AutoCAD or AutoCAD Mechanical? A Productivity Study.

AutoCAD® Mechanical® software, part of the AutoCAD® family of products, saves countless hours of design and rework by automating many common tasks. This study details the productivity gains that users can expect to see when moving from AutoCAD to AutoCAD Mechanical.

Executive Summary

Designed by Autodesk and commissioned to an independent consultant, this study explores 10 common design challenges and shows direct comparisons of the time and effort required to accomplish each specific task in AutoCAD and AutoCAD Mechanical software. **The same tasks were completed 65% faster** using AutoCAD Mechanical.

Key Findings

• Drafting and annotation tasks are **55% faster.**

• Design and engineering tasks are **85% faster.**

• Risk of errors was greatly reduced because of a **60% reduction** in number of commands used.

The Study

The following drawing of a custom conveyor elevator was used in the comparisons. The tests are comprehensive in nature; the tasks were used to create the drawing from scratch, maintain it, and reuse it in other designs. For each task, the number of commands used, number of times each command was accessed, and the total time it took to complete each task using both AutoCAD and AutoCAD Mechanical are documented.

The performance results in this paper were achieved by conducting automation testing over a controlled network. One user, with expert-level experience using both AutoCAD 2007 and AutoCAD Mechanical 2007 software programs, conducted the comparative tests on the same sample using a Dell™ Dimension™ 8400 with a 3.4 GHz Intel® Pentium® 4 processor and 1 GB RAM. Results are approximate and subject to change. Product information and specifications are subject to change without notice. Autodesk provides this information "as is," without warranty of any kind, either express or implied. As with all performance tests, results may vary based on machine, operating system, filters, and even source material. While every effort has been made to make the tests as fair and objective as possible, your results may differ.

These results clearly demonstrate that AutoCAD Mechanical is the more productive 2D mechanical design application. A detailed description of the study follows.


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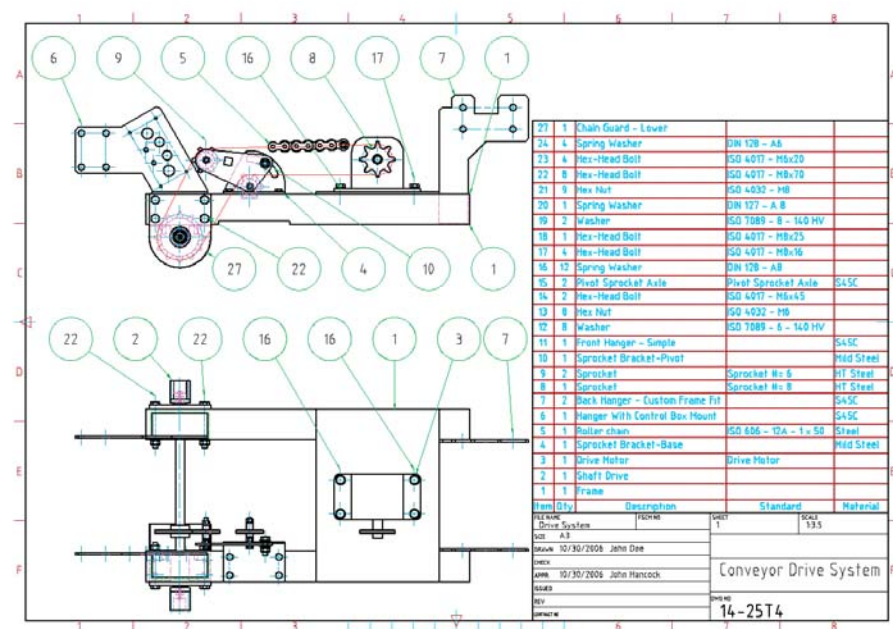
1. Creating and Editing a Screw Connection

Steps

1. Add screw connections
2. Create holes
3. Change the sizes

Study Results

In AutoCAD, the basic geometry for the screws and nuts could be found in the AutoCAD DesignCenter™ function, but the industry standards and size attribute information were not readily available. One thing that made AutoCAD slower was the need to explode blocks to delete or modify the geometry for hidden and trimmed lines. Using AutoCAD Mechanical resulted in a **52% time savings** over basic AutoCAD.
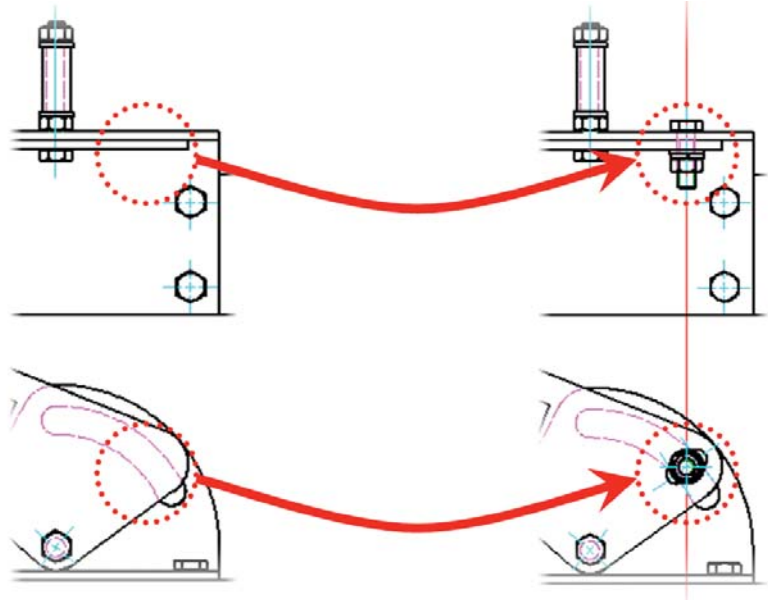
Advantages of AutoCAD Mechanical

- It's easy to navigate the extensive library of parts and features.

- Industry-standard sizes and lengths are provided.

- Once one view is created, the other orthographic view can be projected with no additional effort.

- A simple double-click can change the size of all the related orthographic views in one operation.

- The surrounding geometry for hidden and dashed lines is automatically redrawn, whether you are adding a new part or editing an existing one.

Productivity Gain*	AutoCAD	AutoCAD Mechanical
Number of Commands Utilized	13	6
Number of Times Commands Were Accessed	28	11
Total Time to Complete Task (minutes)	7:25	3:31

Time Saving with AutoCAD Mechanical — 52%

700,000 Standard Parts and Features

AutoCAD Mechanical contains more than 700,000 standard parts like pre-drawn screws, nuts, washers, pins, rivets, and bushings. It also includes 100,000 predrawn standard features such as undercuts, keyways, and thread ends. When incorporated into a design, the feature cleans up the insertion area in the drawing so you don't have to edit the area manually. AutoCAD Mechanical also contains more than 8,000 predrawn holes such as through holes, blind holes, counter-bored holes, countersunk holes, oblong holes, and others.
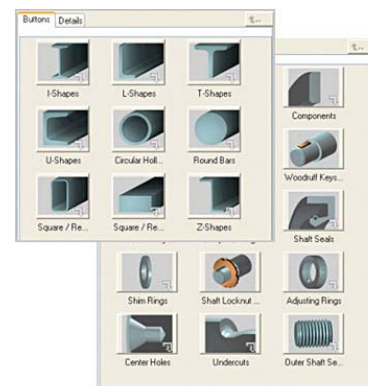
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Steps

1. Add construction lines
2. Draw top view
3. Remove construction lines

Study Results

While the number of commands that were used and number of times those were accessed to create the third view were comparable between AutoCAD and AutoCAD Mechanical, the amount of time required to complete the view using AutoCAD Mechanical was much less. In the case of this simple view, AutoCAD Mechanical was **36% faster.**
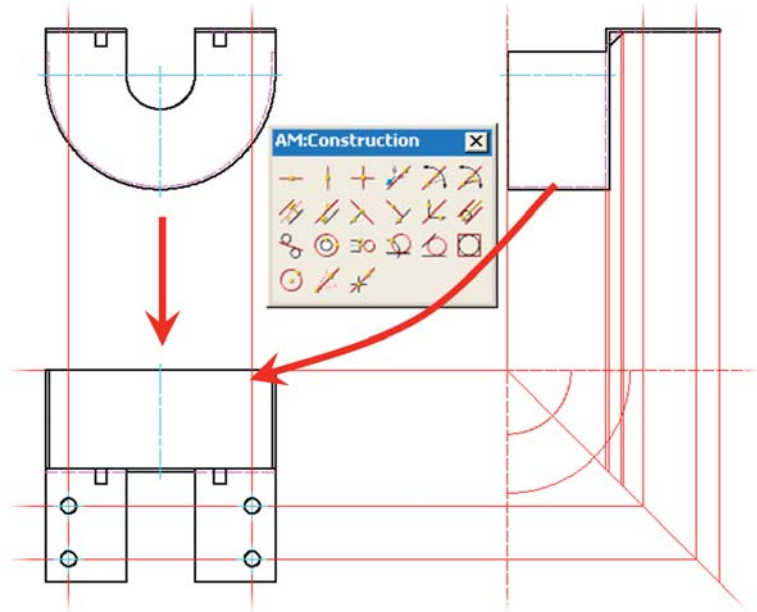
Advantages of AutoCAD Mechanical

- The projection utility bends the construction lines around the correct angle of projection to efficiently create three-view orthographic drawings.
- The construction geometry was automatically placed on a separate layer to toggle visibility off, and this layer doesn't show up when plotting.
- Construction lines could be quickly deleted without the risk of mistakenly selecting actual part view geometry.

Productivity Gain*	AutoCAD	AutoCAD Mechanical
Number of Commands Utilized	10	11
Number of Times Commands Were Accessed	27	25
Total Time to Complete Task (minutes)	4:20	2:46
Time Saving with AutoCAD Mechanical — 36%		

Extended Draw Toolbar for Manufacturing

AutoCAD Mechanical provides additional options over basic AutoCAD software for drawing creation. Included are:

- More than 30 options for rectangle, arc, and circle creation
- Nearly automatic centerline creation and updating
- Specialty lines for break out views and section lines
- A full suite of construction lines for aligning drafting views
- Manufacturing focused hatching patterns and sizes

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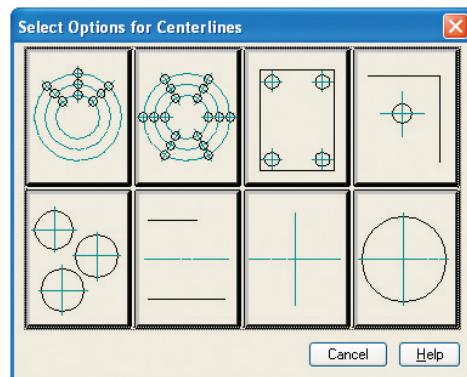
Steps

1. Change scale to 2:1
2. Arrange and add dimensions
3. Add tolerances and information

Study Results

While placing dimensions in both AutoCAD and AutoCAD Mechanical was relatively simple, the main difference is that AutoCAD required twice as many steps to get the job done. AutoCAD Mechanical **completed this task in less than half the time** required by AutoCAD.
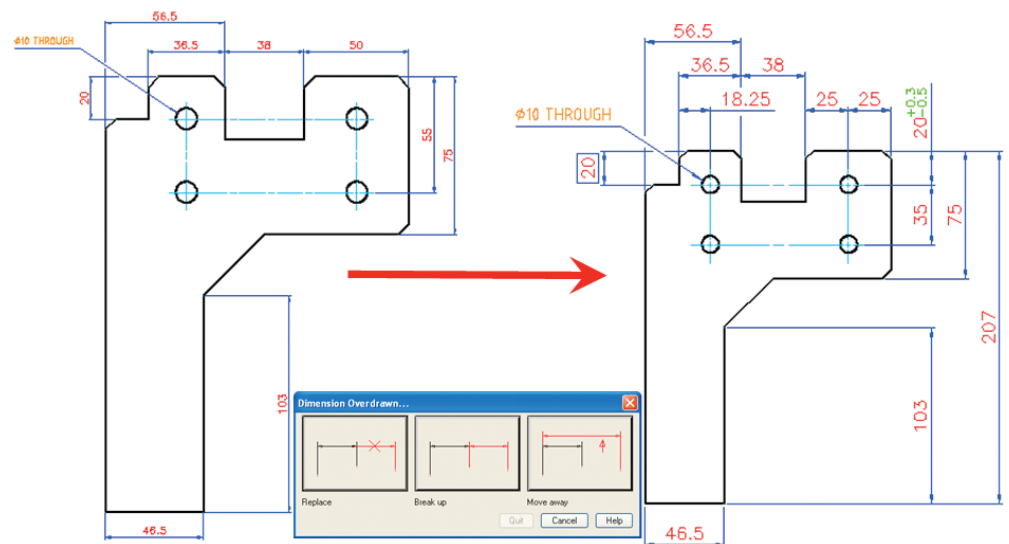

Advantages of AutoCAD Mechanical

- Dimensions created with AutoCAD Mechanical have intelligence about their spatial relationship with one another. If you delete the middle dimension in a group, the others automatically arrange themselves to fill the gap.

- The dimension annotation was quickly modified to meet the notation requirements for the design by double-clicking the dimension and making the appropriate changes in the versatile power dimensioning dialog box.

- It's easy to draw dimensions that meet all the different international drafting standards

Productivity Gain*	AutoCAD	AutoCAD Mechanical
Number of Commands Utilized	8	6
Number of Times Commands Were Accessed	28	7
Total Time to Complete Task (minutes)	5:19	2:20
Time Saving with AutoCAD Mechanical: — 56%		

Powerful and Smart Dimensions

With the streamlined tools in AutoCAD Mechanical, you can create dimensions using abbreviated dialog boxes that conveniently control and expand only the relevant variables for manufacturing. With automatic dimensioning, you can create multiple dimensions with minimal input, resulting in instant groups of ordinate, parallel, or symmetric items that are appropriately spaced. Smart dimensioning tools force overlapping dimensions to automatically space themselves appropriately while integrating tolerance and fit list information into the design. Dimension input can even drive and change design geometry to fit certain sizes.

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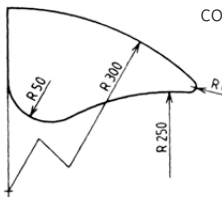
4. Create an Enlarged View to Show Additional Details

Steps

1. Add detail view
2. Scale detail at 2:1
3. Make design change

Study Results

When creating a production drawing it is often necessary to create a view with a different scale to easily show details. Creating a detail view in AutoCAD software is a disjointed process, requiring you to define and maintain a second set of dimension styles and view scales, or even create an entirely new scaled view. These manual operations can lead to erroneous data and cause problems at the manufacturing stage. **In AutoCAD it took longer and twice as many commands were used and accessed to complete this task** versus with AutoCAD Mechanical.
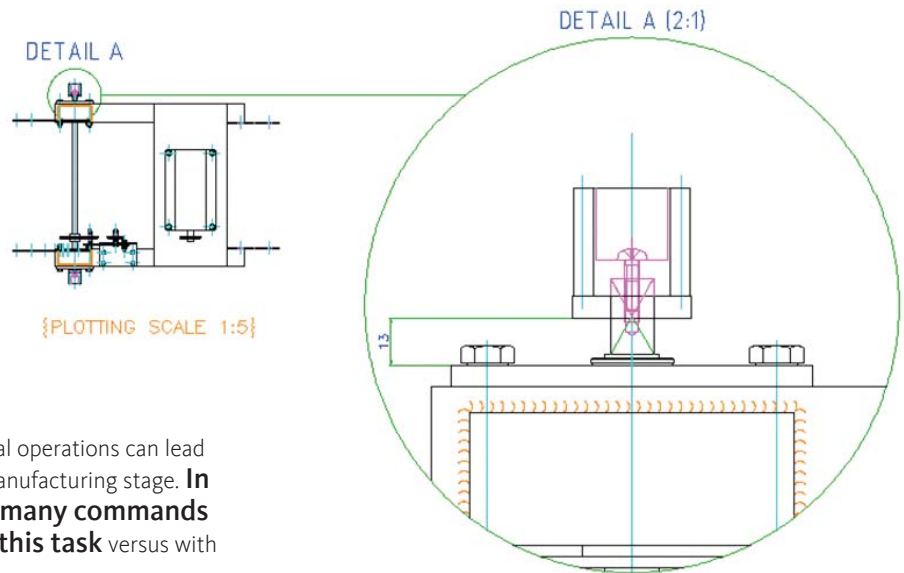
Advantages of AutoCAD Mechanical

- Simply outline the area to be detailed and then specify the scale, location, or detail view name; AutoCAD Mechanical creates the appropriate detail view.

- The detail view is fully associative with the original geometry and always reflects the latest design changes.

Productivity Gain*	AutoCAD	AutoCAD Mechanical
Number of Commands Utilized	13	7
Number of Times Commands Were Accessed	25	10
Total Time to Complete Task (minutes)	3:29	2:12
Time Saving with AutoCAD Mechanical — **37%**		

Reusable Detailing Tools

Built to save you time, AutoCAD Mechanical has a specific tool for almost every aspect of the mechanical drafting process. Many of these drafting tools have the intelligence that helps users easily re-edit features without having to remove and recreate the original feature. For example, a chamfer or fillet can be easily resized through the original dialog parameters by simply double clicking on the chamfer or fillet. The list of tools includes, but is not limited to:

- Detail Views – easily create linked views at different scales

- Hole Charts – automatically updated charts for the shop floor

- Scale Areas – change drawing scale without making duplicate copies

- Title and Revision Blocks –English and metric versions available

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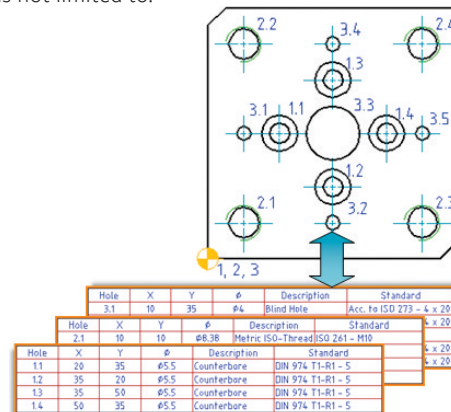
Steps

1. Add details in DIN standard

2. Insert Datums, Surface Texture, and GD&T symbols

Study Results

AutoCAD software can create mechanical symbols and complex dimensions, but it can also require many manual steps and long searches through the property manager to find a particular option. By using AutoCAD Mechanical, this task was **completed in half the time** required by AutoCAD.
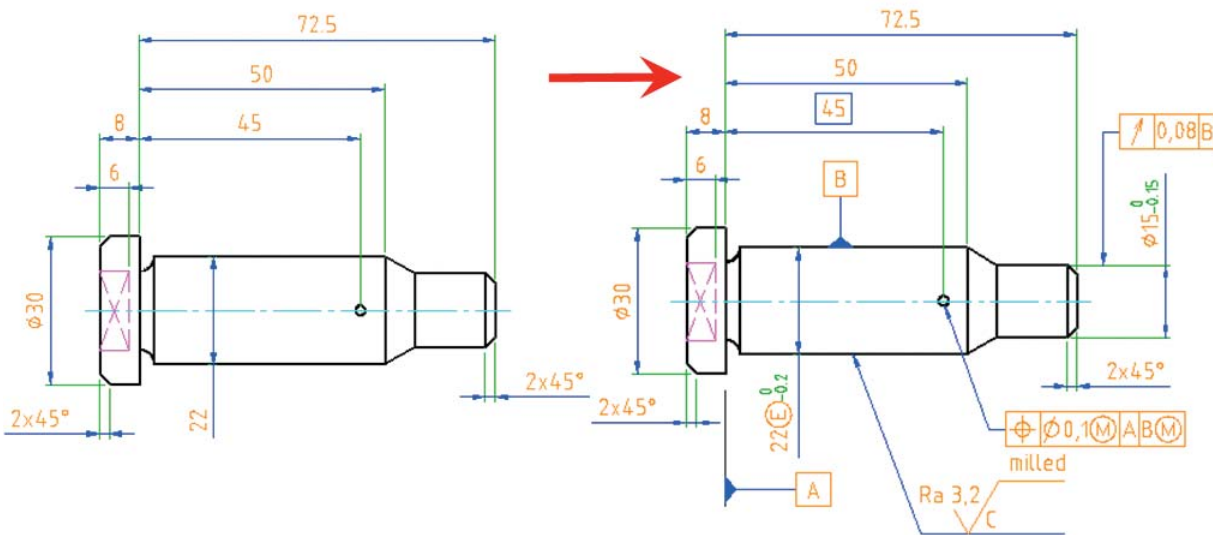

Advantages of AutoCAD Mechanical

- AutoCAD Mechanical includes simplified commands to create standards-based surface texture symbols, datums, geometric dimensioning and tolerance symbols, targets, weld symbols, and notes.

- Simplified dimensioning dialog boxes clearly display the common options for mechanical drawings.

- By using settings in AutoCAD Mechanical, you can scale mechanical symbols automatically.

Productivity Gain*	AutoCAD	AutoCAD Mechanical
Number of Commands Utilized	9	7
Number of Times Commands Were Accessed	20	10
Total Time to Complete Task (minutes)	5:26	2:47

Time Saving with AutoCAD Mechanical — 48%

International Drafting Standards

Multiply productivity with tools that help project teams deliver consistent, standards-based design documentation. AutoCAD Mechanical supports ANSI, BSI, CSN, DIN, GB, ISO, and JIS drafting environments. Adhering to a standard environment helps project teams maintain a common form of communication for consistent production results. AutoCAD Mechanical includes drafting tools to create standards-based surface texture symbols, geometric dimensioning and tolerances, datum identifiers and targets, notes, taper and slope symbols, and weld symbols.
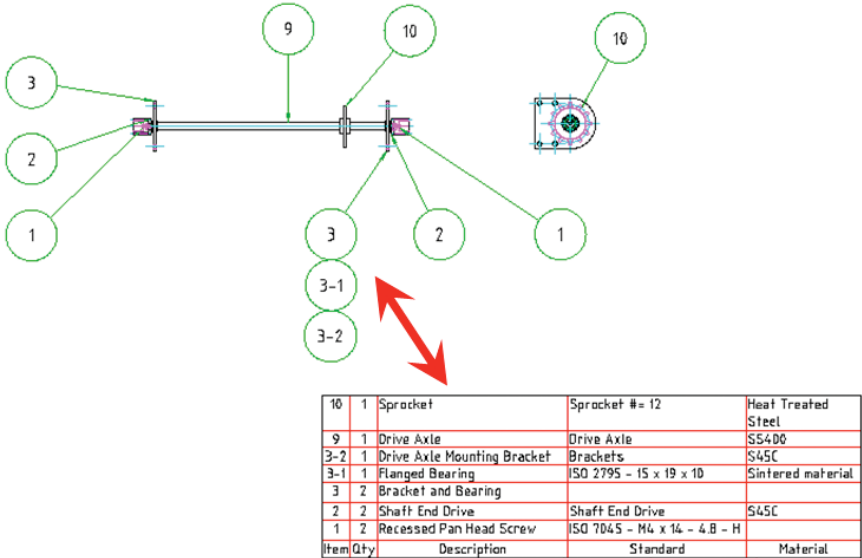

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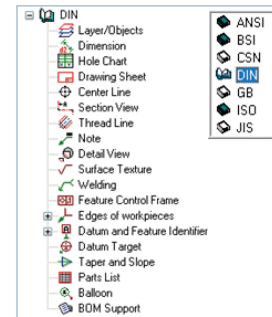
Steps

1. Add parts list
2. Add balloons that match parts list
3. Edit part attributes and balloon numbers

Study Results

To annotate an assembly drawing in AutoCAD software with part item number balloons, you must do a lot of manual geometry creation and manipulation. Because the balloon text value in AutoCAD is not related to the part in the assembly, you must manually enter the item number value. To ensure there are no mistakes, you must continually verify that the value shown in the balloon is correct for that part. If you need to change the location or resequence the number of existing balloons in an AutoCAD drawing, you must spend a great deal of time and effort to complete and verify the changes to the balloons and the parts list. It took three times as long to complete this task using AutoCAD; a **68% productivity gain by using AutoCAD Mechanical.**

| Item	Qty	Description	Standard	Material
10	1	Sprocket	Sprocket #= 12	Heat Treated Steel
9	1	Drive Axle	Drive Axle	S55400
3-2	1	Drive Axle Mounting Bracket	Brackets	S45C
3-1	1	Flanged Bearing	ISO 2795 – 15 x 19 x 10	Sintered material
3	2	Bracket and Bearing		
2	2	Shaft End Drive	Shaft End Drive	S45C
1	2	Recessed Pan Head Screw	ISO 7045 – M4 x 14 – 4.8 – H	

Advantages of AutoCAD Mechanical

- It's easy to add attributes, such as material and part number, to parts as the design progresses.
- Item and attribute information is automatically coordinated between the parts list and the balloons, and changes are accurately captured throughout the drawing.
- During placement of the balloons, you can specify different organizational alignments to assist in conforming to standards and practices.
- The bill of materials automatically recognizes many standard parts (screws, steel shapes, and so forth) and automatically adds them to the parts list.

Productivity Gain*	AutoCAD	AutoCAD Mechanical
Number of Commands Utilized	12	5
Number of Times Commands Were Accessed	59	14
Total Time to Complete Task (minutes)	10:40	3:21
Time Saving with AutoCAD Mechanical — 68%		

Associative Balloons and Bill of Materials (BOMs)

Create automated and associative parts lists and bills of materials (BOMs) that were specifically developed for manufacturing and that automatically update as the design changes. Included is support for multiple parts lists per drawing, collapsible assemblies, automatic recognition of standard parts, and customizable options so features can be revised to match current company practices. Change a design once, and updates ripple through the entire drawing to keep everyone on schedule, reducing costly stops in production from incorrect part counting, identification, and ordering. Export or link BOM data to manufacturing resource planning (MRP) and enterprise resource planning (ERP) systems, or data management systems such as Autodesk® Productstream® software.

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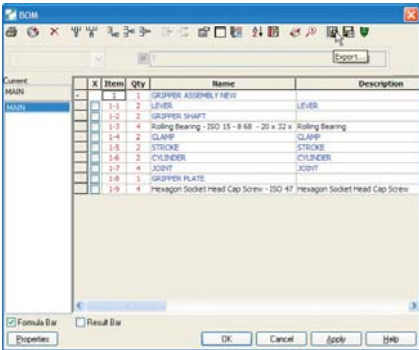
Steps

1. Draw the view

2. Dimension the view

3. Ensure accurate layers and properties

Study Results

Using layers and properties in AutoCAD is not a difficult task but it still requires too many manual tasks. You can spend a significant amount of time and energy checking and moving entities to the correct layer, to meet your company's defined set of rules. It took more than 6 minutes to complete this task using AutoCAD and only 3 minutes with AutoCAD Mechanical, almost a **50% time differential.**
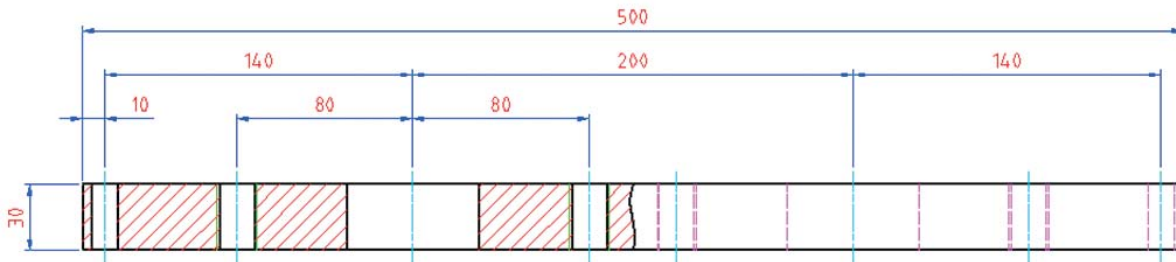

Advantages of AutoCAD Mechanical

• A flexible, customizable layer and property management system assigns drawing objects the appropriate settings automatically.

• It reduces the amount of setup time required before starting a drawing as well as time spent creating, editing, and managing layers and properties.

• The layer and property management system alleviates the burden of manually managing and maintaining accurate data.

Productivity Gain*	AutoCAD	AutoCAD Mechanical
Number of Commands Utilized	14	12
Number of Times Commands Were Accessed	29	18
Total Time to Complete Task (minutes)	6:10	3:22

Time Saving with AutoCAD Mechanical: 45%

Layer Management

The intelligent layer management system in AutoCAD Mechanical automatically places items on the correct layer, color, and linetype as you create your drawing. And, it can be easily customized based on your company requirements. Customizable layer types include:

• Text and hatching

• Centerlines and construction lines

• Hidden lines

• Symbols and notes

• Title borders

Autodesk
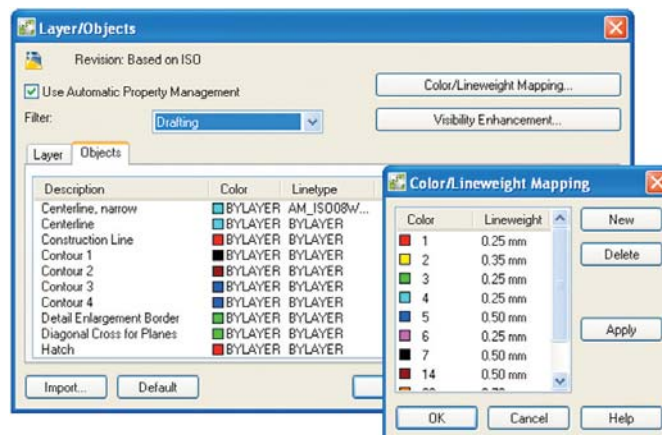
Steps

1. Turn hidden lines to different linetype
2. Change position of bracket
3. Update hidden lines

Study Results

AutoCAD software requires a lot of manual work and geometry manipulation to accurately represent parts and features that are partially or completely hidden in drawing views. Even in the simplest situation where one plate partially obstructs the view of another plate, several lines must be broken, trimmed, and then hidden in the drawing view. This design process is labor intensive and tedious, reducing the time available for mechanical design. By using AutoCAD Mechanical the drafting effort was substantially less. To complete this task using AutoCAD, five times as many commands were accessed and it took three times as long compared to AutoCAD Mechanical; **a 68% time savings.** Furthermore, as the design changed, AutoCAD Mechanical automatically updated the drawing.
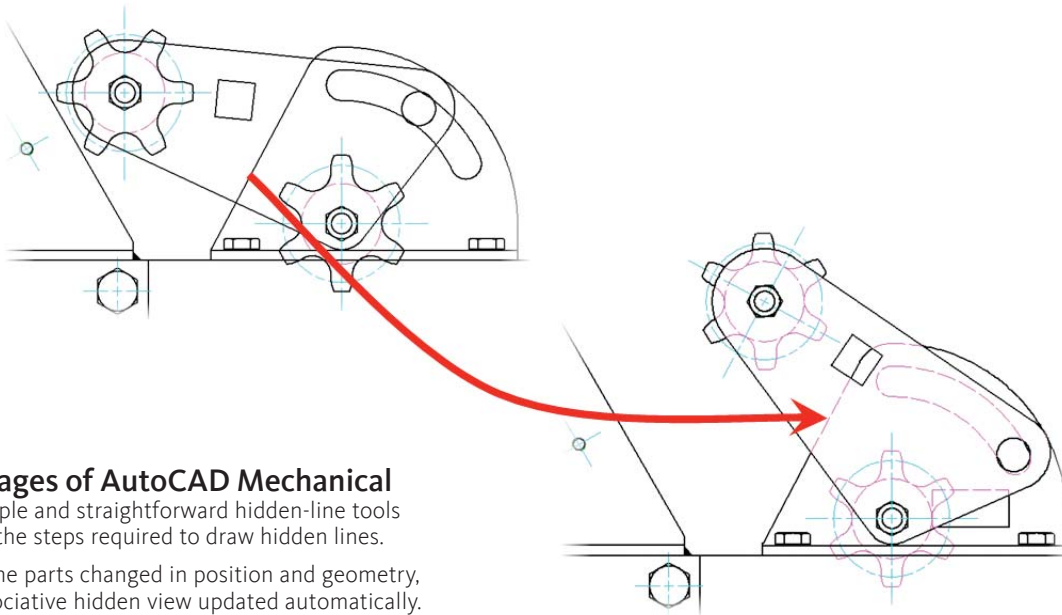
Advantages of AutoCAD Mechanical

- The simple and straightforward hidden-line tools reduce the steps required to draw hidden lines.

- When the parts changed in position and geometry, the associative hidden view updated automatically.

Productivity Gain*	AutoCAD	AutoCAD Mechanical
Number of Commands Utilized	8	6
Number of Times Commands Were Accessed	52	10
Total Time to Complete Task (minutes)	6:48	2:10
Time Saving with AutoCAD Mechanical — 68%		

Hidden Lines

Ramp up productivity by defining simple foreground and background selections that automatically redraw geometry to show hidden or dashed lines of parts that are obstructed by other parts in a design. Hidden lines automatically update when changes occur, virtually eliminating the time required to manually redraw geometry due to design changes.
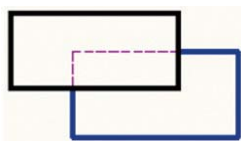
For the first time in 2D, identical parts can have different geometrical appearances when in hide situations, but AutoCAD Mechanical recognizes that they are still identical parts if you need to change the design or
get an accurate count for the parts list. This means you spend less time and effort updating your 2D designs.

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Steps

1. Select a chain and number of links
2. Optimize length calculation
3. Draw the chain

Study Results

When using AutoCAD, you are required to draw each sprocket and pulley manually, a time-consuming task in its own right. To define the path lines, you have to create tangent arcs and lines to sprockets. These path lines are drawn with a specific length in mind, depending on the type of belt or chain selected. Designing sprocket and chain systems quickly becomes a series of trial-and-error workflows consisting of sprocket and path line repositioning. For an inexperienced designer this operation could take hours. With AutoCAD Mechanical, you can create chain and sprocket and belt and pulley systems with the Belt and Chain Generator. Automatically calculate optimal lengths for chains and belts based on your input and insert the assemblies in your design. It took only a fraction of the time to complete this task using AutoCAD Mechanical – **a 92% time savings over basic AutoCAD.**
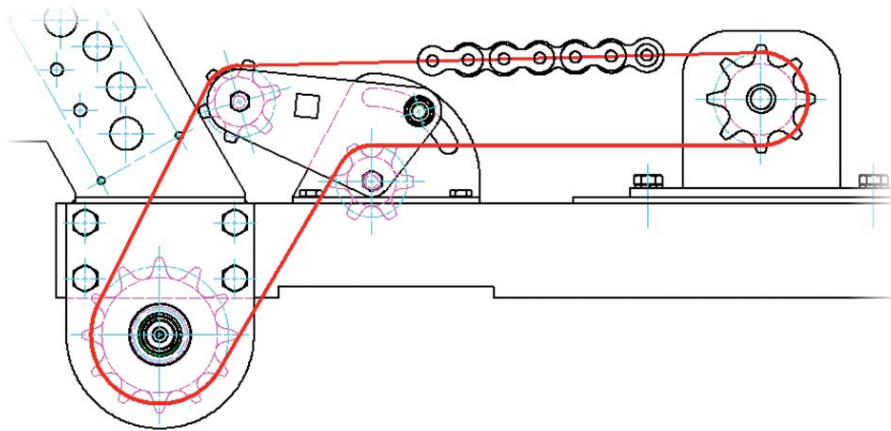
Advantages of AutoCAD Mechanical

- Extensive belt and chain options can be selected from the standard libraries.

- To make changes, just double-click, choose a new size, and the drawing updates.

- After you define the chain path by selecting the sides of the sprockets, the length of the path is automatically optimized so it is of proper length for the standard chain link.

- It is easy to include a few chain links and the representation of the sprockets to help communicate design intent to others.

| Productivity Gain*	AutoCAD	AutoCAD Mechanical
Number of Commands Utilized	N/A	7
Number of Times Commands Were Accessed	N/A	8
Total Time to Complete Task (minutes)	~30:00	2:10
Time Saving with AutoCAD Mechanical — 92%		

Machinery Generators and Calculators

If you are building mechanisms from paper catalogs and manual calculations, then these comprehensive tools can be a huge time-saver. Built into the application environment, they are extremely helpful when making small, iterative changes to improve a design. They not only create parts according to specifications, but also create all of the reports and calculations needed to analyze the design. AutoCAD Mechanical includes shaft, spring, belt, chain, and cam generators.

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10. Data Exchange between CAD Systems

Use AutoCAD Mechanical to detail and document native Autodesk® Inventor™ parts and assemblies. Just browse through Autodesk Inventor files and begin creating new, linked AutoCAD Mechanical drawings that are based on the most current 3D designs. Incorporate design revisions quickly and easily through the associative link—the software automatically notifies you of changes to the Inventor file and regenerates the 2D drawing, including any changes. Visualize design intent by shading and rotating solid models, and review other attributes associated with the Autodesk Inventor design. Information that is stored in Autodesk Inventor models is automatically available to the BOM database in AutoCAD Mechanical, so you can quickly add balloons, parts lists, and annotations to the drawing.
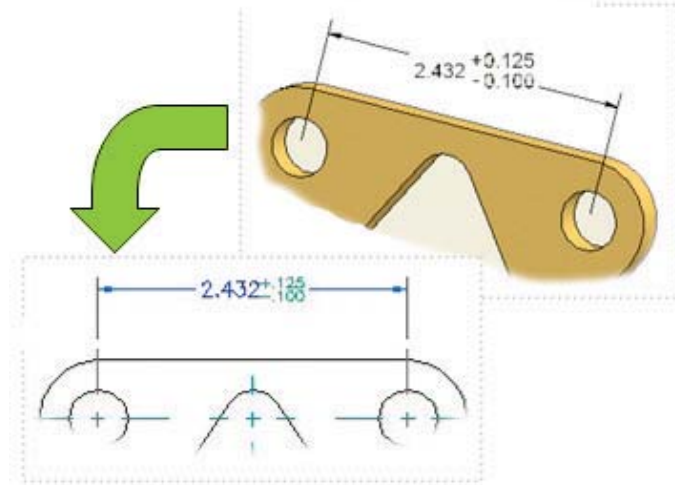
AutoCAD Mechanical also includes the industry-standard IGES (Initial Graphics Exchange Specification) format for importing and exporting data between dissimilar CAD systems. Use the IGES translator to improve the accuracy of data shared with team members on different CAD systems and ensure that all team members have access to project data regardless of the CAD system they are using.

Study Results

There was not enough capability in AutoCAD software to make a valid comparison, and therefore the time to complete the tasks in both systems was not recorded. AutoCAD Mechanical is clearly the more capable and efficient application, saving you hours of time if changes are made to the 3D model.

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Conclusion

We hope that the ten examples in this study have clearly communicated the benefits of using AutoCAD Mechanical.

To complete the same drawings, it required 79:37 minutes using AutoCAD and 24:39 minutes using AutoCAD Mechanical. The time saved using AutoCAD Mechanical amounted to 54:58 minutes, a 65% time savings.

- Drafting and annotation tasks are **55% faster.**
- Design and engineering tasks are **85% faster.**
- Risk of errors was greatly reduced because of a **60% reduction** in number of commands used.

In addition to these ten studies, there are many features and benefits included within AutoCAD Mechanical that have not been mentioned within this study that offer key functionality that is not available in basic AutoCAD. For example, 2D FEA (finite element analysis) is available as shown in the following graphic. 2D FEA enables you to quickly determine potential areas of failure on designs, as well as analyze design integrity under various loads, avoiding costly product testing or field maintenance.
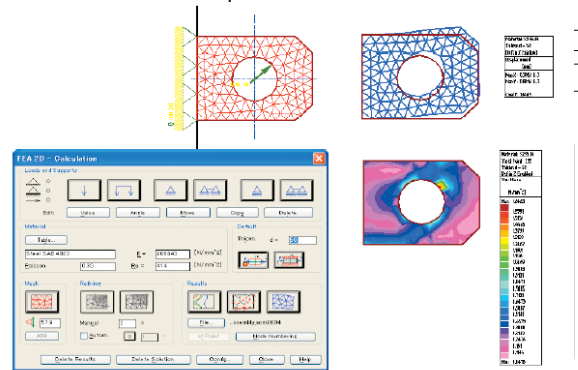
The AutoCAD Mechanical Advantage

Based on these ten studies, AutoCAD Mechanical provides a level of productivity for mechanical designers and drafters that is not possible with general-purpose CAD applications such as AutoCAD. Because AutoCAD Mechanical is built specifically for mechanical design, you will realize immediate productivity benefits such as the ones discussed in this paper. For more information about AutoCAD Mechanical including Test Driving the product, go to www.autodesk.com/autocadmechanical or contact your local reseller. To locate the reseller nearest you, visit www.autodesk.com/reseller.

	AutoCAD (minutes and seconds)	AutoCAD Mechanical (minutes and seconds)	Time Savings with AutoCAD Mechanical
1. Creating and Editing a Screw Connection	7:25	3:31	52%
2. Creating the Top View from Two Other Existing Views	4:20	2:46	36%
3. Edit Dimensions and Scale to Revise a Drawing	5:19	2:20	56%
4. Create an Enlarged View to Show Additional Details	3:29	2:12	37%
5. Detailing a Part with Mechanical Symbols and Notes	10:40	3:21	48%
6. Add Balloons and Corresponding Parts List to a Drawing	5:26	2:47	68%
7. Draw and Annotate a Part with All Entities Placed on the Correct Layer	6:10	3:22	45%
8. Drawing Hidden or Dashed Lines of Hidden Geometry	6:48	2:10	68%
9. Machinery Generators and Calculators	~30:00	2:10	92%
10. Data Exchange	N/A	N/A	N/A
Total Times	79:37	24:39	
Time savings with AutoCAD Mechanical			65%

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