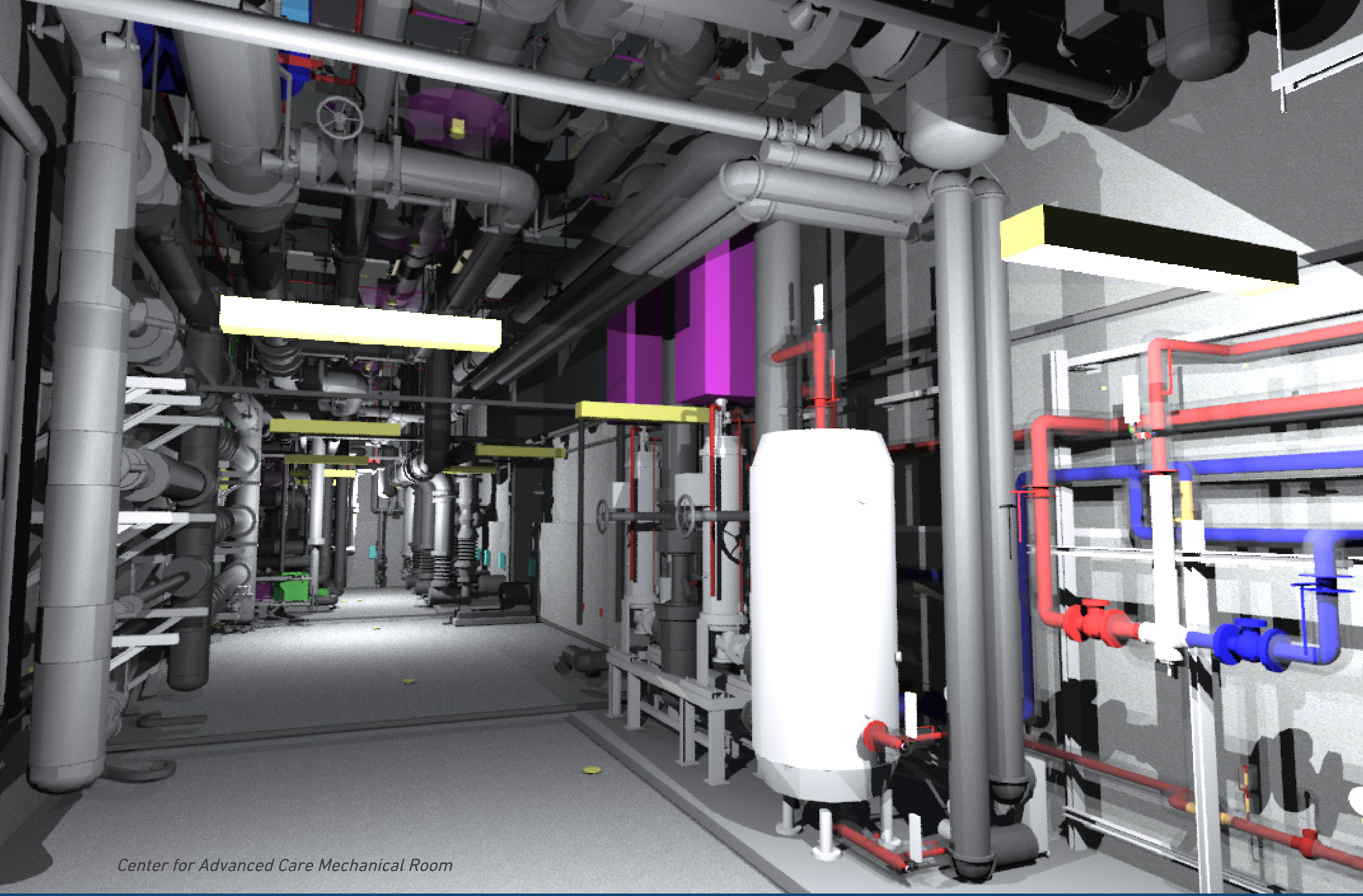
AIA 2016 BIM TAP AWARDS

FROEDTERT & THE MEDICAL COLLEGE CENTER FOR ADVANCED CARE

The success of the Center for Advanced Care project was a direct result of the **collaborative team** who designed, engineered, and constructed it. Their trust in delivering the project with an integrated approach enabled the team to use **innovative tools**, implement efficient processes, and **streamline the design and building process.**

- FROEDTERT & THE MEDICAL COLLEGE OF WISCONSIN



Center for Advanced Care Mechanical Room

BIM is a **non-negotiable tool for us**; it's how we build. BIM provides the team with the opportunity to **build faster and more efficiently**. Using a One-Model approach, each project team member was integrated into the modeling process, informed on how each system impacted the overall building, and responsible for **ensuring high-quality work** that benefited the entire team and project.

- CONTRACTOR'S STATEMENT

The implementation of a highly coordinated BIM plan for the Froedtert Center for Advanced Care project was key to success in terms of time and labor costs. The project team approached our shared challenge with a **commitment to improve the delivery process**. The design and construction team, with support from the owner and legal counsel of all parties, established a **model sharing protocol** that enabled design, CM, and early trade partners access to design models. This enabled parallel coordination to take place in advance of construction, avoided duplication of modeling efforts, and greatly accelerated the development of fabrication models. **The significant reduction of RFIs, visibly well coordinated MEP system execution in the field, and appreciable project cost under-run are testaments to the power of a coordinated and well planned BIM strategy.**

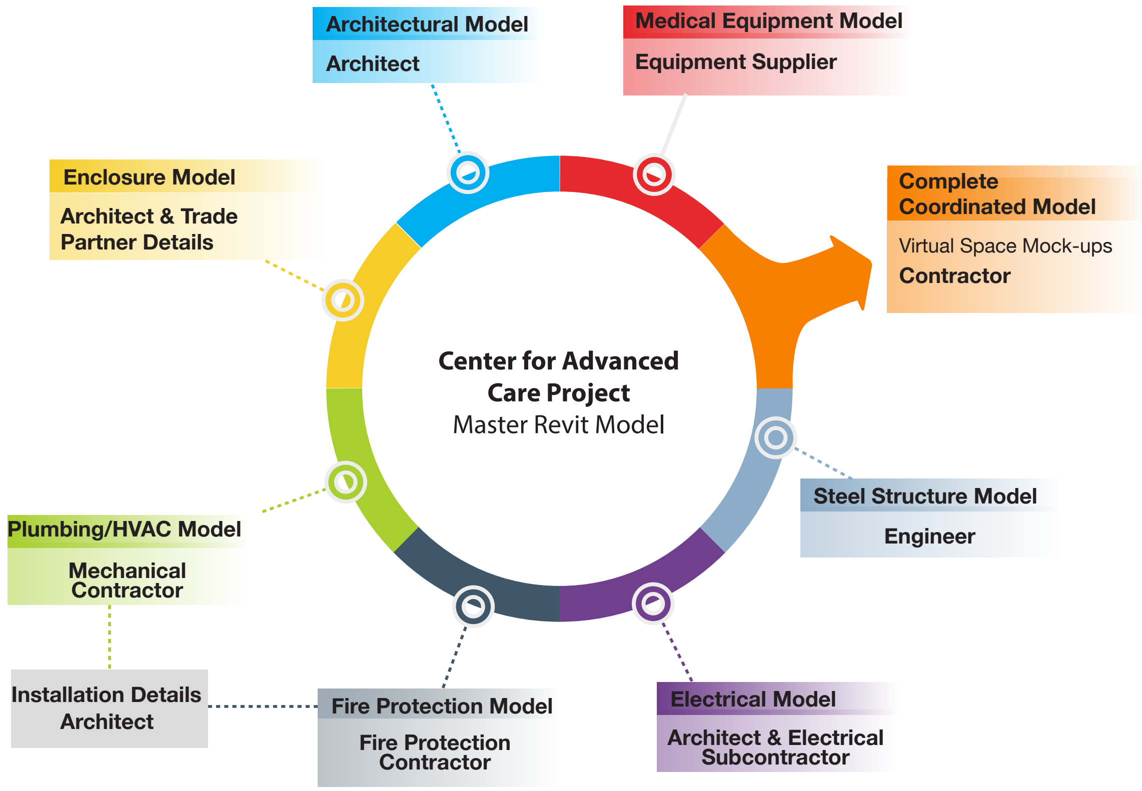
-ARCHITECT'S STATEMENT

PROJECT **OVERVIEW**

Construction of the Froedtert & the Medical College of Wisconsin's 608,000 SF, eight-story, Center for Advanced Care completed in October 2015. Its name reflects the exceptional level of specialty care and medical technologies that are housed there, including the Heart and Vascular Center, Transplant Center, and integrated rooms for surgeries and interventional procedures.

More than 18,000 surgeries, including over 250 transplants, are performed at Froedtert Hospital each year. The new building brings together surgical, interventional, and intensive care areas. Their proximity to each other helps eliminate redundancy, enhance patient flow and safety, optimize operational efficiency, and support new technology adoption.

The team assembled to design, engineer, and build continually focused on innovation, efficiency, and a collaborative spirit to enhance the design and building process.



PROJECT **NARRATIVE**

The team assembled to design, engineer, and build Froedtert & the Medical College of Wisconsin's Center for Advanced Care chose to continually focus on an innovative and collaborative spirit in order to enhance the design and building process. Utilizing the latest Virtual Design and Construction (VDC) building tools and technology, the team developed and pioneered new ways to add value and communicate with each other and key stakeholders. The use of a One-Model concept was a commitment to continuous improvement and was crucial to the overall success of the project.

High standards for project partners were set, and each was held accountable in the delivery of a facility that met the needs of the customer. Collaboration, honesty, concrete answers, and technologically-advanced solutions were invaluable in adding value to the project, thereby increasing the customer's bottom line. The One-Model solution allowed all project partners to work within a Master Revit model.

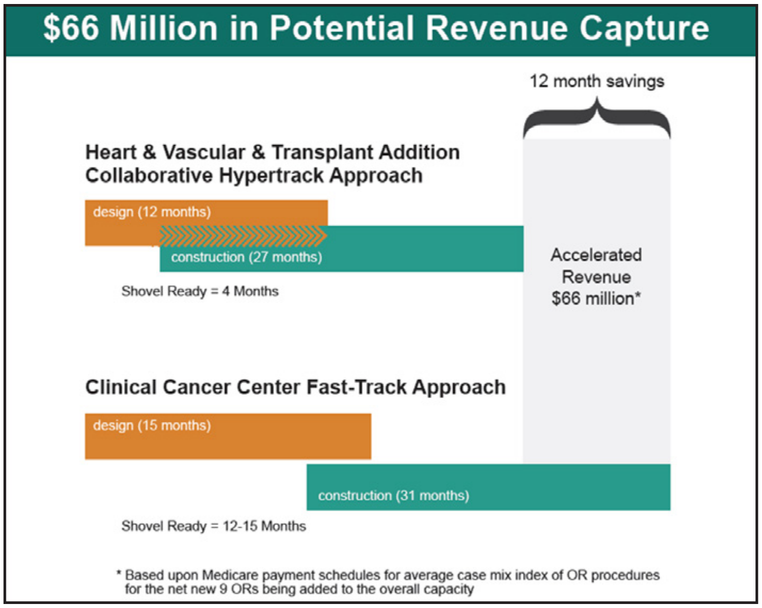
Benefits of this process included:

- early trade partner modeling
- construction coordination simultaneous to release of Construction Documents (CDs) versus the traditional and lengthy approach after CDs
- the ability for subcontractors to produce fabrication-ready models and shop drawings in conjunction with CDs.

To eliminate design redundancy, eight models were incorporated into the One Model. Each partner worked within their respective model, including: Architectural, Enclosure, Civil, Concrete Lift Drawing, Steel Structure, Electrical, Fire Protection, and Plumbing/ HVAC. The result was an integrated, real-time One Model that provided accurate information to all partners. Contributing to the real-time One Model and collaboration was the co-location of the project team and daily interaction with all parties. Initially, the team was co-located at the architect's office but then moved to the project site. Co-location was mandated for all partners and was integral to the target value budget process and value management approach.

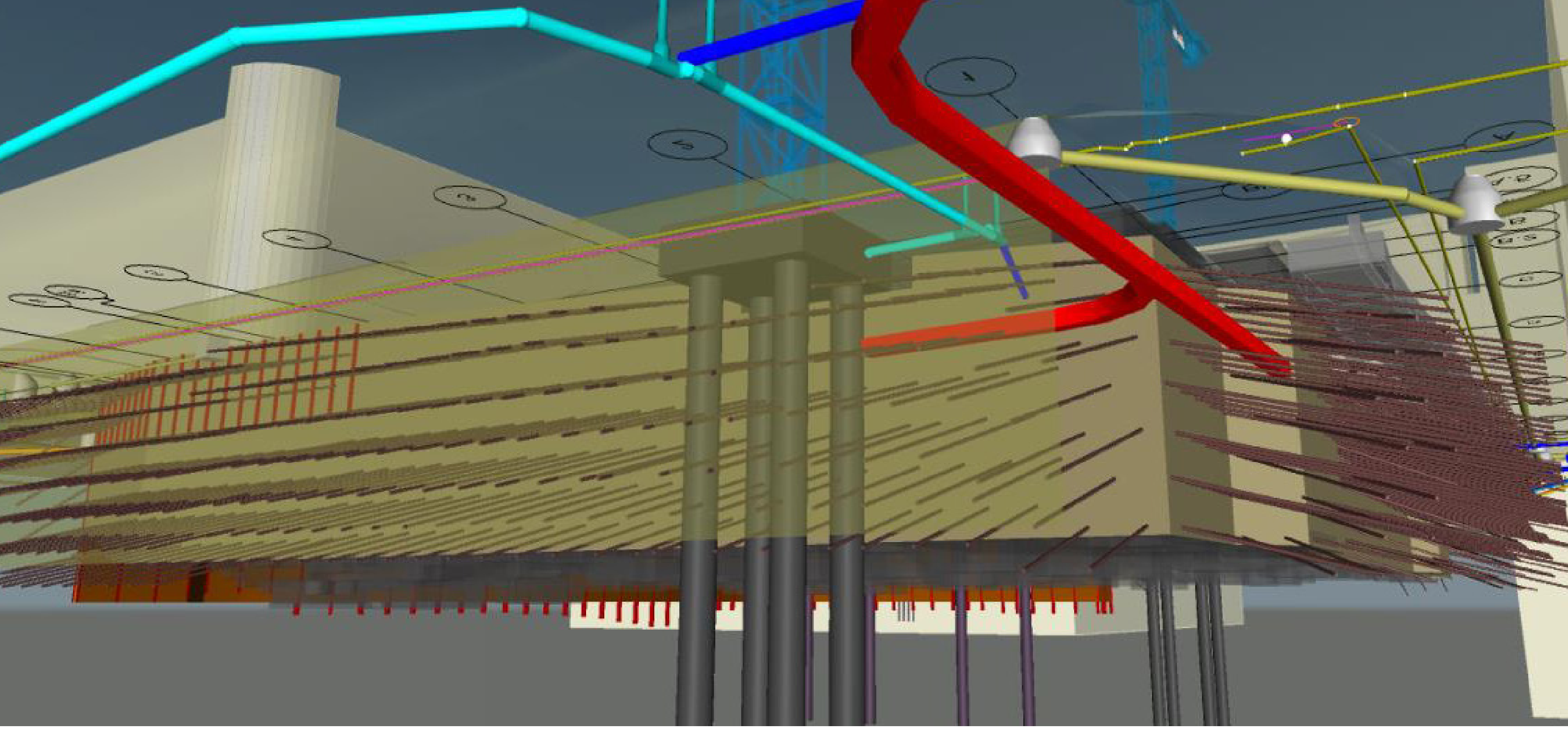
When appropriately managed, this approach can be extremely successful and beneficial for the project. An integrated One-Model approach requires a project-first mentality, long-term vision, communication, value-based decision-making, and a clear Right of Reliance. The One-Model approach also provides Integrated Project Delivery benefits without a tri-party agreement. This partnership resulted from years of successful work between the construction manager and architect, negotiated contract language that allowed for the right to Rely On selected design content at a defined time frame of exchange, language inserted into A201 and B101 agreements, and defined responsibilities for model content in the CDs. A Level of Development document was also used to determine where the design team handed off the CD responsibilities to the construction team.

Compared to a previous project with the same CM/ Architect team, the One-Model Approach resulted in a **50% reduction in RFIs and an 18% reduction in ASIs, as well as the addition of five additional floors per the owner's request with no change to the original completion date of the project.** The One-Model Approach was a value-based solution that focused on eliminating waste during design to meet the business need of the customer. The **One Model significantly contributed to the hyper-track schedule, which allowed the customer to be online twelve months earlier and capture an estimated $66 million in revenue.**



Revenue capture based on comparison of the design and construction time frame of the Center for Advanced Care versus the Clinical Cancer Center (completed in 2008). The same architect and contractor team completed both.

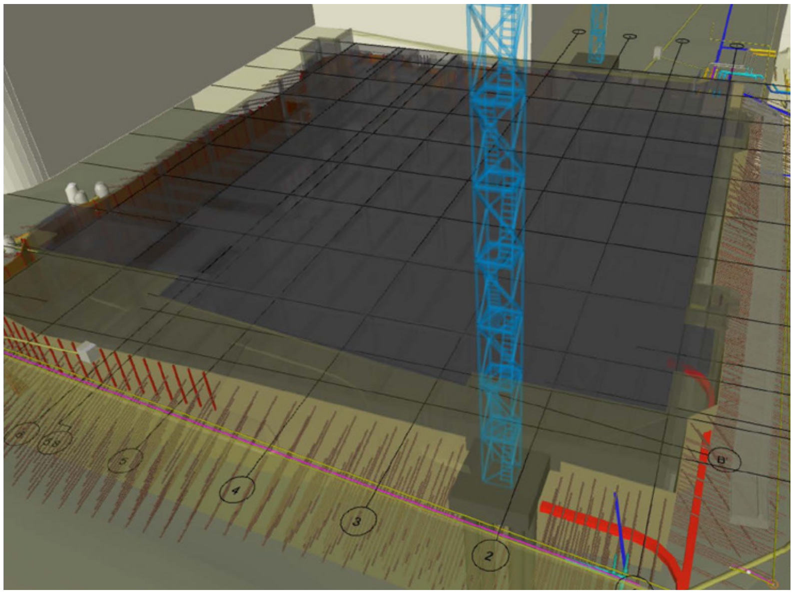
The following examples highlight the most impactful use of technology within the One Model that was implemented to drive the design and construction process.



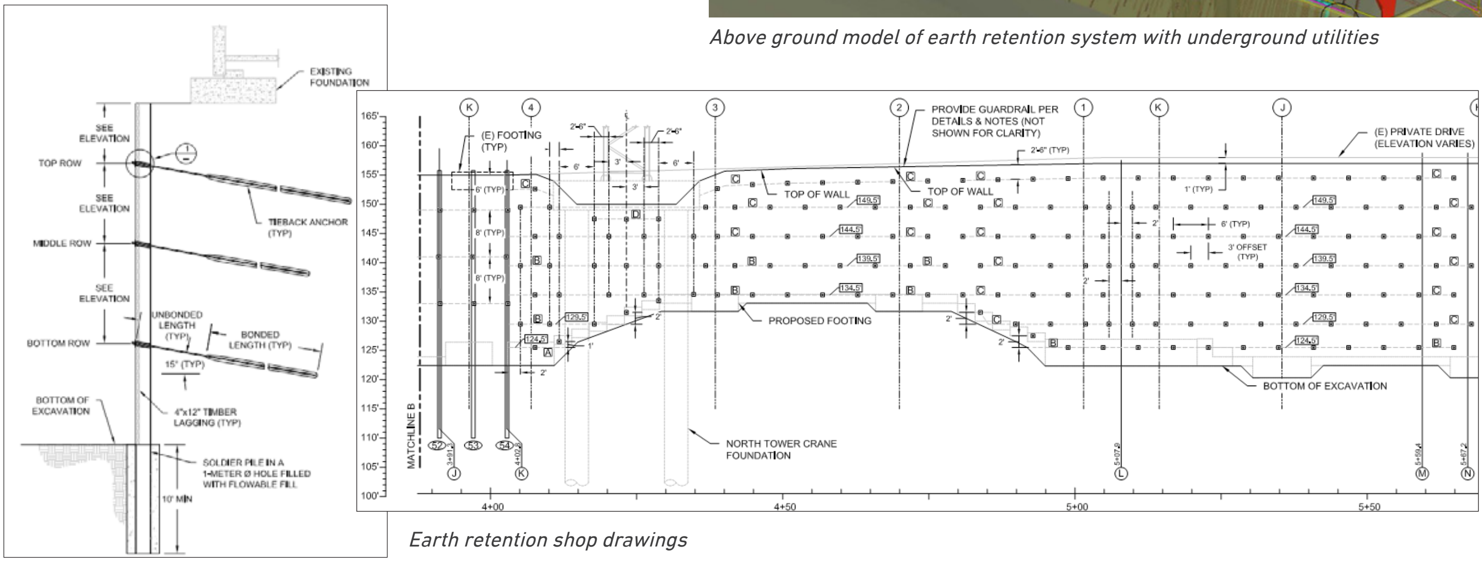
Below ground view of earth retention model with underground utilities

Earth Retention Model

With existing structures and roadways surrounding the building's entire footprint, modeling earth retention systems was paramount to the success of the project. Earth retention models were used to ensure the more than 800 tiebacks drilled into the perimeter did not interfere with existing underground utilities. Within the model, the team determined if the tiebacks would clash with existing utilities: then, the team requested the engineer adjust the angle of drilling prior to installation.



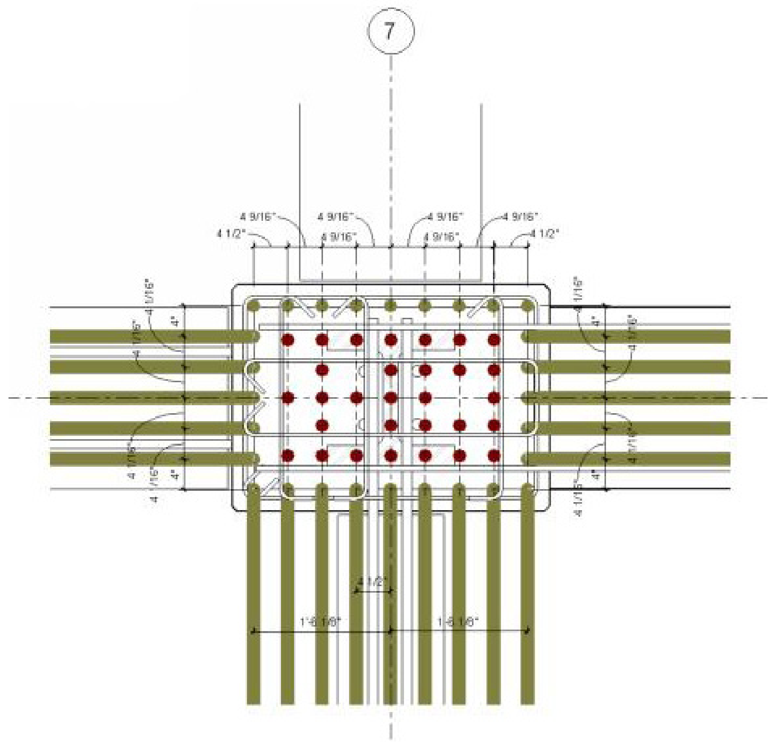
Above ground model of earth retention system with underground utilities



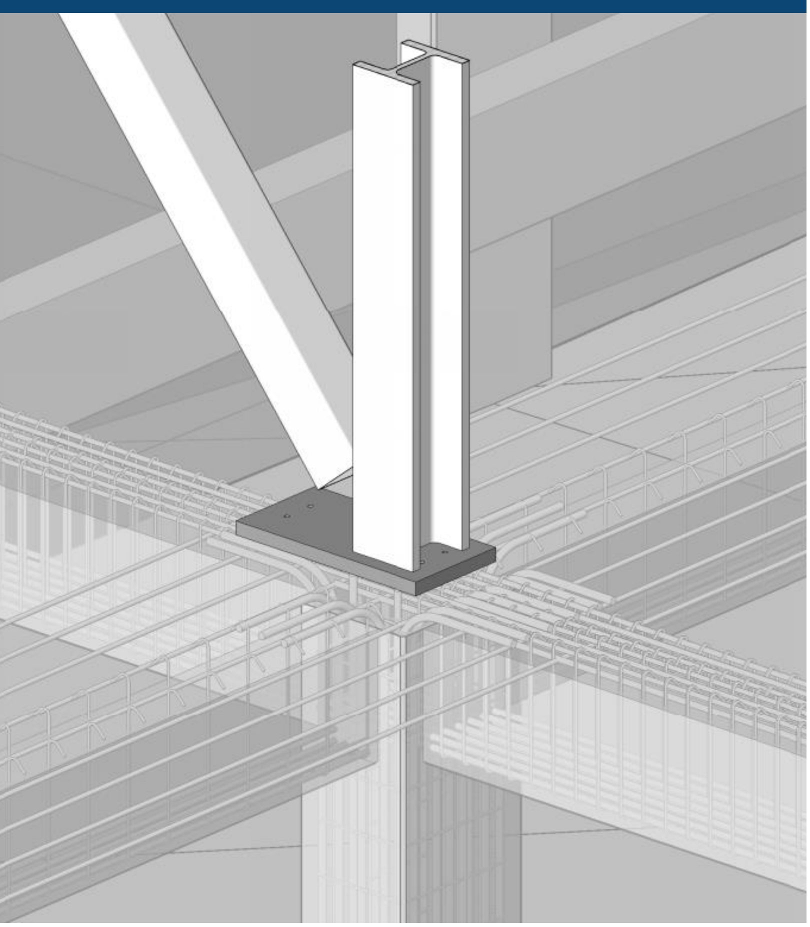
Earth retention shop drawings

Structural Baseplate Design & Construction

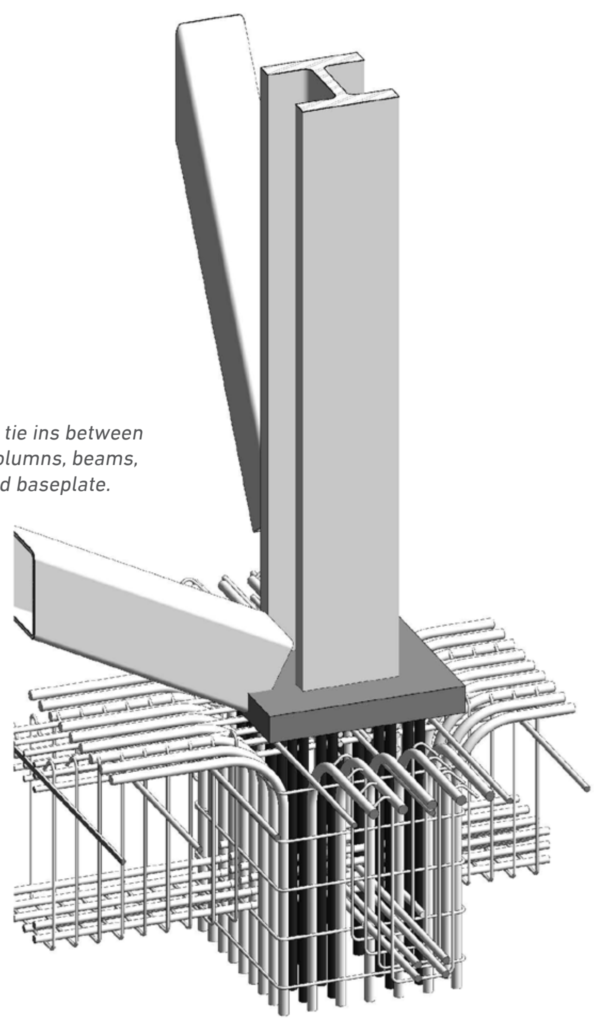
It was determined early on that, with the addition of steel base plates with 72" to 110" dowels, the team would have some major coordination issues getting all the rebar placed inside the columns. Due to the number of column bars (rebar running vertically in the columns), beam bars (bar running horizontally in the top and bottom of every beam), and the dowels that are welded to the bottom of the base plates; it was going to be extremely tight and difficult. What made this even more difficult is the weight of the baseplate (3,820 lbs.) and dowels that need to be suspended in the air during the first pour of the column. It was critical that the bar in the column was coordinated so that when this piece of the puzzle was lowered into place with the crane, it would actually fit. Matching this complexity, there were 27 unique conditions that happen in the building. Modeling these ensured installations went smoothly, and time in the field was saved.



Plan view of one of the coordinated columns. The red dots are the dowels that are welded to the baseplate.



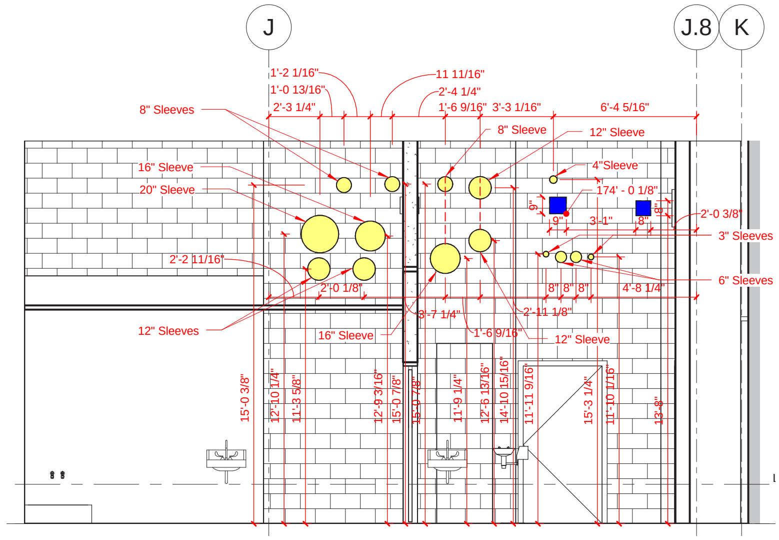
Rebar tie ins between the columns, beams, and baseplate.



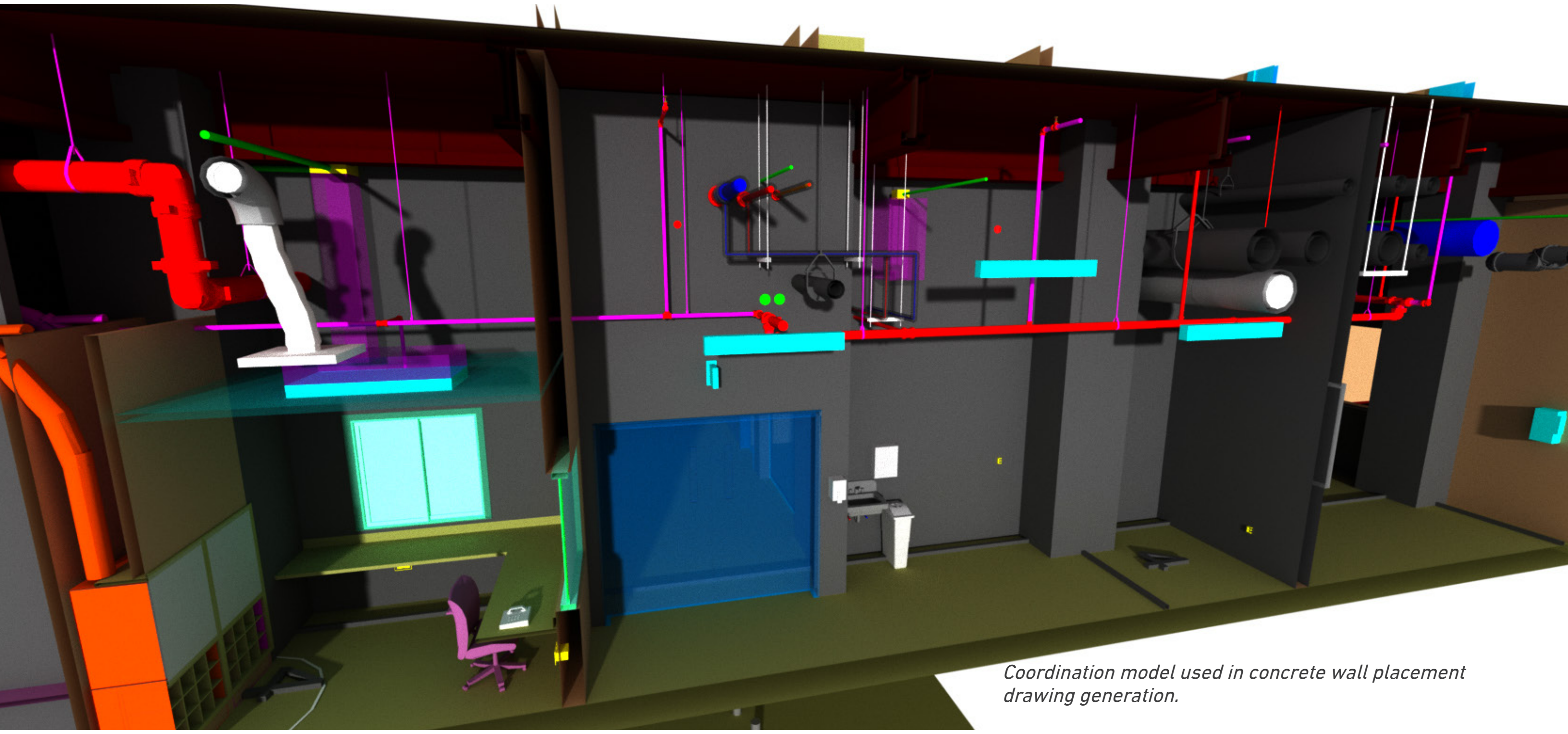
Concrete and Masonry Placement Drawings

2D Masonry Placement Drawings and 2D Concrete Placement Drawings with penetrations for steel embeds, mechanical, electrical, plumbing (MEP), fire protection, and ductwork were created from the Revit model. In total, over 100 concrete placement drawings were created to streamline the installation of cast-in-place concrete. Each placement drawing provides a cohesive document that combines architectural drawings, steel shop drawings, MEP information, form and rebar shop drawings, concrete quantities, etc. in a single, digitally-accessible document. With the success of the concrete placement drawings, the team saw value in creating 30 Masonry Placement Drawings. These drawings identified system penetrations for the masons to work from. Sleeves, electrical boxes, and additional MEP components were prefabricated off-site and installed more efficiently. Benefits of placement drawings included:

- Higher quality finish
- More efficient, quicker work flow, resulting in cost savings
- Increased information available in the field
- Ability to prefabricate electrical boxes, MEP components
- Reduced opportunity for mistakes
- Simplified coordination
- Recorded (as-built) documents as immediately available



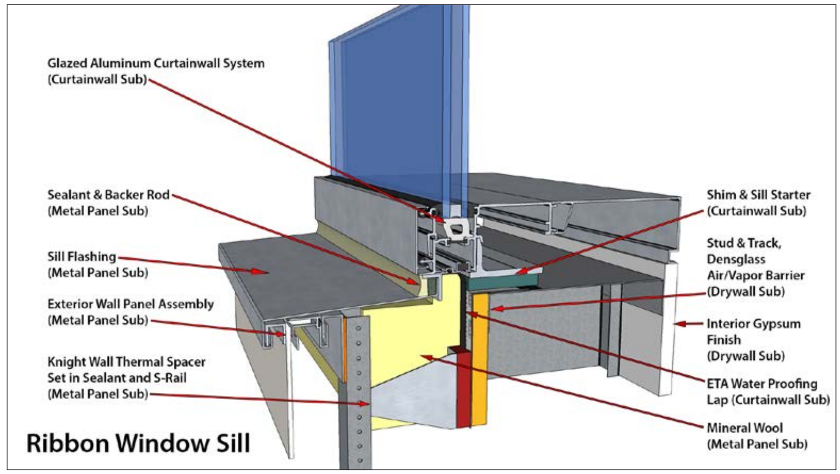
2D Masonry placement drawing



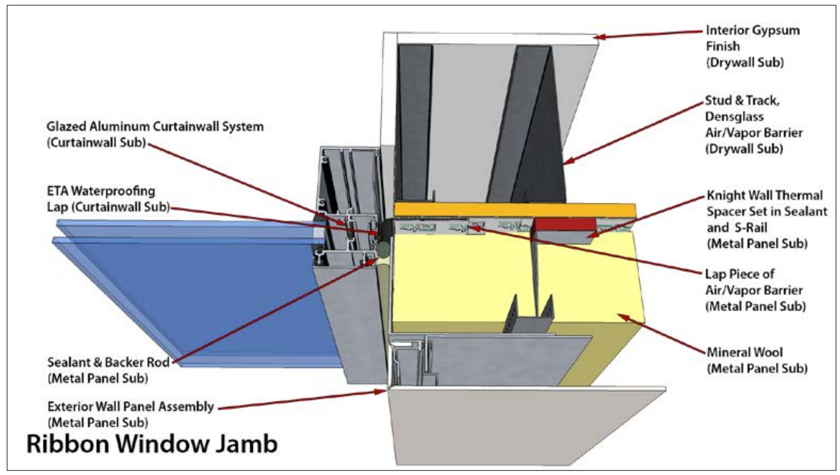
Coordination model used in concrete wall placement drawing generation.

Micro 4D Virtual Mock-ups: Enclosure System

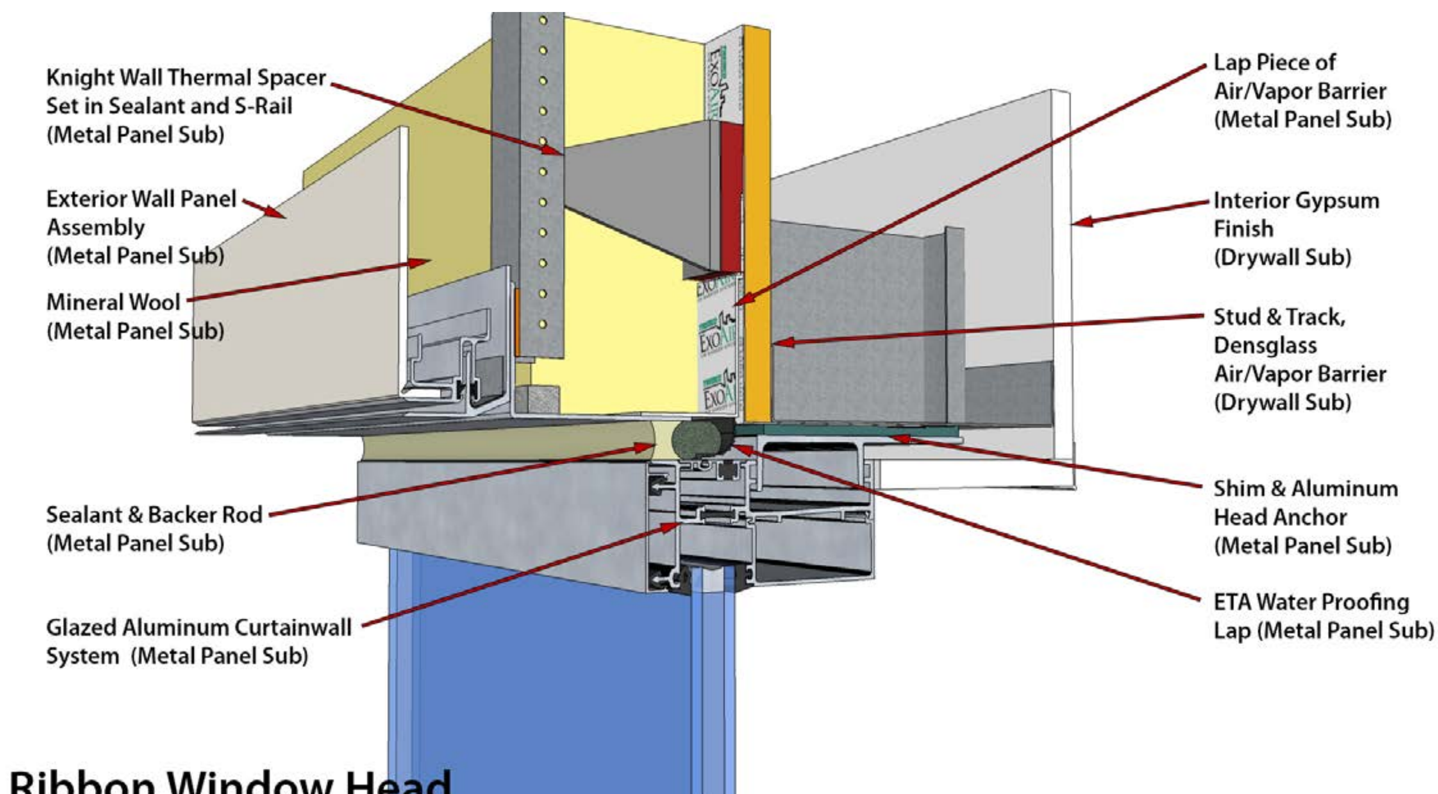
Complex enclosure systems on healthcare projects pose the greatest construction risk over the lifetime of facilities. The Center for Advanced Care's complex system required an approach to minimize this long-term risk. This multifaceted approach involved the use of enclosure consultants who combined proven design methods and lessons learned from previous projects to propose an innovative system. The team hired highly-qualified subcontractors and utilized virtual mock-ups to aid in means and methods exploration as well as inspections. All enclosure subcontractors were involved in identifying the correct sequence of installation by employing the 4D virtual mock-up. In addition to the virtual mock-ups, the team built a full-size enclosure mock-up and tested in a laboratory using the actual construction system. Virtual and physical mock-ups allowed for weaknesses to be identified and fixed prior to in-place work, which created efficiencies in the field.



Enclosure mock-up of the Ribbon Window Sill

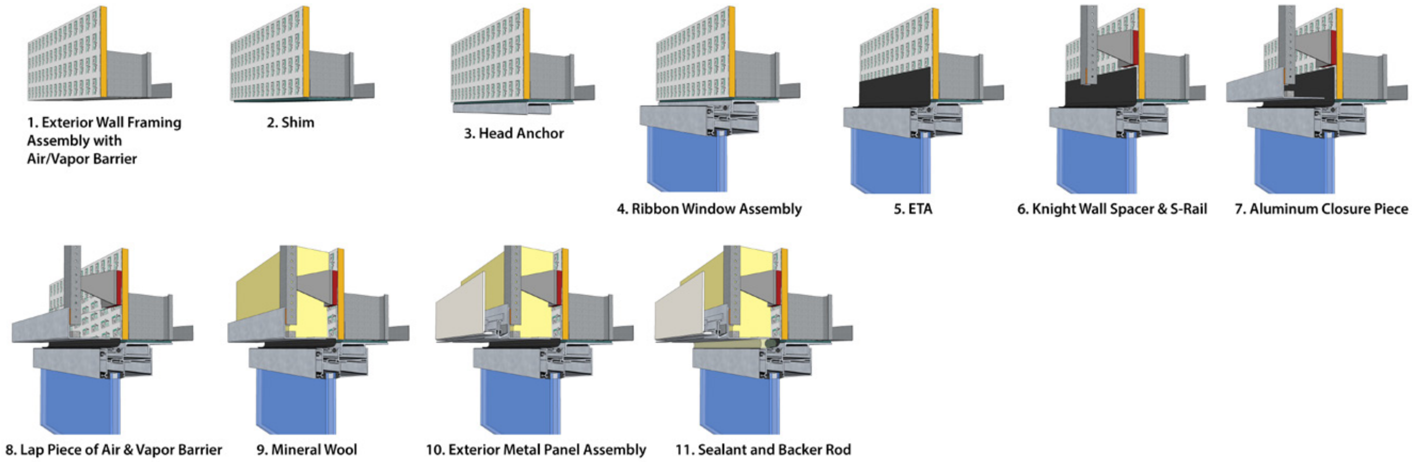


Enclosure mock-up of the Ribbon Window Jamb

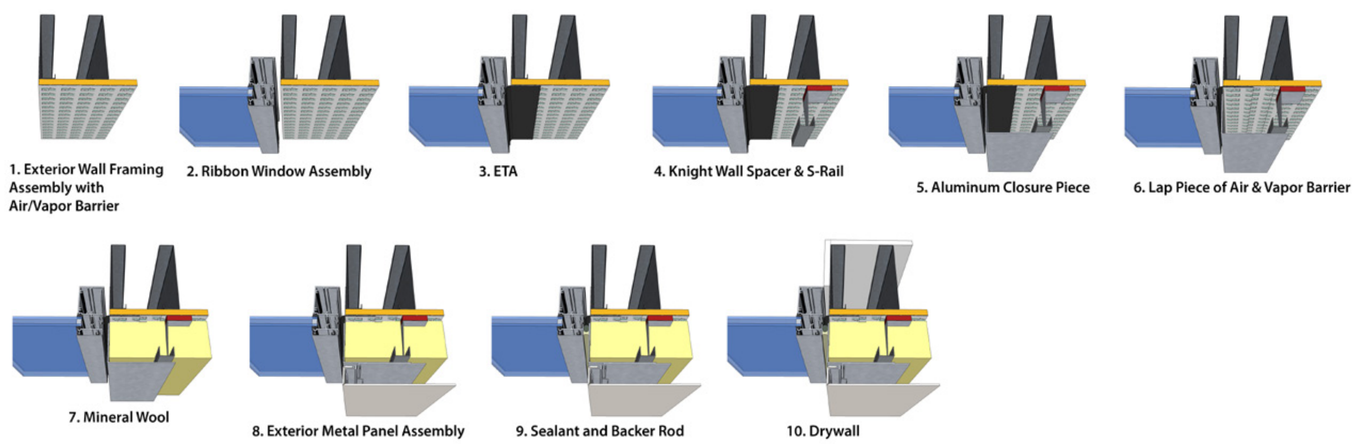


Enclosure mock-up of the Ribbon Window Head

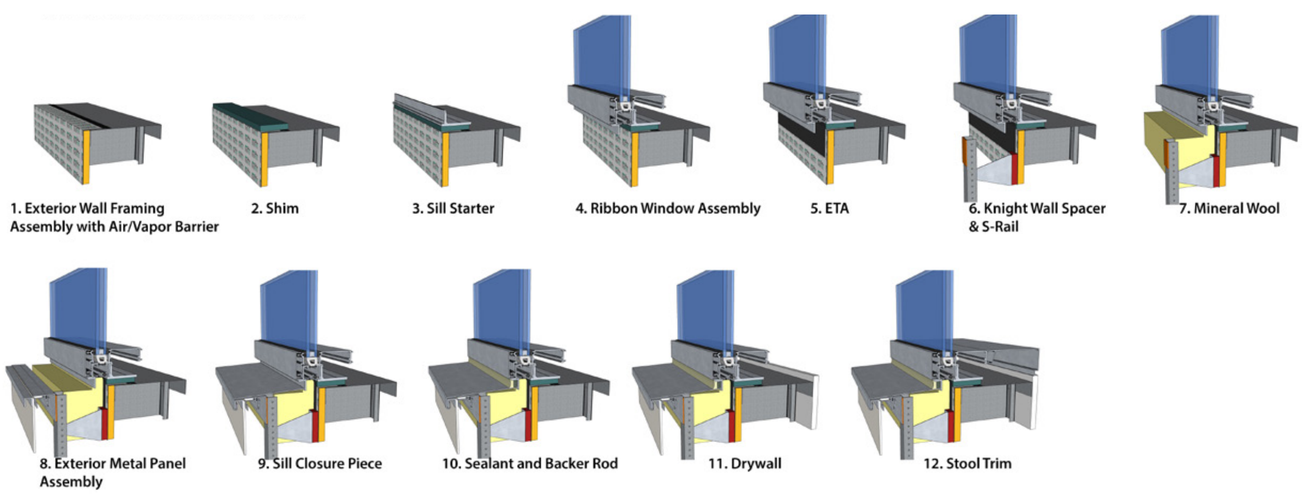
Ribbon Window Head Installation Sequence



Ribbon Window Jamb Installation Sequence

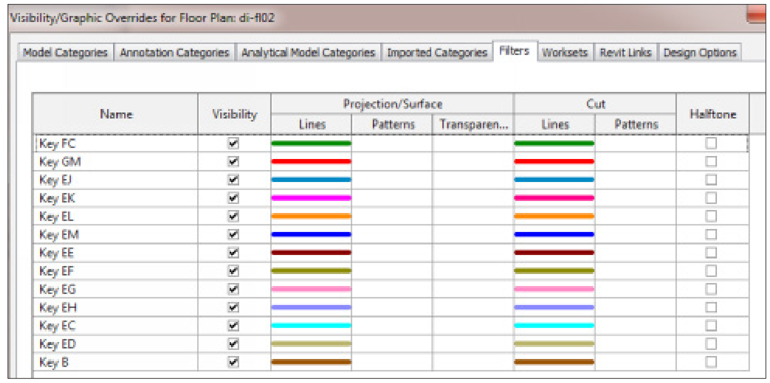


Ribbon Window Sill Installation Sequence

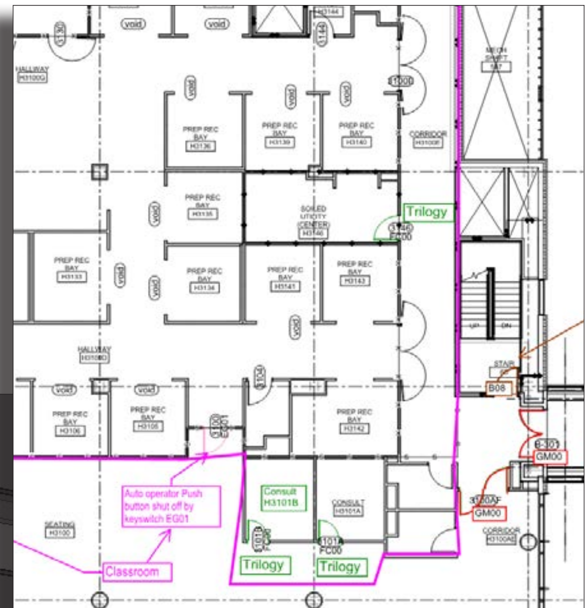


Door Schedule Model

The designer incorporated the data for each door located within the facility into the Revit model. Based on the Revit model, the construction team was able to manipulate data sets to visually identify the necessary hardware sets for each door. These color-coded models were then shared with our customer's security team to determine key access for end users of the facility. From a customer standpoint, the models allowed their security team to understand how their staff would move through the facility and what security access points were needed. The insertion of door data took model use and application to the next level.



Color coding of the keying groups for Center for Advanced Care in Revit

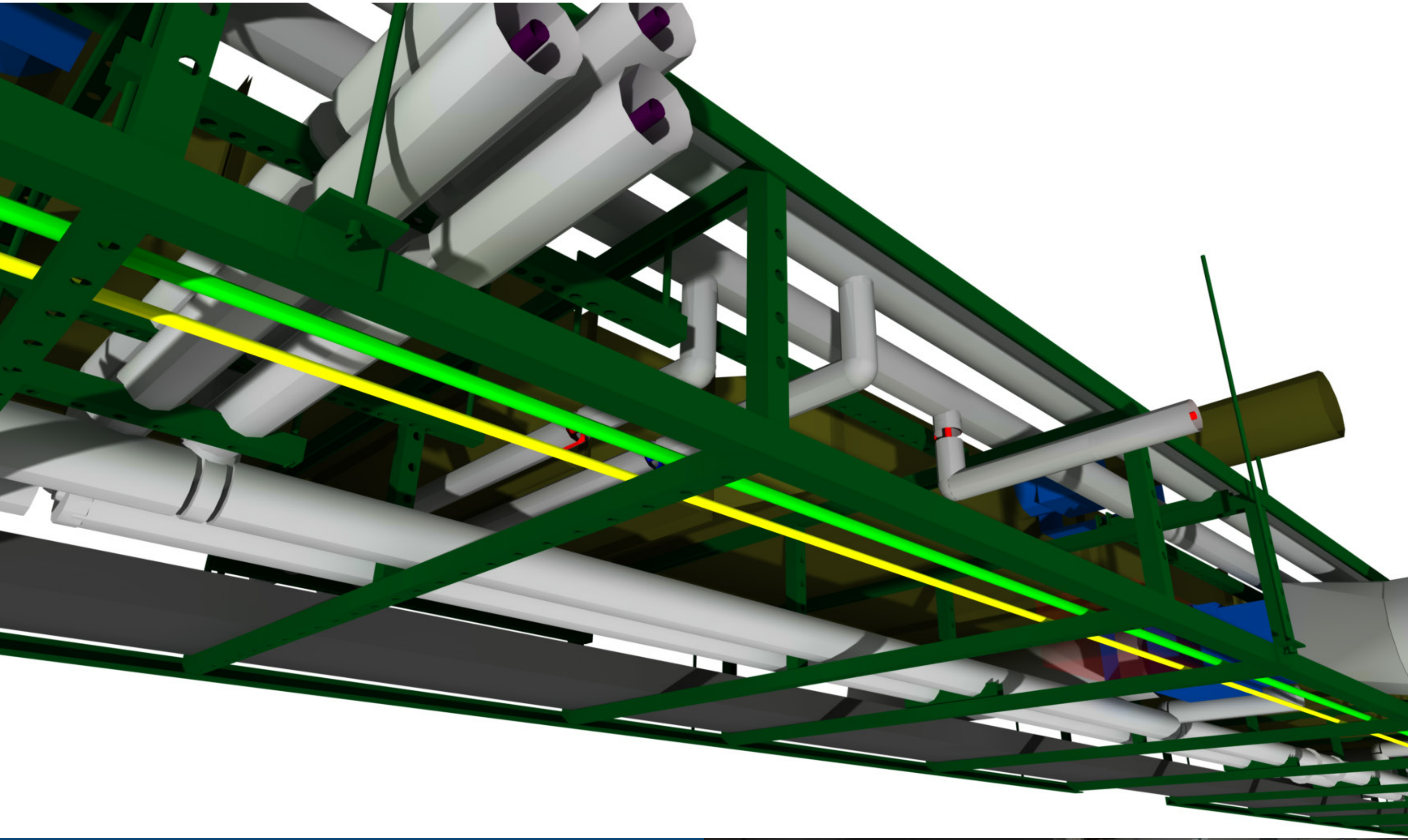


Color-coded floor plan of keying groups in Revit model

Virtual mock-up and actual consultation room

Room Mock-ups

Virtual and physical room mock-ups were utilized on the project. The team virtually mocked-up multiple exam rooms for a variety of departments plus preparatory and recovery bays. Using the mock-ups, nurses and doctors virtually walked through the spaces to make decisions on design elements and identify preferred locations of materials and equipment.



MEP Racks

Installation of mechanical, electrical, and plumbing systems can require meticulous attention to detail and precise coordination with multiple trades. For the 7th and 8th floor build-out, the team explored innovative ways to increase efficiency, ensure quality, create a safer work environment during prefabrication/installation, and expedite installation of MEP systems.

A strong collaboration among the CM, mechanical contractor, and architect produced a solution of prefabricated racking systems that included the necessary plumbing, data racks/cable trays, medical gas components, and duct work. To determine feasibility and constructability, the racks were modeled and coordinated using BIM. Once successfully modeled, 32 total racks for 62 rooms were fabricated in a controlled environment, shipped to the project site, and installed at a rate of four racks per day. **The prefabrication racking process saved at least eight weeks from the project schedule, and 1,000 man-hours, making this solution 500% faster than traditional methods.**

MEP racking systems prefabricated in the shop

MEP racking systems installed

Summary

Without extensive collaboration, the use of technology, and the One-Model Approach, the team would not have successfully delivered this project. The results were a **50% reduction in RFIs, an 18% reduction in ASIs, and the addition of five additional floors with no change to the original completion date.**

The One-Model Approach was a value-based solution that focused on eliminating waste during design in order to ensure a **hyper-track schedule that allowed the customer to be online 12 months earlier and capture an estimated $66 million in revenue.**