BIM to **FIM**

*Building Information Modeling to
Facilities Information Management*

*First Floor*

Second Floor
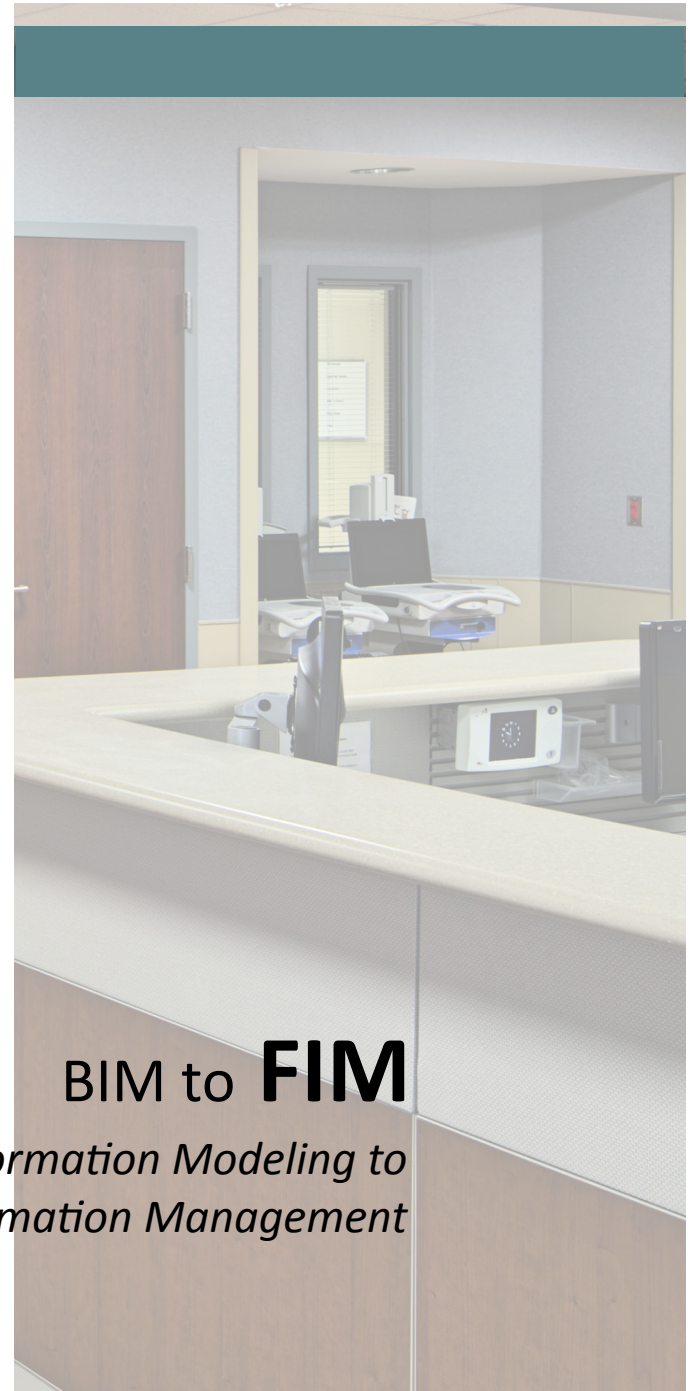
Project Overview

The project consisted of a new 66,300 square foot free-standing rehabilitation facility. The facility includes 40 inpatient rooms, an outpatient treatment clinic, diagnostic imaging, food service, administrative areas, and educational/classroom space. The facility is located on an existing medical campus that contains an acute care facility and several medical office buildings.
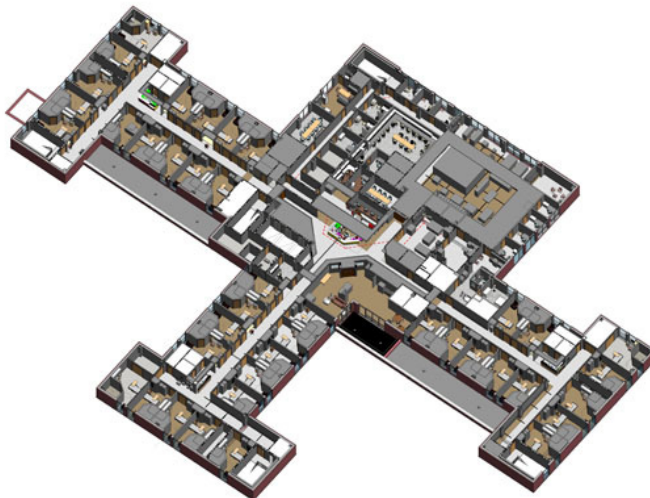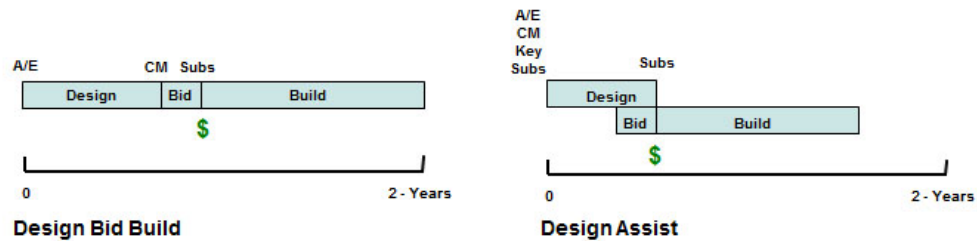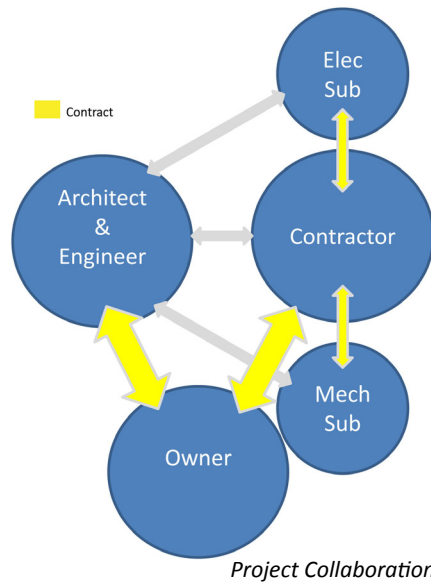

Site Plan

Contractor:

While it has long been a norm for contractors to say that clash detection and systems coordination is the most important piece of the BIM puzzle, it is really becoming a norm – and the normal strategies for quantifying the benefits of coordination have long been trite. In my opinion, the single greatest advantage gained for this project from the use of BIM is yet to be quantified; because, this project is a very early example of what it looks like when an owner understands that BIM is a tool that can be harnessed to manage the 75%-80% of facility costs that are incurred after the building is occupied. Because of the owner's forward-thinking and detailed plan for how to use BIM data, the operation of this facility should be much more efficient than historical models.

Project Delivery Method

A design assist platform was utilized for project development. The design team and general contractor were procured based on qualifications, which included Building Information Modeling experience. The design team then developed a performance specification early in the project timeline that was bid to key subcontractors (mechanical and electrical) or trade partners. These trade partners were brought onboard during early design development to aide in the completion of the project model and contract documents. The rest of the project was bid after the completion of the contract documents.

Project Delivery Comparison

Project Collaboration

Building Exterior

Patient Room - Virtual Mock-Up

Patient Room - Floor Plan

The design was analyzed early in the process for maximizing operational clinical and facility efficiencies. The BIM model allowed for travel distance investigations and three dimensional analysis of clinical care spaces for optimizing location of specific items and just in time material deliverables. A specific example is the travel distance from the Nurse Station to the patient room, and the configuration of the patient wings and sub stations as a result of the three dimensional analysis using the BIM model.

Rehabilitation Hospital

Average Daily Census **32.0** *(Click on value to change)*
Patient/RN Ratio **6.0** *(Click on value to change)*
Patients per Shift **5.3**
RNs per Shift **5.5**

Existing | 3 Wing Modified | Scenario

Round Trip Room to...	Average Distance (ft)	Trips Shift/Pt	Total Distance Traveled per Pt by Shift (ft)	Average Distance (ft)	Trips Shift/Pt	Total Distance Traveled per Pt by Shift (ft)	% Change (Total Distance)
RN Station	216	8	1728	143	8	1141	-34%
Nourishmt	268	4	1072	131	4	524	-51%
Cl Utility	276	5	1380	132	5	662	-52%
Soil Util	262	3	786	287	3	860	9%
Eq/Storage	251	3	753	160	3	479	-36%
Meds	257	7	1799	112	7	781	-57%
Day Room	348	5	1740	291	5	1456	-16%
Gym	389	1	389	366	1	366	-6%
ADL	339	1	339	321	1	321	-5%
X-Ray	328	0.5	164	402	0.5	201	23%
Food Svc	459	1	459	496	1	496	8%
Total	**2267**	**38.5**	**9647**	**1621**	**38.5**	**6267**	**-35%**

Average Distance per RN (ft)	**51,451**	
Average Distance per RN (mi)	**9.7**	
Total Distance - All RNs (miles)	**53.6**	

Average Distance per RN (ft)	**33,426**	
Average Distance per RN (mi)	**6.3**	
Total Distance - All RNs (miles)	**34.8**	

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Time Travel Study

Completed Nurse Station

Project Data Exchange

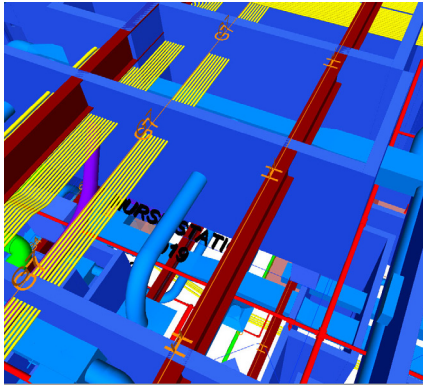|	Conceptual Design	Design	Construction	Facilities Management
Architect	Schematic Model with Performance Specs	LOD 300 Model	AS-built Model Updates → O&M, Submittal, Warrant Input	Final FM Model (used for space management)
MEP Engineer	Schematic Model with Performance Specs	LOD 300 Model	Sub-Contractor Model Review	
Structural Engineer	Schematic Model with Performance Specs	Detailed Mode – 300 LOD	As-built Model Updates	Final FM Model
General Contractor		Model Review and Virtual Coordination	Model Review and Virtual Coordination → O&M, Submittal, Warrant Input	Final FM Model (used for EAM integration)
Mechanical Sub-Contractor		Model Review and Constructability Guidance	Detailed Model for Fab – LOD 400	
Electrical Sub-Contractor		Model Review and Constructability Guidance	Conduit routing and panel coordination	
Special Systems (Med Gas, Low Voltage, P-Tube)			Detailed routing and coordination	

At project on-set the team drafted a BIM Execution Plan (BEP) to define model roles and responsibilities. The BEP documented the breakout of the model for the trade partner coordination, it listed owner BIM deliverables, and provided required software and file types needed throughout the project.

MODEL ANALYSIS PLAN

ANALYSIS	ANALYSIS TOOL	ANALYSIS COMPANY	MODEL	PROJECT PHASE	FILE FORMAT REQ'D
VISUALIZATION	Revit Design Review		Architectural Model	SD/DD/CD	.RVT
STRUCTURAL	RAMSteel		Structural Model	DD/CD	.RVT
CLASH DETECTION	Navisworks		All Models	SD/DD/CD	.RVT/.NWC/.DWF
QUANTITY TAKEOFF	VICO		All Models	DD/CD	.RVT/.NWC/.DWF
SCHEDULING	VICO - Review for Navis import		All Models	DD/CD	.RVT/.NWC/.DWF
COST ANALYSIS	VICO		All Models	SD/DD/CD	.RVT/.NWC/.DWF
ENERGY/SUSTAINIBILITY	Green Building Studio Ecotect Trane Trace		Architectural Model MEP Model	SD/DD/CD	.RVT/.GBXML
DAYLIGHTING/LIGHTING	Ecotect		Architectural Model	DD/CD	.RVT/.GBXML/.FBX

BIM Execution Plan

Rehabilitation Hospital

Clash Detection

Coordination Meeting

Model Coordination

Virtual coordination for the project began during early design phases. The team used a file share site along with weekly postings to exchange files for coordination. As the project progressed the team held several co-location sessions at the architect's office, where design and contracting team worked together in the same space to develop the model. These sessions included live clash detection reviews and real-time model changes to address design and constructability issues.
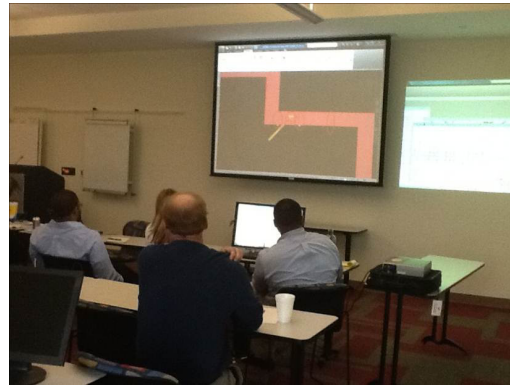
Owner:
The biggest benefit realized from the BIM process during construction was the elimination of change orders due to the coordination process. On a standard design/bid/build project there are always coordination issues that result in additional costs to the project. For this project when a change order was issued due to coordination issues, we were able to reject the change request based on all coordination being completed in the BIM model.
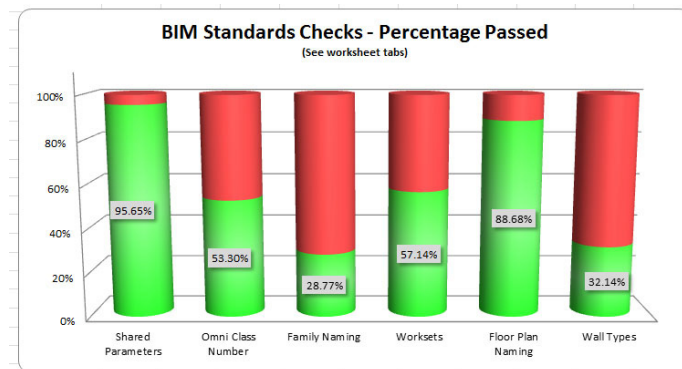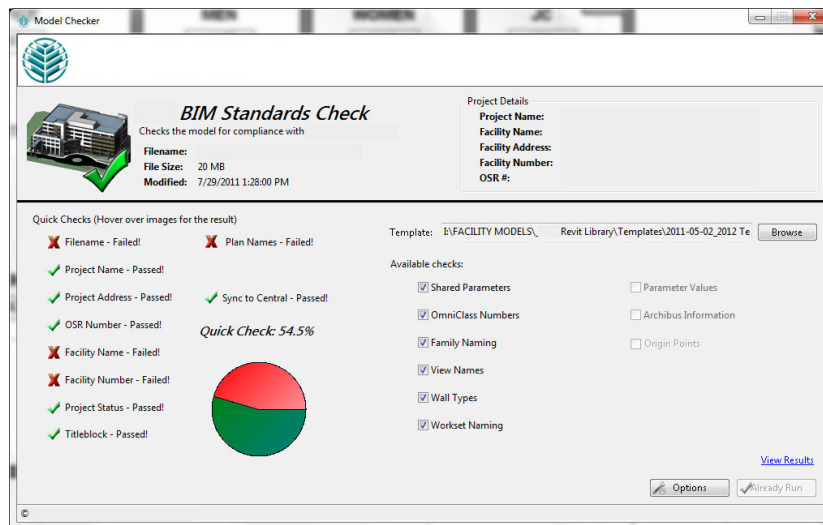

Construction

Virtual Coordination Model

Rehabilitation Hospital
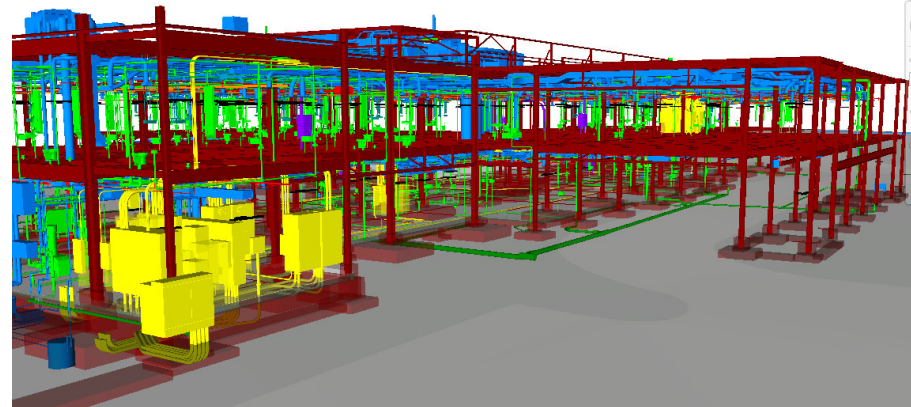
Owner's Standard Check Add-in

Owner's Standard Check Add-in

ARCHITECT:
The owner has developed a BIM standard that allowed for coordination with an understanding of consistent model deliverables. Through this approach, all team members were able to provide consistently detailed designs and configurations at the various stages of the project. Routine analysis and coordination by the Owner allowed team members to better understand where areas of development and refinement were needed, as well as design concerns and cost impacts.

BIM Project Standards

The owner provided BIM standards for the project that included a document outlining submission requirements and a BIM Execution Plan, as well as Revit Templates and Revit Add-ins. This project influenced the development of the Owner's future BIM contracts. Lessons that were incorporated into the owner's BIM contracts include:

•   Setting milestone phase model development requirements

•   Making the owner's Revit template a contract requirement

•   Adding a more detailed Model Element Table showing Element Authoring responsibility

Finish Add-in

The owner provided a Revit add-in package to the team to assist with BIM standard compliance and owner item coordination. The productivity add-ins consist of room naming convention input and check, finish input, and owner provided medical equipment input. Utilizing automated Revit utilities eliminated manual data entry for the design team and reduced errors in meeting owner standards.
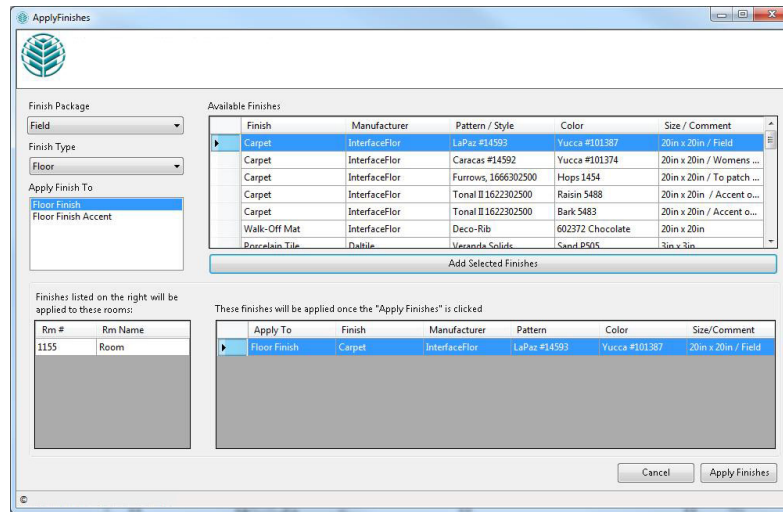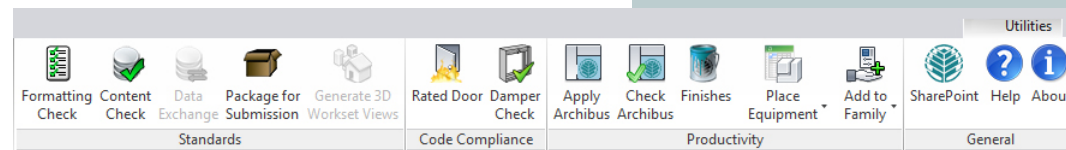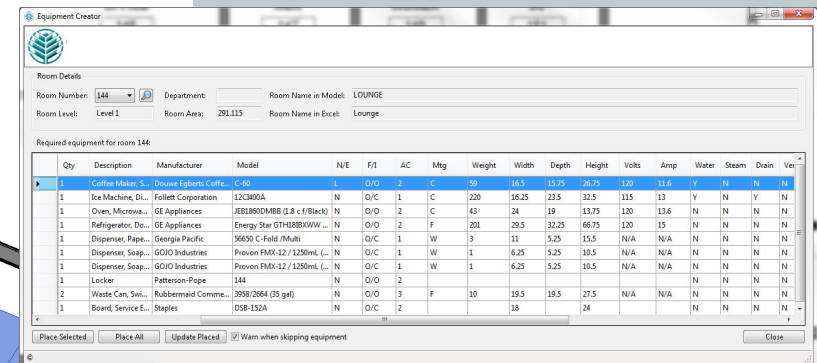

Add-in Package
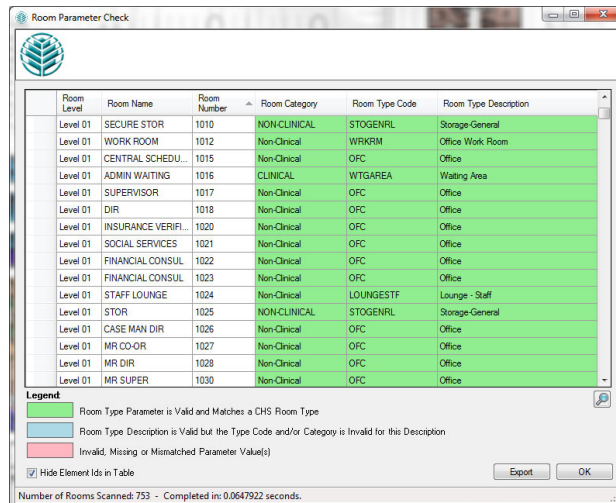
Archibus Data Check

Equipment Placement Add-In

EAM Export from Model

The owner set expectations at the beginning of the project that final deliverables would be used for facilities management. These deliverables include Revit Models from all team members, final coordination model, and digital documentation (drawings, specifications, and operations data.) After receipt the owner has linked Revit models to their space management system as well as used the deliverable to pilot Revit integration with their enterprise asset management system (EAM.)

Enterprise Asset Management/CMMS Savings:
- Expected reduction in data input and collection from **450 hours to 120 hours**

Space Management within Model

Space Management Savings:
- Reduced space management data input and collection from **30 hours to 1 hour**
- Increased accuracy in SF using system generated rather than manual tracing of floor plan

Rehabilitation Hospital

Owner Statement:

The Rehabilitation Hospital project team provided a BIM deliverable that is being utilized for facilities management. Active owner participation in the model development documentation, setting model expectations, and validating deliverables throughout the project is necessary in the Building Information Modeling to Facilities Information Management evolution. The owner must work with the team to ensure the that models created during the project contain the information and correct level of detail to transition from construction documents to facility management tools. The project team collaboration provided design and construction savings along with value that will be seen on the operations as well.

Architect Statement:

The use of the BIM allowed for investigations at a three dimensional level that promoted analysis in all dimensions rather than traditional palling processes. In this manner, quicker, real time analysis and updates allowed for interpretive designs and analysis through the shared website. The BIM allows the client to have the opportunity to maintain the deliverable for future facility management. Analysis, record maintenance, and cost saving opportunities through engineering analysis will allow the building to be more clearly understood and serve an opportunity for equipment, engineering, and architectural management.

Contractor Statement:

The owner implemented its standards for model formatting and data requirements, as well as its standard BIM Execution Plan for the entire Project team. We, the contractor, applied our coordination standards and coordination sign off procedure for the design-assist subcontractors. The most important new procedure employed on the project, from my standpoint, was the use of the highly-developed owner requirements for facility management information to be included in the model. This was our first time to provide a set of models for an owner that had their own clear plan for how they intend to use BIM for the long-term value of the facility.

Summary

The use of BIM on this project leveraged the data input and collection of the project team into the building operations. Substantial operation savings have been achieved allowing the owner to efficiently integrate this new building into their Facilities Management program. Instead of taking months to collect data needed for facilites management, the model turn over provided a data transfer that populated space management and enterprise asset management systems. This translated into real staff hour savings for the owner. The project aided in the development and refinement of the owner's Building Information Modeling Standards for Facilities Management

Building Exterior

Rehabilitation Hospital