View Navisworks Freedom Model (click here)

Raising the bar with BIM

This new Veterans Affairs Medical Center campus accommodates approximately 1.2 million square feet of facilities including a 134-bed hospital, 120-bed nursing home, residential rehabilitation, diagnostic and treatment beds, multi-specialty care clinics, chapel, support and administration areas. The facility will provide a full spectrum of inpatient and outpatient services to Veterans throughout Central Florida.

Sited on a 65-acre greenfield site, the campus is located within a new medical research development and sandwiched between natural waterways and protected habitats. The design was driven by the following client

◊ View Navisworks Freedom Model (click here) established goals: create a symmetrical and monumental design; align the facility with the major entrance axis into the site; provide two separate entrances dividing inpatient and outpatient; establish a monumental and federalist architectural character conveying a sense of grandness; and incorporate the latest in sustainable and healthy technologies.

The design team initiated a charrette process and worked with multiple user groups to address and identify these desired goals of the project including the character of the buildings on campus, program requirements, functional layouts, electrical / mechanical issues and sustainability. The resulting design reflects a symmetrical, stately facility intended to honor its users while promoting safety, sustainable design, flexibility and staffing efficiency. Integral parts of the final design include physical security and force protection along with infectious disease control. Sustainable design principles include prescribing the use of recovered materials, achieving waste reduction and establishing energy efficiency in design. The project is being designed to achieve LEED Silver certification.

The VA Medical Center project has used Building Information Modeling (BIM) from the initial kick-off, through design and into its current stage of construction. The methodology of BIM as used in this project was spawned by the VA project manager in 2005, who spoke early on of expectations for the VAMC to be developed using virtual design and construction technology, allowing designers and contractors to accurately see conditions before their physical completion. Throughout the last five years this project has evolved with changes in technology and practice. The basic concept in developing BIM is to generate information in a format that can be viewed and/or accessed by all stakeholders during the project's lifecycle. This means that as the information passes from design to detail, architect to contractor, contractor to owner, there should be no "re-inventing" of information. This information, in the form of smart data, should have the ability to be grouped, phased, counted, scheduled, priced, electronically specified and document connected, electronically code reviewed and conflict resolved. The definition of deliverables may vary depending on the client's requirements, but this basic expectation for intelligent and harvestable data is our goal.

Initially, the VA Medical Center project concept was visualized using program data to produce space planning and designed geometry. By inputting this data and giving it intelligence and relationship information, BIM models helped generate and validate design without losing time by reproducing information as it passed from one design discipline to the next. This program data was also molded into earlier modeled concept designs which could be compared and analyzed virtually. These early concept models allowed both the VA and the project design team to visualize the design and validate that the program requirements were incorporated.

As the project progressed through Design Development and Construction Documents, the project team continued to develop concept models that became vehicles for intertwining multiple disciplines by forming parametric relationships for viewing and coordinating the design. Models consisted of electronic associations between detail elements and specifications for the smallest piece of equipment to the facility's broadest site boundaries that allowed for instant validation of design and coordination.

Throughout all phases of design, the project team generated conflict resolution models to analyze potential conflicts that may occur during construction. These models allowed for virtual problem-solving before their results would be felt in the field. Building systems were consistently monitored and compared on a daily basis that prevented inconsistencies. As a benefit to these early conflict resolutions, a stronger and closer relationship with all disciplines began. More conversations occurred among disciplines at early stages to test design concepts and foresee consequences or benefits for these decisions.


FOR
WHO
SERVED

Breaking Down the System
One of the many benefits of BIM technology throughout this project was the ability to help us understand the buildings by combining all discipline models, seeing their live interaction tri-dimensionally with the use of “visibility” features that allow isolating the different building components by categories as displayed in the following series of images. Mechanical Systems (Upper Left), Interior Partitions (Upper Right), Building Structure (Lower Left) and Building Structure and Interior Partitions (Lower Right).

Site Photos

The aggressive schedule of the VAMC and its multiple packages and phases has created a real time race between development of design, construction documents and moving of dirt and flow of concrete.


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BIM Model Accountability

Due to the scale, typology and complexity of the VA project, new concepts and procedures had to be resourcefully developed to maintain a fluid workflow amongst team members. A workflow was based on the idea of accountability that viewed the BIM Model as an actual team member that facilitated a series of data streams. This accountability of the BIM Model was solely grounded on the principle that all BIM elements composing the model accounted for data that was used for the benefit and streamline of all disciplines during the course of the project phases. The project team made a conscious effort to avoid introducing drawing elements that did not possess any data that counteracted the driving principle of accountability.

A key value to our firm's guiding principles is "Service with Integrity." With this new technology, ***Modeling with Integrity*** has become a natural evolution of our value system. Through the use of BIM modeling, we have provided the VA not only with a physical building to occupy, but also a physical BIM model to be used along the lifecycle of the building and as a vehicle for facility management. The model itself has served the client two-fold – as a tool of design and as a tool of reference summarizing the project's enormous scale and complexity of components in a three-dimensional platform.

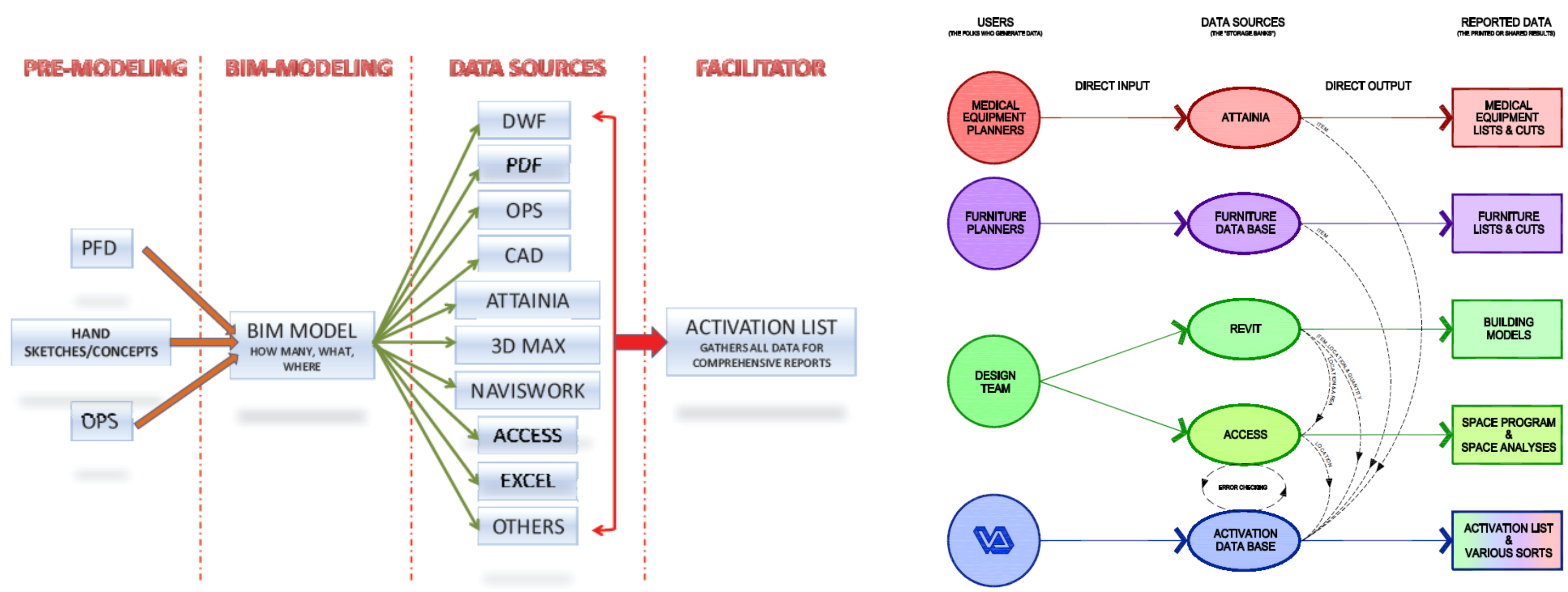
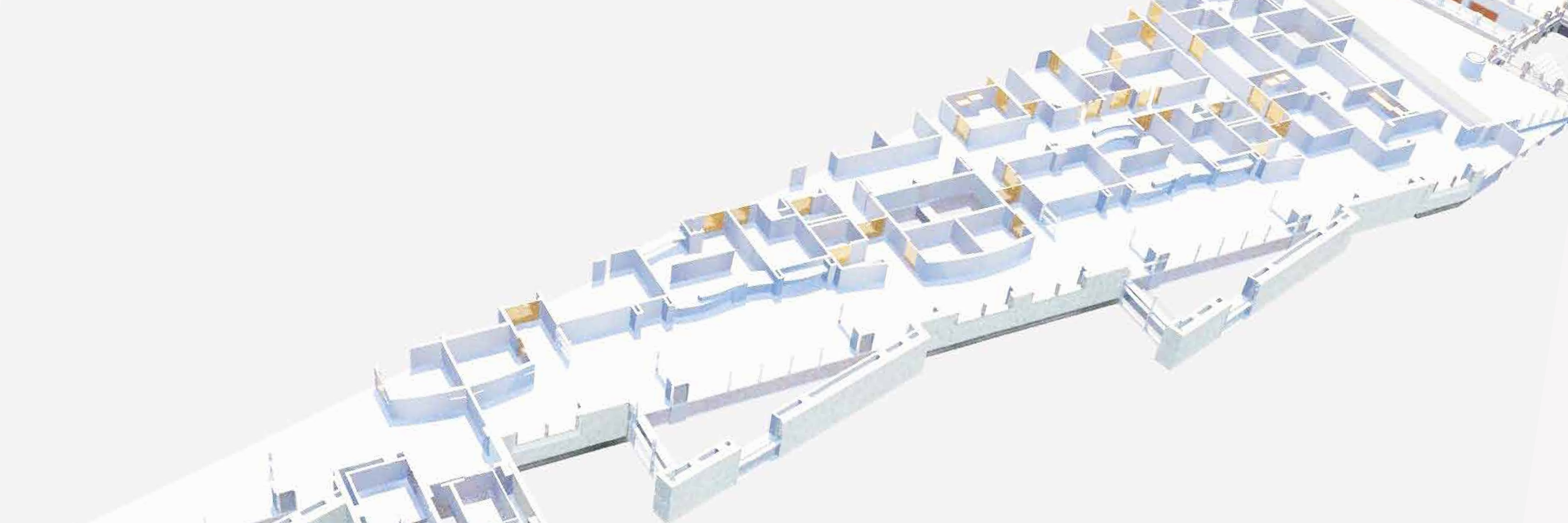


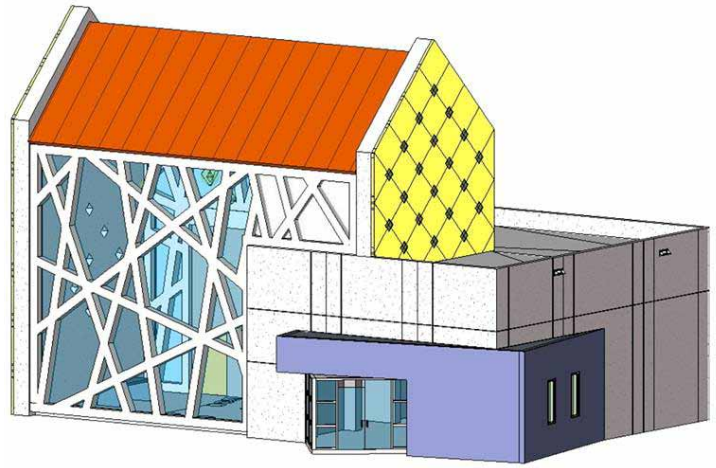
Figure 1.1 The BIM models allowed for flexibility of Data source use. In a effort to truly take advantage of a "streaming data" concept, we used various methods of passing data from one source to the next and in many cases back again.



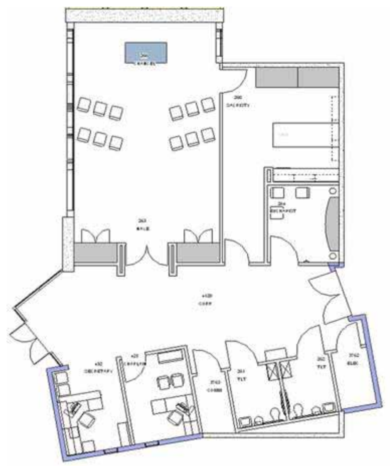
Gross Area Tabulations by Building & Department

Department Number & Name		As Programmed	As Re-aligned	As Planned	Deviation	
		Department Gross Area (SF)			Difference (SF)	(%)
PROGRAMMED						
HOSPITAL & CLINICS						
Inpatient Programs						
100	Medical, Surgical, & Neurological Nursing Units: Med 1	19,850	19,966	19,639	-327	-1.64%
100	Medical, Surgical, & Neurological Nursing Units: Med 2	19,186	19,836	19,413	-423	-2.13%
100	Medical, Surgical, & Neurological Nursing Units: Surgery	21,622	21,938	20,701	-1,237	-5.64%
102	Intensive Care Units: Cardiological, Medical, and Neurological Unit	11,928	9,841	8,564	-1,277	-12.97%
102	Intensive Care Units: Surgical Unit	8,588	8,943	8,797	-146	-1.63%
110	Psychiatric Nursing Units: Mental Health Unit 1	18,284	18,363	16,155	-2,208	-12.02%
110	Psychiatric Nursing Units: Mental Health Unit 2	15,470	16,361	15,349	-1,012	-6.19%
600	On-Call Suite *Create this suite from programmed elements of the Intensive Care Units, and shift those areas here.*	0	2,525	2,290	-235	-9.29%
Totals for Inpatient Programs :		**114,927**	**117,773**	**110,908**	**-6,865**	**-5.83%**

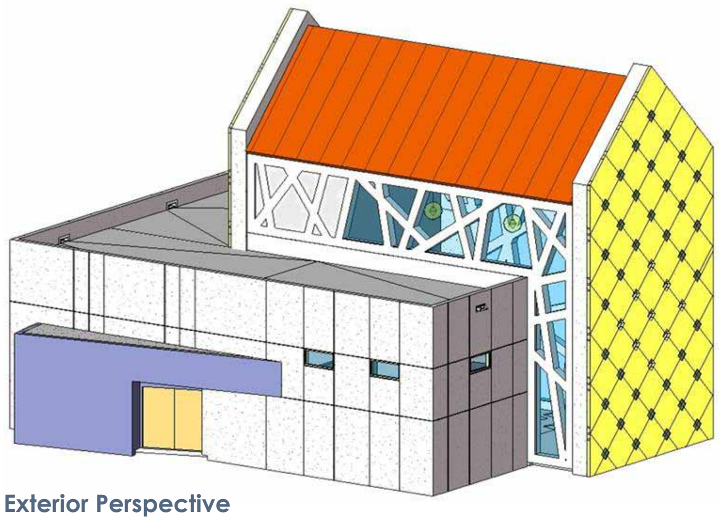
Figure 1.2 Table exemplifies a BIM generated spreadsheet that compares the client provided program with the elements as designed. This information presents the planner with live information detailing the deviations occurring between the Program and the Design.



Exterior Perspective



Floor Plan

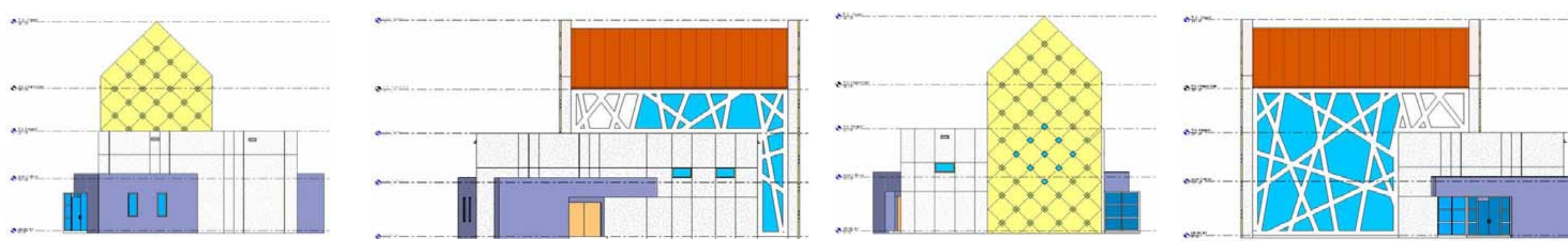


Exterior Perspective

New Planning Tools

Because of the complexity in scale and healthcare program of the VA project, the concept of BIM Model Accountability began during the early planning stages with the integration of the Program for Design spreadsheet. This client-provided document, which lists thousands of required rooms and information, was integral for the Medical Planning team. Before BIM, this spreadsheet was laboriously manually inputted. With BIM integration, the text-based data is converted into three-dimensional elements that contain the client's program requirements. The Program for Design is now represented as a three-dimensional geometry without any manual intervention. The data streamed through planning and the stored data become a key function linking the components of all disciplines. Team members are continuously transferring and validating the BIM elements. Walls, equipment, finishes, doors, engineering systems...etc are all intertwined within these data sets. This was the first step in achieving accountability. All of the BIM components were counted, located and scheduled. Since the VA Project Schedule was based on a fast track multi-package, multi-phase delivery, the models were set up to be accessible to the contractor to aid in discipline coordination, conflict resolution, construction sequencing and cost estimation.

Figure 1.3 The images represent elements from the design phase. The intent was to simultaneously attend to the Planning and Exterior Design as an effort to provide quicker resolutions to the design.



Building Elevations

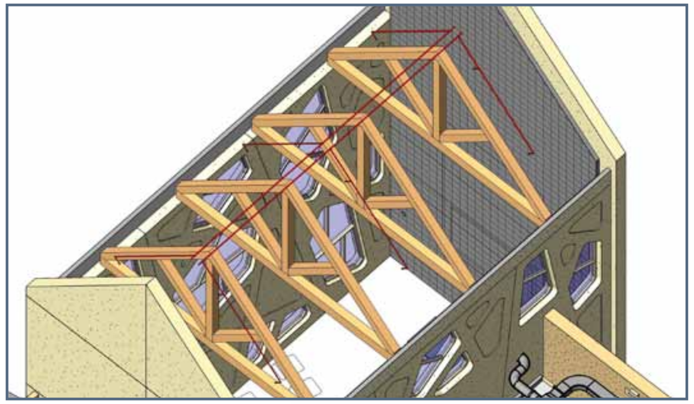


Figure 1.4 3D Roof framing analysis integrating fire protection systems.

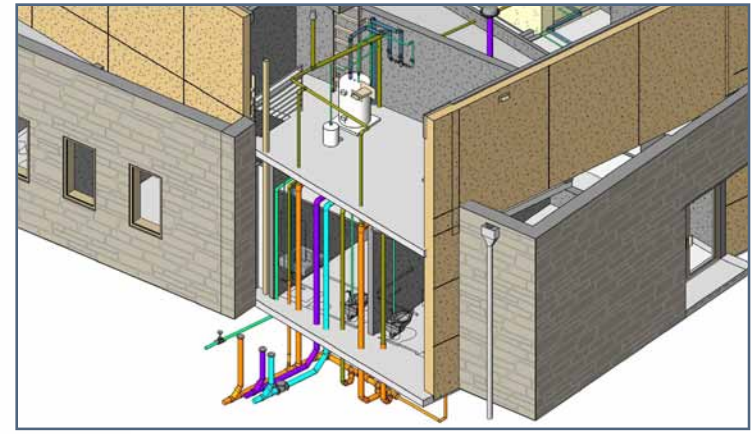


Figure 1.5 3D validations of sub-grade building systems

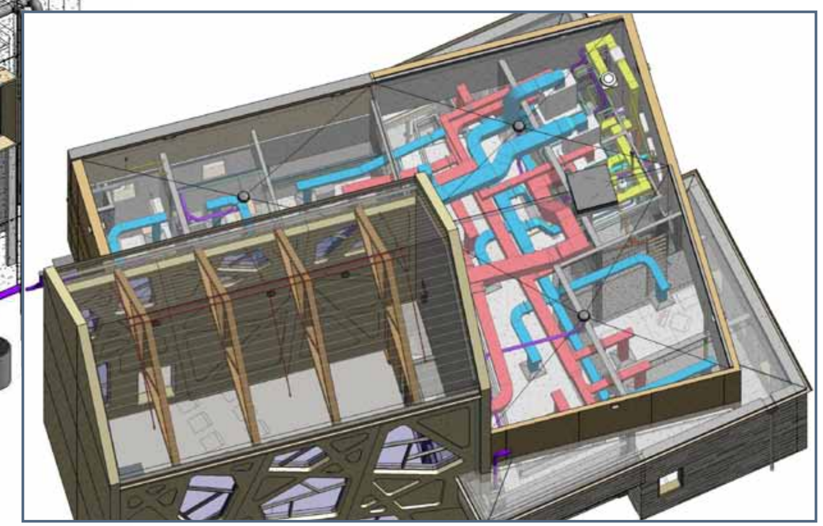


Figure 1.6 3D validation of systems integration

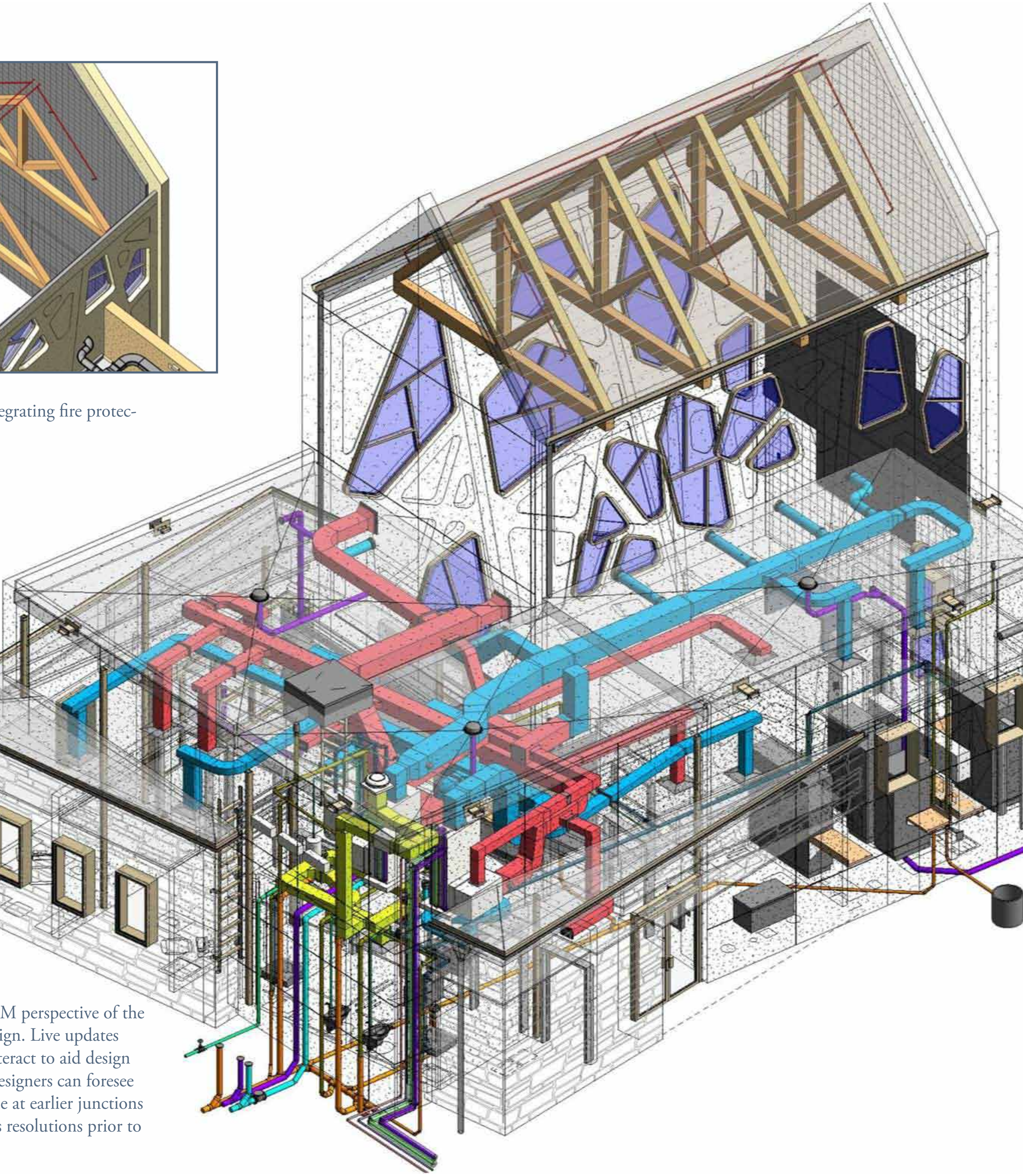
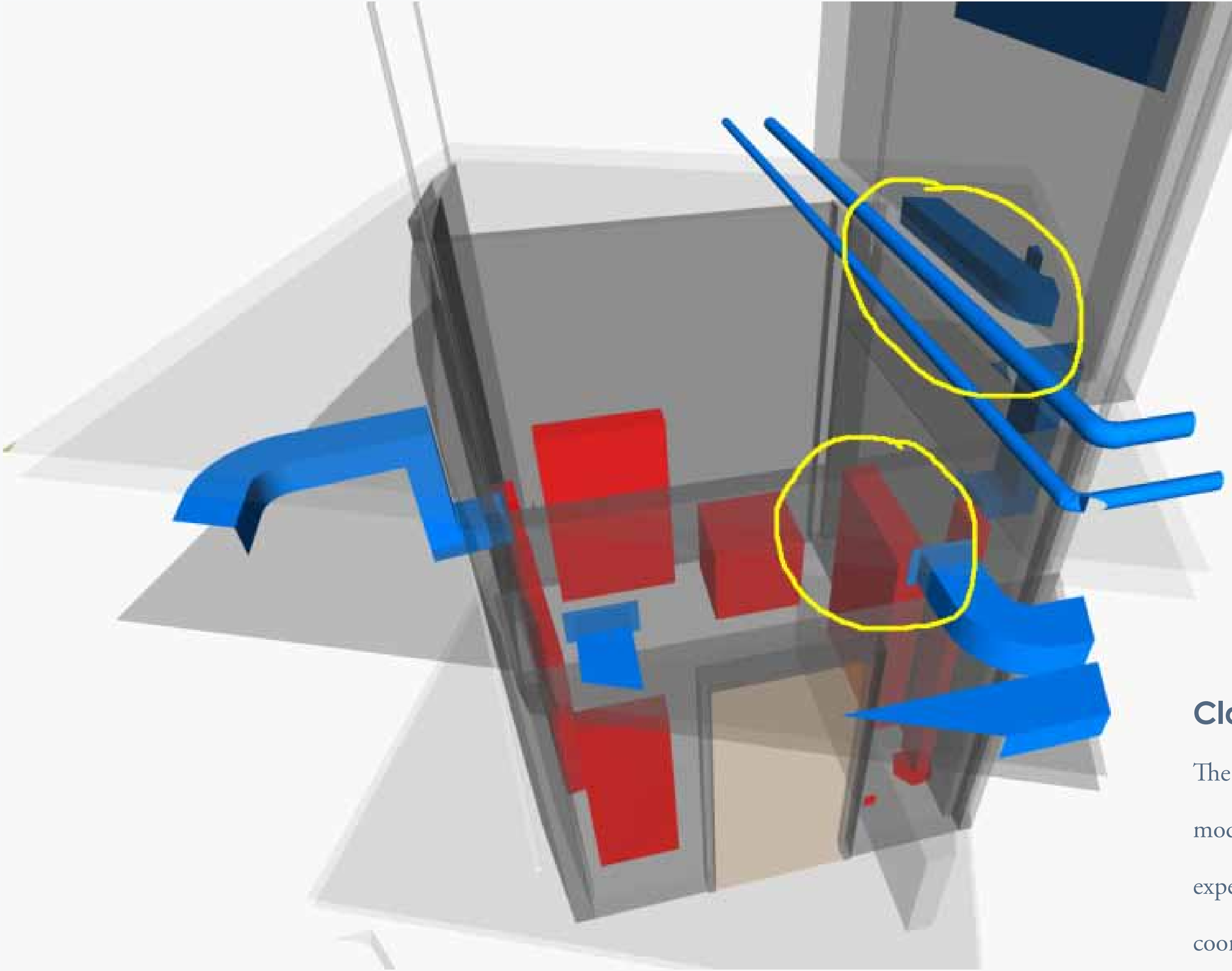


Figure 1.7 The image depicts a BIM perspective of the integration of systems with the design. Live updates of building systems consistently interact to aid design decisions at all phases of design. Designers can foresee the volumetric quality and outcome at earlier junctions and are able to provide and address resolutions prior to construction.



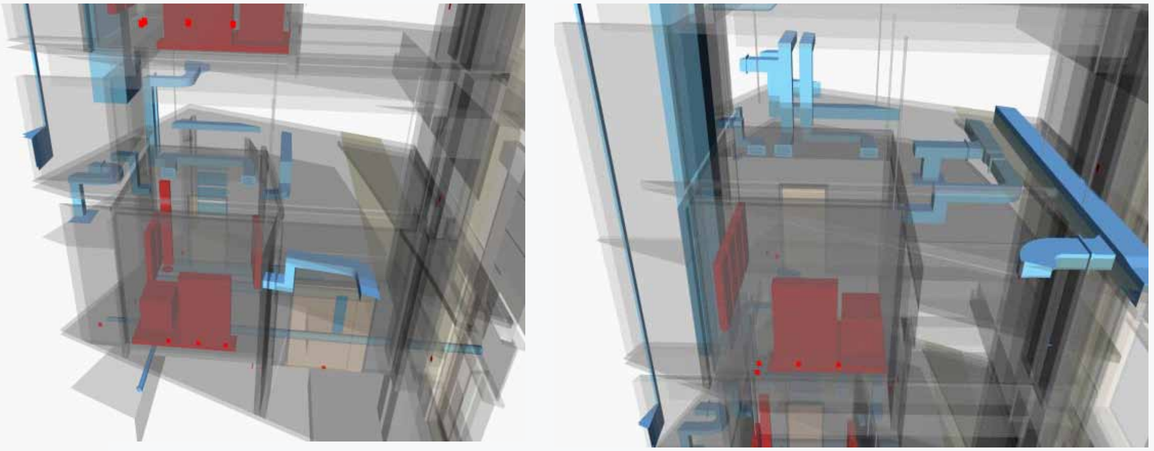


Figure 1.8 A/E team use 3D models to assemble a composite coordination model in Naviswork to clash detect inconsistencies among disciplines and feedback to improve BIM modeling.

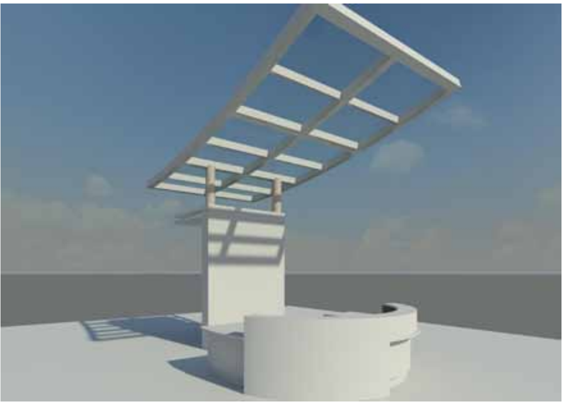
Clash Detection

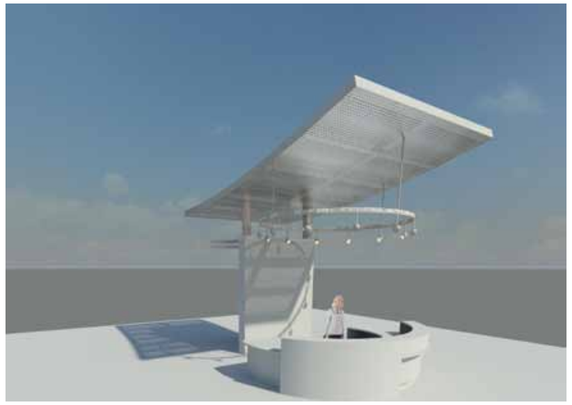
The design team used the three-dimensional models to assemble a composite or "clash detection" model. This model was used to spatially coordinate the building systems, and address any conflicts within the model to avoid expensive delays and cost increases. Clash detection was used as a Quality Control tool by the design team to reduce coordination time during the Construction Administration stage and to give the contractor a basis to produce and coordinate fabrication models.

Content Integrity

A well trained development team is key to standardizing content. Content should be simple, flexible, parametric, and fully tested using approved coordinated parameters.

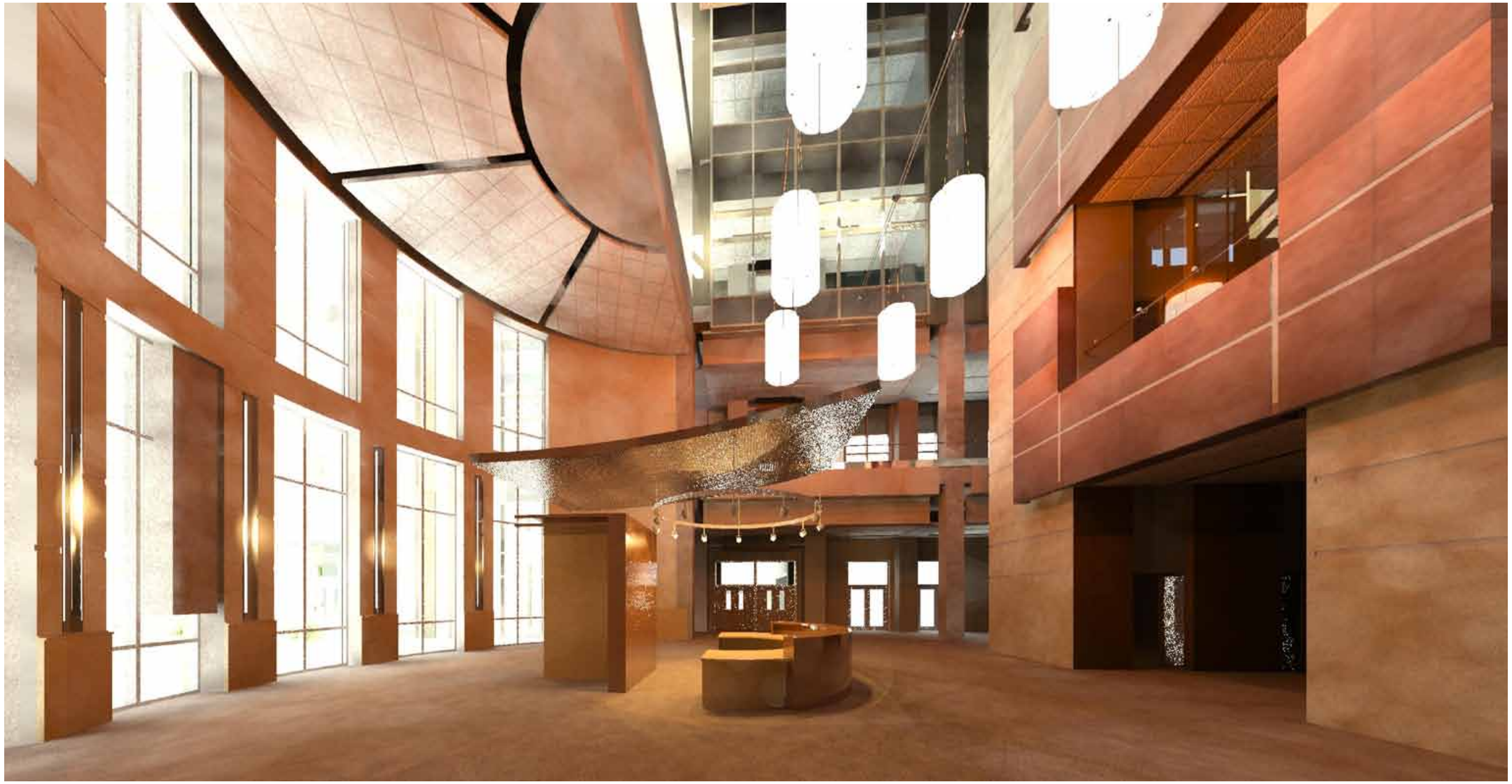
Since the implementation of BIM in our office five years ago, one of the recurrent obstacles was the lack of BIM standards. We tried to avoid the blind assimilation of standards that had two-dimensional historical precedence. Instead, we embraced the development of our new standards with a vision and theory of what the industry's future deliverables will be. Given the early stages of BIM standard development, we used a mix of best practices with our own set of standards for items such as model linking, sharing of model by users, object naming conventions, etc. With technology evolving at a fast pace, our standards are periodically reviewed and posted to our Intranet which is accessible to all users who provide constructive feedback on improving processes and workflows. Since the development of our in-house BIM standards, we have influenced project owners and agencies who are currently looking at implementing their own BIM standards as a delivery requirement.

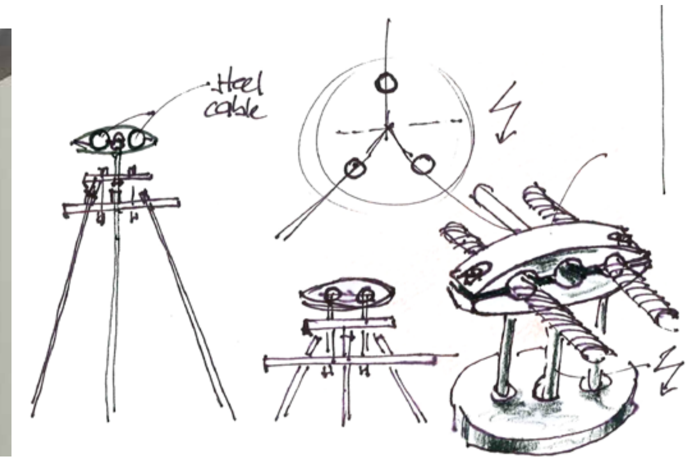




Model Integration

Stages of design development for small design features of the project are displayed in this sequence of images, from basic conceptual massing, to material selection, to finally integrating it with the main model.



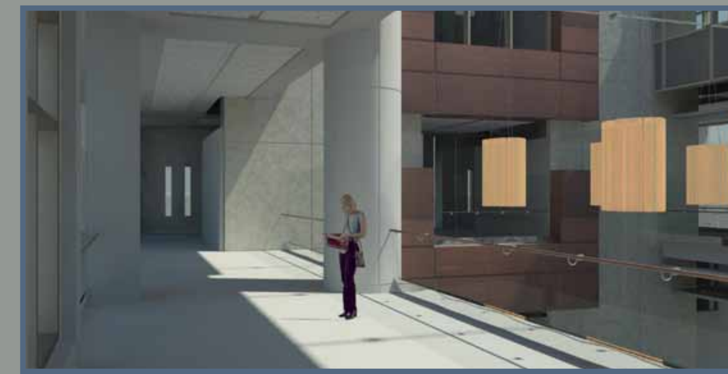


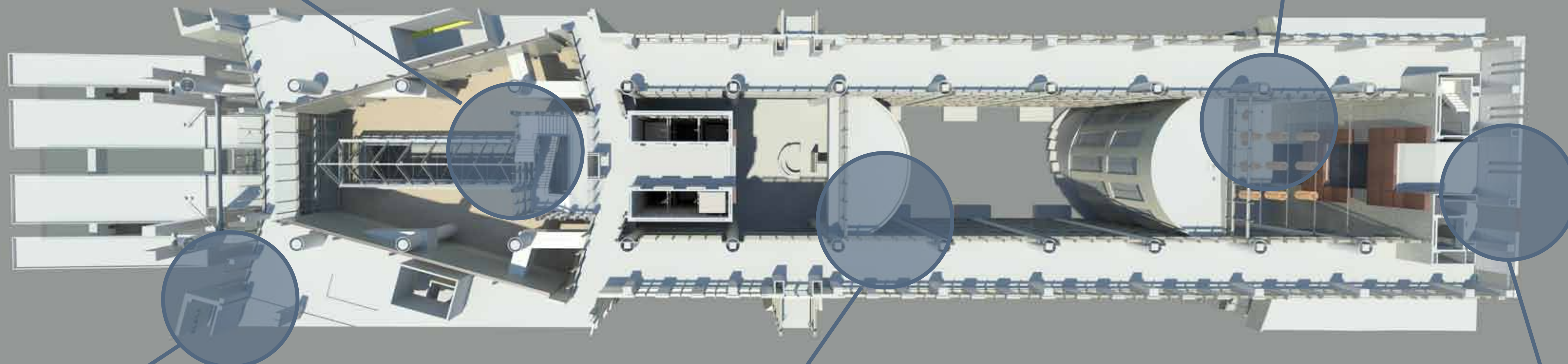
Concept to Fabrication

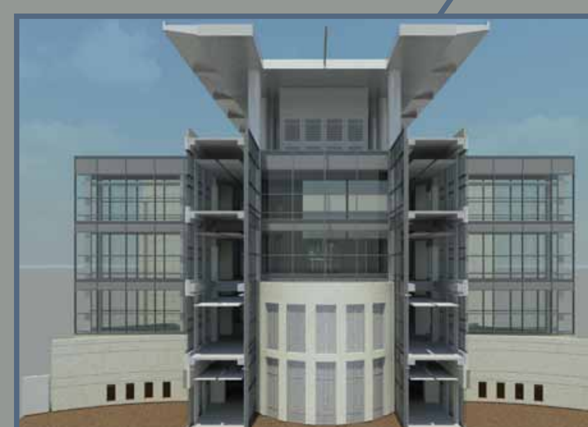
Details of cable connections for the light fixtures were developed from hand sketches to modeled objects that can later be used for custom fabrication. All “custom” objects could be used on future projects.

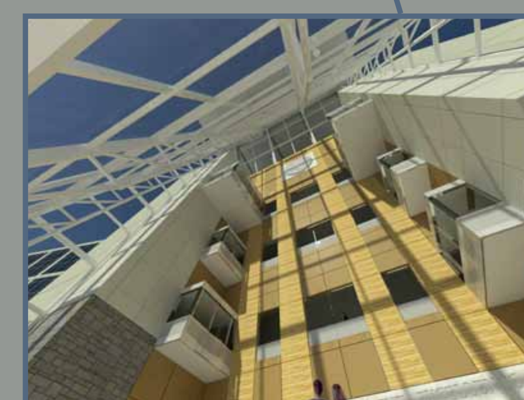
Visual Exploration

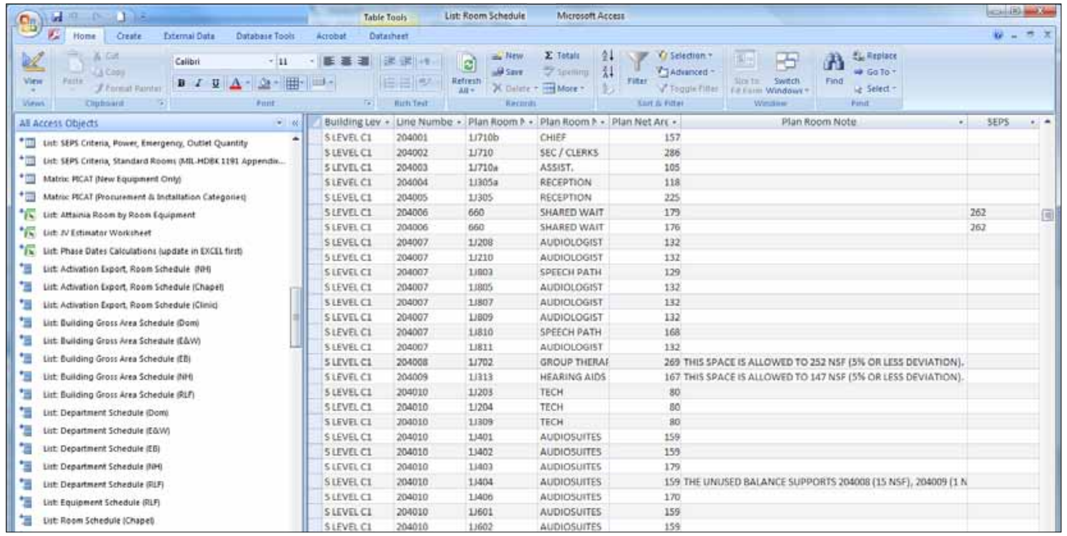
BIM technology allows us the capture any instance of the building that requires further exploration and interaction with the design team and the client, regardless of how miniscule or extensive the case is. This powerful set of tools helps the team anticipate issues during any stage of the project.





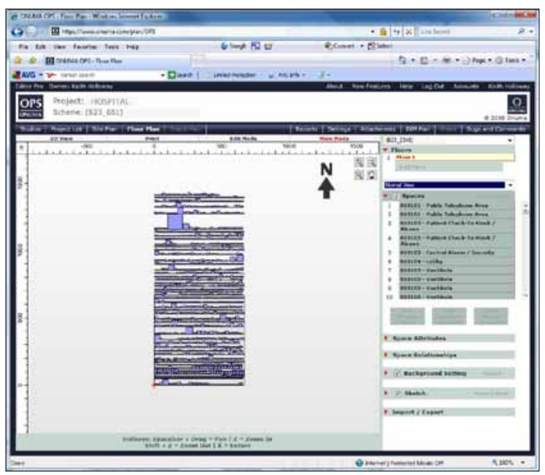


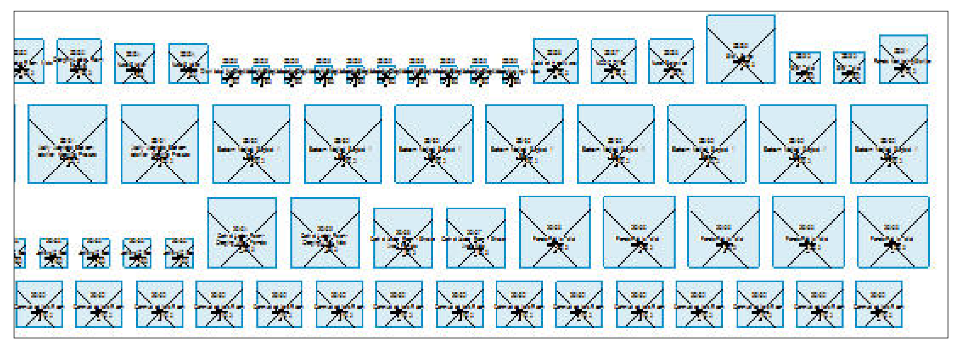




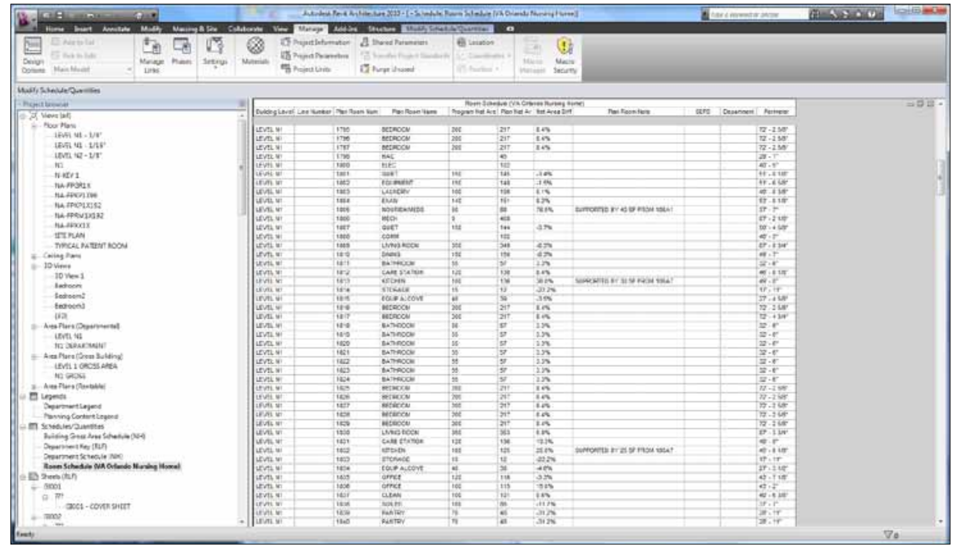
Clients provide a Program for Design, specifying exact squares footages for every department and room in the project. The information is provided in database format and includes also a room code that is used to determine the basis of design requirements for that room (equipment, furniture, finishes, etc.). The database is compiled (picture left) and exported in spreadsheet format.

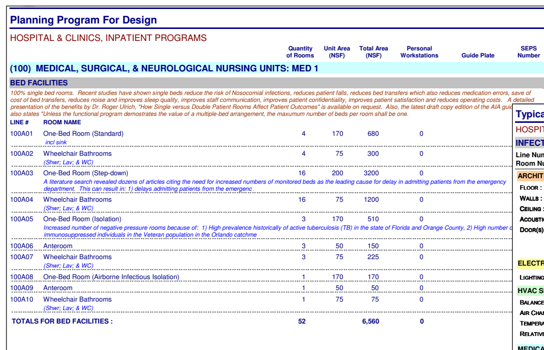
Web-based software is used for preliminary planning. The room information in spreadsheet format is imported in the planning application to generate three-dimensional intelligent room objects. Rooms can be grouped by floor and department. This can be a beneficial tool when placing large quantities of spaces. The picture below shows the rooms turned into three-dimensional smart data.

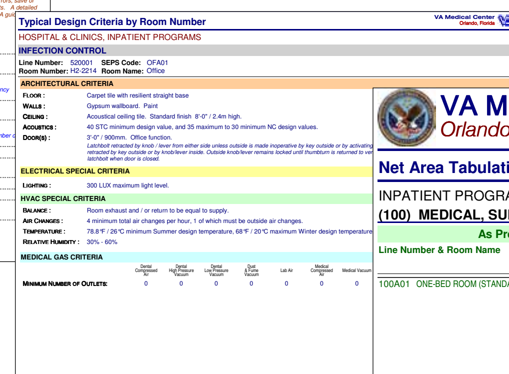


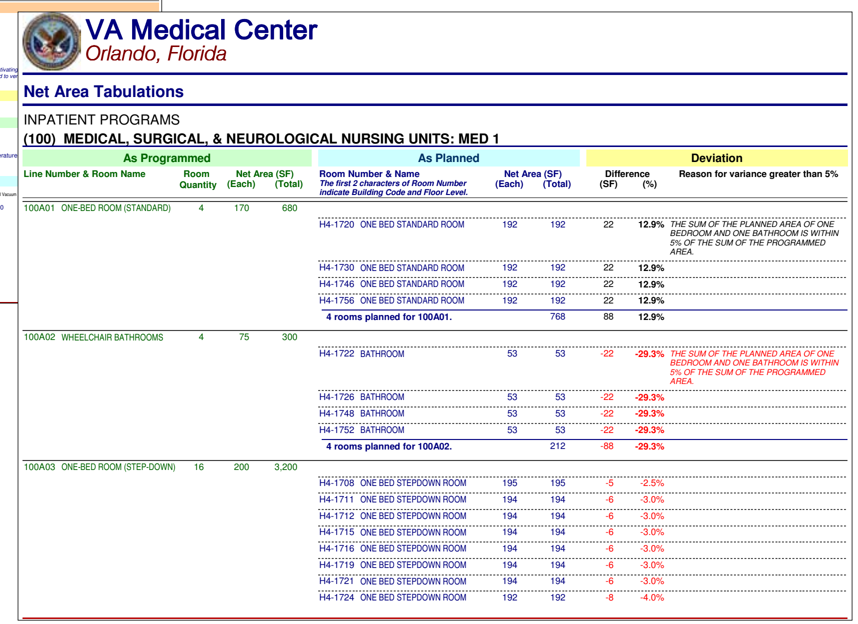


The smart rooms are imported into BIM software and include properties such as room number, name, department, etc. The spreadsheet shows how the rooms look when imported (pictured right).









VA Medical Center
Orlando, Florida

Net Area Tabulations

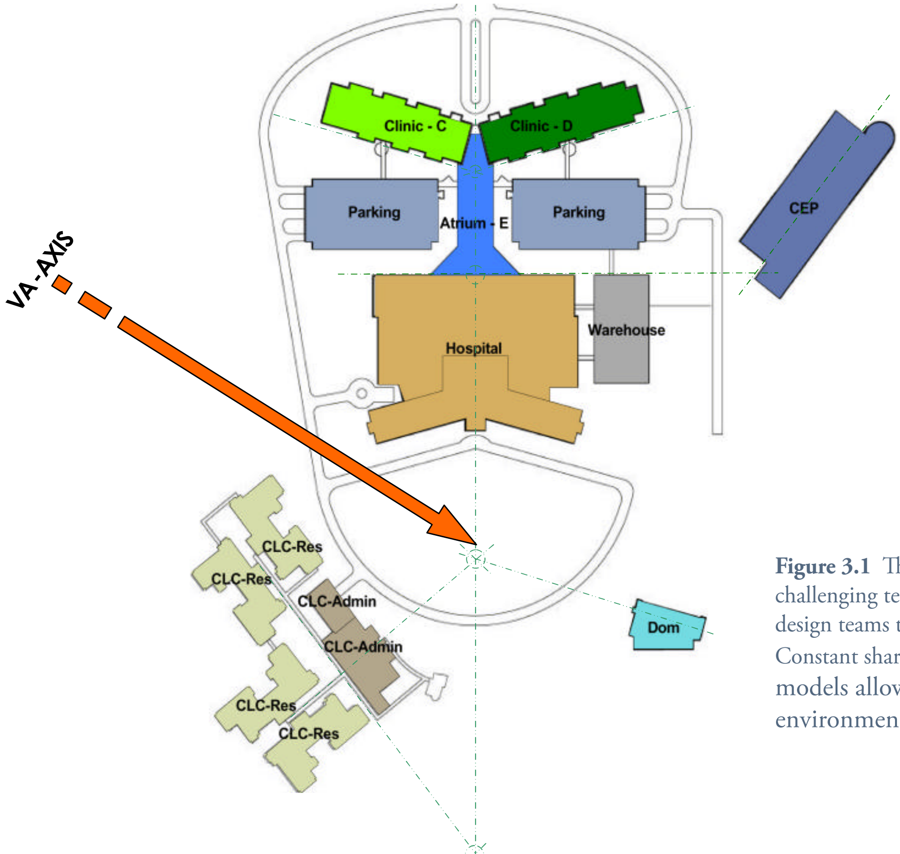
INPATIENT PROGRAMS

(100) MEDICAL, SURGICAL, & NEUROLOGICAL NURSING UNITS: MED 1

As Programmed				As Planned			Deviation		
Line Number & Room Name	Room Quantity	Net Area (SF) (Each)	(Total)	Room Number & Name *The first 2 characters of Room Number indicate Building Code and Floor Level.*	Net Area (SF) (Each)	(Total)	Difference (SF)	(%)	Reason for variance greater than 5%
100A01 ONE-BED ROOM (STANDARD)	4	170	680						
				H4-1720 ONE BED STANDARD ROOM	192	192	22	12.9%	THE SUM OF THE PLANNED AREA OF ONE BEDROOM AND ONE BATHROOM IS WITHIN 5% OF THE SUM OF THE PROGRAMMED AREA.
				H4-1730 ONE BED STANDARD ROOM	192	192	22	12.9%	
				H4-1746 ONE BED STANDARD ROOM	192	192	22	12.9%	
				H4-1756 ONE BED STANDARD ROOM	192	192	22	12.9%	
				4 rooms planned for 100A01.		768	88	12.9%	
100A02 WHEELCHAIR BATHROOMS	4	75	300						
				H4-1722 BATHROOM	53	53	-22	-29.3%	THE SUM OF THE PLANNED AREA OF ONE BEDROOM AND ONE BATHROOM IS WITHIN 5% OF THE SUM OF THE PROGRAMMED AREA.
				H4-1726 BATHROOM	53	53	-22	-29.3%	
				H4-1748 BATHROOM	53	53	-22	-29.3%	
				H4-1752 BATHROOM	53	53	-22	-29.3%	
				4 rooms planned for 100A02.		212	-88	-29.3%	
100A03 ONE-BED ROOM (STEP-DOWN)	16	200	3,200						
				H4-1708 ONE BED STEPDOWN ROOM	195	195	-5	-2.5%	
				H4-1711 ONE BED STEPDOWN ROOM	194	194	-6	-3.0%	
				H4-1712 ONE BED STEPDOWN ROOM	194	194	-6	-3.0%	
				H4-1715 ONE BED STEPDOWN ROOM	194	194	-6	-3.0%	
				H4-1716 ONE BED STEPDOWN ROOM	194	194	-6	-3.0%	
				H4-1719 ONE BED STEPDOWN ROOM	194	194	-6	-3.0%	
				H4-1721 ONE BED STEPDOWN ROOM	194	194	-6	-3.0%	
				H4-1724 ONE BED STEPDOWN ROOM	192	192	-8	-4.0%	

This gives the medical planners a starting point to lay out floors and departments. A room schedule can then be exported to the database software (pictured right).

The data from client (programmed) is then compared against the live data from the model (planned) to find deviations, validate the program and ensure the design meets the requirements of the owner. Data is compiled and reported using database software.



REVIT FILES:
Under H:\2150\RVT\ \Master **link origin to origin** the following files.
-2150 Clinic Shell-Core Central
-2150 Clinic Structure
-2150 CLC Administration Central
-2150 CLC Residential Central (copy this link three times, rotate and mirror it as necessary.
-2150 Parking Garage Central
-2150 CEP Central
2150 Shell-Core Hospital Centra
-EB Hospital Clinic Structure

Figure 3.1 The VAMC project provided a challenging test for bringing multiple models and design teams together into a cohesive grouping. Constant sharing of information through models allowed teams to work in a real time environment.

	Model Count				
	JV1	JV2	STRUC	TOTAL	Data
CEP	4	0	1	5	226,800
Chapel	5	0	1	6	203,200
DOM	1	5	0	6	10,400
Hospital	1	9	0	10	55,700
Master	3	0	0	3	43,200
Package 1A	1	0	0	1	39,200
Shared	1	0	0	1	7,400
Bridge	1	0	0	1	19,700
Security Buildings	2	0	2	4	91,100
Parking Garages	6	2	0	8	166,200
Warehouse	1	3	1	5	11,900
Clinic	34	1	0	35	1,100,600
CLC	17	0	2	19	373,600
Total	**77**	**20**	**7**	**104**	**2,349,000**

The work sharing effort for this project is a monumental task. To date, the effort has involved more than 200 individuals interfacing with over 100 models containing over 4 gigabytes of information. The VAMC project is a joint-venture effort and is supported by a variety of consultants. With this large of a group spread across the nation, a global interface was required. Moving large amounts of information required the use of traditional FTP sites and more interactive shared server sites such as Project Docs and New Forma.

By using these information transfer portals, the team was able to orchestrate the various Building Information Models on the site, in such a manner that they shared coordinate relationships. Being globally positioned relative to the site allows building locations and updated survey information to fluctuate during design. Given the nature of the team, requirements of the different disciplines, and limits of hardware, software and processing speeds, it was neccessary to break the project down into manageable model sizes. This decision and many others were worked out early during development of the BIM implementation plan. Developing this plan allowed the various team members to move forward in parallel with a set framework as guidance. Making these early group decisions based on a mix of experience and theory allowed the team to work cohesively. Information within the models was further broken down into transferrable portions as required by the team for various discipline requirements. The data sharing of rooms, equipment, finishes, miscellaneous elements etc., were exported as Excel or text-based data files and linked to various platforms for analytical studies and element reporting.

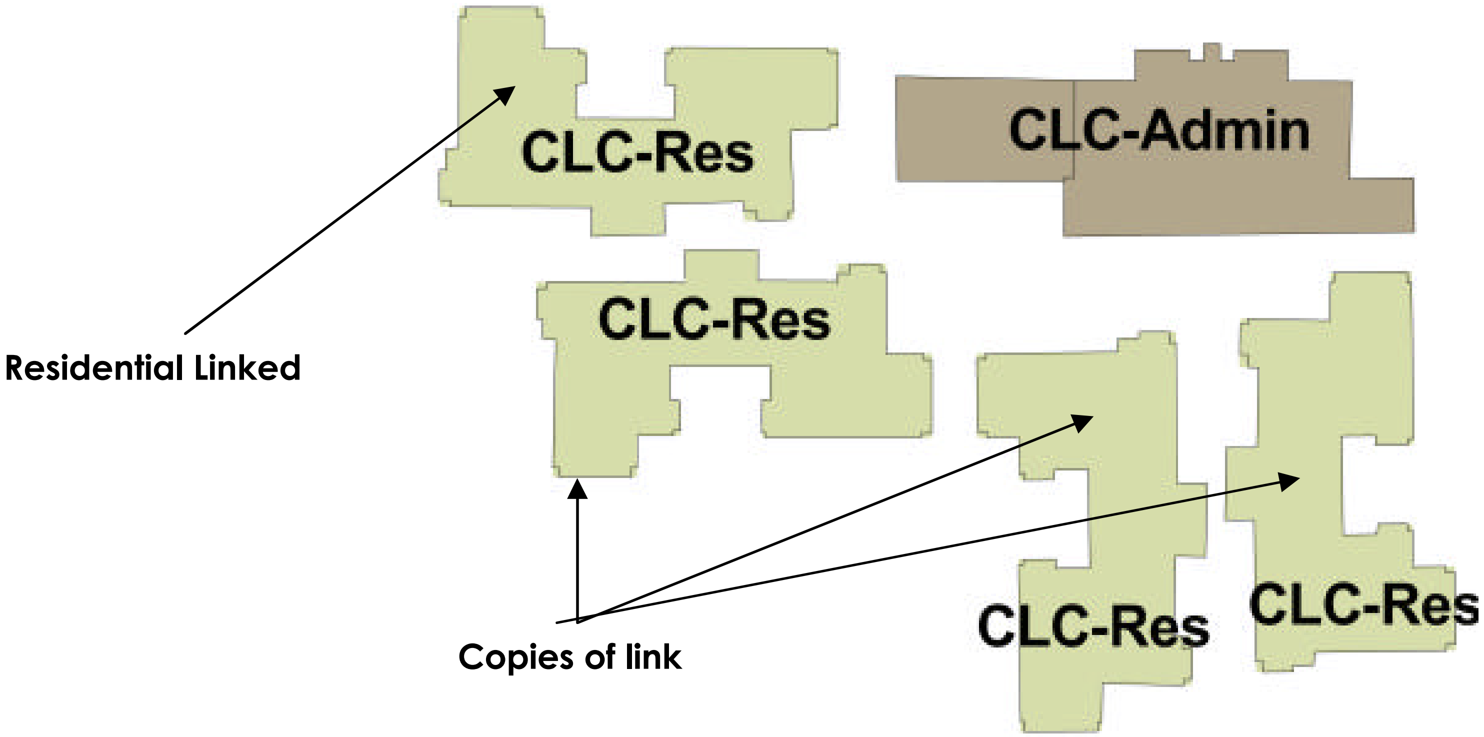
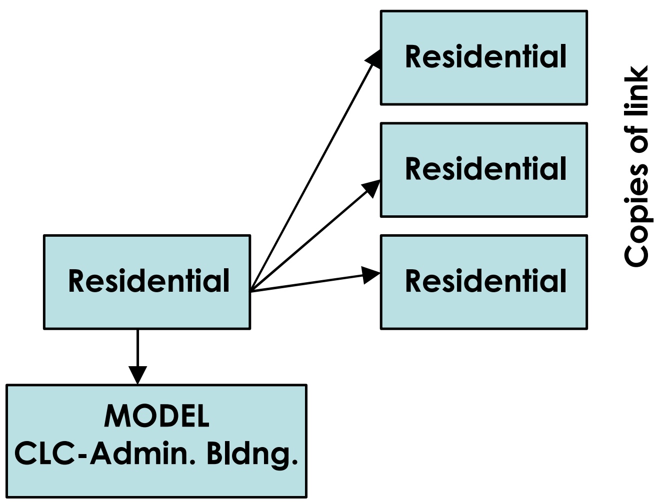
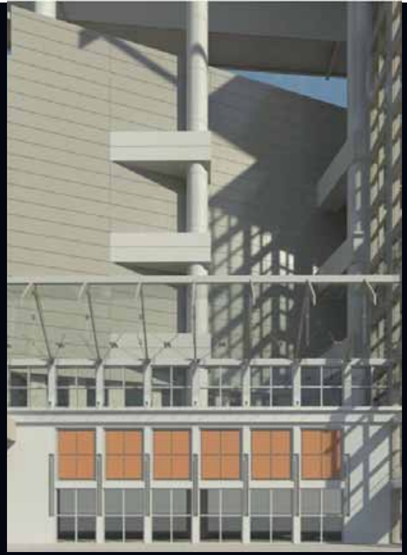


Figure 3.2 The Community Living Center allowed us to test out models as a repetitive use element. Each residential unit could be repeated with minor embellishments to each unit.

REVIT FILES:
Under H:\2150\RVT\ \Nursing Home
-2150 CLC Administration Central
-2150 CLC Residential Central



benefits achieved



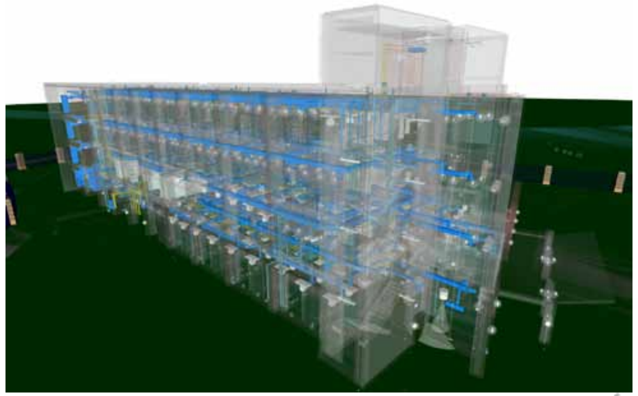
While working on the VA project, the entire team has reaped the rewards of being able to instantly see changes that affect the entire design process. These subtle changes, as we all know, can become huge complications. But with BIM, they are minimal at best and are detected in the earliest stages creating an environment where everyone knows their part and the integration of all team members is seamless because everyone sees the work as it happens. BIM has allowed us to develop more integrated solutions, allowing the client a better understanding of building spaces, systems and construction methods.

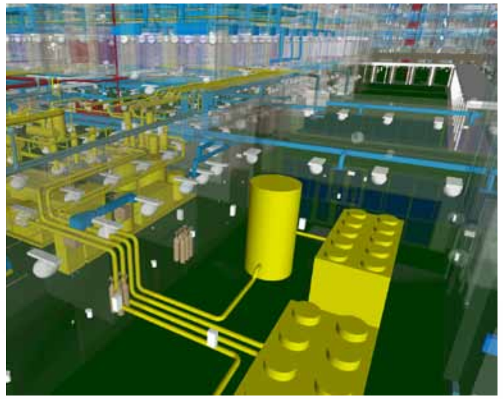
Throughout the VA project, we have leveraged BIM to provide the following benefits:

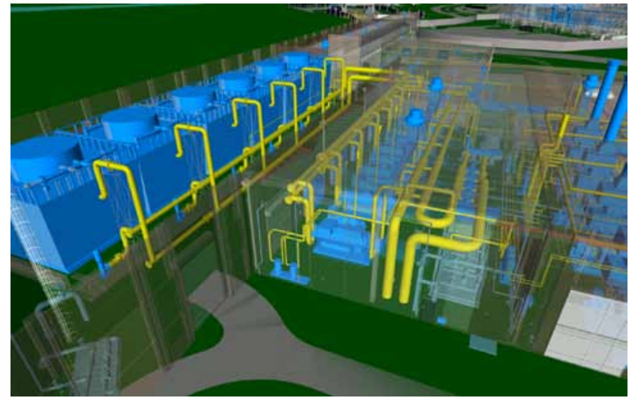
- Ability to manage costs and budgets
- Streamline our workflow
- Improve team communication
- Resolve conflicts
- Analyze design options
- Calculate lifecycle usage

Specific owner benefits include:

- Consistent data from initial planning through final design;
- Capability to extract data from schedules that can be exported to user-friendly text, spreadsheet files;
- Ability to maintain and track equipment and furniture data through construction to the purchasing phase;
- Maintaining the schedule of rooms and areas allows owners to control the size of the project;
- Producing schedules that show interior finishes associated with rooms, ceiling heights and materials helps owners validate their program requirements;
- Producing three-dimensional views of interior rooms with equipment and furniture help owners visualize the finished space.

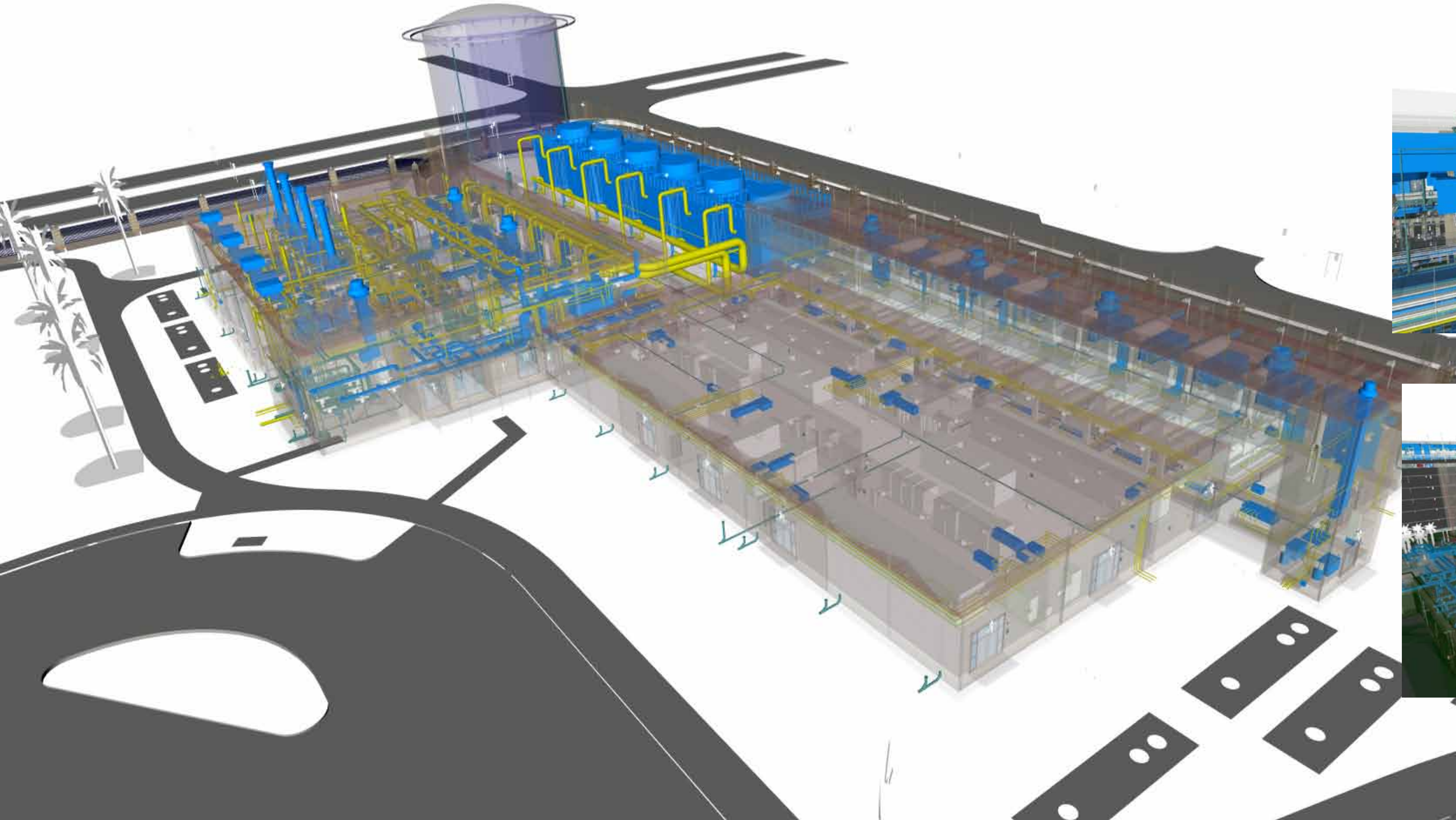


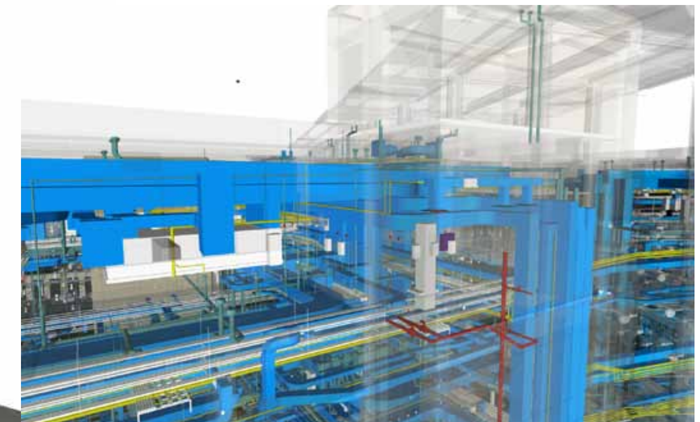


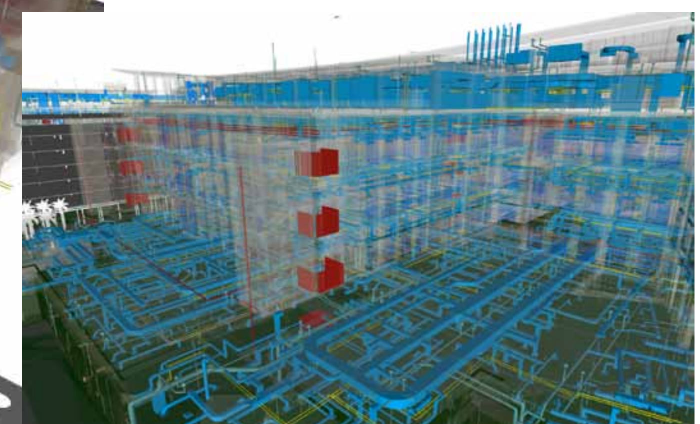


Virtual Architecture and MEP

The power of BIM has taken discipline coordination to a new height. Information goes beyond being descriptive and becomes a virtual experience. This experience allows for validation of coordination to occur prior to the first physical steps of the construction process.

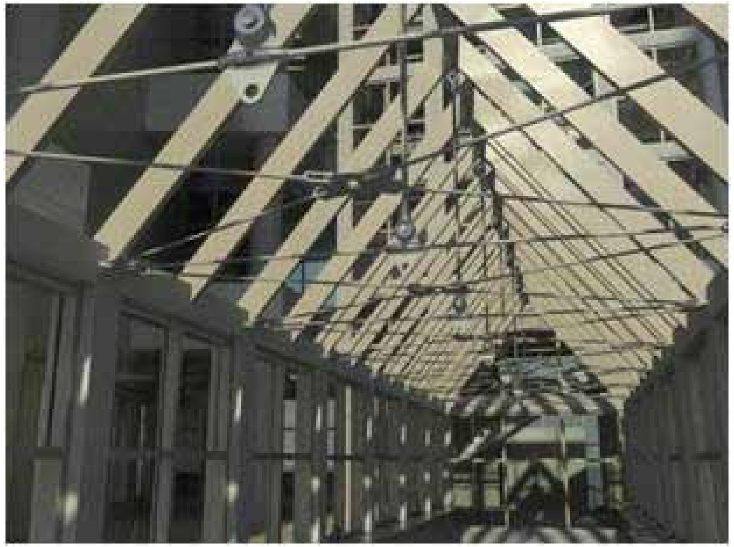




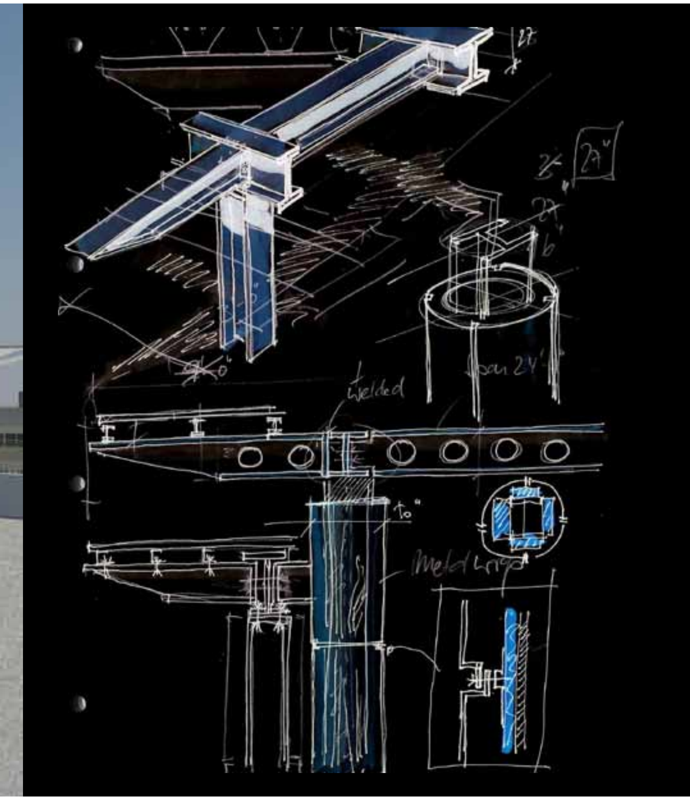


nontechnology factors contributing to success

Implementing a new technology is always a challenge. It requires a dedicated commitment of the decision makers and implementers. The success of the VA project relied heavily on the high level of BIM skills of the design team. To help facilitate and speed up the learning curve, we have implemented an aggressive training program, including the creation of a BIM Committee in charge of defining standards and procedures, and an internal online forum to discuss issues and share knowledge. Periodical meetings, learning sessions and seminars have helped build knowledge and a sense of achievement throughout the project team.



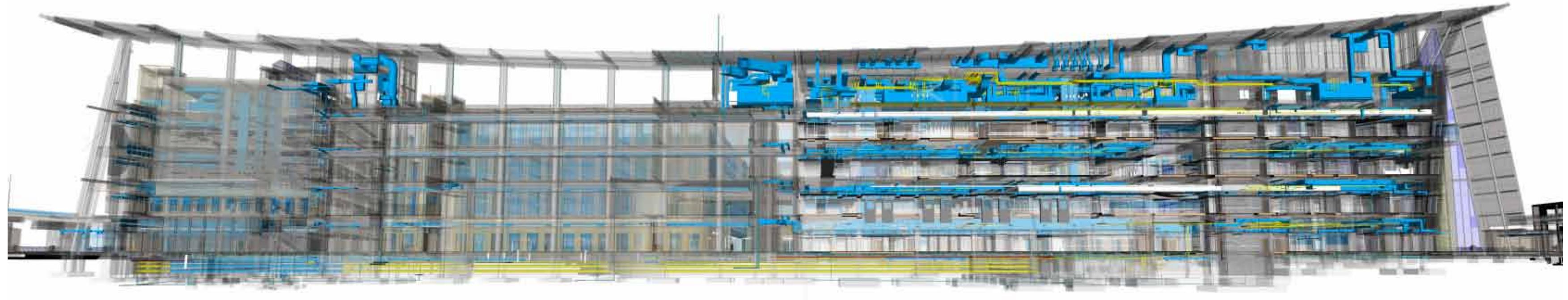
Our aggressive approach has led us to the forefront of this industry evolution. Our BIM leaders are recognized professionals who are members of organizations for the advancement and use of BIM (National Institute of Building Sciences, buildingSMART alliance™, etc.), BIM professors at local colleges and universities, and speakers at BIM events (local user groups, Autodesk University, etc.).

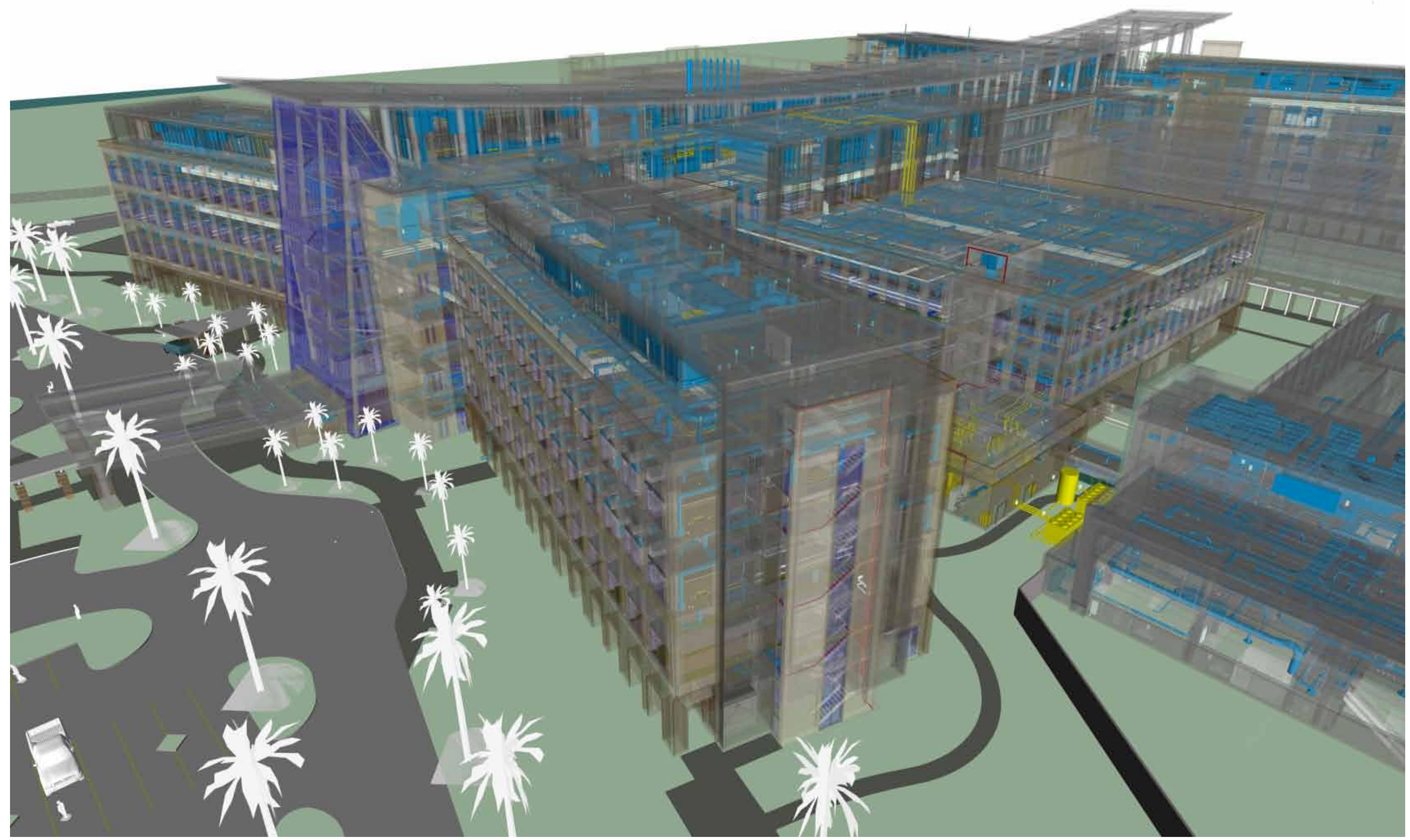


Architect's Statement

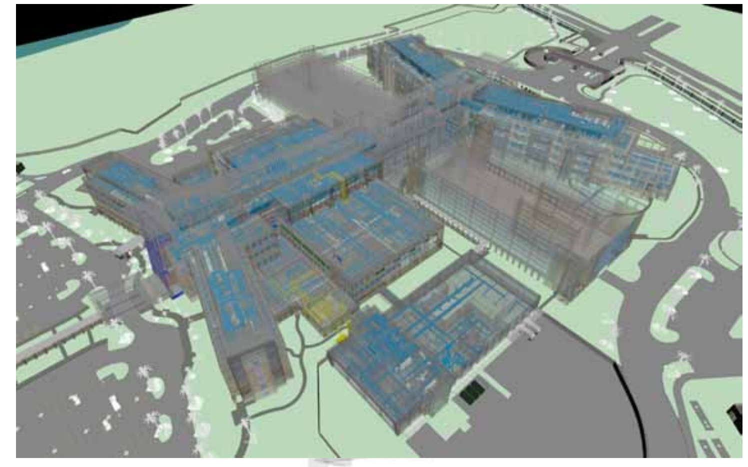
Due to the enormous scale of the project, complexity of programming and design, and multiple project teams located in five different states, the use of BIM and associated technologies has been key to providing an integrated medical campus that will honor and serve our Veterans in Central Florida.

The client intended this project to be a new paradigm in federal healthcare for our Veterans – it should be a place of healing through the practice of Evidence-Based Design and sustainability and honor the patients who serve our country through its physical scale and materials.





The major program elements composed along the main spine placed the clinic with higher patient volumes toward the entrance and the hospital to the south offering tranquil views of the water. Two 1,300-car parking structures are located between these two elements connected by a glass, steel and concrete atrium covered by a large sweeping roof that spans the entire length of the complex. The "super roof" aids in wayfinding while collecting rainwater and housing solar panels along its entire length. The south entrance has a tall glass atrium facing the water and the north ceremonial entrance is composed of large monumental columns supporting the roof. A one-story high wainscot binds all of the masses together allowing the tower elements to sit on top while simplifying the entire composition.



Owner's Statement

Bringing a new VA Medical Center to Veterans in Central Florida is an achievement the whole community can celebrate. Through numerous challenges including changes in site selection, budget concerns and changes in healthcare requirements the project team has prevailed in delivering a truly remarkable design that exceeds expectations for creating a healing environment for Veterans. The four-story 1.2 million square foot facility has emphasized clinical adjacencies and patient-friendly features throughout. The project is not only designed to provide world-class healthcare but to be a monument to honor those who have served.

Features of the new facility include 100% single patient rooms designed with families in mind as well as efficient effective healthcare and patient amenities. Ability to provide quality care and education with state-of-the art technology has been designed into the space for a thoroughly integrate approach. Flexibility to meet future needs is enhanced through the use of interstitial space between floors. Clinic spaces are flexible to meet future changes in healthcare as well has have spaces for healthcare teams to work together for the best needs of the patient rather than sending patients to multiple fragmented points of care. Site planning includes maximizing healing views of water for patients and residents while keeping the busiest sections close to the main roadway and parking.

The use of BIM has assisted the owner in numerous ways including showing a three -dimensional fly-over that has been posted on our website and developing list of equipment items throughout the facility. Information directly from BIM is used as the basis of the VAMC list of procurement planning and preliminary equipment budgets. We are proud to deliver the best care to Veterans in Central Florida through this state-of the art medical center.

Contractor's Statement

At the time the superstructure, parking garages and warehouse projects were awarded, it was unclear as to how BIM would play into the coordination of these two packages. As construction began, however, it was extremely evident that the use of BIM enabled the entire project team to identify and resolve potential issues that may have had a substantial impact to the future phases of the project. Not only does it help establish a partnering culture among all team members, it also encourages shared resolution of potential issues. The ability of BIM to create a working three-dimensional model allows the project team members to identify and correct installation issues before they occur. This proactive approach eases the project coordination effort for all parties involved, making the time spent more productive. It is this coordination that alleviates the potential for major conflicts, resulting in a quality end product that exceeds the project team's expectations.