the ABC’s of AutoCAD Mechanical

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Class summary

In this fast paced, rapid fire session we'll look at the things that make AutoCAD Mechanical special. We'll explore why you should be using it for your mechanical and manufacturing design and detailing including looking at the built-in calculators, component library, detailing and annotation tools, defining structure, and the other "nuts and bolts" contained within.

Key learning objectives

At the end of this class, you will be able to:

- Effectively use the AutoCAD Mechanical interface
- Create BOM, use balloons, perform dimensioning, and use other mechanical detailing tools
- Use Structure to define "smart" components within your 2D geometry
- Use the Mechanical geometry creation tools and advanced layer management to more quickly and efficiently create your manufacturing drawings

About Me

- CAD/CAM Engineering Technologist (1998)
- Application Specialist for IMAGINiT Technologies (1998 – 2010)
- Technical Services Manager for Prairie Machine & Parts (2010+)

- **Married – Father of 4 beautiful daughters (talk about time / project management)**

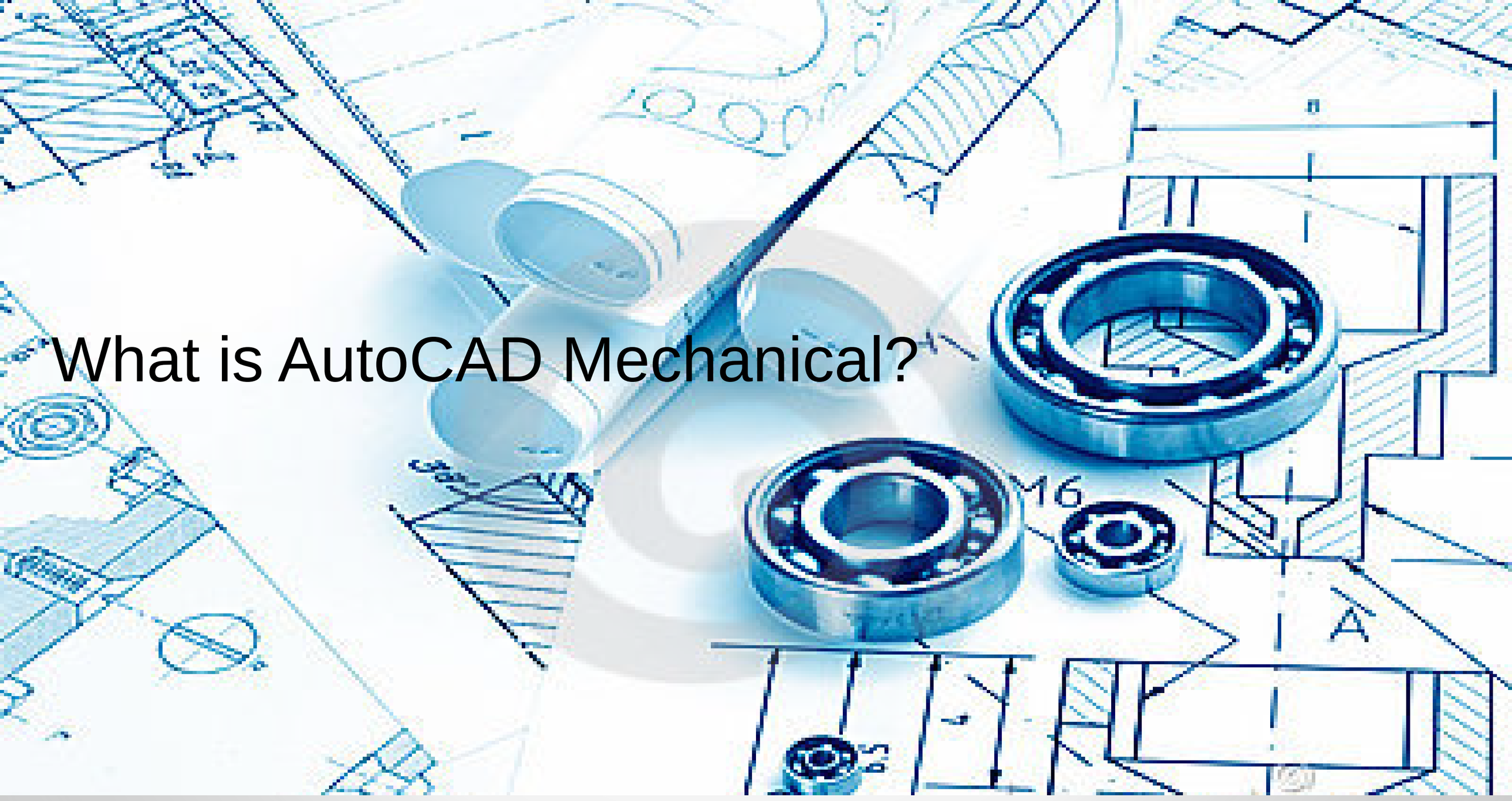


The ABC’s of AutoCAD Mechanical

A
B
C
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Z

What is AutoCAD Mechanical?



The ABC's of AutoCAD Mechanical

AutoCAD

B
C
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J
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L
M

AutoCAD Mechanical is based on AutoCAD meaning that everything you can do in AutoCAD you can do in AutoCAD Mechanical….

You might have to look for it or it may not be in the same location but its in there, somewhere

The ABC's of AutoCAD Mechanical

AutoCAD
B
C
D
E
F
G

History

I
J
K
L
M

- Initially released as an addition to Mechanical Desktop 2.0 (AutoCAD 2014) with one toolbar of extra "mechanical" functionality
- AutoCAD Mechanical 14.5 released with
  - Mechanical specific dimensioning tools
  - Mechanical Symbols (Welding, Surface Texture, etc)
  - Parts Lists and Balloon
- Autodesk acquired German based Genius and the fun began

"*Genius is a technology leader in mechanical applications for AutoCAD and Mechanical Desktop. For over 10 years, Genius has been developing software for Autodesk products, and since 1995 the company has been a vital member of Autodesk's Mechanical Applications Initiative*"



- Originally not included with Inventor it is now included with the various mechanically focused suites from Autodesk

Mechanical Design Productivity

- Mechanical drawing and detailing tools
- Extended draw toolbar for manufacturing

Mechanical Design Productivity

AutoCAD
B

Centerlines & **C**onstruction Lines

D
E
F
G
History

Jnfer Constraint Integration

J
K
L
M
N

P**O**owerSnaps

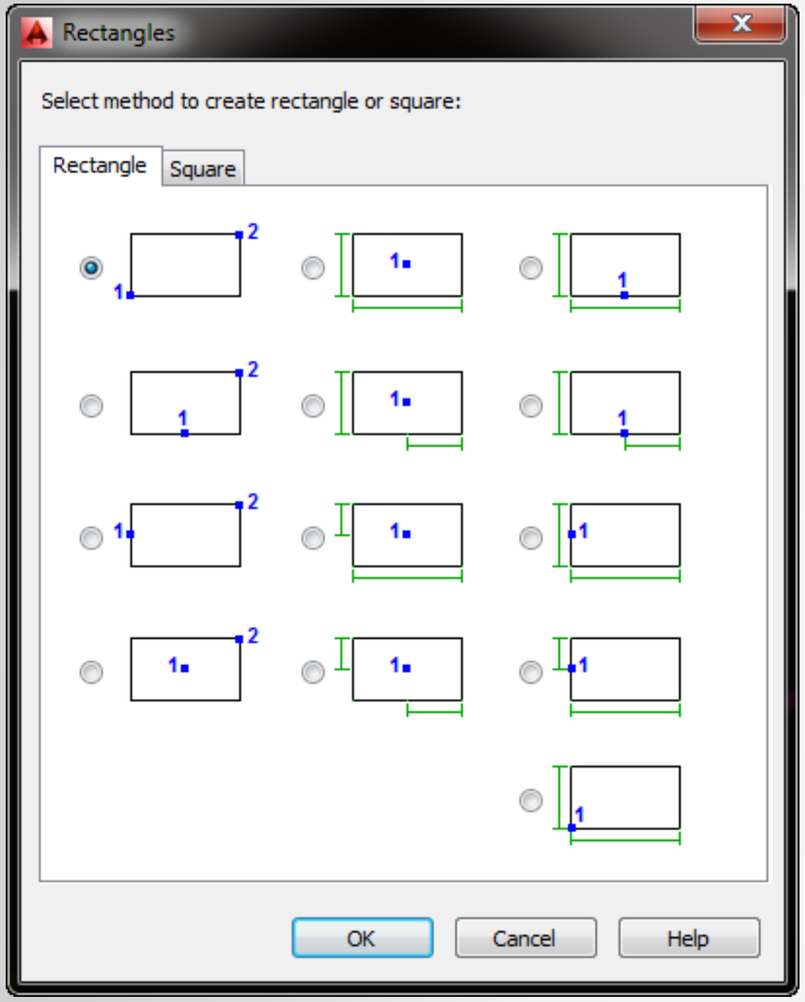
P
Q
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Xtended Functionality

Y

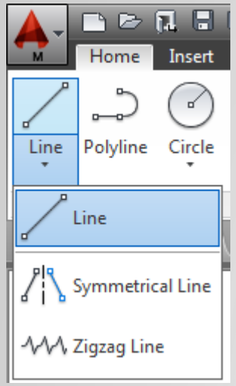
ZigZag & other special lines

Rectangle



AutoCAD provides one method to create a rectangle (two corners)… AutoCAD Mechanical expands this to over **13-options**!

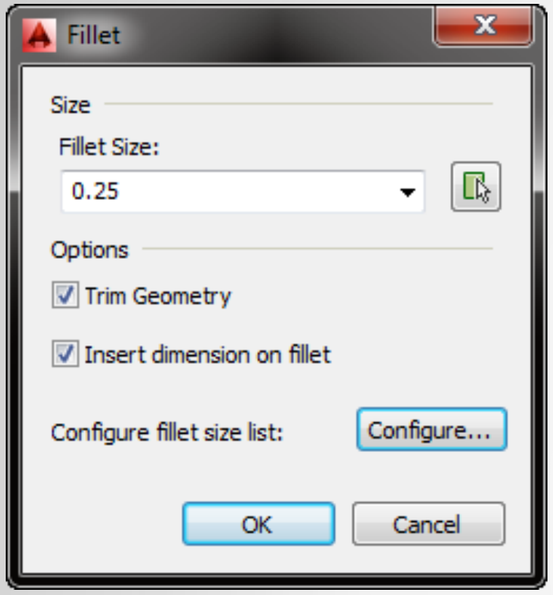
Symmetrical & Zizag Lines



Zigzag Line – Draws a Zigzag line placed on the appropriate Layer

Symmetrical Line – After creating / specifying the center line mirrors the newly created polyline segments about the centerline

Fillets & Chamfers



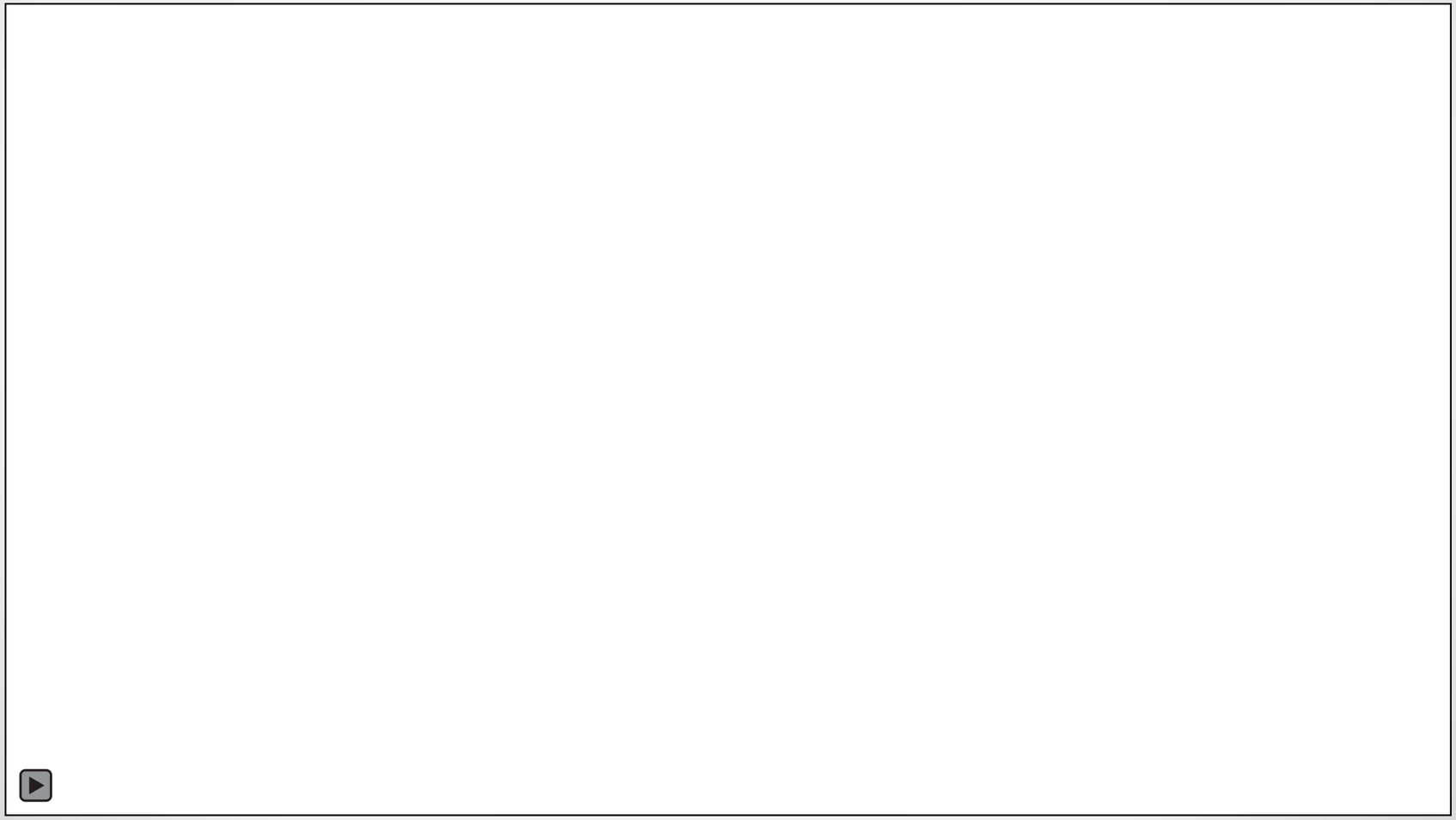
ACM takes standard fillet and chamfer functionality and:

- makes the configuration and usage dialog driven
- makes resizing easy via a double-click
- provides an option to only trim out part of the selected geometry

AMJOIN

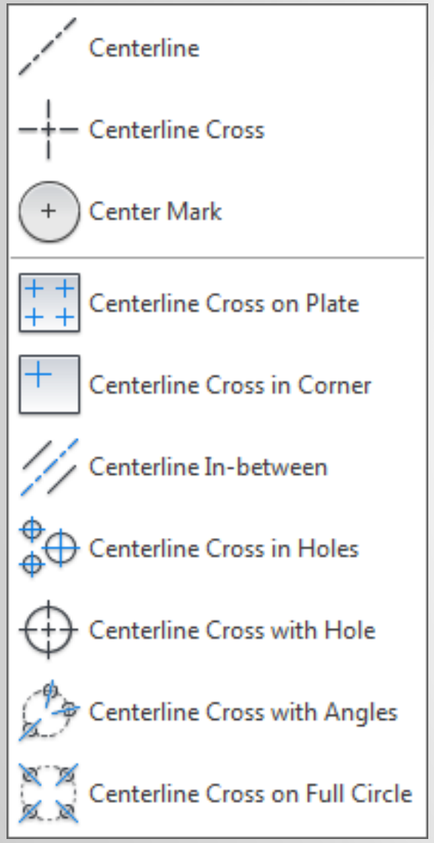
Similar to the AutoCAD join feature but provides its own workflows and options…

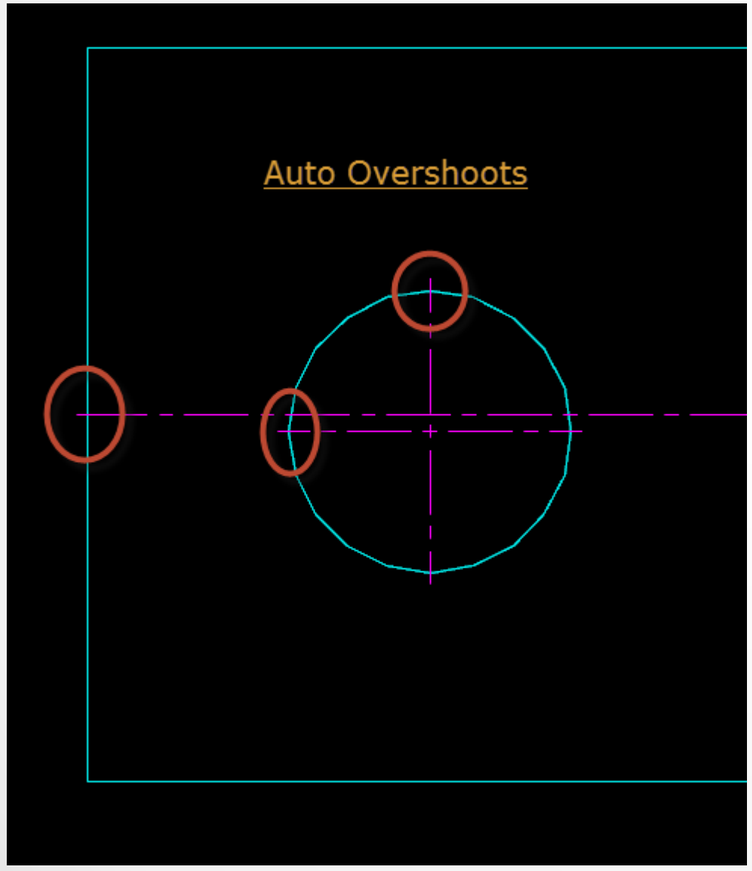
"*You can also join overlapping entities to form a single element. When overlapping entities join to form a single element, the "overlapped" line draws only once during plotting, preventing the plotter pen from tearing the paper."*

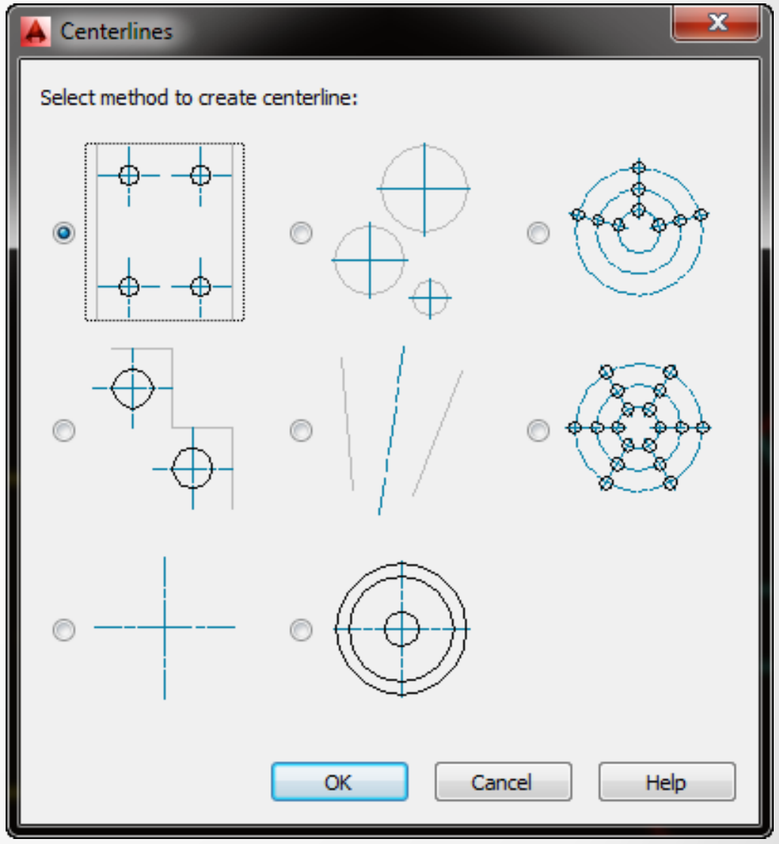


Centerlines

Generate centerline objects that are automatically placed on the centerline layer with appropriate offsets.



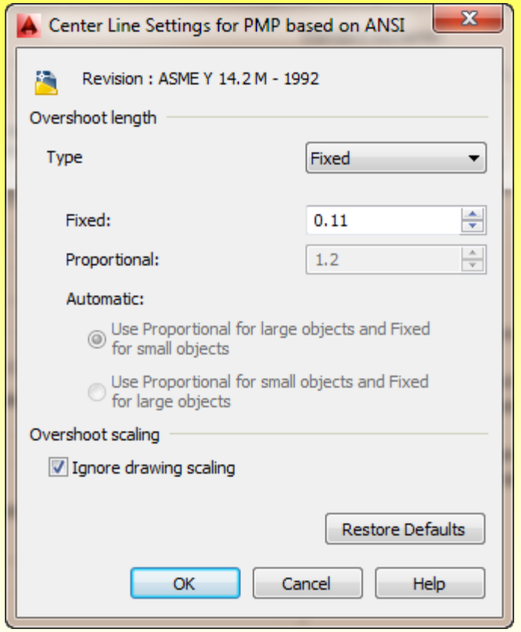




Centerlines

Generate centerline objects that are automatically placed on the centerline layer with appropriate offsets from the points or objects selected / snapped too.

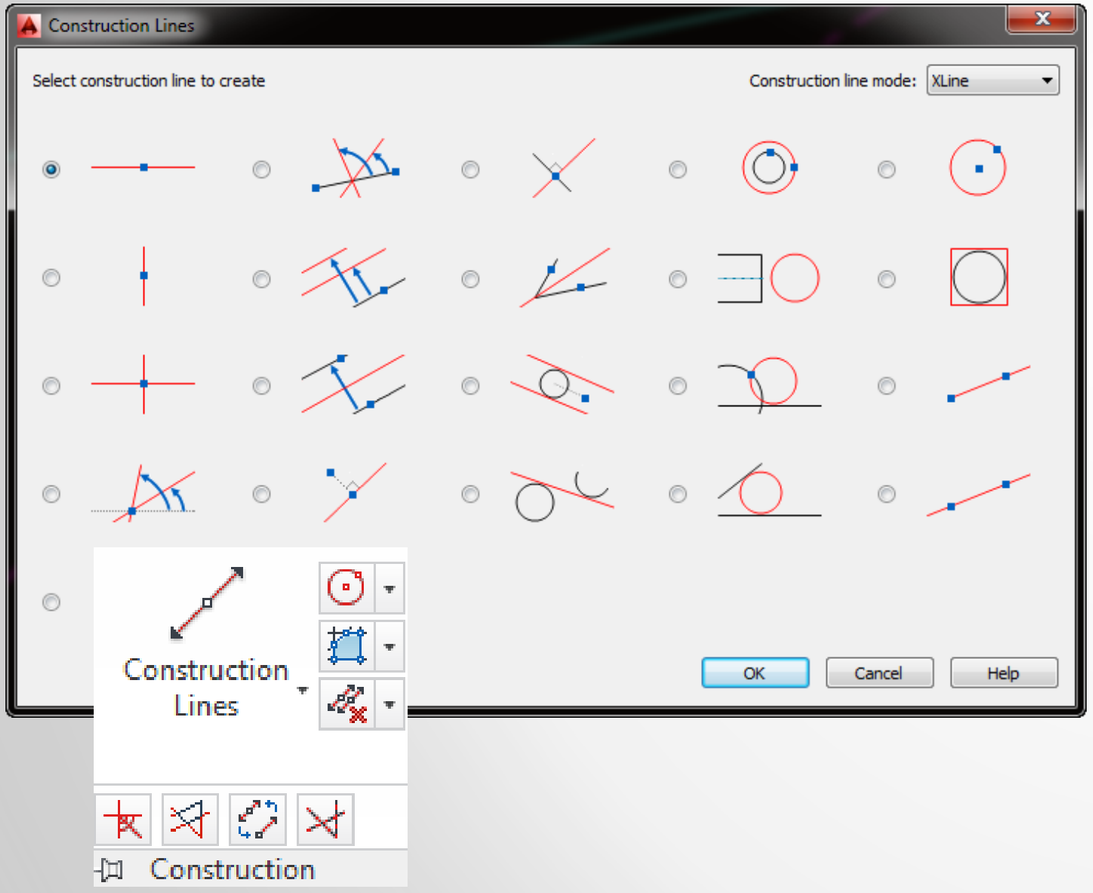
Configurable within the standards



Construction Lines

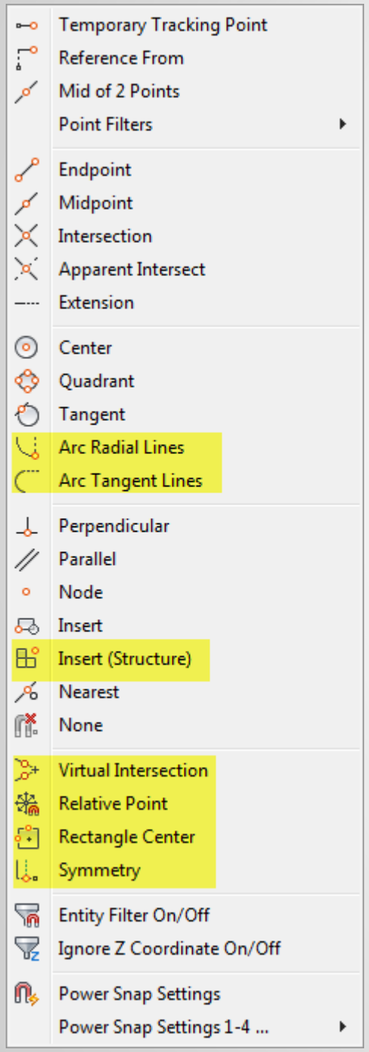
ACM provides a set of tools to

- quickly generate xlines and rays for mechanical application
- quickly turn off / on and delete the construction lines

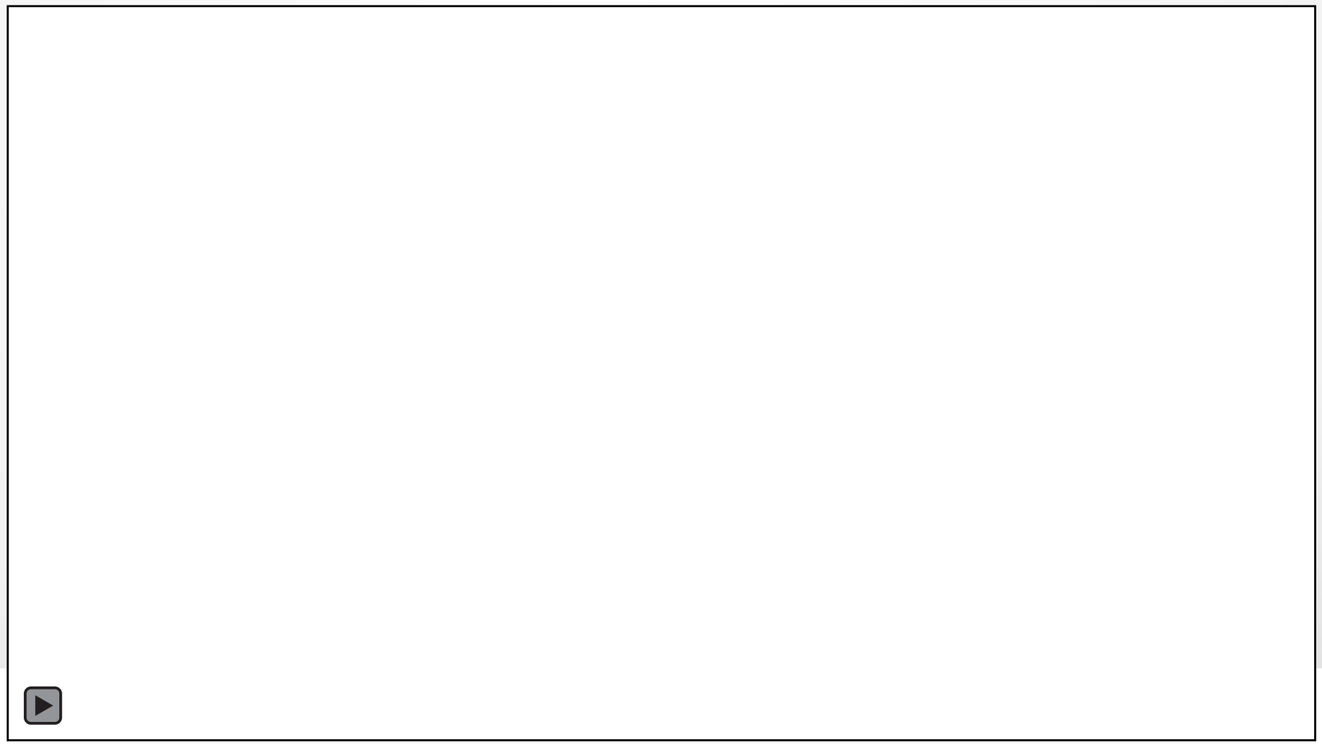


Power Snaps

ACM expands on AutoCAD's Object Snaps by… adding additional snapping options

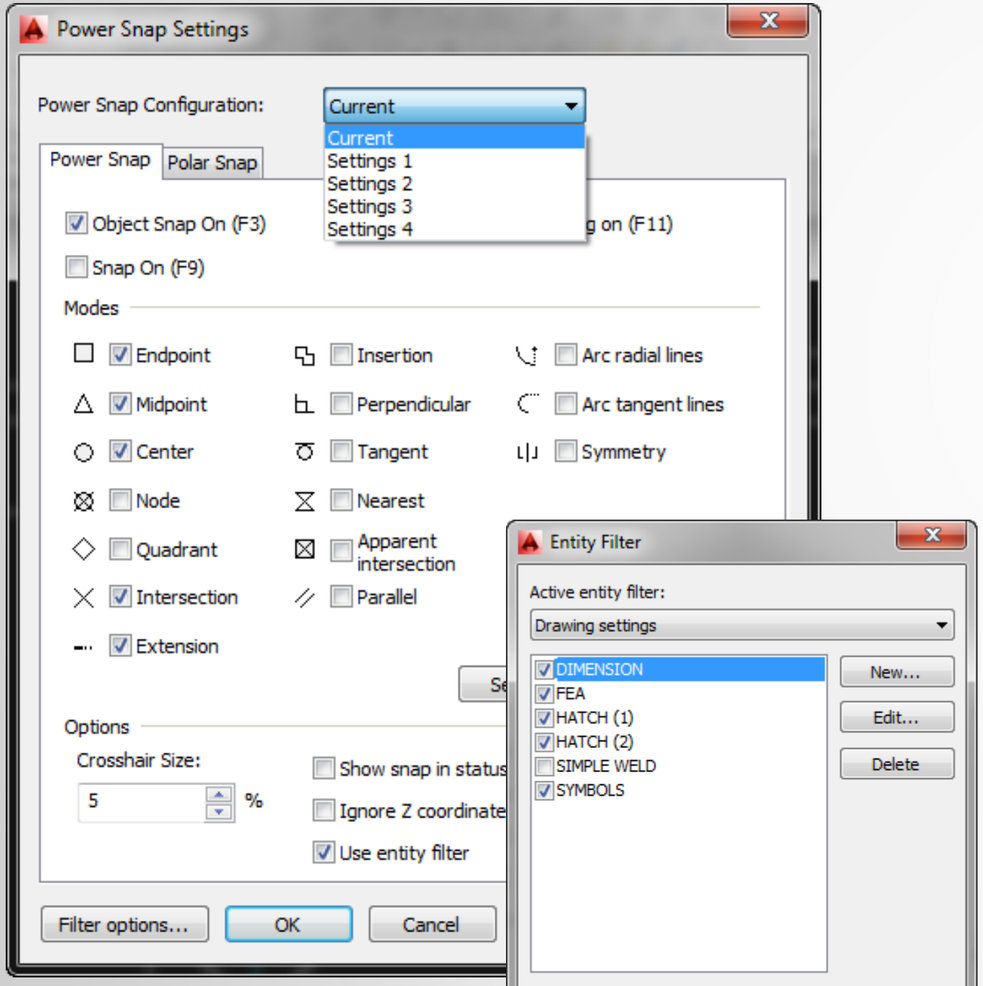


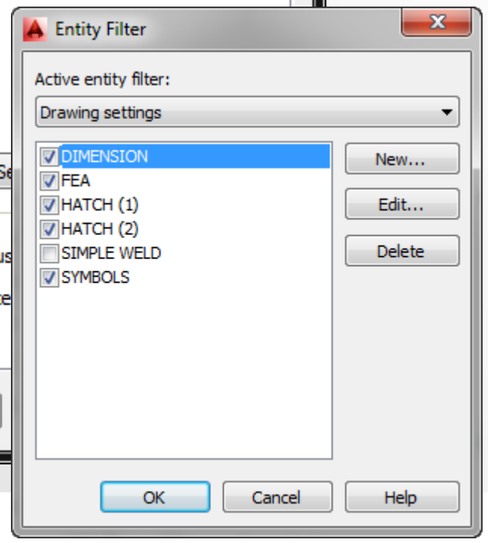
- **Rectangle Center** – pick two sides of a rectangle (or lines) and it prompts for the offset amount (default is half)
- **Virtual Intersection** – Snaps to the "virtual" intersection, the extension of two lines. Works by picking two lines
- **Arc Radial & Arc Tangent** – for working with arcs, snapping to a point on the phantom line that passes through an arc center point and one of the arc endpoints.
- **Relative Point** - Define a point relative to the last used point

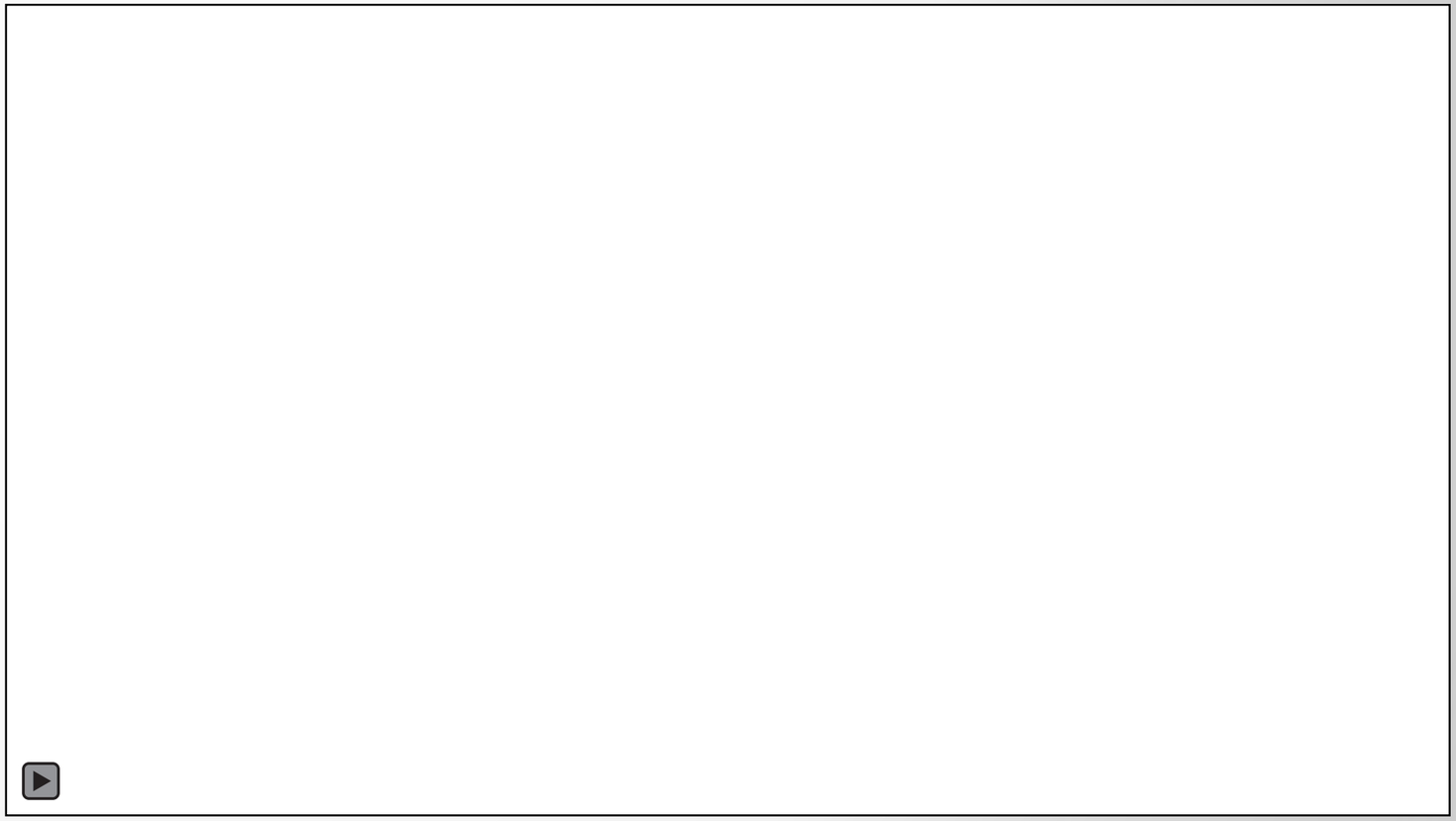


Power Snaps

ACM expands on AutoCAD's Object Snaps by… giving the ability to save "sets" of object snaps to set the available snaps and apply filters







Mechanical Design Productivity

Mechanical drafting standards

Mechanical Design Productivity

AutoCAD
B
Centerlines & Construction Lines
D
E
F
G
History
Infer Constraint Integration

JIS & Other International Standards

Killer Standards Management

Layer Management

M
N
pOwersnaps
P

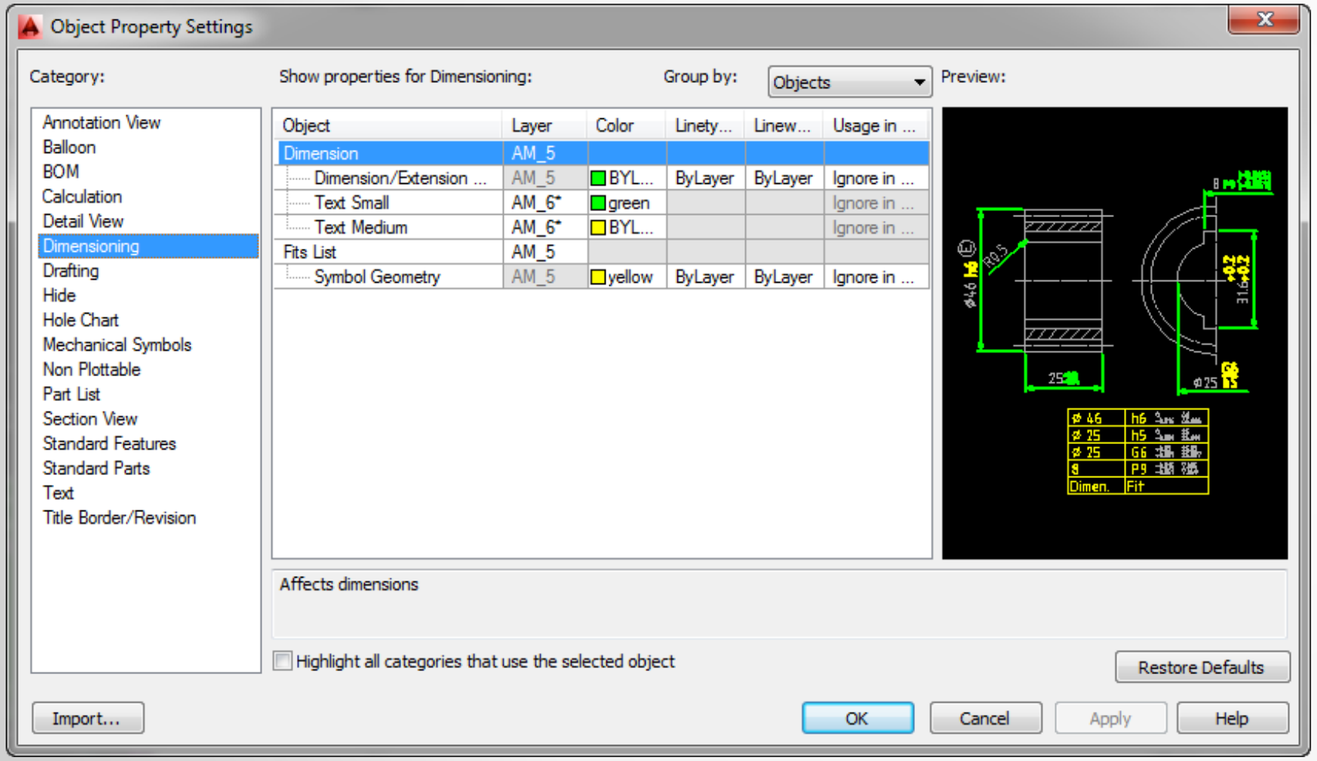
Quick Templates

R
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Xtended Functionality
Y
ZigZags

Standards Management

What's one of the most annoying things when working with AutoCAD?

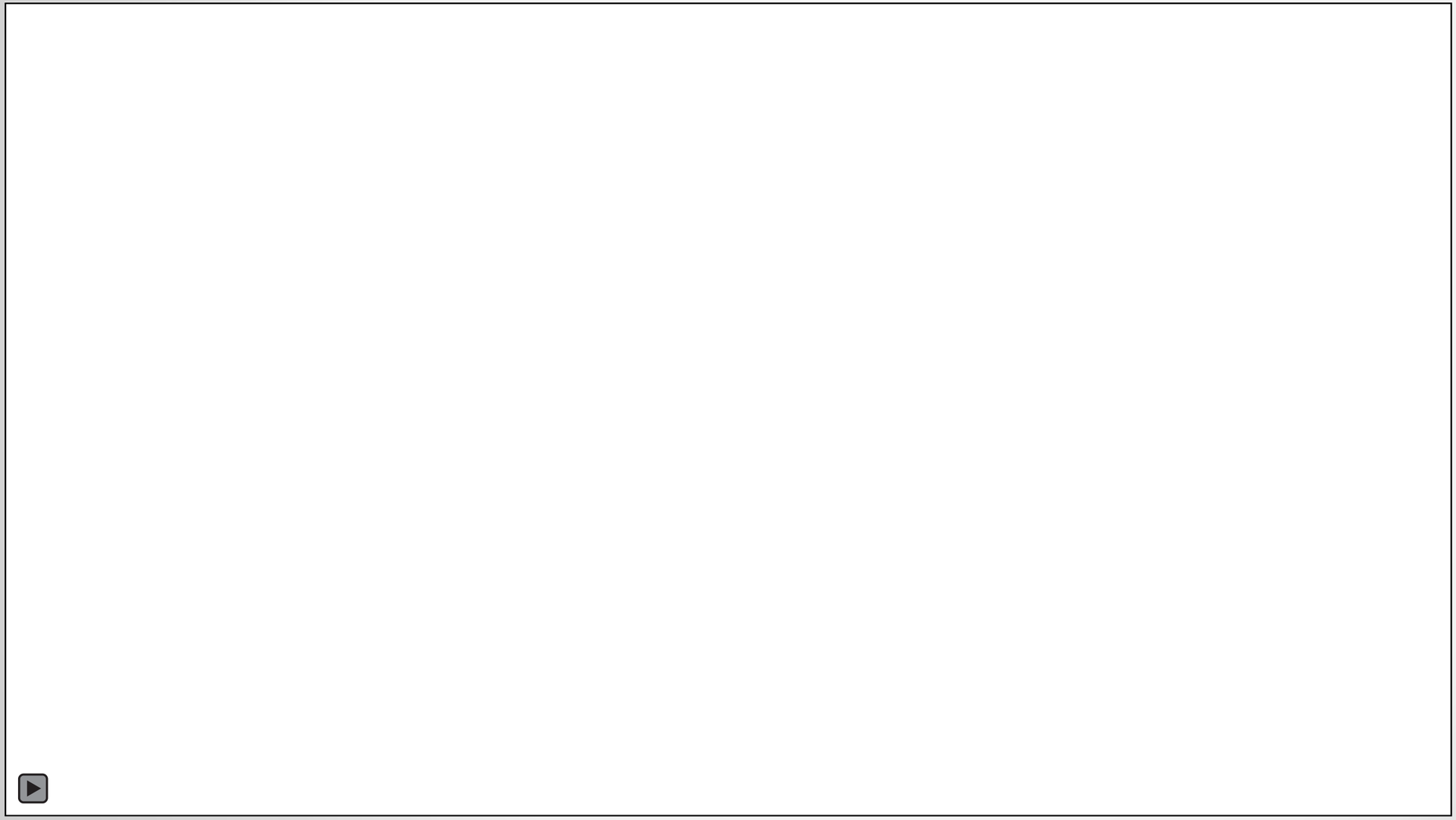
Creating objects on the wrong layer!... No more with ACM!



With ACM's Object Property Settings you define the layers and the objects that should automatically placed onto these layers!

Standards Management

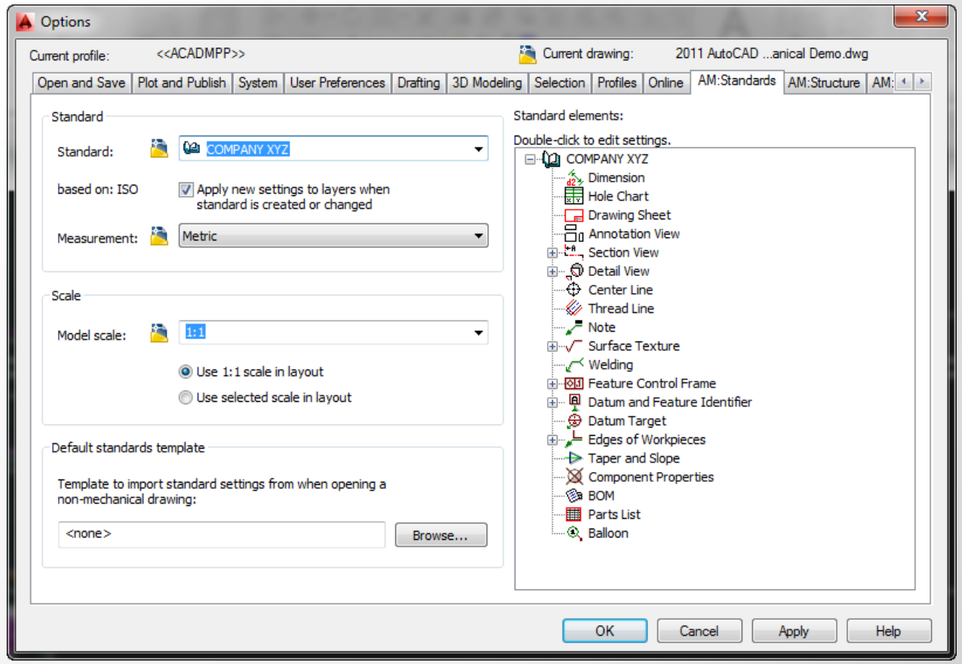
With ACM’s Object Property Settings you define the layers and the objects that should automatically placed onto these layers!



Standards Management

With ACM's Standards you can…

- Define multiple standards (think different customers, different standards like ansi vs iso, etc)
- Set a default template so that when any AutoCAD drawing is first touched by ACM the template configuration is automatically loaded
- Refresh the standards of a drawing at any time to match the template
- Control default settings like layers, dimension styles, text settings, and ACM specific entities like parts lists and balloons
- Quickly adjust the scale of the drawing updating all annotation objects (dimensions, text, leaders, linetype scale, etc)





Mechanical Design Productivity

Machinery generators and calculators

Mechanical Design Productivity

AutoCAD
B
Centerlines & Construction Lines
D
E

FEA

Gears
History
Infer Constraint Integration
JIS & Other International Standards
Killer Standards Management
Layer Management

Moment of Inertia & other calculators

Nuts & Bolts (Bolt Generator)

pOwersnaps

PowerCopy, PowerRecall, and PowerView

Quick Templates

Retaining Rings (Shaft Generator)

S
T

Unlimited Access to Content

V
W
Xtended Functionality
Y
ZigZags

Content, Content, Content…

AutoCAD Mechanical includes over 700,000 standard components…

- Features (Holes)
- Fasteners (Screws, Buts, Washers, etc)
- Shaft Parts (Bearings, Clips, Retaining Rings)
- Steel Shapes (HSS, Tubing, Pipe)

Content is easily adjusted after placing… just double click

Content Library is customizable, adjust what's there or add your own

Use Power View to quickly generate the different views of the component or feature

Content, Content, Content…



Screw Connections

Use the screw connection wizard to quickly create fastener assemblies

- Use to generate the holes, fastener, nuts, and washers required to bolt two plates together
- The wizard only shows components that you can combine (as in go together from a standards perspective)
- Save combinations for future use (making it quicker)
- The length of the fastener will be automatically selected based on your point selection, you will be warned if no suitable length is found
- Check Calculations can be performed to determine diameters

Power Erase will remove the screw connection (all components and features) and repair any geometry effected by the screw connection

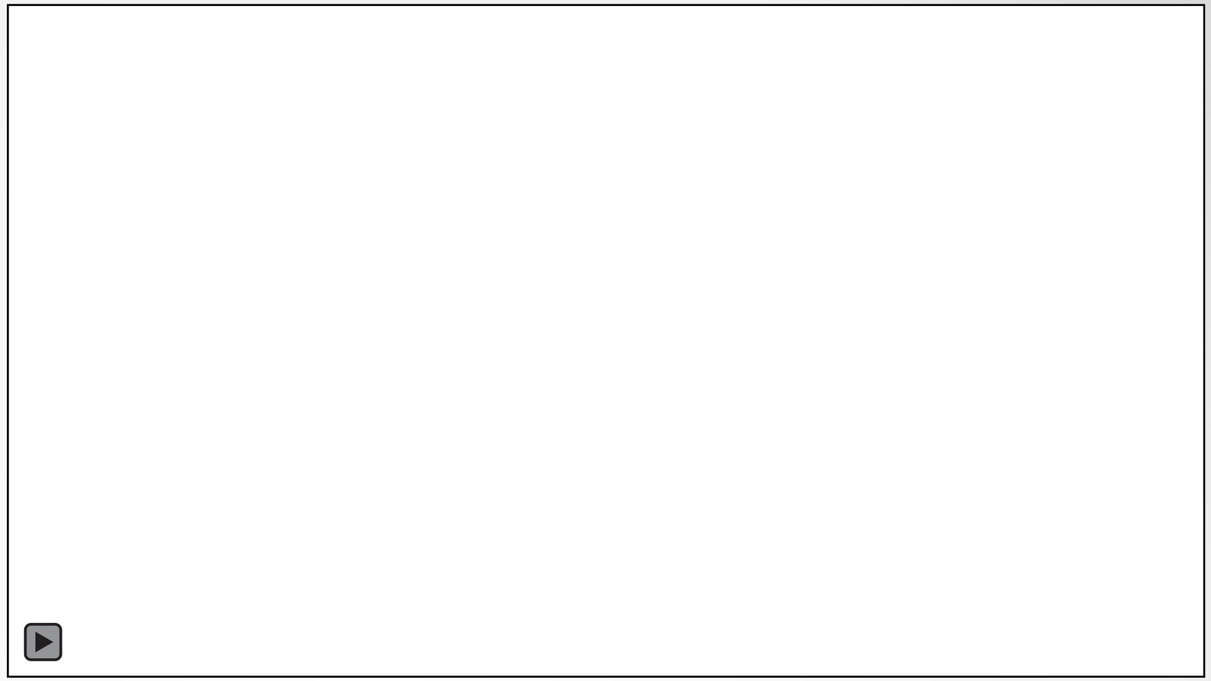
Screw Connections

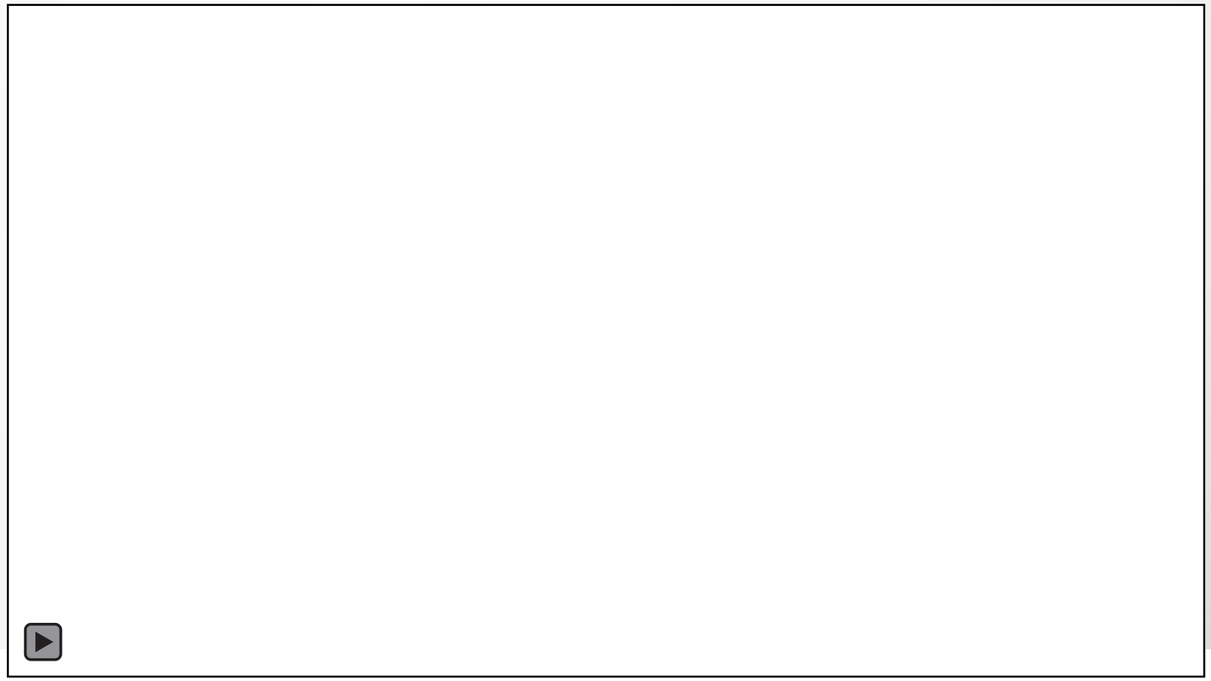
Use the screw connection wizard to quickly create fastener assemblies



Generators

- Screw Connection
- Shaft Generator
- CAM
- Springs
- Chains & Belts





Shaft Generator

Quickly build-up shafts using different sections which ACM positions automatically one after the other.

- Add cylindrical or conical sections, features (holes, chamfers / fillets, grooves, threads, profiles and wrench fittings) and standard parts (bearings, gears, retaining rings, seals, etc)
- Edit at any time via a double-click

Use the Shaft Calculator to calculate deflection lines, bending moments, torsion moments, and safety factors. Also can be used to determine shaft strength at selected points

Shaft Generator

Quickly build-up shafts using different sections which ACM positions automatically one after the other.



Calculations

Both standalone and built into the various generators to do…

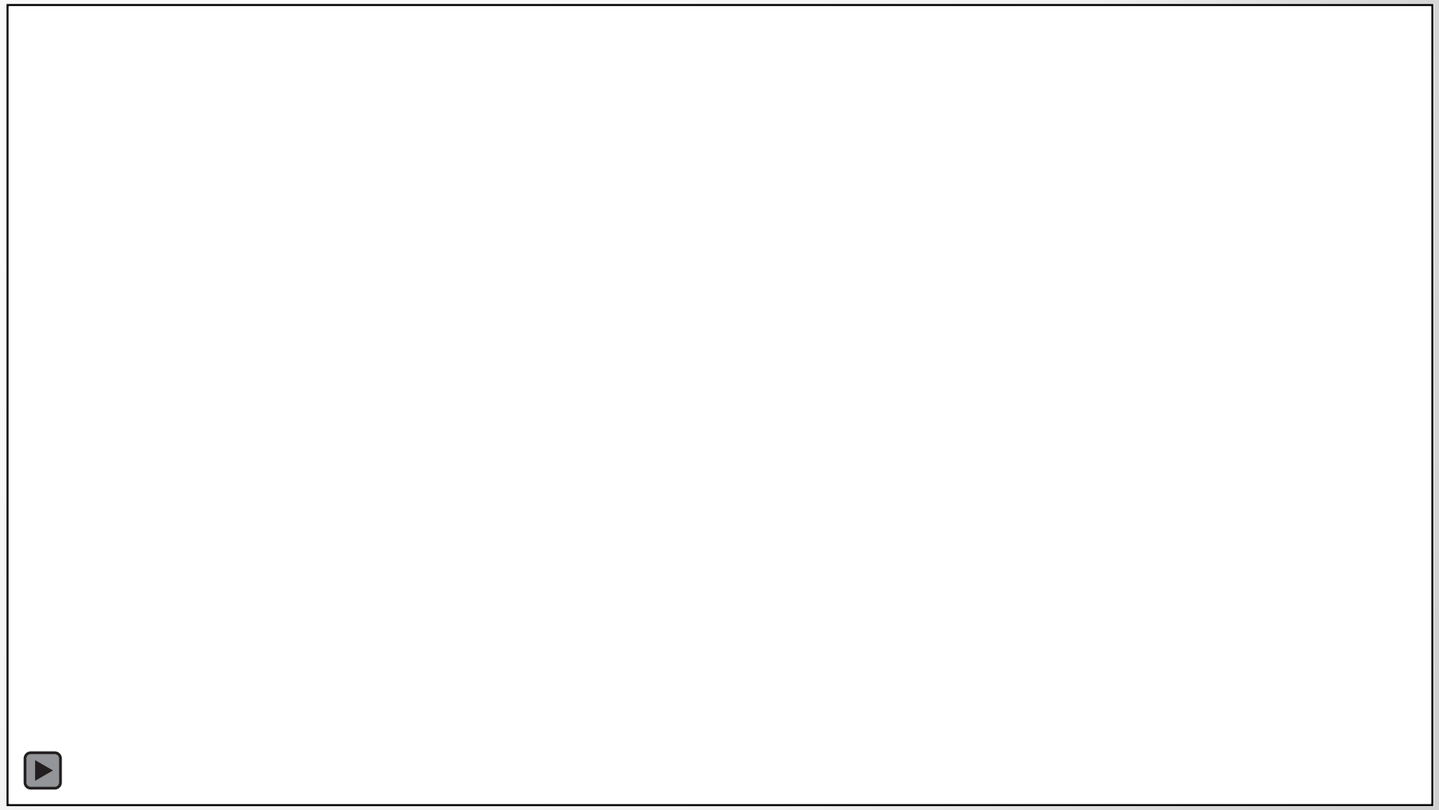
- FEA
- Moment of Inertia & Deflection Line
- Shaft, Bearing, & Screw Calculators
- CAM Design and Calculation

Moment of Inertia and Deflection Line

Moment of Inertia (MOI) calculates the moment of inertia of a closed shape (if you can hatch it you can do a MOI calculations). After specifying the cross section and the direction of the load force ACM computes the

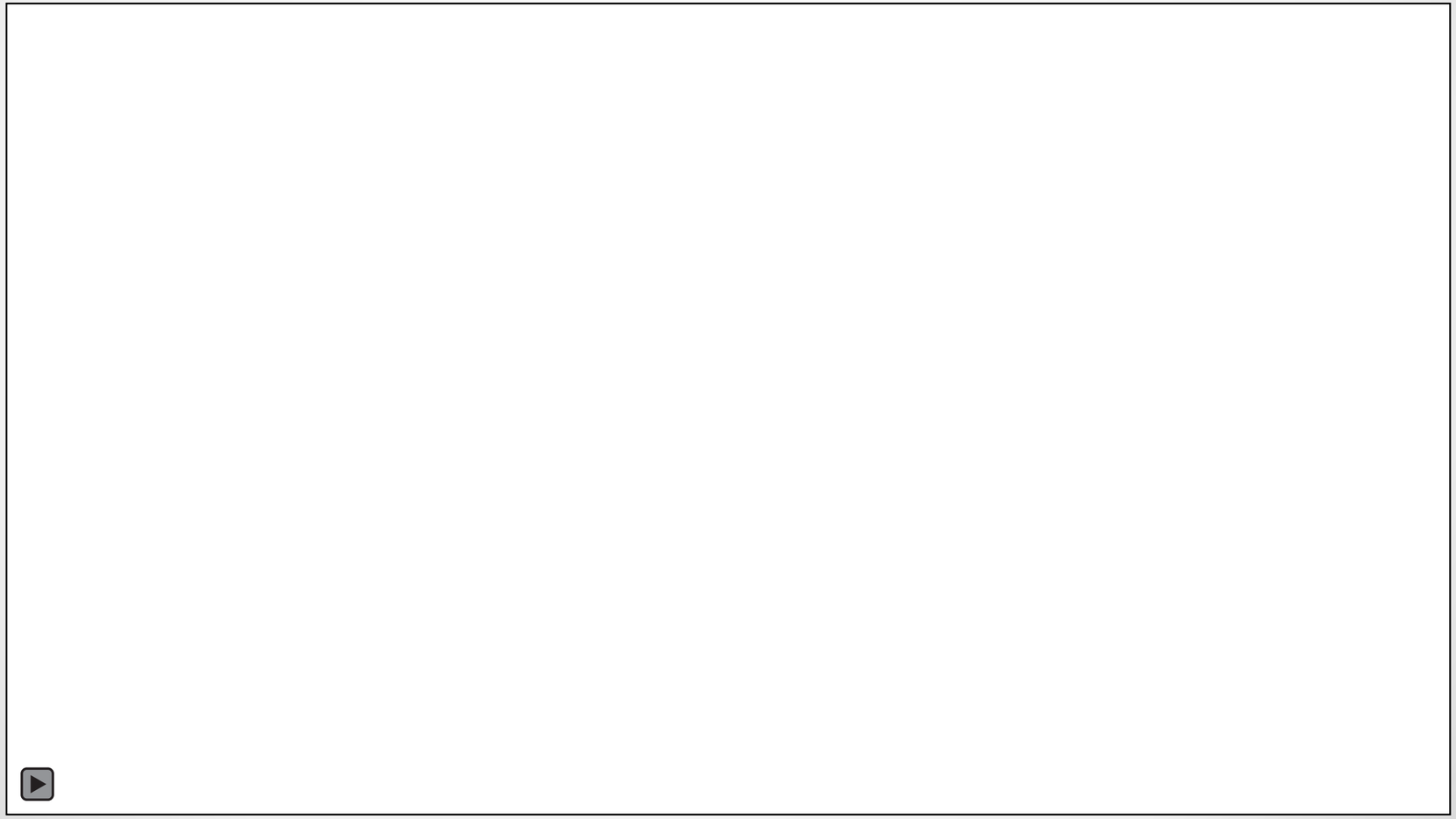
- location of the center of gravity
- direction of the main axes moment
- moments of inertial along both axes
- effective moment of inertia
- angle of deflection.

Deflection Line calculates & draws the deflection line / moment line of a beam that you've applied forces.



FEA

"Performs a Finite Element Analysis on a two dimensional object that is subject to a static load. ***Summary:*** *You can calculate stress and deformation in a plane for plates of a given thickness or in a cross section with individual forces and stretching loads."*



Mechanical Engineering Documentation

Mechanical Design Productivity

AutoCAD

BOM’s & Balloons

Centerlines & Construction Lines

Dimensions

Edge Symbols & Other Symbology

Fits Lists & Hole Charts

Gears

Hide Situations

Infer Constraint Integration
JIS & Other International Standards
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S
T
Unlimited Access to Content

Views

Welding

Xtended Functionality

s**y**nergy for Mechanical Engineering

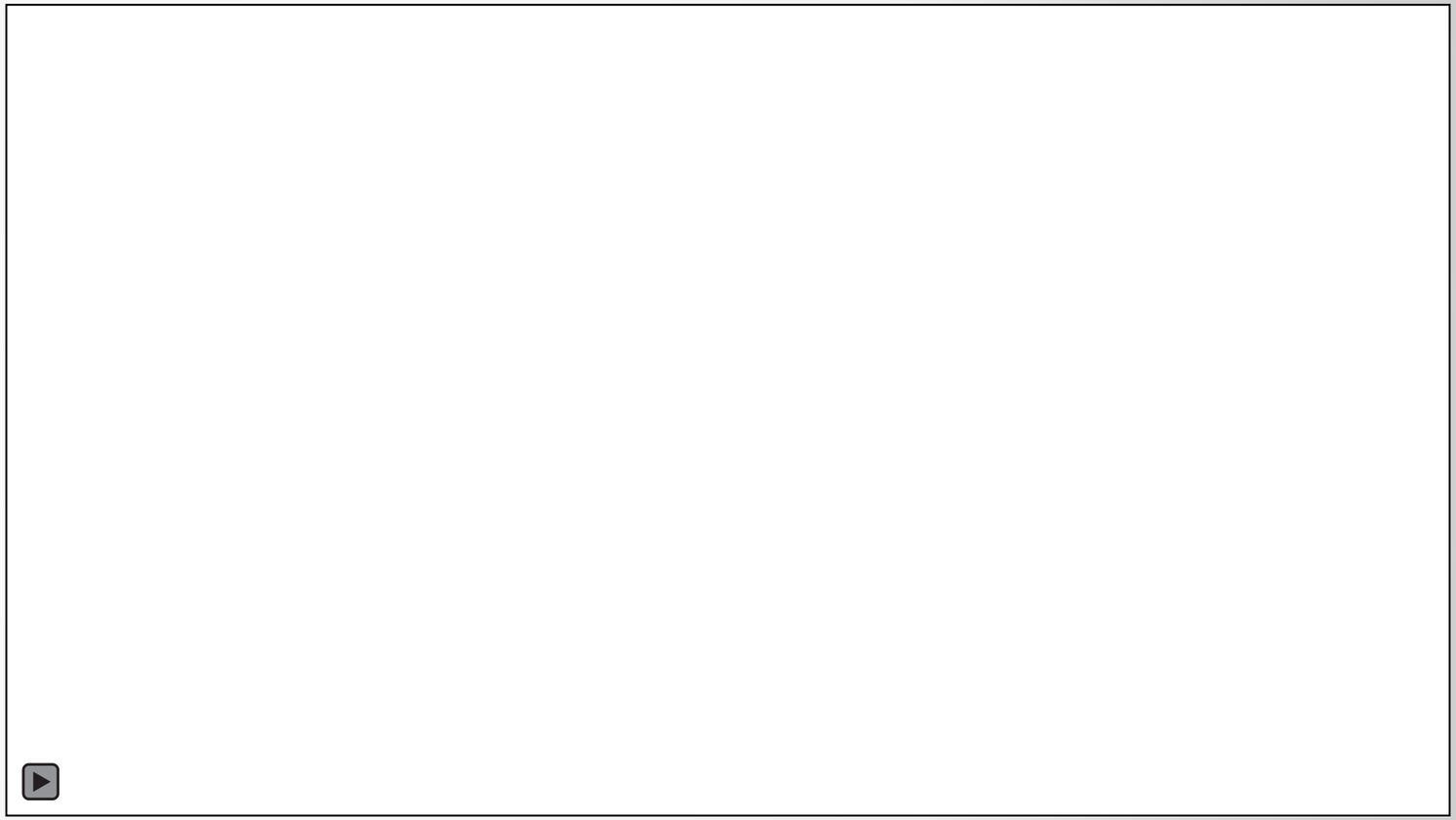
ZigZags

Power Dimensioning

An Autodesk Study showed that placing dimensions with AutoCAD required twice as much time as with ACM

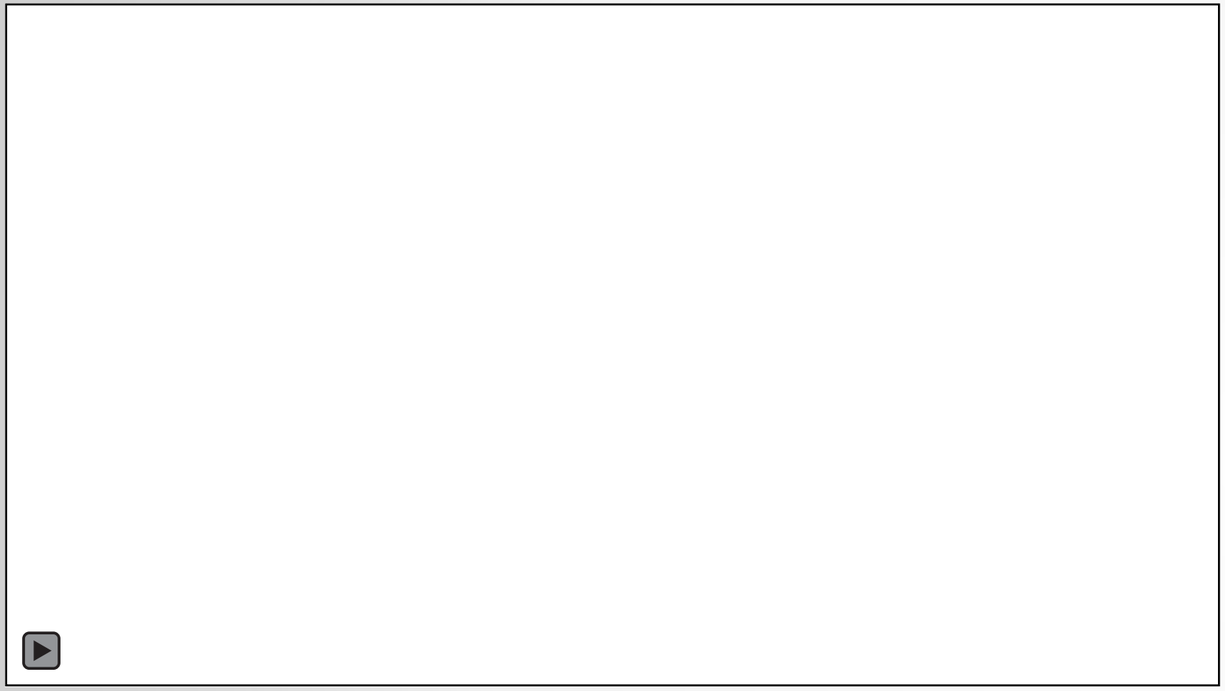
AutoCAD Mechanical's Power Dimensions are

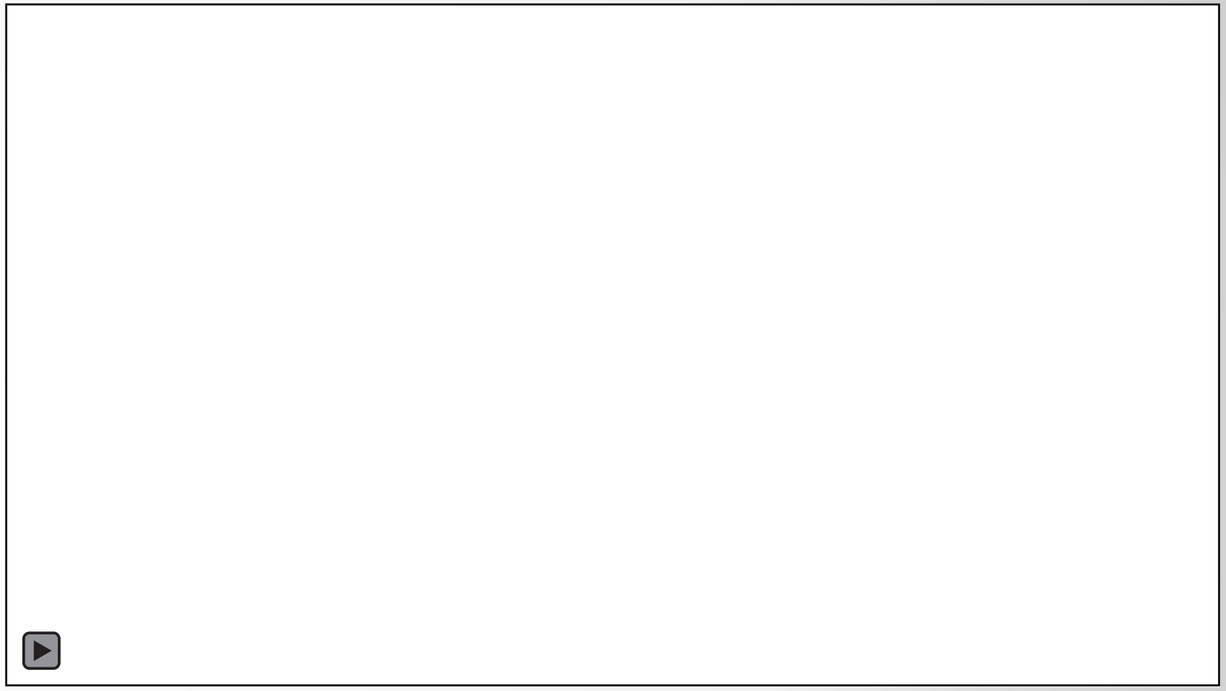
- One command for all dimension options, additional commands for creating multiple dimensions and for merging / splitting dimensions
- smart and understand their *spatial relationship* with one another.
- quick and easy to be modified



Power Dimensioning

An Autodesk Study showed that placing dimensions with AutoCAD required twice as much time as with ACM

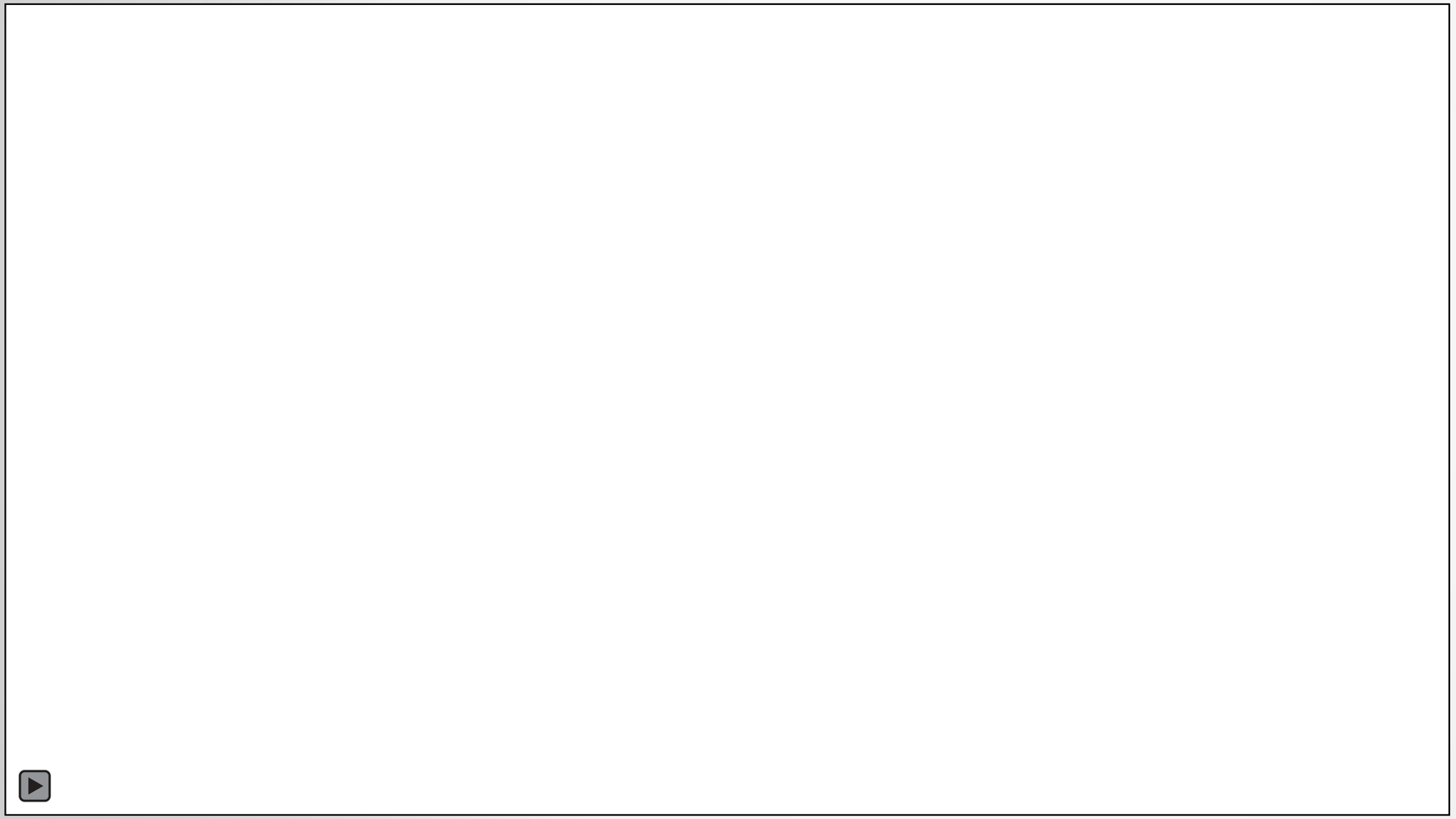




Symbology

Use the built-in ACM symbol tools to quickly create standards-based surface texture symbols, datums, geometric dimensioning and tolerance symbols, targets, weld symbols, and notes.

- Modify via a double-click
- Treated as an annotation with the ACM scale drawing feature



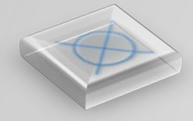
Hole Charts

ACM Hole Charts create a table showing the type of hole, quantities, and coordinate values (based on your selected datum)

- Format is controlled via the Standards



Part References and Bill of Materials

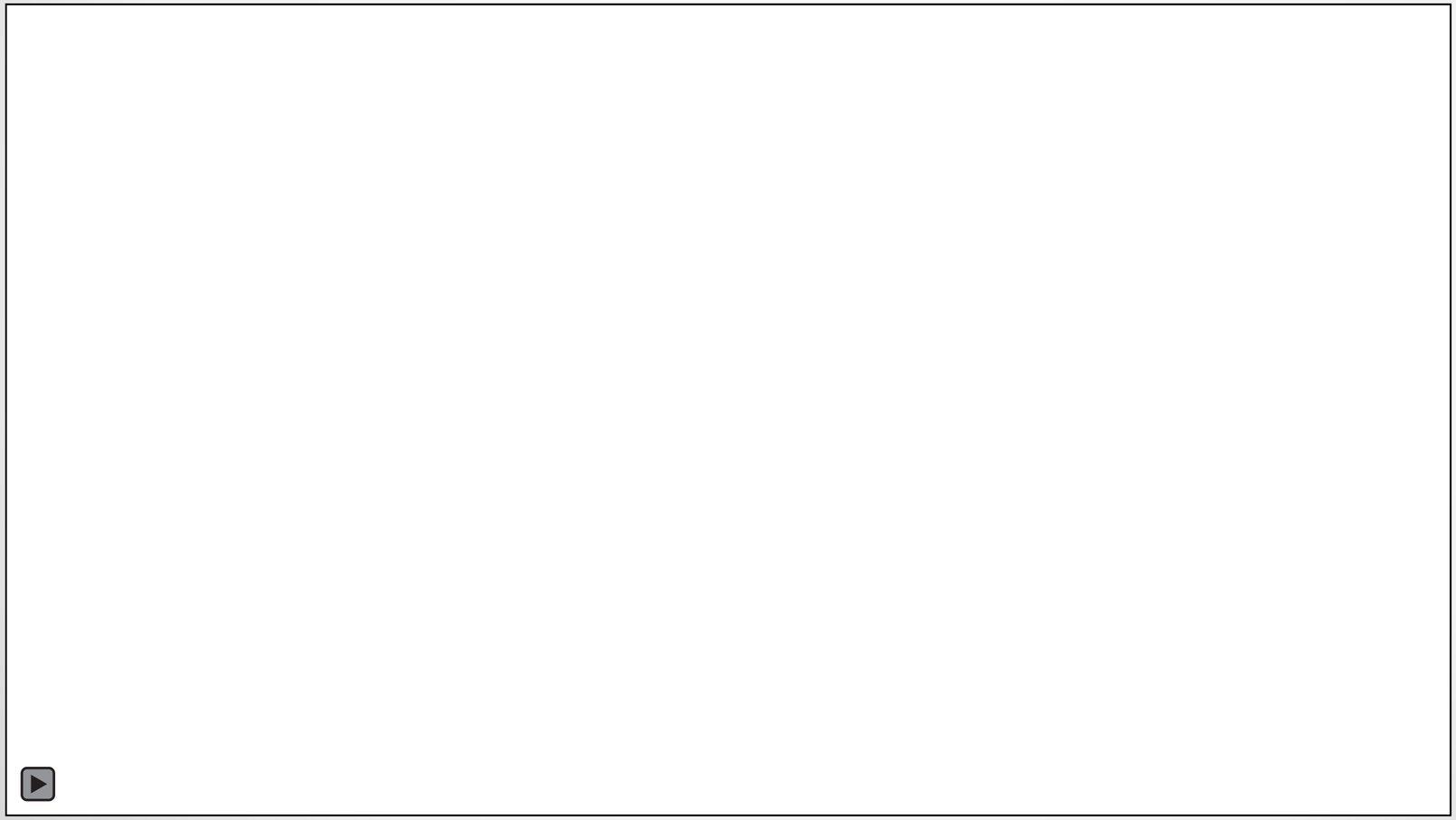


Part References are used to tag objects and assign meta data

- What data the Part Reference contains is controlled via the standard



The Bill of Materials (BOM) is the collection of the Part References and their meta data

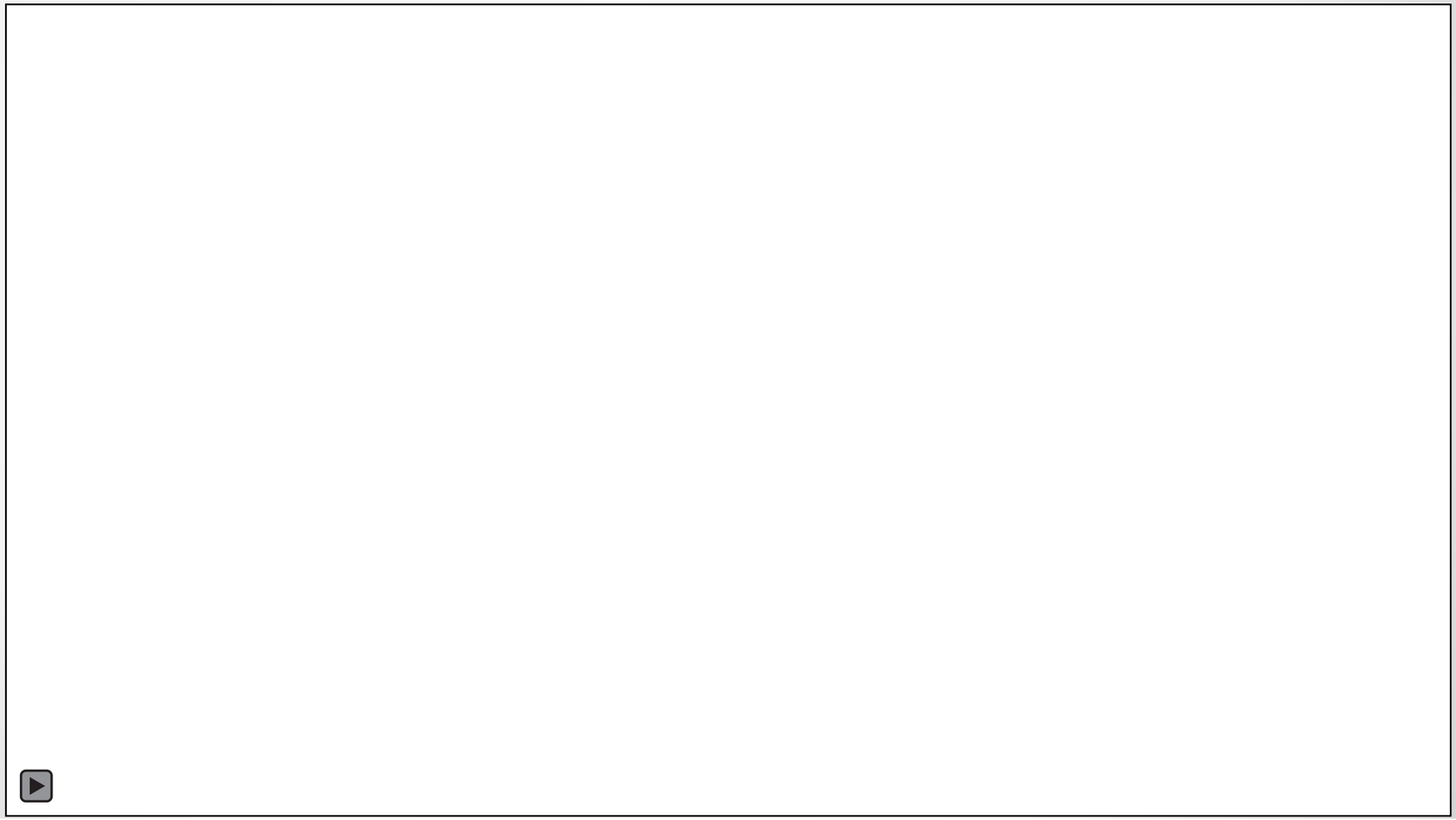


Parts Lists

Item	Qty	Description	Standard	Material
1	1	Hex-Head Bolt	ISO 4017 - M6x20	
2	1	Hex-Head Bolt	ISO 4017 - M6x20	
3	1	Hex-Head Bolt	ISO 4017 - M6x45	
4	1	Hex-Head Bolt	ISO 4017 - M6x45	
5	1	Hex-Head Bolt	ISO 4017 - M8x25	
6	1	Hex-Head Bolt	ISO 4017 - M8x70	
7	1	Hex-Head Bolt	ISO 4017 - M8x70	
8	1	Hex-Head Bolt	ISO 4017 - M8x70	
9	1	Hex-Head Bolt	ISO 4017 - M8x70	
10	1	Hex Nut	ISO 4032 - M6	
11	1	Hex Nut	ISO 4032 - M6	
12	1	Hex Nut	ISO 4032 - M6	
13	1	Hex Nut	ISO 4032 - M6	
14	1	Hex Nut	ISO 4032 - M8	
15	1	Hex Nut	ISO 4032 - M8	
16	1	Hex Nut	ISO 4032 - M8	
17	1	Hex Nut	ISO 4032 - M8	
18	1	Hex Nut	ISO 4032 - M8	
19	1	Recessed Pan Head Screw	ISO 7045 - M4 x 14 - 4.8 - H	
20	1	Recessed Pan Head Screw	ISO 7045 - M4 x 14 - 4.8 - H	
21	1	Spring Washer	DIN 127 - A 8	
22	1	Sprocket	Sprocket #= 12	
23	1	Sprocket	Sprocket #= 6	SS440
24	1	Sprocket	Sprocket #= 6	4130
25	1	Sprocket	Sprocket #= 6	1010
26	1	Sprocket	Sprocket #= 6	18-8
27	1	Sprocket	Sprocket #= 8	AL
28	1	Washer	ISO 7089 - 6 - 140 HV	
29	1	Washer	ISO 7089 - 6 - 140 HV	
30	1	Washer	ISO 7089 - 6 - 140 HV	
31	1	Washer	ISO 7089 - 6 - 140 HV	
32	1	Washer	ISO 7089 - 6 - 140 HV	
33	1	Washer	ISO 7089 - 6 - 140 HV	
34	1	Hex Nut	ISO 4032 - M6	
35	1	Hex-Head Bolt	ISO 4017 - M6x20	
36	1	Washer	ISO 7090 - 6 - 140 HV	
37	1	Washer	ISO 7090 - 6 - 140 HV	
38	1	#1 SHAFT	ACM84	
39	1	1/2" PLATE		

Parts Lists are the BOM that you insert into the drawing.

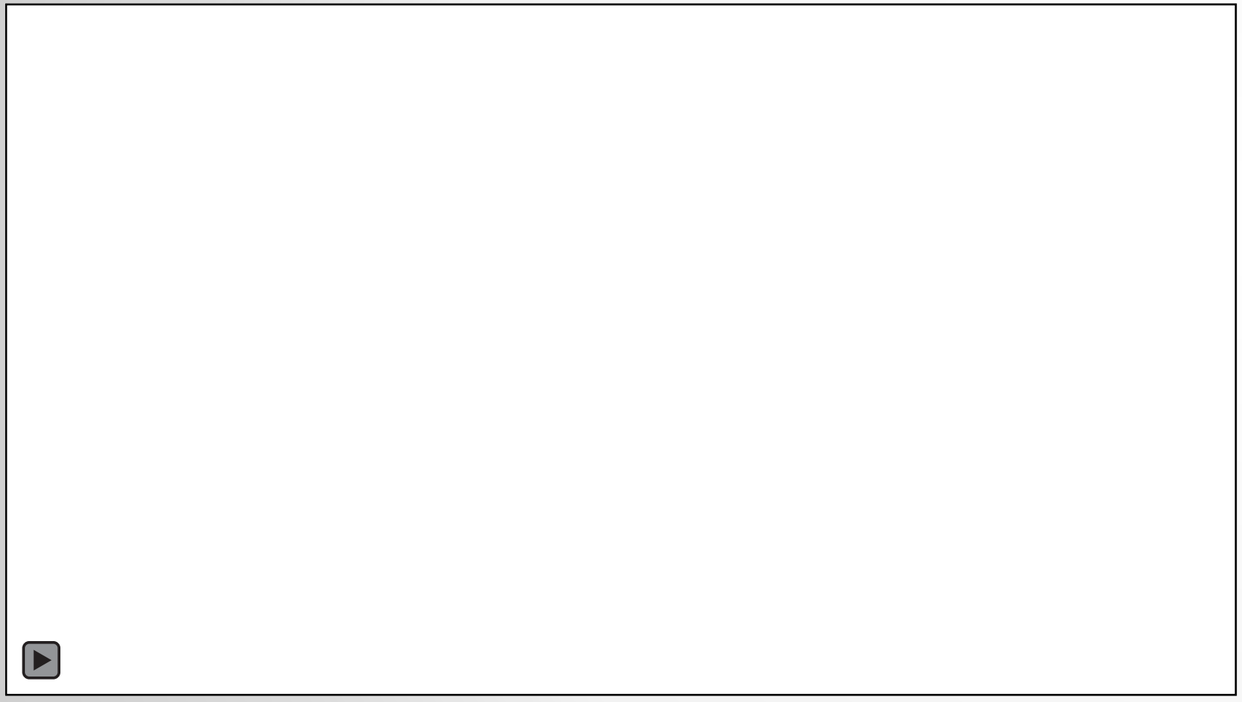
- It does not need to contain all of the information contained within the BOM
- Can be filtered
- Changes to the BOM (or Part References) automatically reflect in the Parts List
- Format is controlled by the active Standard but can be overridden after insertion

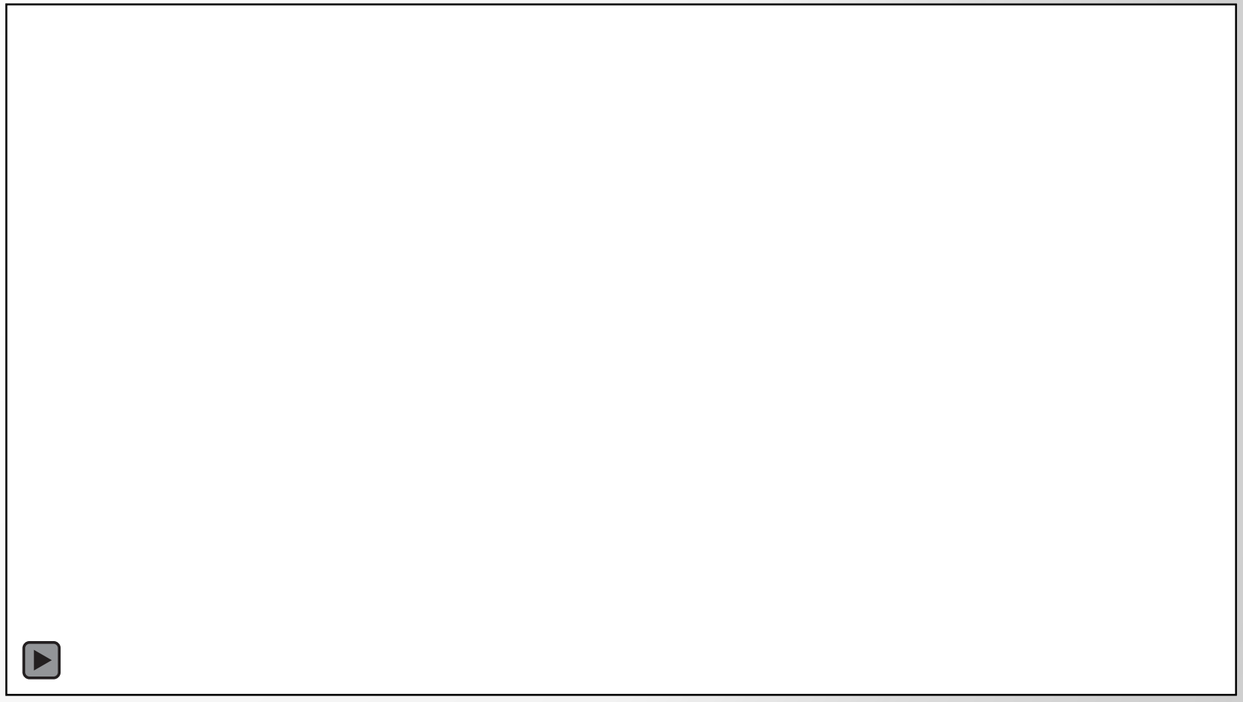


Balloons

Balloons can be created (manually or automatically) from any Part Reference in the drawing

- Format controlled by active standard
- Adjusting the order of the items in the BOM will automatically update the balloon numbers
- Features to adjust the numbering from the drawing
- Can collect balloons to group multiple bubbles on one leader





Hide Situations



"*Draws hidden lines to represent hidden edges, when you specify what objects lie in front and what objects lie behind*"… and they automatically update as you make changes to the geometry!



Mechanical Engineering Documentation

Autodesk Synergy for mechanical engineering

Mechanical Design Productivity

AutoCAD
BOM’s & Balloons
Centerlines & Construction Lines
Dimensions
Edge Symbols & Other Symbology
Fits Lists
Gears
Hide Situations
Infer Constraint Integration
JIS & Other International Standards
Killer Standards Management
Layer Management
Moment of Inertia & other calculators
Nuts & Bolts (Bolt Generator)
pOwersnaps
PowerCopy, PowerRecall, and PowerView
Quick Templates
Retaining Rings (Shaft Generator)

Structure

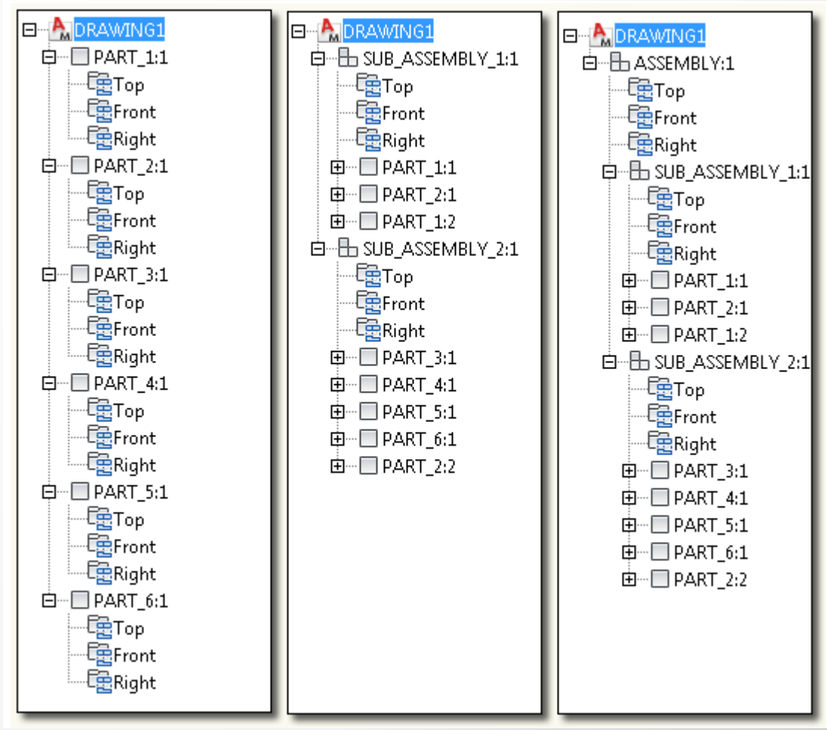
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ZigZags

Structure

ACM Structure is like blocks on steroids, a combination of blocks and groups, to define components. Although just 2D geometry the components defined by ACM are both parts and assemblies defining the *structure* of the assembly you are building. The BOM is automatically built as the structure is defined.

From the ACM help…

"*Mechanical Structure offers all the advantages of both Blocks and Layer Groups and more. Since mechanical structure is designed for the explicit purpose of organizing a drawing. The features go beyond visibility enhancements (offered by layer groups), reuse of geometry, and automatic BOM updates (offered by blocks).*"



Structure

ACM Structure is like blocks on steroids, a combination of blocks and groups, to define components.



What are the next steps?

Mechanical Design Productivity

pOwersnaps
PowerCopy, PowerRecall, and PowerView

Questions?

Retaining Rings (Shaft Generator)
Structure

Test it, Trial it, sTart using iT!

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