

Conceptual Design Made Easy with AutoCAD

Easier Path to Good Design

Now more than ever, good design can mean the difference between success and failure. Owners expect interesting, often organically shaped architectural designs for their new buildings and campuses. Consumers expect ever-higher levels of innovation—both technological and aesthetic—in their manufactured products. Concept and creativity are key. But both manufacturing companies and architecture, engineering, and construction (AEC) firms can be challenged to find the time for a lengthy conceptual design stage. To be successful under today's tight deadlines, they must be able to iterate conceptual designs quickly and easily—refining, communicating, and ultimately executing on ideas faster, and better, than their competitors.

For decades, AutoCAD[®] software, one of the world's leading 2D and 3D design applications, has been an architecture and manufacturing mainstay. And in the last three years, Autodesk has integrated powerful conceptual design tools into AutoCAD, making it quicker and easier to explore ideas and achieve even better design.

This white paper describes the capabilities and uses of Autodesk[®] SketchBook[®] Designer 2012 for AutoCAD[®] plug-in, as well as the conceptual design capabilities in AutoCAD software, including solid modeling, mesh modeling, surface modeling, and Autodesk[®] Inventor[®] Fusion technology. The paper also illustrates the power of these tools by detailing sample conceptual design workflows for the AEC and manufacturing industries. With the latest releases of AutoCAD, users gain the flexibility to design and shape almost any forms imaginable—with unprecedented speed and ease.

Robust Conceptual Design Tools

With the conceptual design tools now in AutoCAD, manufacturers, builders, architects, engineers, and designers can take designs further than ever before.

Autodesk SketchBook Designer

Users can now integrate industry-standard SketchBook illustration and image manipulation capabilities directly into their AutoCAD workflow using the Autodesk SketchBook Designer for AutoCAD plug-in. With brushes, vector strokes, and a variety of creative tools, users can create concept variations, illustrations, compositions with 3D models, and other image assets.

Mesh Modeling

The mesh modeling tools in AutoCAD help users very quickly iterate organic shapes via a sculptural approach. They can create primitive mesh shapes, such as boxes, cones, cylinders, and wedges, then simply push or pull the forms directly to explore design ideas with the direct manipulation capabilities in AutoCAD. They can also split a mesh face and extrude faces to deform the mesh object. Once a user has decided on a design, he or she can then convert meshes

to smooth or faceted solids or surfaces. In the same AutoCAD environment, users can move smoothly back and forth between solid and mesh objects.

Surface Modeling

The surfacing modeling tools and direct modeling capabilities in AutoCAD make it easier for users to create curves to generate surfaces—and not just NURBS surfaces. AutoCAD creates explicit surfaces that let users access the properties belonging to their method of creation at any time. With the surface associativity feature, when users update original linework to curves, the corresponding surfaces update automatically.

Solid Modeling

With the solid modeling tools in AutoCAD, users can create solid models from profiles or primitives more easily. They can then directly manipulate a solid by pushing and pulling faces, edges, and vertices—making it exponentially easier to work with solids in the AutoCAD environment. New and updated solid modeling tools in AutoCAD offer the utmost flexibility and control for 3D design.

Autodesk Inventor Fusion

Inventor Fusion could set a new standard for ease of use in professional 3D modeling—extending the 3D conceptual design capabilities of AutoCAD to an incredibly intuitive environment and making it possible to edit and validate models from almost any source. Because Inventor Fusion is a direct modeler, working with solid and surface models is faster and simpler.

AutoCAD Conceptual Design for AEC

The conceptual design tools now in AutoCAD give architects the flexibility they need to iterate and modify initial building designs more quickly. Let's look at a sample building design workflow.

Intuitive Mesh Sculpting

Using the Autodesk SketchBook Designer, an architect can intuitively sculpt a mesh and make initial sketches, all in one medium. She can use 3D information from an AutoCAD model to create an underlay that serves as a background for her concept sketches—then paint strokes using industry-leading tools that make it possible to deform the sketch in previously unimaginable ways. She can then take these images back into her modeling space. Alternatively, she can make sketches in AutoCAD using real curves. Each of these sketches converts to a spline, which she can directly manipulate with speed and control.

Powerful Surface Creation

With the sketch complete, it's time to create explicit surfaces in AutoCAD—which means that surfaces keep properties relative to their method of creation. There are no task dialogues—everything happens on the canvas next to the design, allowing the architect to focus her attention and energy on the concept. For example, to define continuity between surfaces, she can simply click on controls next to the surface. And it's easy to check curve smoothness using analysis tools in AutoCAD such as Zebra and curvature analysis.

If a problem arises, the architect simply clicks back onto a surface and makes any required changes. AutoCAD automatically solves the relationship between different surfaces, updating the model based on her direct manipulation. The result: freedom to try a range of different ideas quickly.

Let's assume that the architect now wants to create an opening in the roof. She can trim the surface with the ellipse already created, simply selecting the area she wishes to remove. Thanks to the surface associativity feature, when she experiments with the geometry, the whole model updates; there's no need to rebuild anything. The architect can also project geometry into other surfaces or solids, and continue to make additional trim operations, to create a highly organic floor based on the roof's footprint—all her changes are tracked automatically.

Adding Realism

Before developing the idea further, or running validations and tests on the model, the architect may want to enhance the model presentation. To do so, she simply goes back to Autodesk SketchBook Designer, inserts a photograph as a layer, and applies the modifiers used in the sketch from the stand-alone version of Autodesk SketchBook Designer to the photograph. By distorting, scaling, and repeating the image, she can enhance the model's presentation without moving out of the conceptual design phase.

Bringing Models into Autodesk Revit Architecture

Once the conceptual design is ready, the architect can bring the model into Autodesk® Revit® Architecture software for further detailing. For example, she might take the roof into the conceptual mass environment and try subdividing the shape, then explore options for paneling. She can repeat this process for the rest of the model, converting each face into different architectural components (such as walls or curtain walls) in Revit.

Using AutoCAD in the conceptual design phase gives architects the power and flexibility to explore a wide range of ideas very quickly. They can then bring those innovative designs into Autodesk Revit-based software to slice floors and complete the building model.

AutoCAD Conceptual Design in Manufacturing

With pressure to develop innovative and aesthetically appealing products faster than ever, manufacturers need easy-to-use tools that let them quickly iterate and modify conceptual designs for their products. Let's take a look at how a small manufacturer can use the conceptual design tools in AutoCAD to design a case for an electric shaver designed in Autodesk® Inventor® software. This is just a sample design workflow; there are many different workflows designers and engineers at a manufacturing company could employ.

Sketching Ideas

The designer first exports a DWG™ file of the razor's exterior from Inventor into AutoCAD, using the AEC Exchange function. Then, with Autodesk SketchBook Designer, he makes an underlay of this solid model on an AutoCAD canvas and starts sketching over it. This way, he can check that the razor will fit into the case he designs. If any changes are made to the model, the designer can update the underlay.

Then, with the sketching feature enabled via the Autodesk SketchBook Designer plug-in, he can use powerful illustration and fill tools to add color and detail to his design. The Transform tool lets him manipulate geometry quickly until he finds the right look for the case. Free-form vector curves created in Autodesk SketchBook Designer can be pushed back into AutoCAD as native 2D geometry.

Creating Curves and Surfaces

Now that he's created a sketch he likes, the designer can use that image to trace splines in AutoCAD. He can create curves using control vertices, or use direct manipulation to stretch, add, remove, or refine vertices without going into spline editing commands.

Once the curves are as he likes them, the designer can create explicit surfaces—each surface maintains the properties belonging to its method of creation. Because surfaces are associative, AutoCAD tracks changes to original geometry and rebuilds surfaces automatically, saving the designer time and helping him avoid errors.

Now it's time to blend surfaces. The designer uses the direct manipulation capabilities in AutoCAD to edit continuity and blend, all without leaving the model or using dialogue boxes that can disrupt workflow.

Understanding Manufacturability

To ready his shaver case design for fabrication, the designer must create a solid that can be opened in Autodesk Inventor. But first, he must analyze the shape to understand whether the part is manufacturable. For example, he may discover a lack of continuity between the top and side of the case. Using the Blend Surface tool, he can easily change continuity and ensure proper curvature between surfaces.

Beyond 3D to Digital Prototyping

The designer now has a 3D case design—but today, that's no longer enough. The manufacturer needs to go beyond 3D to Digital Prototyping, using Autodesk Inventor software. Opening the AutoCAD DWG file in Inventor, an engineer adds details for fabrication—he might shell the geometry, add ribs to the structure, and add a series of aesthetic and technical details. Now the conceptual design is a real plastic part, ready for production.

AutoCAD: A Flexible, Powerful Tool for Conceptual Design

Even three years ago, it would have been unlikely for an architect, designer, or engineer to use AutoCAD to experiment with conceptual designs. But that's no longer the case. AutoCAD now includes powerful, flexible conceptual design tools that make it simpler and faster to explore ideas and create models primed for the next stage of development in Autodesk Revit or Autodesk Inventor software. In the familiar environment of AutoCAD, users can create almost any shape imaginable and intuitively experiment with concepts that give their designers and manufacturers a competitive advantage.

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Designs That Rock

How do you wow fans at a Bon Jovi concert? Tait Towers rose to the challenge by designing a spectacular stage set incorporating complex circular stages, five robots, more than 500 magnetic video tiles, and 500 miles of cable.

Tait Towers relied on the 3D modeling tools in AutoCAD software to conceptualize a vision for the stage, video wall supports, and lighting towers. “With the 3D capabilities of AutoCAD software, it’s fast and intuitive for us to turn ideas into conceptual designs we’re confident that we can build,” explains Tyler Kicera, a lead designer with Tait Towers.

Rendering the conceptual designs with Autodesk® 3ds Max® Design software, Tait Towers secured feedback from Bon Jovi and the production designer before finalizing the detailed 3D design required for manufacturing.

“As sets have gotten more elaborate, production schedules are ever tighter. That’s the reason we rely on AutoCAD software. It helps accelerate conceptual design, reviews, and manufacturing,” says John Filson, chief information officer at Tait Towers.

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