AS319193-L

3D Modeling with the Best, AutoCAD!

Vince Sheehan
Sr. Civil Designer

Learning Objectives

- Learn how to create 3D Solid, Surface, and Mesh objects using various tools.
- Learn how to edit the objects using tools such as Union, Slice, Extrude Face, Fillet, and so on.
- Learn how to apply texturing and materials to 3D objects.
- Learn how to export the 3D objects to various formats.

Description

In this lab, you'll learn how to create 3D geometry using AutoCAD solid, surface, and mesh tools. Create 3D assets for Revit families, Civil 3D and InfraWorks models, Inventor software, game engines, and other software environments. Edit the 3D objects using various editing tools, such as Union, Slice, Extrude Face, Fillet, and so on. Export the 3D objects. This class is designed to expand your AutoCAD 3D modeling knowledge.

Speaker(s)

Vince has been using Autodesk products since 1992. He has been working in the GIS, Civil Engineering and Surveying field since 1995. He currently serves as Sr. Designer for a civil engineering consulting firm located in Richmond, Virginia. He is also a Design Specialist and Blogger on the site Poly In 3D where he writes tutorials and how to tips for Autodesk products. Vince has also been 3D modeling and rendering for over 15 years using a verity of Autodesk® products and other non-Autodesk® products. Autodesk University 2012 lab speaker on Civil 3D 2013, Civil View 2013 and 3ds Max Design 2013. Autodesk University 2015 lab speaker on Vehicle Tracking 2016. Autodesk University 2017 lab speaker on Autodesk Stingray and AutoCAD.

vsheehan@comcast.net
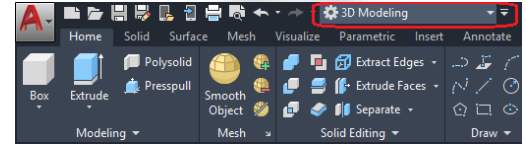
Poly In 3D Blog

Vincent Sheehan (@vlsheehan) | Twitter

Vince Sheehan | Linked in
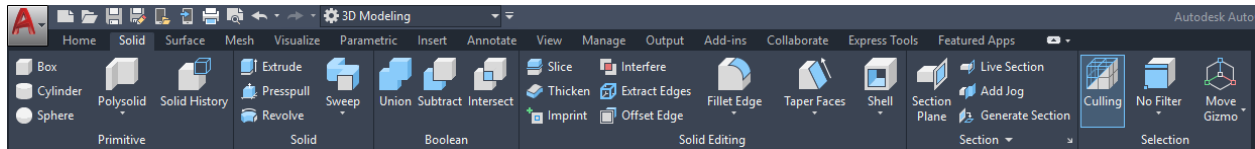
Launch AutoCAD 2020

3D Modeling Workspace
Set the workspace to "3D Modeling". This will have all the necessary tools to create 3D assets and 3D environments.
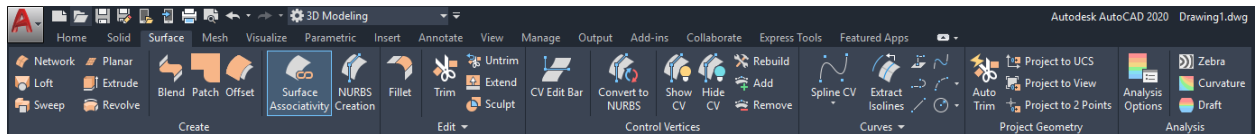

3D Modeling Ribbon Menus

Below are the modeling types used in this exercise. 3D Solid, 3D Surface, 3D Mesh and 3D Face.

Solid Tab:

3D Solid objects consist of primitive shapes and extruded profile. Solids contain volume/mass properties.

Surface Tab:

3D Surface creation tools are similar to the 3D Solid tools such as sweeping, lofting, extruding, and revolving. 3D Surfaces can also be created by blending, patching, offsetting, filleting, and extending other surfaces. They do not contain volume/mass properties.

Mesh Tab:
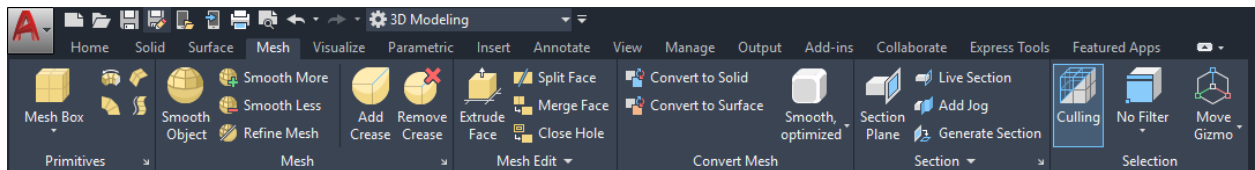
3D Mesh is similar to 3D Surfaces. They contain vertices, edges, and faces that use polygonal representation. They also do not contain volume/mass properties.

Coordinates/UCS, Commands, Views, Visual Styles and Draw/System Variables

Adjusting the UCS:
Click the Home Tab, Coordinates panel.
Default UCS is World coordinates. Adjust the Z-Axis by click the Z button. Select and object face or object intersection the drag the mouse in the direction to establish the Z-Axis.

Dynamic UCS:
Located in the Status bar. When creating an object, Dynamic UCS temporarily aligns the XY plane of the UCS to a planar face on objects such as 3D solids and planar mesh elements.
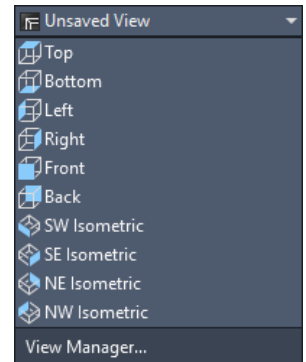
Views:
Click the Home tab, View panel or click View Controls on the upper left of the workspace.
[-][SW Isometric][2D Wireframe]
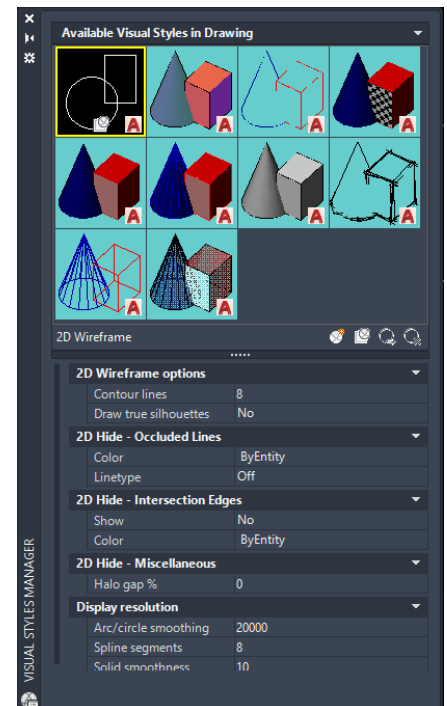(The command to turn on the Viewport Controls is **VPCONTROL**.)

3D Osnap:
Snaps the cursor to 3D solids, surfaces, and point cloud segments.

Visual Styles:

Click the View tab, Palettes panel or click Visual Style Controls on the upper left of the workspace.
[-][SW Isometric][2D Wireframe]

Facetres (System Variable):
Facetres adjust the smoothness of rendered objects and shadows.

Initial calue: 0.5000
Valid values are from 0.01 to 10.0.

Viewres (Command):
Controls the sharpness of circles, arcs, splines, and arced polylines using short vectors.

Surftab1 (System Variable):
Sets the mesh density in the M direction for the REVSURF and EDGESURF commands.

Surftab2 (System Variable):
Sets the mesh density in the N direction for the REVSURF and EDGESURF commands.

3D Orbit:
Rotate/Orbit the view in the current viewport. Drag the cursor horizontally, the camera moves parallel to the XY plane. Drag the cursor vertically, the camera moves along the Z axis.
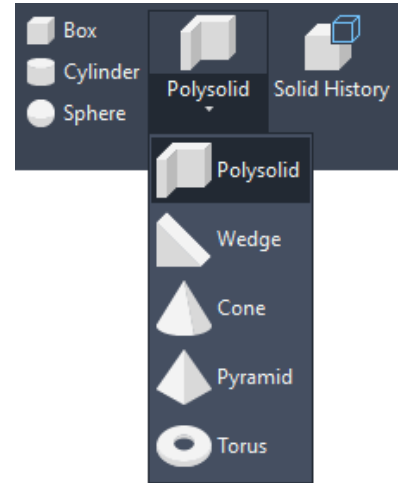
Creating Primitive Objects

Primitive objects are basic 3D shapes made of solid or mesh objects.

1. **Solid Primitive Objects. Solid tab, Primitive panel.**

   a. Box
   b. Cylinder
   c. Sphere
   d. Polysolid
   e. Wedge
   f. Cone
   g. Pyramid
   h. Torus
   i. Show History (Records the history of the solid objects).

2. **Mesh Primitive Objects. Mesh tab, Primitive panel.**

   a. Mesh Box
   b. Mesh Cone
   c. Mesh Cylinder
   d. Mesh Pyramid
   e. Mesh Sphere
   f. Mesh Wedge
   g. Mesh Torus
   h. REVSURF (Revolve Surface)
   i. EDGESURF (Edge Surface)
   j. RULESURF (Ruled Surface)
   k. TABSURF (Tabulated Surface)
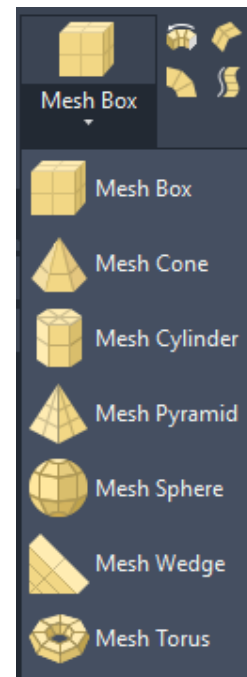
3. **Drawing Objects. Home tab, Draw panel.**

   a. Line
   b. Polyline
   c. 3D Polyline
   d. Spline
   e. Helix
   f. Circle
   g. Polygon
   h. Rectabgle
   i. Ellipse
   j. Region
   k. 3DFace

Creating Solid Objects

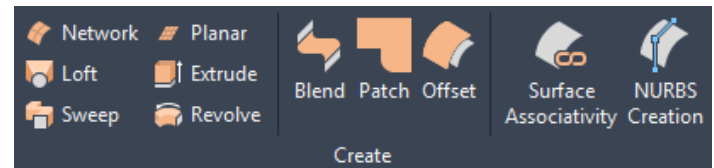1. **Solid objects can be created by several different methods**

   a. Open "C:\DATASETS\AS319193-L - 3D Modeling with the Best, AutoCAD\DWG\Solid Shapes-01.dwg".
   b. Click Solid tab, Solid panel.
   c. Click **Extrude**. Select the yellow shapes. Specify height of extrusion of 5 then press **Enter**.
   d. Click **Presspull**. Select the blue Solid object face then move the mouse to either side.
   e. Click **Revolve**. Select the red half lamp shape objects. Snap Endpoint to the bottom left #1 then upper left #2. Type 360 then press press **Enter**.
   f. Click **Sweep**. Select the cyan circle. Click **Alignment** in the command line then select the cyan polyline.
   g. Click **Loft**. Select the series of magenta circles.
   h. Click **Thicken**. Select the green surface object. Type the specifed thickness of 5 then press **Enter**.
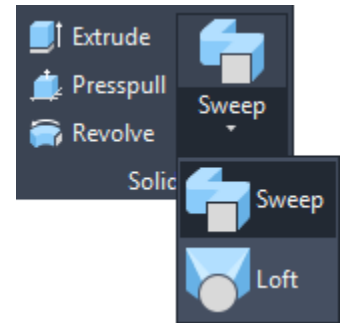
Creating Surface Objects

1. **Surface objects can be created by several different methods.**

   a. Open "C:\DATASETS\AS319193-L - 3D Modeling with the Best, AutoCAD\DWG\Surface Shapes-01.dwg".
   b. Click Surface tab, Create panel.
   c. Click **Network**. Select the red polylines 1, 2, & 3 then press Enter. Select polylines 4 &5 then press Enter.
   d. Click **Loft**. Select the series of magenta circles.
   e. Click **Sweep**. Select the cyan circle. Click **Alignment** in the command line then select the cyan polyline.
   f. Click **Planar**. Select the green polygon.
   g. Click **Extrude** then select the yellow polygons. Specify height of extrusion of 5 then Enter.
   h. Click **Revolve**. Select the red half lamp shape objects. Snap Endpoint to the bottom left #1 then upper left #2. Type 360 then press Enter.
   i. Click **Blend.** Select the green surface circle edge #1 then press Enter. Select the green surface circle edge #2 then press Enter. Click the List Icon then select G0, G1 or G2.
   j. Click **Patch**. Select the top edge of a blue shape then press Enter. Select the List Icon then select G0, G1 or G2.
   k. Click **Offset**. Select the top edge of an orange shape. Type 0.5 then press **Enter**.
   l. Click Trim

Editing 3D Objects
1. **Editing 3D Solid objects can be achieved by several different methods.**
   a. Open "C:\DATASETS\AS319193-L - 3D Modeling with the Best, AutoCAD\DWG\Solid Shapes-01.dwg".
   b. Click the Solid Tab on the Ribbon.

   #### Union
   a. Click the **Union** button on the Boolean panel.
   b. Select the two red spheres to join together.

   #### Subtract
   a. Click the **Subtract** button on the Boolean panel.
   b. Select the two yellow spheres to subtract one object from another.

   #### Intersect
   a. Click the **Intersect** button on the Boolean panel.
   b. Select the two cyan spheres to join the objects where they intersect.

   #### Fillet Edge
   a. Click **Fillet Edge** button on the Solid Editing panel.
   b. Select an edge marked #1 on the red cube.

   #### Chamfer Edge
   a. Click the **Chamfer Edge** button under the Fillet Edge button on the Solid Editing panel.
   b. Select an edge marked #1 on the yellow cube.

   #### Taper Face
   a. Click **Taper Face** button on the Solid Editing panel.
   b. Select the face marked #1 on the green cube.
   c. Snap endpoint to #2 then #3.
   d. Type 15 to taper the face 15 degrees.

   #### Extrude Faces
   a. Click **Extrude Faces** button on the Solid Editing panel.
   b. Select a face marked #1 on the cyan cube, type a distance of 1 then Enter.

   #### Offset Faces
   a. Click **Offset Faces** button on the Solid Editing panel.
   b. Select a face marked #1 on the blue cube, type a distance of 1 then Enter.

   #### Shell
   a. Click **Shell** button on the Solid Editing panel.
   b. Select the magenta cube, type a distance of 0.5 then Enter.

2. **Editing 3D Surface objects can be achieved by several different methods.**
   a. Open "C:\DATASETS\AS319193-L - 3D Modeling with the Best, AutoCAD\DWG\Surface Shapes-01.dwg".
   b. Click the Surface Tab on the Ribbon.

   #### Fillet
   a. Click the **Fillet** button on the Edit panel.
   b. Select a blue surface then select the green surface.
   c. Click the Radius in the command line, type 0.5 then Enter.

   #### Trim
   a. Click the **Trim** button on the Edit panel.
   b. Select the green surface then Enter.
   c. Select the blue circle then Enter.
   d. Click inside the circle then Enter. The **Untrim** command will untrim the area.

3D Mail Drop Box

1. **Constructing a 3D drop box with solids.**

   a. Open "C:\DATASETS\AS319193-L - 3D Modeling with the Best, AutoCAD\DWG\Dropbox.dwg". (Outlines of the drop box are already in the drawing on the layer "GUIDELINES".)
   b. Set **DROPBOX** layer current.
   c. Click the **Extrude** button on the Solid tab, Solid panel.
   d. Click **Mode** in the command line.
   e. Click **Solid**.
   f. Select the cyan color leg/frame.
   g. Click **Path** in the command line.
   h. Select the magenta polyline.
   i. Repeat **Extrude**.
   j. Select the blue square.
   k. Drag the solid up then Snap Endpoint to the bottom corner of the green polyline.
   l. Repeat **Extrude**.
   m. Select the white rectangle.
   n. Drag the solid outwards then Snap Endpoint to the bottom corner of the green polyline.
   o. Repeat **Extrude**.
   p. Select the green polyline.
   q. Drag the solid across the main box then Snap Endpoint to the corner of the solid.
   r. Click the **Solid, Subtract** button under the Home tab, Solid Editing panel. (This will subtract 3D solids from another.)
   s. Select the solid created in steps p & q then then right click/enter.
   t. Select the solid created in steps m & n then right click/enter.
   u. Click the **Solid, Union** button under the Home tab, Solid Editing panel.
   v. Select the lower and upper half of the drop box. (This will combine multiple 3D solids into a single 3D solid.)
   w. Mirror the leg/frame solid to the opposite side.
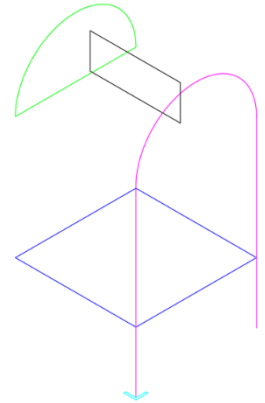
2. **Assigning Textures and Materials.**

   a. Refer to steps 8. Assigning Textures and Materials for importing texture images and creating materials.
   b. Click the **Material Browser** button from the Visualize tab, Materials panel or type materials from the command line.
   c. Two materials for the drop box are save in the drawing. (MB1 and MB2)
   d. Select the three 3D solids that makeup the drop box.
   e. Right click on the MB1 materials then click Assign to Selection.
   f. Click MB2 then drag it while holding the Control (ctrl) key to the side of the drop box.
   g. Repeat step f for the opposite side of the drop box.
   h. To adjust the material mapping, click the **Material Mapping** button from the Visualize tab, Materials panel then while holding the Control (ctrl) key, pick the side of the drop box.

3D Canopy

1. Constructing a 3D canopy with Surfaces.

    a. Open "C:\DATASETS\AS319193-L - 3D Modeling with the Best, AutoCAD\DWG\ Canopy.dwg". (Outlines of the canopy are already in the drawing on the layer "GUIDELINES")

    b. Set "CANOPY - COVER" layer current.

    c. Click the **Network** button under the Surface tab, Create panel.

    d. Select the top yellow polylines then enter.

    e. Select the top red polylines then enter.

    f. Click the **Loft** button under the Surface tab, Create panel.

    g. Select the lower green and the yellow polylines then enter.

    h. Repeat step "e" for the left and right side and the back.

    i. Set "CANOPY - POST" layer current.

    j. Click the **Sweep** button under the Surface tab, Create panel.

    k. Select the green circle then enter.

    l. Click **Alignment** in the command line.

    m. Click **Yes** to align sweep object perpendicular to path before sweep.

    n. Select the cyan polyline.

    o. Set "CANOPY - SHELF" layer current.

    p. Click the **Extrude** button under the Surface tab, Create panel.

    q. Select the brown shelf support polyline then enter then type 0.1 for an extrusion height.

    r. Repeat steps "n – o" for the rest of the shelf supports.

    s. Click the **Extrude** button under the Surface tab, Create panel.

    t. Select all the white rectangle polylines then enter then type 8.2 for an extrusion height.

    u. Add materials as shown in section 9. (Materials already loaded in drawing)
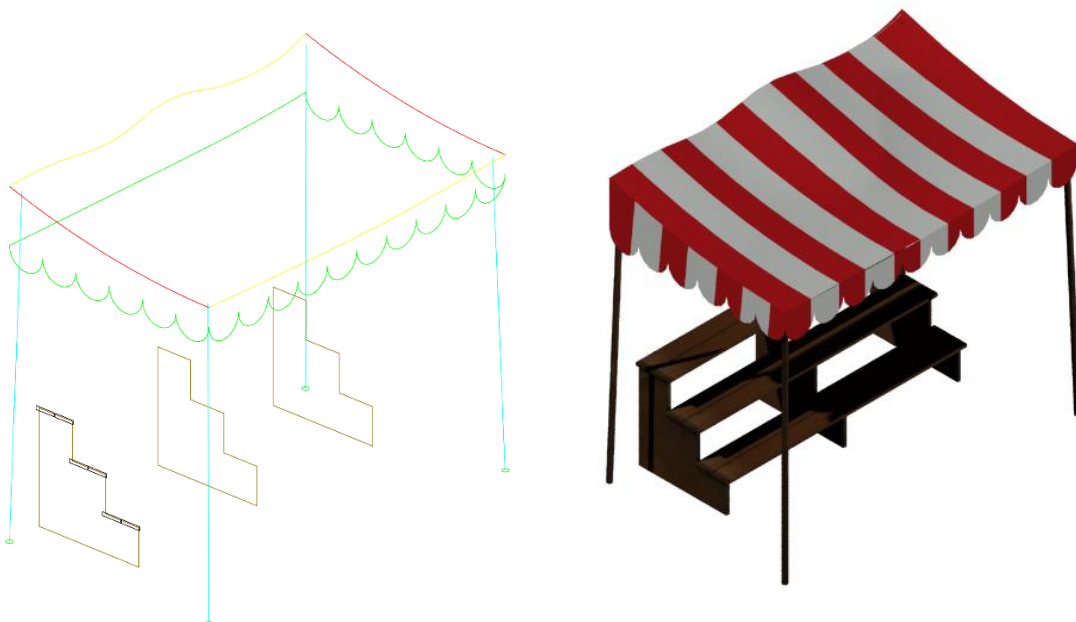
3D Car Wheel

1. Constructing a 3D wheel with solids.

    a. Open "C:\DATASETS\AS319193-L - 3D Modeling with the Best, AutoCAD\DWG\Car Wheel.dwg". (Outlines of the wheel are already in the drawing on the layer "GUIDELINES".)
    b. Click the Solid Tab on the Ribbon.
    c. Set layer **3DWHEEL** current.
    d. Click the **Revolve** button on the Solid panel.
    e. Click **Mode** in the command line then select **Solid**.
    f. Select the two green polygons then press **Enter**.
    g. Specify Axis Start Point. Snap Endpoint to one end of the red centerline then Snap Endpoint to the other end of the red centerline.
   h. Type 360 at the command line then press **Enter**.

2. Constructing the lug bolt holes.

    a. Set layer 3DWHEEL-HOLES current.
    b. Click the **Revolve** button on the Solid panel.
    c. Click **Mode** in the command line then select **Solid**.
    d. Select the blue polygon then right click or hit **Enter**.
    e. Specify Axis Start Point. Snap Endpoint to one end of the yellow centerline then Snap Endpoint to the other end of the yellow centerline.
    f. Type 360 at the command line then press **Enter**.
    g. Array the newly created cylinder by typing **3DARRAY** at the command line then press **Enter**.
    h. Select the newly created cylinder.
    i. Click **Polar** in the command line then press Enter.
    j. Click **Axis** of rotation in the command then press Enter.
    k. Snap Endpoint to one end of the red centerline then Snap Endpoint to the other end of the red centerline.
    l. Click **Items** in the command, type 5 then press **Enter** twice.
    m. Click the Solid Tab on the Ribbon.
    n. Click the **Subtract** button on the Boolean panel.
    o. Select the newly created cylinder then press **Enter**.
    p. Select the center section of the wheel then press **Enter**.

3. Constructing the 3D wheel spokes.

a. Set layer 3DWHEEL SPOKES current.
b. Click the Surface Tab on the Ribbon.
c. Click the **Loft** button on the Create panel.
d. Click **Mode** in the command line then select **Solid**.
e. Select the two white rectangles then press **Enter**
f. Click **Guide** in the command line, select the cyan polyline then press **Enter**.
g. Array the newly created cylinder by typing **3DARRAY** at the command line then press **Enter**.
h. Select the newly created cylinder.
i. Click **Polar** in the command line then press **Enter**.
j. Click **Axis** of rotation in the command then press **Enter**.
k. Snap Endpoint to one end of the red centerline then Snap Endpoint to the other end of the red centerline.
l. Click **Items** in the command, type 5 or 6 then press **Enter** twice.
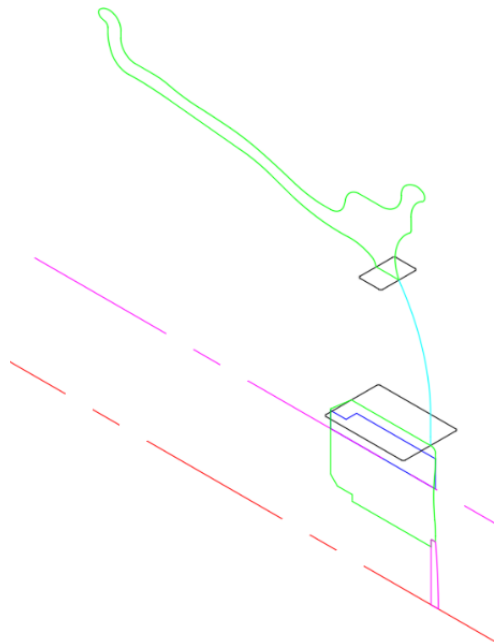
3D Pulley

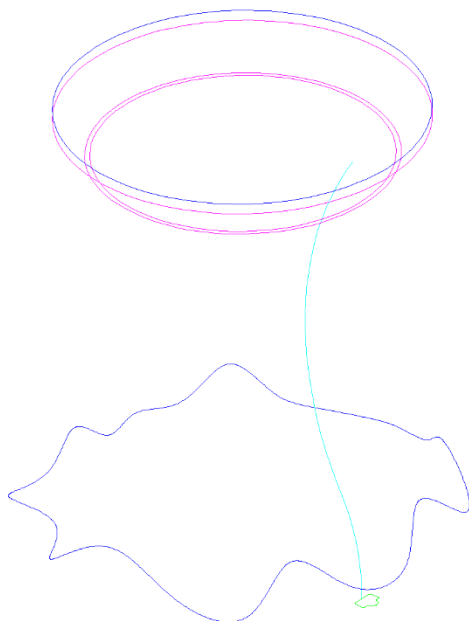1. **Construct the 3D pulley with the tools solid learned in this handout.**

    a. Open "C:\DATASETS\AS319193-L - 3D Modeling with the Best, AutoCAD\DWG\Building Frame.dwg. (Outlines of the pulley are already in the drawing on the layer "GUIDELINES".)
    b. Set Pulley layer current.
    c. **Extrude** the blue close polygon a length of 2.0.
    d. **Extrude** the green closed polygons 0.10.
    e. **Extrude** the cyan closed polygons 0.05.
    f. **3DArray** the newly created solids around the red centerline.
    g. **Revolve** the closed magenta polyline 360° around the red centerline.
    h. **Subtract** the solids created from the blue polyline from the main pulley.
    i. **Union** the solids created from the green polygons to the main pulley.
    j. **Subtract** the solid created from the cyan polygon from the main pulley.
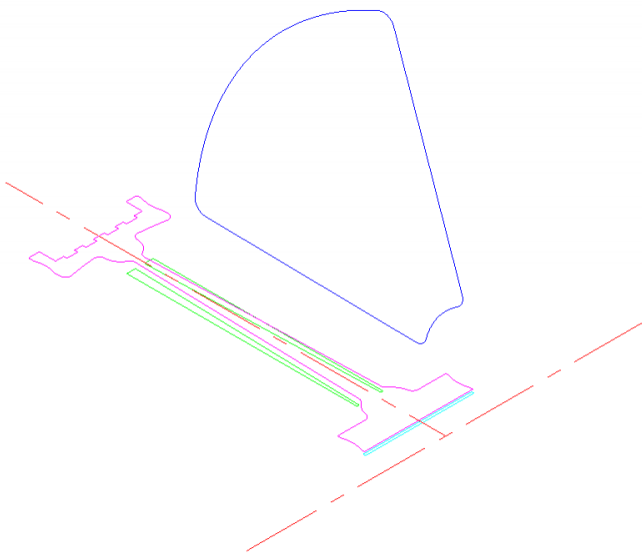
3D Table and Tablecloth

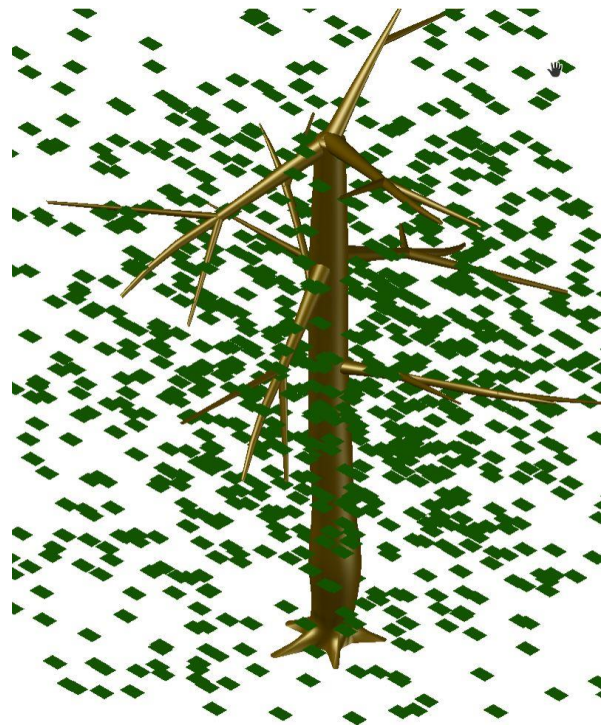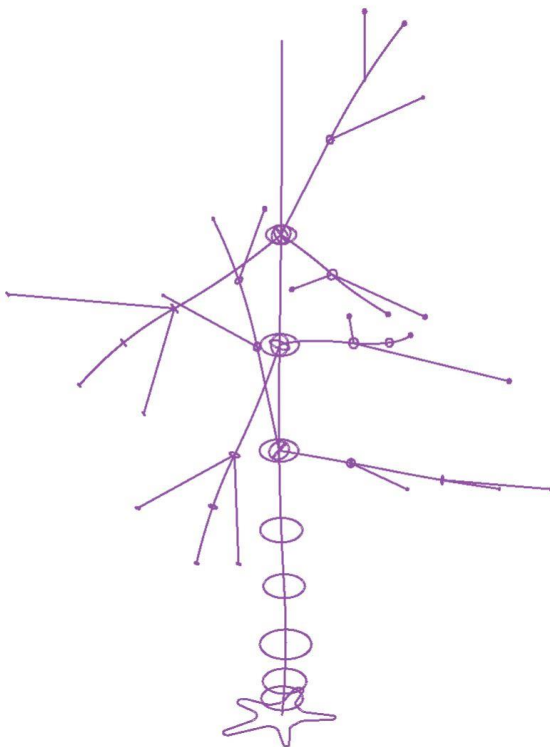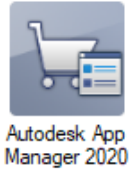1. **Construct the 3D pulley with the solid and surface tools learned in this handout.**

   a. Open "C:\DATASETS\AS319193-L - 3D Modeling with the Best, AutoCAD\DWG\Table.dwg. (Outlines of the tablecloth are already in the drawing on the layer "GUIDELINES".)
   b. Set Table layer current.
   c. **Extrude** the green closed polygons using the cyan polylines ad a path.
   d. **Array** the table legs around 0,0.
   e. **Extrude** the magenta circles 0.333.
   f. **Subtract** the inter solid from the outer solid.
   g. **Extrude** the red circle 0.0833.
   h. **Fillet** the top edge of the tabletop 0.05.
   i. Set Tablecloth layer current.
   j. **Loft** using the lower blue spline and the top blue circle.
   k. **Patch** the top of the tablecloth using the top blue circle.
   l. Apply a cloth material to the tablecloth.

3D Tree

**1. Construct the 3D tree with surface or solid tools learned in this handout.**

a. Open "C:\DATASETS\AS319193-L - 3D Modeling with the Best, AutoCAD\DWG\Tree.dwg".
b. (Outlines of the tree trunk are already in the drawing on the layer "GUIDELINES".)
c. Set the TRUNK SURFACE current.
d. **Loft** the magenta closed magenta polylines.
e. Set LEAVES SURFACE layer current.
f. Create the leaves using a **3DFACE**.
g. Scatter the leaves around. (3rd party scatter app can be found in the Autodesk App Manager under the Add-Ins tab on the ribbon.

Autodesk App
Manager 2020

3D Framed Building

1. **Complete the building frame with the tools learned in this handout.**

   a. Open "C:\DATASETS\AS319193-L - 3D Modeling with the Best, AutoCAD\DWG\Building Frame.dwg".
   b. The closed magenta polyline can be used for Extruding, Revolving, Sweeping, Lofting and so on.
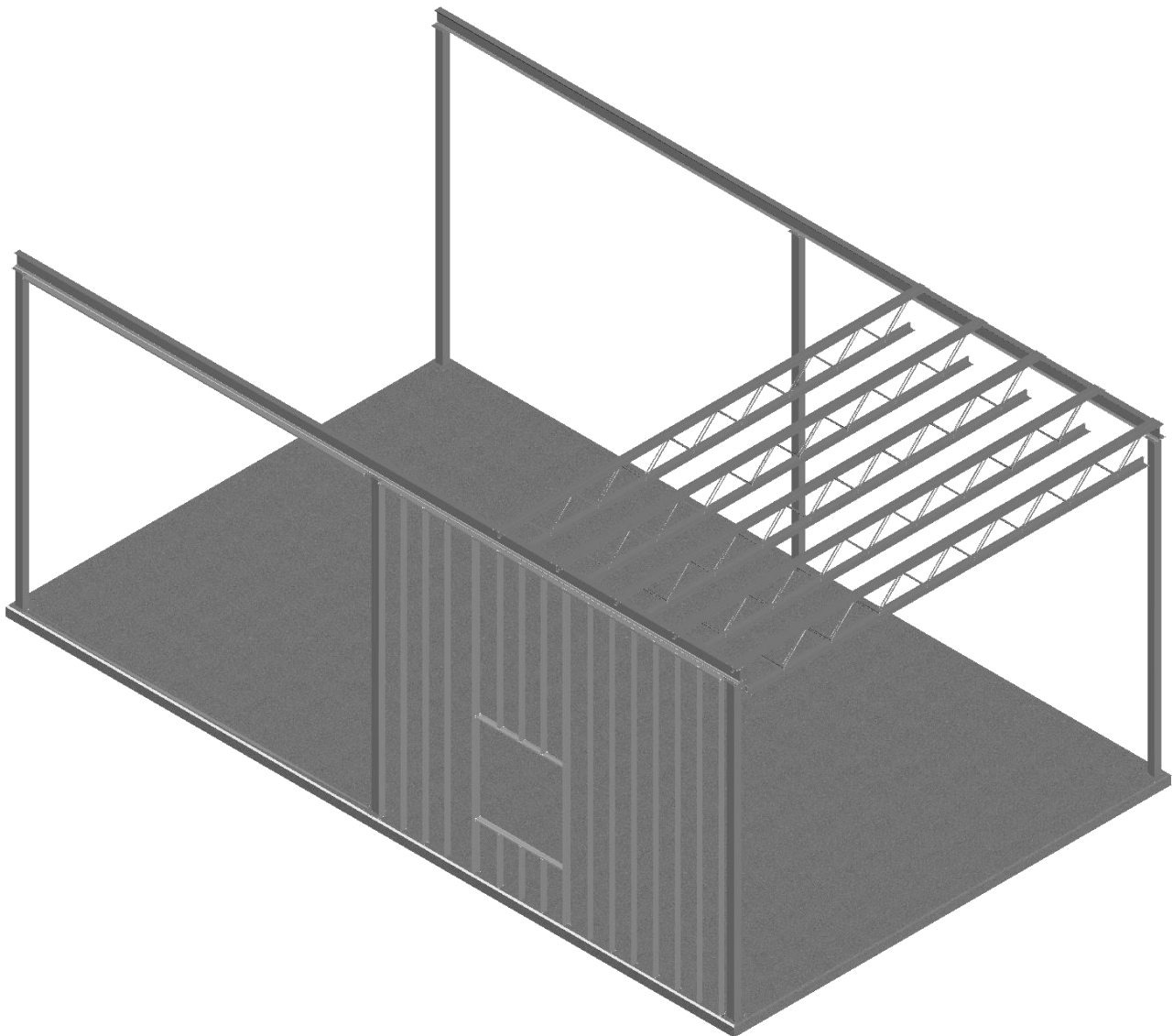
Assigning Textures and Materials.

a. Open "C:\DATASETS\AS319193-L - 3D Modeling with the Best, AutoCAD!\DWG\Dropbox.dwg".
b. Isolate layer "DROPBOX".
c. Click the **Material Browser** button under the Visualize tab, Materials panel.
d. Click the Create New Material button the select New Generic Material. (The Materials Editor will open)
e. Rename the material name to "Dropbox_01".
f. Click the white image box then select Dropbox_01.png from the "Textures" folder.
g. Close the Texture Editor and Materials Editor.
h. Set the Visual Style to "Realistic" to see the materials.
i. To adjust the material mapping, click the **Material Mapping** button under the Visualize tab, Materials panel then while holding the "Control" (ctrl) key, pick the side of the drop box.
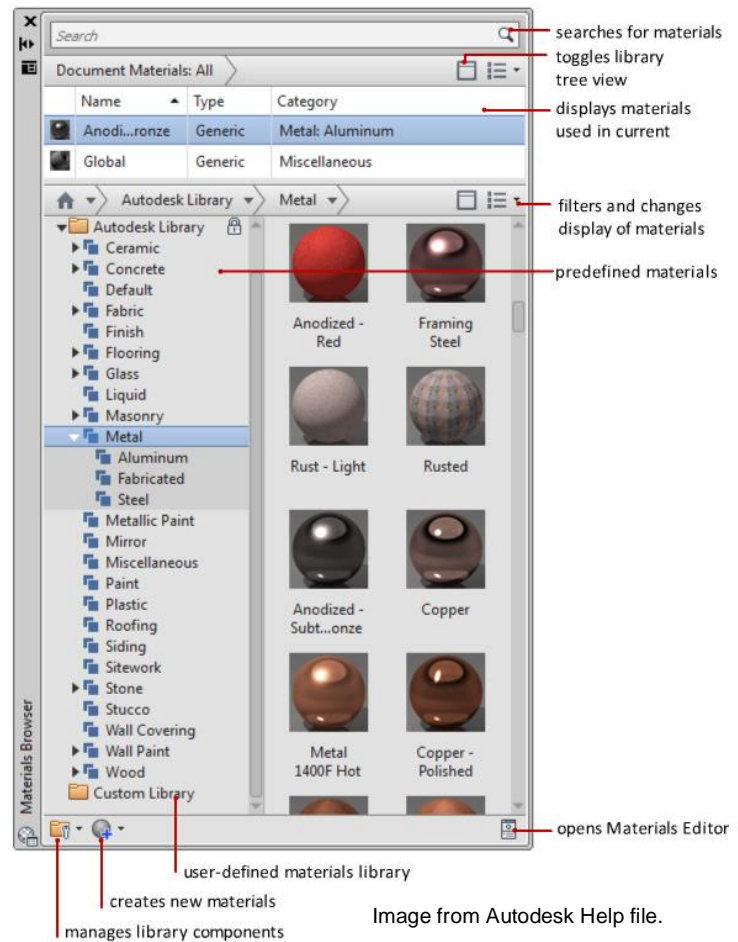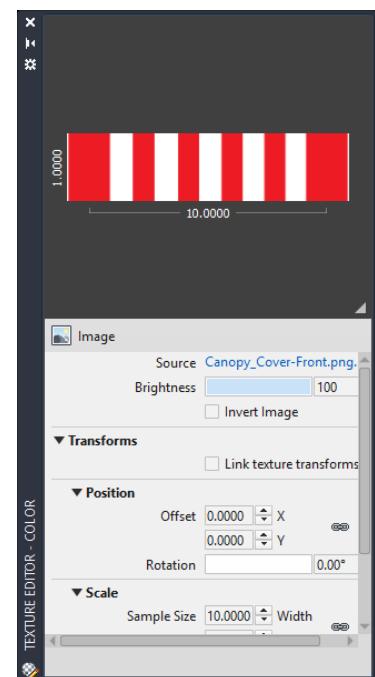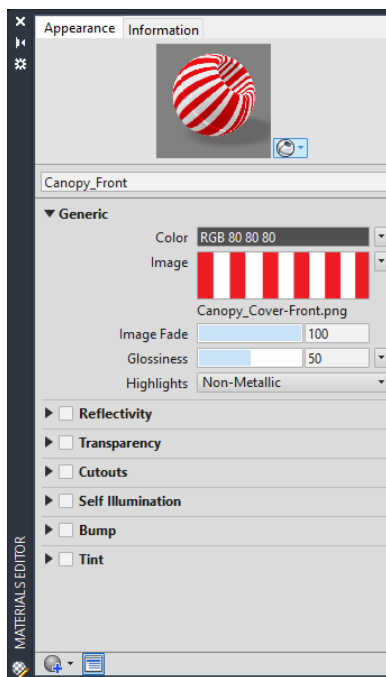j. Repeat for additional materials.

Labels pointing to the Material Browser image:
- searches for materials
- toggles library tree view
- displays materials used in current
- filters and changes display of materials
- predefined materials
- opens Materials Editor
- user-defined materials library
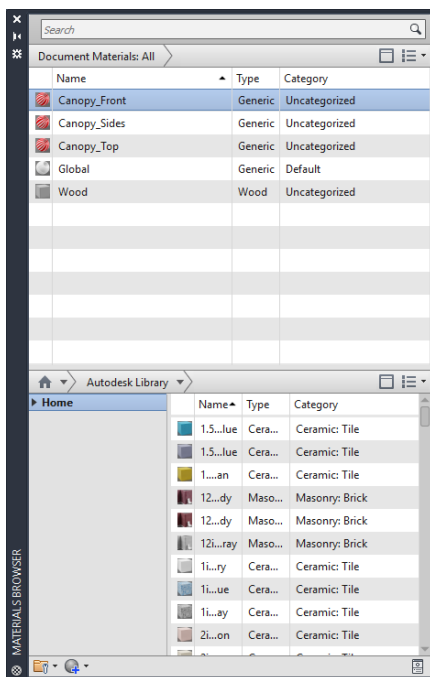- creates new materials
- manages library components

Image from Autodesk Help file.

Additional Resources:

Pre-made assets can also be found in the AutoCAD Civil 3D or AutoCAD Architecture install as Multiview Blocks.

c:\Users\All Users\Autodesk\C3D 2020\enu\Data\Symbols\Mvblocks\

Thanks for attending!