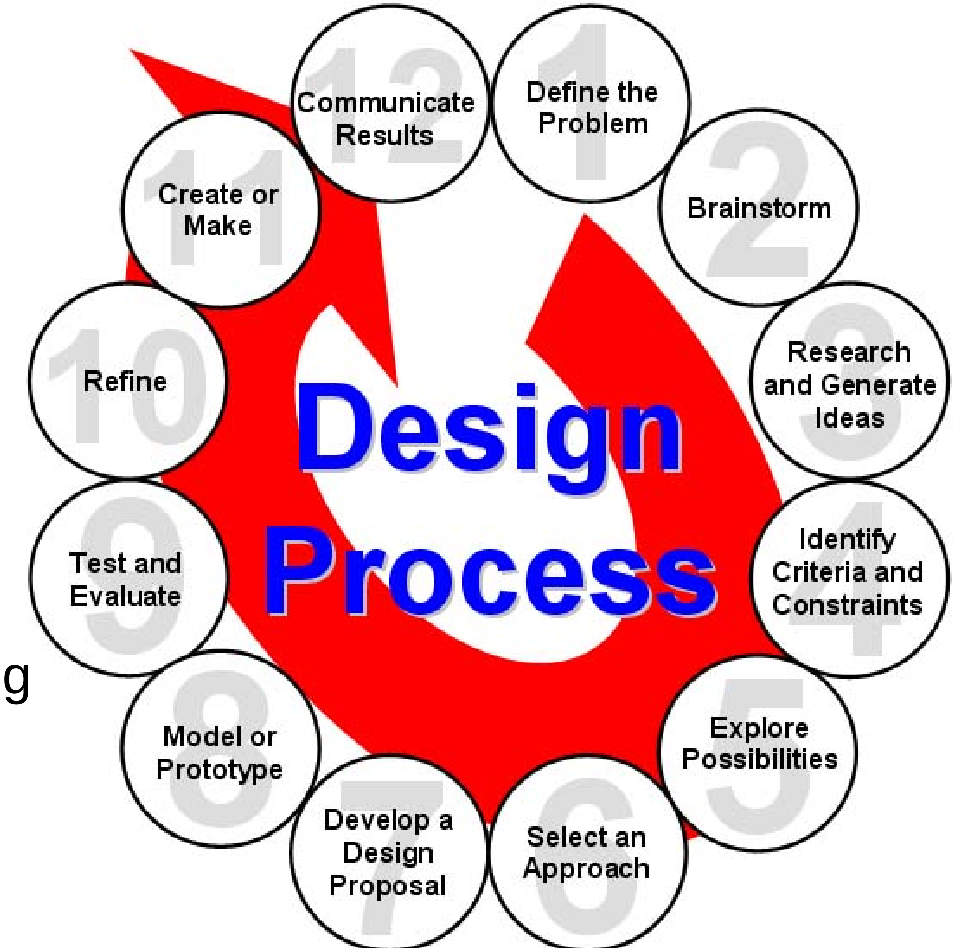
IED Final Study Guide

Example Design Process

1. Define a Problem
2. Brainstorm
3. Research and Generate Ideas
4. Identify Criteria and Specify Constraints
5. Explore Possibilities
6. Select an Approach
7. Develop a Design Proposal
8. Make a Model or Prototype
9. Test and Evaluate the Design using Specifications
10. Refine the Design
11. Create or Make Solution
12. Communicate Processes and Results



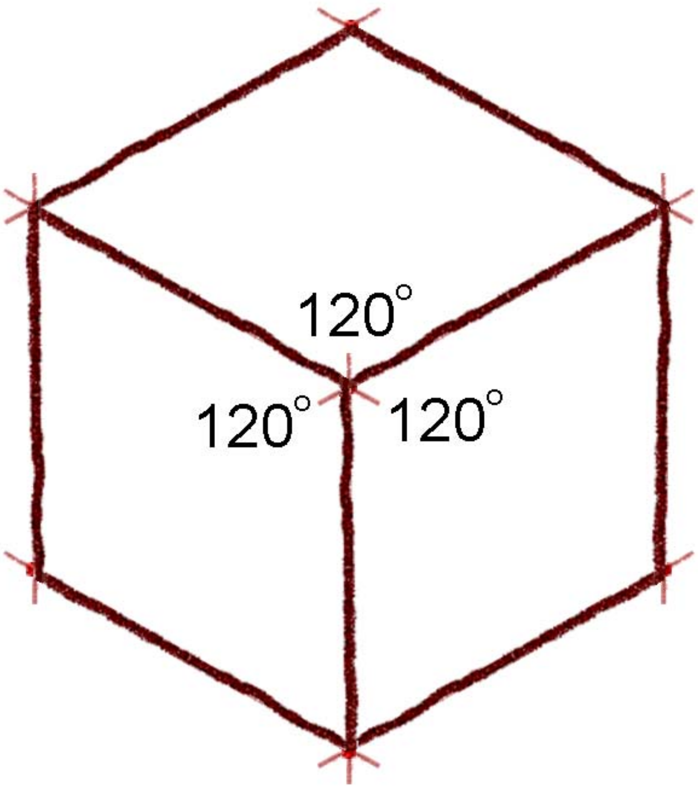
– ITEA *Standards for Technological Literacy*

Isometric Pictorials

Isometric means *equal measure*.

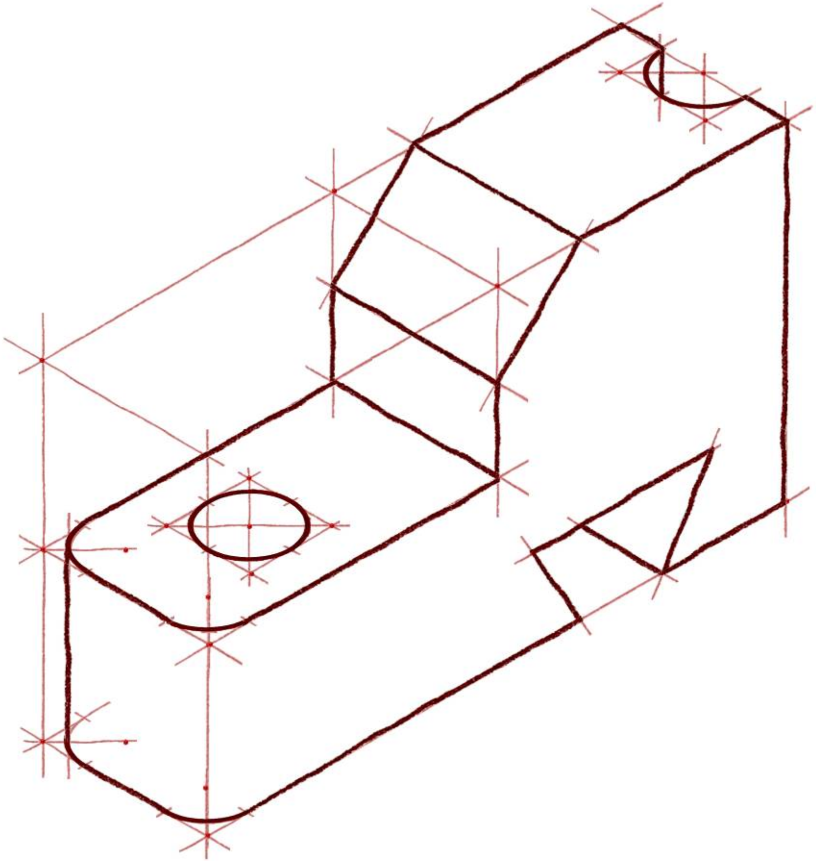
Three adjacent faces on a cube will share a single point. The edges that converge at this point will appear as 120 degree angles or 30 degrees from the horizon line.

These three edges represent height, width, and depth.



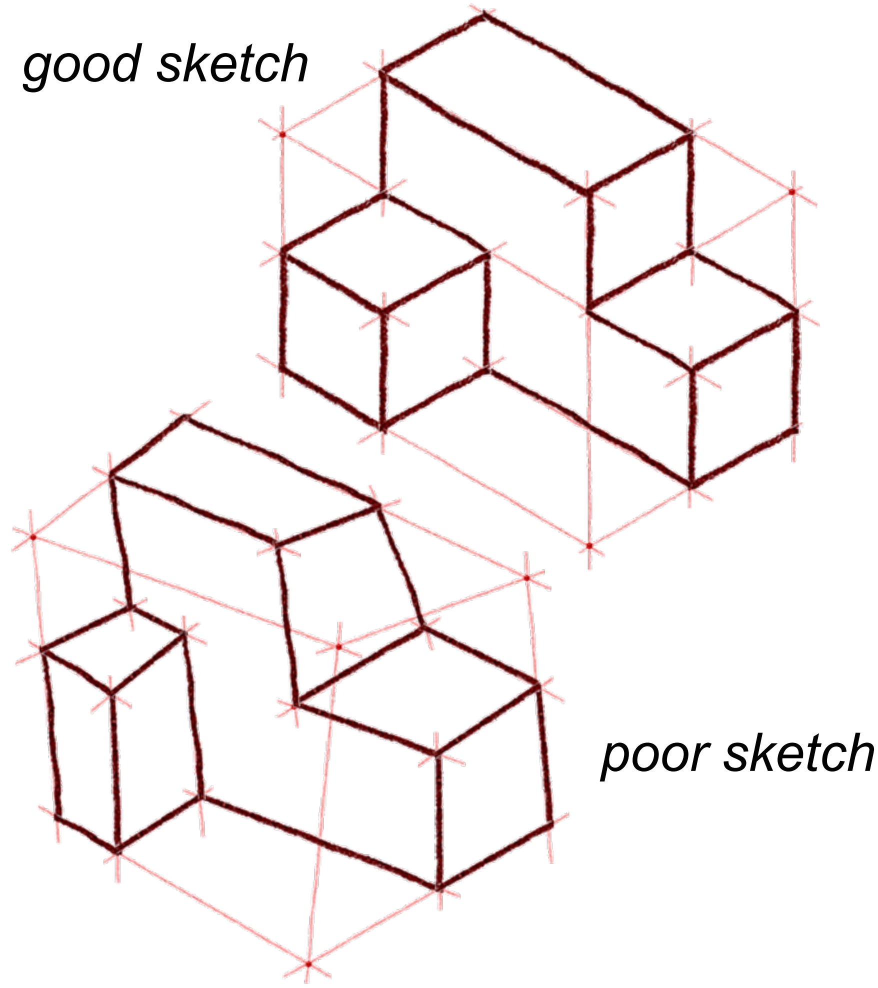
The Box Method

The *box method* is a technique used in sketching to maintain proportionality. It starts with a sketcher envisioning an object contained within an imaginary box.



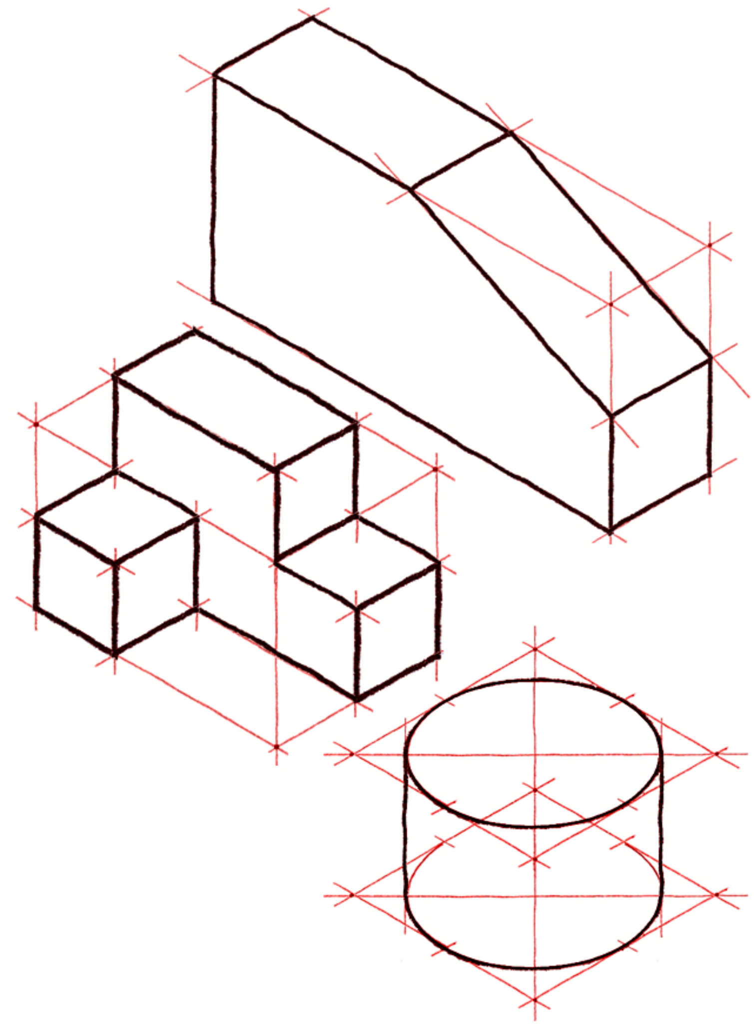
Proportion and Estimation

Good sketching requires a sense of proportion, and the ability to estimate size, distance, angles, and other spatial relationships.



Isometric Sketching

The following examples show the steps used to create isometric sketches of simple geometric objects, along with tonal shading techniques.

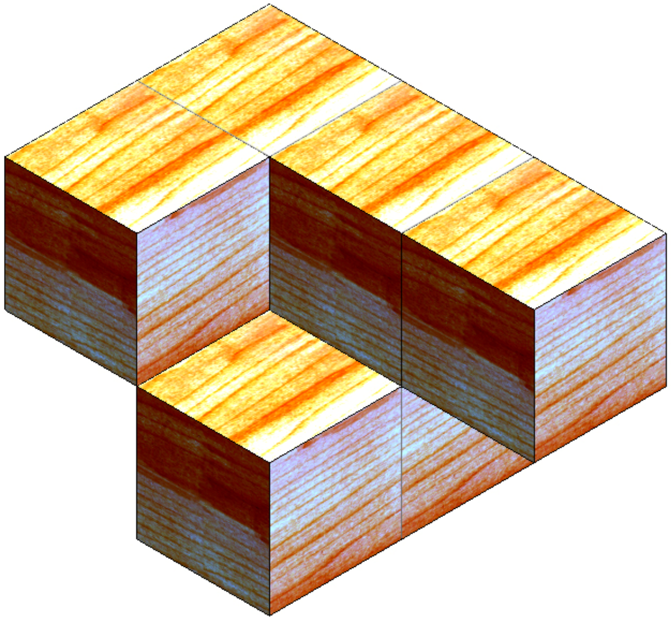


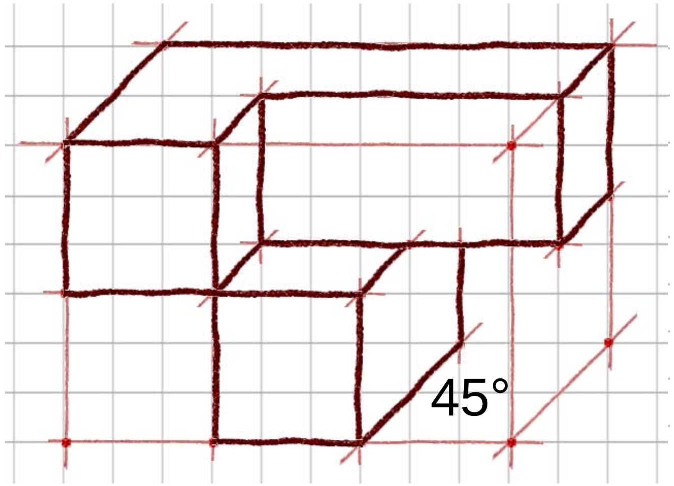
Oblique Pictorials

Oblique Pictorials

An *Oblique pictorial* starts with a straight-on view of one of the object's faces, which is often the front face.

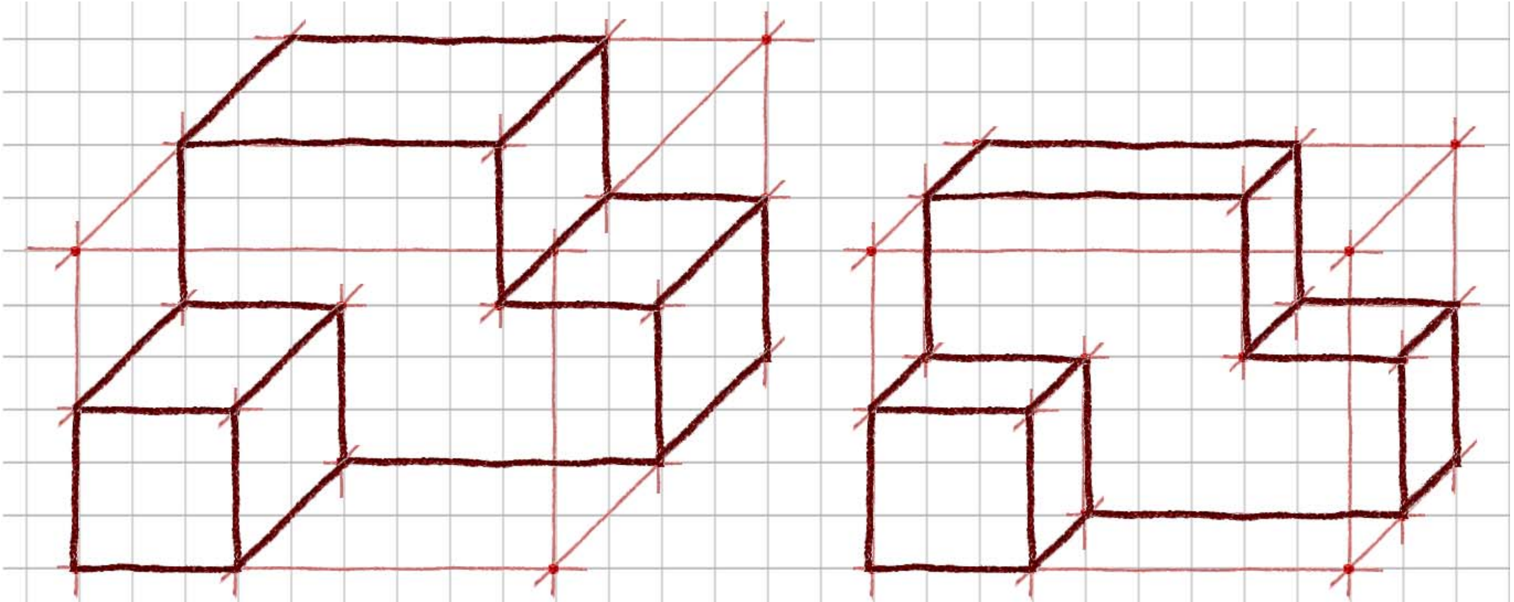
Angled, parallel lines are drawn to one side to represent the object's depth. Common oblique angles include 30°, 45°, and 60°.





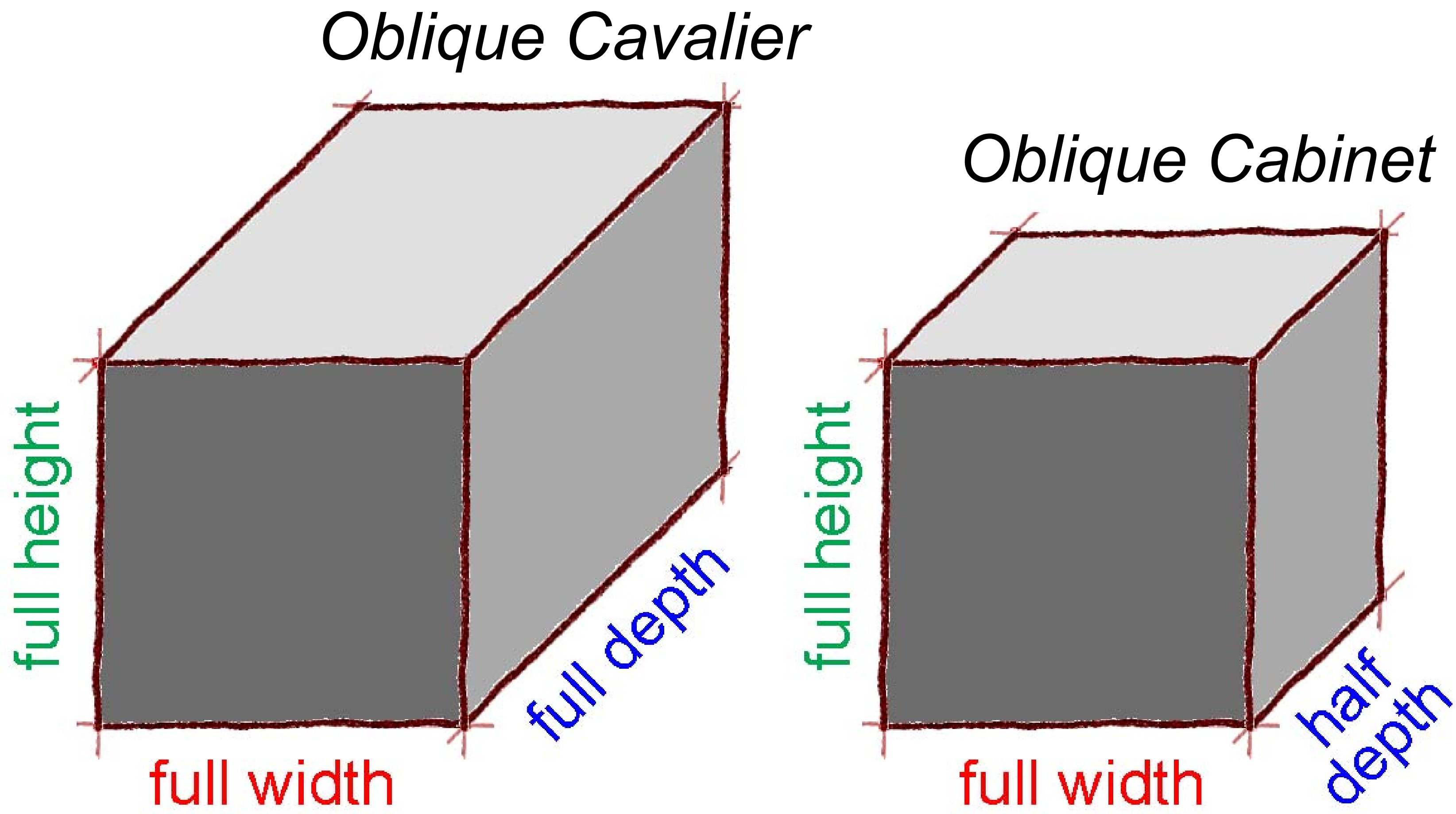
Types of Oblique Drawings

There are two types of *oblique pictorials*: *cavalier* and *cabinet*. The difference between the two is based on how the *depth* of the object is represented.



Oblique Cavalier *Oblique Cabinet*

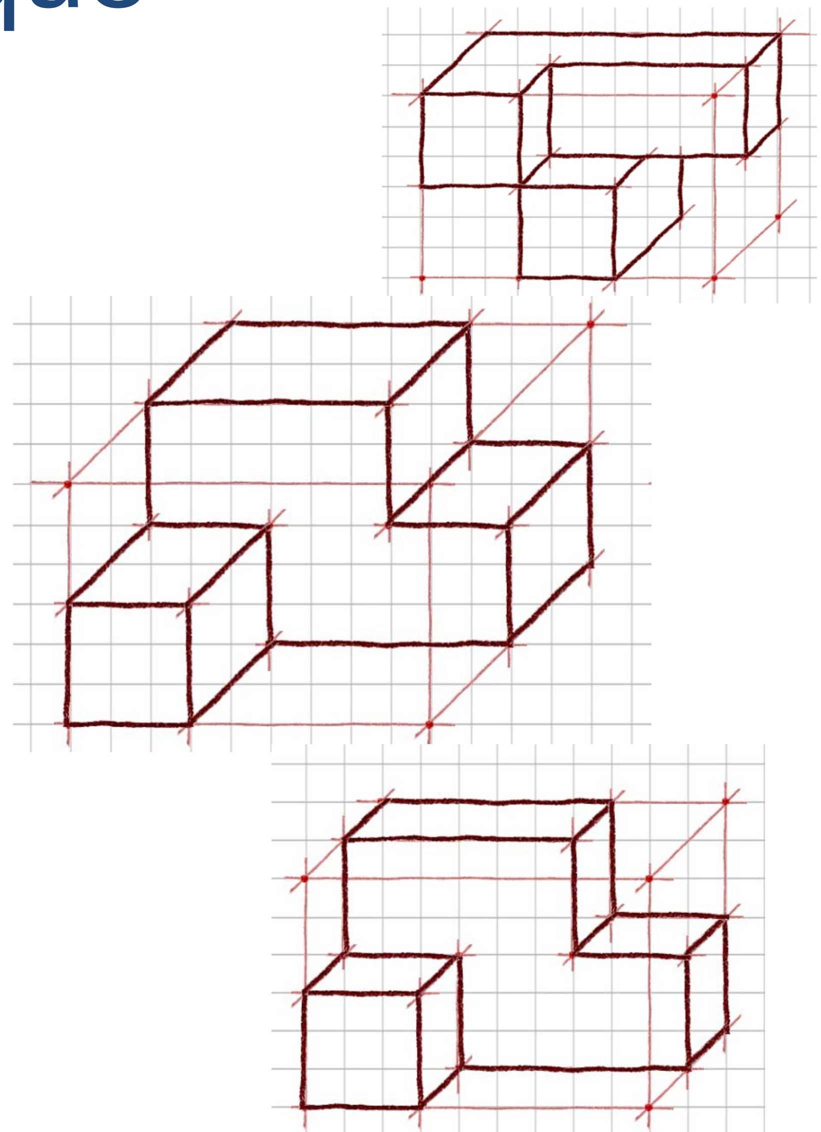
Types of Oblique Drawings



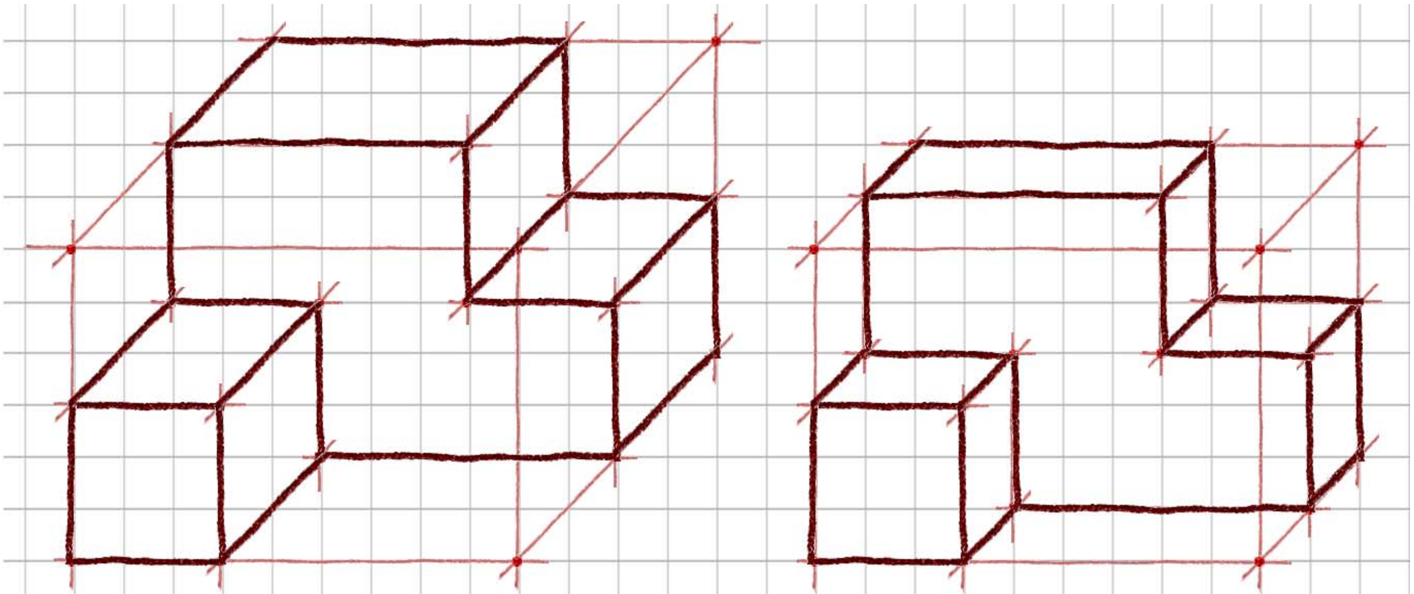
General Oblique

A general oblique is a type of oblique pictorial that represents an object’s width and height, but the depth can be any size and drawn at any angle.

The idea is to worry about getting the thought down as a sketch not worrying about the depth or angle.



The Box Method



The *box method* is a sketching technique that is used to maintain proportionality. It starts with the sketcher envisioning an object contained within an imaginary box.

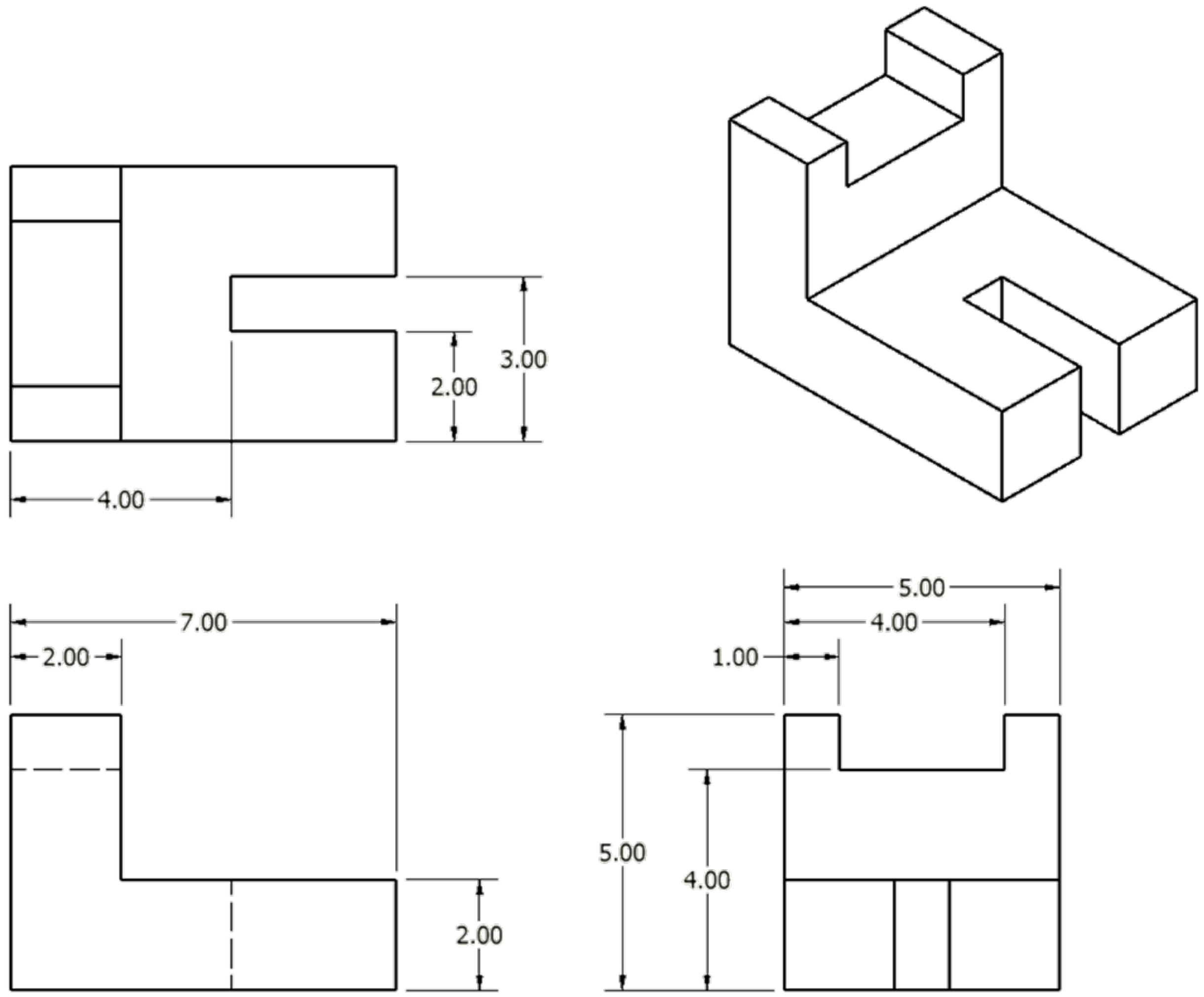
Sketching Multiview Drawings

Multiview Drawing

A *multiview drawing* is one that shows two or more two-dimensional views of a three-dimensional object.

Multiview drawings provide the shape description of an object. When combined with dimensions, multiview drawings serve as the main form of communication between designers and manufacturers.

Multiview Drawing



Width, Depth, and Height

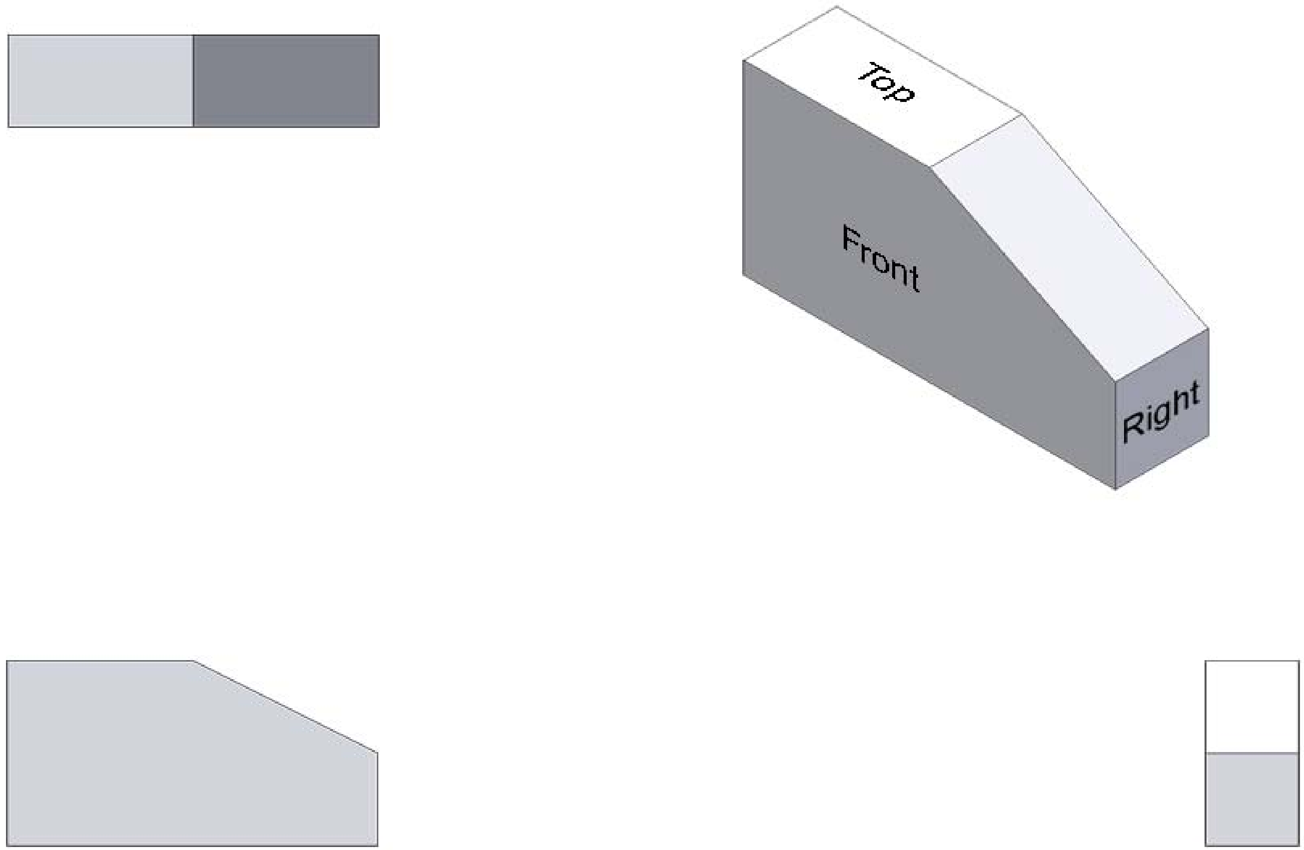
All three-dimensional objects have *width*, *height*, and *depth*.

Width is associated with an object's *side-to-side* dimension.

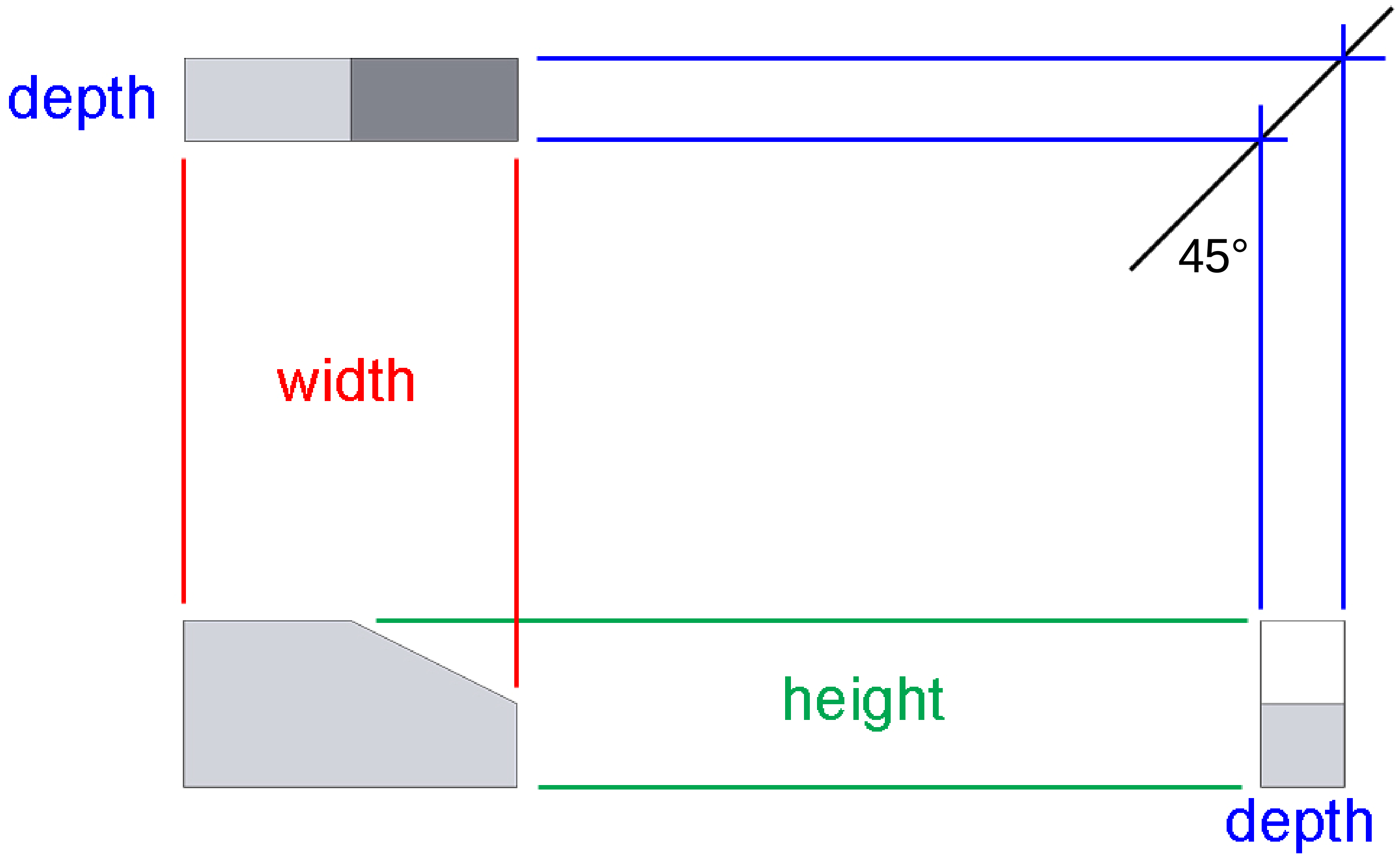
Height is the measure of an object from *top-to-bottom*.

Depth is associated with *front-to-back* distance.

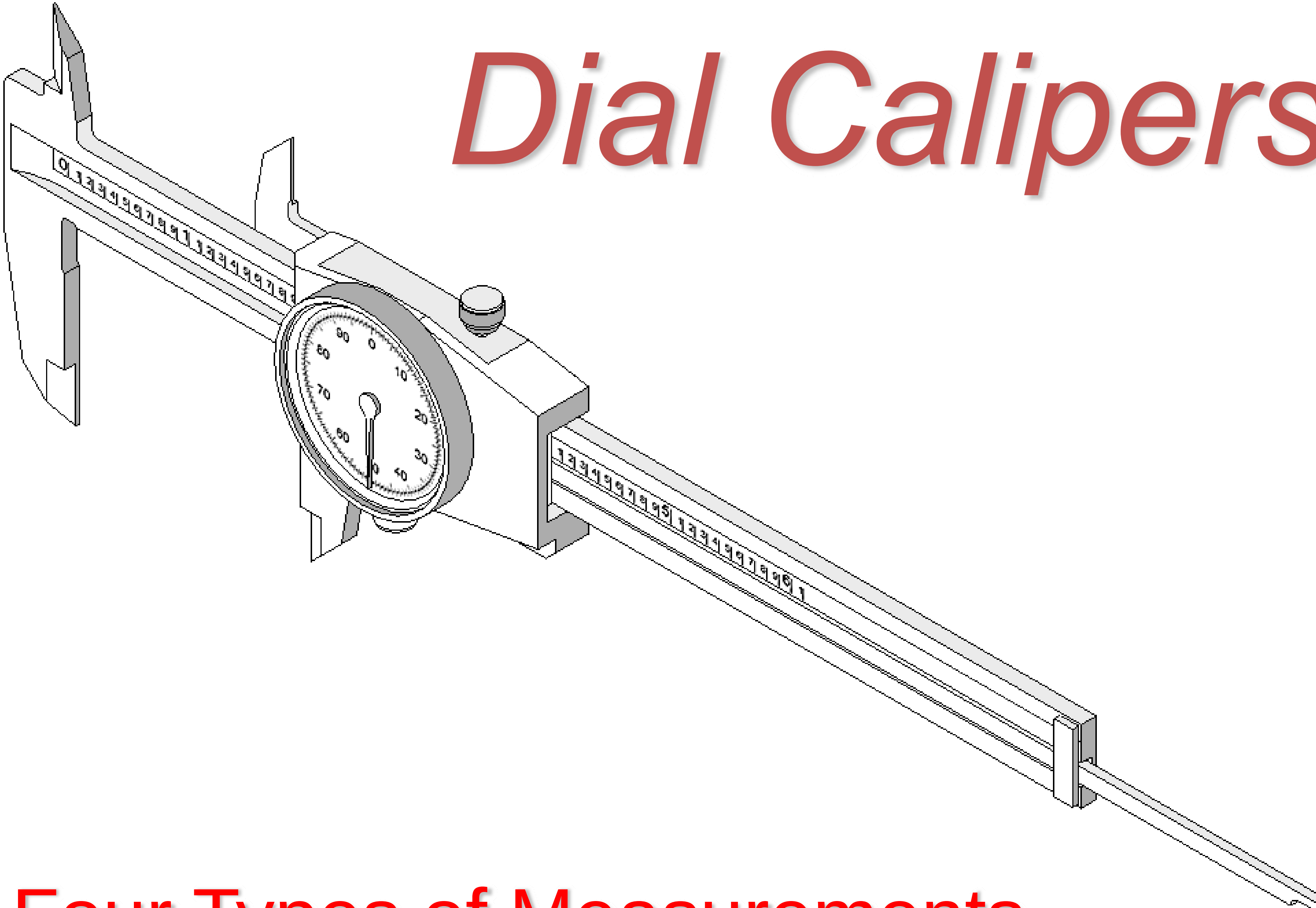
Width, Depth, and Height



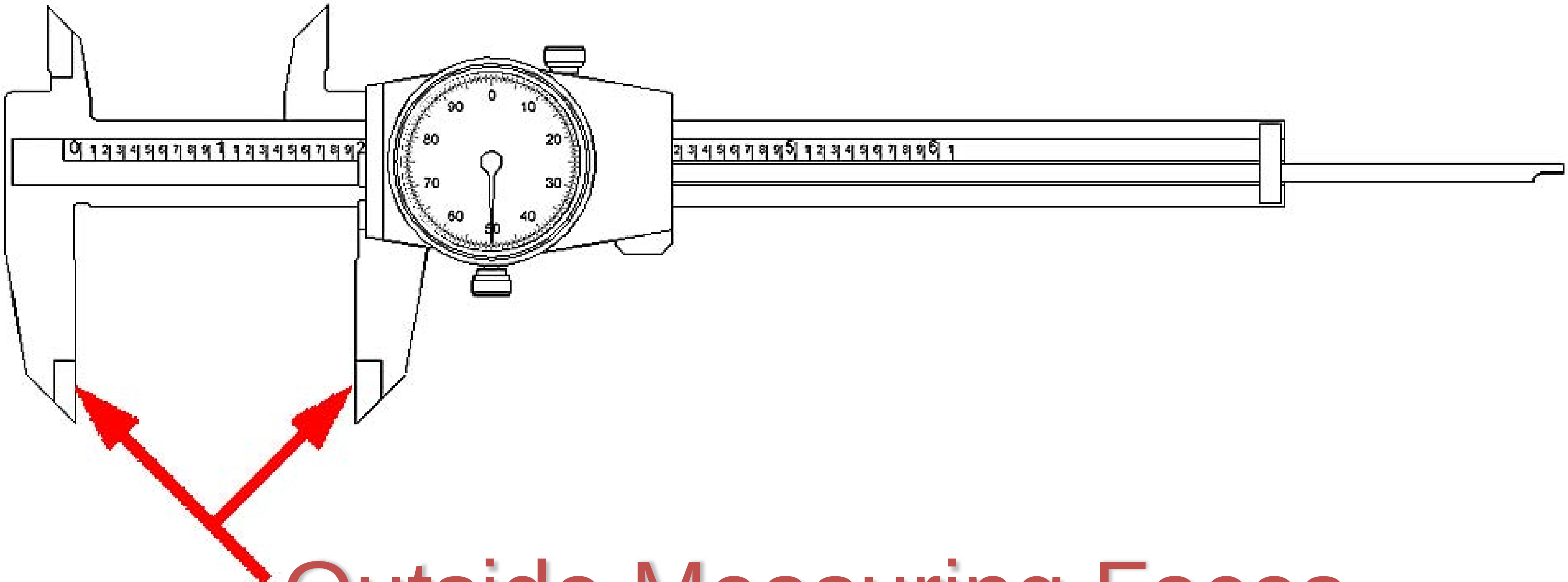
Width, Depth, and Height



Dial Calipers

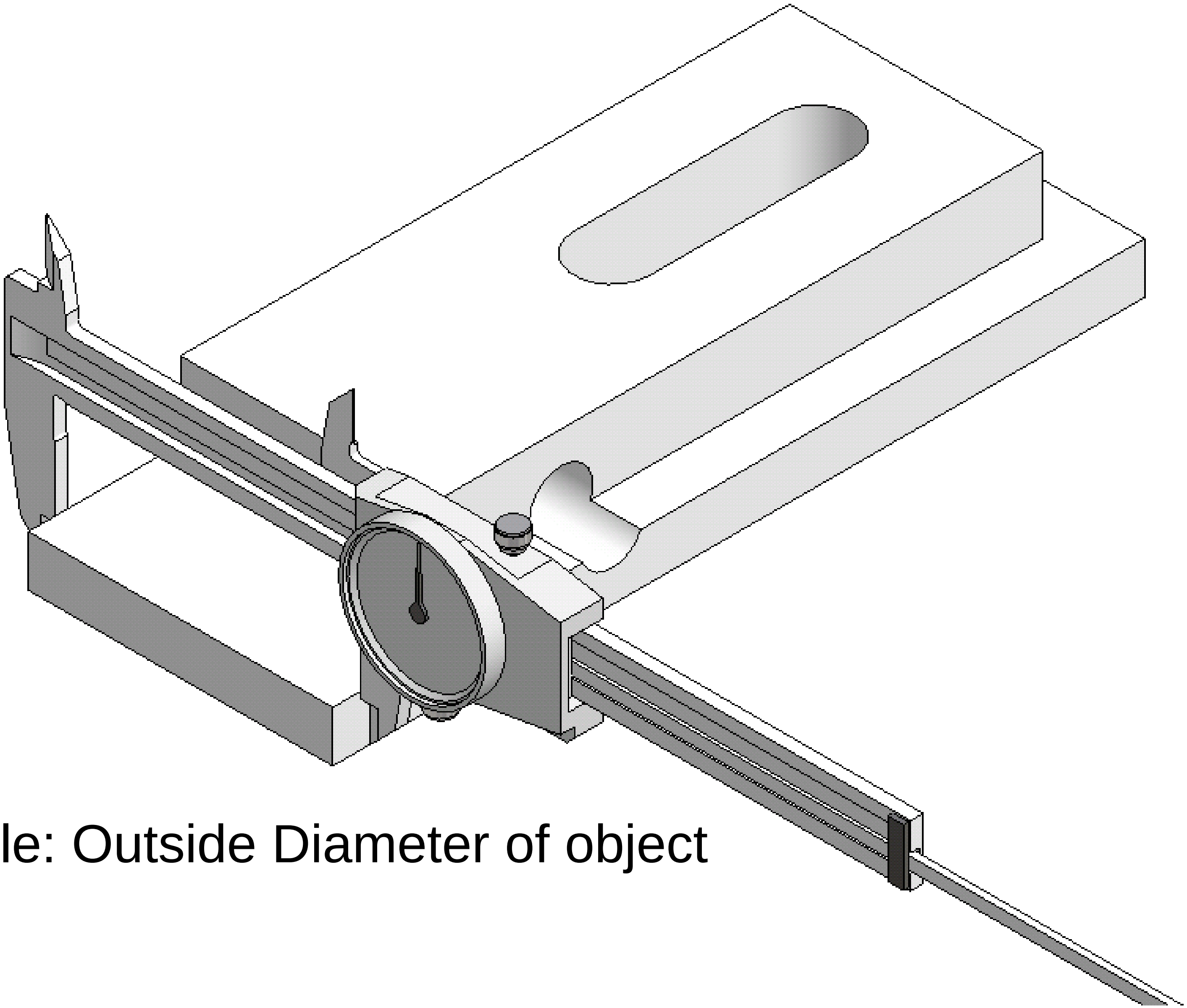


Four Types of Measurements



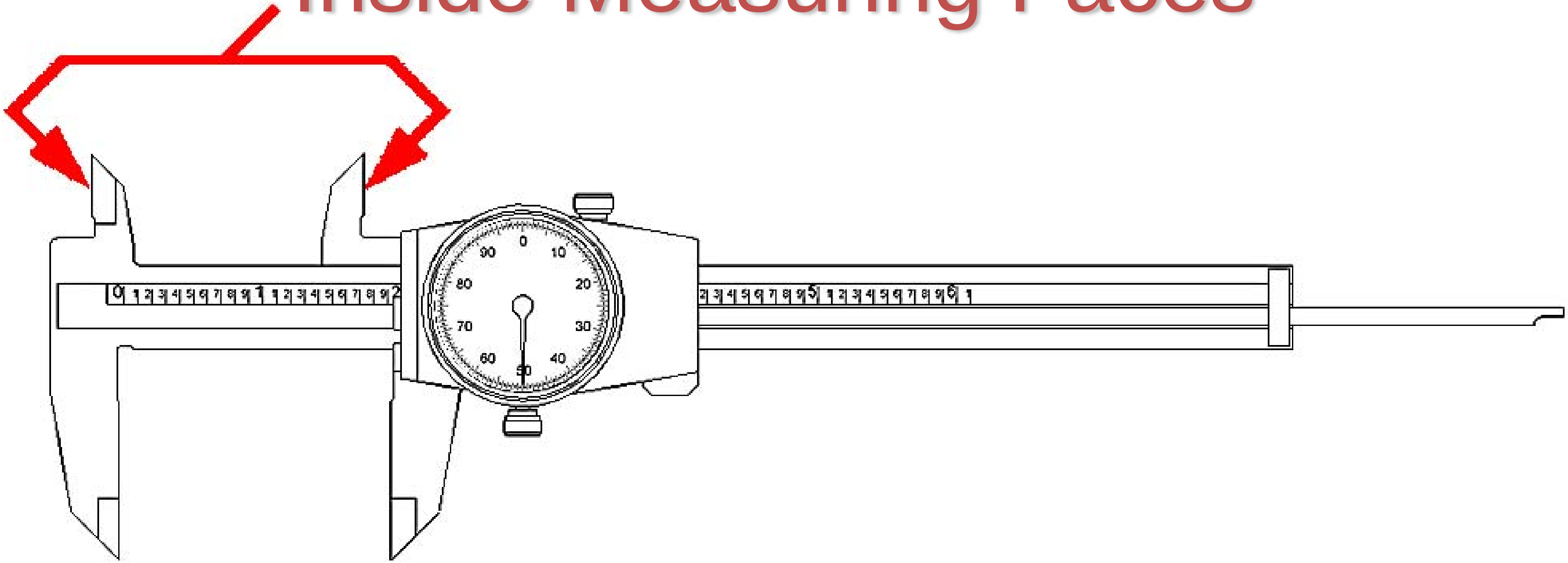
Outside Measuring Faces

These are the faces between which outside length or diameter is measured.



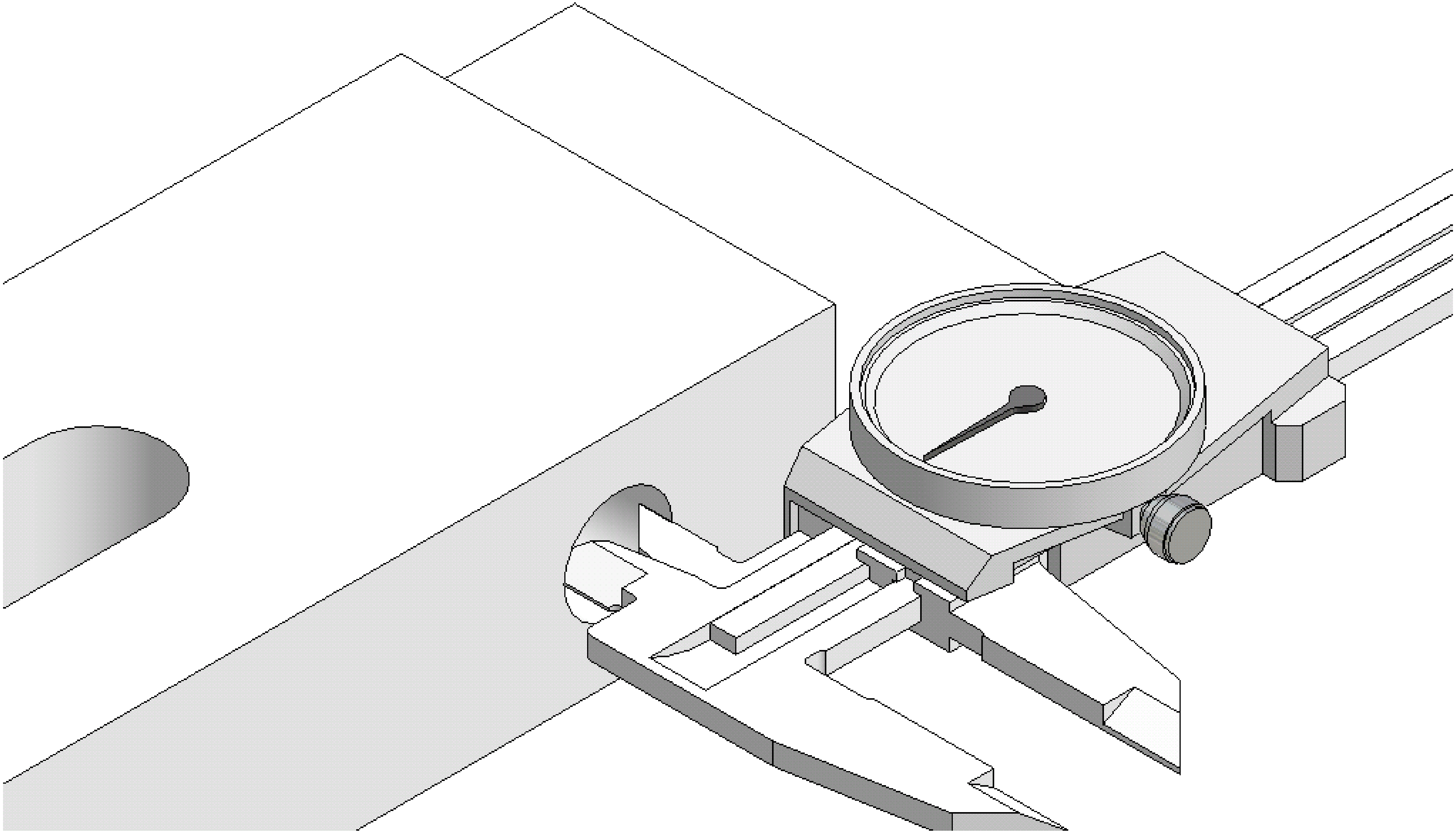
Example: Outside Diameter of object

Inside Measuring Faces

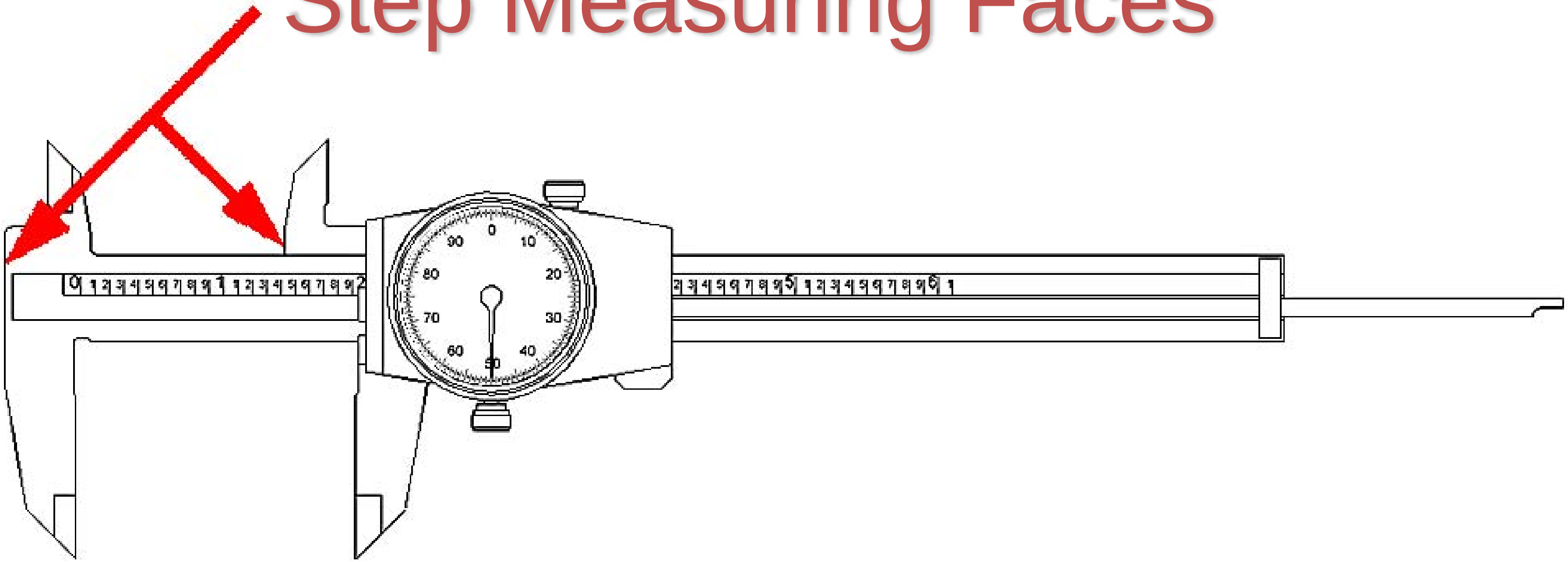


These are the faces between which inside diameter or space width (i.e., slot width) is measured.

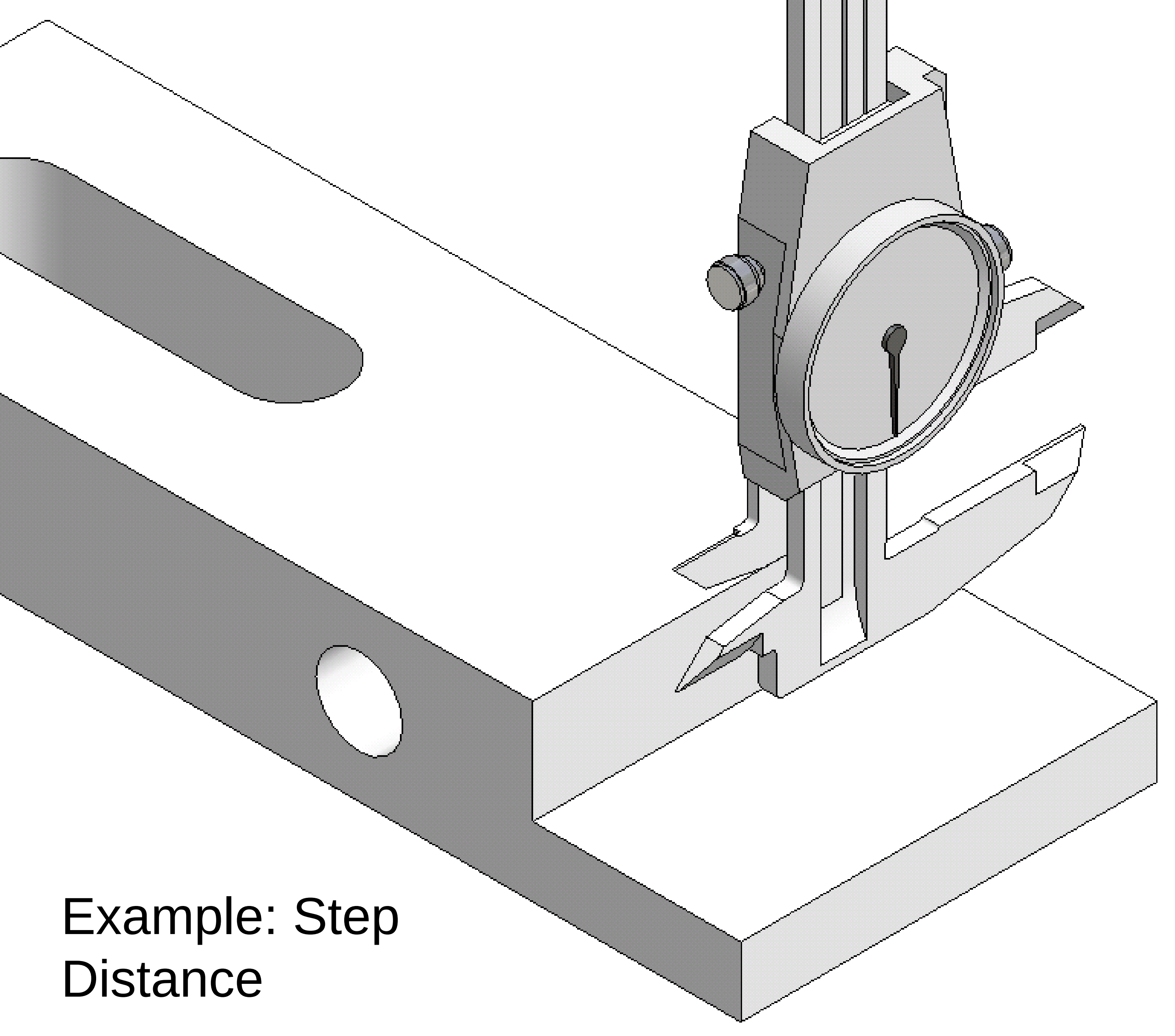
Example: Inside measuring



Step Measuring Faces

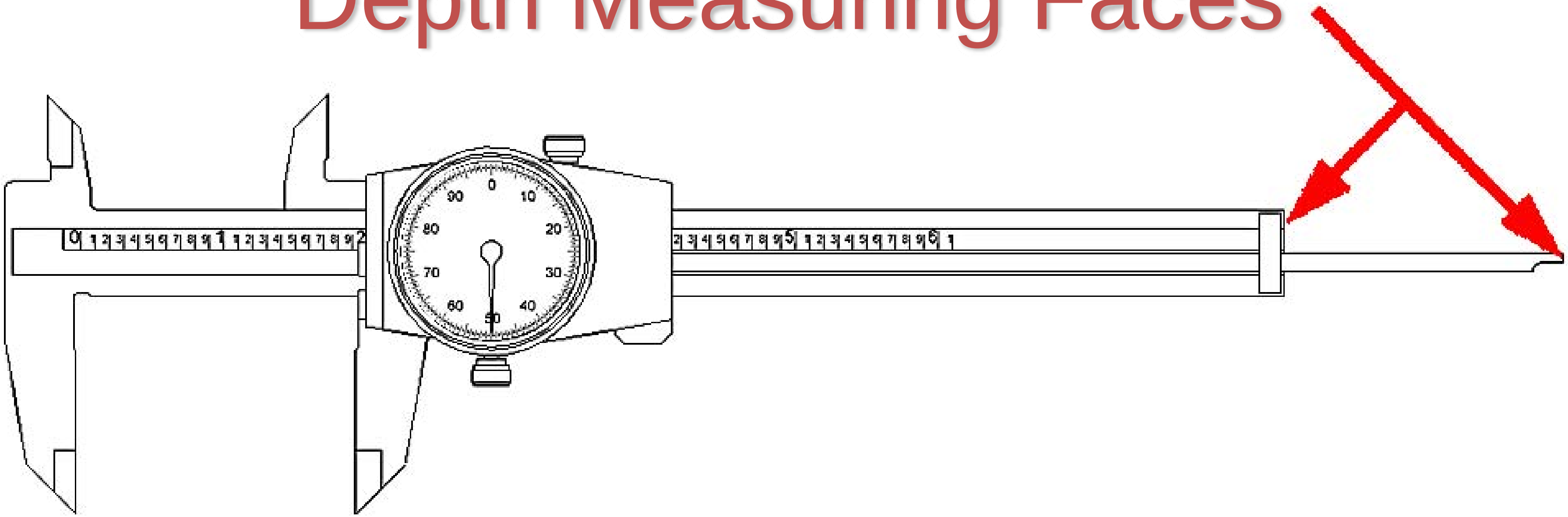


These are the faces between which stepped parallel surface distance can be measured.

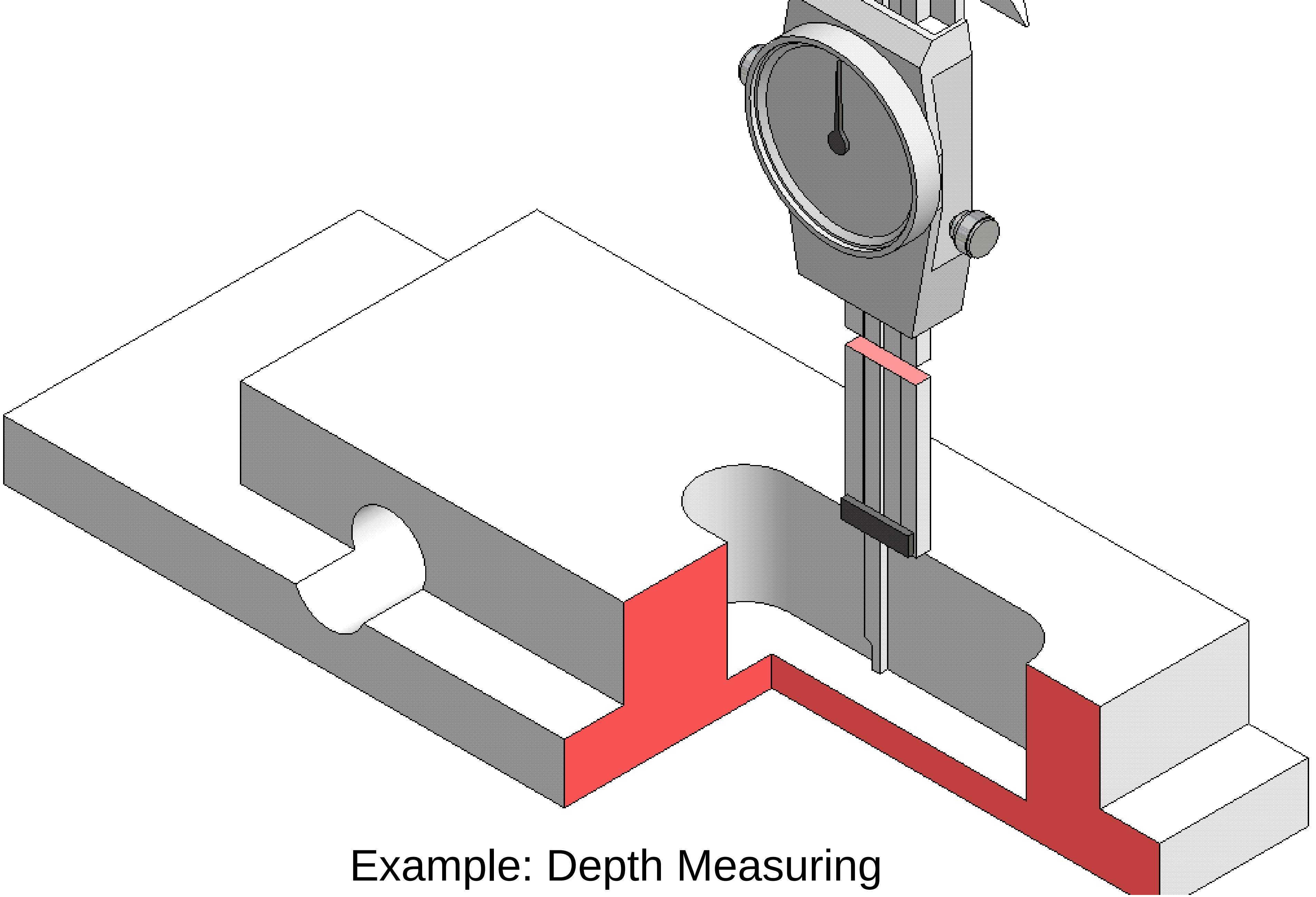


Example: Step Distance

Depth Measuring Faces

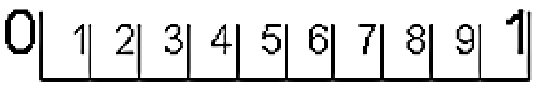


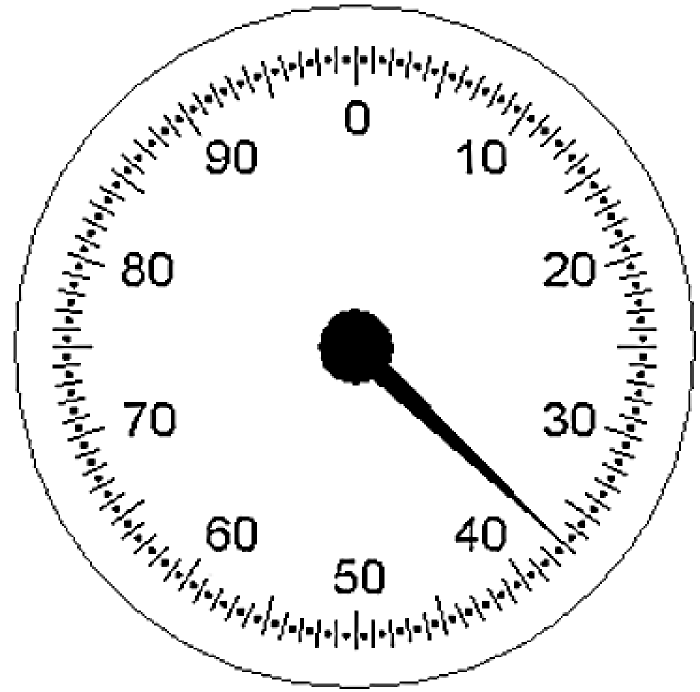
These are the faces between which the depth of a hole can be measured.



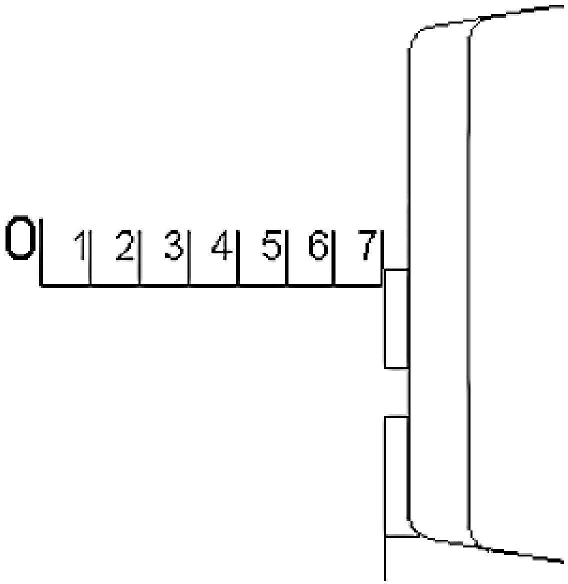
Example: Depth Measuring

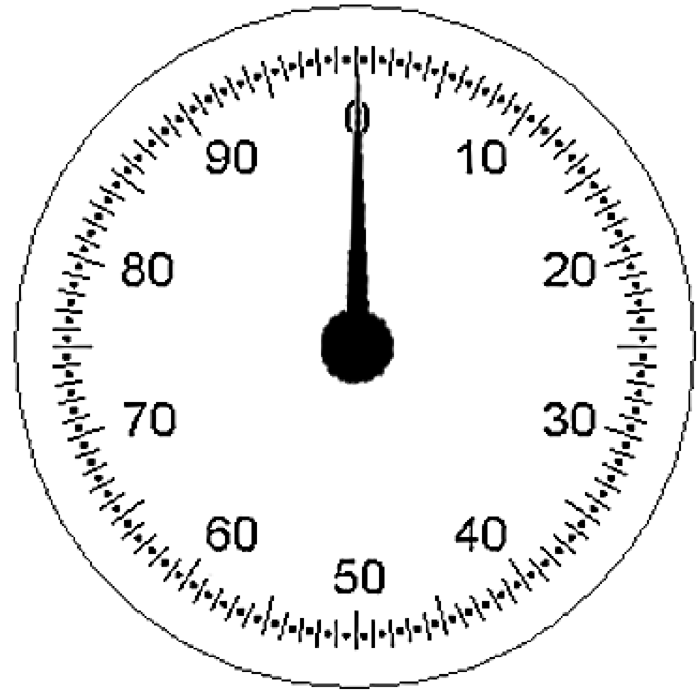
Note: Work piece is shown in section. Dial Caliper shortened for graphic purposes.



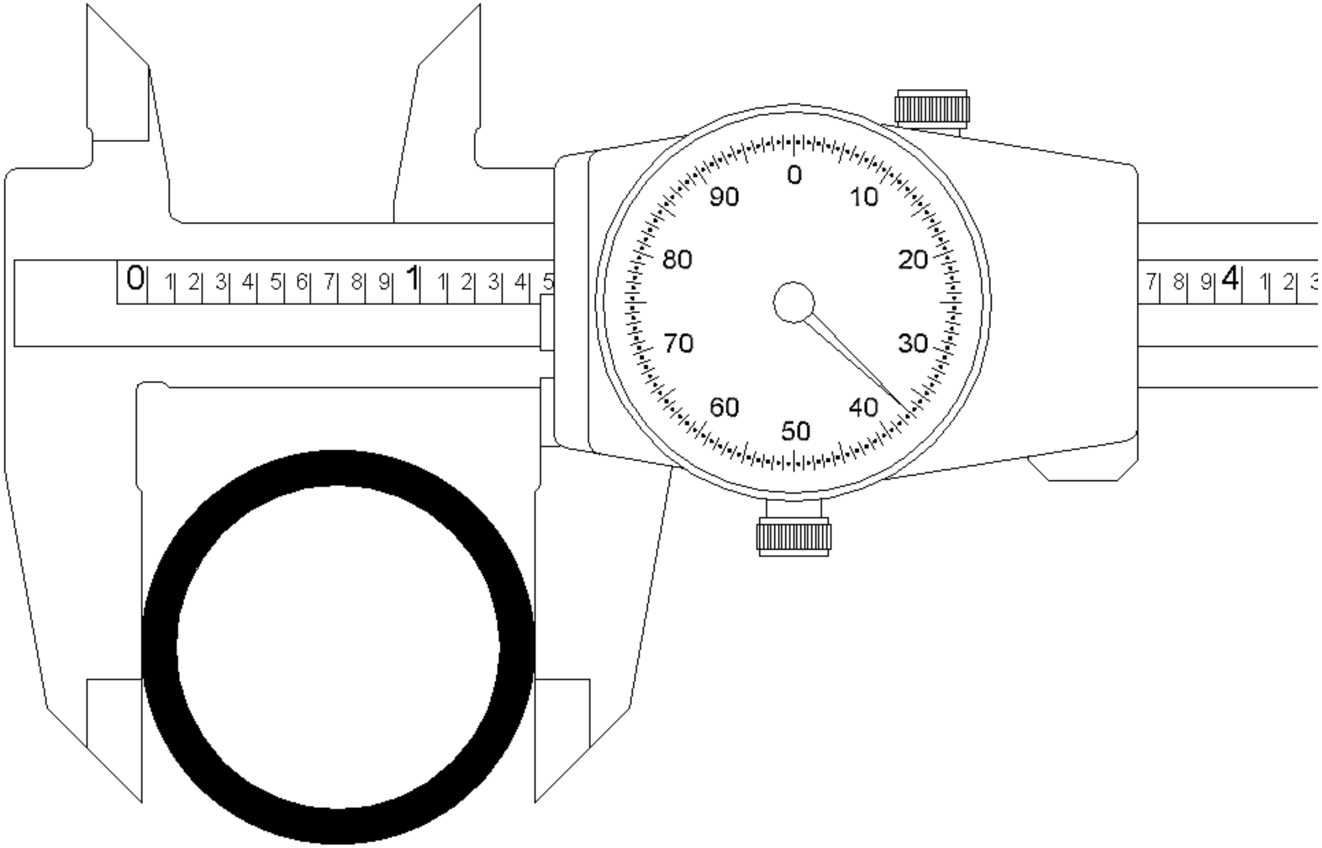


The *dial* is divided 100 times, with each graduation equaling one thousandth of an inch (0.001”).

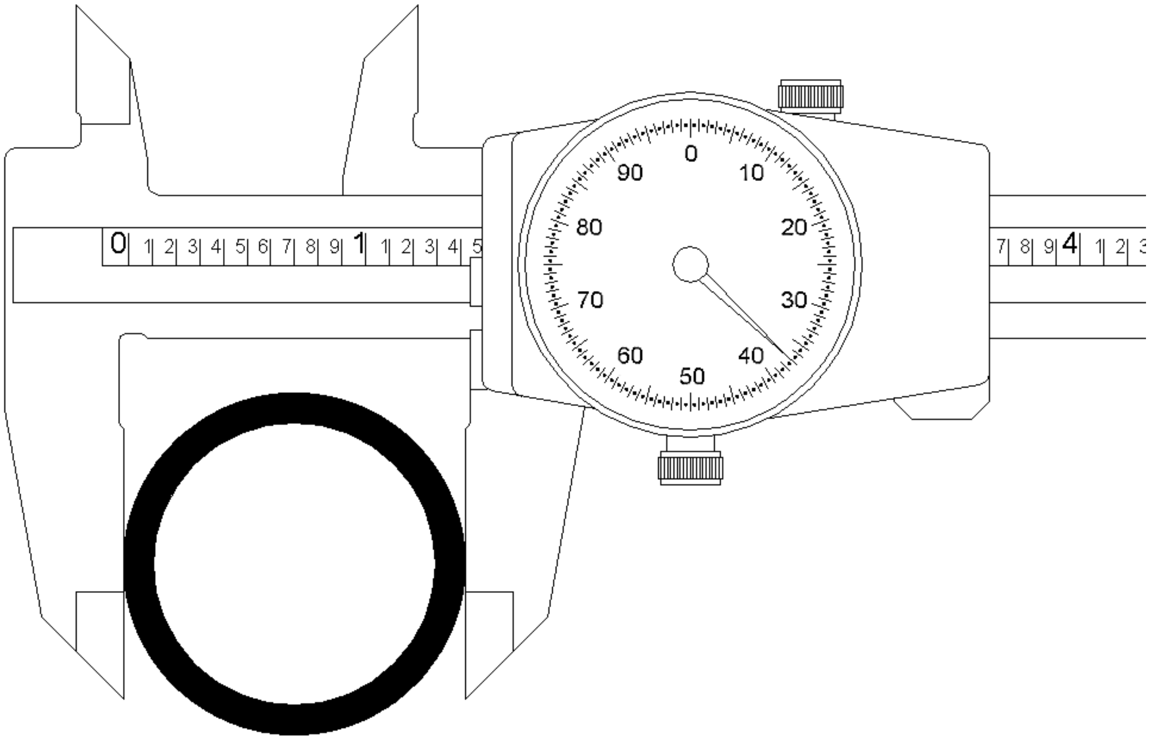




Every time the *pointer* completes one rotation, the *reference edge* on the *slider* will have moved the distance of one *blade scale* increment (0.100”).



To determine the outside diameter of this pipe section, the user must first identify how many inches are being shown on the *blade scale*.

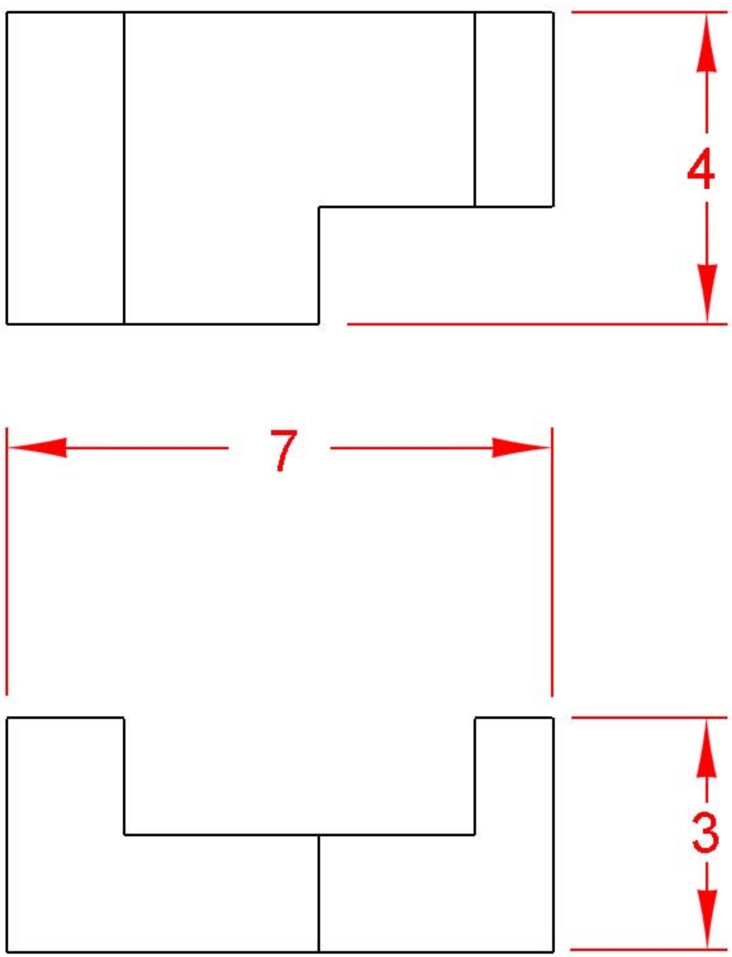


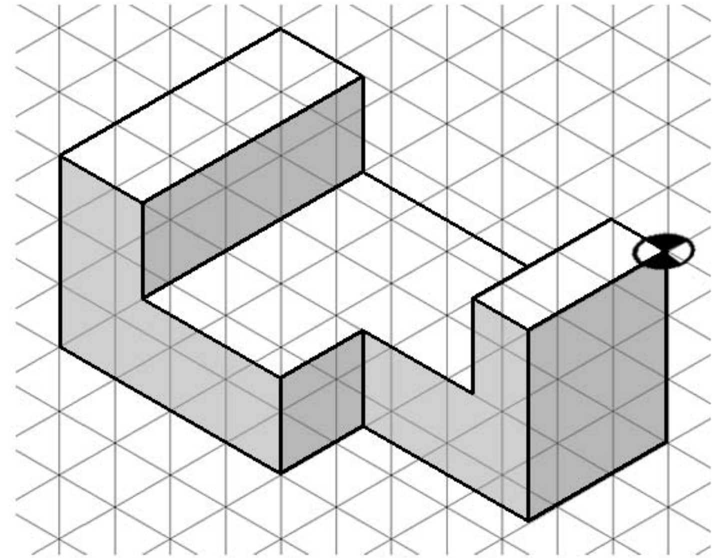
1.000”
0.400”

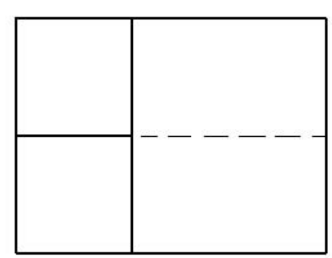
The *reference edge* is located between the 1 and 2 inch marks. So, the user makes a mental note…1 inch.

The user then identifies how many 0.1” increment marks are showing to the right of the last inch mark.
In this case, there are 4…or 0.400”.

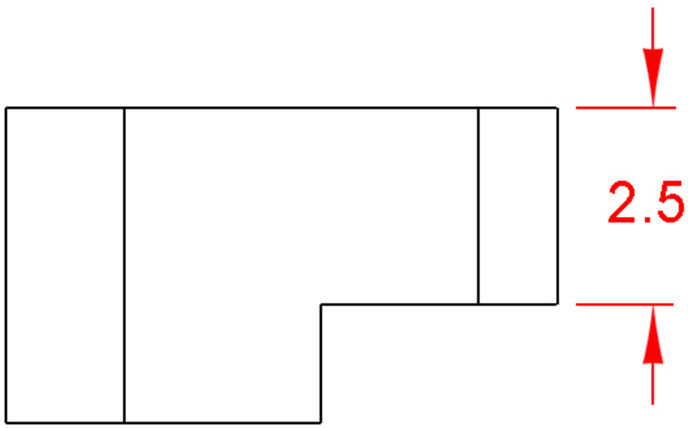
Size Dimensions

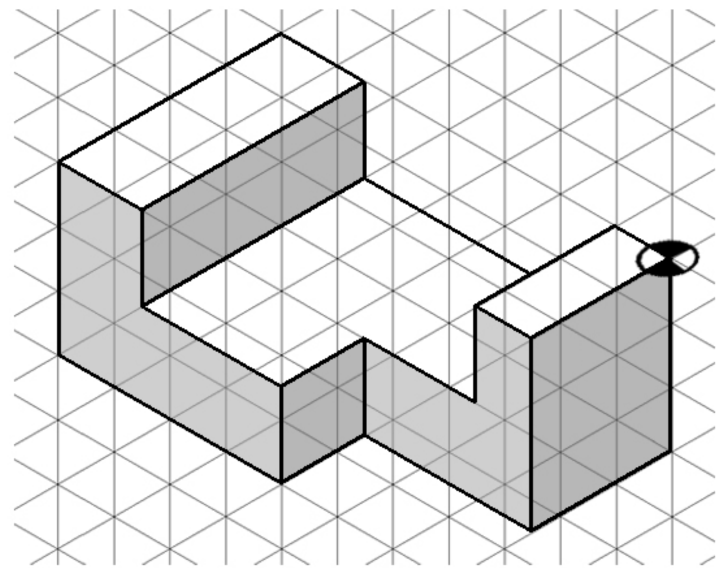


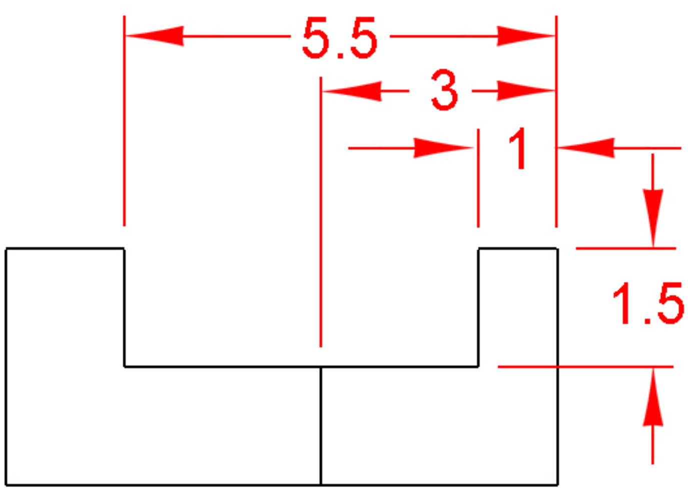


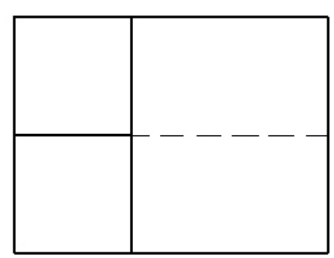


Location Dimensions





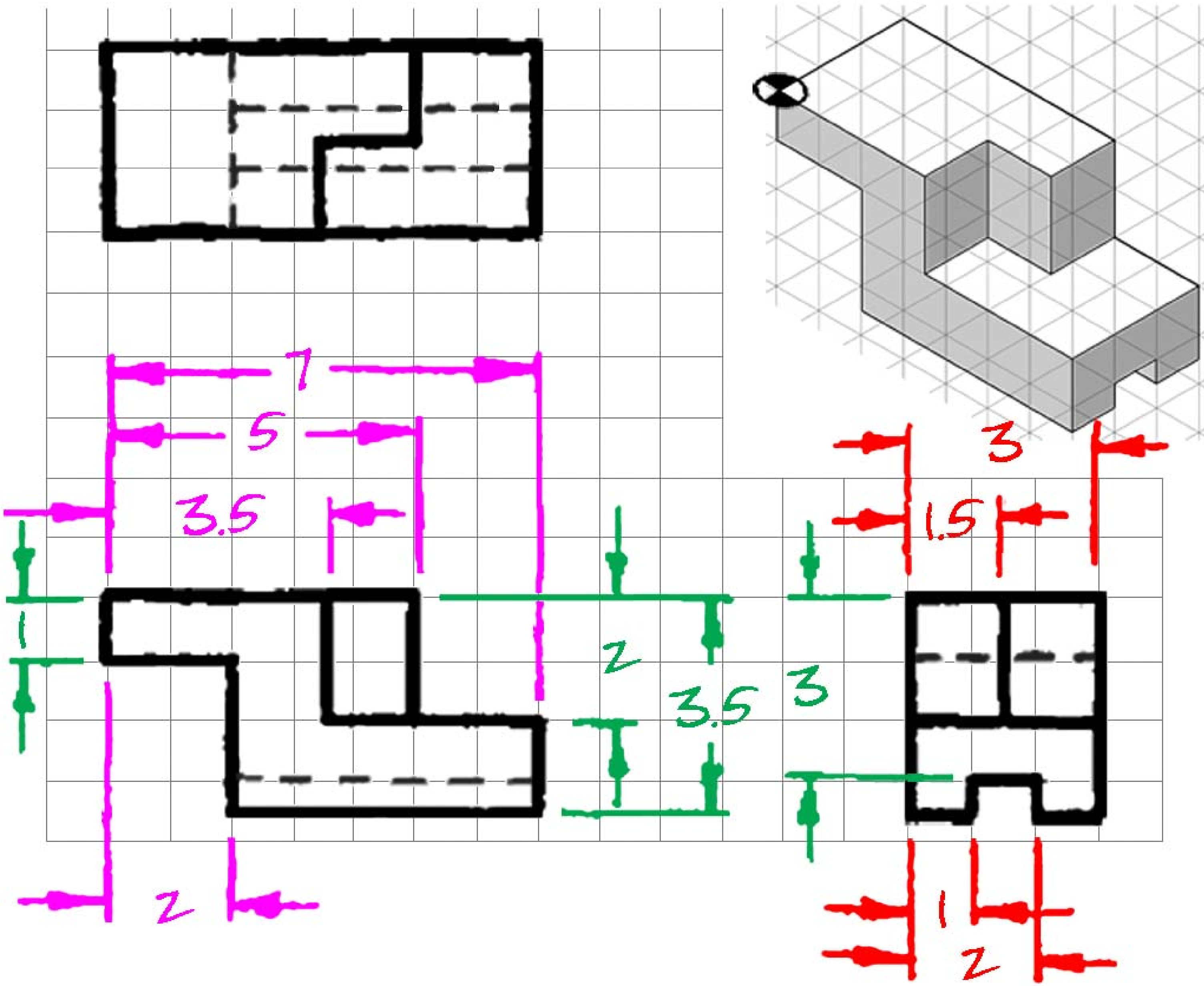




~~Width~~

~~Height~~

~~Depth~~



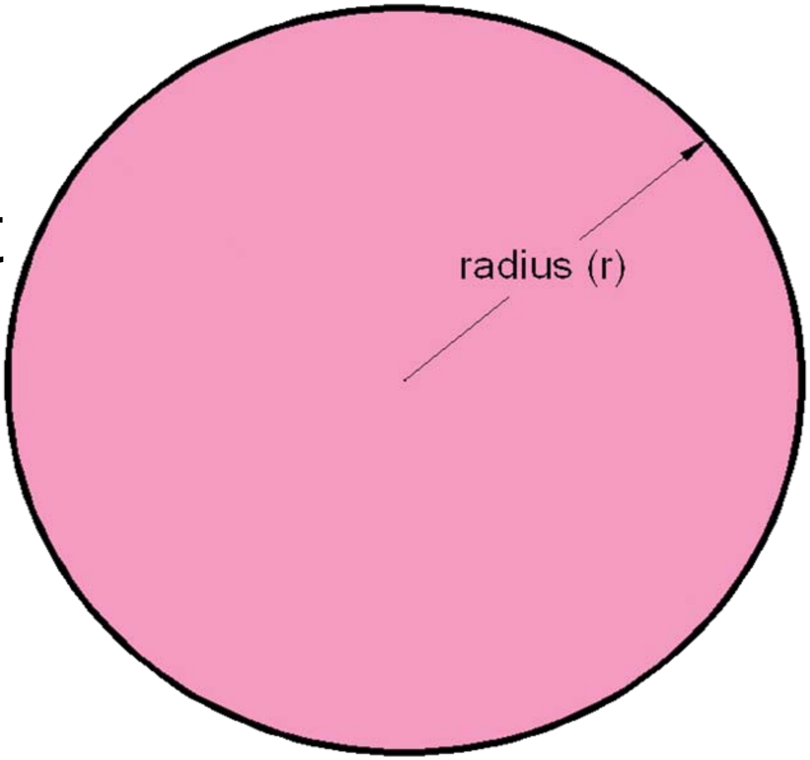
Area of a Circle

To calculate the area of a *circle*, the *radius* must be known.

$\pi \approx 3.14$

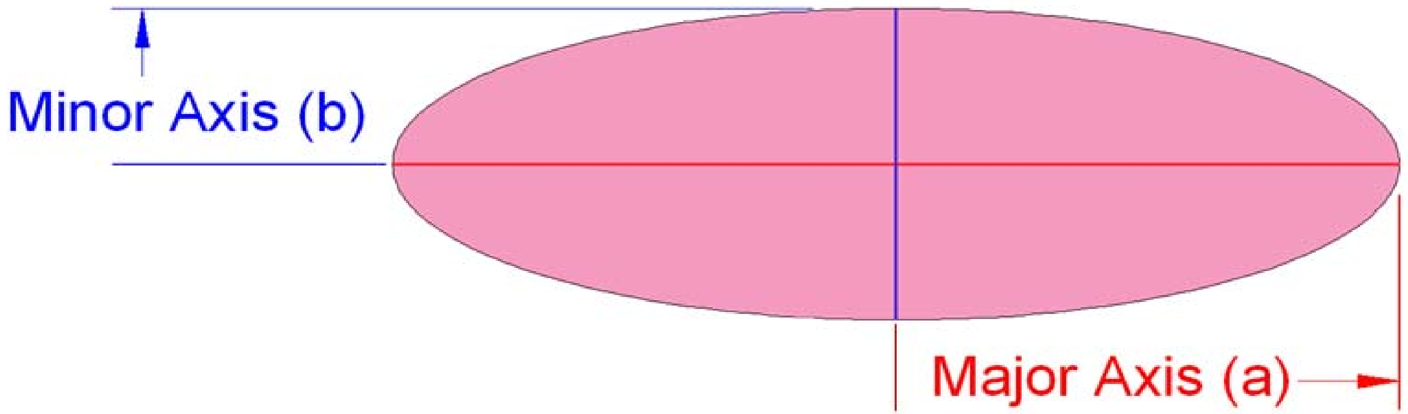
r = *radius*

A = *area*



$A = \pi r^2$

Ellipses



To calculate the area of an *ellipse*, the lengths of the *major* and *minor axis* must be known.

2a = major axis

2b = minor axis

$\pi = 3.14$

A = *area*

$A = \pi ab$

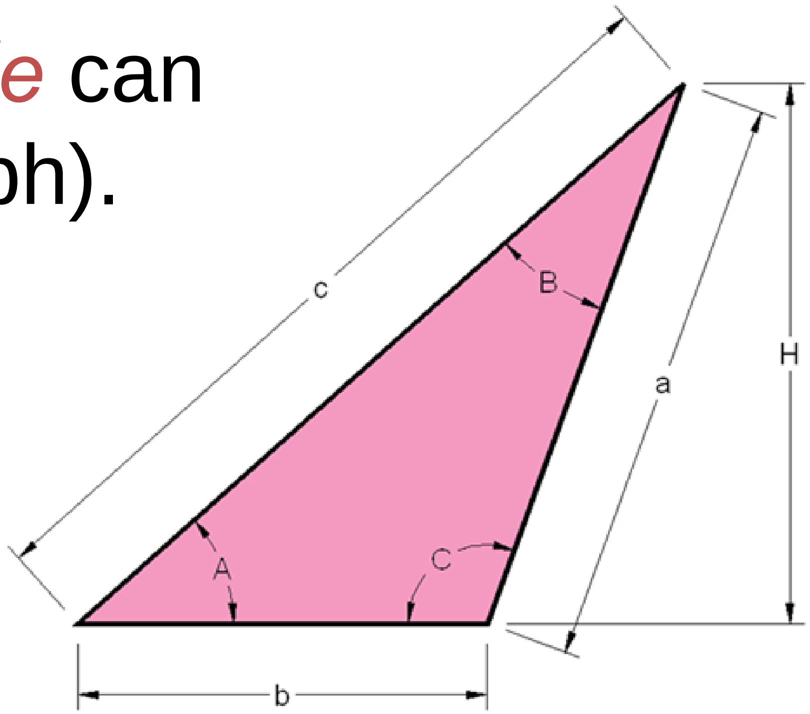
Area of a Triangle

The area of a *triangle* can be calculated by .5(bh).

b = *base*

h = *height*

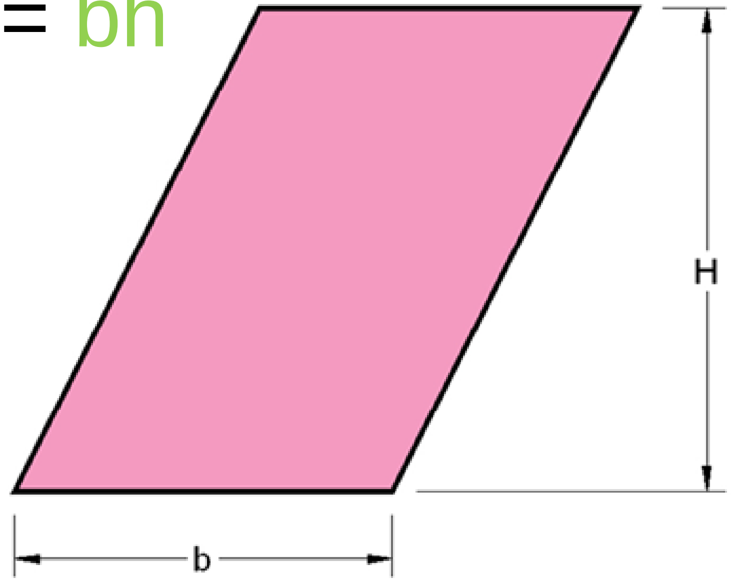
A = *area*



A = *.5(bh)*

Parallelograms

The area of a *parallelogram* can be calculated by $A = bh$



b = *base*

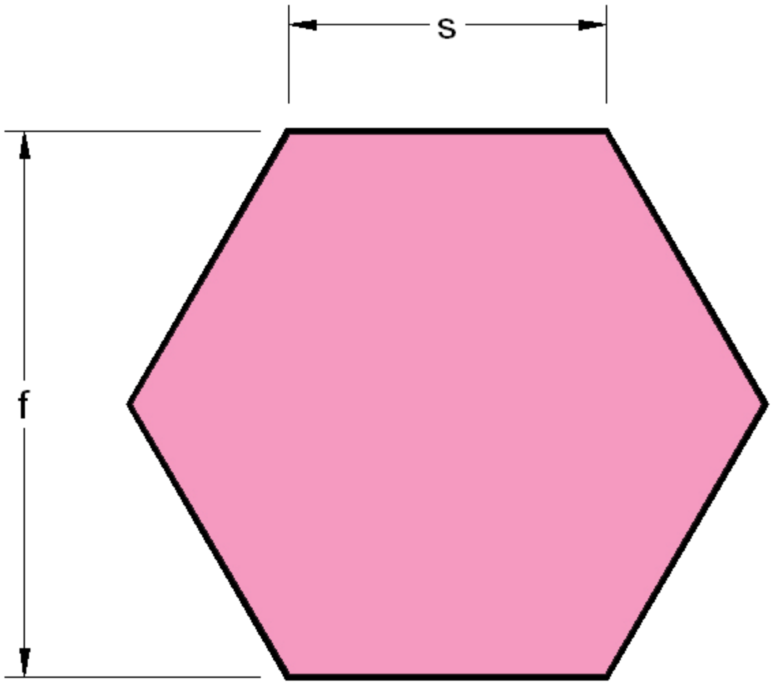
h = *height*

A = *area*

$A = bh$

Multisided Polygons

To calculate the area of a *multisided polygon*, a side length, distance between flats (or diameter of inscribed circle), and the number of sides must be known.



Multisided Polygons

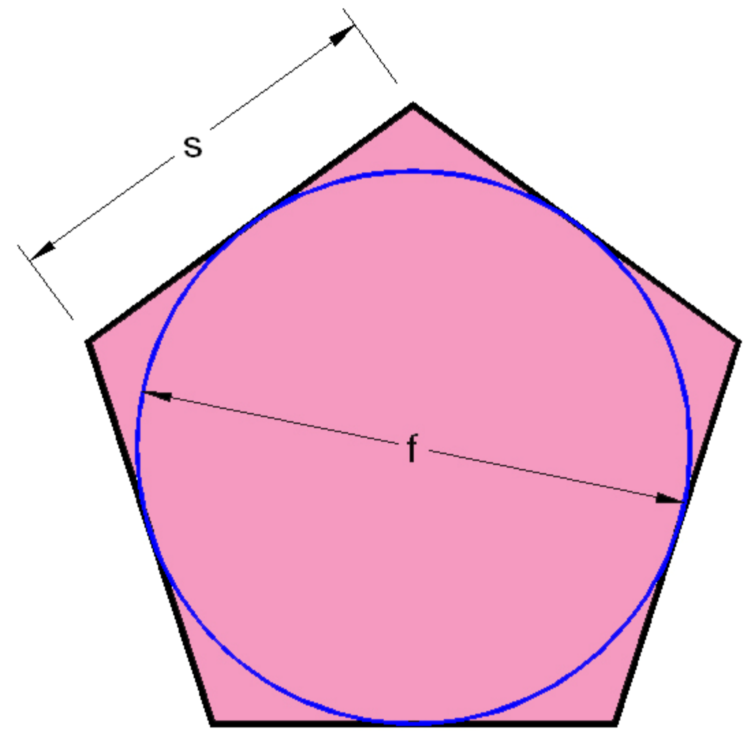
Area calculation of a *multisided polygon*:

s = *side length*

f = *distance between flats or diameter of inscribed circle*

n = *number of sides*

A = *area*



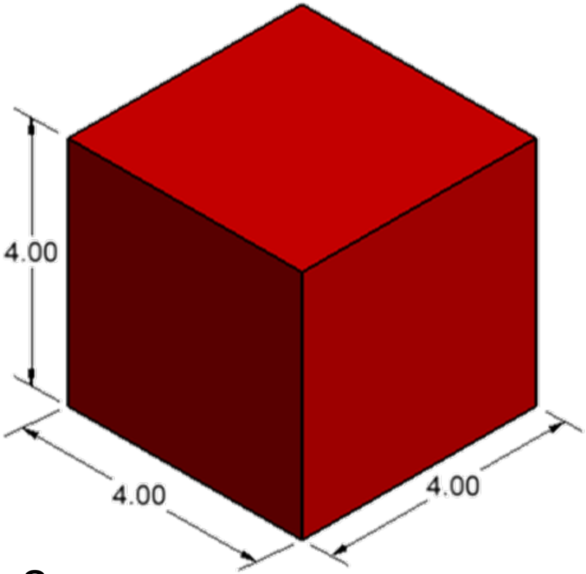
$$A = n\,\frac{s(.5f)}{2}$$

Volume of a Cube

A *cube* has sides (s) of equal length.

The formula for calculating the *volume* (V) of a *cube* is:

$$V = s^3$$



$V= s^3$

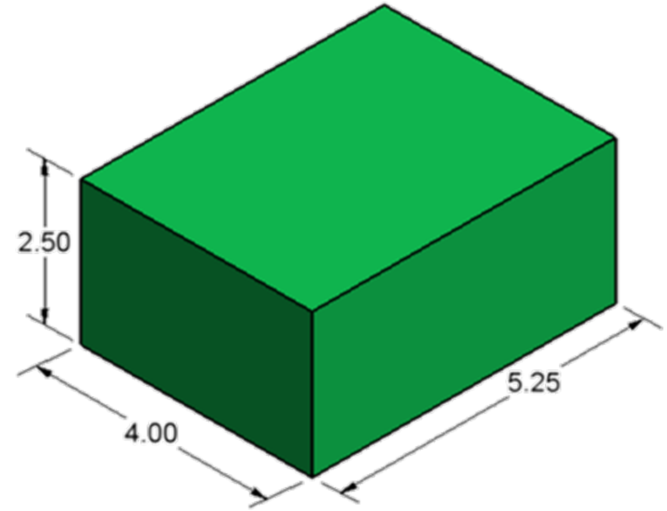
$V= 4 \text{ in} \times 4 \text{ in} \times 4 \text{ in}$

$\boxed{V = 64 \text{ in}^3}$

Volume of a Rectangular Prism

The formula for calculating the *volume* (V) of a *rectangular prism* is:

$$V = wdh$$



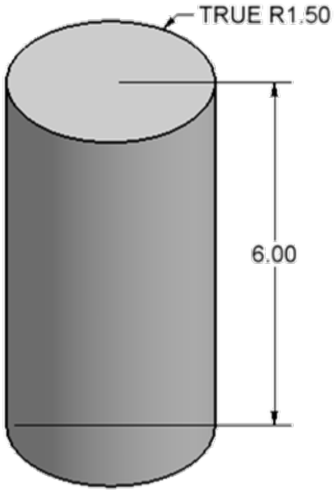
$V = wdh$

$V = 4 \text{ in} \times 5.25 \text{ in} \times 2.5 \text{ in}$

$\boxed{V = 52.5 \text{ in}^3}$

Volume of a Cylinder

To calculate the *volume* of a *cylinder*, its radius (r) and height (h) must be known.



The formula for calculating the *volume* (V) of a *cylinder* is:

$$V = \pi r^2 h$$

$V = \pi r^2 h$

$V = 3.14 \times (1.5\ \text{in})^2 \times 6\ \text{in}$

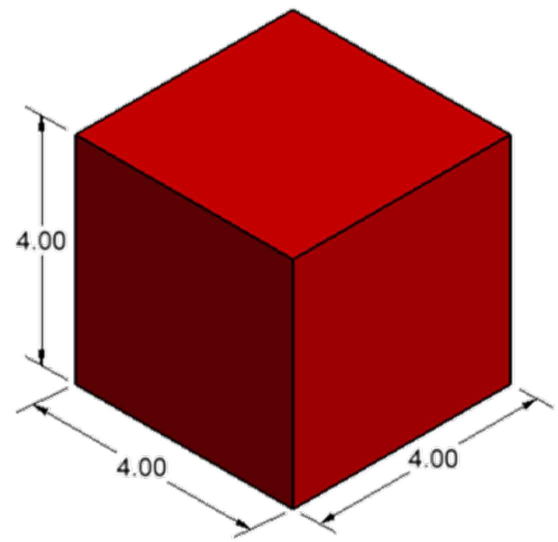
$\boxed{V = 42.39\ \text{in}^3}$

Surface Area Calculations

In order to calculate the *surface area* (SA) of a *cube*, the *area* (A) of any one of its faces must be known.

The formula for calculating the surface area (SA) of a *cube* is:

$$SA = 6A$$



$SA = 6A$

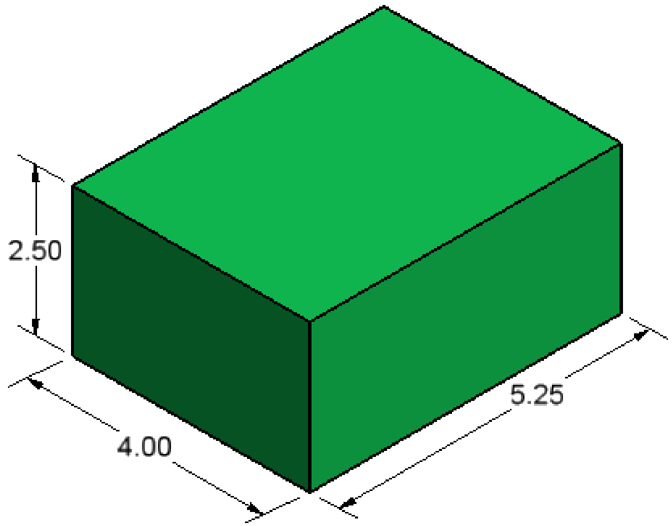
$SA = 6 \times (4 \text{ in} \times 4 \text{ in})$

$\boxed{SA = 96 \text{ in}^2}$

Surface Area Calculations

In order to calculate the *surface area* (SA) of a *rectangular prism*, the *area* (A) of the three different faces must be known.

$$SA = 2(wd + wh + dh)$$



$$SA = 2(wd + wh + dh)$$

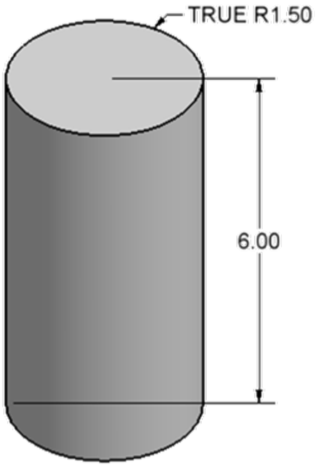
$$SA = 2 \times 44.125 \text{ in}^2$$

$$\boxed{SA = 88.25 \text{ in}^2}$$

Surface Area Calculations

In order to calculate the *surface area* (SA) of a *cylinder*, the area of the curved face, and the combined area of the circular faces must be known.

$$SA = (2\pi r)h + 2(\pi r^2)$$



$$SA = 2(\pi r)h + 2(\pi r^2)$$

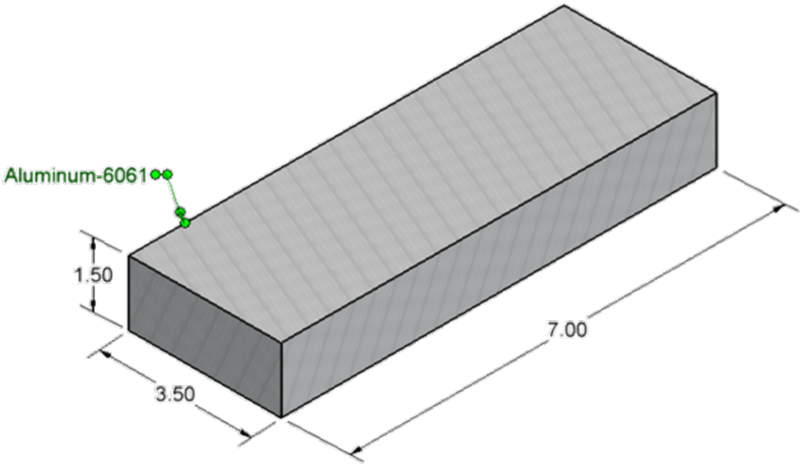
$$SA = 56.52\ in^2 + 14.13\ in^2$$

$$\boxed{SA = 88.25\ in^2}$$

Calculating Weight

To calculate the *weight* (W) of any solid, its *volume* (V) and *weight density* (D_w) must be known.

$$W = VD_w$$



$$W = VD_w$$

$$W = 36.75\ in^3 \times .098\ lbs/in^3$$

$$\boxed{W = 3.6\ lbs}$$

Parametric Equations

Algebraic equations that use variables can be substituted for individual numeric values.

*d7 = ((d2*d0)/d5)+2 in*

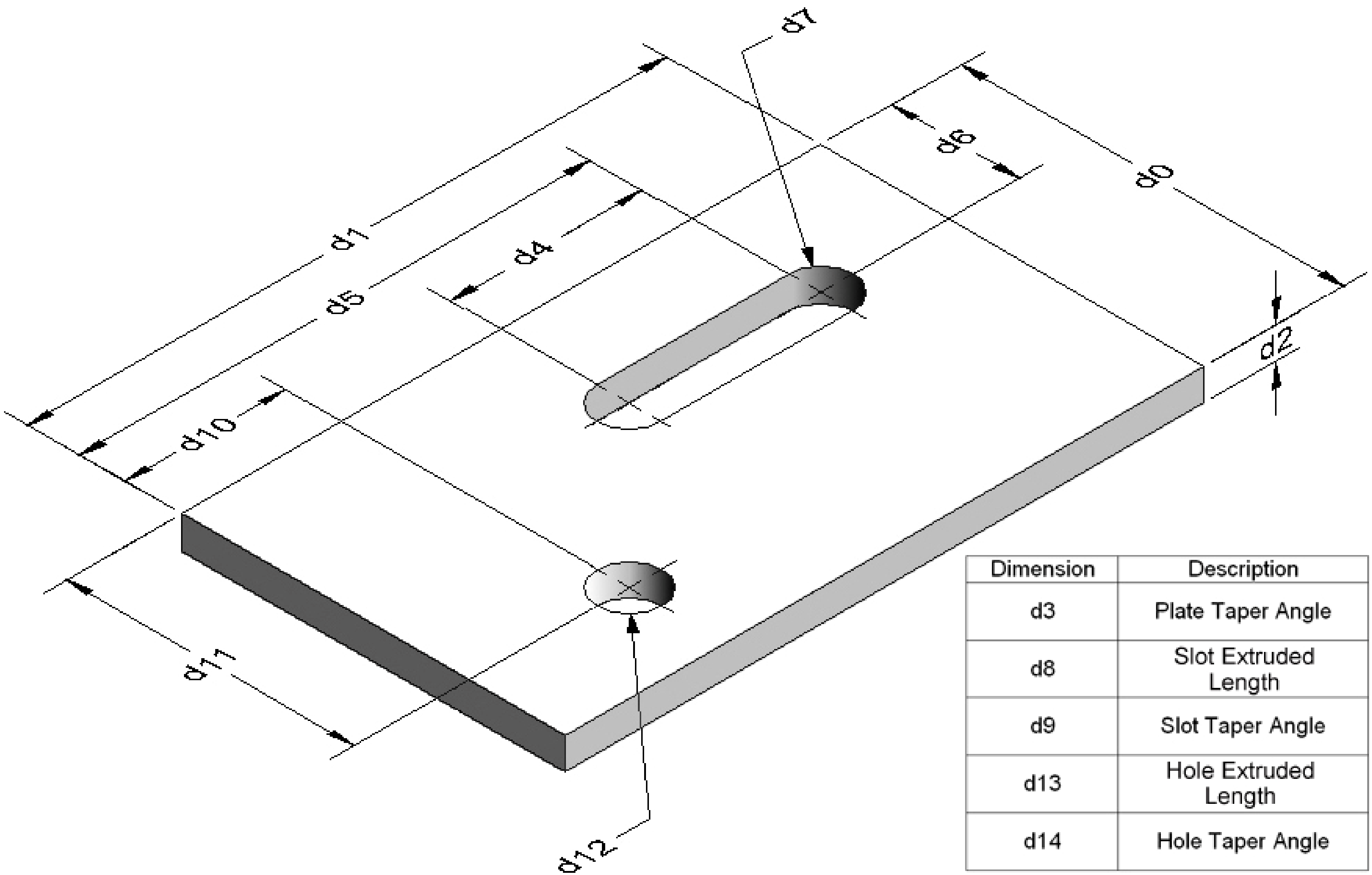
The resulting dimensional value may change, but the formula will remain constant.

Symbols:	**+**	**-**	*****	**/**
	add	*subtract*	*multiply*	*divide*

Parametric Equations

Scenario: A child’s proportions are similar to those of an adult. A chair could be dimensioned in such a way that a change in the seat height could scale all the other chair features uniformly.

Each dimension is given a designation, starting with d0.



Dimension	Description
d3	Plate Taper Angle
d8	Slot Extruded Length
d9	Slot Taper Angle
d13	Hole Extruded Length
d14	Hole Taper Angle

Parametric Equations

Dimension	Description	Geometric Relationship	Parametric Equation	Value
d0	Overall Plate Depth	--	--	3 in
d1	Overall Plate Width	5:3 ratio; overall plate width to overall plate depth		5 in

If dimension d0 is the only linear dimension that will have a numeric value, then it must be used to develop an equation that will maintain proportionality:

d1 = d0 in*(5/3) *or* d1 = d0 in/(3/5)

5 in = 3 in x 1.66667 5 in = 3 in ÷ .6

Parametric Equations

Dimension	Description	Geometric Relationship	Parametric Equation	Value
d0	Overall Plate Depth	--	--	3 in
d1	Overall Plate Width	5:3 ratio; overall plate width to overall plate depth	d0*(5/3)	5 in

Both equations work, so either may be used in the CAD program as a parametric equation for dimension d1 to maintain proportionality.

d1 = d0 in*(5/3) *or* d1 = d0 in/(3/5)

5 in = 3 in x 1.66667 5 in = 3 in ÷ .6