Transition to 3D Fabrication Workflows

Autodesk is committed to the use of Building Information Modeling (BIM) to drive integrated and connected data across the building lifecycle. Autodesk® Fabrication solutions help extend BIM workflows to mechanical, electrical, and plumbing (MEP) contractors. With help from these solutions, contractors can more quickly and easily convert 2D and 3D design-intent models into constructible, 3D detail models populated with real-world, purchasable components that can be used to accurately estimate project costs and detail MEP systems for fabrication—without wasting valuable time and resources on redrawing designs or recapturing lost data.

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Introduction

According to the McGraw-Hill Construction *Prefabrication and Modularization SmartMarket Report* (2011), prefabrication and modularization are seeing increasing popularity among design and construction professionals. Many see these practices as ways to improve worksite productivity, safety, competitive advantage, and ROI. Others value them for their ability to reduce construction waste and build greener projects. Among the hundreds of AEC professionals surveyed, the highest levels of current and future usage were reported among mechanical contractors, design-build firms, and subcontractors, including mechanical, electrical, and plumbing (MEP) systems fabricators.

MEP systems detailers and fabricators are responsible for converting the design-intent models into detail-level, constructible fabrication models populated with either real-world purchasable or fabricatable components that, in turn, help enable more accurate estimates of project costs and drive MEP systems fabrication.

Traditionally, detailers/fabricators received MEP design-intent drawings in one or more 2D formats, including DWG™, PDF, JPEG, and even, in some cases, paper. To convert these types of 2D drawings to a format useful for cost estimation and fabrication, contractors using traditional tools are forced to manually redraw the designs by hand—an approach that is time-consuming, often results in data loss, and ultimately produces a detailed, but still a flat, 2D design that is difficult for other disciplines to interpret properly.

More recently, MEP designers and engineers have started trending toward providing 3D design-intent models produced in software such as Autodesk® Revit® or Autodesk® AutoCAD® MEP. 3D models are easier to understand than 2D drawings, but these schematic models nonetheless still lack intelligence and require time-consuming, hands-on redrawing of their generic model components into real-world, purchasable and fabricatable components.

The emergence of advanced 3D workflows

The emergence of Building Information Modeling (BIM) over the past decade—along with its associated advancements in trade and discipline interoperability—has caused these inefficient ways of working to begin giving way to new, more productive workflows.

BIM first gained traction among architects, who gradually pushed it downstream to structural, civil, and MEP engineers. Today, BIM use is widespread in Architecture, Engineering, and Construction (AEC) industries. Project owners and government agencies around the world have begun mandating its use on projects of every size and its impact has permeated every stage of the design process—including MEP systems fabrication.

Figure 1. Fabrication level detail model of HVAC system
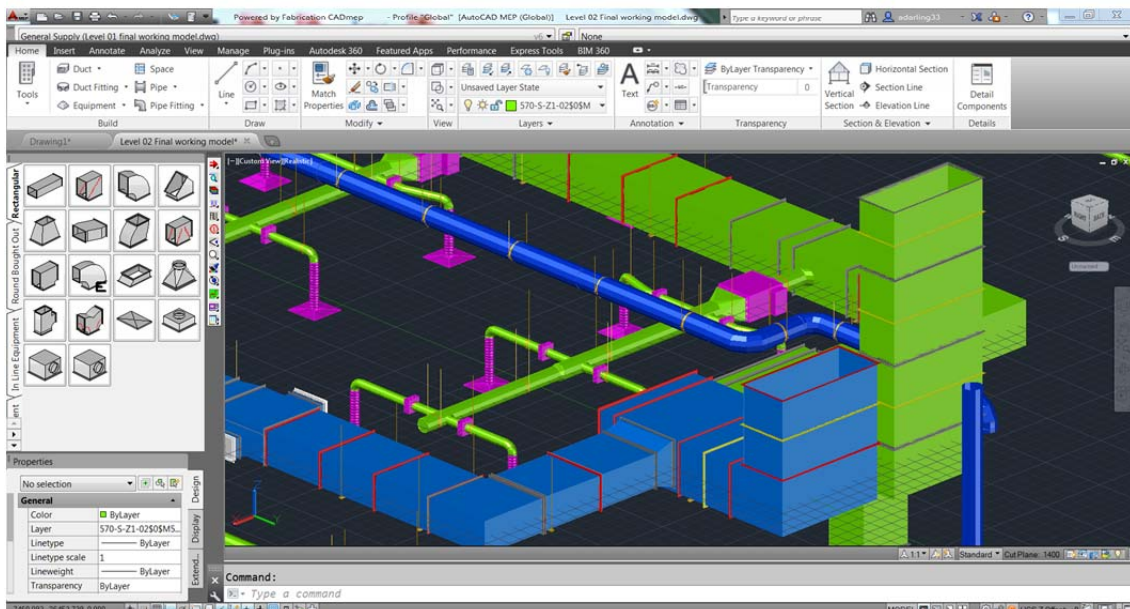
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Autodesk® Fabrication solutions provide new tools that help MEP contractors to streamline and accelerate their workflows, whether they continue to work with 2D input models or transition to a complete, end-to-end 3D workflow.

When working with clients who continue to produce 2D deliverables, MEP contractors can take advantage of tools that allow them to significantly accelerate the manual redrawing process. These tools simultaneously incorporate both constructability and intelligence into the redrawn models. The immediate benefits are increased productivity, coordination, and competitive advantage. In the longer term, contractors who take this approach have future-proofed their firms against the growing number of owners, government agencies, architects, and MEP engineers who require the use of intelligent 3D workflows.
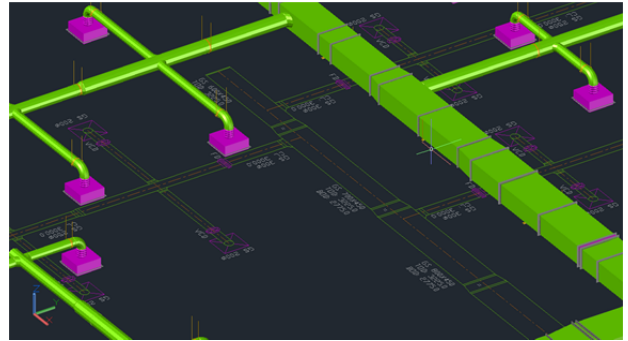

Figure 2. Use 2D deliverables to create detail model

Using Autodesk Fabrication CADmep or Autodesk Fabrication ESTmep, MEP contractors who adopt an end-to-end 3D workflow can significantly reduce manual redrawing by automatically convert an incoming 3D design model into a fabrication-level detailed model, swapping out the generic items for, or mapping them to specific, real-world, intelligent components with associated pricing, labor costs, performance information, and more.

For example, a contractor receiving a PDF layout of the MEP systems can use Autodesk Fabrication CADmep or Autodesk Fabrication ESTmep to quickly trace over elements and create an accurate model of the systems in a fraction of the time required by remodeling from scratch. If the contractor receives a 3D model created in either Revit or AutoCAD MEP, he or she can easily convert the systems. Once the model is converted, the contractor can ensure that the systems are clash-free prior to beginning estimation and fabrication.

This approach saves a tremendous amount of time and minimizes human error as it eliminates both manual redrawing and all associated data loss. The resulting fabrication model is more geometrically—and thus spatially—accurate and ready for coordination with other trades and services.

A unified database

At the heart of the Autodesk Fabrication solutions is a single, integrated database of content and information. In traditional fabrication detailing and estimating workflows, data exists in software-specific, disconnected silos. As a result, contractors have difficulty transferring data among detail drawings, estimates, and fabrication outputs with disparate file formats from disparate software solutions. Thus, without a common database, information is commonly lost in transfer, often resulting in inaccurate cost estimates, detailing errors, and change orders. In many cases, what the contractor ends up estimating or fabricating is not what he or she originally designed.

The integrated Autodesk Fabrication content libraries and database, however, are common to all three fabrication disciplines, the detail modeling, estimating, and fabrication solutions, which:

- Support detailing, fabrication, and installation workflows
- Create accurate, competitive bids and cost estimates
- Manage and control the ductwork manufacturing production line

With a common database, when something changes in one application—drawing, estimation, or fabrication—it is reflected throughout the products, with no loss of data.

Figure 3. Common database for Fabrication CADmep, ESTmep and CAMduct
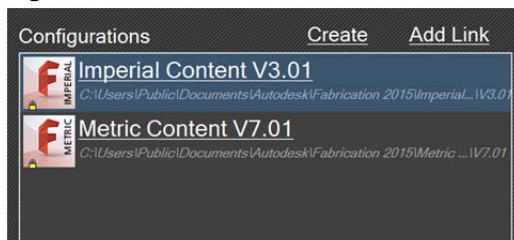
More accurate estimates

In this optimized, intelligent 3D workflow environment, library elements possess values—such as material, fabrication, and labor costs—that project estimators can easily capture. As MEP contractors add components to or remove them from the model, they are simultaneously adding or removing the costs associated with purchasing, fabricating, and installing the components. Linking components to costing helps enable MEP contractors to simultaneously create highly accurate bids that not only account for parts, but for labor as well.

Move directly into fabrication

Once the contractors have submitted a bid and won a project, they can move the model created to estimate the bid directly into Autodesk Fabrication CADmep or ESTmep for further detailing, with no loss of time and data and no need to manually redraw content. Comprehensive libraries of 3D parametric fixtures and fittings help contractors meet manufacturing requirements.

Change is easy

By adopting Autodesk Fabrication solutions, contractors can produce more accurate estimates and bids, quickly generate fabrication-level models, and move directly to fabrication, retaining the "I" in BIM throughout. As discussed in the *Prefabrication and Modularization SmartMarket Report*, many MEP contractors have already made the switch to intelligent, 3D fabrication workflows.

Many more, however, are reluctant to make the switch, being concerned with adoption issues such as the learning curve and loss of productivity due to lack of understanding. Fortunately, the learning curve is relatively easy because Autodesk Fabrication CADmep is based on AutoCAD software, sharing the same interface and basic tool set. The most important part of setting up the solution involves articulating the basic rules that will govern the conversion or mapping process and setting up the mapping and costs based on your company's standards.

For example, there are two methods for exporting Revit content so that it can be used within CADmep.

The first method is Store Design Line Elements. This method should be used where Revit elements can be matched to corresponding Items in CADmep. These are usually standard elements such as ducts, pipes, cable trays, straights, and fittings. This process will convert the Revit System to a CADmep Design Line.

The second method, Store Graphic Elements, should be used where no match can be made between Revit elements and CADmep Items. A custom Revit Family of an air handling unit would be an example of a Revit element with no corresponding CADmep Item. The raw geometry of the exported Revit elements is used to create CADmep Items with the connectors at the correct locations.

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