A Quick Start to AutoCAD 3D Solid Modeling

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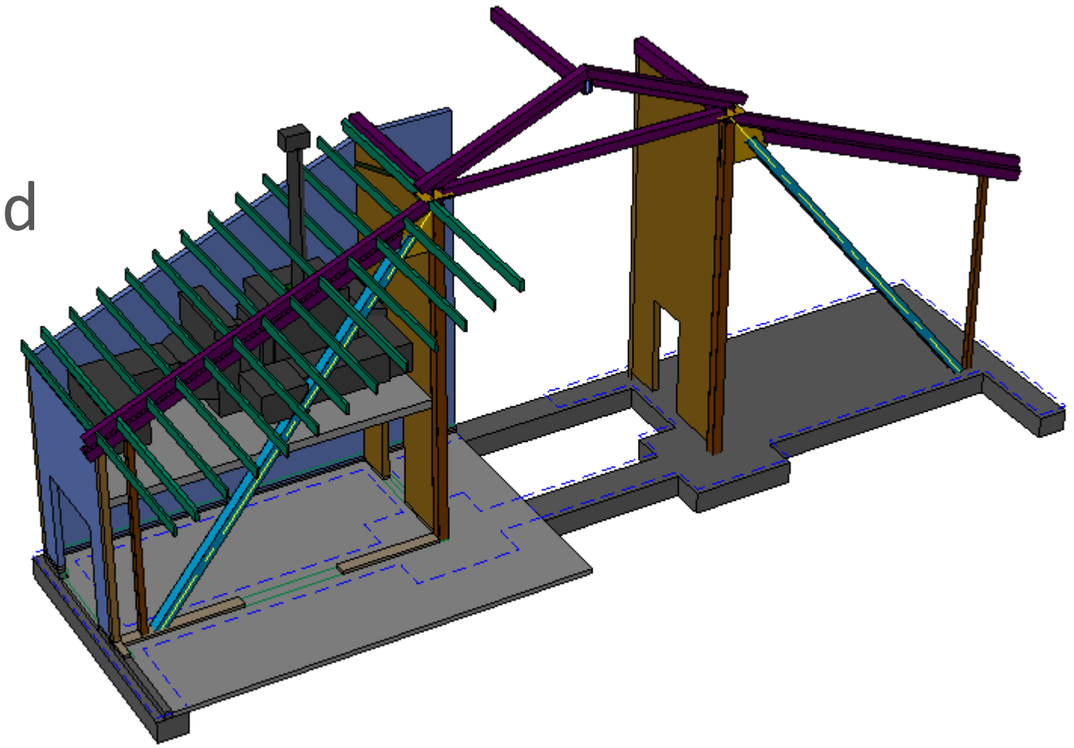
General course objectives

- Learn the basics of 3D solid modeling using only 9 commands.
- Become familiar with practical tips and techniques with real-life models.
- Learn the next steps for becoming proficient in 3D solid modeling.



But which 9 commands are essential?

Commands (56+)

3DFLY (Command)
3DMOVE (Command)
3DORBIT (Command)
3DROTATE (Command)
3DSCALE (Command)
3DWALK (Command)
BOUNDARY (Command)
BREP (Command)
BOX (Command)
CONE (Command)
CONVTOSOLID (Command)
CONVTOSURFACE (Command)
CYLINDER (Command)
EXPORT (Command)
EXTRUDE (Command)
FLATSHOT (Command)
HIDE (Command)
INTERFERE (Command)
INTERSECT (Command)
LIVESECTION (Command)
MASSPROP (Command)
MIRROR3D (Command)
OFFSETEDGE (Command)
PLAN (Command)
PRESSPULL (Command)
PROJECTGEOMETRY (Command)
PYRAMID (Command)
REGEN3 (Command)
REGION (Command)
REVOLVE (Command)
ROTATE3D (Command)
SECTION (Command)
SECTIONPLANE (Command)
SECTIONPLANEJOG (Command)
SECTIONPLANESETTINGS (Command)
SECTIONPLANETOBLOCK (Command)
SECTIONSPINNERS (Command)
SHADEMODE (Command)
SLICE (Command)
SOLDRAW (Command)
SOLIDEDIT (Command)
SOLPROF (Command)
SOLVIEW (Command)
SPHERE (Command)
SUBTRACT (Command)
SWEEP (Command)
TORUS (Command)
UNION (Command)
UCS (Command)
UCSICON (Command)
VPOINT (Command)
VISUALSTYLES (Command)
VISUALSTYLESCLOSE (Command)
VSCURRENT (Command)
VSSAVE (Command)
WEDGE (Command)

System Variables (65+)

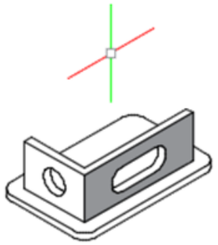
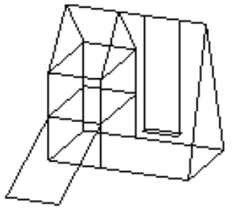
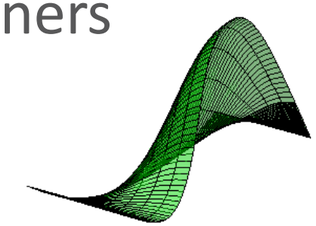
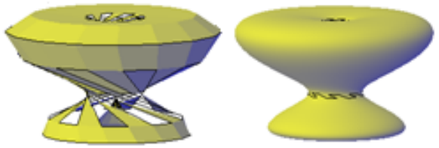
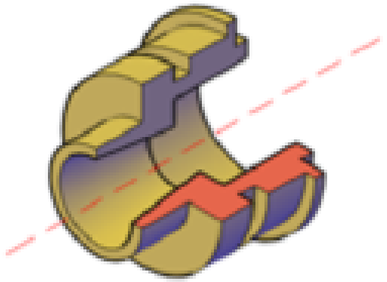
BACKZ (System Variable)
DELOBJ (System Variable)
DISPSILH (System Variable)
DRAGVS (System Variable)
FACETRES (System Variable)
FRONTZ (System Variable)
HIDEPRECISION (System Variable)
IMPLIEDFACE (System Variable)
INTERSECTIONDISPLAY (System Variable)
ISOLINES (System Variable)
LENSLENGTH (System Variable)
LOFTANG1 (System Variable)
LOFTANG2 (System Variable)
LOFTMAG1 (System Variable)
LOFTMAG2 (System Variable)
LOFTNORMALS (System Variable)
LOFTPARAM (System Variable)
OBSCUREDCOLOR (System Variable)
OBSCUREDLTYPE (System Variable)
ORBITAUTOTARGET (System Variable)
PERSPECTIVE (System Variable)
PERSPECTIVECLIP (System Variable)
SHOWHIST (System Variable)
SECTIONOFFSETINC (System Variable)
SECTIONTHICKNESSINC (System Variable)
SHADEDGE (System Variable)
SOLIDCHECK (System Variable)
SOLIDHIST (System Variable)
STEPSIZE (System Variable)
STEPSPERSEC (System Variable)
SUBOBJSELECTIONMODE (System Variable)
TARGET (System Variable)
VIEWDIR (System Variable)
VIEWMODE (System Variable)
VIEWTWIST (System Variable)
VSBACKGROUNDS (System Variable)
VSEDGECOLOR (System Variable)
VSEDGEJITTER (System Variable)
VSEDGELEX (System Variable)
VSEDGEOVERHANG (System Variable)
VSEDGES (System Variable)
VSEDGESMOOTH (System Variable)
VSFACECOLORMODE (System Variable)
VSFACEHIGHLIGHT (System Variable)
VSFACEOPACITY (System Variable)
VSFACESTYLE (System Variable)
VSHALOGAP (System Variable)
VSINTERSECTIONCOLOR (System Variable)
VSINTERSECTIONEDGES (System Variable)
VSINTERSECTIONLTYPE (System Variable)
VSISOONTOP (System Variable)
VSLIGHTINGQUALITY (System Variable)
VSMATERIALMODE (System Variable)
VSMONOCOLOR (System Variable)
VSOBSCUREDCOLOR (System Variable)
VSOBSCUREDEDGES (System Variable)
VSOBSCUREDLTYPE (System Variable)
VSOCCLUDEDCOLOR (System Variable)
VSOCCLUDEDEDGES (System Variable)
VSOCCLUDEDLTYPE (System Variable)
VSSHADOWS (System Variable)
VSSILHEDGES (System Variable)
VSSILHWIDTH (System Variable)
VSSTATE (System Variable)
WORLDVIEW (System Variable)

Quick preview

- Viewing commands – 3DORBIT, PLAN
- UCS commands – UCS, UCSICON
- Profile operations – EXTRUDE, REVOLVE
- Boolean operations – UNION, SUBTRACT, INTERSECT

Definitions for context

- Isometric drafting – illustrations in flat “2½ D”
- Wireframe modeling – pipe cleaners
- Surface modeling – paper thin
- Mesh modeling – sculpting, smoothing chicken wire
- **Solid modeling – volume and mass**

2D commands used in 3D modeling

Viewing in 3D

The User Coordinate System

Profile operations

Boolean operations

Best practices and advice

Next steps

2D commands used in 3D modeling

These are the commands that I use the most for 3D solid modeling

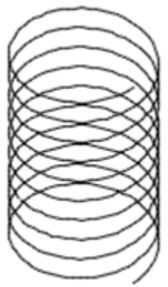
- Move, copy, rotate, mirror, erase
- Ortho mode and direct distance entry
- Polylines, circles, lines

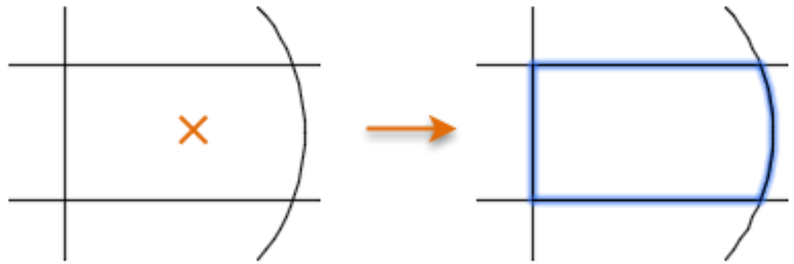
Tip: Create reference and construction geometry to reduce errors.

2D commands used in 3D modeling

These are the commands that I use the most for 3D solid modeling

- Move, copy, rotate, mirror, erase
- Ortho mode and direct distance entry
- Polylines, circles, lines
- ★ BOUNDARY—creates 2D profiles
- HELIX (spirals, springs, threads)





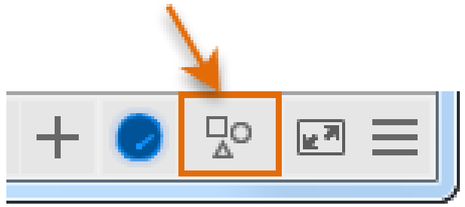
Tip: Causes of boundary fails:

- Area is not fully enclosed
- Objects off screen, extreme zooms
- Super complex boundary
- Non-plan view

Inquiry, visibility, and controls

These are the commands that I use the most in 3D solid modeling

- ★ ID, DIST, PROPERTIES
- GROUP and UNGROUP for assemblies
- ★ Isolate and Hide objects



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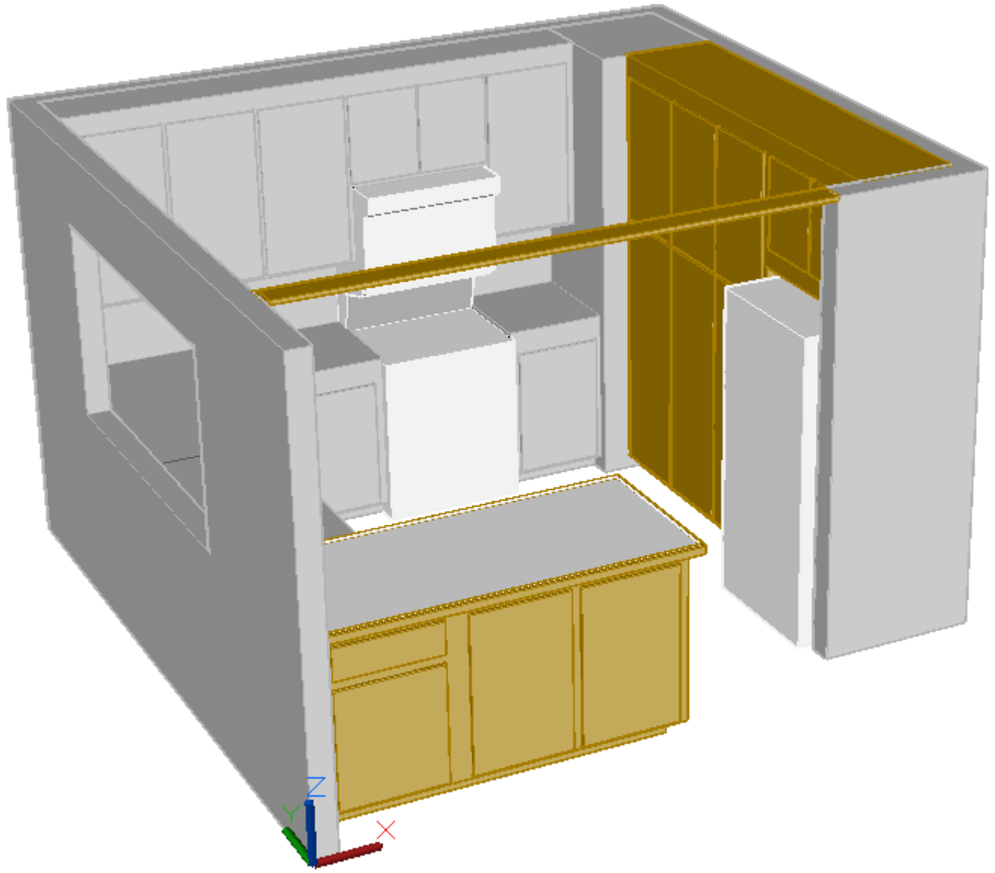
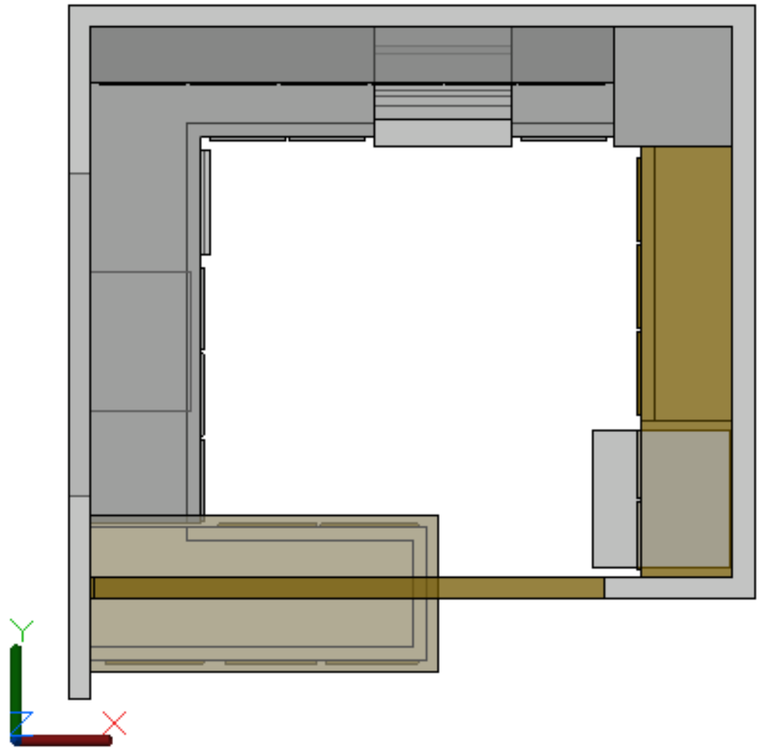
Viewing in 3D

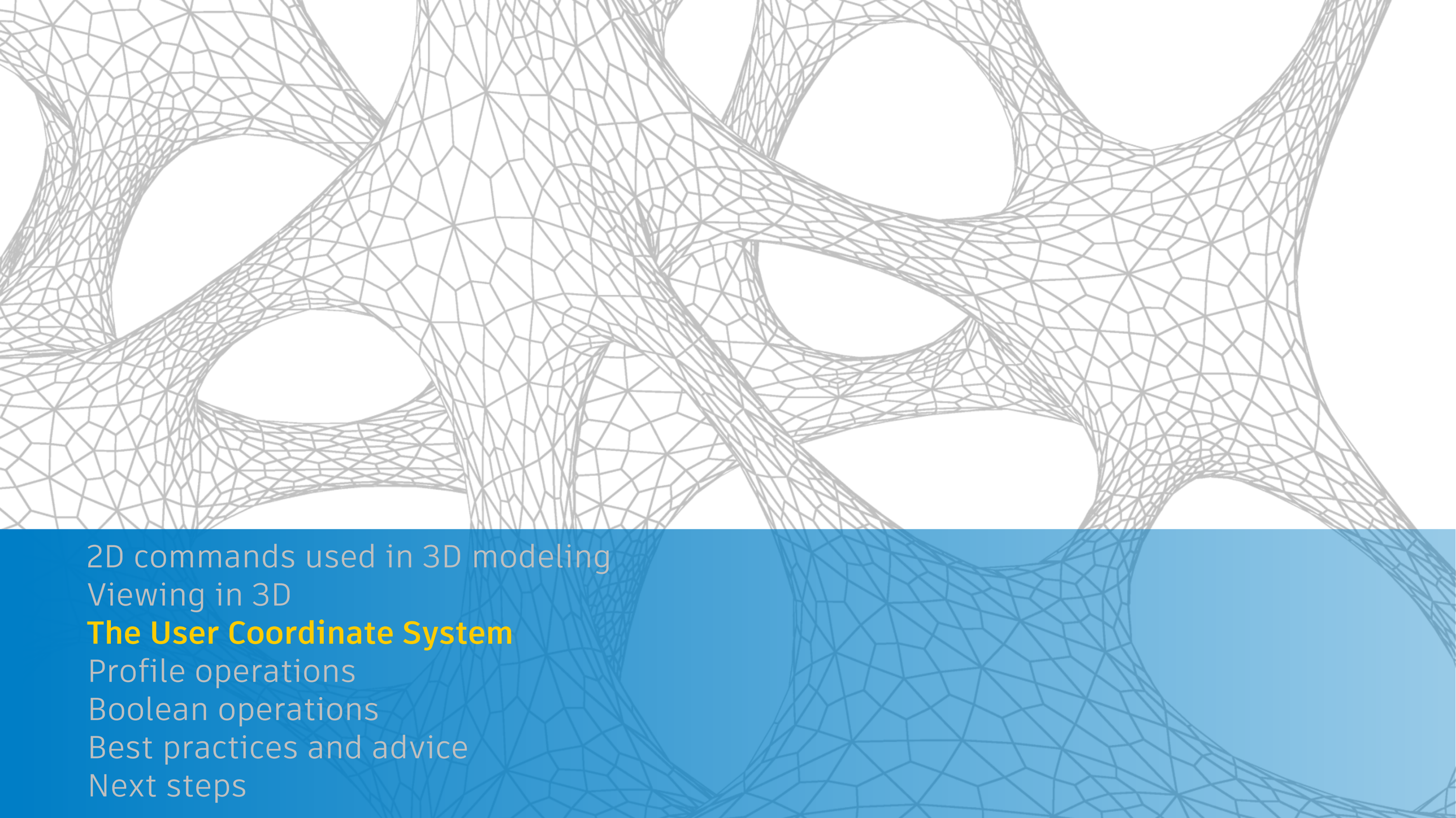
- 3DORBIT (3DO)
  - Perspective vs. orthographic
  - Visual styles (VS)
  - Options > Display tab > Colors
  - Quick: Shift + press mouse wheel



Viewing in 3D

- 3DORBIT (3DO)
- PLAN
  - XY plane of the current UCS
  - Mechanical Design vs. Architectural conventions





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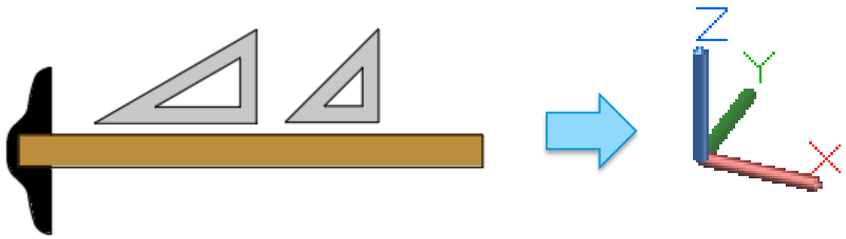
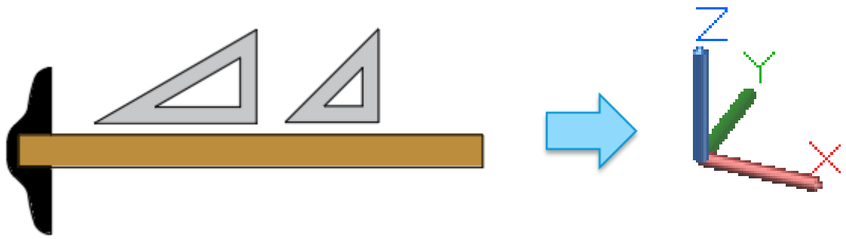
The User Coordinate System

- What is it?



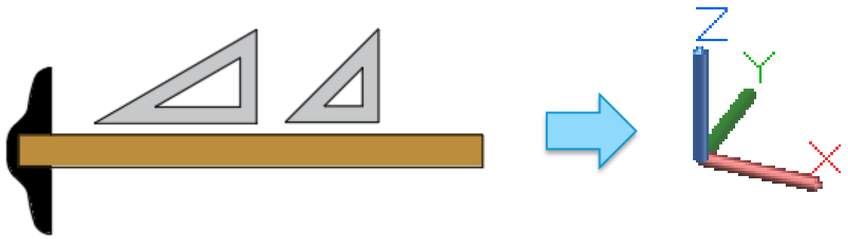
The User Coordinate System

- What is it?
- What's it for?



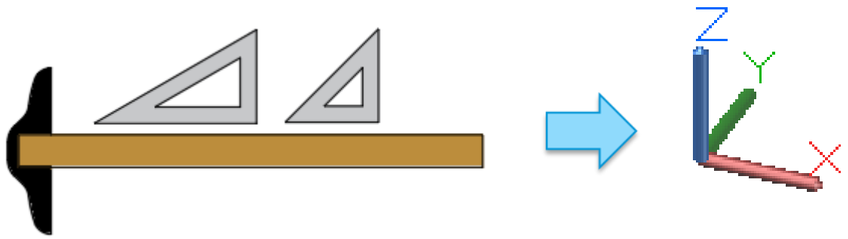
The User Coordinate System

- What is it?
- What's it for?
  - Orientation - Construction plane for creating 2D objects



The User Coordinate System

- What is it?
- What's it for?
  - Orientation - Construction plane for creating 2D objects
  - Orthogonal directions - X, Y, Z for direct distance entry, Ortho mode



The User Coordinate System

- What is it?
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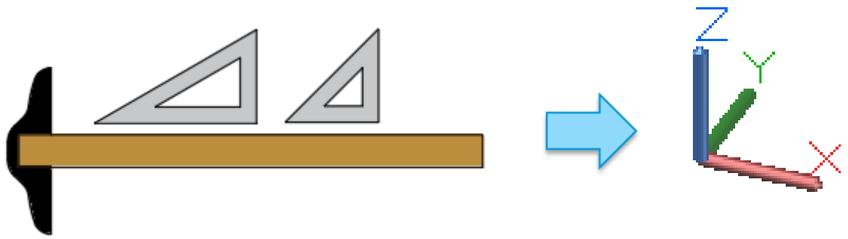
  - Orthogonal directions - X, Y, Z for direct distance entry, Ortho mode
  - Rotation axis - The Z axis is the "hinge" for rotation, right-hand rule



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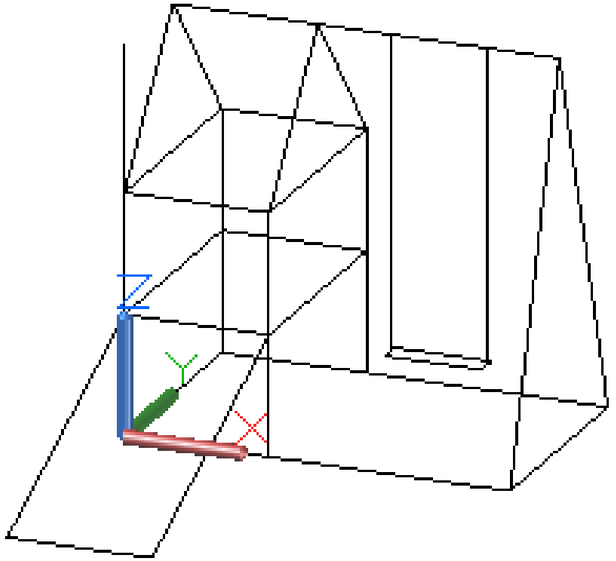
Tip: Turn off dynamic UCS by setting UCSDETECT = 0 [F6]

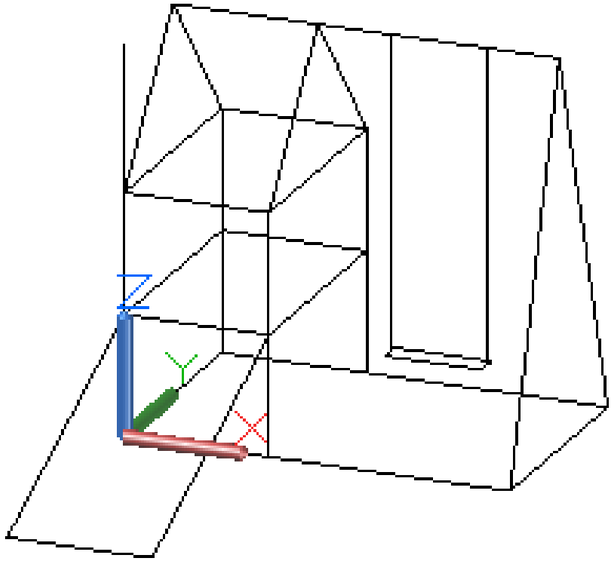
The User Coordinate System

- What is it?
- What's it for?
- UCS – The essential options



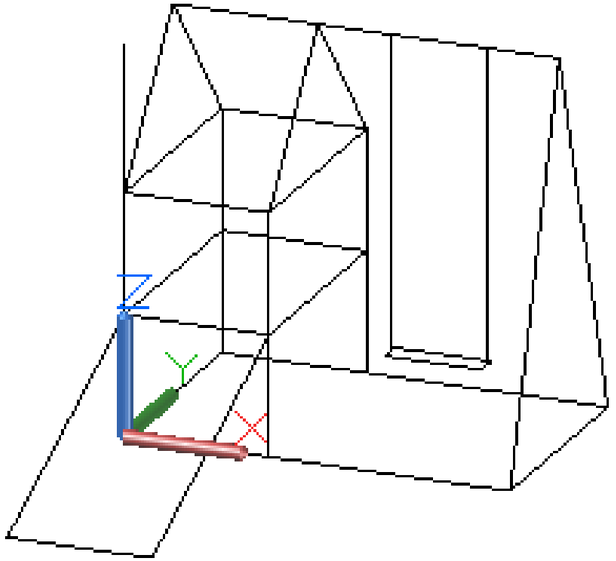
The User Coordinate System

- What is it?
- What's it for?
- UCS – The essential options
  - 3P (default) – Locates the XY construction plane

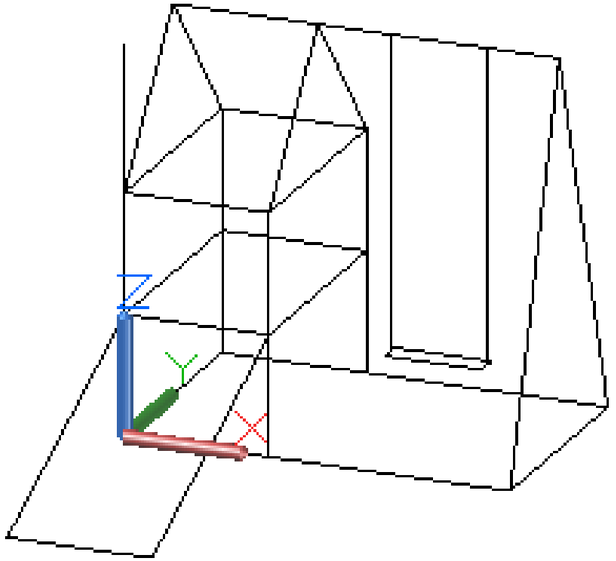


The User Coordinate System

- What is it?
- What's it for?
- ★ UCS – The essential options
  - 3P (default) – Locates the XY construction plane
  - ZA – Specifies the Z-axis for rotations

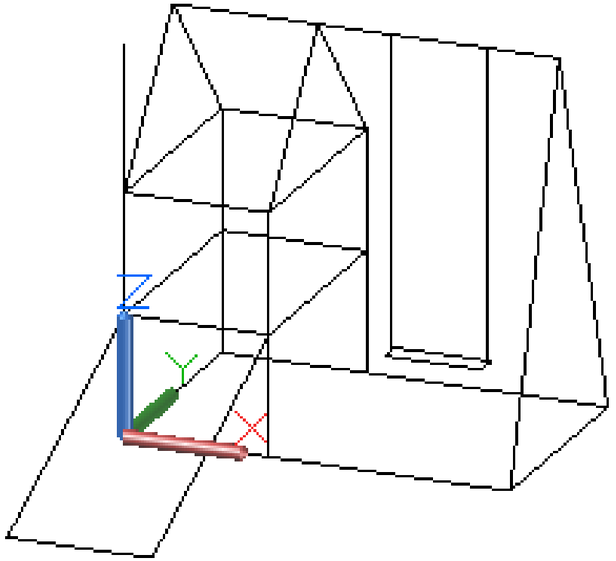


The User Coordinate System



- What is it?
- What's it for?
- UCS – The essential options
  - 3P (default) – Locates the XY construction plane
  - ZA – Specifies the Z-axis for rotations
  - W – Returns the UCS to be coincident with the World Coordinate System

The User Coordinate System



- What is it?
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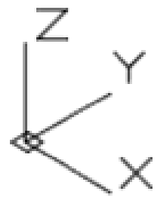
- UCS – The essential options
  - 3P (default) – Locates the XY construction plane
  - ZA – Specifies the Z-axis for rotations
  - W – Returns the UCS to be coincident with the World Coordinate System

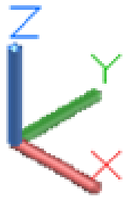
Tip: Enter UCS ZA, and UCS W (Enter) directly at the Command prompt

The User Coordinate System

- What is it?
- What's it for?
- UCS – The essential options
- UCSICON – Controls the display of the UCS icon



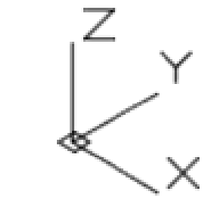
2D Wireframe



All other VS

The User Coordinate System

- What is it?
- What's it for?
- ★ UCS – The essential options
- UCSICON – Controls the display of the UCS icon
  - On + Origin for modeling (default)
  - Off for screenshots



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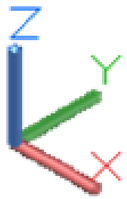
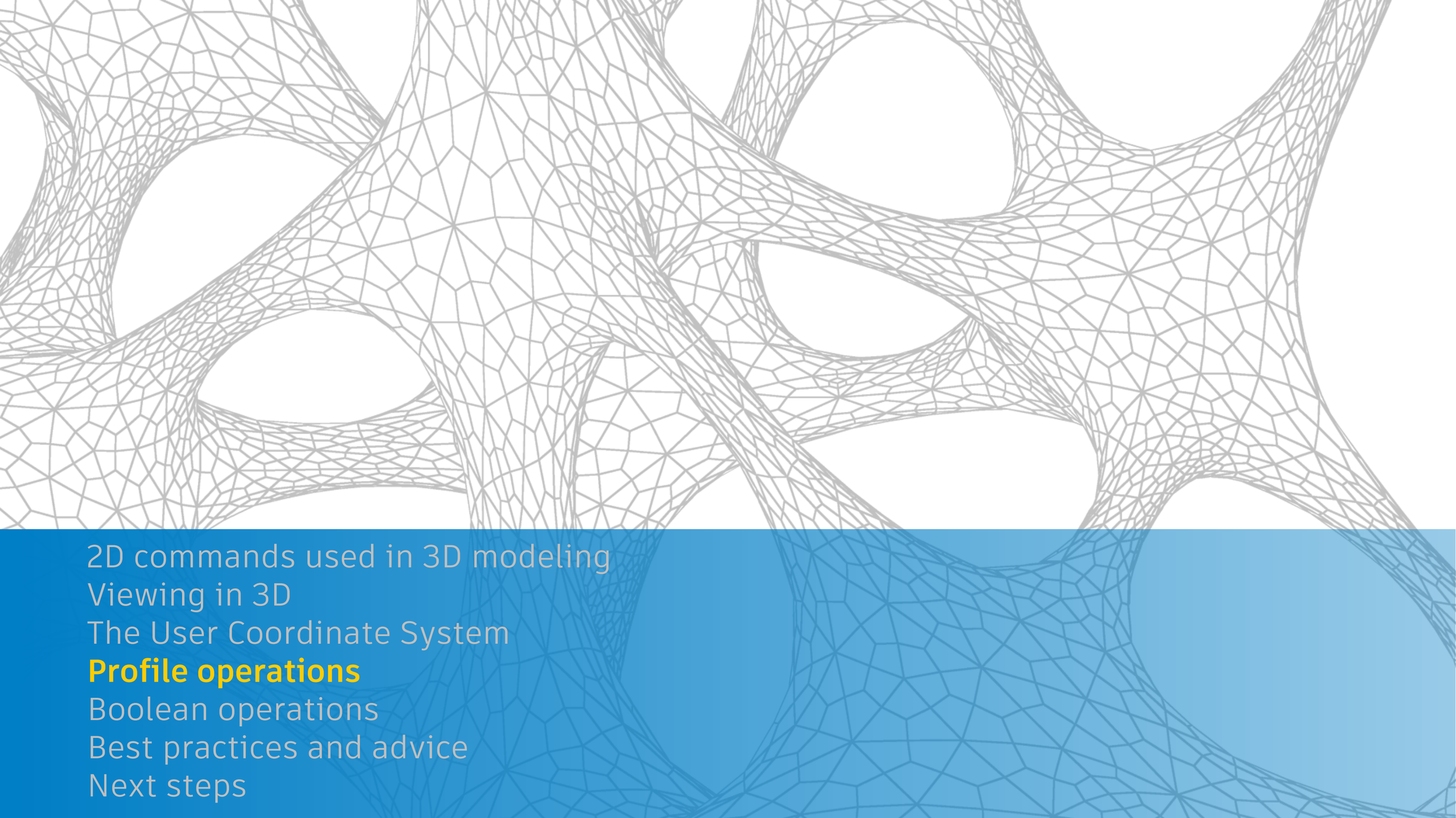


All other VS



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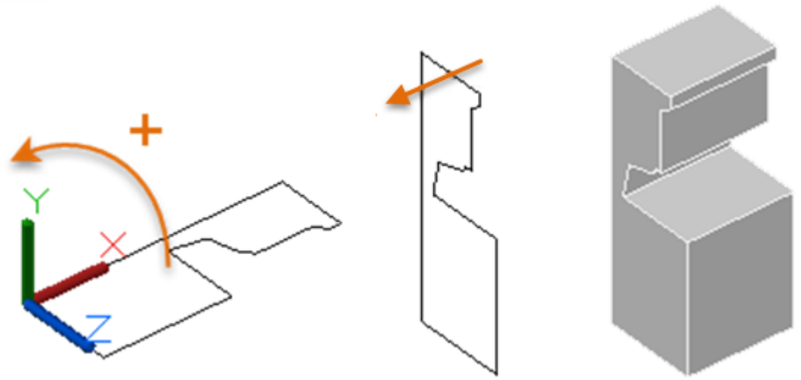
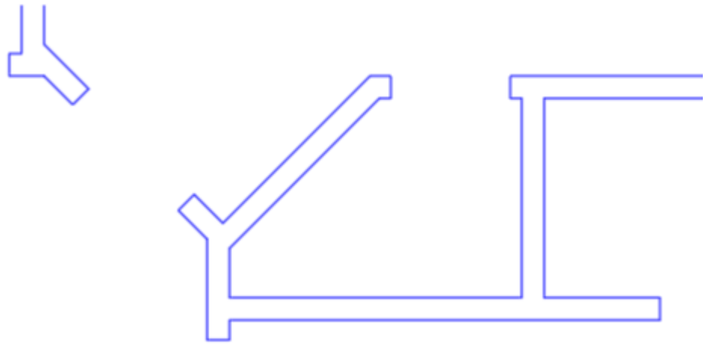
Profile operations

- EXTRUDE Direction /Path
  - Select closed objects
  - Rules for positive direction



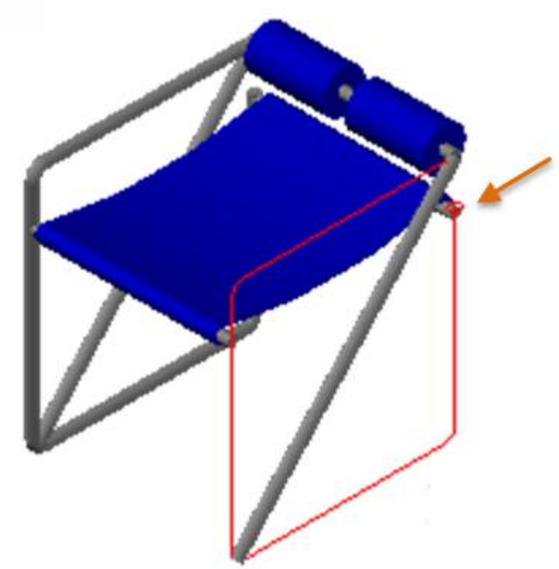
Tip: Work in isometric views



Tip: Limit boundary complexity

Profile operations

- EXTRUDE Direction /Path
  - Profiles need to be aligned to path or use SWEEP
  - Use 2D polyline paths for fillets



Profile operations

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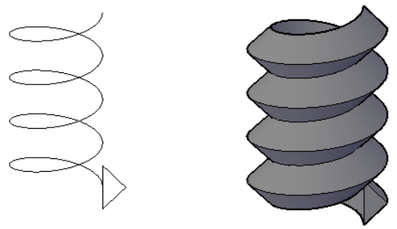
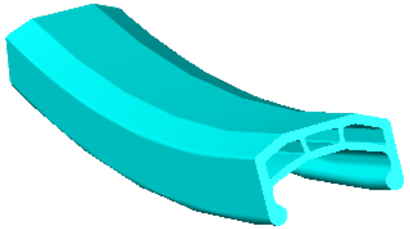


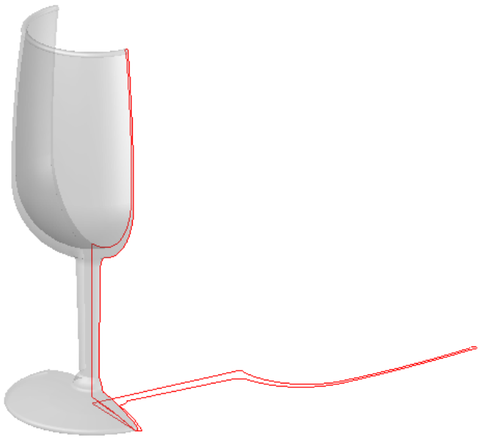
Tip: Use EXTRUDE /Path to create threads

Tip: Use the FACETRES system variable to smooth facets

Profile operations

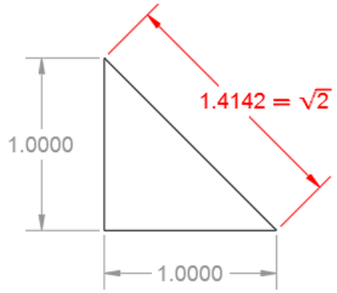
- EXTRUDE Direction /Path
- REVOLVE (axis)





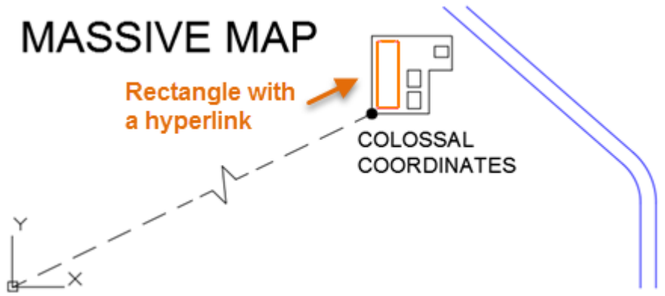
Profile operations

- EXTRUDE Direction /Path
- REVOLVE (axis)



Tip: Set DELOBJ = 0 to retain profile geometry

- Why? (1) Reference, (2) Revisions, and (3) Precision
- Keep profiles on separate reference layers
- Choose a distinctive color for profiles



Working with Large Coordinates in AutoCAD | AutoCAD Blog | Autodesk
blogs.autodesk.com/autocad/working-large-coordinates-in-autocad/ ▾
Sep 29, 2017 - AutoCAD expert Dieter Schlaepfer details best practices for **working with large coordinates in AutoCAD**. Make the most of your precision ...

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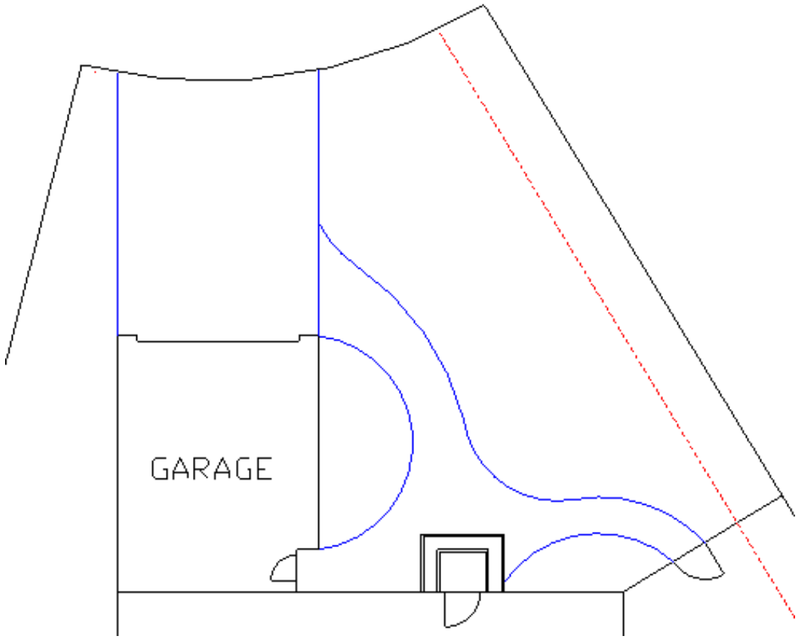
Boolean operations

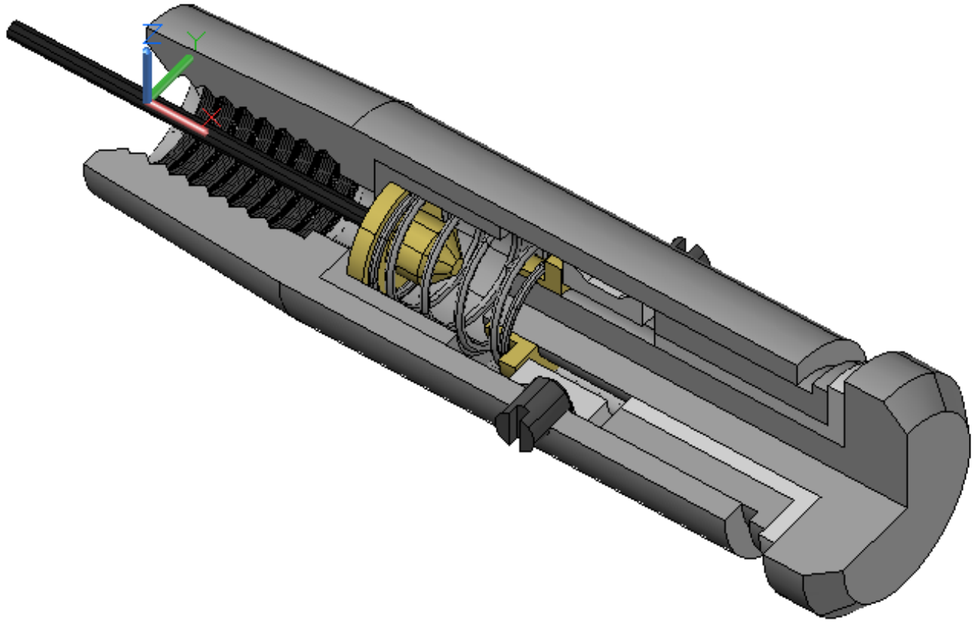
- UNION
- SUBTRACT
- INTERSECT



EXTRUDE, UNION, MASSPROP

Boolean operations

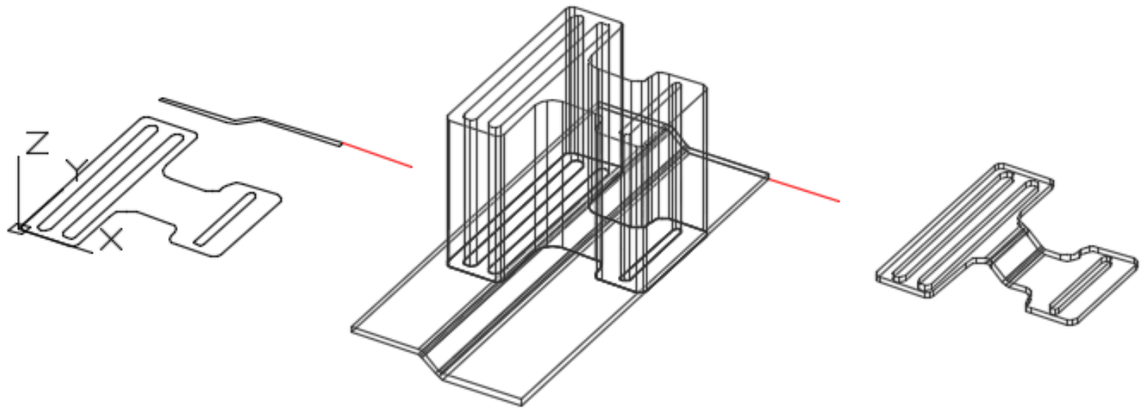
- UNION
- SUBTRACT
- INTERSECT



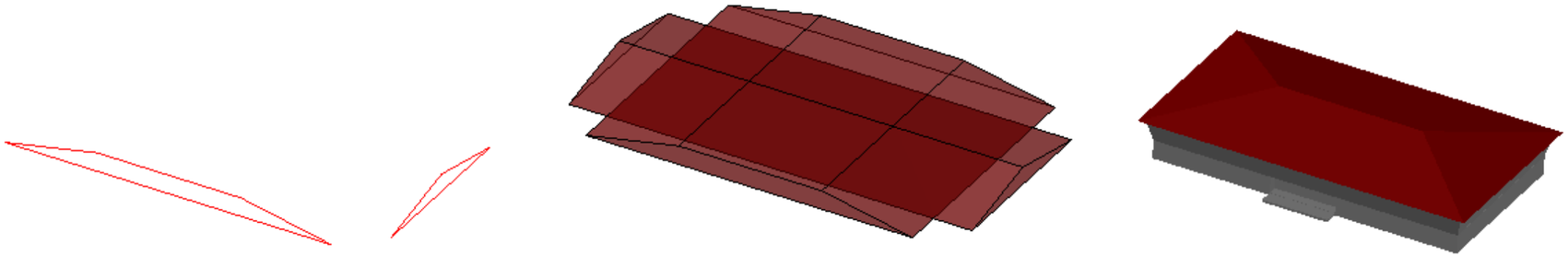
REVOLVE, EXTRUDE, SUBTRACT, GROUP

Boolean operations

- UNION
- SUBTRACT
- INTERSECT



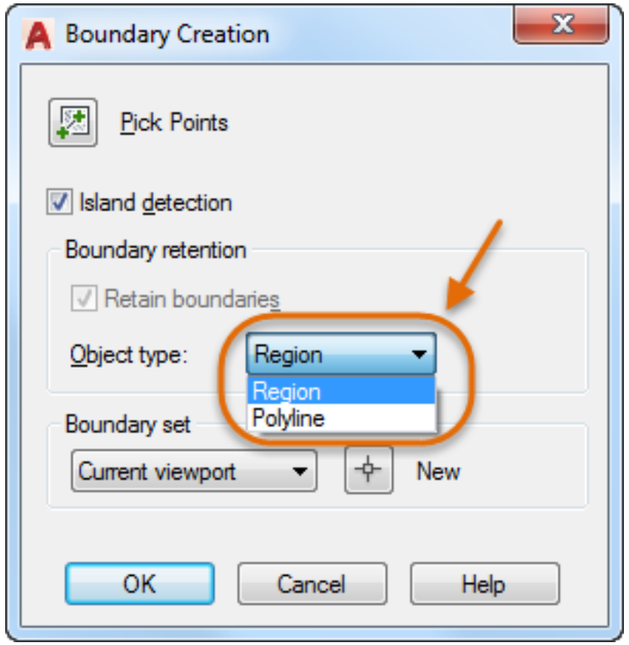
UCS ZA, ROTATE, EXTRUDE, INTERSECT

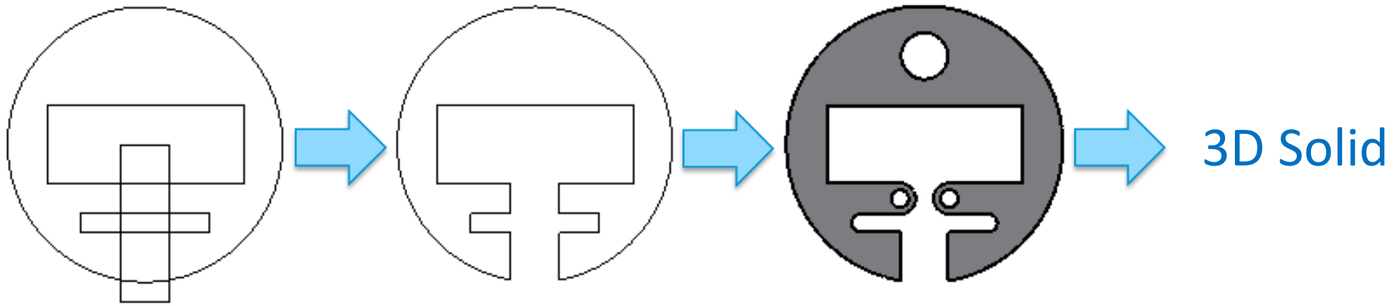


Boolean operations - Bonus

- BOUNDARY, REGION
- 2D Boolean operations

Tip: Use a wireframe visual style for easy selection





Geometry

Boundary (Region)

Boolean Operations

Quiz

- Viewing commands
- UCS commands
- Profile operations
- Boolean operations

Quiz

- Viewing commands – 3DORBIT, PLAN
- UCS commands
- Profile operations
- Boolean operations

Quiz

- Viewing commands – 3DORBIT, PLAN
- UCS commands – UCS, UCSICON
- Profile operations
- Boolean operations

Quiz

- Viewing commands – 3DORBIT, PLAN
- UCS commands – UCS, UCSICON
- Profile operations – EXTRUDE, REVOLVE
- Boolean operations

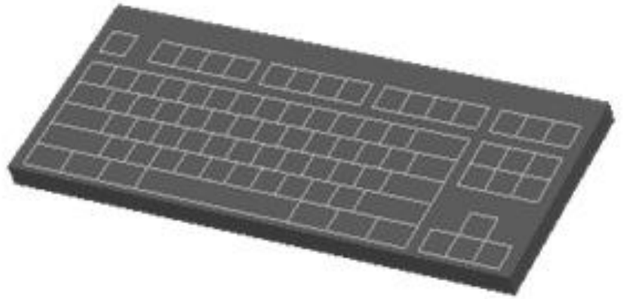
Quiz

- Viewing commands – 3DORBIT, PLAN
- UCS commands – UCS, UCSICON
- Profile operations – EXTRUDE, REVOLVE
- Boolean operations – UNION, SUBTRACT, INTERSECT

2D commands used in 3D modeling
Viewing in 3D
The User Coordinate System
Profile operations
Boolean operations
Best practices and advice
Next steps

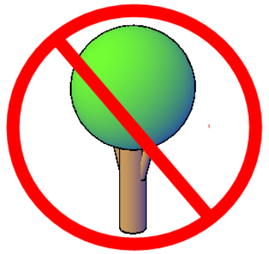
Best practices and advice

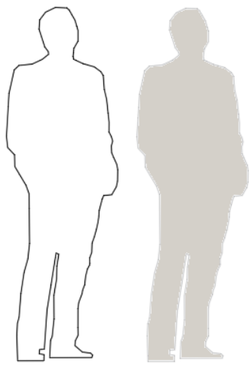
- Learn with simple models, become comfortable with the 9 commands
- Use layers to manage visual complexity
- Create and retain 2D profiles (set DELOBJ to 0)
- Move and rotate 2D profiles and 3D objects into place
- Check and recheck distances and dimensions
- Limit the detail to what is justified for your goals

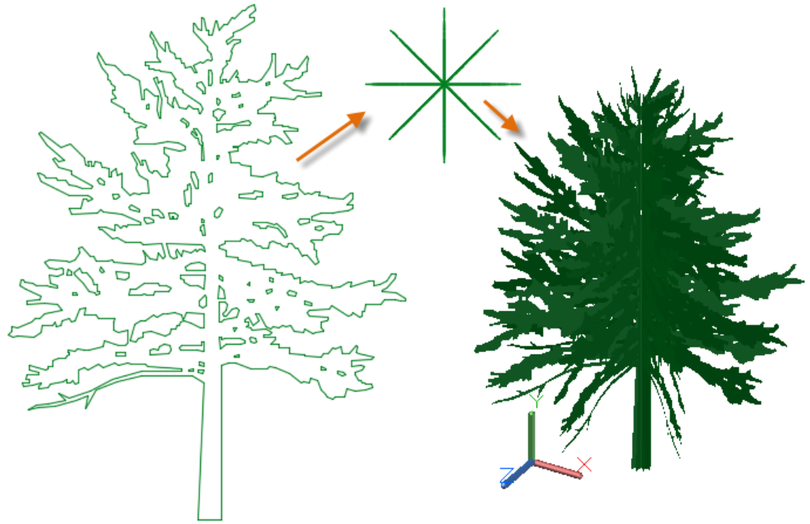


Best practices and advice

- Delay filleting to preserve sharp corners for measuring and locating
- Use GROUP to associate objects that you don’t want to UNION
- Create blocks from repetitive objects to reduce DWG size
- Save a version of a model at each stage so you can revert
- 3D landscaping – purchase and insert as blocks
- People – outline or transparent extrusion







2D commands used in 3D modeling
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Next steps

- Submit feedback survey
- Download the class presentation, notes, and drawing files
- Review this presentation **ASAP** when you get home
- Create some simple models, try things with the 24 class models
- Review the Further Study section in the class handout
- Explore the 3D Basics ribbon workspace
- Experiment and have fun!

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