SRM INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)

18MES101L – Engineering Graphics and Design

Exercise - 7

Combination of Solids - 1

Basic Definitions

- **What is solid?**

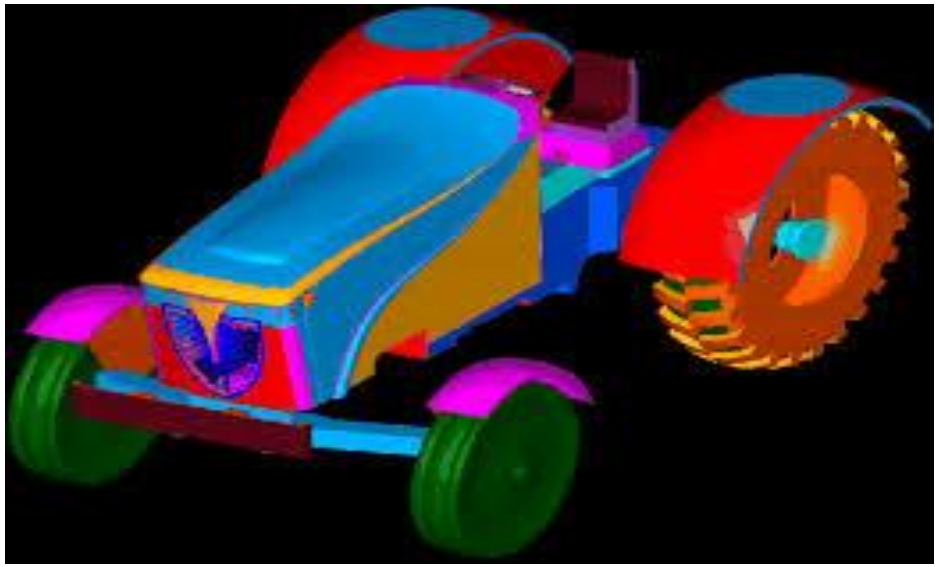
  Solid is having three dimensions.

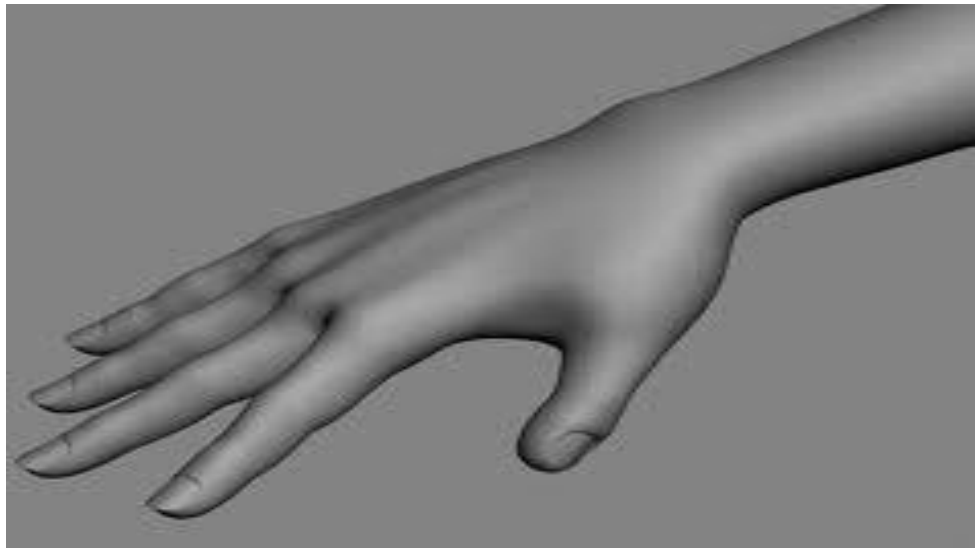
- **What is solid modeling?**

  Solid modeling (or modeling) is a consistent set of principles for mathematical and computer modeling of three-dimensional solids.

SRM
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)

Solid modeling





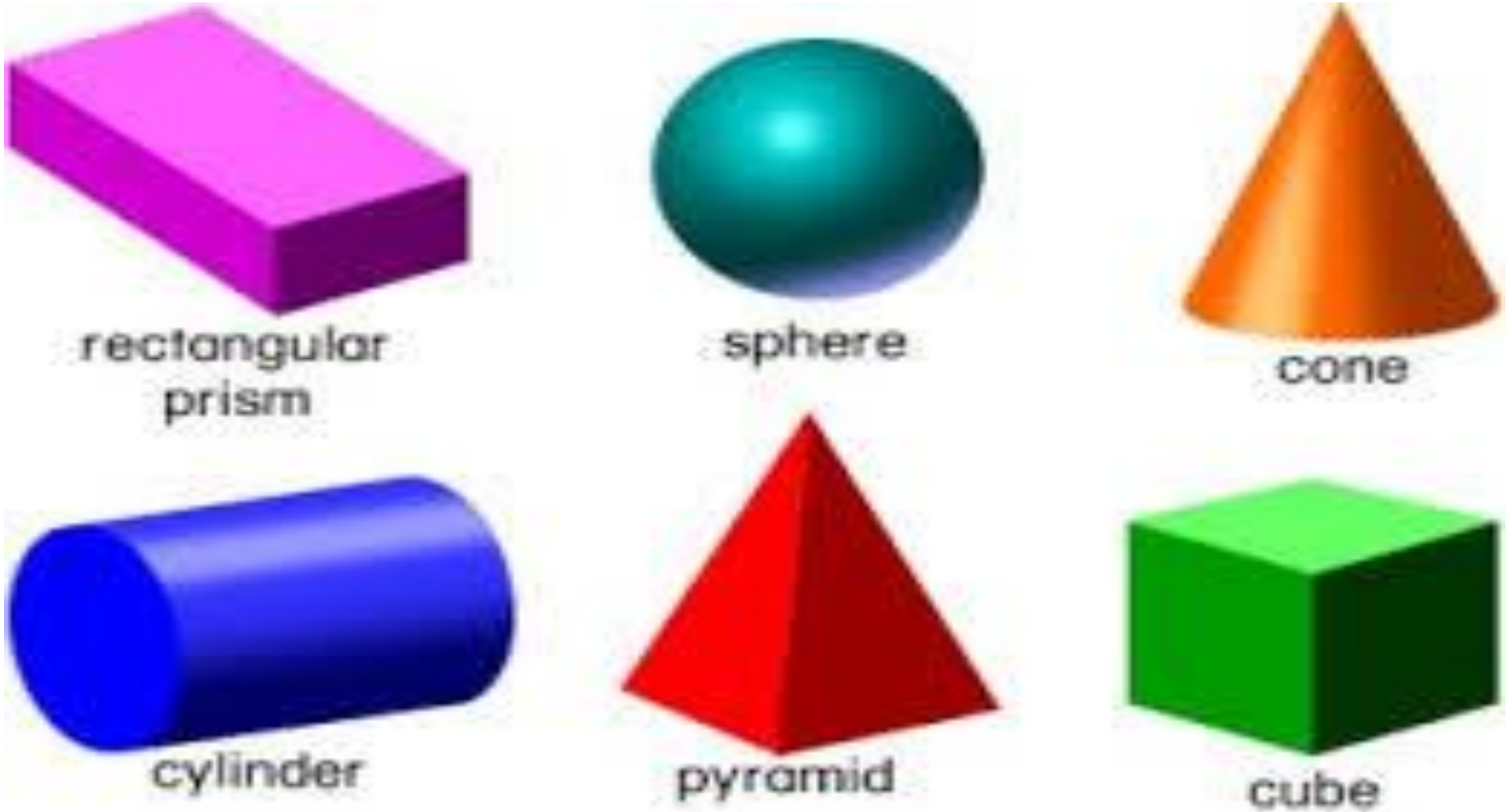
Basic Definitions

Primitives:

- Solid modeling packages having a CSG-compatible user input, and therefore, provide users with a certain set of building blocks, often called **primitives**.
- **Primitives** are simple basic shapes and are considered the solid modeling entities which can be combined by a mathematical set of boolean operations to create the solid
- The four most commonly used primitives are: block, cylinder, cone, sphere
- These are based on four natural quadrics, planes, cylinders, cones and spheres

SRM
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)

Solids



- Solid models can consists of primitive shapes such as (Already used in Projection of Solids exercises)
  - Sphere
  - Cylinder
  - Cone
  - Pyramid
  - Cube
  - Box

Boolean Operations

- The Boolean commands work only on solids or regions.
- The first stage in a solid model creation consists in obtaining one or more primitives.
- The next stage consists in using Boolean operations of Union, Subtract or Intersect in order to create the solid model.

- Boolean operations are used to combine solid primitives to form the desired solid.
- The available operators are

  Union (U or +)

  Intersection (∏ or I)

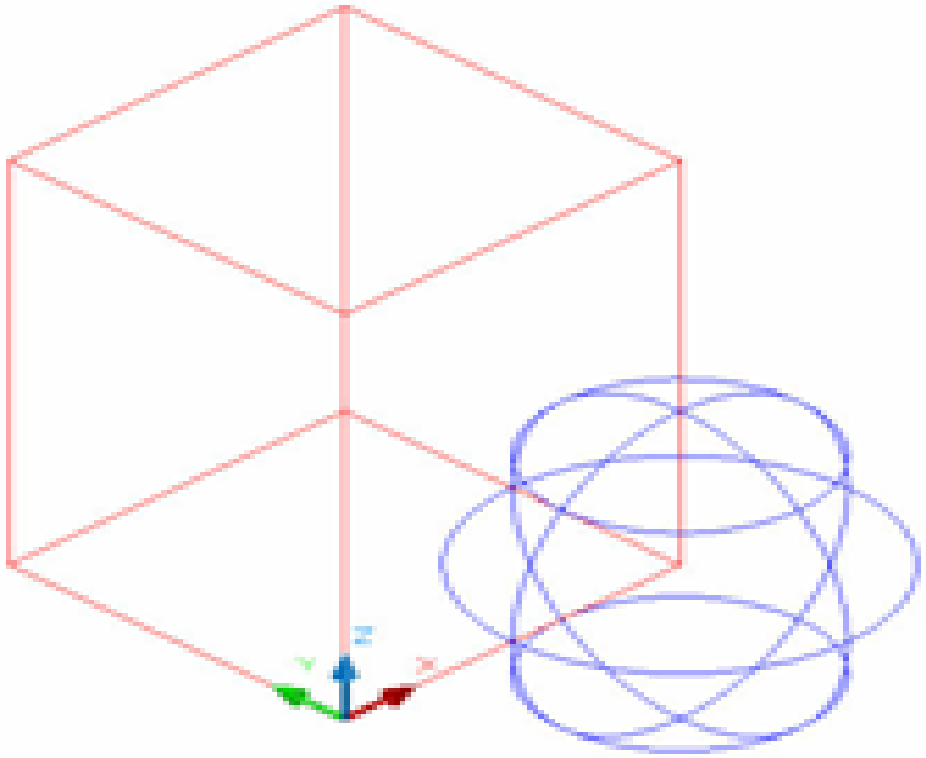
  Difference or subtract (-)

- The Union operator (U or +): *is used to combine or add together two objects or primitives.*
- The Intersection operator (∏ or I): *intersecting two primitives gives a shape equal to their common volume.*
- The Difference operator (-): *is used to subtract one object from the other and results in a shape equal to the difference in their volumes.*

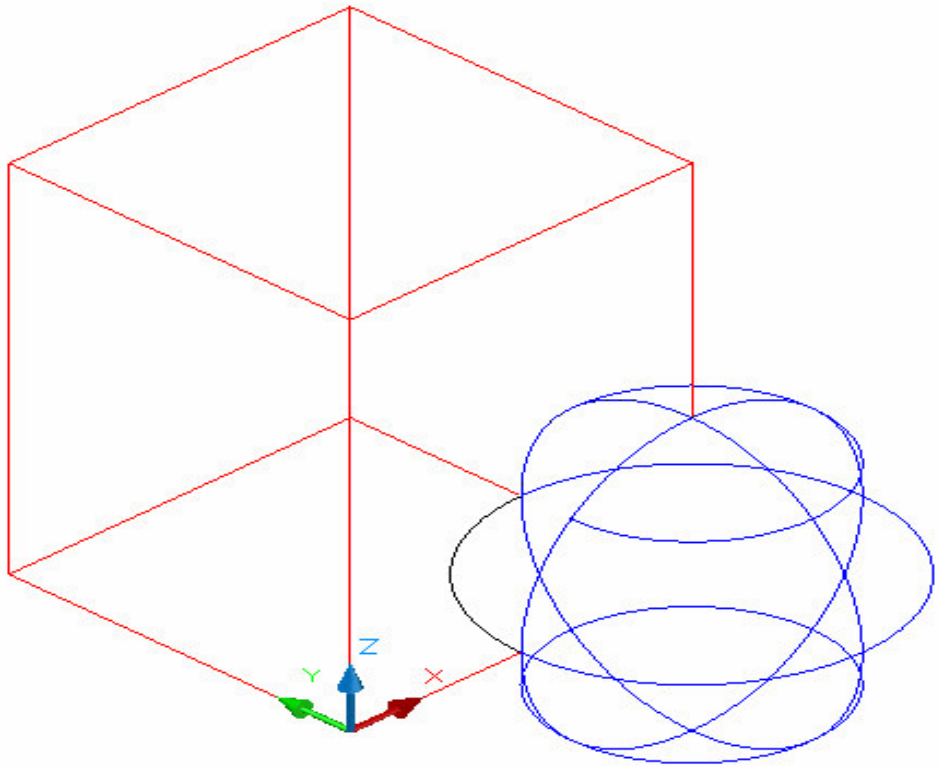
SRM INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)

Union

Before Union

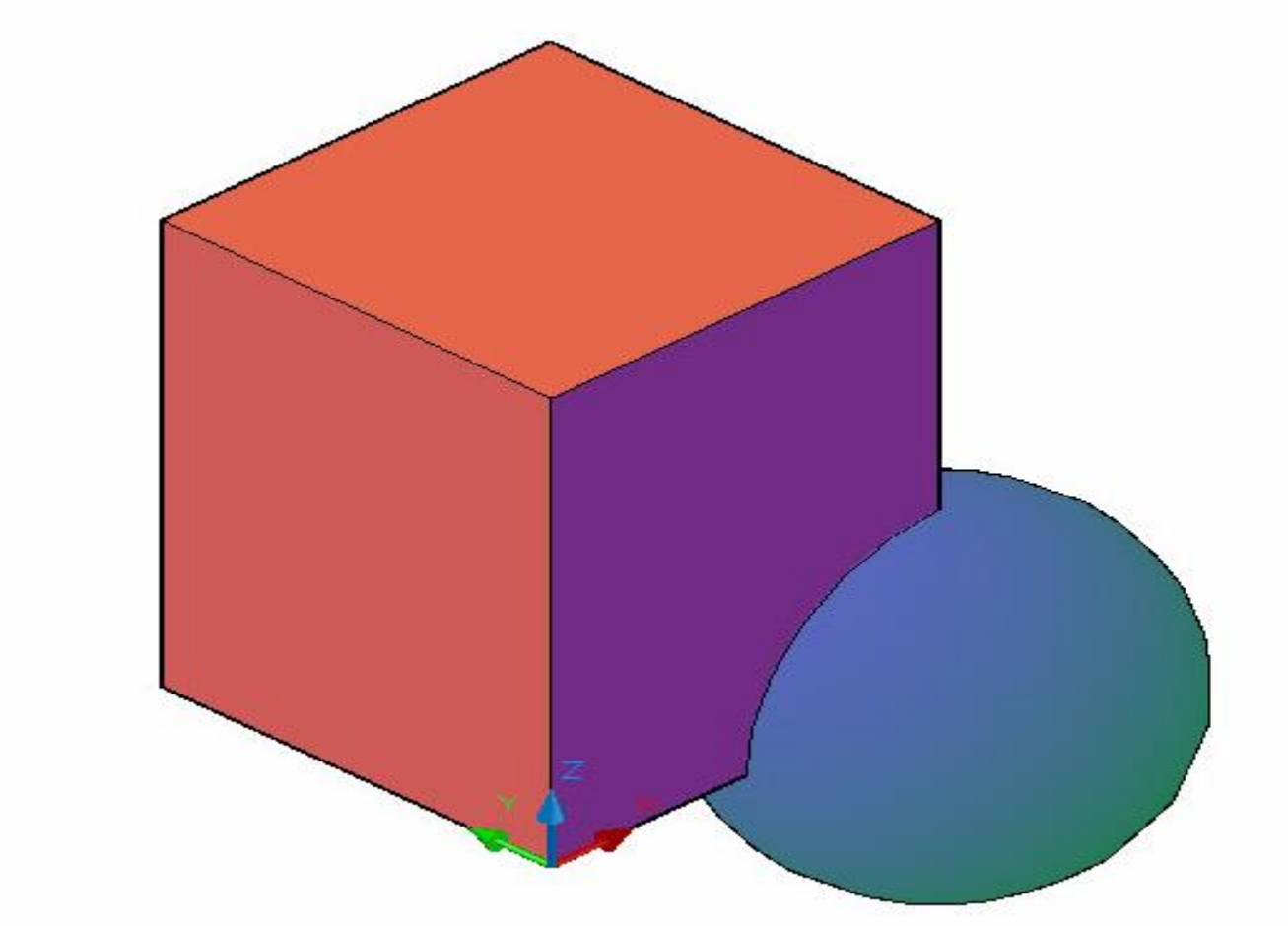


After Union

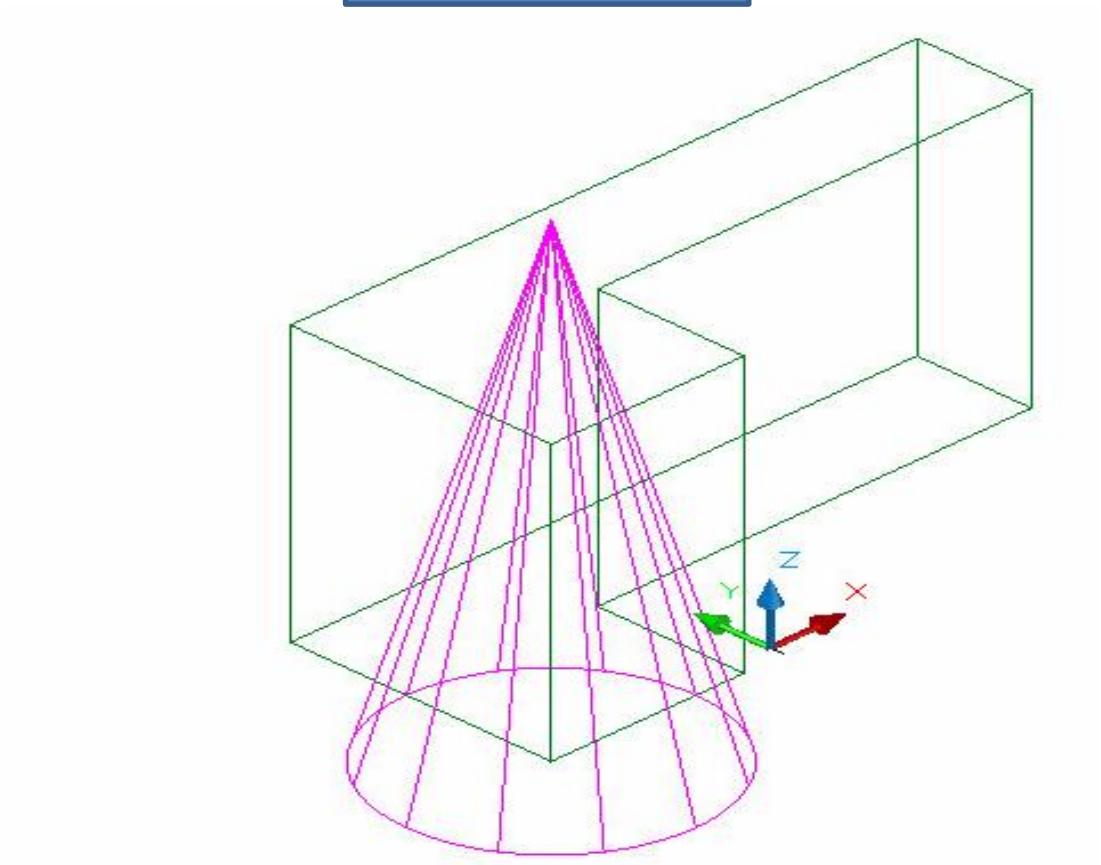


SRM
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)

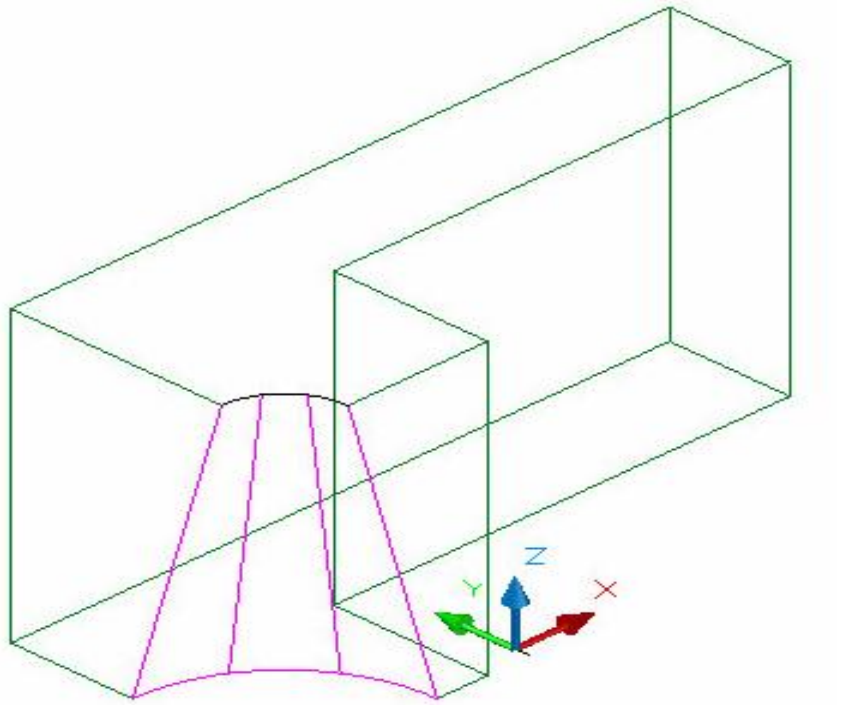
Union



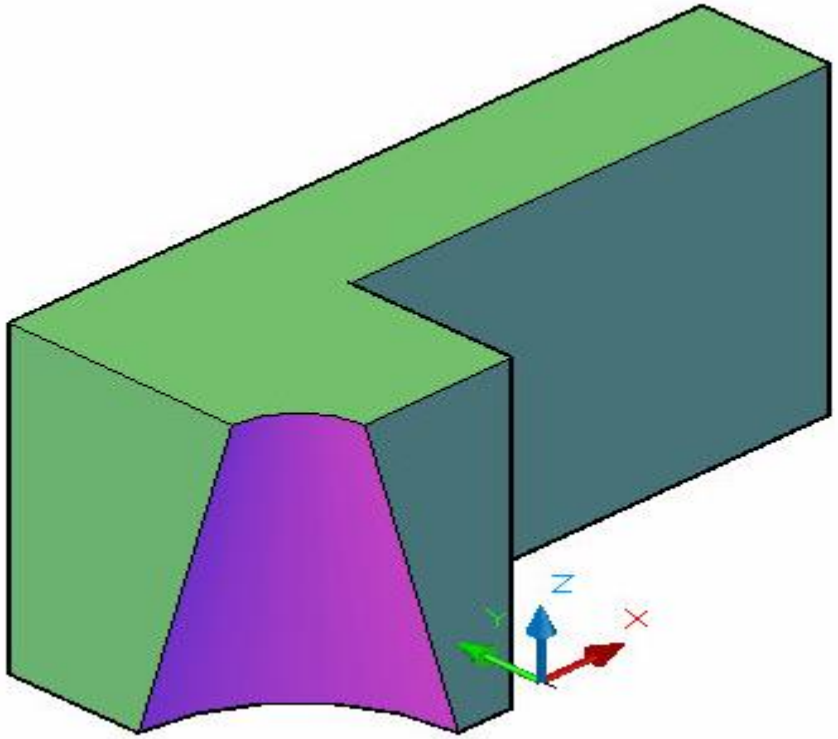
Before Subtract



After Subtract

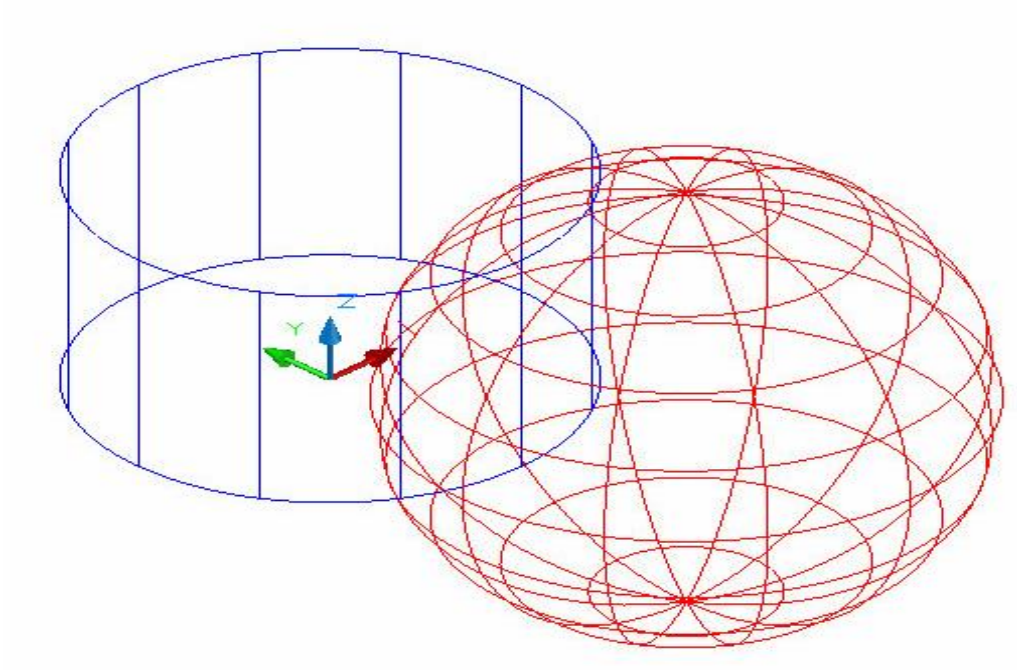


Subtract

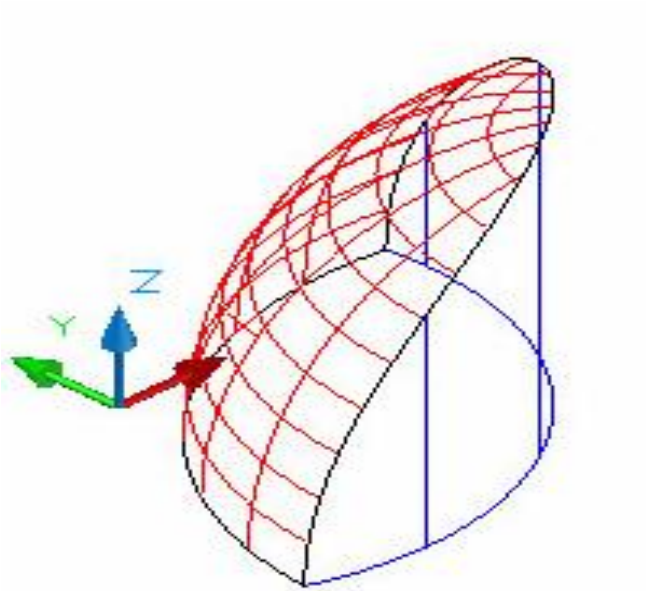


Intersection

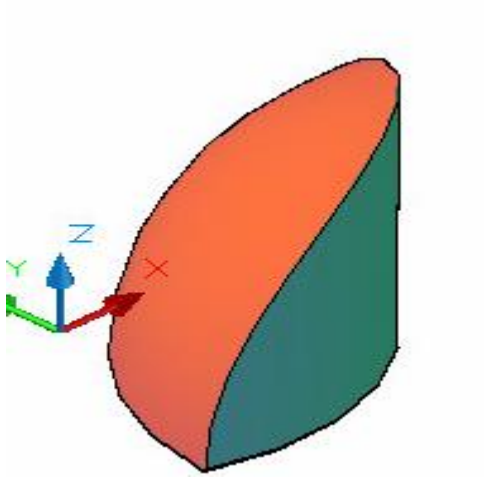
Before Intersection



After Intersection

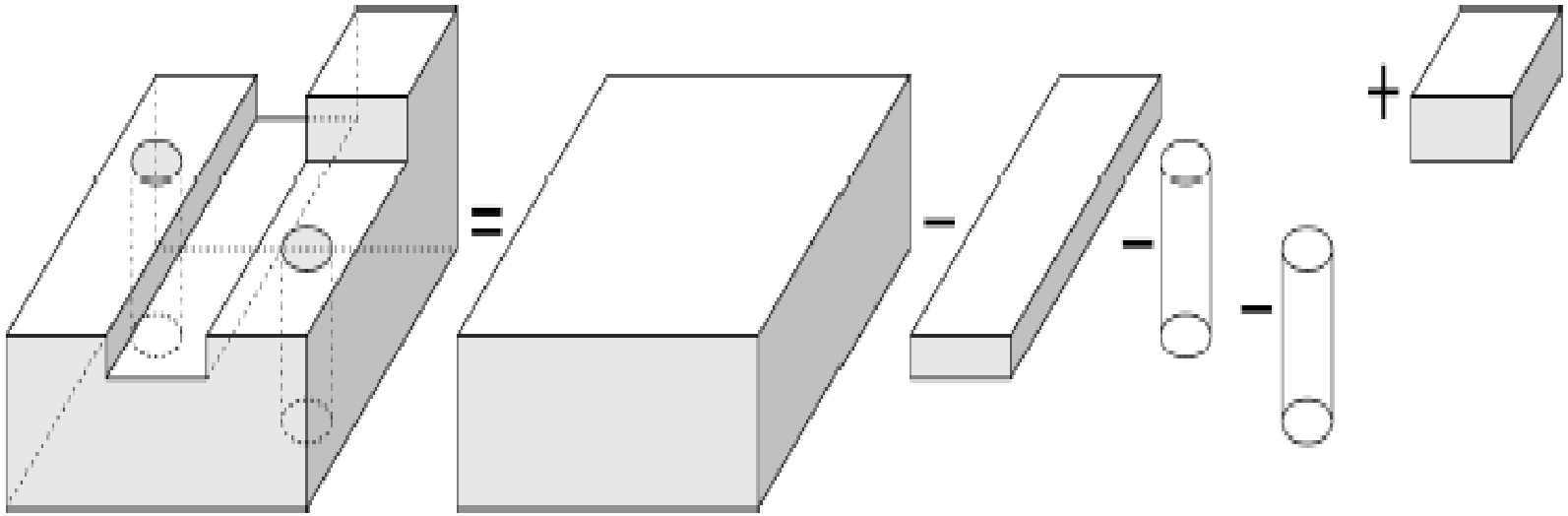


Intersection

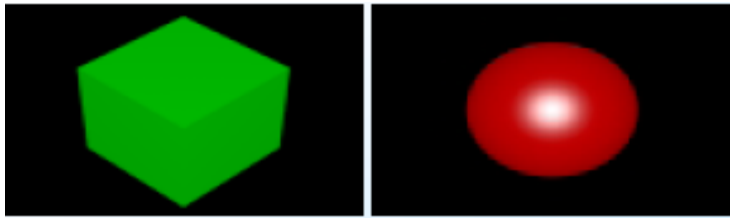


Constructive Solid Geometry

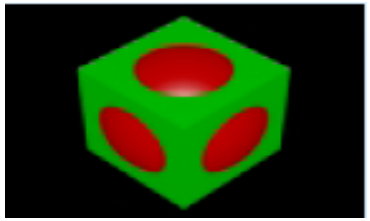
- A CSG model is based on the topological notation that a physical object can be divided into a set of primitives (basic elements or shapes) that can be combined in a certain order following a set of rules (Boolean operations) to form the object.
- CSG combines solid objects by using three different boolean operations



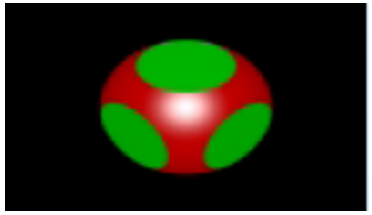
CSG Combine



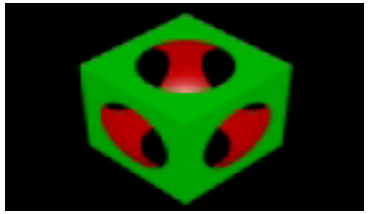
CSG - Union



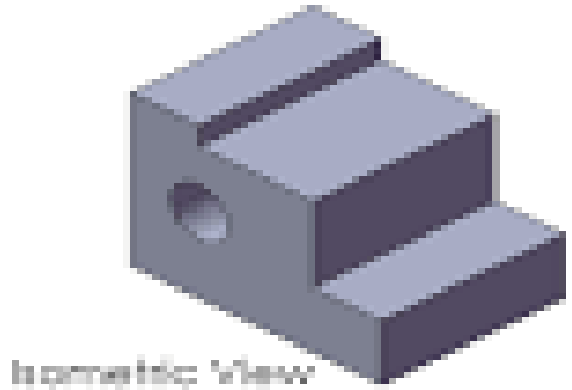
CSG - Intersection



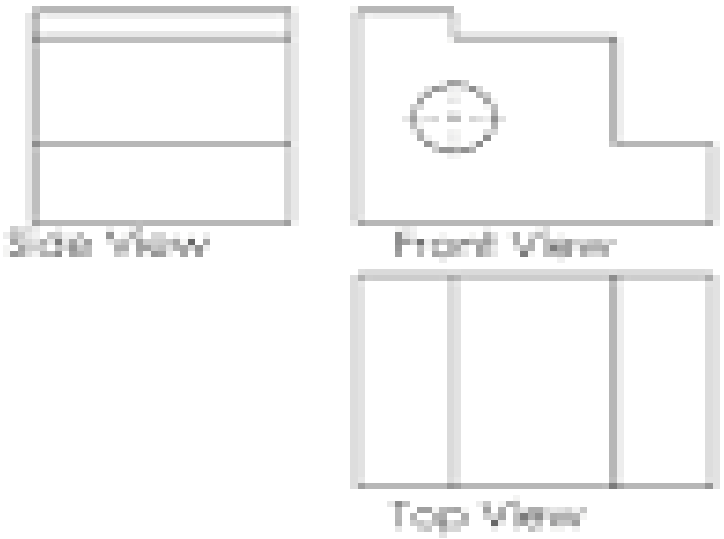
CSG - Subtract



Orthographic Vs Isometric projection

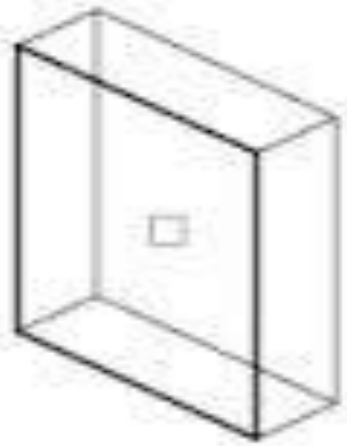


Orthographic view

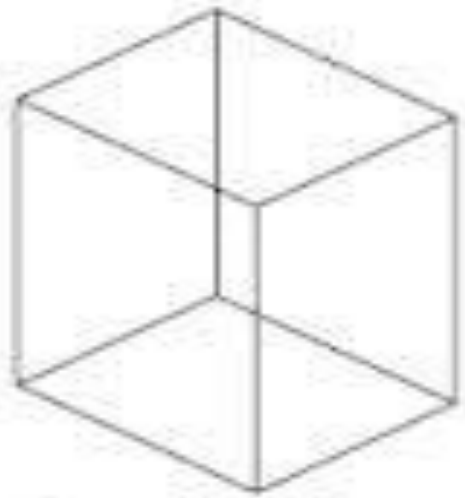


Extrude

- The **Extrude feature** is one of the most common **features** .An **Extrude** is used to convert a 2D figure into a 3D object,

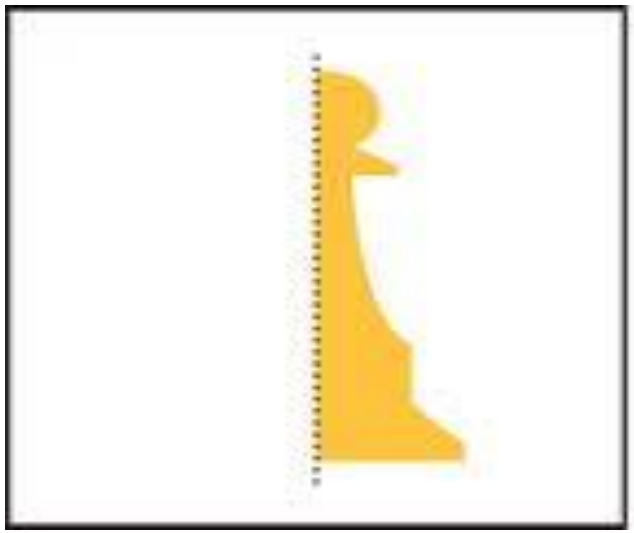


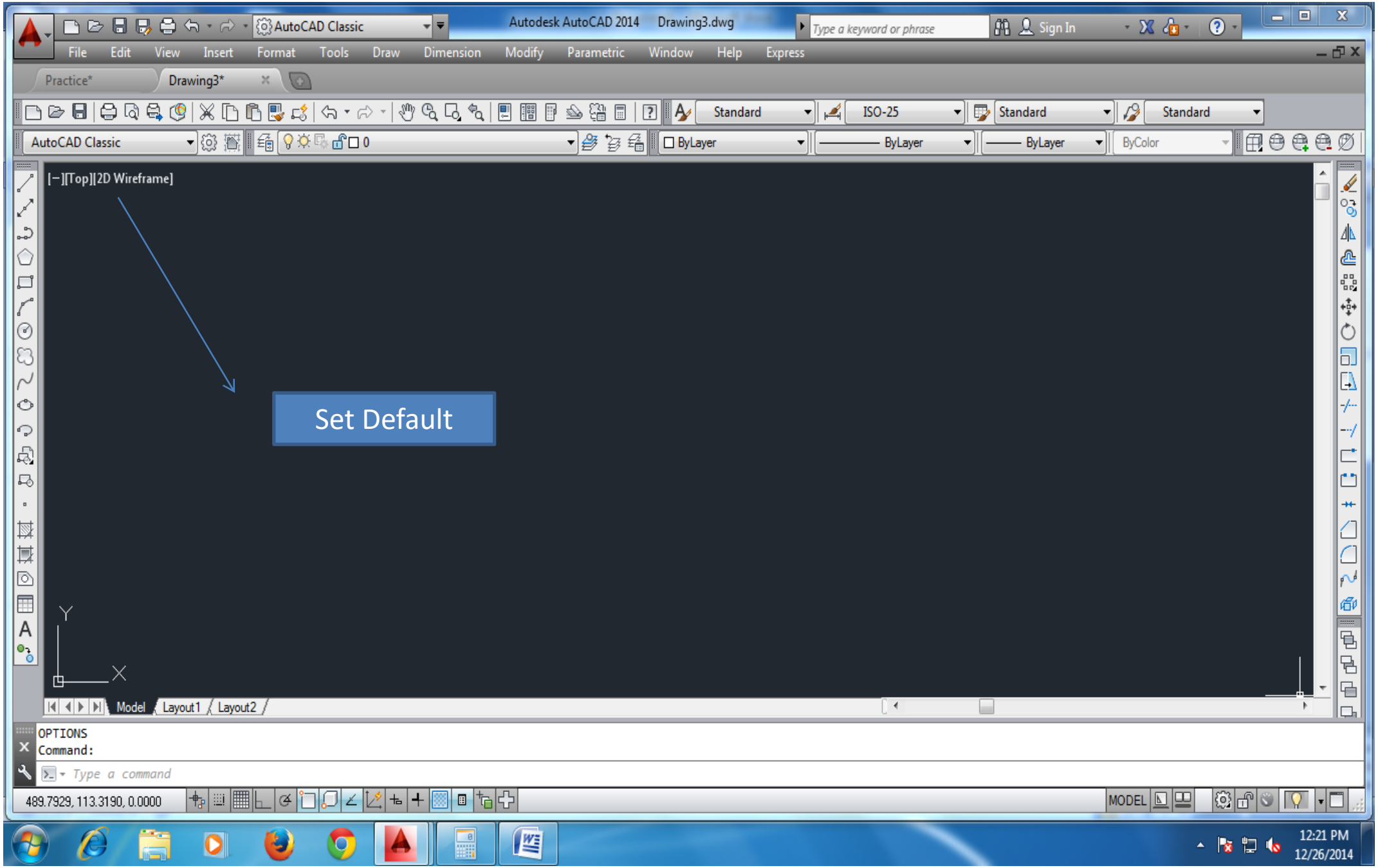
face selected

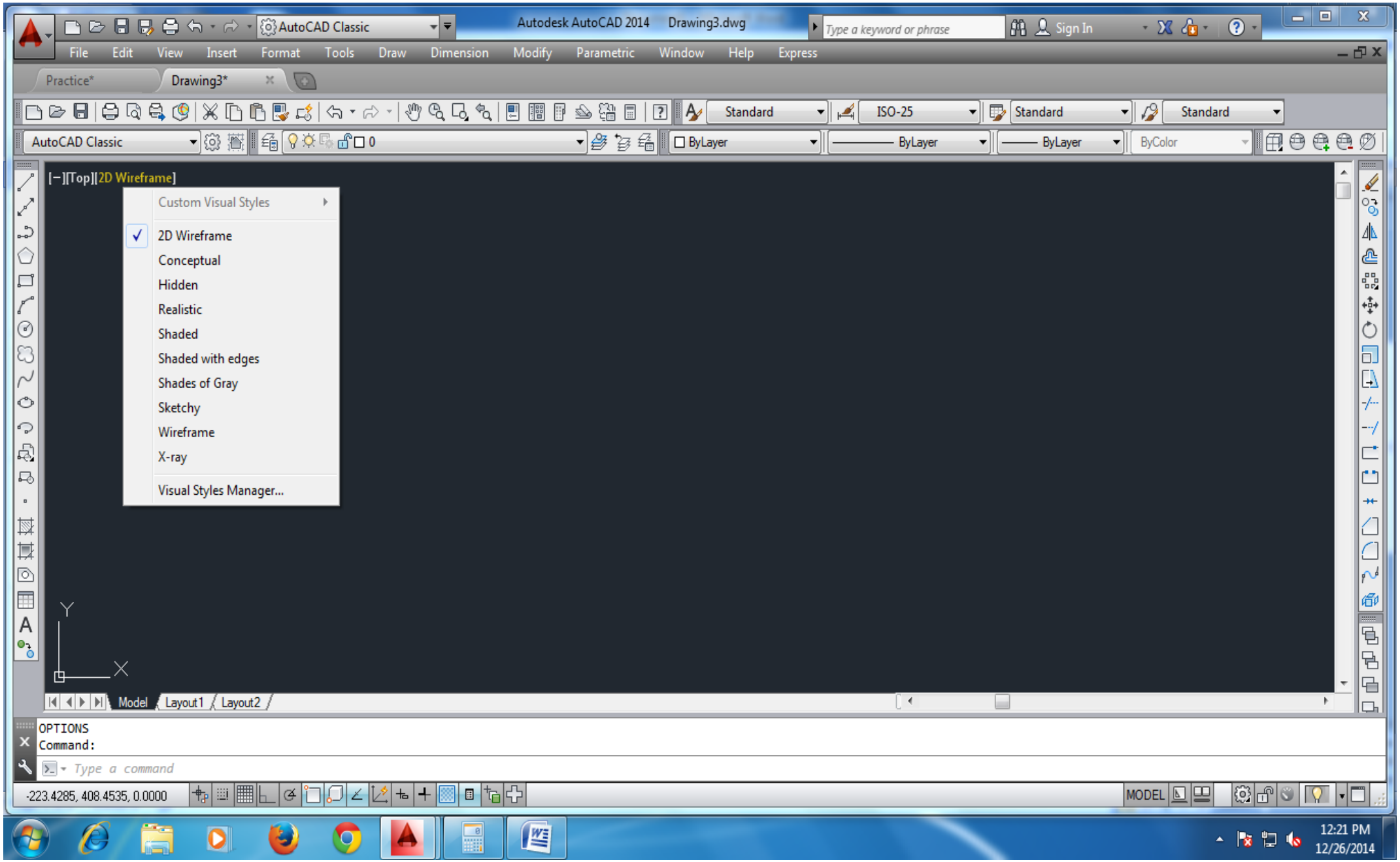


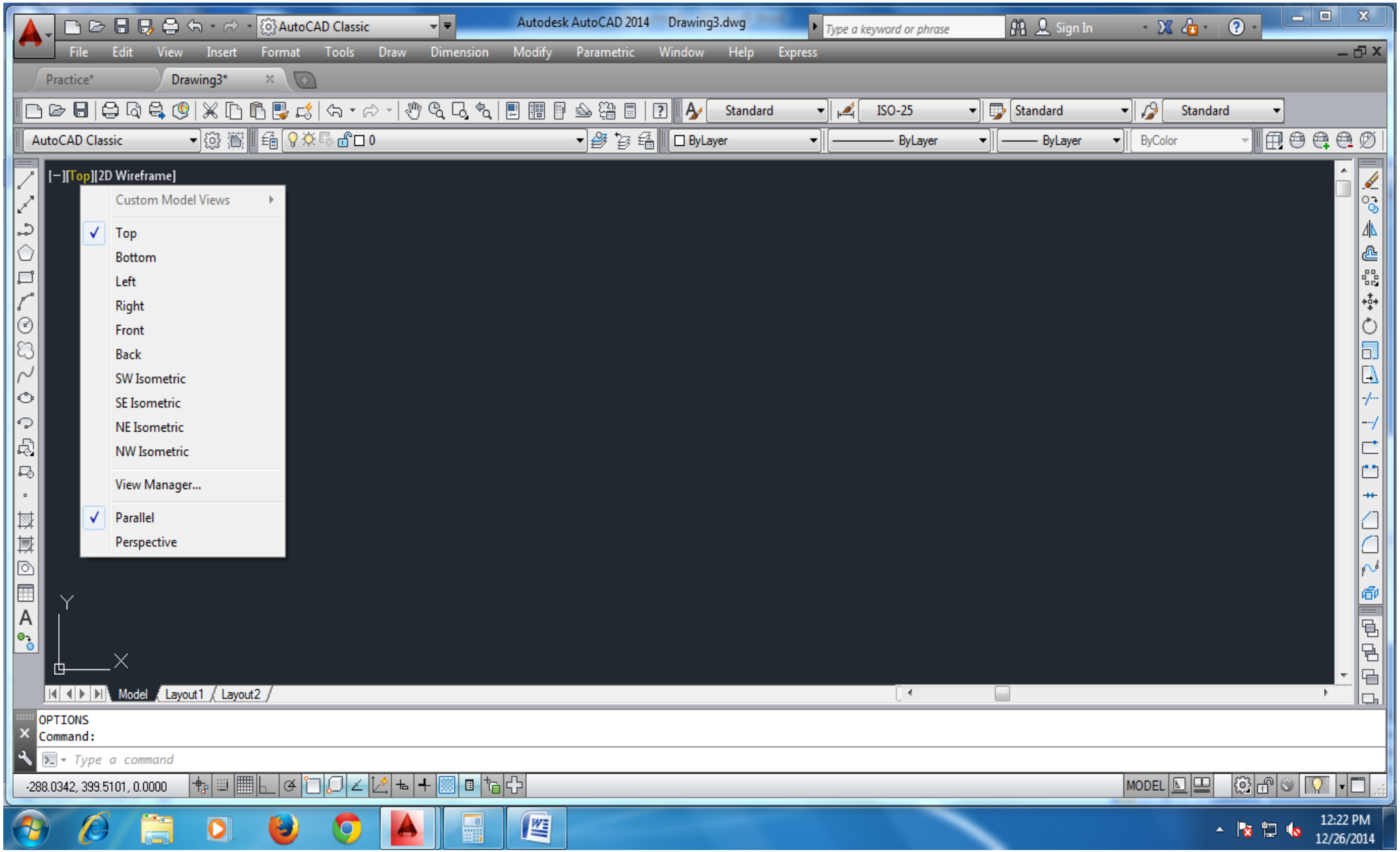
face extruded

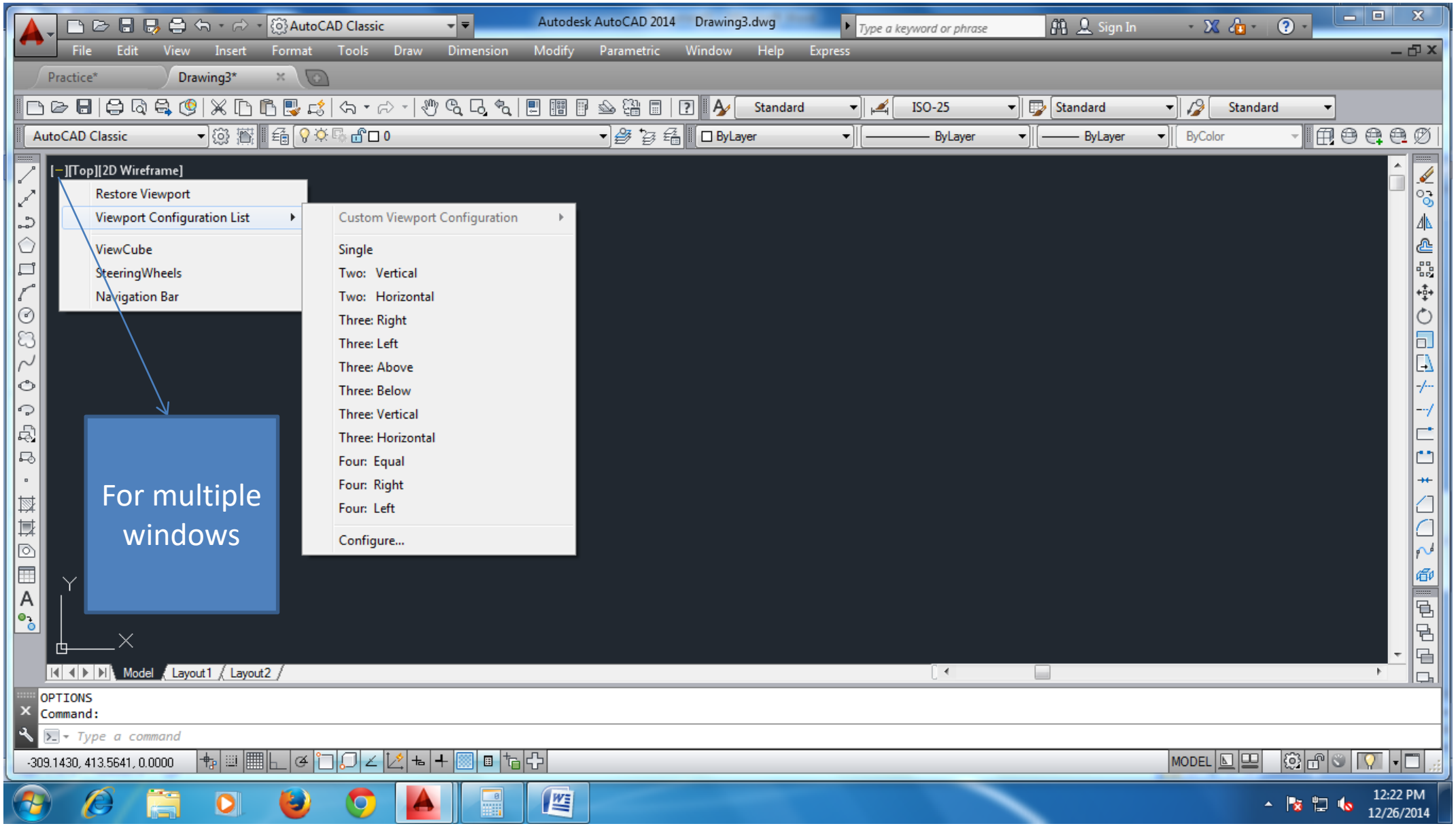
Revolve: The Revolve feature is created by revolving a sketched profile around an axis of revolution. The angle and direction can be controlled independent of the sketch.

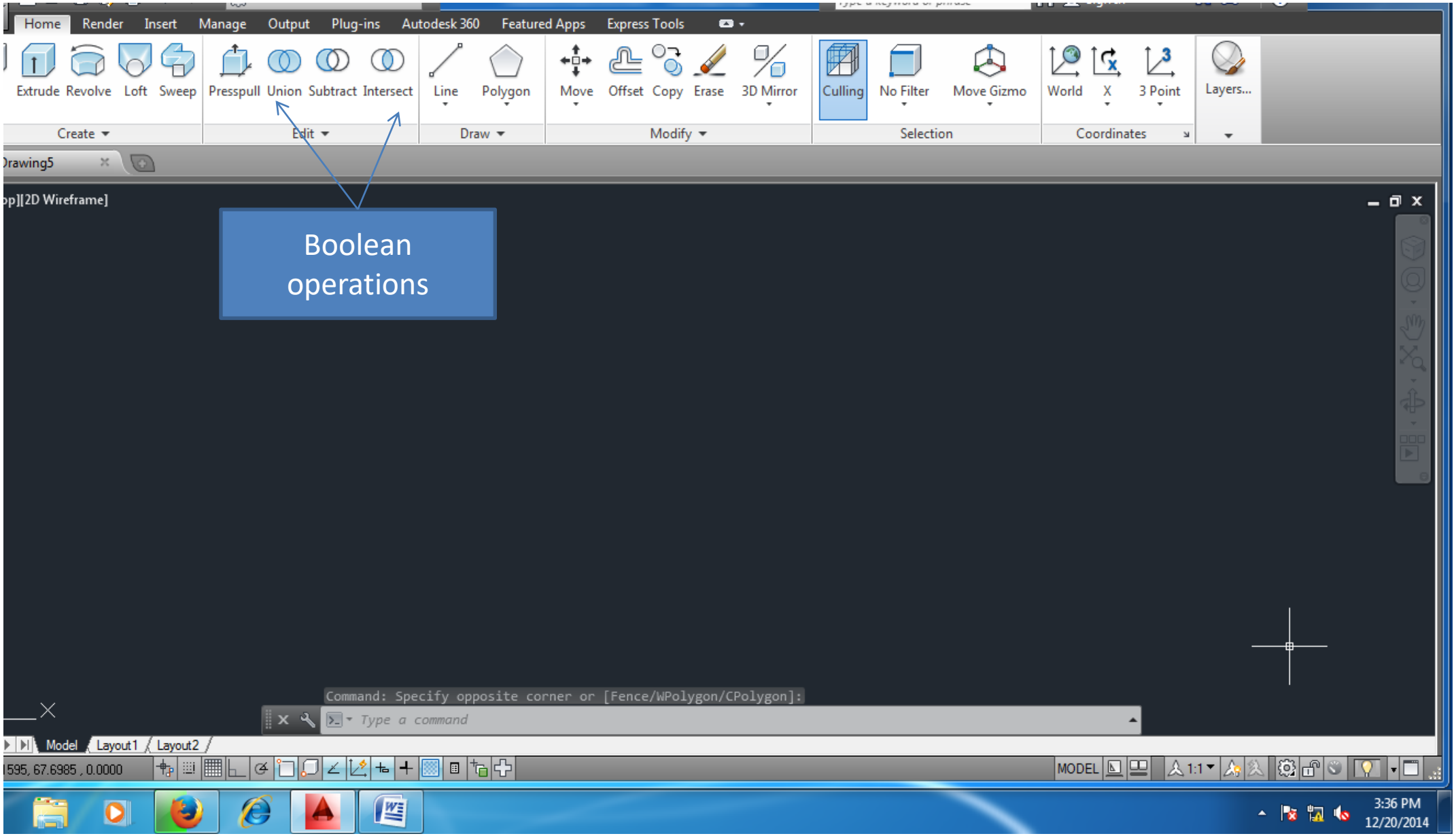


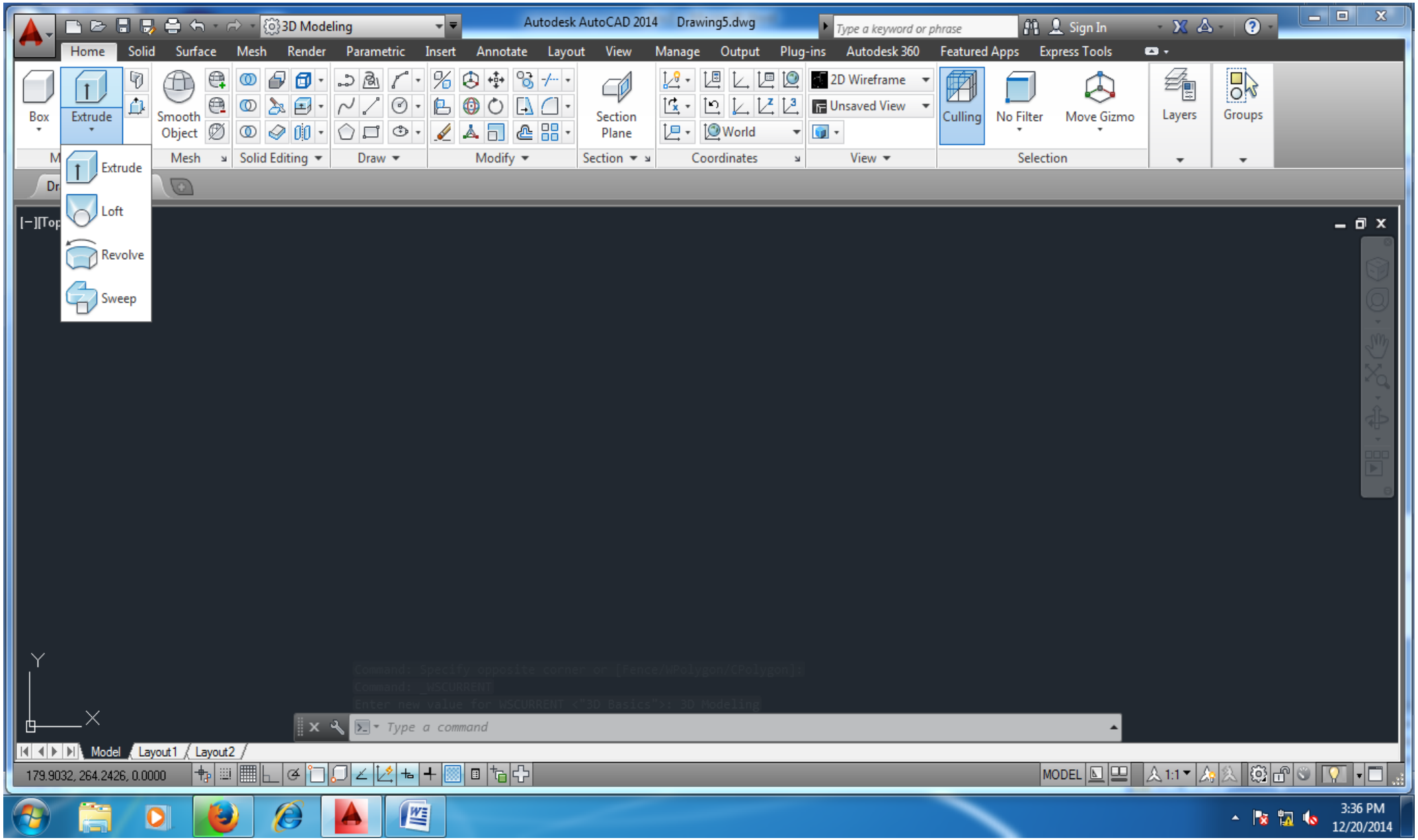

AutoCAD Classic
Autodesk AutoCAD 2014 Drawing3.dwg
Type a keyword or phrase
Sign In
File Edit View Insert Format Tools Draw Dimension Modify Parametric Window Help Express
Practice*
Drawing3*
Standard
ISO-25
Standard
Standard
AutoCAD Classic
0
ByLayer
ByLayer
ByLayer
ByColor
[−][Top][2D Wireframe]
Set Default
Model
Layout1
Layout2
OPTIONS
Command:
Type a command
489.7929, 113.3190, 0.0000
MODEL
12:21 PM
12/26/2014


AutoCAD Classic
Autodesk AutoCAD 2014 Drawing3.dwg
Type a keyword or phrase
Sign In
File Edit View Insert Format Tools Draw Dimension Modify Parametric Window Help Express
Practice*
Drawing3*
Standard
ISO-25
Standard
Standard
AutoCAD Classic
0
ByLayer
ByLayer
ByLayer
ByColor
[−][Top][2D Wireframe]
Custom Visual Styles
2D Wireframe
Conceptual
Hidden
Realistic
Shaded
Shaded with edges
Shades of Gray
Sketchy
Wireframe
X-ray
Visual Styles Manager...
Model
Layout1
Layout2
OPTIONS
Command:
Type a command
-223.4285, 408.4535, 0.0000
MODEL
12:21 PM
12/26/2014


AutoCAD Classic
Autodesk AutoCAD 2014 Drawing3.dwg
Type a keyword or phrase
Sign In
File Edit View Insert Format Tools Draw Dimension Modify Parametric Window Help Express
Practice*
Drawing3*
Standard
ISO-25
Standard
Standard
AutoCAD Classic
ByLayer
ByLayer
ByLayer
ByColor
[−][Top][2D Wireframe]
Custom Model Views
Top
Bottom
Left
Right
Front
Back
SW Isometric
SE Isometric
NE Isometric
NW Isometric
View Manager...
Parallel
Perspective
Model
Layout1
Layout2
OPTIONS
Command:
Type a command
-288.0342, 399.5101, 0.0000
MODEL
12:22 PM
12/26/2014

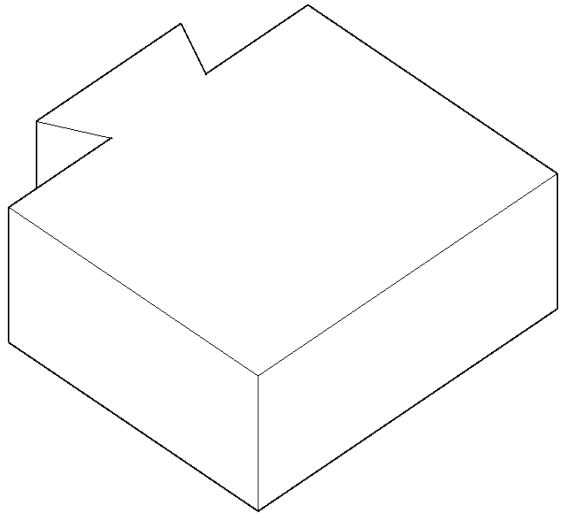

AutoCAD Classic
Autodesk AutoCAD 2014 Drawing3.dwg
Type a keyword or phrase
Sign In
File Edit View Insert Format Tools Draw Dimension Modify Parametric Window Help Express
Practice*
Drawing3*
Standard
ISO-25
Standard
Standard
AutoCAD Classic
ByLayer
ByLayer
ByLayer
ByColor
[−][Top][2D Wireframe]
Restore Viewport
Viewport Configuration List
ViewCube
SteeringWheels
Navigation Bar
Custom Viewport Configuration
Single
Two: Vertical
Two: Horizontal
Three: Right
Three: Left
Three: Above
Three: Below
Three: Vertical
Three: Horizontal
Four: Equal
Four: Right
Four: Left
Configure...
For multiple windows
Model
Layout1
Layout2
OPTIONS
Command:
Type a command
-309.1430, 413.5641, 0.0000
MODEL
12:22 PM
12/26/2014

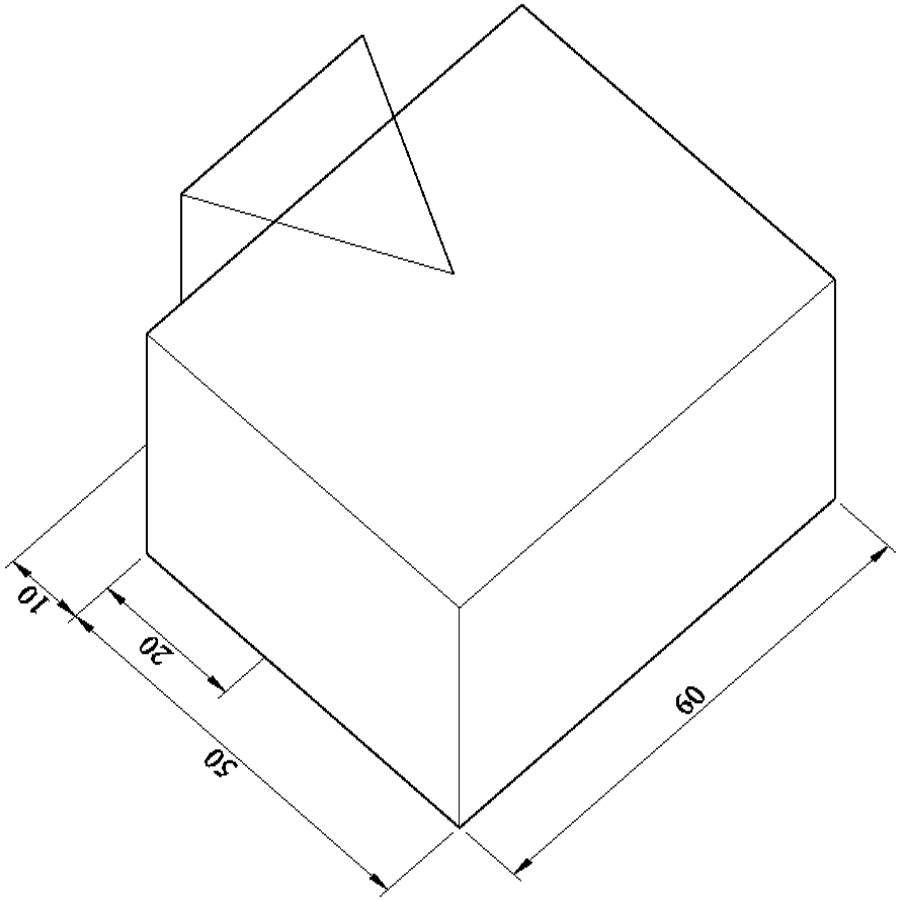

Home
Render
Insert
Manage
Output
Plug-ins
Autodesk 360
Featured Apps
Express Tools
Extrude
Revolve
Loft
Sweep
Presspull
Union
Subtract
Intersect
Line
Polygon
Move
Offset
Copy
Erase
3D Mirror
Culling
No Filter
Move Gizmo
World
X
3 Point
Layers...
Create
Edit
Draw
Modify
Selection
Coordinates
Drawing5
Boolean operations
Command: Specify opposite corner or [Fence/WPolygon/CPolygon]:
Type a command
Model
Layout1
Layout2
MODEL
3:36 PM
12/20/2014


3D Modeling
Autodesk AutoCAD 2014 Drawing5.dwg
Type a keyword or phrase
Sign In
Home
Solid
Surface
Mesh
Render
Parametric
Insert
Annotate
Layout
View
Manage
Output
Plug-ins
Autodesk 360
Featured Apps
Express Tools
Box
Extrude
Smooth Object
Section Plane
2D Wireframe
Unsaved View
World
Culling
No Filter
Move Gizmo
Layers
Groups
Mesh
Solid Editing
Draw
Modify
Section
Coordinates
View
Selection
Extrude
Loft
Revolve
Sweep
[−][Top]
Command: Specify opposite corner or [Fence/WPolygon/CPolygon]:
Command: _WSCURRENT
Enter new value for WSCURRENT <"3D Basics">: 3D Modeling
Type a command
Model
Layout1
Layout2
179.9032, 264.2426, 0.0000
MODEL
1:1
3:36 PM
12/20/2014

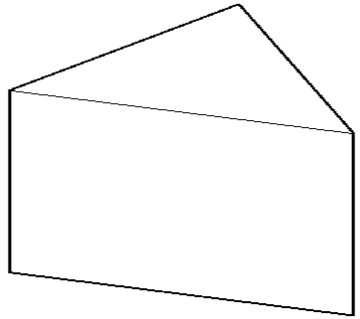
Model basic boolean operations

Union

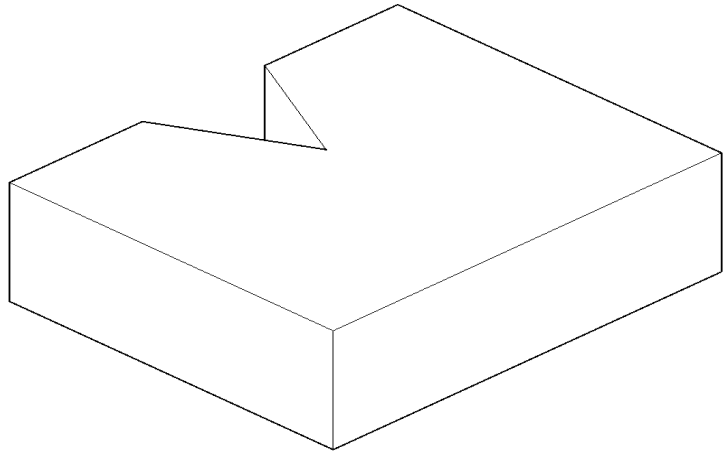




Actual model



Intersection



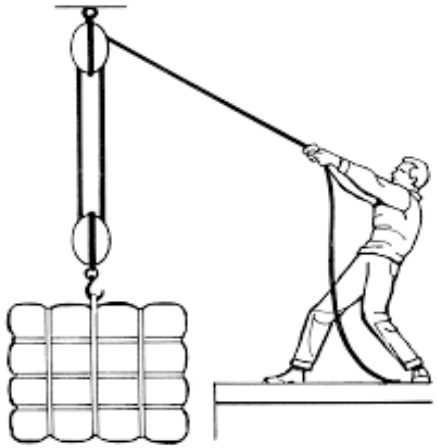
Subtract

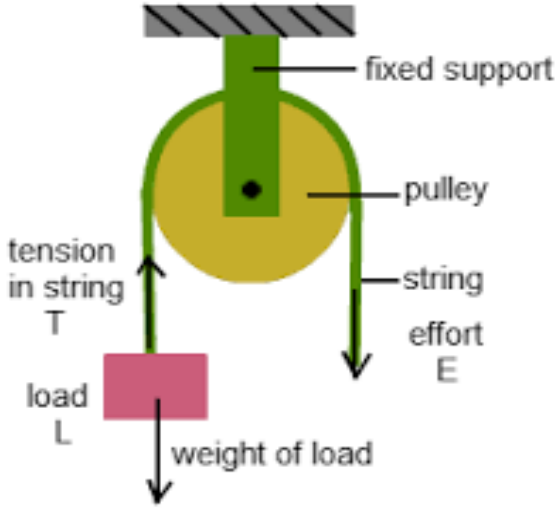
Model using drafting package

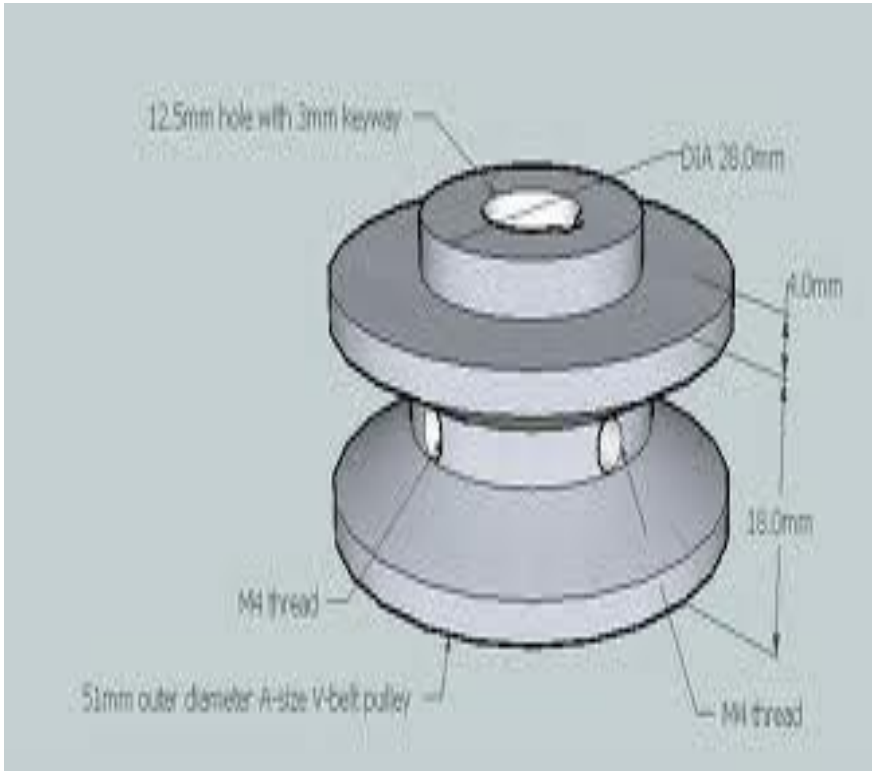
Model a pulley:

A wheel with a grooved rim around which a cord passes, which acts to change the direction of a force applied to the cord and is used to raise heavy weights.

Pulley

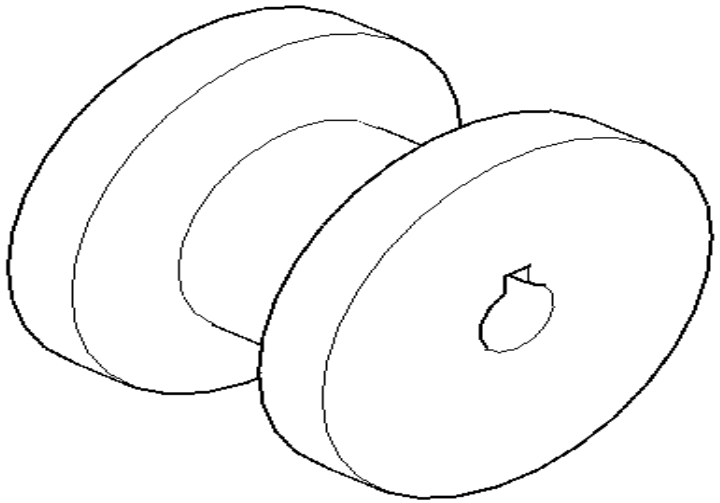




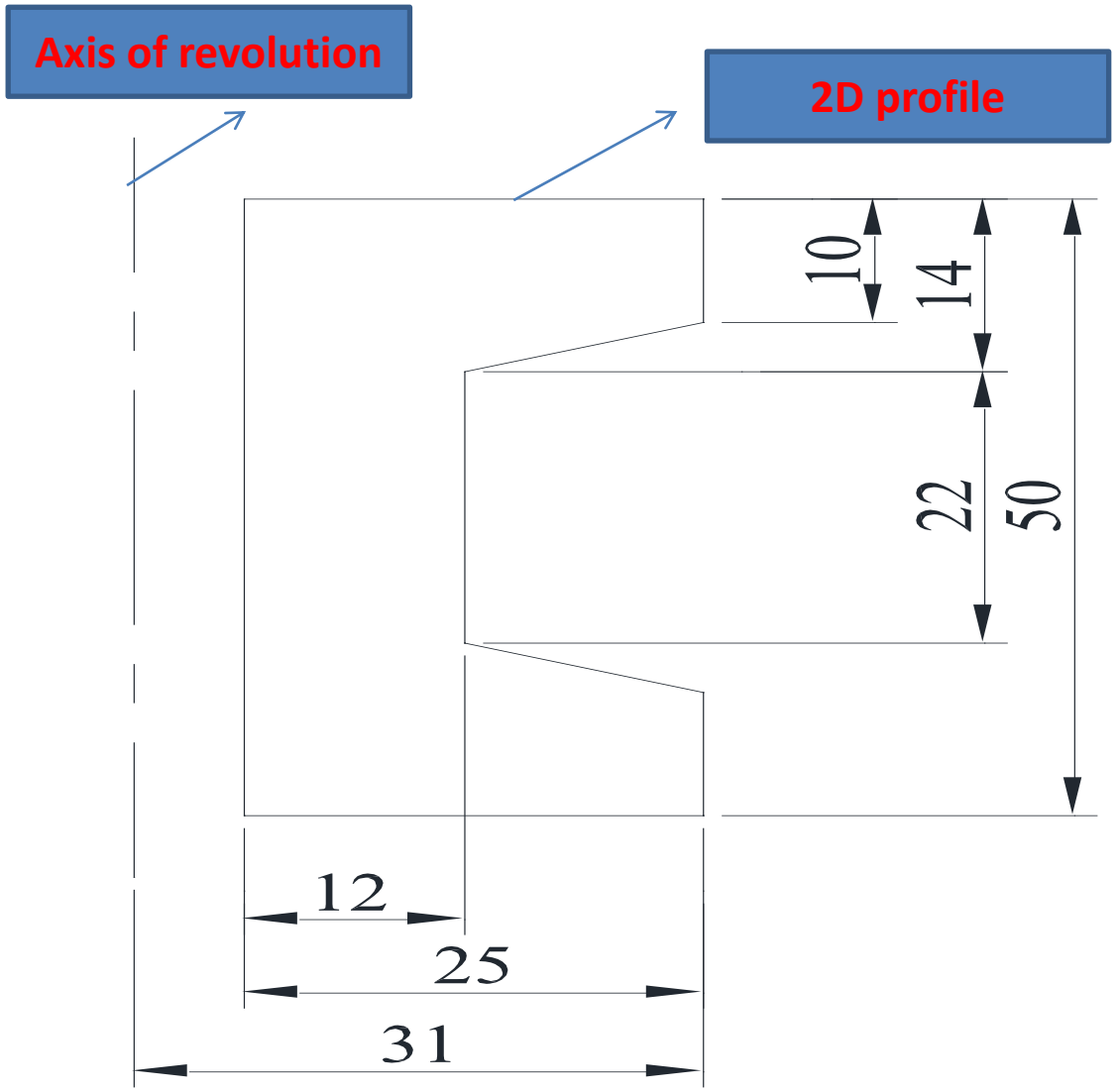


2D Command **:** Line, Circle, Rectangle
3D Command : Revolve, Subtract
(OR)
2D Command : Circle, Rectangle
3D Command : Extrude, Subtract

Question-1



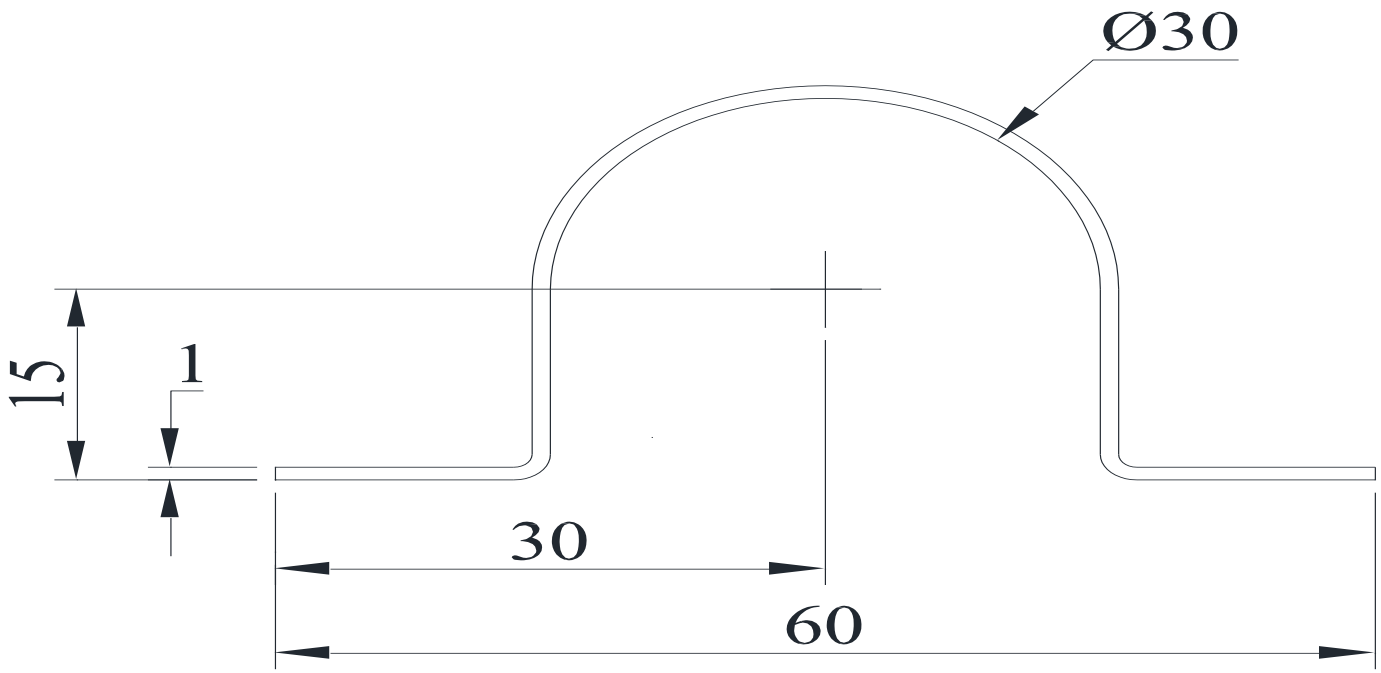
After revolve

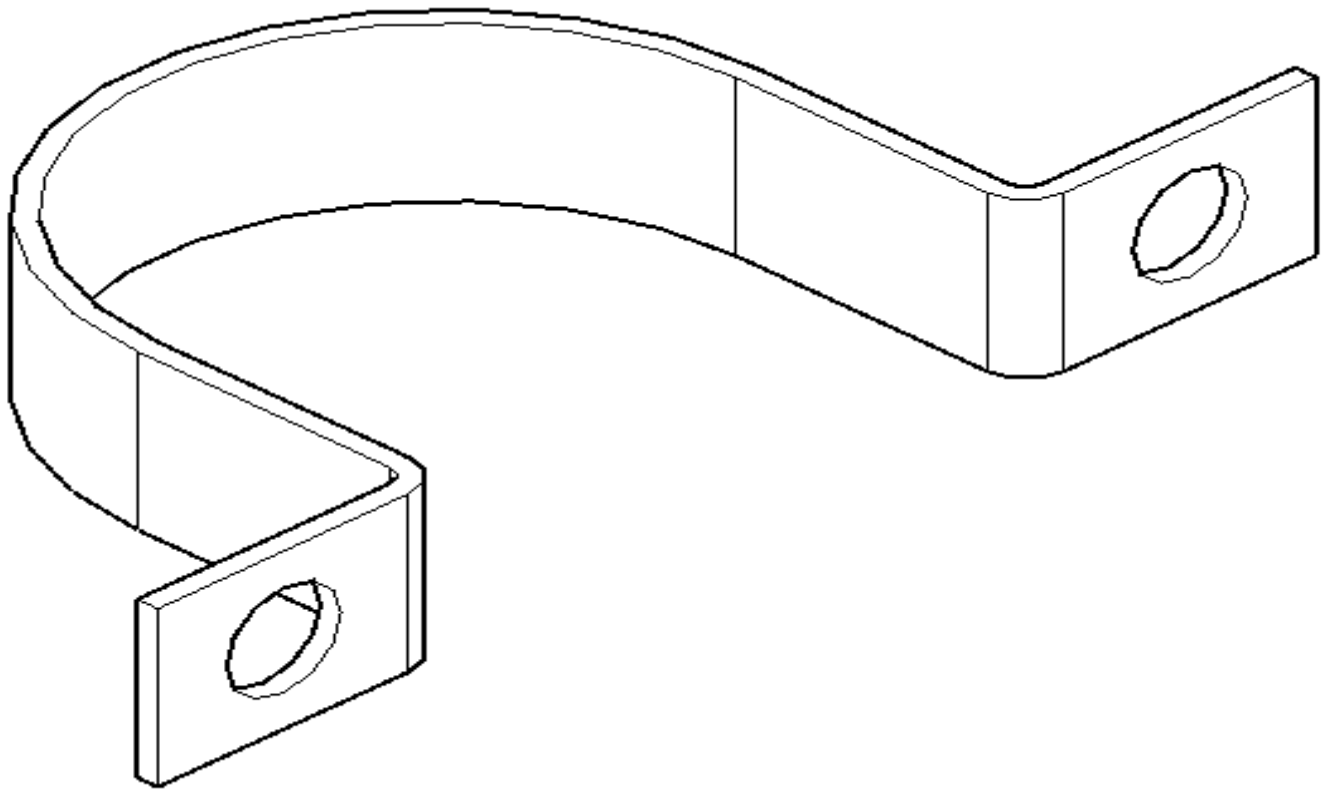


Model using drafting package

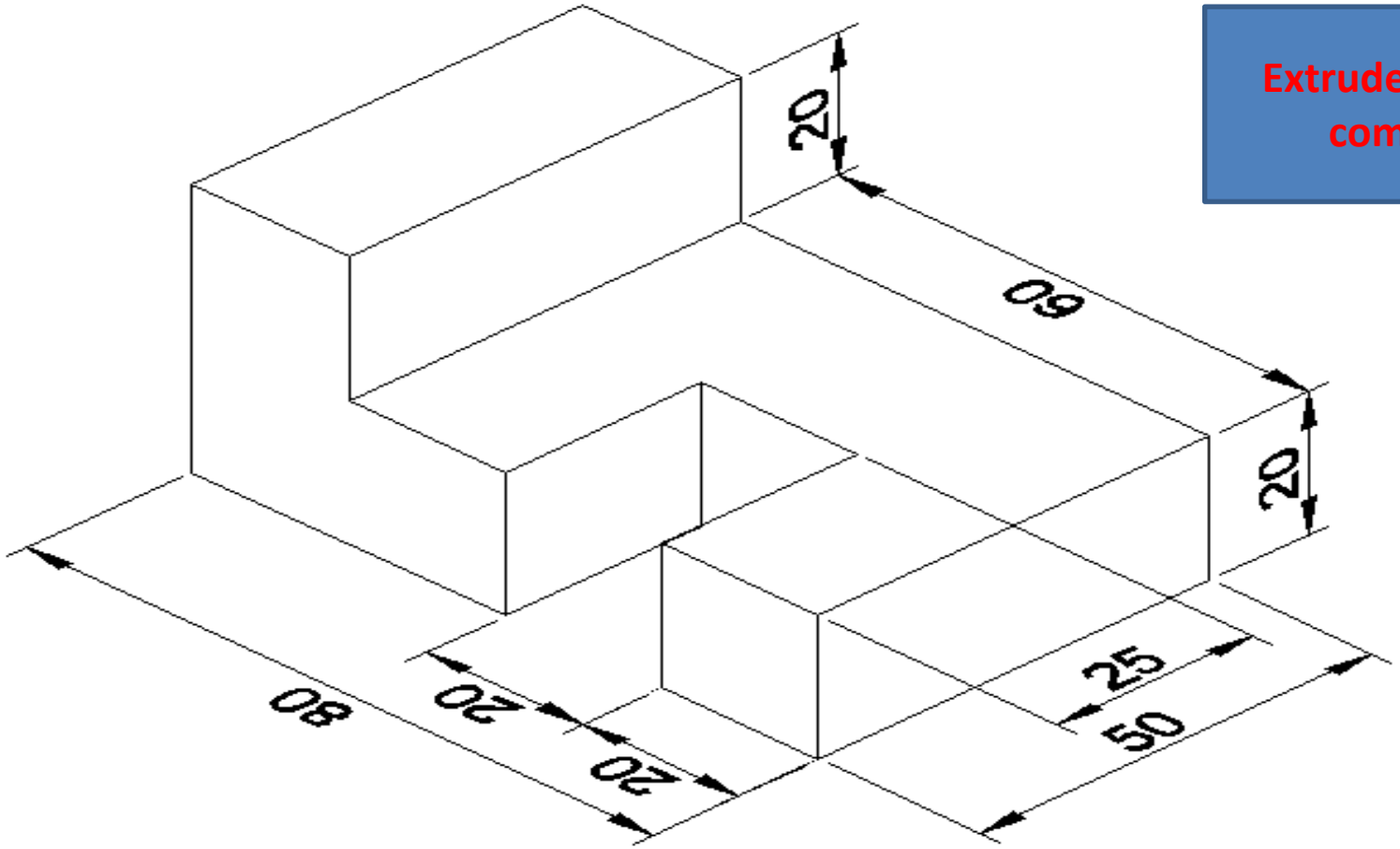
2D Command : Line, Arc, Fillet, Circle, Trim

3D Command : Region, Extrude, Subtract



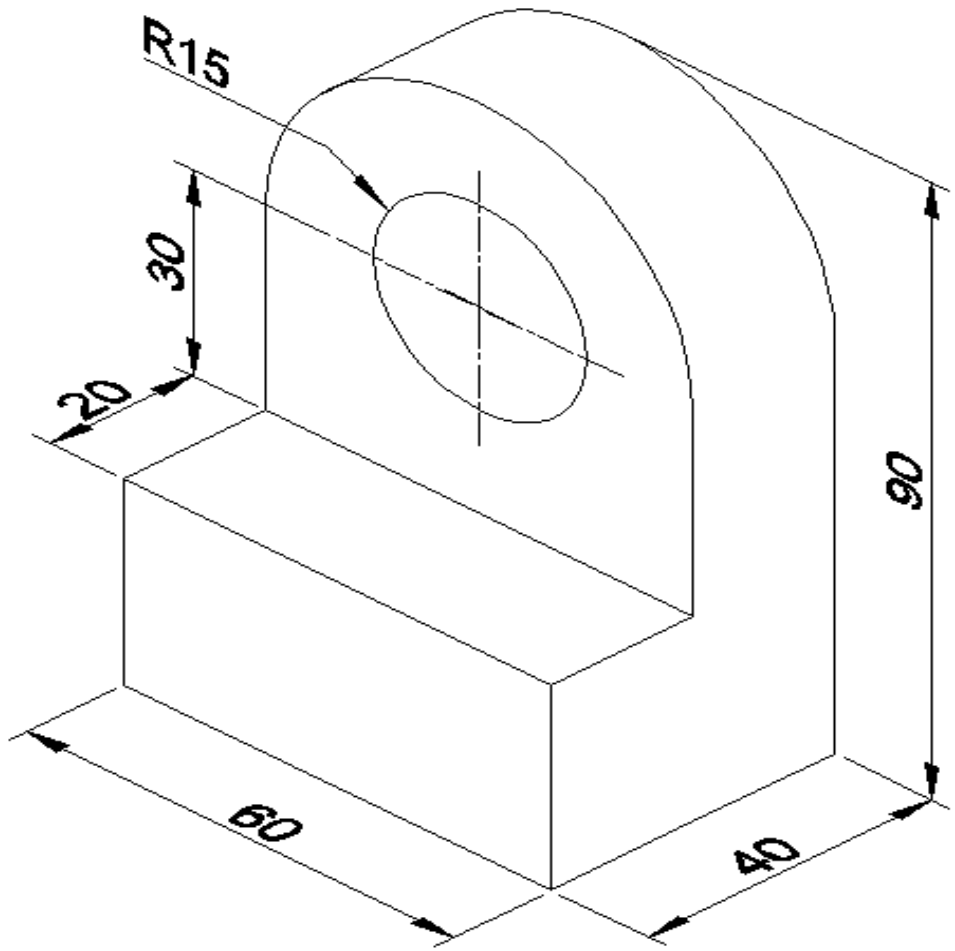


Model using Drafting package



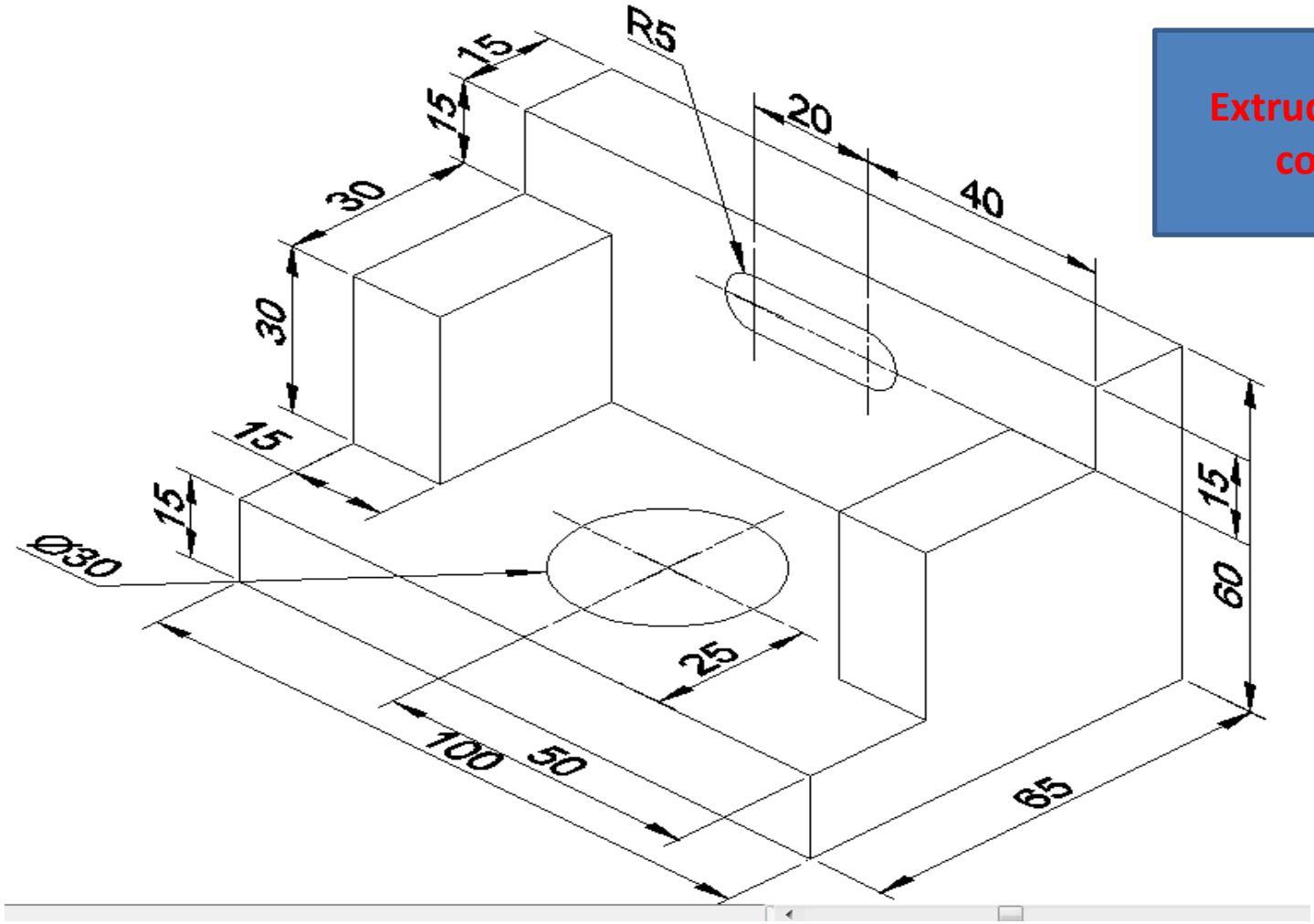
Extrude, subtract command

Model using Drafting package



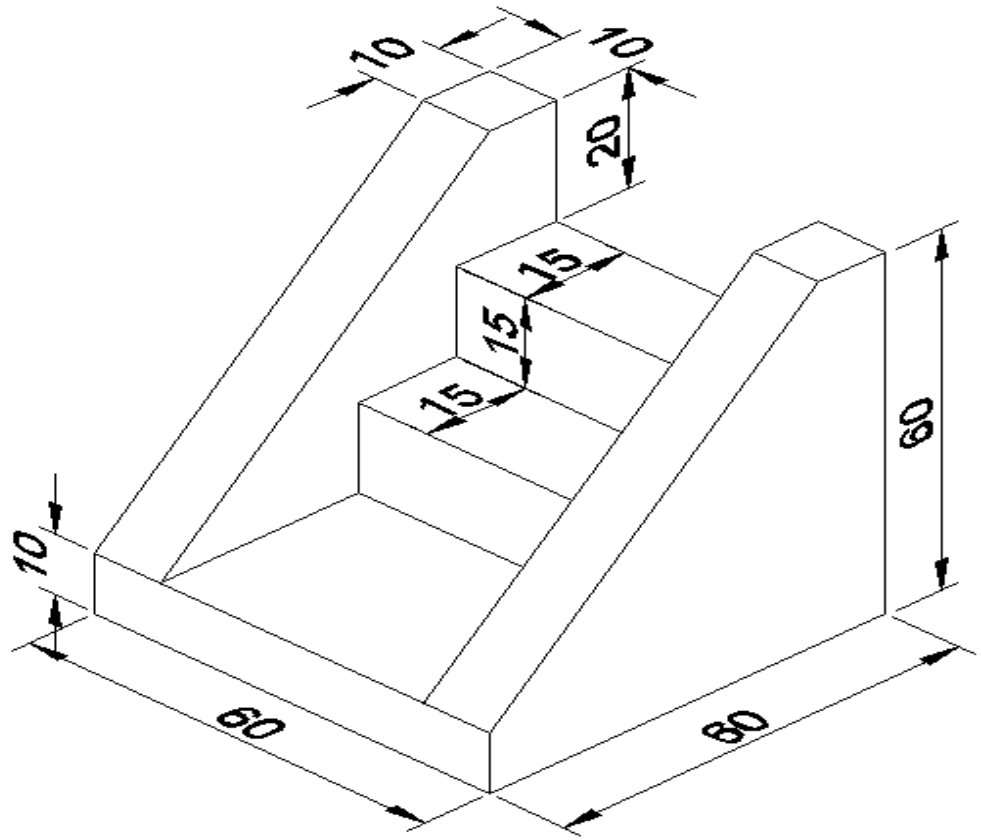
Extrude, Subtract command

Model using Drafting package



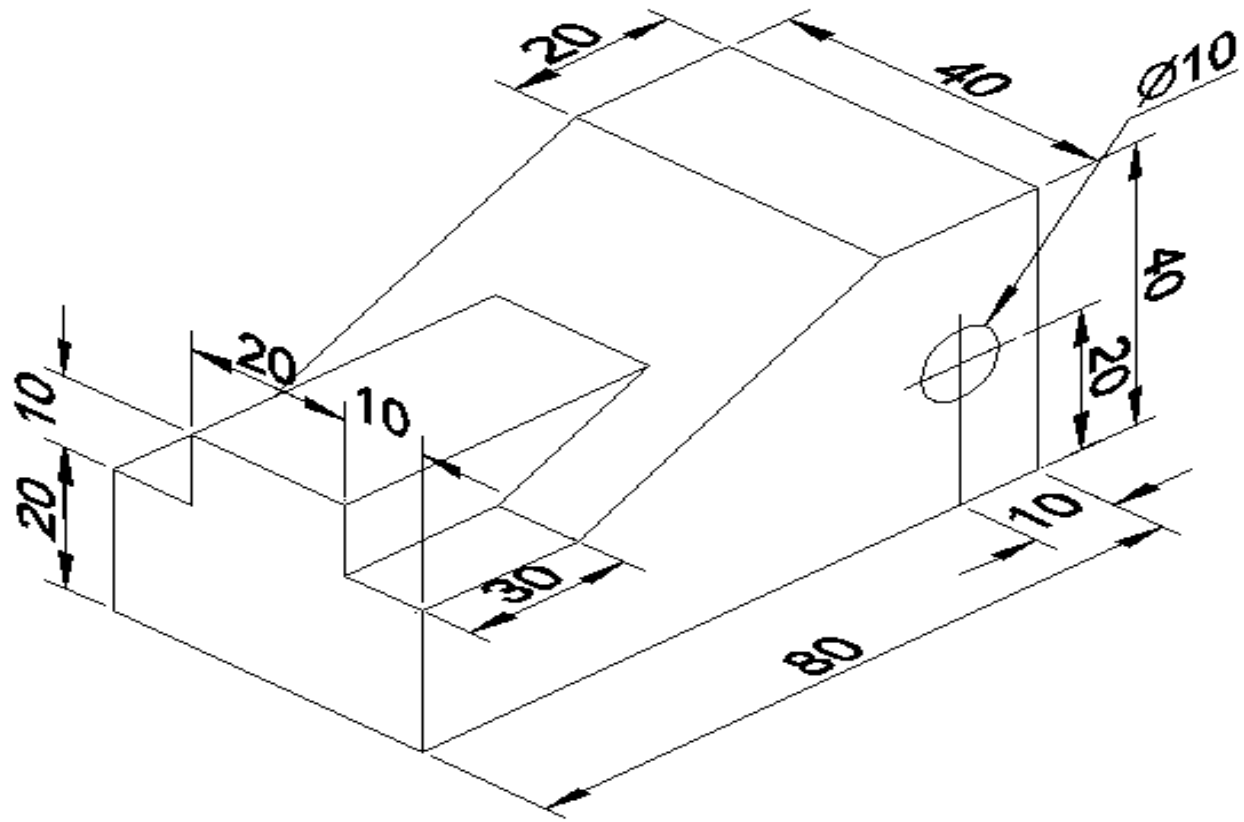
Extrude, Subtract command

Model using Drafting package



Extrude, Subtract command

Model using Drafting package



Extrude, Union, Subtract command