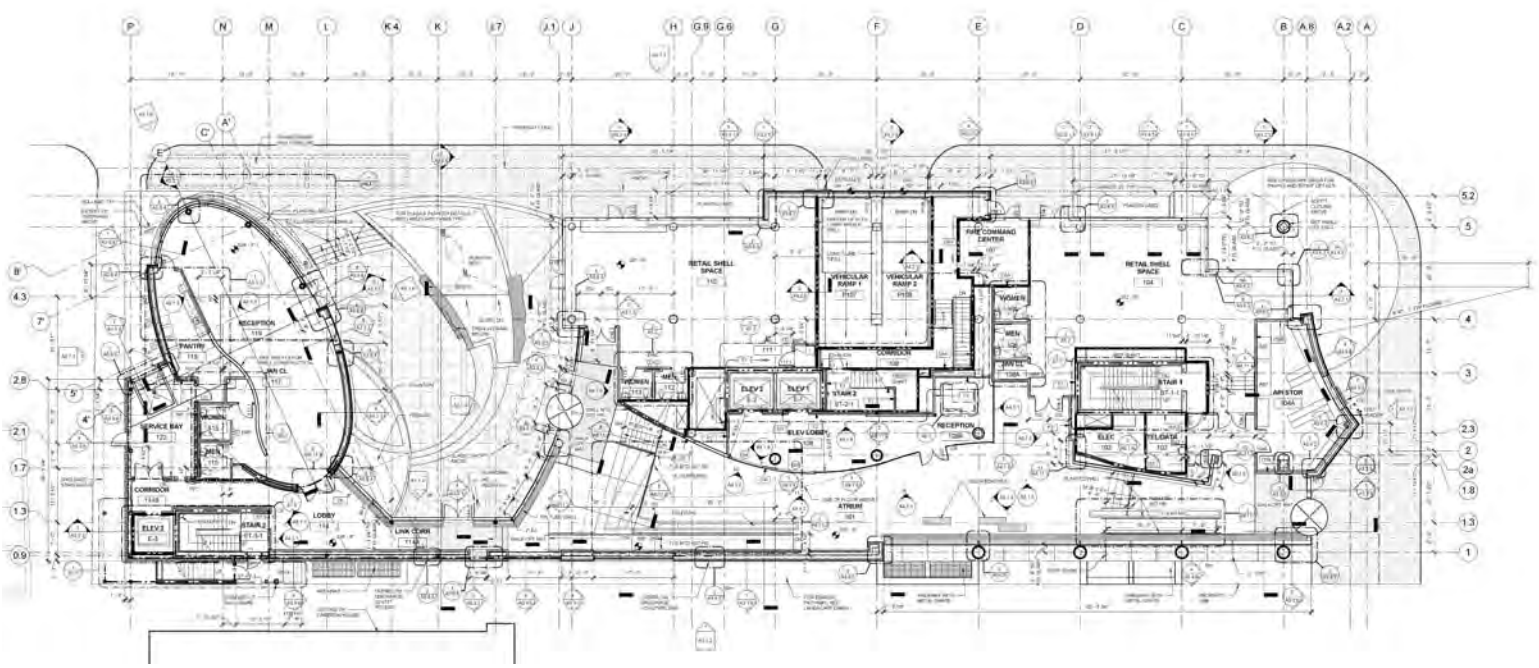

UNITED THERAPEUTICS

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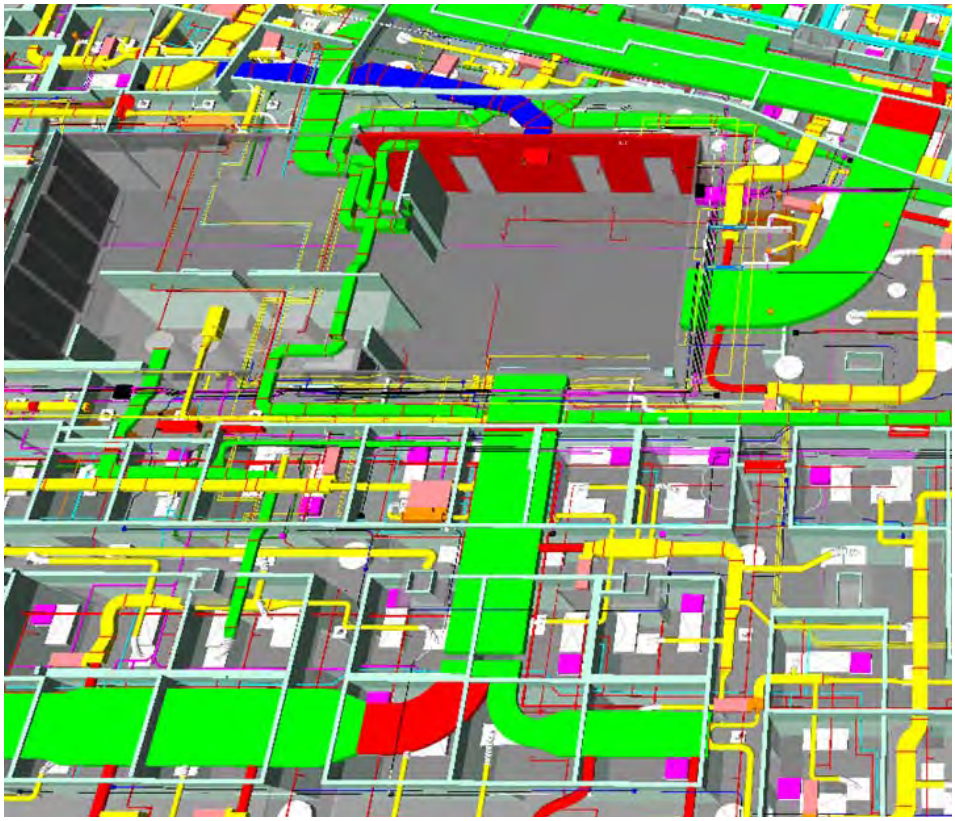
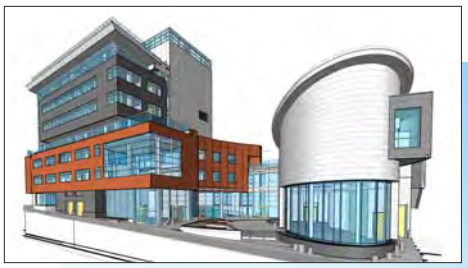
SILVER SPRING, MD

When the team was awarded the project, the Owner's goal was to occupy the project within 19 months. This very ambitious deadline required innovative communication to be successful.

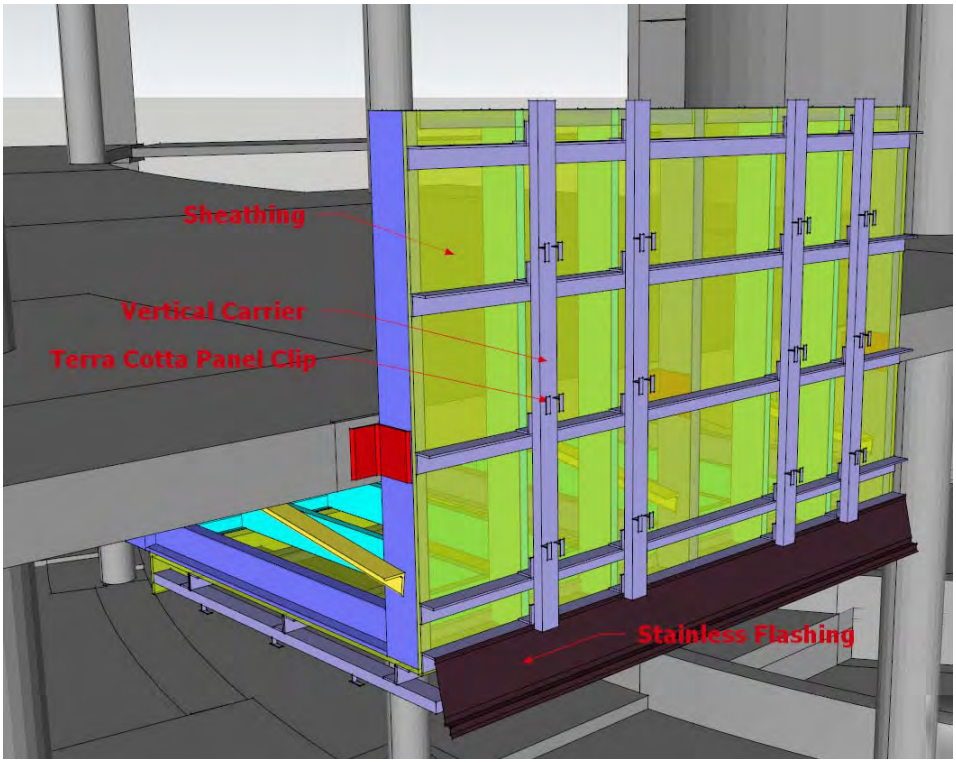
The overall project consists of approximately 100,000 square feet including two levels of below grade parking and support spaces with seven additional floors of multi-use spaces and offices. A schematic level design was provided in ArchiCAD from the Design Architect. As the AE of record, we were able to utilize portions of this model as we developed the detailed model in Revit. The client has a forward thinking philosophy and embraced the 3D technology as a communication tool. The interior architecture is a unique blend of organic shapes and forms with modern technology creating an innovative working environment. Collaborative and unique spaces, including open interactive floor plans, open atriums, multi story spaces, chromatherapy work pods, a tea room, zen garden and daycare, also create interesting challenges and opportunities for the BIM model. Our goal was to streamline communications inside and outside of our firm, thereby reducing costs and increasing efficiency while delivering a high level of design with increased client input.

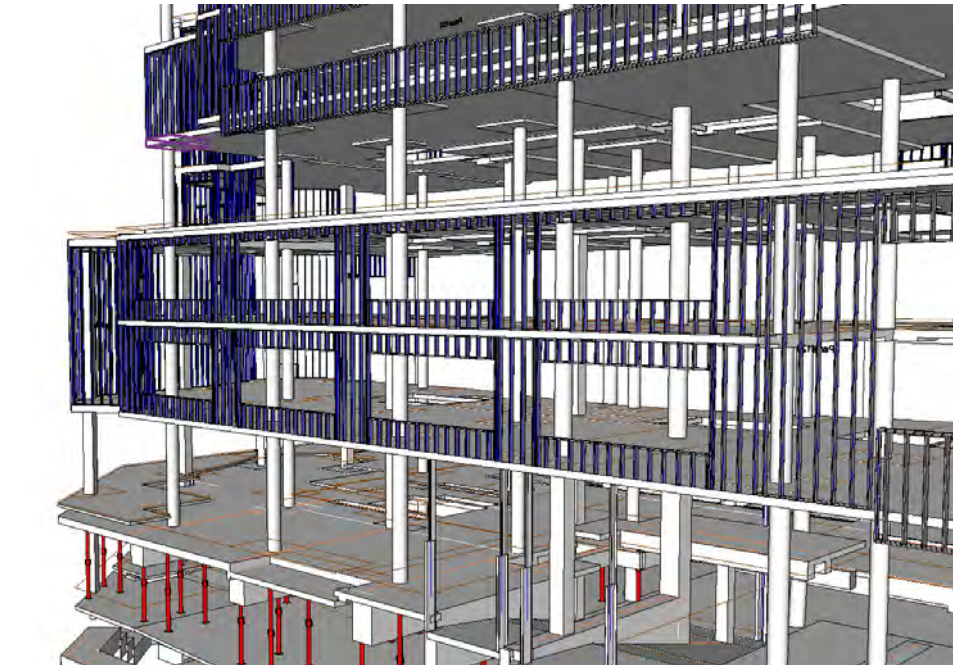


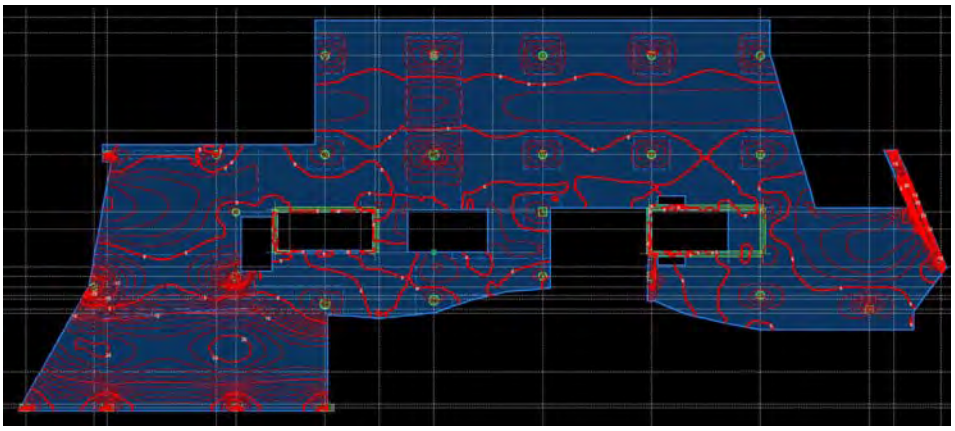
As a firm we were an early adaptor of BIM technologies. The project was documented in Autodesk's Revit. Our firm is committed to using technology to explore project phasing, construction documentation, creating 3D imagery, performing energy and efficiency studies, design validation, and engineering coordination.



Creative use of BIM technologies led to efficient ways to rapidly communicate design ideas. The speed at which the project team was designing and documenting presented a problem of ensuring the latest information was being shown to our client and her representatives. Much of the building's core and shell was available in 3D from early in the process and remained fairly consistent. However the design of the specialized interiors changed continually throughout the project.





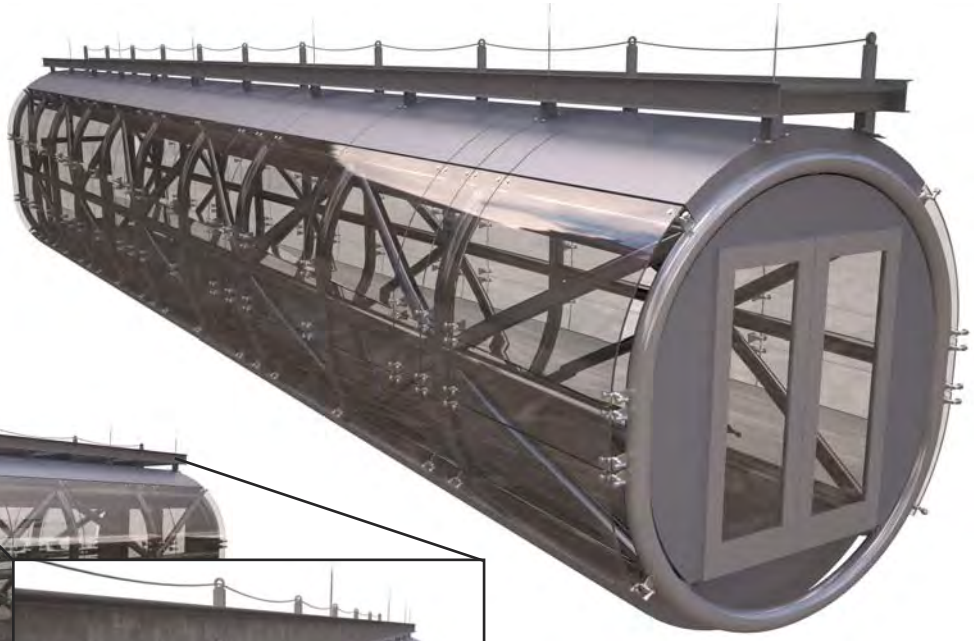


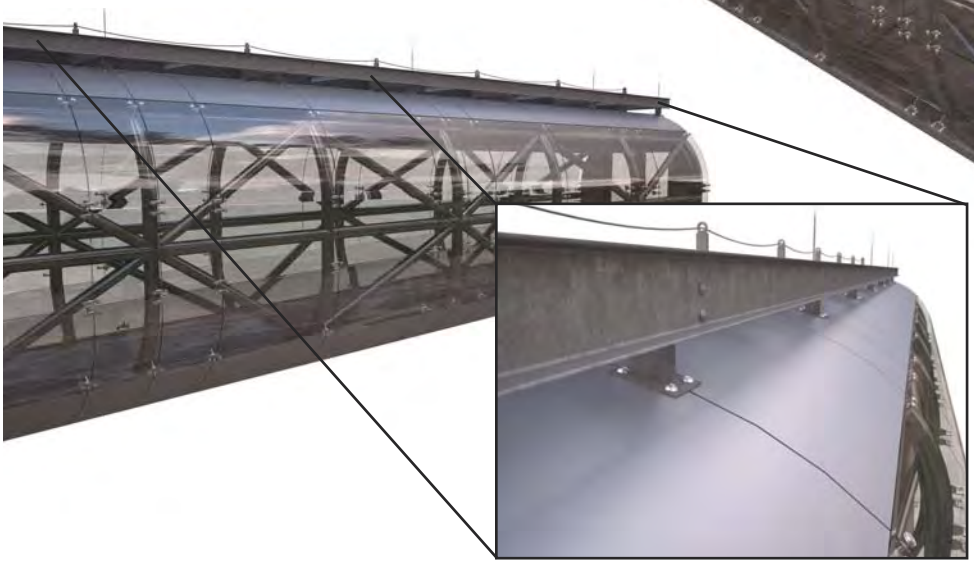
Embracing the latest BIM technologies enables our team to reevaluate existing procedures in place at our firm. Our primary team consisted of a project principal, project manager, project architect, designers, engineers and interior designers.

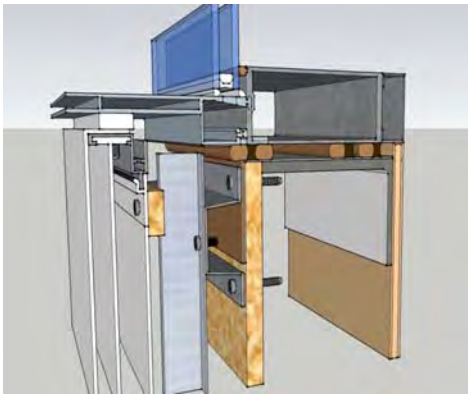
Each team member committed to delivering this project using BIM technology to evaluate and analyze design constructability of the building while providing exceptional design services to our client. Individual responsibilities were expanded to include a BIM model manager and a visualization technology manager.

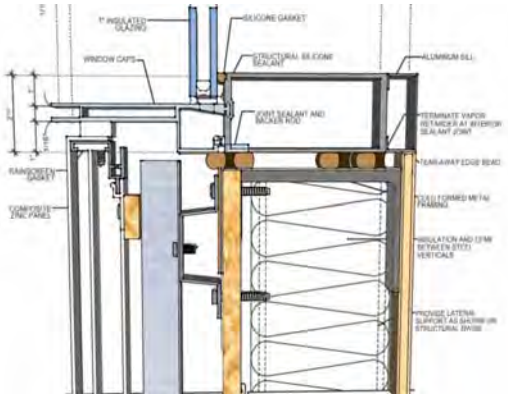
The BIM Model Manager was responsible for understanding all inter-related aspects of the BIM model.

Her role was to validate the model during each phase for level of detail, build Revit families, coordinate content between disciplines, enforce standards, and continue to participate in design review meetings. This role included continual meetings with our structural and MEP engineers for model coordination.









The Visualization Technology Manager worked directly with the BIM Model Manager and the designers to develop and maintain a web-hosted 3D model for client review and collaboration.

The Technology Manager created a custom application to translate in real-time the Revit model, while coordinating design decisions such as finishes, furnishing, and interior detailing on a regular basis.

"I found the software helped the team produce documents in such a short time. Even with the learning curve and short deadline, we were able to produce high-quality documents. Sometimes it was a trial with all the moving parts and people but I don't think we would have been able to deliver the project as it was using traditional CAD practices."

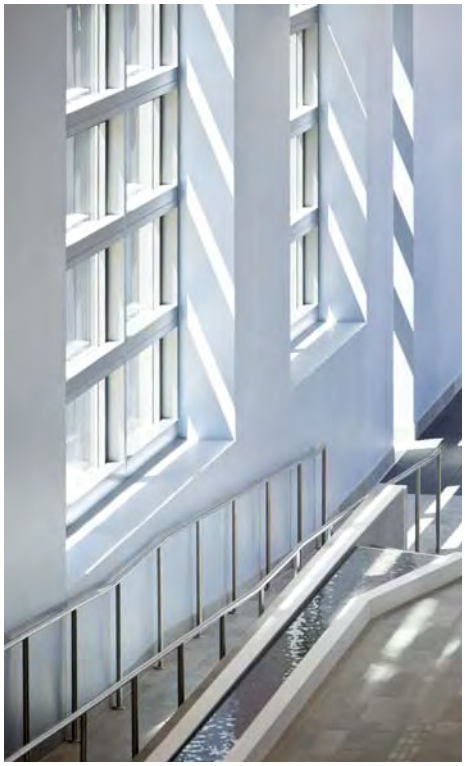
- Architect & BIM Model Manager

"Having a comprehensive 3D model from the very beginning allowed us to get into the space and design much more quickly. We were able to generate concepts and work with client much earlier in the process. We were able to begin producing our documentation much earlier than we do in CAD."

- Interior Designer

"It was a fun challenge to take the off-the-shelf program and make it do some really remarkable things. I was happy to see our client being able to interact with a model in a very simple yet powerful way."

- Visualization Technology Manager



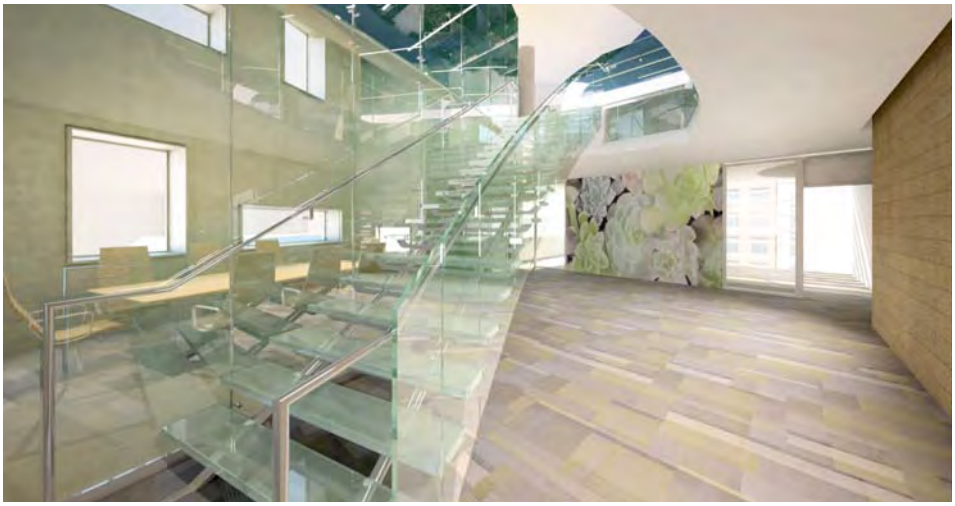
An updated BIM template was created at project inception to maintain office standards and better reflect the workflow of our firm.

We reevaluated and created a new file structure to facilitate collaboration and better organize the complexity of a BIM project.

Our visualization technology group embraced the opportunity to expand what BIM means to our firm.

We used cutting-edge video game technology to meet the demands of this challenging project. Design concepts created in our BIM software were updated in real-time to a web-based version of the building. The building, its surroundings and interiors were available to the client and representatives via the internet.

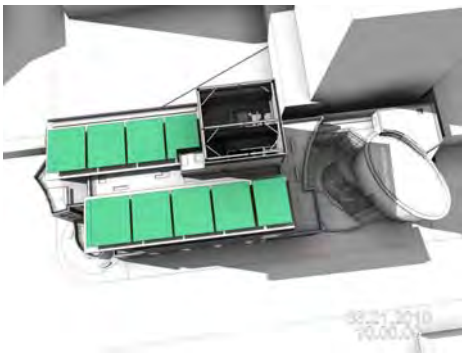
This provided our clients the opportunity to review the design almost anywhere and anytime. Using simple videogame style controls and interface, they were able to explore the building in its entirety by navigating through the spaces in an avatar like fashion or by using preset views focused on specific areas.

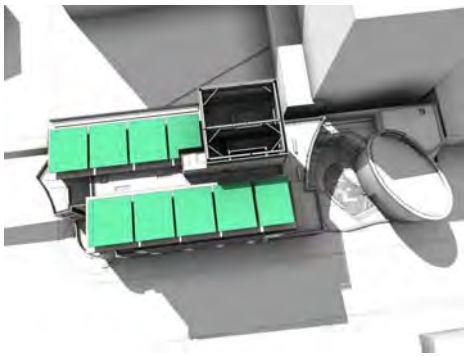


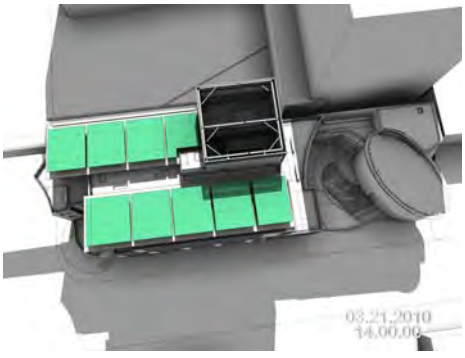
This virtual model not only included the core and shell developed in our BIM software, but also all interior design. Finishes, furnishing, lighting and artwork were also added to the model providing a level of detail and feedback no off-the-shelf software is providing.

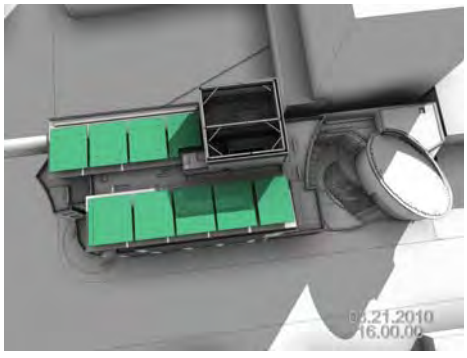
Natural and artificial light, reflections, flowing water and media screens were also simulated in the visualization. Until a few years ago this level of detail would need to be created as pre-rendered 3D stills or animation. Had we used traditional methods much more time would have been spent waiting for feedback.

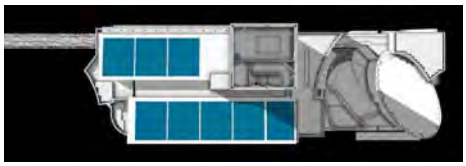
Using similar technology we able to create sun and shadow studies to validate the PV design. The adjacent buildings were modeled and the shadow studies were shared between the client, CM, PV consultant to optimize a bifacial PV array.







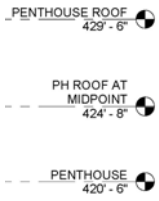


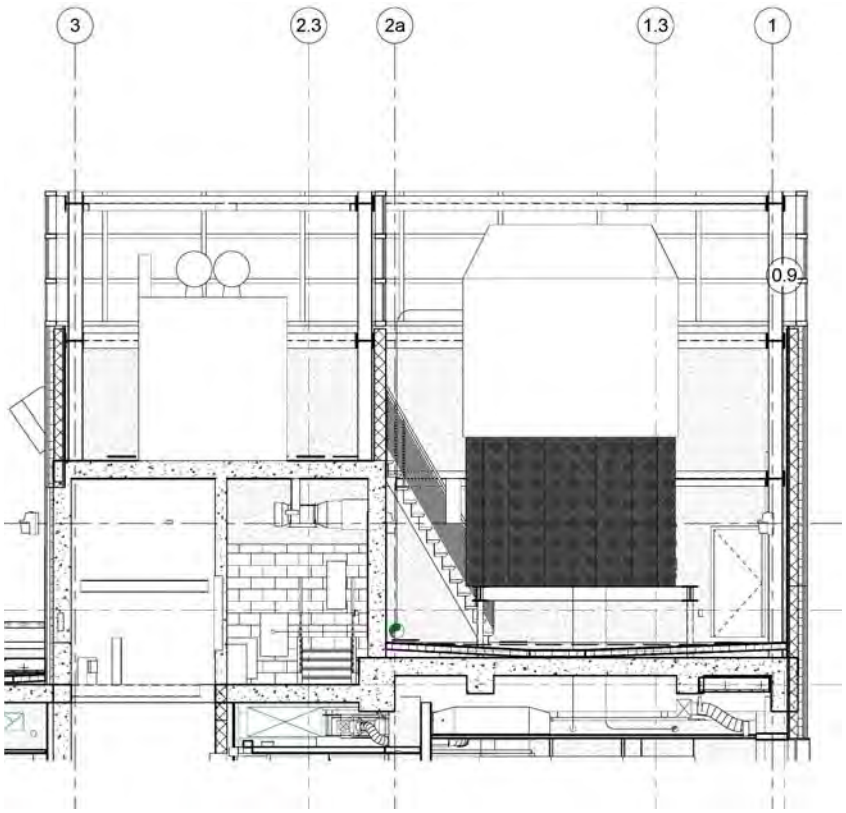


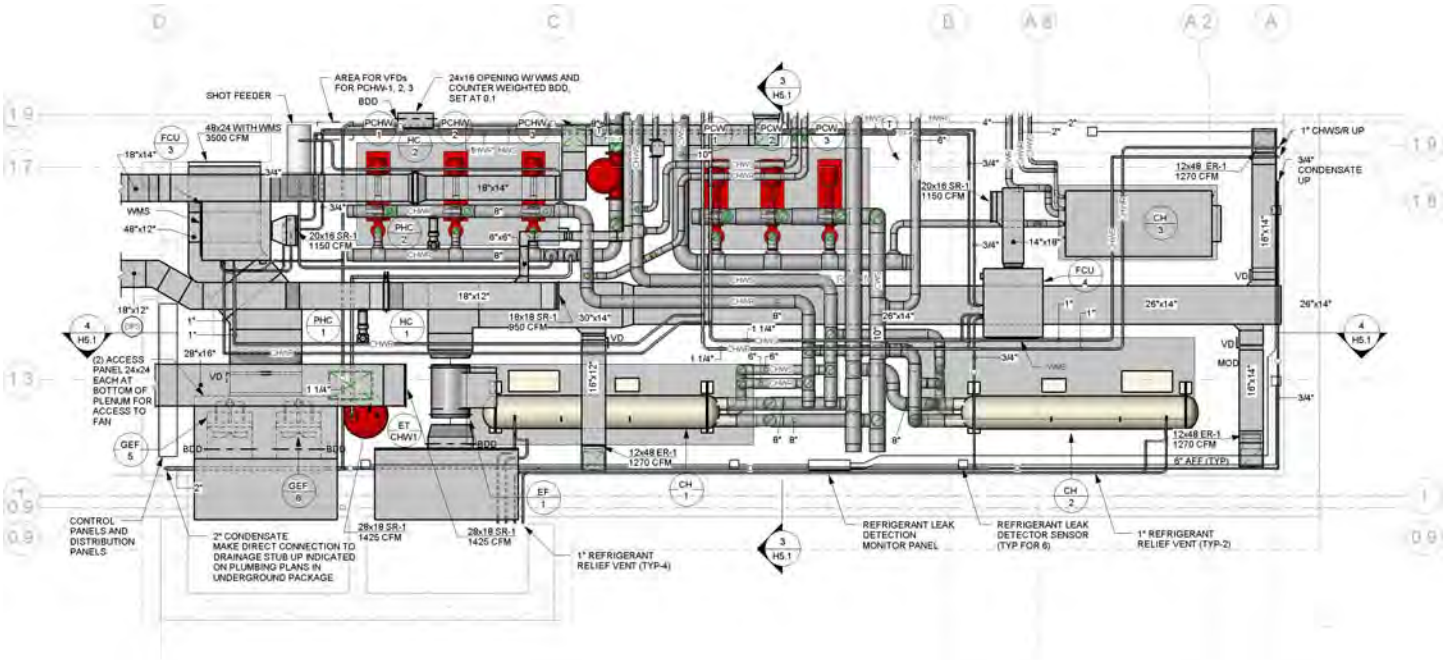
All major engineering was performed in-house which facilitated real time collaboration of the model.

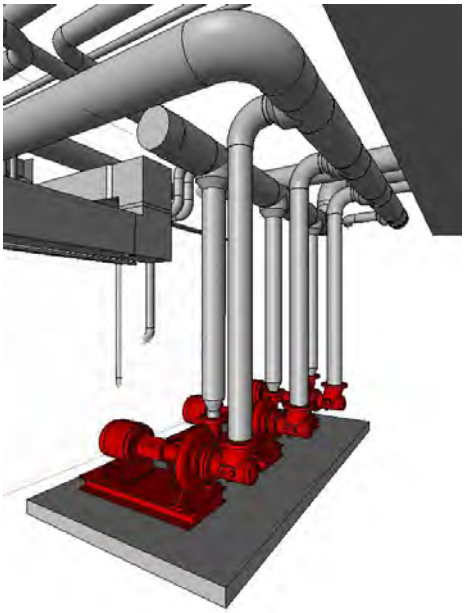
In addition, an internal “cloud” was created to allow the team members to work on the Revit model by using the computing power of our central server and some very high end processors instead of their desktop computers.

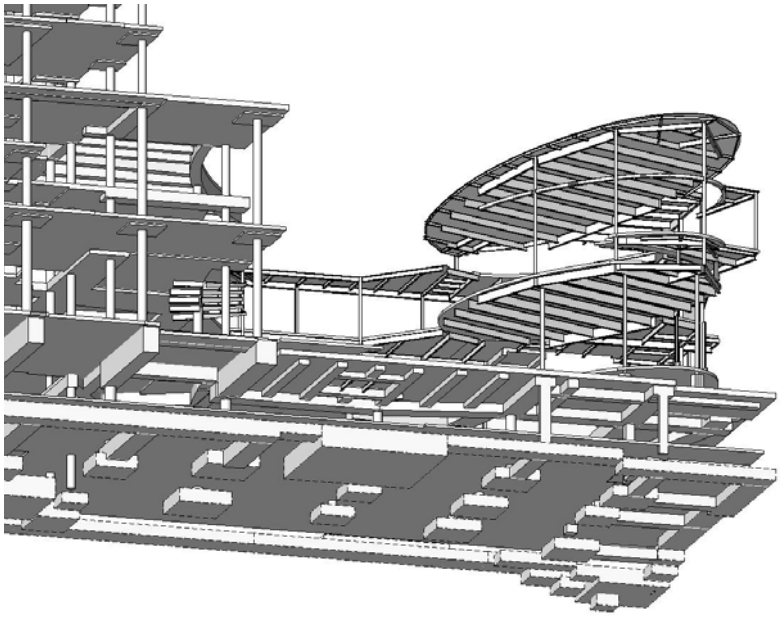
The desktop computers were used as terminals only and allowed certain team members to work more efficiently as the model grew in complexity.











A sharepoint project portal was then created to facilitate the exchange of model files to specialty consultants as well as the CM.

The CM was given the Structural and Architectural models early on to begin modeling the sheeting and shoring and review phasing and construction sequencing on the very tight site. Subsequent versions of the model were then used by the CM to facilitate coordination of trades. Subcontractors are now modeling the MEP distribution during the shop drawing process using the AE model as a background. The CM is going to use Navisworks in addition to some shop specific software to facilitate coordination and clash detection. The CM has also created a matrix of "model flow" and transfer between entities during the shop drawing and construction process. This matrix also sets responsibilities for all extended team members. The CM identified five major areas of focus on their Analysis Plan including: MEP coordination & clash detection, Prefabrication of MEP Assemblies, Quality Control/Visual Management, Virtual Mock ups, and Skin System.

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