



Solid Editing in AutoCAD – Part One

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Mohmed Zuber Shaikh, Civil Engineer by profession is associated with Sardar Sarovar Narmada Nigam Limited, Bharuch in India. He is enjoying AutoCAD capabilities since 1990- Release 10 – and still hanging on with different versions. 3D Modelling and training is his passion using AutoCAD and 3D studio MAX.

While learning and practicing solid modeling, your expertise on commands of solid editing options can results in better looking model with less time consumed on creation. I will be running a series of articles on AutoCAD solid modeling editing options. This article is the first one in the series. In early 2007, I thought of full ATP on it, somehow it could not be done as expected and I promised Jen and Marilyn for running a series of articles on same subject. And here it is...

Solids editing

Editing on solids is different than 2D objects editing. There is no parallel comparison for 2D editing with real life objects, whereas solid editing is very near to real life object modifications. BOX is nothing but a log of wood OR metal, which can take size of your assumption. The best thing is that any solid object or composite object can be drilled, polished, painted, chopped, welded, sliced and what not! Well you need appropriate tools to do it.

There are few solid creation commands in AutoCAD, but more commands for editing those solids. The concept is similar to real life objects, building things block by block. The SPEED of solid model creation is also depending on how well you can handle solid editing commands. More inclination towards solid editing would certainly enhance your prospects in respect of expertise and speed. The first editing option is UNION. Any number of adjoining or overlapped objects can be converted in to a composite one object by this option. Solids sharing no common mass (away from each other) can also be UNION. In such case UNION is like grouping or BLOCK making, where objects can be ungrouped. The SEPARATE option under SOLIDEDIT can reverse the process of UNION performed on objects away



from each other. If objects are sharing some common mass, UNION will result in losing of their individual identity in respect of shape & mass to form a new composite solid with different mass properties.

SUBTRACT is among the most widely used editing commands in AutoCAD. As name suggests, object is subtracted from another object or composite solid to form new mass. If 'A' solid object is subtracted from 'B' solid, 'A' is losing its identity as solid. In course of this vanishing act, 'A' solid will remove common volume between 'A' & 'B' solids. Subtracting an equal depth CYLINDER from BOX will show you BOX with hole.

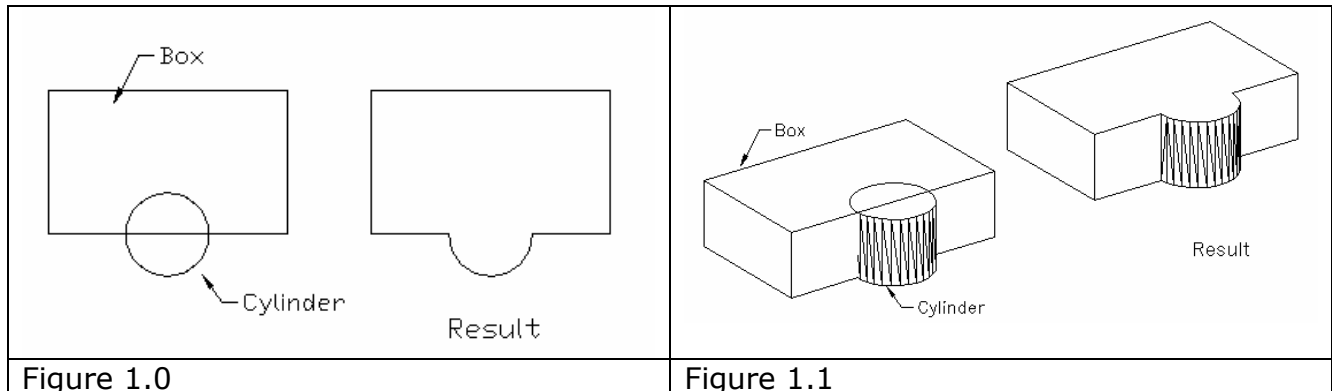
INTERSECT and INTERFERE will help you in finding common volume between selected objects. In case of intersect, original objects are NOT retained. Interfere develop new object using common volumes of selected objects, while retaining original objects as it is. An effect of vertical cylindrical shaft's tilting on shaft casing can be studied exactly using Interfere. If solid shaft is losing its vertical alignment and tilted equal to 3 degree, there will be a wear and tear effect on casing. You can exactly create mathematical model

The Editing commands covered in this part are listed below.

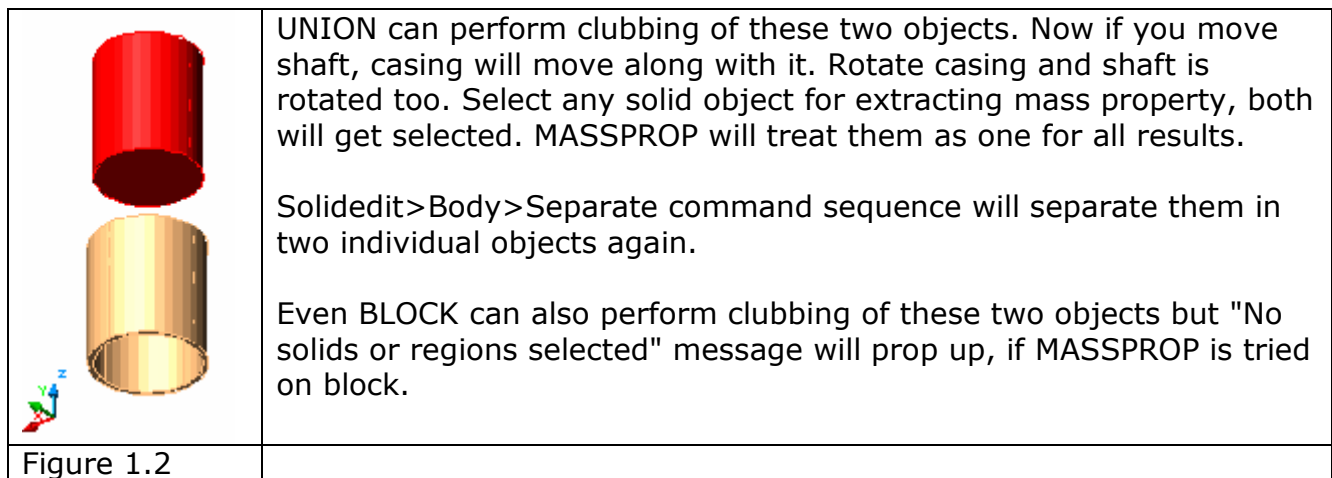
- Union
- Subtract
- Intersect
- Interfere
- Fillet
- Chamfer

1.1 UNION

<p>Union</p> <p>Command: union Select objects: <i>Select Box</i> Select objects: <i>Select Cylinder</i> Select objects: <i>Press Enter</i></p>	<p>MASSPROP will show mass of box (10x5x2 size) as 100, mass of cylinder (R=1, Ht=2) as 6.2832.</p> <p>The composite object after union operation will have mass of 103.1416</p>
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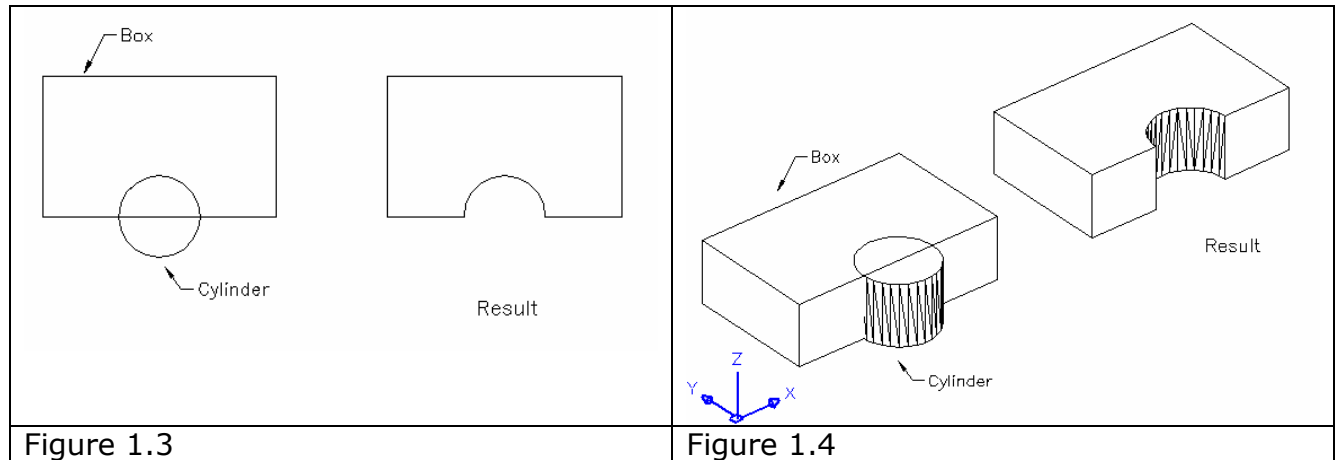


UNION can also be performed on objects, which are away from each other but their bond is meaningful in engineering terms. Like making union of shaft and casing. In most of the cases both will move together in drawing space.

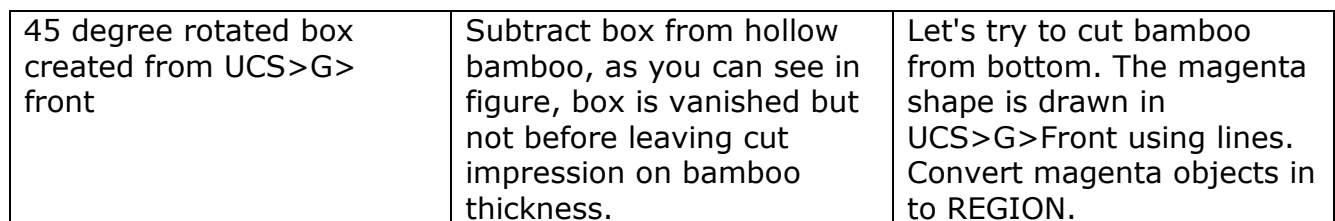
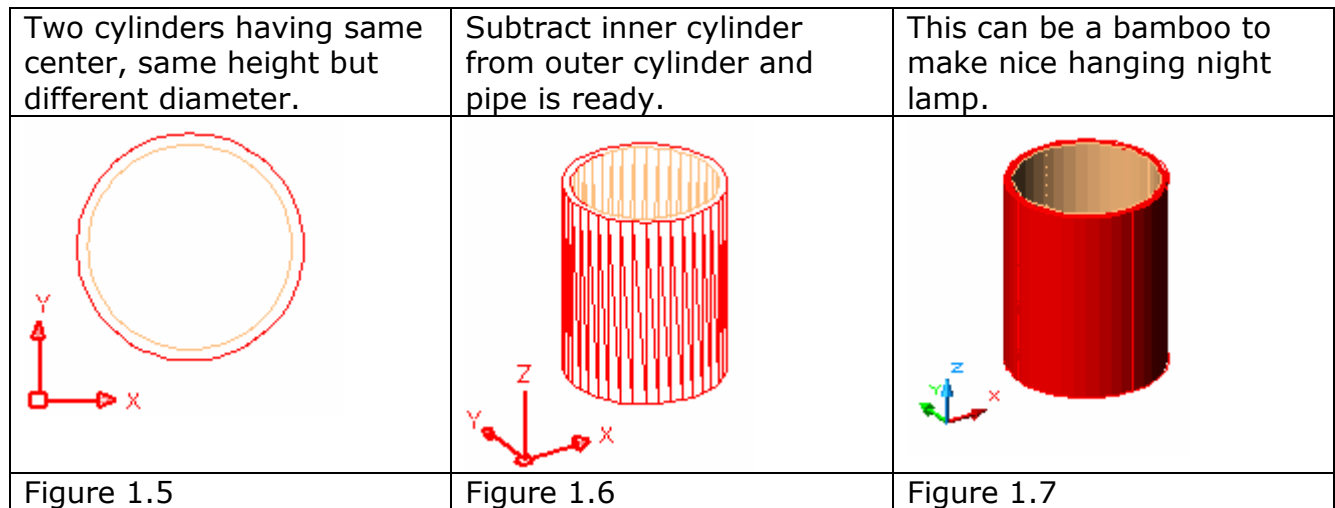


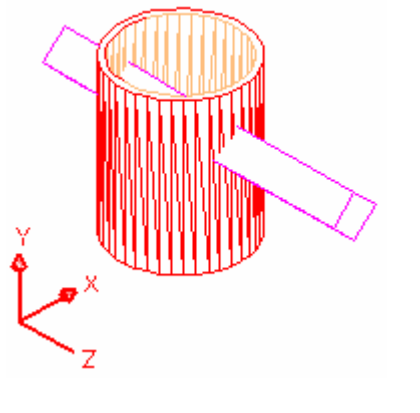
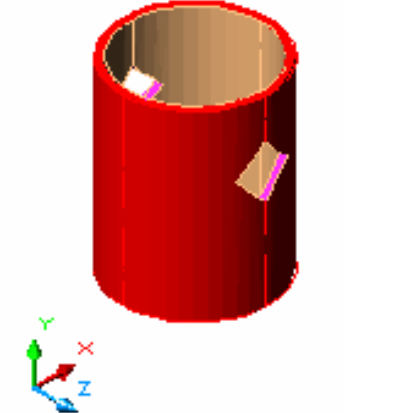
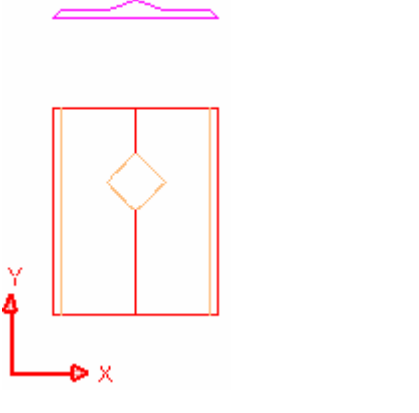
1.2 SUBTRACT

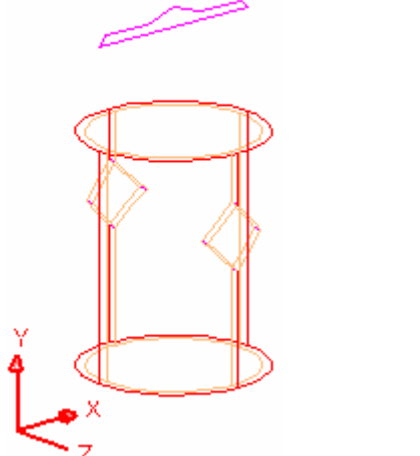
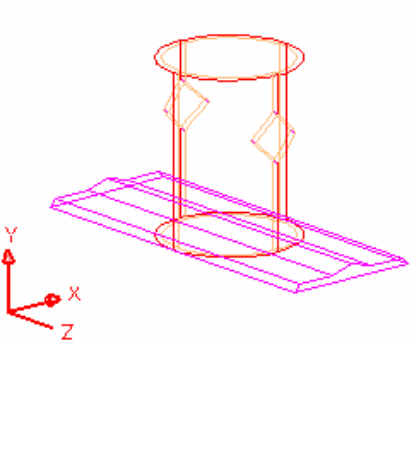
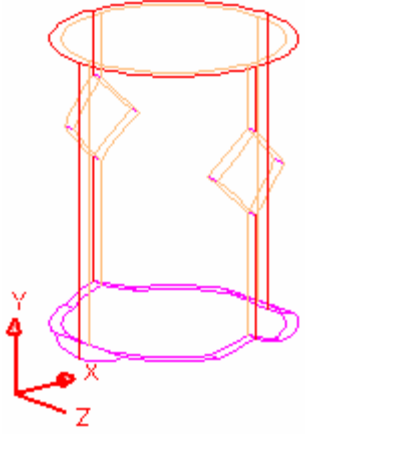
<p>SUBTRACT</p> <p>Command: SU Select solids and regions to subtract from .. Select objects: <i>Select Box</i> Select objects: <i>Press Enter</i> Select solids and regions to subtract .. Select objects: <i>Select Cylinder</i> Select objects: <i>Press Enter</i></p>	<p>The subtraction of cylinder from box, as shown in figures, results in semicircular hole. Cylinder is losing its identity after subtract operation. The height of cylinder beyond the height of box makes no difference in result. If height of cylinder is less than box, there will be a cut in the box up to cylinder height only.</p> <p>If box is subtracted from cylinder, only half cut cylinder will remain.</p>
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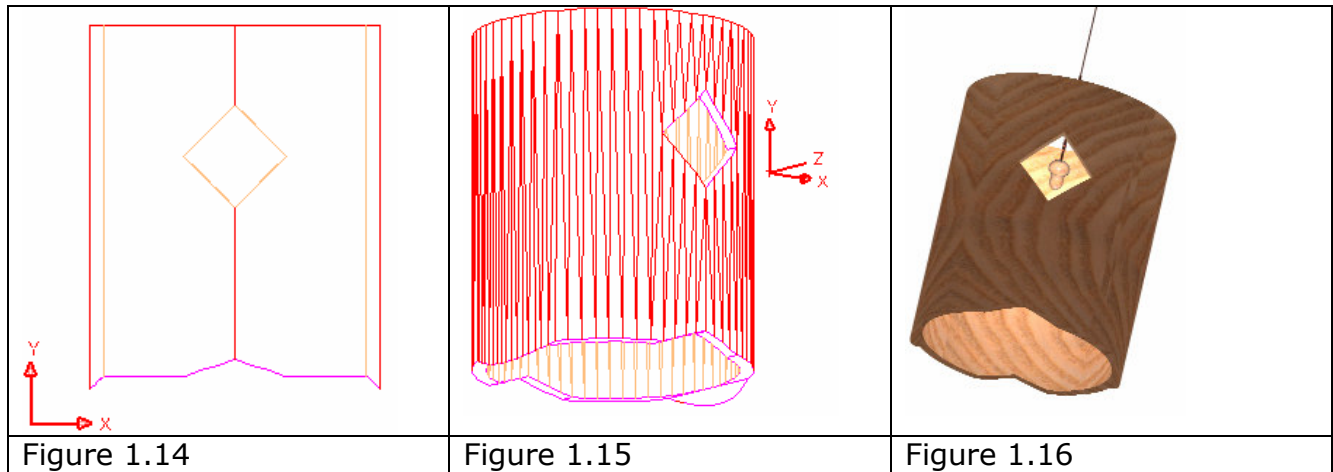
The use of SUBTRACT is extremely varied. Your imagination is the only limit in the use of subtraction.



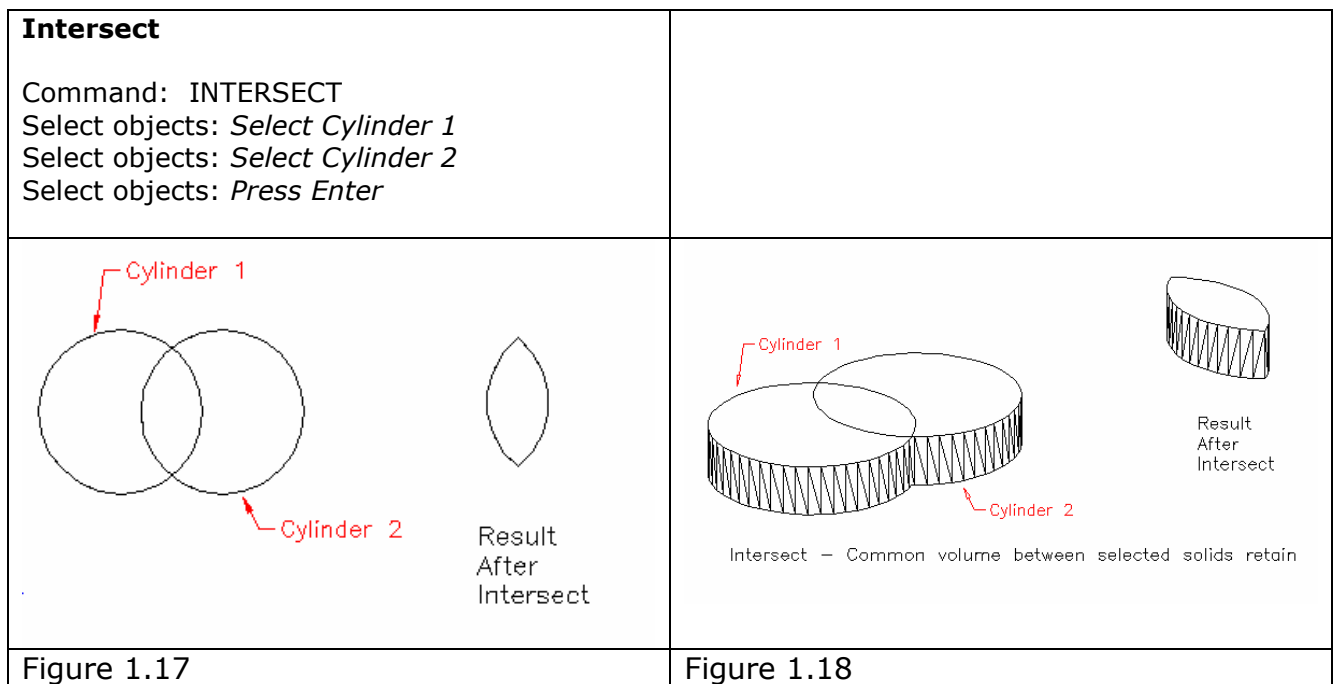
		
Figure 1.8	Figure 1.9	Figure 1.10

Viewing from third quadrant	Magenta region is extruded and placed at the bottom of bamboo.	Subtract magenta region from bamboo.
		
Figure 1.11	Figure 1.12	Figure 1.13

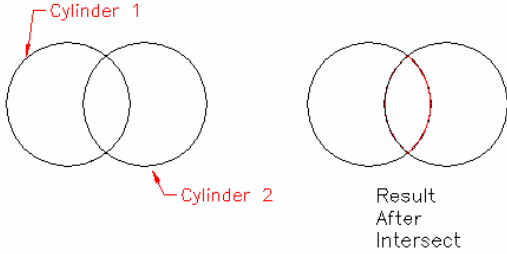
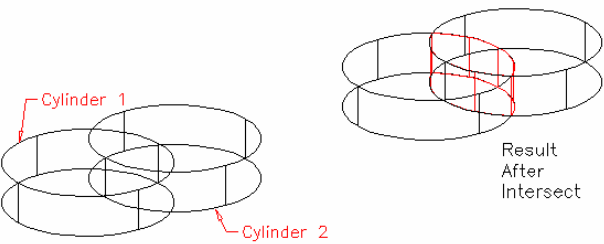
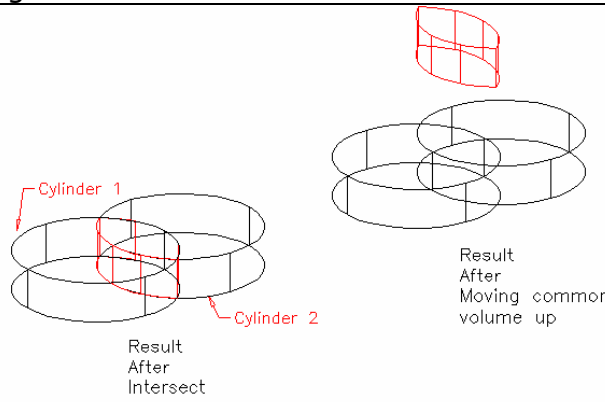
PLAN view in UCS>G>Front	HIDE view of bamboo	Place light in the bamboo, apply material and night lamp is ready.
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1.3 INTERSECT



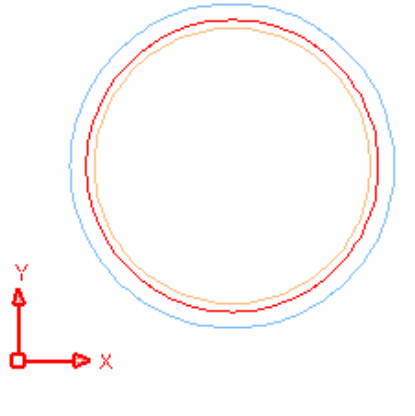
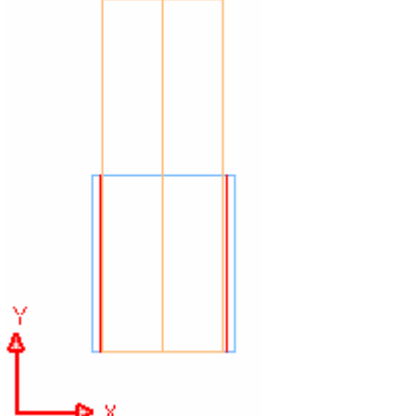
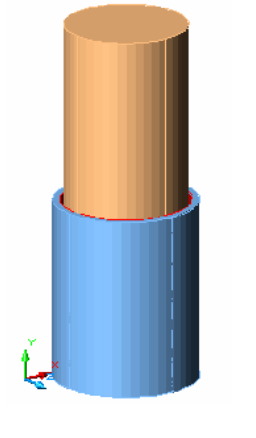
1.4 INTERFERE

<p>Interfere</p> <p>Command: inf INTERFERE Select first set of solids: Select objects: Select Cylinder 1 Select objects: Press Enter Select second set of solids: Select objects: Select Cylinder 2 Select objects: Press Enter Comparing 1 solid against 1 solid. Interfering solids (first set): 1 (second set): 1 Interfering pairs : 1</p> <p>Create interference solids? [Yes/No] <N>: y</p>	 <p>Interfere—Common volume between selected solids is created with current color and original objects retained.</p>
 <p>Interfere—Common volume between selected solids is created with current color and original objects retained.</p>	<p>Figure 1.19</p>  <p>Result After Intersect</p> <p>Result After Moving common volume up</p>
<p>Figure 1.20</p>	<p>Figure 1.21</p>

1.5 SHAFT STORY

What will be effect on casing due to two degrees tilt in shaft? At what degree casing will fail? What improvement is required in design of casing? Well! For answering all above questions, you don't need to manufacture the entire shaft assembly. With mathematical model of AutoCAD, you are just 10 commands away from solution.

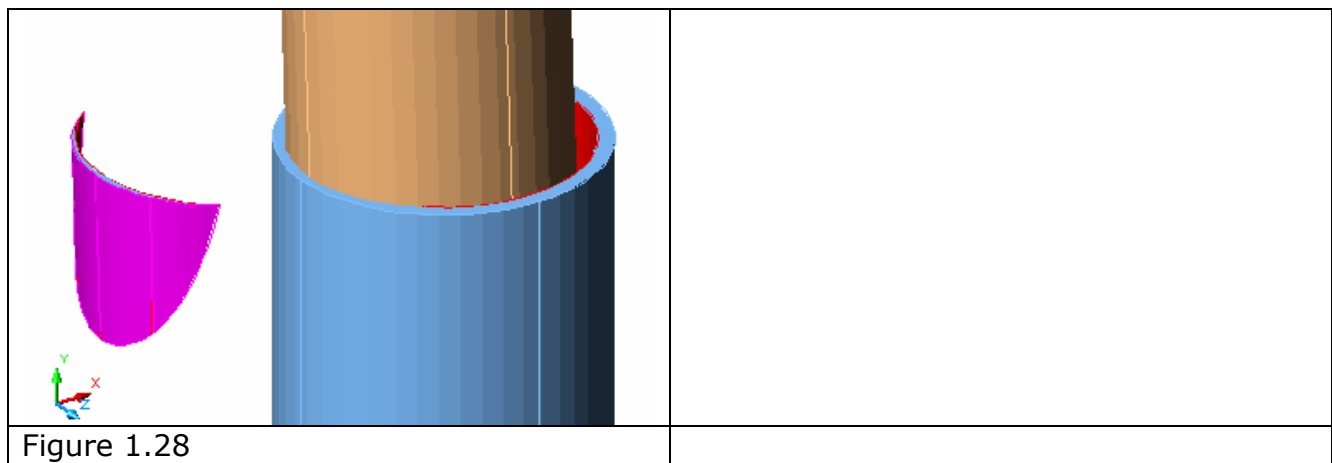
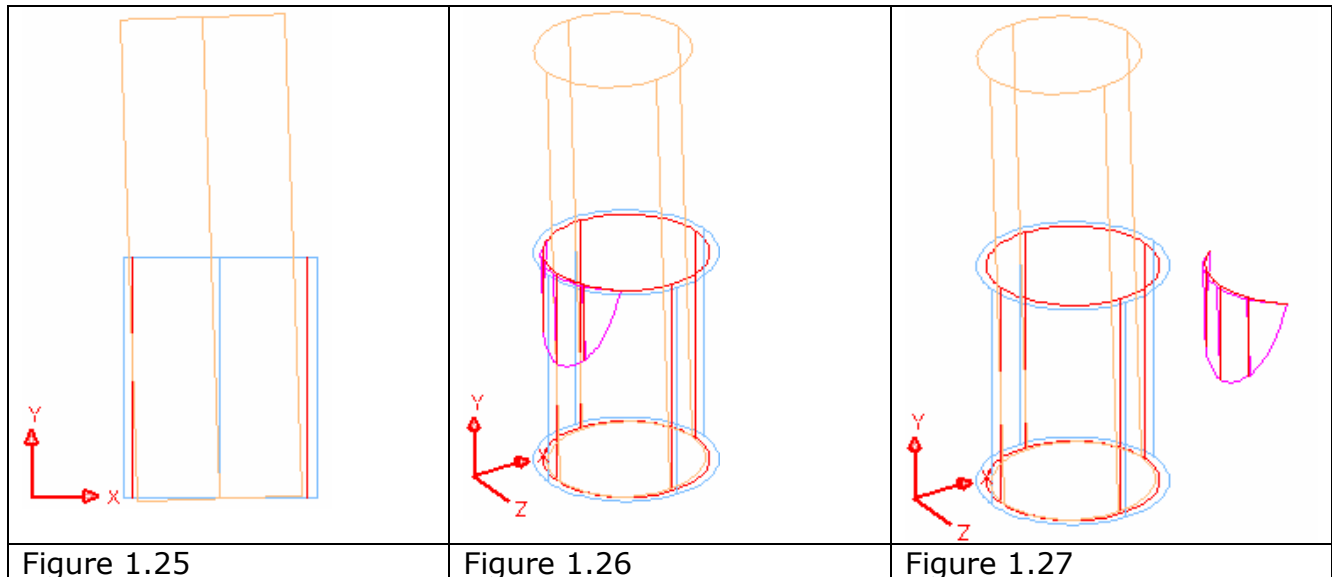
<p>Subtract middle cylinder from outermost cylinder, which will be housing the</p>	<p>PLAN view in UCS>G>left</p>	<p>SHADEed View from third quadrant</p>
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<p>shaft. The innermost cylinder with double height is behaving like shaft.</p> <p>Model in World UCS</p>		
		
<p>Figure 1.22</p>	<p>Figure 1.23</p>	<p>Figure 1.24</p>

As it is clear in figure there is a gap between shaft and casing. The slight tilt in shaft may lead to friction between them and erosion in casing metal. We are going to use INTERFERE command for finding exact cut developed in casing due to tilt of certain degree in shaft.

Shift to UCS>G>Front, so that you can tilt-ROTATE- the shaft to desired degree. Because of such rotation, there will be an intersecting mass between shaft and casing. You can move this interference solid at any location for further study in respect of shape of cut, mass, volume, weight and many metallurgical analyses.

<p>You are in PLAN view of UCS>G>Front</p> <p>Use ROTATE command to rotate shaft two degrees. The interference between shaft and casing is clearly visible.</p>	<p>Use INTEREFERE command. The magenta color solid is the intended solid lump.</p>	<p>The interference solid is moved from its original location for further study.</p>
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1.6 FILLET & CHAMFER

The simplest modifications like Fillet and Chamfer can be performed on Solids also.

Command: fillet

Current settings: Mode = TRIM, Radius = 1

Select first object or [Polyline/Radius/Trim/mUltiple]: *Select Object*

Enter fillet radius <12.0000>: 12

Select an edge or [Chain/Radius]: *Select Edge common to two faces as shown in figure*

1 edge(s) selected for fillet.



Command: CHAMFER

(TRIM mode) Current chamfer Dist1 = 1, Dist2 = 1

Select first line or [Polyline/Distance/Angle/

Trim/Method/mUltiple]: *Select Object*

Base surface selection...

Specify base surface chamfer distance

<25.0000>: 25

Specify other surface chamfer distance

<25.0000>: 25

Select an edge or [Loop]: *Select Edge common to two faces as shown in figure*

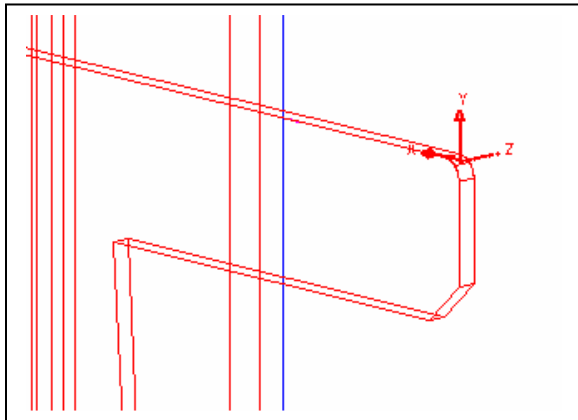


Figure 1.29

The Part Two of solid editing series will mainly concentrate on Solid Editing of Faces

