

Transitioning to BIM – A Guide for MEP Firms

Building Information Modeling (BIM) is an intelligent model-based process that provides insight for creating and managing building and infrastructure projects faster, more economically, and with less environmental impact. As BIM continues to gain momentum in the AEC industry, more and more owners, architects, and even contractors are demanding the use of BIM to support building design, construction, and lifecycle management.

This paper offers insight into how mechanical, electrical, and plumbing (MEP) engineering firms are transitioning to BIM by profiling the best practices of one firm that has recently implemented Autodesk® Revit® MEP.

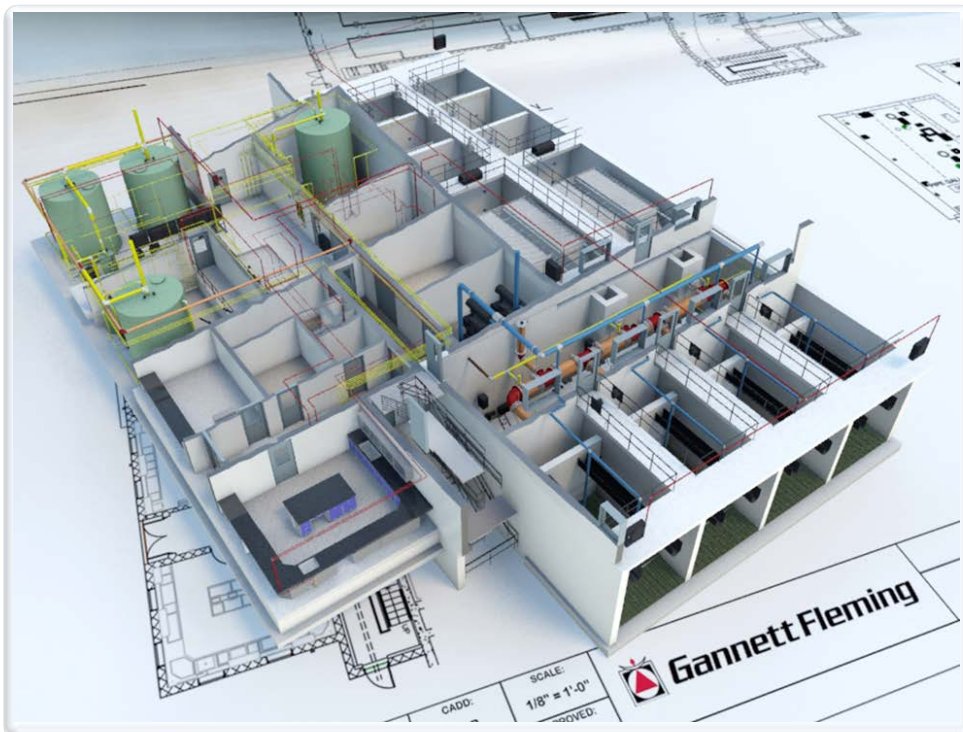


Figure 1. Infrastructure firm Gannett Fleming transitioned to Revit MEP in 2010.

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Introduction

McGraw-Hill Construction reported that in 2009, almost half of the building industry is already using BIM to deliver better performing, higher quality buildings—a 75% increase in usage in just two years¹. MEP firms are in the middle of this transition, using new technologies and processes that are changing traditional approaches for project design, delivery, and management.

The paper profiles how one firm—Gannett Fleming, Inc.—made the transition to BIM. Headquartered in Camp Hill, Pennsylvania, Gannett Fleming provides consulting engineering, planning, and construction management services from more than 60 offices worldwide. Like many engineering firms, Gannett Fleming has used AutoCAD® and AutoCAD® MEP software (the discipline-specific version of AutoCAD) for many years. The strength and familiarity of the AutoCAD environment has helped the firm effectively deliver thousands of very complex projects. This paper highlights how Gannett Fleming moved to a BIM workflow based on Autodesk® Revit® MEP software, while continuing to rely on the familiar AutoCAD platform for certain design and documentation tasks.

¹ McGraw-Hill Construction, “*SmartMarket Report: The Business Value of BIM*”, July 2009

Deciding to Move to BIM

Gannett Fleming is a multipurpose engineering and architectural firm. Their architectural departments were the first to embrace BIM with help from Autodesk® Revit® Architecture software in 2006, followed by the structural groups who began using Autodesk® Revit® Structure in 2007. In 2010, the firm's MEP engineering groups decided to transition to BIM and began implementing the Revit MEP software.

With many different choices for BIM solutions, several factors influenced Gannett Fleming's decision to use Revit MEP. Having utilized AutoCAD for many years, the firm wanted to use a BIM solution from Autodesk. In addition, since other groups in Gannett Fleming were already using Revit software, the firm had a large existing base of experienced Revit users.

More importantly, Revit MEP gave the firm a competitive advantage. Many of its clients and design partners were already using Revit software, and the firm understood the value of being a BIM-ready multidiscipline firm.

The migration to Revit MEP was not a decision made lightly, as Gannett Fleming had years of experience and success using AutoCAD MEP. Any new design platform had to meet or exceed its existing design process. In addition, the new platform has to accommodate Gannett Fleming's various MEP disciplines—including process, mechanical HVAC, electrical power, electrical lighting, and plumbing—helping the firm to coordinate projects across these design disciplines.

The McGraw-Hill report cited earlier also stated that 70% of owners reported a positive ROI from BIM and half of owners indicated that a significant benefit of BIM was overall better construction project outcomes. The increasing demand for BIM from owners coupled with Gannett Fleming's realization that BIM could help the firm design better buildings that benefit its clients was another major factor in the firm's decision to move to BIM.

Preparing for Change

Planning Ahead

Gannett Fleming began its transition to BIM by assembling a team of Revit experts to lead the effort. This team was responsible for the firm's BIM implementation strategy. The implementation strategy addressed process changes, educational requirements, and the integration of the firm's existing tools for design, analysis, and documentation (including Revit Architecture and Revit Structure).

Gannett Fleming's implementation team included specialists from the architectural, structural, and MEP disciplines. For each new BIM project, the firm drew from this team and assigned one of its specialists to manage the use of BIM on that project.

Right-sizing Infrastructure

Gannett Fleming was committed to realizing the value of BIM and wanted to ensure that its technology infrastructure supported the complex models and increased opportunities for collaboration that are inherent to BIM. To that end, the firm identified what workstations were sufficient for the Revit MEP software and BIM workflows, and what workstations needed to be upgraded or replaced.

Gannett Fleming used the worksharing capabilities of Revit MEP to share a single, centralized project file amongst its project team (see sidebar). One of the advantages of worksharing is a reduction in network traffic.

As a result, Gannett Fleming determined that their network was sufficient for BIM and no upgrades were necessary, however the firm did invest in extra server storage capacity to store the supporting Revit MEP files and data.

Revit software uses a process called *worksharing* to share a single, centralized project file amongst a project team. A master project file, also known as a 'central file', contains all building model data subdivided into functional areas and saved in a shared location on a network so that more than one person can work on that project. Individual users save a copy of this central file to their local workstation, allowing them to work independently in that model. This local file acts as an interface mechanism for synchronizing local changes with the central file.

Training for Success

Next Gannett Fleming's implementation team developed a comprehensive training program and identified the necessary budget to help the firm transition from CAD to BIM. The program included both corporate BIM training and product training.

Corporate BIM Training - Introducing BIM into the office affects more than the CAD users—it introduces methodology changes that ripple throughout a company, affecting business processes, project staffing, technology requirements, and even service offerings. Unlike the move from manual drafting to CAD, BIM is a strategic initiative that requires company-wide support to succeed. Gannett Fleming's corporate BIM training program helped its executives, project managers, and other influential project members understand what BIM is, why it necessitates process changes, and how it could benefit Gannett Fleming.

Product Training - At the start of each new project, CAD users attended in-house Revit MEP product training, taught by one of the specialists from the implementation team. This dedicated team of BIM specialists also provided advanced training, ongoing project support, and just in time mentoring (as needed), easing the apprehensions of its novice BIM users. The BIM specialist also assisted with custom family creation (see sidebar). As projects progressed, newly trained Revit MEP users took over content development, resulting in faster turnaround.

All Revit MEP modeling elements are created with Revit *families*. This includes the mechanical and electrical equipment, lighting and plumbing fixtures, duct, and piping that are used to assemble a building model, as well as the callouts, fixtures, tags, and detail components that are used to document a project. Revit MEP includes an extensive library of predefined families. In addition, users can create new families to add custom elements to Revit MEP models.

Rethinking Design and Drawing Production

An important component to the Revit MEP product training was the fundamental change from a drawing-based workflow to a model-based process. During a traditional CAD-based project, each discipline creates its own set of files (drawings). At key milestones, the project team gathers all the contract document sheets. A model-based BIM approach renders that workflow obsolete.

For example, users create Revit models and all the project documents are either graphical views (drawings) or tabular views (schedules) of this underlying model. Instead of exchanging drawings, project teams share models for project coordination and design review. The Revit software automatically coordinates design changes and updates all relevant project documentation including schedules, elevations, sections, or plan drawings.

Today Gannett Fleming typically uses a central Revit MEP model for its projects (see the previous Revit worksharing sidebar). This enables users to connect building systems (HVAC, electrical, or plumbing for example) to the various components in a building. As a result, multiple people work in one model file. Users add their own design discipline to the model and create model views that reflect the requisite contract document sheets needed for their particular discipline.

When Gannett Fleming migrated to BIM, this transition to a model-based approach for design and documentation was the firm's most significant workflow change as it altered the way the teams were working. All of the firm's new Revit MEP users had to be trained and practice in the new approach.

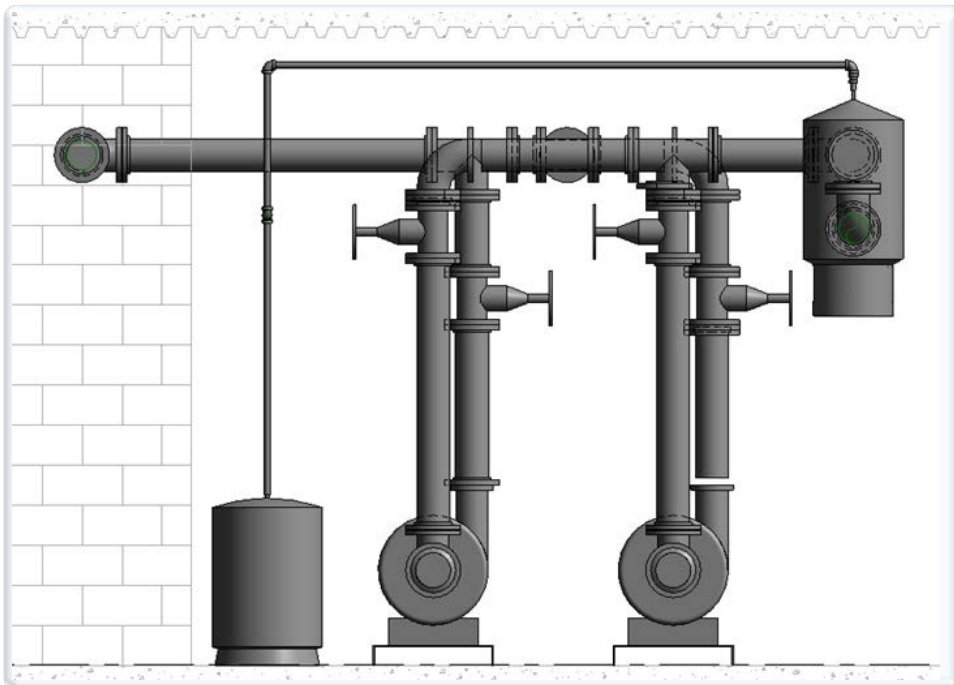


Figure 2. Model-based design and documentation requires a change in process.

Piloting New Workflows

Gannett Fleming was fully aware that using BIM across design disciplines and companies requires significant workflow retooling. To help the firm better understand these methodology changes, the team decided to redesign two existing projects using BIM. These projects would be pilots for its Revit MEP implementation and, in addition, help the firm plan how best to use Revit MEP in conjunction with extended multidiscipline design teams.

The firm chose a small commercial building and a small water treatment plant for the pilot projects. The water treatment plant is a 4 MGD (million gallons per day) facility that incorporates traditional and new design elements. The commercial building is a four-story, 75,000-square-foot building located in Harrisburg, Pennsylvania that includes retail shops, restaurants, as well as office and educational spaces. The project, which features a geothermal heating system with photovoltaic solar roof panels, has achieved LEED® Core & Shell Gold certification. The projects were originally scheduled to be designed using AutoCAD.

At the onset of the projects, the firm established what software solution every member of the team was using and then developed a plan of action to share and coordinate information and project files. Gannett Fleming's BIM project execution plan was an essential tool for the pilot project and the firm now develops a similar plan for all of its BIM projects.

BIM Project Execution Plan		Gannett Fleming	
Overview			
The intent of this BIM Execution Plan is to provide a framework that will let the architects, engineers, and construction managers deploy building information modeling (BIM) technology and best practices on this project faster and more cost-effectively. The BIM Project Execution Plan defines uses for BIM on the project (e.g. design authoring, cost estimating, and design coordination), delineates roles and responsibilities of each party, the detail and scope of information to be shared, relevant business processes and supporting software, along with a detailed design of the process for executing BIM throughout the project lifecycle.			
Project Information			
Project Owner			
Project Name			
Project Address			
Project Description			
Project Number			
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Figure 3. Gannett Fleming's BIM project execution plan was an essential tool for the firm's BIM pilot.

This project execution plan defines the roles of the key BIM players on the extended project team for all the major project disciplines. To capture the overall design process, this team definition encompasses architects, structural engineers, civil engineers, landscape architects, as well as its own mechanical, electrical, lighting, and plumbing engineers. The project execution plan also documents Gannett Fleming team members from different groups and/or different locations, and external design partners and consultants from different companies.

In addition, Gannett Fleming factors related products for model sharing, collaboration, and data management—such as Autodesk® Revit® Server, Autodesk® Buzzsaw® software as a service, and Autodesk® Vault Collaboration AEC software—into its plan to fully define the flow of project information throughout the team.

Sharing Project Data

If the whole project team is using software based on the Revit® platform, the project execution plan includes the methodology for sharing the various Revit models and addresses any issues related to sharing models created using different versions of the software (as needed).

If some members of the team are not using Revit software, Gannett Fleming must adjust its approach for file/information sharing and project coordination accordingly. Generally, this means that the firm will be incorporating DWG-based AutoCAD design data into its Revit models.

On the other hand, if Gannett Fleming is the only member of the team using Revit MEP, the firm must define how it will share and coordinate information and files with other members of the project team. Generally, this means exporting selected Revit MEP views to DWG format, enabling AutoCAD users to reference those DWG files for their design and documentation needs.

When necessary, this transfer of project data between BIM and CAD systems becomes an additional step in Gannett Fleming's process. The firm documents the data transfer process in its project execution plan and accounts for the additional time in its project schedule.

Retooling for BIM, Step by Step

During the Gannett Fleming's pilot projects, the implementation team evaluated how best to use Revit MEP and its existing software tools in the context of a model-based design process—from early schematic through to detailed design and documentation.

Step 1 - Early Schematic Stage (Analysis, Primary Structures and Equipment)

Gannett Fleming's pilot team began by interviewing the original design teams to understand how they accomplished their early schematic design tasks using a CAD-based workflow. The team then retooled that process to take full advantage of the capabilities of its new BIM software.

For example, Gannett Fleming designs a large number of buildings for water treatment plants. Previously, the process team started the schematic design by having a senior designer work with the engineers to create a process flow diagram and hydraulic profile of the site. These diagrams were usually created as paper sketches. Next, the designer created an initial 2D schematic design in AutoCAD using lines, arcs, and circles.

The process designer also created a 2D AutoCAD footprint of the building, which was used to locate pipelines, duct, and other equipment in the building. Since the footprint was defined for schematic purposes only, the printed drawings were passed to the architect and architectural drafters recreated the building footprint as an architectural AutoCAD drawing, using their own templates and company standards.

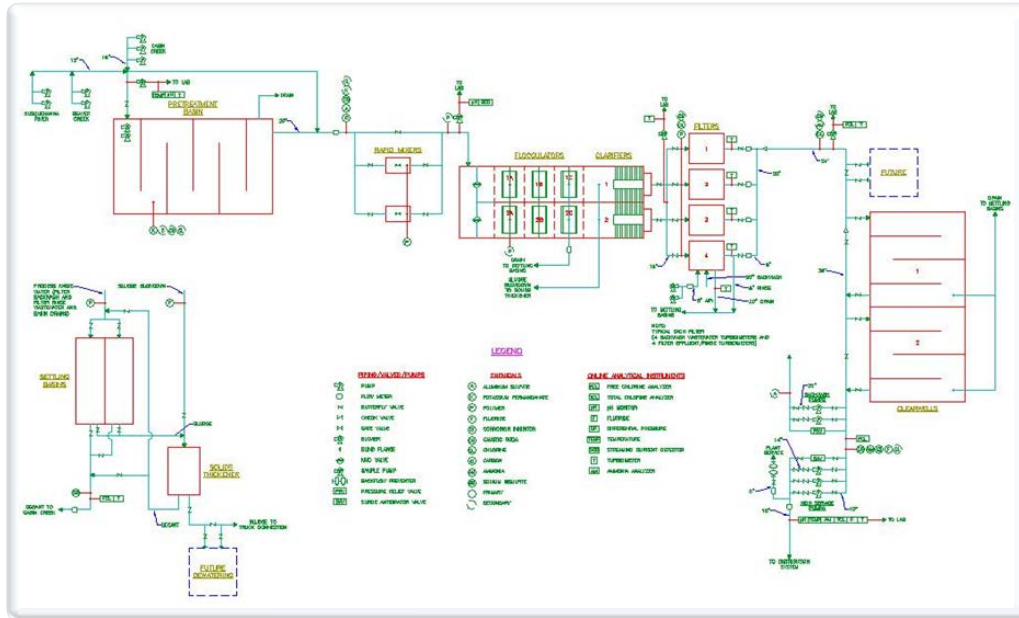


Figure 4. Gannett Fleming uses Revit MEP to create initial schematic models.

To improve this process, Gannett Fleming started its BIM pilot by using Revit MEP to create an initial schematic model versus 2D linework. Even this simple change gave the design team a better idea of how the building systems work because the schematic model included building levels at real world elevations.

The model also helped the designers to visualize how the building would be assembled and uncover potential constructability issues much earlier in the design process. This is particularly important during site-critical projects where the hydraulic profile is the driving force behind the design.

Another advantage of using Revit MEP at the early schematic stage is the ability to use the schematic model for a variety of other design activities (see sidebar). During its pilot, Gannett Fleming's implementation team learned how to use the Revit MEP model for energy analysis. During the original design of the commercial building, the information needed for energy analysis had to be manually entered into the energy analysis program the firm uses.

The BIM team worked with the original design team to understand what specific data was required for their energy analyses and built that into their new BIM workflow for schematic design so that the firm's Revit MEP design models were suitable for future energy analyses.

The intelligent information contained in Revit MEP models can be used for many kinds of calculations and analysis such as energy analysis, building systems connectivity, and sun path simulation. In addition, the models can be shared with other engineering teams for their design needs, such as sanitary and storm drainage or site design.

Implementation Tips

- During the pilot, the Gannett Fleming team started their schematic design by using Revit MEP to create a basic architectural model of the building, including rooms, names, numbers and engineering spaces. Next, the team created a structural model using Revit Structure and moved walls originally created in the architectural model to the structural model since they were structural walls.

However, as they were new Revit users, they did not realize that by doing this the room's bounding walls (that are used to define the room spaces) were lost. The structural model was linked to the architectural model, and the rooms were redefined. As a result, when the model was used for energy analysis, the analysis failed since the original bounding element (the room) was lost in the architectural model. The issue was resolved by linking the structural model to the MEP model, and making it a room-bounding element.

This misstep highlights the importance of not replicating CAD-based practices in BIM workflows. Gannett Fleming CAD users were still applying tasks using the same method as they had in AutoCAD, where the structural engineer was recreating the drawing from an original architectural drawing. The team could have instead used the Copy/Monitor tool to copy walls from the architectural model into the structure model, helping to save considerable rework and avoiding the eventual abandonment of using spaces to assist with the creation of the analytical model. In hindsight, they learned to wait until the architectural and structural model are more clearly defined and coordinated before creating the MEP model.

- Another issue involved the creation of levels within a model and the ownership of these items. Typically, the Revit user only uses one level type to define a floor level (the default datum level). Visually, the level graphic looks the same in an elevation view, regardless of the use of the level. During its pilot, Gannett Fleming used top of wall and top of structure levels, in addition to floor datum levels. Without the visual and informational cue, the engineering teams created plan views in the MEP models of all levels, regardless of whether or not the project was going to have a plan view based on that particular level.

The solution was to add additional level types, making non-datum levels non-room bounding, and changing their color and line pattern, so that it was easily discernable from the traditional datum level. By addressing these issues early in the schematic design process, additional benefits were gained by using Revit to create the early design models and fine-tuning it to help the designers gain a better understanding of what was actually happening with the building design.

Step 2 - Understanding and Implementing Systems

Once Gannett Fleming's conceptual models were completed, the engineering teams began to create the actual layout of piping and HVAC systems. As with the early conceptual models, the firm's traditional approach was to have the engineer sketch out the system on paper or as 2D AutoCAD elements. Using model-based design, Gannett Fleming was able to transfer the bulk of this task to the designers. Using Revit MEP, the designers modeled the major equipment at the proper locations and then routed their own systems for the equipment.

During its Revit MEP pilot training, the Gannett Fleming team approached this stage of their design by thinking of equipment as targets and sources. Components that receive air, fluid, or power were targets and those targets were supplied by sources. Using this logic, the team was focused on designing a complete building system (going from the source to the target) and therefore took into consideration the location and orientation of equipment.



Figure 5. Using model-based design, Gannett Fleming was able to transfer the bulk of system layout from engineers to designers.

For example, in one of the pilot projects, the designer placed the roof top units (also referred to as sources) in the model and then worked from the lowest level up, creating the logical system that connected main floor water source heat pump terminal units (the targets) to the primary air-handling unit, and so on. Then the team used the Revit MEP automatic layout features to route the physical duct and compare the resulting routing to the project's original 2D plans.

The team discovered areas that could have been tweaked in their original 2D CAD layout to create a more efficient system and also found a problem with alignment through a chase. By visualizing the system design in the Revit MEP model, the designers could more quickly isolate and study solutions for the vertical transition from the ground floor to the roof.

In addition, one of the firm's new Revit MEP users was able to use various vendors' part selection programs to help build and design a Revit family of fans with the manufacturers' fan design data that were needed for the project. Once the family was complete, he used the fan components in his Revit MEP design, automatically incorporating the manufacturer's fan design data from the fan component directly into the Revit model. This allowed him to reuse that data to review the entire connected system and to check to see if it matched the design criteria.

Step 3 - Creating the Layouts

When the time arrived to start refining piping and duct layouts, Gannett Fleming blended its model-based BIM approach with its traditional CAD practices. Experienced senior designers used Revit MEP to create layouts. The layouts were then printed and reviewed by the engineers, who made redline revisions and comments, which were then incorporated by the user. In some cases, the engineer and designer worked side by side to make the change, reducing the number of steps needed to create the layouts.

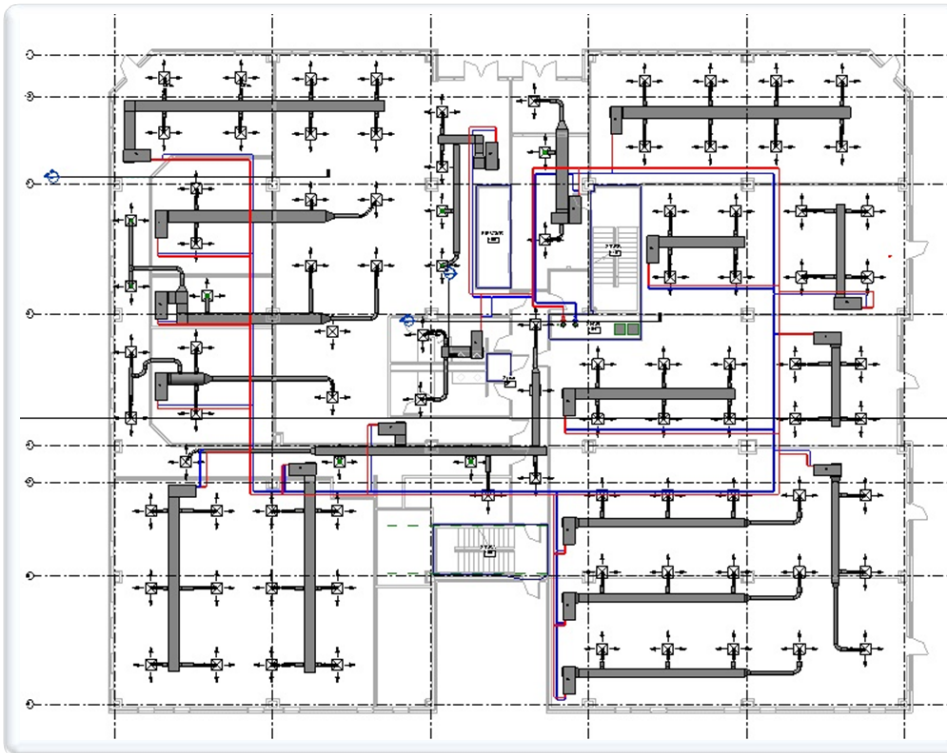


Figure 6. To refine piping and duct layouts, Gannett Fleming blended its model-based BIM approach with its traditional CAD practices.

In Gannett Fleming's traditional process, connection and routing issues were typically resolved late in the design process or even in the field. Using Revit MEP and the concept of the Revit central file (see previous Revit worksharing sidebar), the designers coordinated the project as they went, performing clash detection against other systems. By having all objects from all disciplines readily available, the quality of the design in earlier stages was dramatically improved and allowed the design teams to focus on other areas, such as improving design efficiencies.

Another area of improvement was the electrical layout and data associated with motor control centers. The manufacturers that Gannett Fleming works with (and specifies on a regular basis) provided the team with Revit content, making it much easier for the team to create their layouts. In addition, the manufacturers' Revit families (see previous Revit families' sidebar) included key data the electrical designer needs to verify loads and help create properly defined circuits for equipment in the facility.

Gannett Fleming's electrical designers still used manufacturers' online sizing and layout tools, but now they also received the correct part as a Revit MEP family. Gannett Fleming took advantage of its relationship with its manufacturers to create a more accurate representation of this electrical room, helping the team quickly identify and resolve space issues and avoid the need to change the original room sizes.

Step 4 - Annotating and Documenting the Model

Gannett Fleming's CAD-based documentation process relied on Excel® spreadsheets and other tabular specifications to define data such as equipment schedules and load calculations. The fact that those items (and the data they contained) were disconnected from the design created many opportunities for discrepancies between the CAD documents and the specifications. Intelligent Revit models gave Gannett Fleming an opportunity to help correct this situation.

REVIT TRANSITIONING TO BIM – A GUIDE FOR MEP FIRMS

By building the Revit MEP model in logical steps and embedding important data during the equipment placement and system layout, the firm's Revit MEP users set the stage for streamlining its documentation process.

To revamp their documentation process, Gannett Fleming's BIM team started by spending a substantial amount of time reviewing how design data was included and presented in its CAD-based construction documents and found numerous inconsistencies, even between its own disciplines and offices. Next, the team reformatted all the schedules—regardless of discipline—and modified the appearance of schedules so they all matched. In addition, they changed the layout of the schedules so that important design information was in the same place on every schedule for every discipline, which helps contractors quickly locate data.

LIGHTING FIXTURE SCHEDULE									
TYPE	DESCRIPTION	LAMP QTY.	LAMP TYPE	MOUNTING	MAX. WATTAGE	VOLTS	BASIS FOR DESIGN		REMARKS
							MANUFACTURER	MFR. CATALOG #	
	FLUORESCENT STAIR LUMINAIRE	1		WALL	60	120	LIGHTOLIER	LM80-1-54-PG-EM	PROVIDE WITH EMERGENCY POWER PACK
A	2'X2' INDIRECT FLUORESCENT	2	24W T5HO	RECESSED	48	120	LEDALITE	9422-01-0T-R224-S	PROVIDE WITH LUTRON DIGITAL DIMMING BALLAST, ECC T504 UVW-2
B	2'X2' INDIRECT FLUORESCENT	2	14W T5	RECESSED	34	120	LEDALITE	9422-01-0T-P214-S	
C	MIRROR LUMINAIRE	2	14W T5	WALL	32	120	TECH LIGHTING	T08EC LUN24-C	
D	1'X1' SHOWER LUMINAIRE	1			60	120			SHOWER LIGHT PROVIDED BY PREFABRICATED SHOWER STALL MFG
E	FIBERGLASS INDUSTRIAL ENCLOSED AND GASKETED	2	54W T5HO	SUSPEND	110	120	COLUMBIA LIGHTING	LUN4-204-EP-SGL	STEM SUSPENSION
EM.1	LOW PROFILE EMERGENCY LIGHTING UNIT	2	18W INCAN	WALL	36	120	DUAL LITE	CVS-6-RNSH0010-1-V	BATTERY PACK WITH EV OUTPUT FOR ADMIN AREAS
EM.2	INDUSTRIAL PROFILE EMERGENCY LIGHTING UNIT	2	18W INCAN	WALL	36	120	DUAL LITE	LM-56-1-V-AHDSH0010	INDUSTRIAL BATTERY PACK WITH EV OUTPUT FOR NEBA 12 AREAS
EM.3	INDUSTRIAL PROFILE EMERGENCY LIGHTING UNIT	2	18W INCAN	WALL	36	120	DUAL LITE	LM-56-1-V-AHDSH0010	INDUSTRIAL BATTERY PACK WITH EV OUTPUT FOR NEBA 12 AREAS
EM.4	EXIT SIGN SINGLE FACE	0	LED	WALL	4	120	DUAL LITE	CVER-1-D-N-E	ADMIN AREAS, PROVIDE DIRECTIONAL ARROWS WHERE SHOWN
EM.5	EXIT SIGN SINGLE FACE	0	LED	SEE FLANG	4	120	DUAL LITE	SEHL-S-G-E-E-EC	NEBA 12 AREAS
EM.6	EXIT SIGN DOUBLE FACE	0	LED	SEE FLANG	4	120	DUAL LITE	SEHL-S-G-E-E-EC	NEBA 12 AREAS
EM.7	EXIT SIGN SINGLE FACE	0	LED	WALL	4	120	DUAL LITE	LC-U-G-E-E-1	NEBA 12 AREAS
F	INDUSTRIAL FLUORESCENT	1	54W T5HO	SUSPEND	60	120	LIGHTOLIER	TU-4-P-104	STEM SUSPENSION, PROVIDE WITH WIRE GUARD
G	INDUSTRIAL FLUORESCENT	2	54W T5HO	SUSPEND	110	120	LIGHTOLIER	TU-4-P-104	STEM SUSPENSION, PROVIDE WITH WIRE GUARD
H	FLUORESCENT STAIR LUMINAIRE	1	54W T5HO	WALL	60	120	LIGHTOLIER	LM80-1-54-PG-EM	PROVIDE WITH EMERGENCY POWER PACK
J	INDUSTRIAL FLUORESCENT WALL FUTURE	2	54W T5HO	WALL	110	120	DAY-BRITE LIGHTING	CP-2-54-S-1T-00F	
K	CUTOFF WALL SCONCE	1	COMPACT FLUOR 32W TRIPPLE BLK	WALL	36	120	GARBCO	101-BT-32TRF-88F-F-FC8	PROVIDE WITH INTEGRAL PHOTOCONTROL
K.1	CUTOFF WALL SCONCE	1	COMPACT FLUOR 32W TRIPPLE BLK	WALL	36	120	GARBCO	101BWC-WT-32TRF-88F-F-BCF	PROVIDE WITH COLD TEMPERATURE EMERGENCY BATTERY AND INTEGRAL PHOTOCONTROL

Figure 7. During equipment placement and system layout, Gannett Fleming embeds important data in the Revit model to streamline its documentation process

By embedding specific data in both type and instance parameters in Revit families, Gannett Fleming was able to leverage tags in the model to easily display the necessary data. For example, the lighting designer embedded intelligent information such as load, voltage, mounting, and other design data into each type of light. When a light fixture is added to a model, the data embedded in the fixture is automatically populated in the light fixture schedule. This streamlined the process, as the lighting designer was able to review the data early in the project, and take advantage of having the schedule automatically populated as the designer used the various lighting families.

Although the team still performed their lighting analysis outside of the Revit model, they gained a production benefit from the use of Revit MEP because they did not have to populate a schedule in Excel manually.

The extensive work completed in the pilot's earlier stages helped Gannett Fleming produce high quality, detailed documentation in both hard copy and model form. Using its new BIM tools, the firm's goal is to provide both traditional paper documents as well as a Revit model to its clients for their facilities management, operations, and maintenance. This will help increase customer satisfaction and deepen Gannett Fleming's relationships with its clients.

Adapting to BIM

As Gannett Fleming's pilot project progressed, the various MEP disciplines had different experiences with the new workflows, causing the implementation team to adjust their new BIM workflows and/or put more emphasis on certain aspects of its BIM training. Discussions arose around the ownership of key components—how model elements created by one discipline affected the other project disciplines.

The HVAC team followed the four-step process very closely. For the first step, they tried to analyze as much of the building as possible with spaces and zones. The team faced some challenges at first but through communication and an iterative process they were able to use the space and zone tools to achieve the results they needed. .

The HVAC team members embraced the target and source concept. They modeled the major equipment first and then used the Revit MEP software's system-based layout capabilities to connect the components in a logical system and add physical ducting. The only issue occurred when attempting to attach exhaust grilles directly to a duct. To solve this problem, the BIM team showed the engineer how to connect them by using transitions. The team also developed a custom Revit family for those situations.

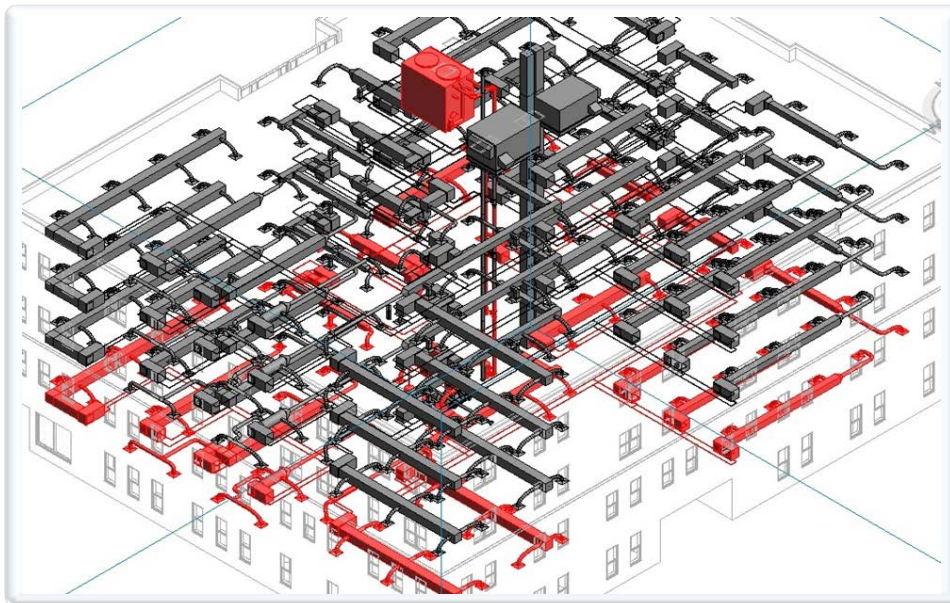


Figure 8. Gannett Fleming uses automatic routing features in Revit MEP to model HVAC systems.

Implementation Tips

The pilot's electrical and plumbing groups did not take to BIM quite as readily as the HVAC group. Gannett Fleming's BIM team worked with the electrical team to help them find ways to start their design before the other discipline designs were completed, such as adding placeholder targets and sources that could be later used to edit circuits and other engineering data. In this manner, Gannett Fleming's electrical group learned how to use BIM to their advantage—starting the design earlier in the process and helping to save time over the life of the project.

In another situation, the plumbing group faced a challenge by the fact that the architect modeled all the plumbing fixtures using a variety of wall-based and non-hosted families.

Since they could not use the wall-based families through linked models, the group had to learn the nuances of family ownership to streamline their workflow on future projects. The team discovered two approaches for future projects:

1. The first involves using non-hosted placeholder families for all plumbing fixtures, defined as Revit MEP families with connections and data. The architects place these families and the plumbing designers use the batch copy feature of the Copy/Monitor tool to place the parts in the Revit MEP model.
2. For the second approach, the architects place reference planes where fixtures are located. Then the plumbing designers place the fixtures based on the reference planes, which allows them to reference all MEP fixtures in the architectural model.

Key Items for Success

As with any new process, BIM represents a learning curve and Gannett Fleming is demonstrating today how with investment up front to embracing a design methodology change, you can reap the benefits in the long run. Here are the key takeaways from Gannett Fleming's implementation experience.

- Clearly define and identify tasks from the early schematic design phase that need to be complete before the rest of the team begins their work. For example, on Gannett Fleming's pilot the engineers started their layouts too early in the process—before the floor level elevations or the hydraulic profile were confirmed. This resulted in major rework later in the project.
- Define what components are needed for the project and what custom Revit content needs to be created. Early in the implementation, Gannett Fleming's BIM team identified strong users and helped them become subject matter experts and content developers. These users were able to either find the missing content (by using products such as Autodesk® Seek web service or reaching out to manufacturers directly) or create the necessary Revit families themselves. In addition, these expert users helped the rest of the team in areas such as model linking, defining standard views and title blocks, and creating spaces linked to rooms.
- Engage your vendors in the BIM process and push them for BIM content. Gannett Fleming worked with its regular equipment vendors to provide basis-of-design parts, improving the quality and visualization of its families and models. Most of the firm's vendors responded favorably.
- Help your design team to embrace new model-based approaches. When Gannett Fleming engineers or designers reverted to drafting early in the pilot project, they missed the opportunity to engage in more valuable design tasks. Training CAD users to adopt BIM is critical to set the correct direction and expectation.

- But don't ignore documentation production. For firms like Gannett Fleming that are using both CAD and BIM solutions on the same project, it is especially important to define when and how contract documents are produced. In addition, the firm made a concerted effort to produce the same quality documents as were produced by traditional CAD drafting tools, such as AutoCAD. This effort will benefit Gannett Fleming in the long-term, enabling the firm to use its substantial legacy CAD libraries.
- Develop a thorough implementation and training plan, and tie it directly to your projects. Gannett Fleming's earlier attempts to move to BIM consisted of having one or two people (who were unfamiliar with Revit software) learn to use the software from a training manual and through trial and error. This approach proved unsuccessful and caused early efforts at BIM to fail. A thorough implementation with the right resources and time commitments are required.

Summary

In 2010, Gannett Fleming made the commitment to transition its MEP group to BIM—and do it the right way. The firm's BIM process is still evolving. As it learns from each new project, Gannett Fleming makes adjustments in standards, methodology, and design process—and each new project shows measurable gains. By framing the use of BIM in the context of a project, the entire team knows where and how tasks have been changed and improved, boosting their enthusiasm for and acceptance of BIM. Delivering BIM implementation training in conjunction with projects helps the team see the benefits of Revit MEP and use the software to its full potential.

Gannett Fleming's new BIM software and processes enables its engineers and designers to explore more options and make better decisions earlier in the design process. Its model-based projects are more coordinated, helping to reduce information submissions and change order submissions during construction. This helps the firm deliver the project to the owner on time and within budget, and ultimately facilitates the owner's use of BIM for its facilities operations and management.

About Gannett Fleming, Inc.

Gannett Fleming is a global infrastructure firm focused on planning, environmental, design, technology, and construction management services. Since 1915, the firm has embraced a culture of service and innovation to achieve its key mission: to make its clients successful. From more than 60 offices worldwide, Gannett Fleming provides customized solutions that improve communities and sustain the world. The firm is proud to be ISO 9001:2008 certified.

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