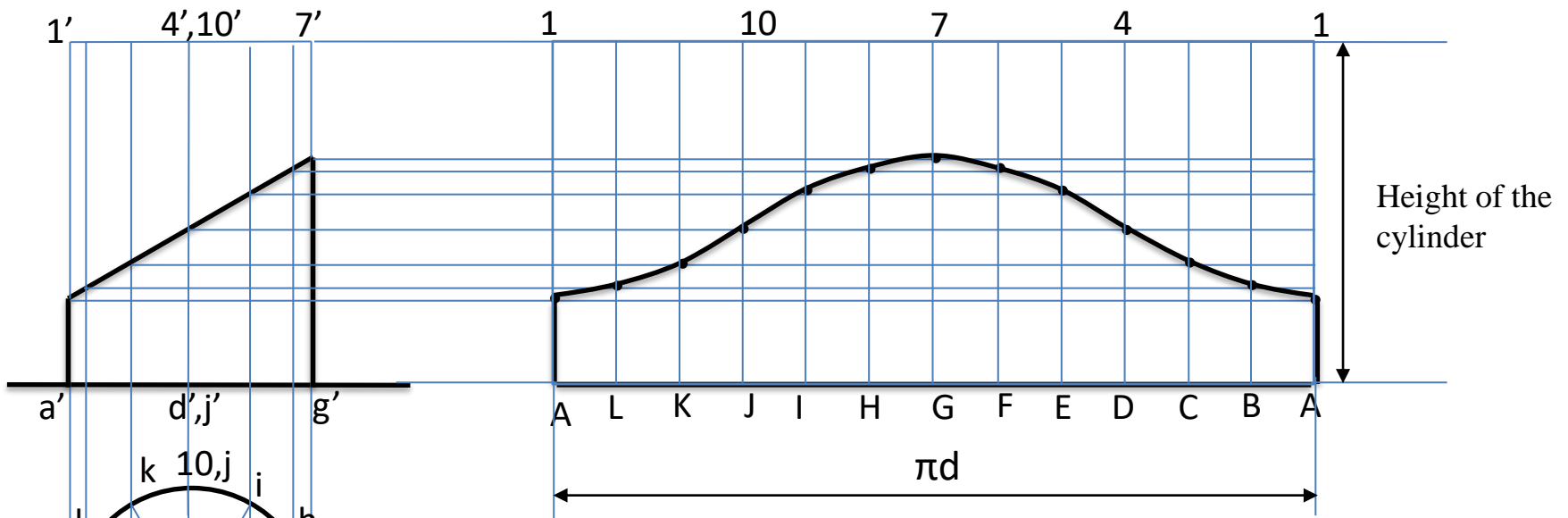
Development of Truncated Right Prism

$l(3',g')$ and $l(2',h')$ are true lengths
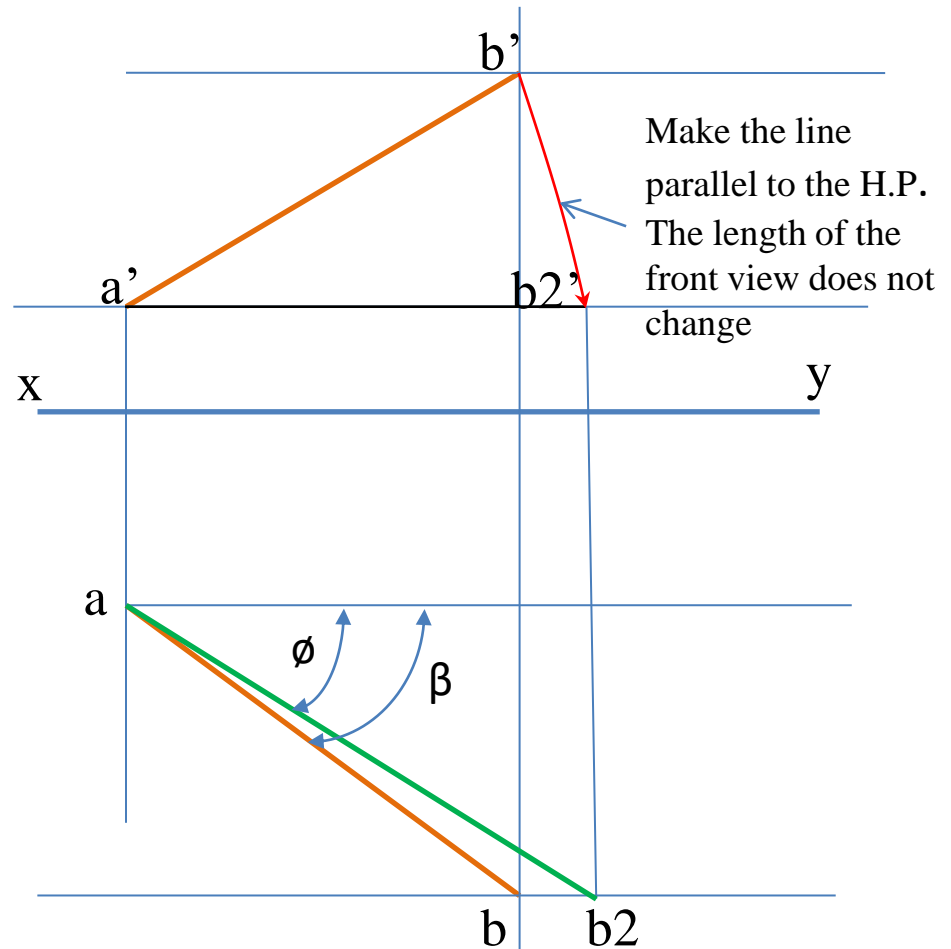
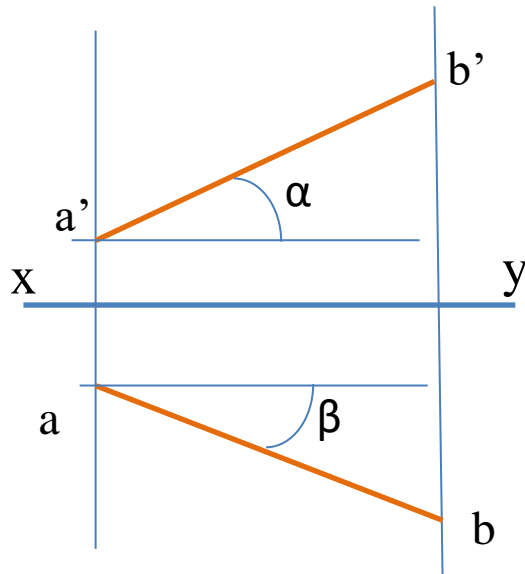$l(3',g') = l(3'',G)$ and $l(2',h') = l(2'',H)$

8

Development of Truncated Right Cylinder


Height of the cylinder

πd

- Divide circle in top view into 12 parts
- In development, A-A is equal to circumference of circle
- Mark generators L,K,..B by dividing A-A into 12 parts
- Use generators and projectors from FV to get development

ISOMETRIC VIEW

Projections of a line inclined to both H.P. and the V.P.

b'

a'

α

x   y

a

β

b

Make the line
parallel to the H.P.
The length of the
front view does not
change

b'

a'   b2'

x   y

a

ø   β

b   b2

- The top view and the front view are inclined to the xy line
- The length of the line in the top view and the front view is less than the true length
- α and β are the apparent angle of inclination with the H.P. and the V.P. and are greater than the true angles of inclination

# Projections of a line inclined to both H.P. and the V.P.
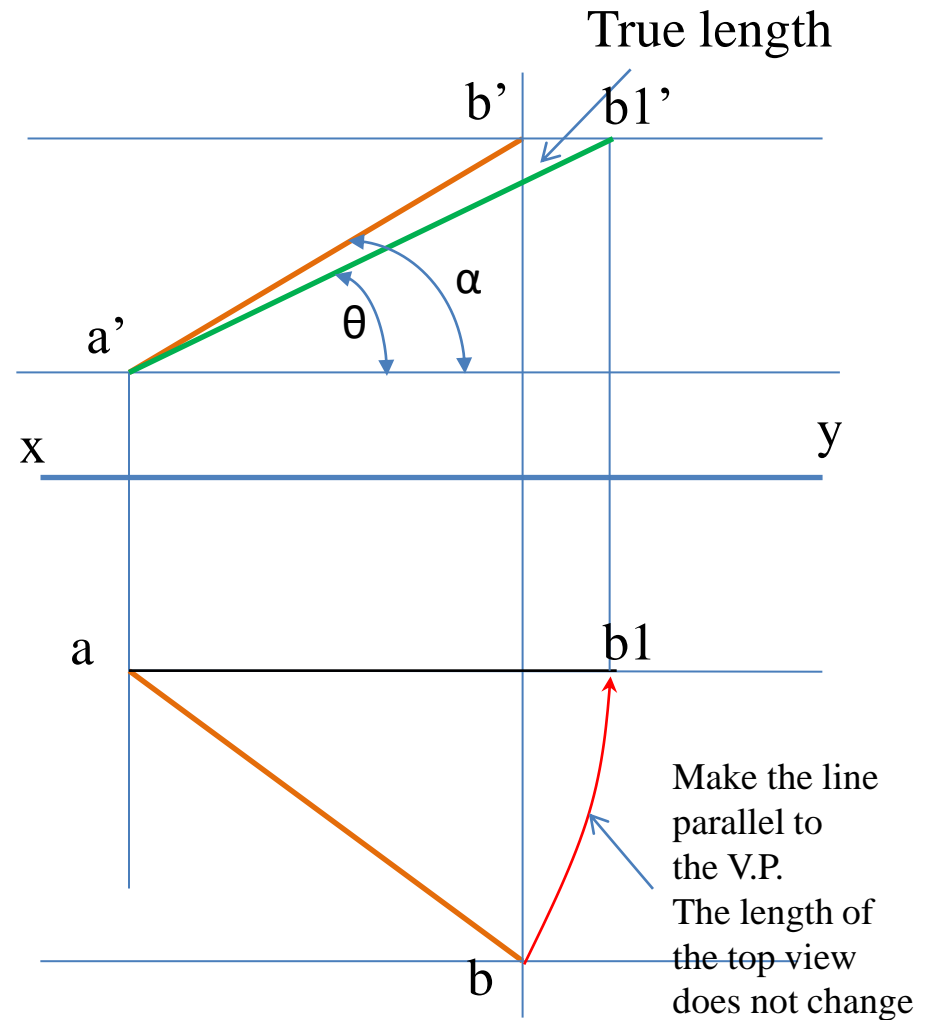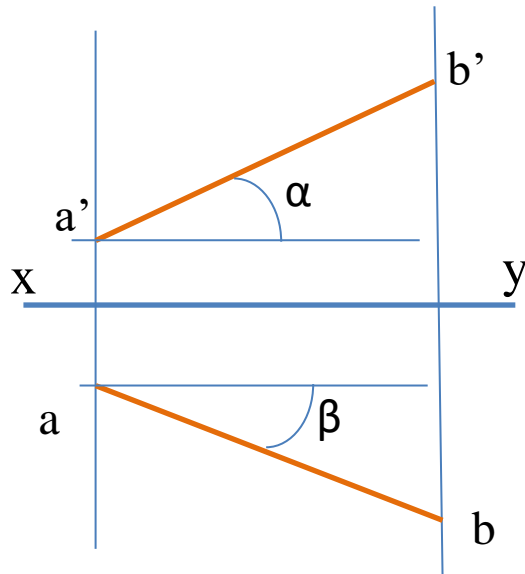
True length

b'

b'   b1'

a'

α

a'   θ   α

x ————————————— y

x ————————————— y

a

a   b1

b

- The top view and the front view are inclined to the xy line
- The length of the line in the top view and the front view is less than the true length
- α and β are the apparent angle of inclination with the H.P. and the V.P. and are greater than the true angles of inclination
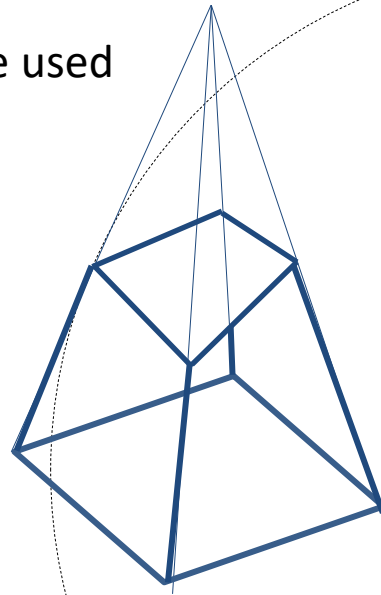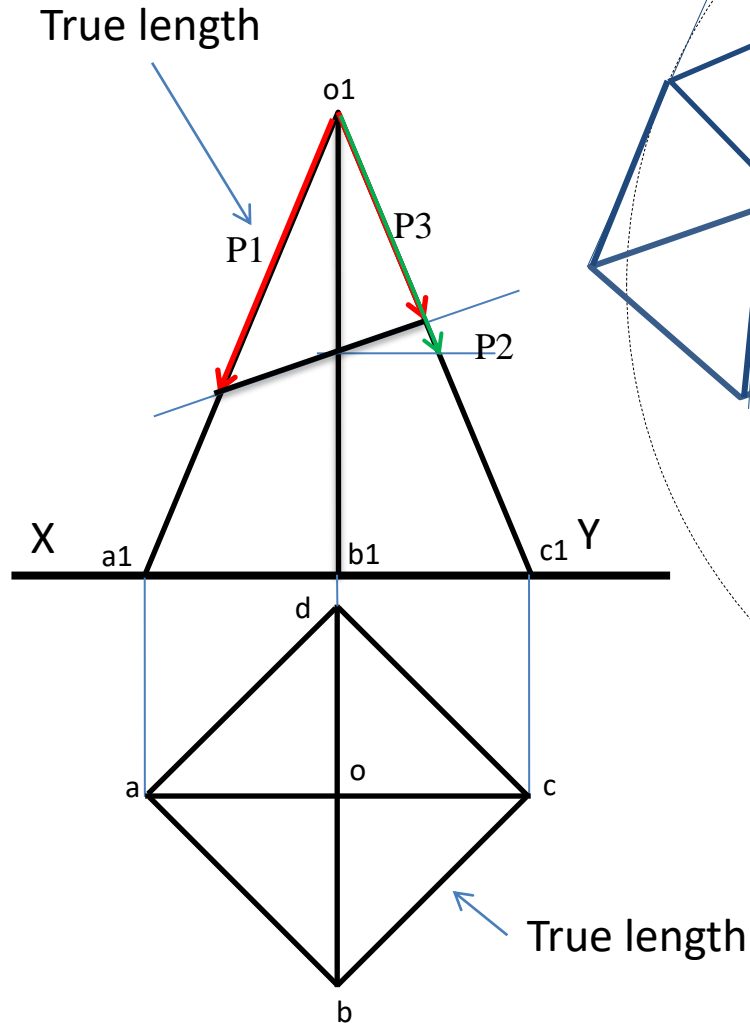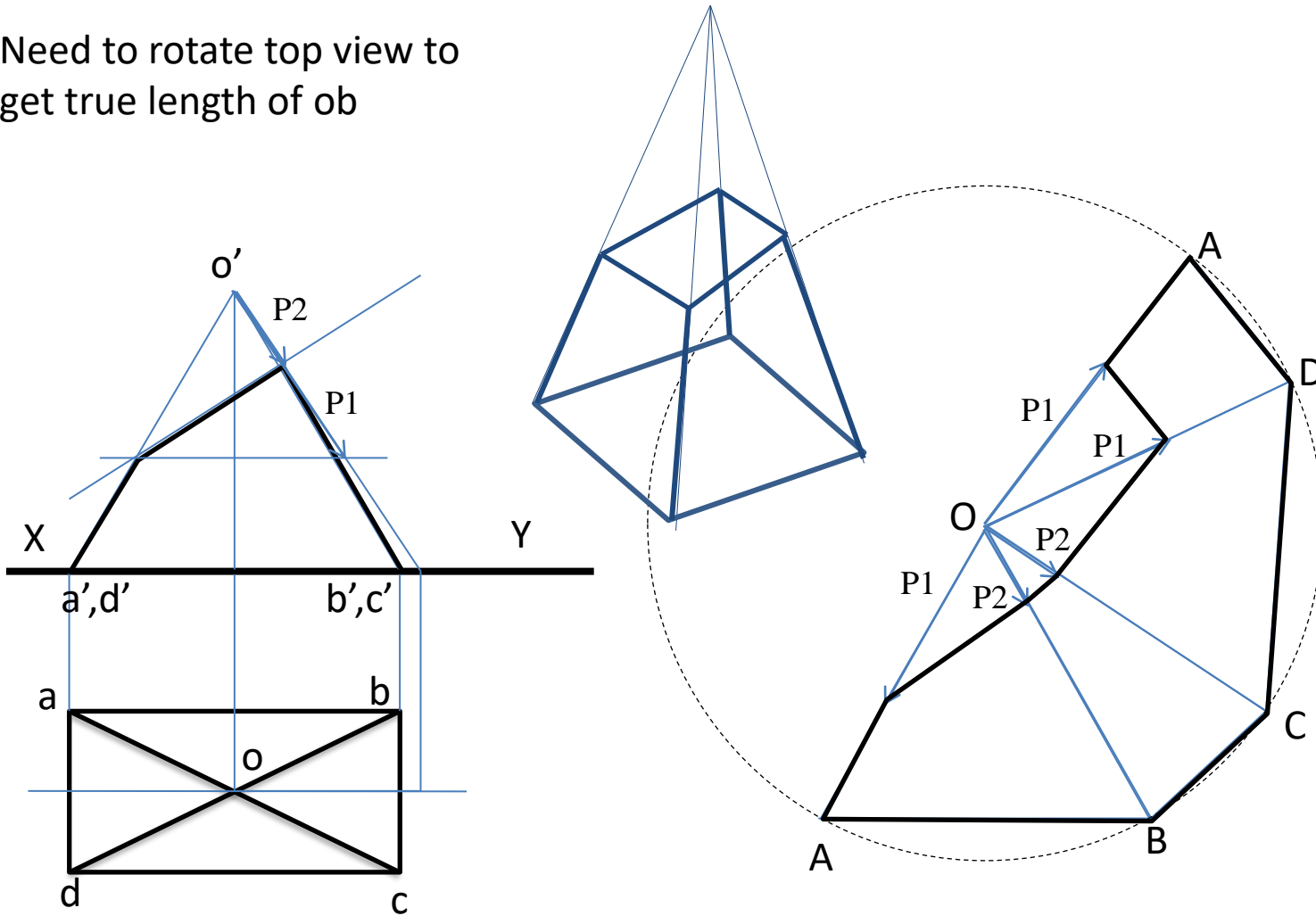
Make the line parallel to the V.P.
The length of the top view does not change

b

Development of Truncated Right Pyramid

- Symmetry of pyramid can be used to get true length O-P2
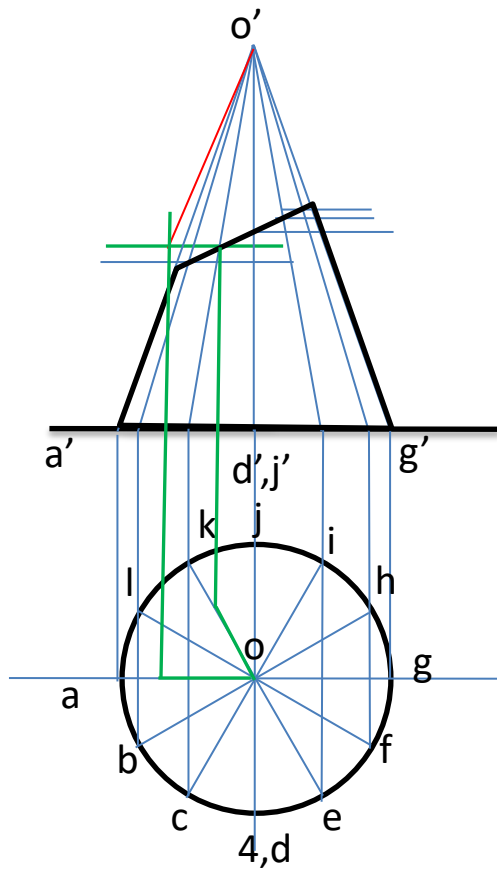
True length
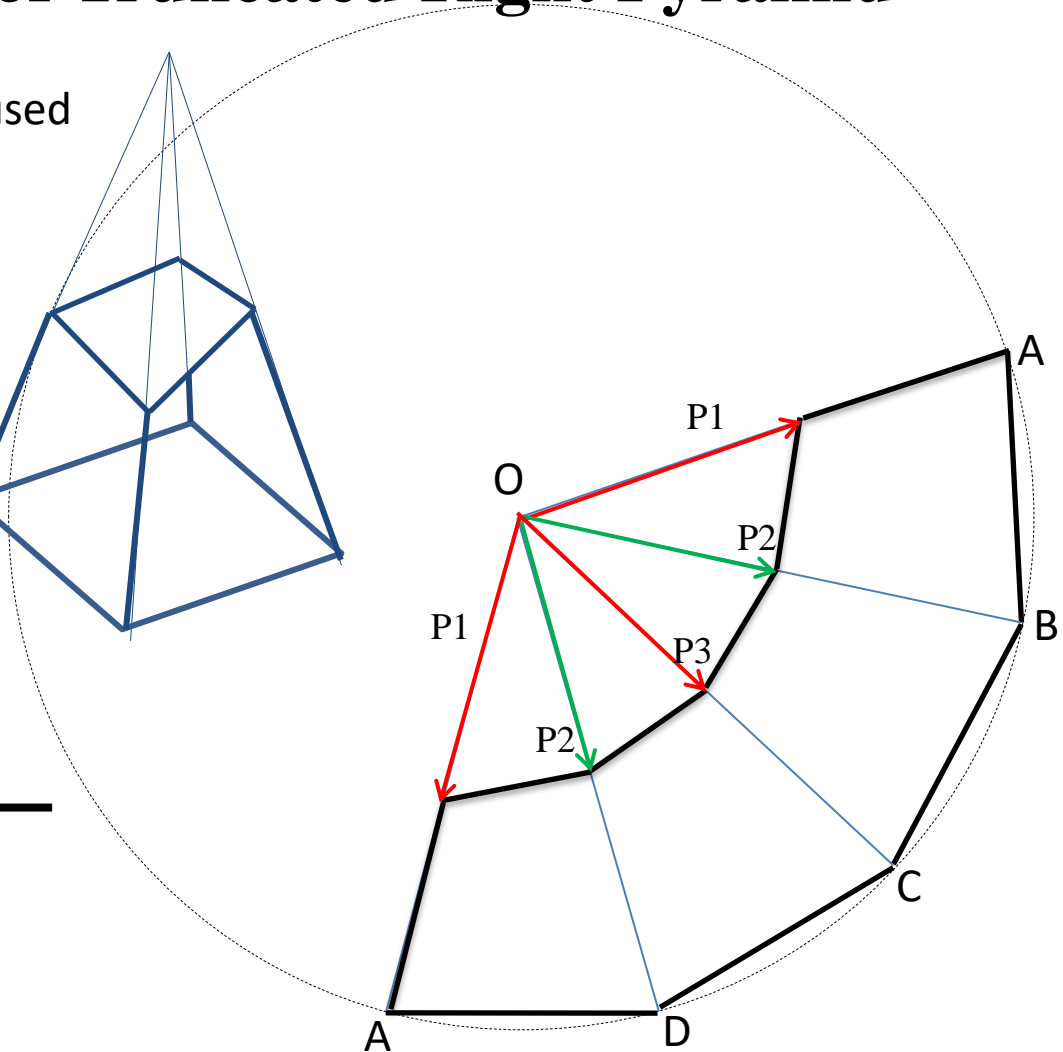
True length

- Use generators (edges from the tip) to mark points on development
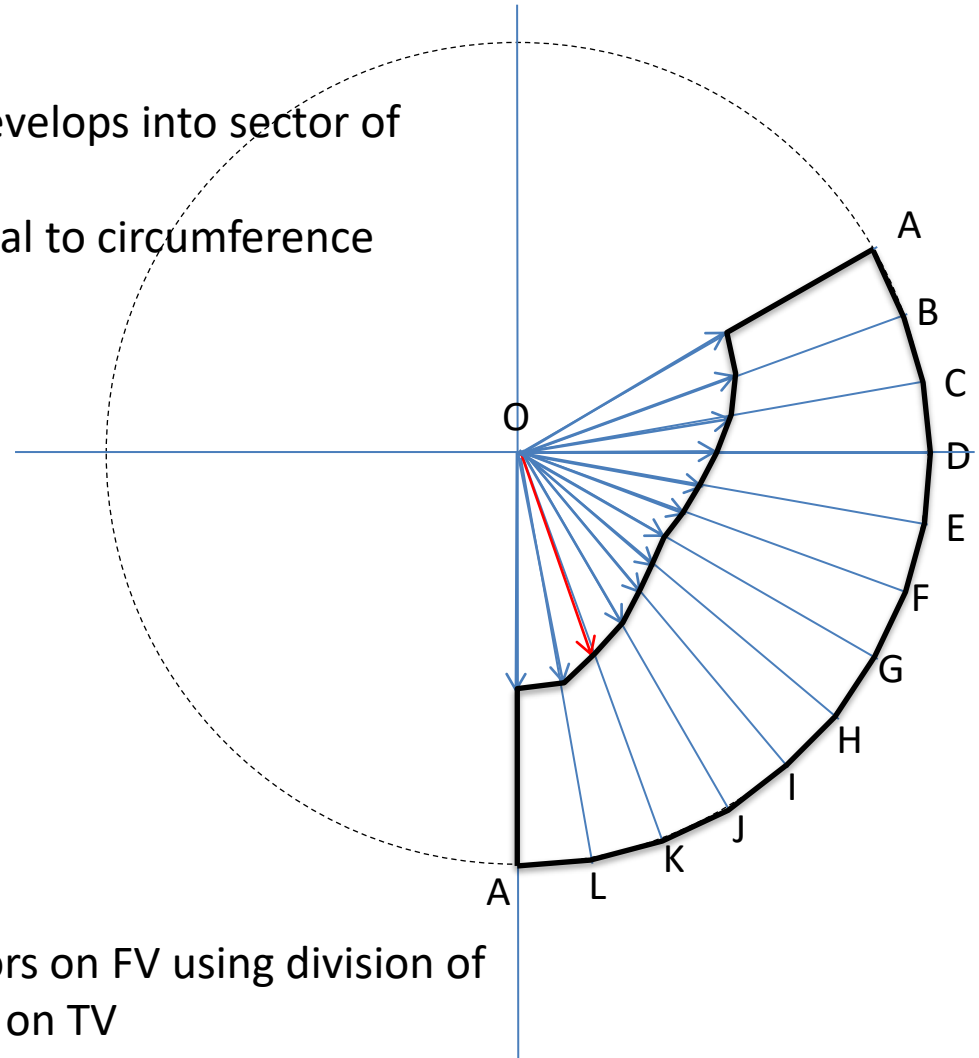
Development of Truncated Right Pyramid

Need to rotate top view to
get true length of ob
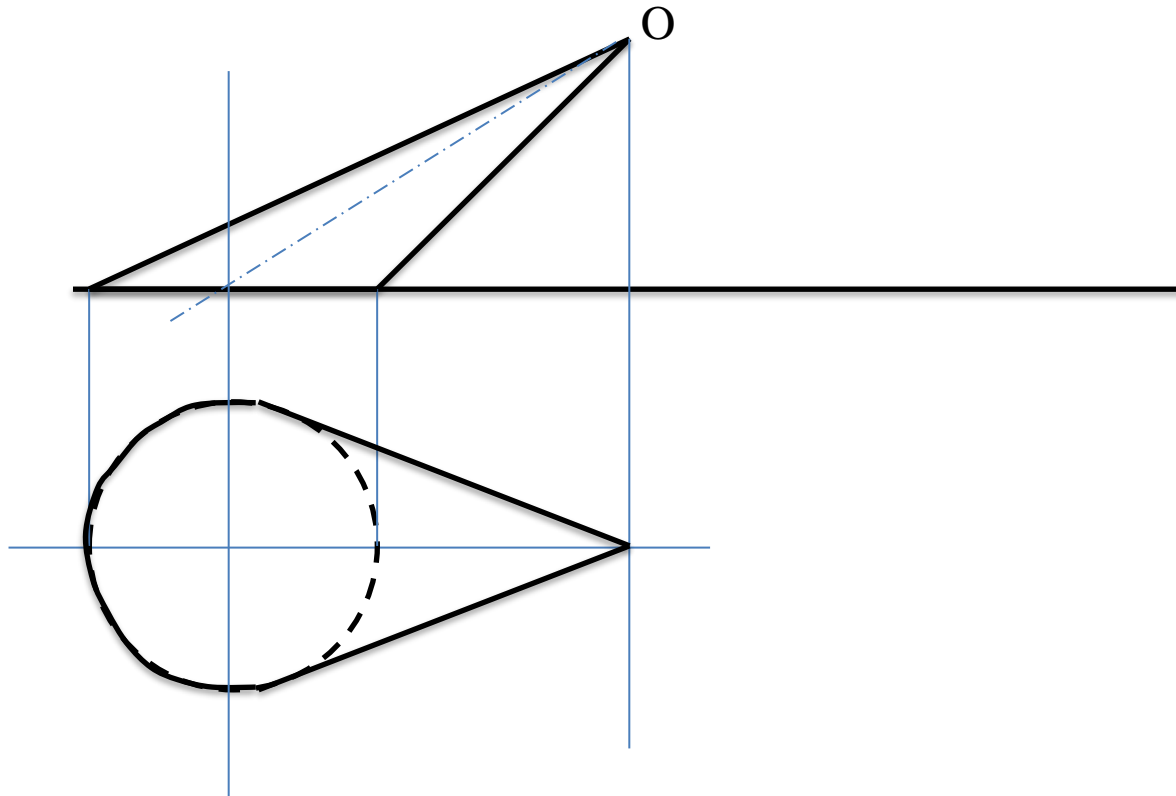
Development of Truncated Right Cone

- Cone develops into sector of a circle
- A-A equal to circumference of base

- Draw generators on FV using division of circumference on TV
- Symmetry of cone can be used to get true lengths

Development of Oblique Cone

Oblique – Axis of the cone nor perpendicular to its base

Development of Oblique Cone

Triangulation method – Approximate method to develop surfaces
- Cover the lateral surface with numerous small triangles that approximately lie on the surface
- These triangles when drawn with their true size with their common edges joined produce an approximate development

O

Example of getting
O4'' is shown

6'   5'   4'   3' 2' 1'

6

1

2

5

4   3

O

Half development

6''

5''

4''

3''

2''

1''
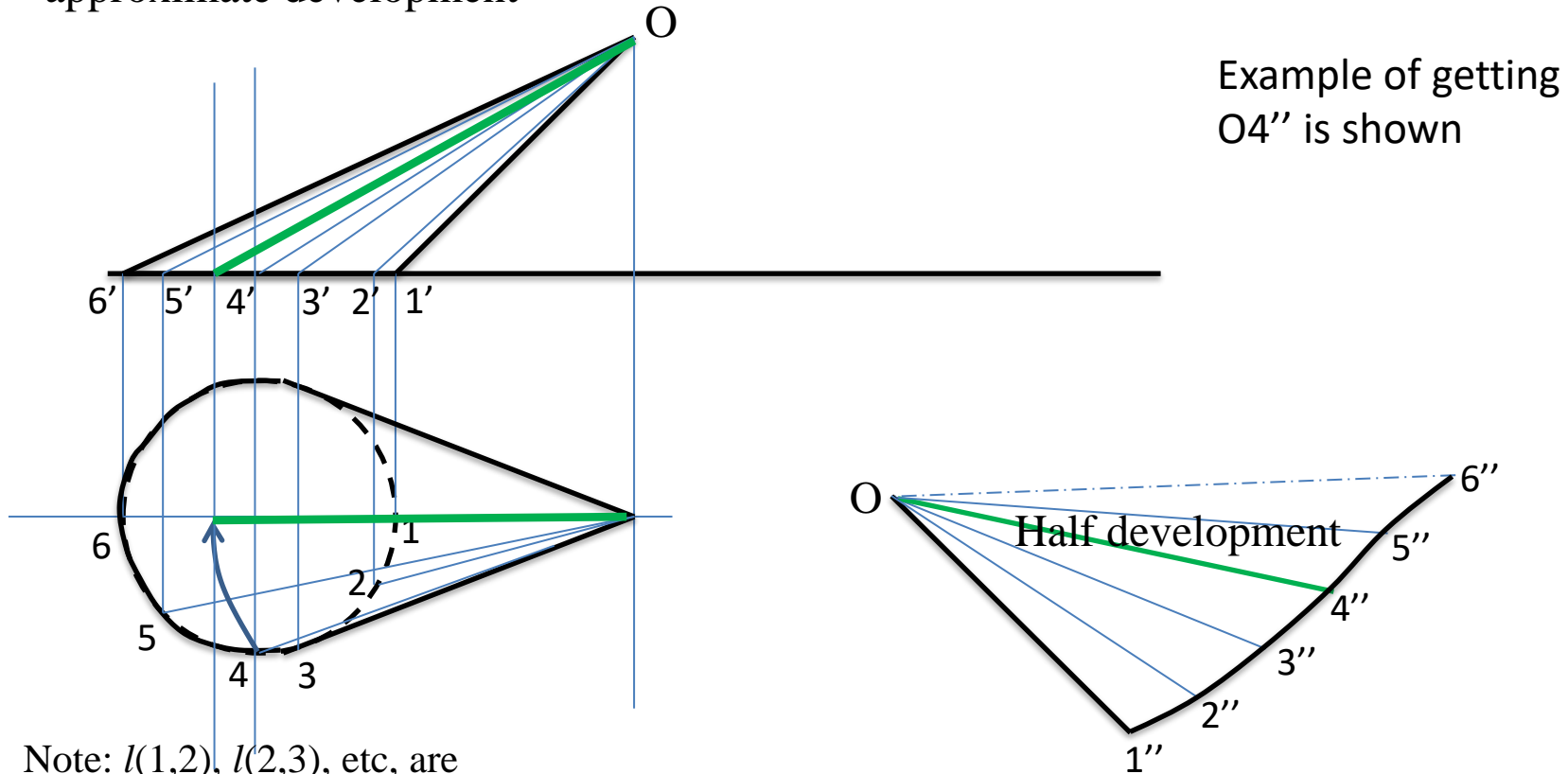
Note: $l(1,2)$, $l(2,3)$, etc, are the true chord lengths

$l(1,2) = l(1'',2'')$, $l(2,3) = l(2'',3'')$, and so on

Transition Pieces

Transition Piece – A special pipe joint used to connect two or more pipes of different shapes and sizes

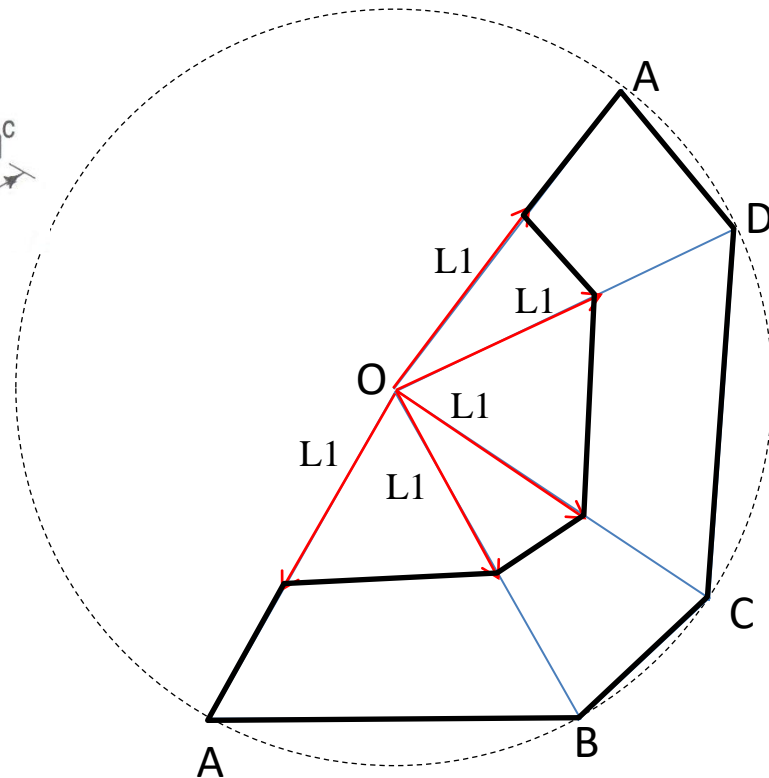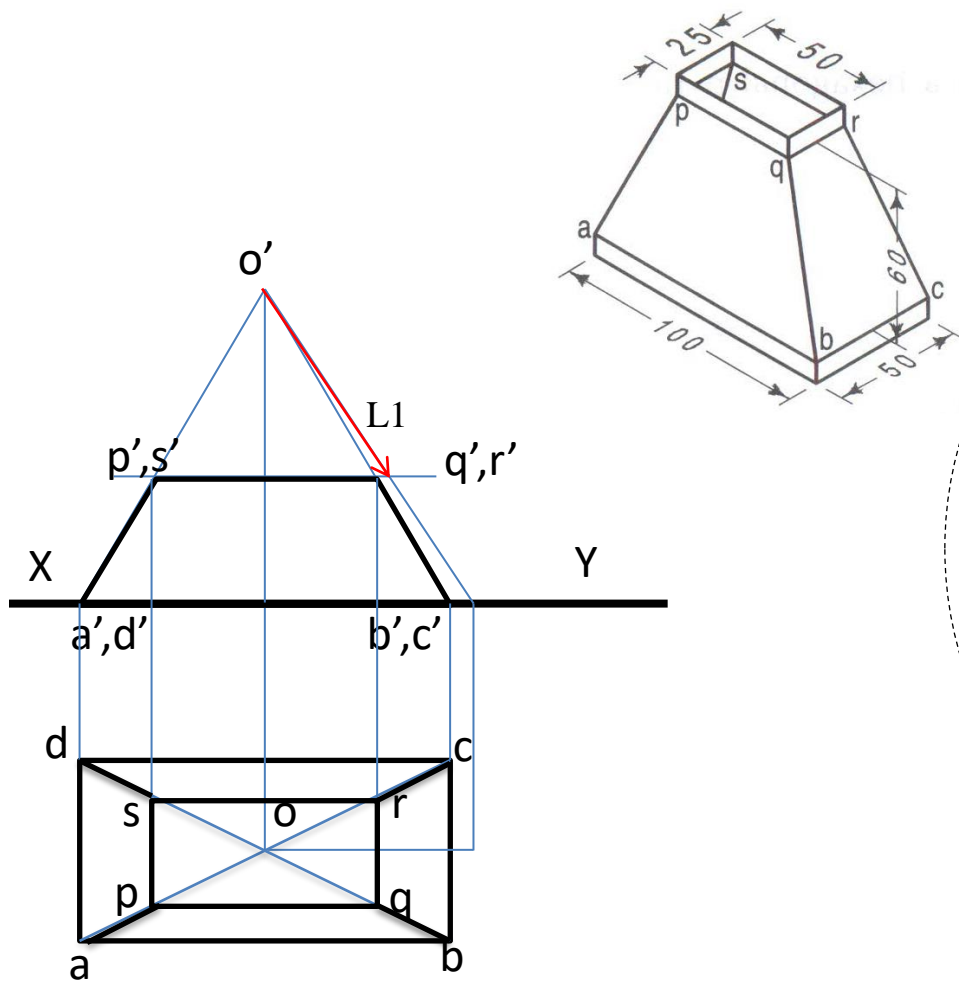| Round to Rectangular	Round to Oval	Oval to Oval	Round to Rectangular

Typical Transitional pieces
- Connecting two rectangular pipes of different sizes on different axes
- Connecting two circular pipes on different axes
- Connecting a square and a circular pipe

Development of Transition Piece connecting Two Rectangular Pieces

END