Introduction

In September 2017, a roundtable discussion was organized by CanBIM Designers Committee to discuss issues of mechanical, electrical and plumbing engineering in regards to BIM. Even though BIM is not a new technology at this point, BIM usage has increased dramatically in the last decade due to more powerful computers and increasing complexity of buildings where BIM processes can facilitate design and construction solutions. There has been a high adoption rate among architects and not only have clients started to demand these solutions, in some countries use of BIM is mandated by legislation.

As the industry is transforming, it is observed that MEP disciplines have been encountering difficulties when implementing BIM. The discussion was intended to explore the reasons and solutions to the issues MEP disciplines encounter. This article is a summary of the ideas presented in this discussion.

To ensure various viewpoints were presented in the discussion, attendees working in different fields of industry were selected such as MEP designers, multidisciplinary designers, architects, contractors, sub-contractors and design-builders.Topics selected from issues encountered at different phases and aspects of construction were discussed by attendees. This article is authored to document the opinions discussed in the workshop and share the findings with the Canadian AEC industry.

Changing Scope of MEP Design

It is generally accepted that the amount of information submitted within a BIM model is more than what is submitted in a “traditional” CAD drawing due to information embedded in the models and utilization of 3D geometry. This information can be utilized towards goals such as facility management, analysis, creating equipment schedules and design coordination. The consensus was, even though the models contain more data, utilization of the tools at our disposal allows designers to create these design models in a similar amount of time.

Level of Development

Level of Development (LOD) has been causing misunderstandings for the industry due to either missing definitions in BIM Forum LOD Specifications (as it is the most commonly used one in North America) or misunderstandings regarding how it is meant to be used.

Establishing the understanding that instead of identifying a project’s scope such as “design to LOD 300”, defining the LOD of each specific item and design tolerances is required to set the expectations. Even though LOD 300 is considered the level required for construction drawings, there might be no benefit in modeling them to this level for some elements. In projects where a joint venture effort is present, it could also be possible to follow a workflow where the designer can avoid LOD 300 coordination and let the installer produce installation drawings directly from schematic design. Several attendees have worked in projects where this method was successful.

While Level of Development can indicate accuracy of the model items and is commonly used in North America to indicate modeling requirements, it does not mandate any non-graphical information to be included. The document merely suggests they “may” be included. This certainly adds to the confusion at contracting and execution and needs to be addressed.

Representation in 2D and 3D

In MEP, 2D single line plan drawings have been traditionally produced to present a clear visibility of the routing of piping/conduits at a 1/100 scale floor plan. If they are on top of each other or too close to be presented by adjacent thick lines, they were drawn side by side, to be indicative in 1/100 scale, as opposed to their actual designed locations.

Abiding by traditional graphic standards while using the same model for single line drawings, and indicating a working, coordinated design location for those pipes and ducts has proven challenging. This has often resulted in Models that cannot reasonably be used for clash detection during design, and do not fully illustrate design intent if provided to a contractor.

To solve this problem, there are several possible approaches suggested by the attendees:

- Changing drawing scales to 1/50 or lower when necessary
- Issuing multiple drawings for systems at different heights
- Prioritizing the modeling and show systems in their accurate locations, then produce isometric/section views to convey design intent

Feasibility of these solutions depends on the delivery requirements of the project. In cases where the deliverable is a model and production of 2D drawings are not mandated, this problem is not encountered. Several attendees have already worked on such projects and it is likely that delivering a model as opposed to drawings will become the trend in the future.

It should also be noted that Revit is what most people use today as their BIM authoring tool in Canada (and attendees of this discussion) and shortcomings of Revit contribute to this issue with 2D representation as users are forced to use workarounds to resolve these constantly. Even though the software has improved over the years, some fundamental functionality is still missing. For the industry to address this issue rather than implementing workarounds, the designers and software developers will have to work on solutions that can accommodate both single line drawings and 3D geometry.

Interoperability

Interoperability, while a popular buzzword, is not easy to achieve with software alternatives available today. The attendees expressed that when different disciplines work with different software, this often causes issues especially with representation of items on 2D drawings and data exchange.

It should also be noted that Revit's market domination in North America also pushes more people and more disciplines to work solely on Revit and sometimes even the clients specify Revit models as a deliverable. It could be stated that interoperability concerns are partly ignored both by Revit users and Autodesk due to one platform becoming extremely popular.

One particular area where interoperability is significant for MEP is analysis. While there are alternatives that can utilize a BIM to run lighting or HVAC analysis, the analysis software often requires a lot of editing to the design model before it can be used. Users expect simpler operation and better integration with existing data in this regard.

Trades/Sub-Contractors Using BIM

Designers and contractors are rapidly implementing BIM in their workflows but sub-contractors tend to be more resistant to the change. While contractors encourage and educate the subs to utilize the software and model capabilities, the biggest challenge is the initial cost of transition. There is a certain cost to acquire the software and content required to implement BIM processes as well as training costs and

possibly the cost of new hires. Once the content, software and people are transitioned to utilize BIM, ongoing costs are lower and there is an eventual return on investment.

Proving the cost of BIM is justified can be a challenge as well. BIM processes solve problems proactively, with planning and coordination. Therefore, calculating the cost savings are based on problems avoided, which is almost an abstract comparison.

On occasion, sub-contractors eagerly adopt the workflow after they see its capabilities. Also, the general contractor undertaking the BIM coordination or the sub-contractor outsourcing this aspect to a third entity is still a viable option.

Contracting and Deliveries

As more information started flowing between parties in the industry, responsibility of each entity and what is required for delivery can sometimes be ambiguous. The consensus seems to be that, BIM (or BIM workflows) is not what creates more work. BIM is merely utilized to facilitate the scope of work assigned to the teams. If there are aspects to the project such as facility management data entry, specific coordination efforts, visualization etc. these are items that need to be contracted and priced accordingly.

To avoid overcommitting on a project, the most useful precaution is to educate company staff regarding BIM terminology, time commitment for different aspects of clear communication with client and educating company staff regarding possible services, terminology and time commitments involved with those.

Metric vs Imperial

While most projects are labeled with metric dimensions, in parts of Canada a lot of dimensions related to MEP such as piping sizes and ceiling grids are built with imperial dimensions. This can cause issues both in design and construction phases if soft conversions are used. Over the span of a ceiling, designing with inaccurate units might create a difference of several tiles or equipment connections might not work with the piping.

Considering there are very few countries that use imperial and metric is considered to be a more scientific and accurate measurement system, best course of action is to use accurate measurements with hard conversions. For instance, modeling and indicating a 24” ceiling tile as 609.6mm instead of 600mm is much more accurate and if rounding is required it can be indicated as 610mm due to rounding which is still more accurate than 600mm and less likely to cause coordination issues. Likewise, as unusual as it may seem to those who have been working in the field for many years, indicating a 4” pipe as 101.6mm (or rounded to 102mm) is the better choice. Modeling accuracy should take priority over numbers rounded to increments of 5 or 10.

BIM in Education and Shortage of Workforce

Mechanical/electrical engineers, technicians and technologists are typically not trained to work solely on construction as there are many possible fields they can work in. As a result, people in the MEP part of the industry generally don’t get exposed to even existence of BIM as a concept during their education. Now, in Canada there are programs available in a few schools providing post-graduate courses on BIM Management but those joining the program are already aiming to have a career related to BIM and very few in numbers. So, the shortage of staff capable of understanding BIM practices remains. Candidates are left to discover either their roles’ involvement with BIM or BIM management as a possible career path on their own. A BIM course exploring the fundamentals and theory is necessary to ensure the students are aware of the career options and possibilities brought by this workflow.

Another reason of shortage in the workforce is the way MEP drawings have been produced until BIM became ubiquitous. Drawings were not dimensioned and shown schematically on a 2D plan and very few sections were produced to ensure services would fit in provided spaces. Also, the drafters did not necessarily have a good understanding of the contents of drawings and how the building systems work. A BIM Modeler/Designer has to be capable of modeling in 3D and understand how MEP systems operate to ensure the model is accurate both in regards to the geometry and intelligence embedded in the model. Therefore, many experienced drafters need to be re-trained to operate with a fundamentally different design execution method. At this point in the construction industry, “drafter” positions are obsolete and designers or BIM modelers have replaced them in any workplace utilizing BIM. This is a position that requires more skill and knowledge than drafting. Training their existing staff is a struggle most companies are going through right now to keep up with the rapidly increasing demand for BIM deliveries.

Future of BIM for MEP

One of the trends emerging in design industry and one we can see examples of in architecture lately is computational design. It is reasonable to expect this to become viable for MEP in the near future. As opposed to placing equipment and routing/coordinating systems manually, it could be possible to feed required design parameters to a script to have the computer offer alternatives to create clash free systems.

While delivery of drawings still rely on 2D medium such as pdf files or hard copy prints today, with technologies like VR, AR, mobile apps and GIS utilizing a 3D model to construct directly from a model is becoming more feasible as full potential of these technologies unfold.

In regards to Revit, better integration and interoperability of design software with schematics, facility management and analysis software is one of the most important improvements professionals are looking forward to.

Most companies are still in process of building their inter-disciplinary workflows and adapting to the new possibilities brought by BIM and cloud computing/storage technologies. Live model and information sharing is more feasible than ever thanks to cloud services and high speed internet becoming a necessity not only for construction but for any business. Although, it should be noted that there are security concerns regarding the information being uploaded to a cloud server from both designers and clients. These concerns are not always justified and being over-protective regarding building data can be an obstacle in the way of data sharing and effective collaboration strategies.

The entire construction industry is currently transforming and while MEP has dragged behind so far, the increasing demand is pushing everyone in the industry towards a fast adoption of BIM. Technology, software and people are enabling better workflows, smarter models and better collaboration between different parties in the industry as we move forward.

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Attendee List

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