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)
- ConvertToSolid (Command)
- ConvertToSurface (Command)
- Cylinder (Command)
- EXPORT (Command)
- Extrude (Command)
- FlatShot (Command)
- Hide (Command)
- Interferes (Command)
- Intersect (Command)
- LiveSection (Command)
- MassProp (Command)
- Mirror3d (Command)
- OffsetEdge (Command)
- Plan (Command)
- PressPull (Command)
- ProjectGeometry (Command)
- Pyramid (Command)
- Regen3 (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)
- OBSCUREDTYPE (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)
- VSBACKGROUND (System Variable)
- VSEDGECOLOR (System Variable)
- VSEDGEJITTER (System Variable)
- VSEDGELEX (System Variable)
- VSEDGEVHANG (System Variable)
- VSEDGES (System Variable)
- VSEDGESMOOTH (System Variable)
- VSFACECOLORMODE (System Variable)
- VSFACEHIGHLIGHT (System Variable)
- VSFACEOPACITY (System Variable)
- VSFACESTYLE (System Variable)
- VSHALOGE (System Variable)
- VSINTERSECTIONCOLOR (System Variable)
- VSINTERSECTIONEDGES (System Variable)
- VSINTERSECTIONTYPE (System Variable)
- VSISSONTOP (System Variable)
- VSLIGHTINGQUALITY (System Variable)
- VSMATERIALMODE (System Variable)
- VSMONOCOLOR (System Variable)
- VSREFERENCECOLOR (System Variable)
- VSREFERENCECOLOR (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.
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🌟 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
2D commands used in 3D modeling

**Viewing in 3D**

The User Coordinate System
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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
2D commands used in 3D modeling
Viewing in 3D

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The User Coordinate System

- What is it?
The User Coordinate System

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- What’s it for?
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  - Orientation - Construction plane for creating 2D objects
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  - Orthogonal directions - X, Y, Z for direct distance entry, Ortho mode
The User Coordinate System

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- **What’s it for?**
  - **Orientation** - Construction plane for creating 2D objects
  - **Orthogonal directions** - X, Y, Z for direct distance entry, Ortho mode
  - **Rotation axis** - The Z axis is the “hinge” for rotation, right-hand rule
The User Coordinate System

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Tip: Turn off dynamic UCS by setting UCSDETECT = 0 [F6]
The User Coordinate System

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  - 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

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  - 3P (default) – Locates the XY construction plane
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Tip: Enter UCS ZA, and UCS W (Enter) directly at the Command prompt
The User Coordinate System

- What is it?
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- 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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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

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

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
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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 → 3D Solid
Quiz

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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
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Next steps
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!