INSTITUTE FOR SYSTEMS BIOLOGY

2012 AIA TAP / BIM AWARDS

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2012 AIA TAP / BIM AWARDS

THE USE OF BIM ALLOWED THE DESIGN TEAM TO RAPIDLY ADAPT TO THE CHANGING PROGRAM NEEDS OF THE CLIENT WHILE MAINTAINING THE DESIGN INTENT

ARCHITECT'S STATEMENT

This project sought to dramatically change the closed-door corporate layout of the existing facility into a dynamic free flowing work space that fosters collaboration, fitting with the cutting edge research and collaborative working culture of the client's organization. The main design intent was to create open office and lab areas, highlight the lab support and core labs functions, and create inviting collaborative zones.

The use of BIM allowed the design team to rapidly adapt to the changing program needs of the client while maintaining the design intent. Renderings, axonometric floor plans, and diagrams produced from the model were utilized for design visualization and communication throughout the design of the project. Custom families developed for this project aided in the coordination of complex building components such as lab equipment and a complex decorative light layout.

To accomplish this major transformation, meet aggressive sustainability goals, and adapt the design to the evolving program needs required a highly collaborative team. The design team was an important part of the overall project team that achieved the vision for the tenant improvement. The knowledge and innovative thinking the design team brought to the project complemented the client's knowledge and expertise centered on science and technology.

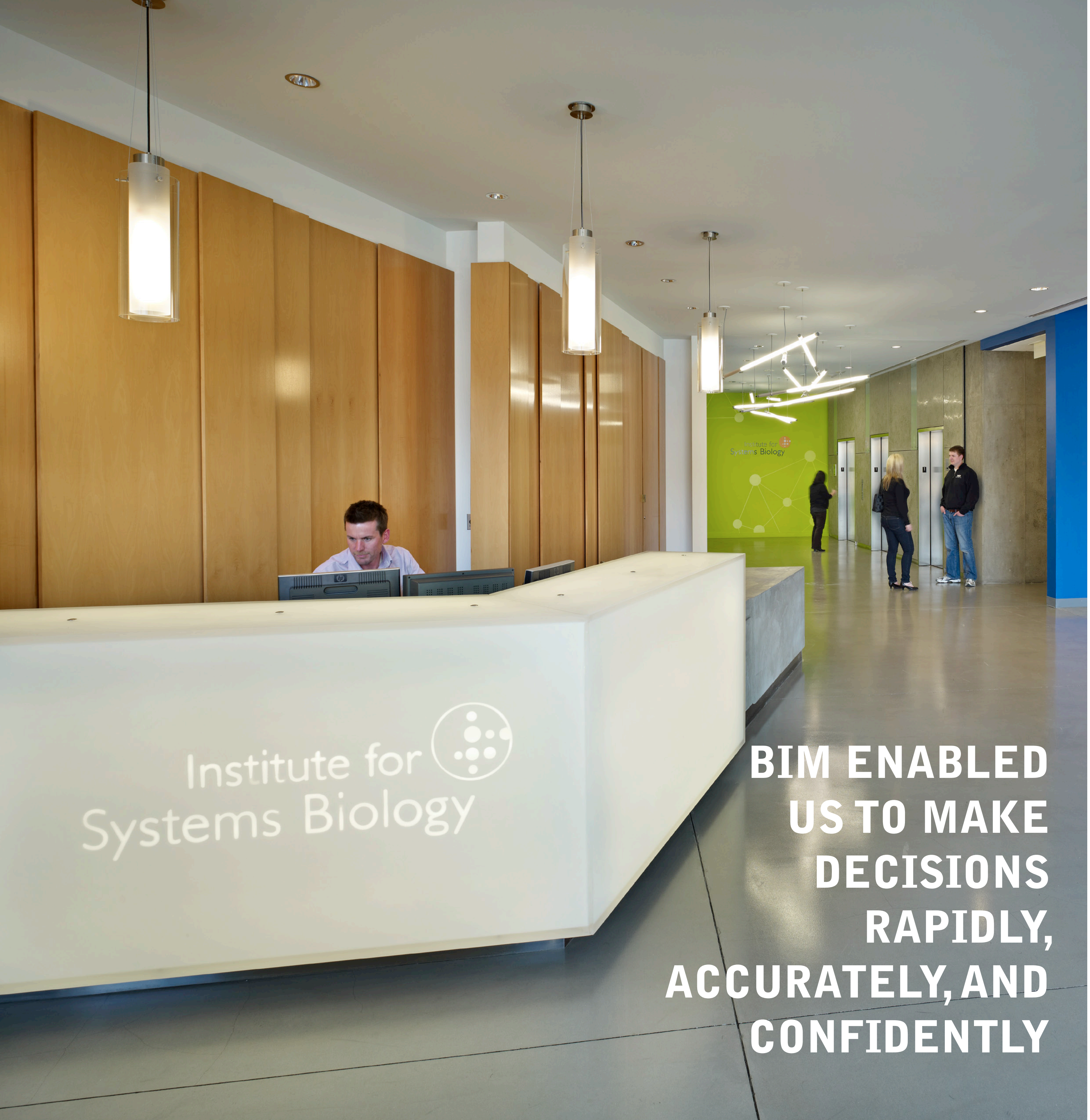
THE COLLABORATIVE NATURE OF THE TEAM ALSO FOSTERED INNOVATION THROUGHOUT THE PROJECT

CONTRACTOR'S STATEMENT

By using BIM for the planning, design, construction, and operations of this project, the entire team enjoyed increased communication, understanding, and confidence.

We have a strong, collaborative relationship with both the designer and owner. Moreover, leveraging BIM in nearly every aspect of the project empowered us to effectively and broadly partner with all project stakeholders and suppliers, enabling sharing of information and ideas rapidly and extensively. At the heart of this enhanced collaboration with BIM was the free exchange of model source data between parties to ensure the most accurate, reliable documentation of design intent. This enabled us to deliver the project on budget while preserving design intent, and meet an accelerated delivery date in an already aggressive project schedule.

The collaborative nature of the team also fostered innovation throughout the project. We leveraged the team's BIM standards, and evolved them to support new processes and introduce new tools to deliver the project. By integrating BIM with our site-specific safety plan, using Augmented Reality on the project site, calculating quantities to support LEED documentation, and handing over an as-built model to support facility operations and maintenance, the team readily embraced innovative processes and tools across the entire project life cycle.



BIM ENABLED US TO MAKE DECISIONS RAPIDLY, ACCURATELY, AND CONFIDENTLY

O OWNER'S STATEMENT

One of our major goals was to leverage BIM to generate and manage building life cycle data from design, through construction, and into facilities management. With a collaborative project team, we made innovative use of BIM to mitigate problems, increase efficiency, and ultimately deliver a successful and higher quality facility for less cost.

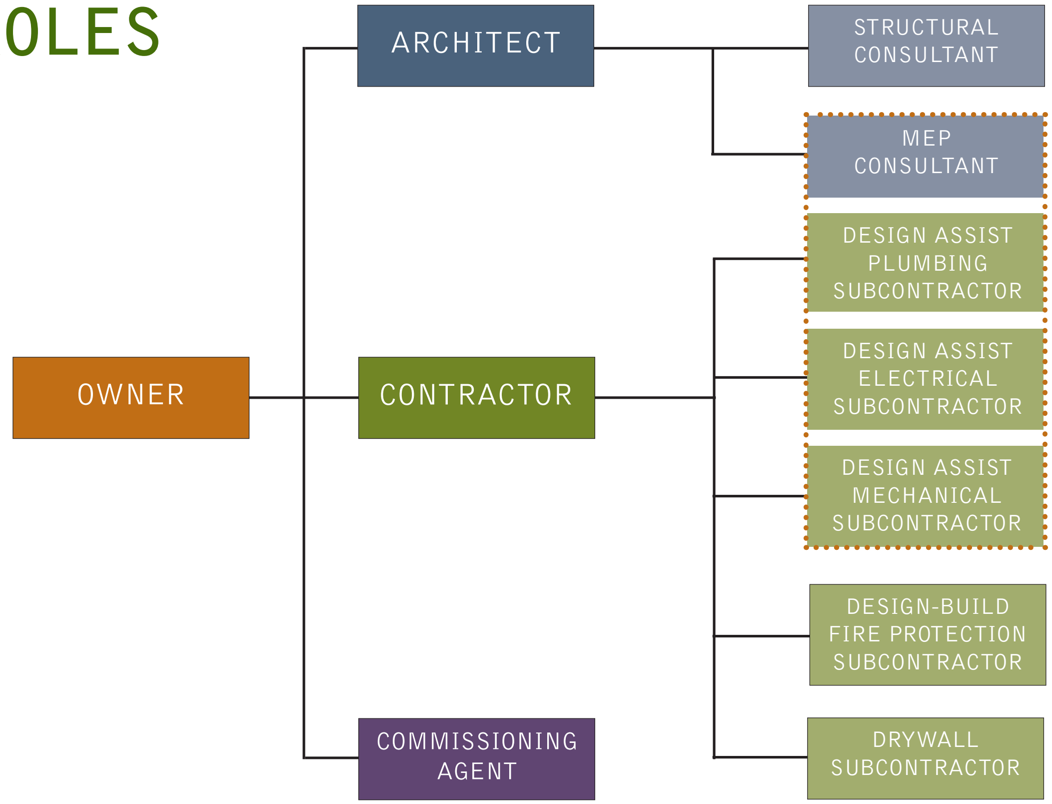
During design, the team developed the model to provide a real-time, 3-D walkthrough of the project, which was presented to over 300 staff at a company retreat. Although the design was well into development, this walkthrough provided the project team with additional information needed to make construction more efficient and eliminate uncertainties before starting the construction process.

During construction, we needed to accelerate the completion of the facility by a month in order to start up the vivarium on time. The contractor detailed the architect's design model to develop a virtual mockup of the cage rack washer and surrounding assemblies, resolving and eliminating ambiguity in the details. BIM enabled us to make decisions rapidly, accurately, and confidently.

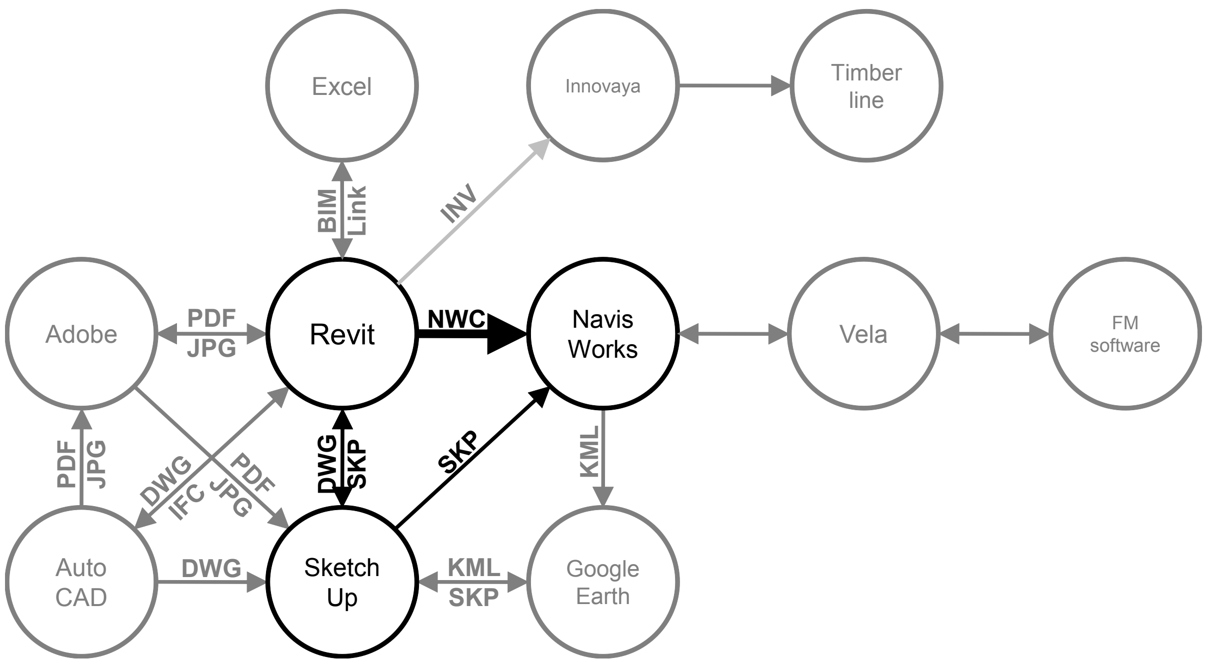
The contractor developed a hand-over model, currently used by our field engineers to support ongoing operations and maintenance, and we are working towards integrating it with a facilities management system.

THE TEAM READILY EMBRACED INNOVATIVE PROCESSES AND TOOLS ACROSS THE ENTIRE PROJECT LIFE CYCLE

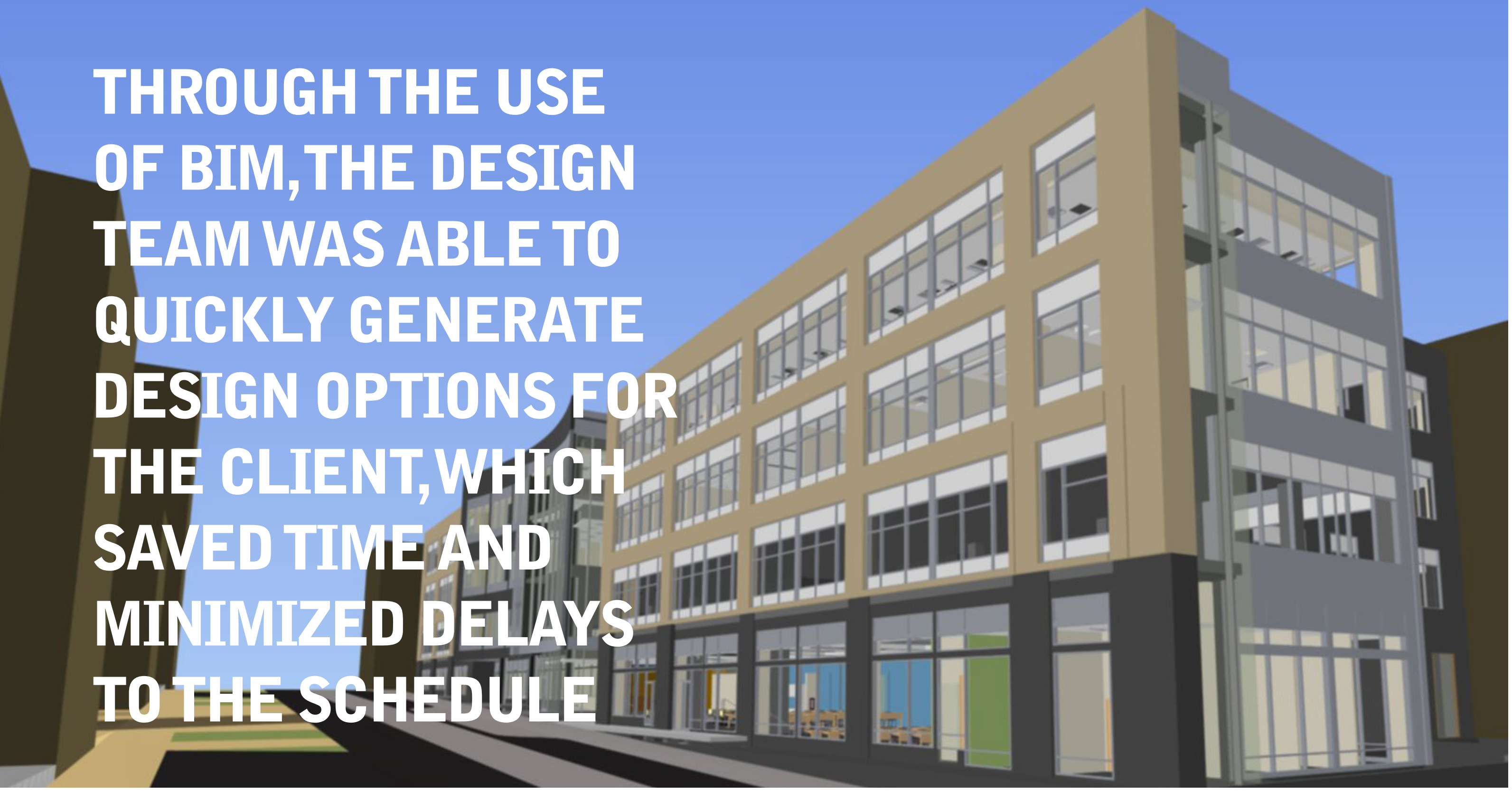
ROLES



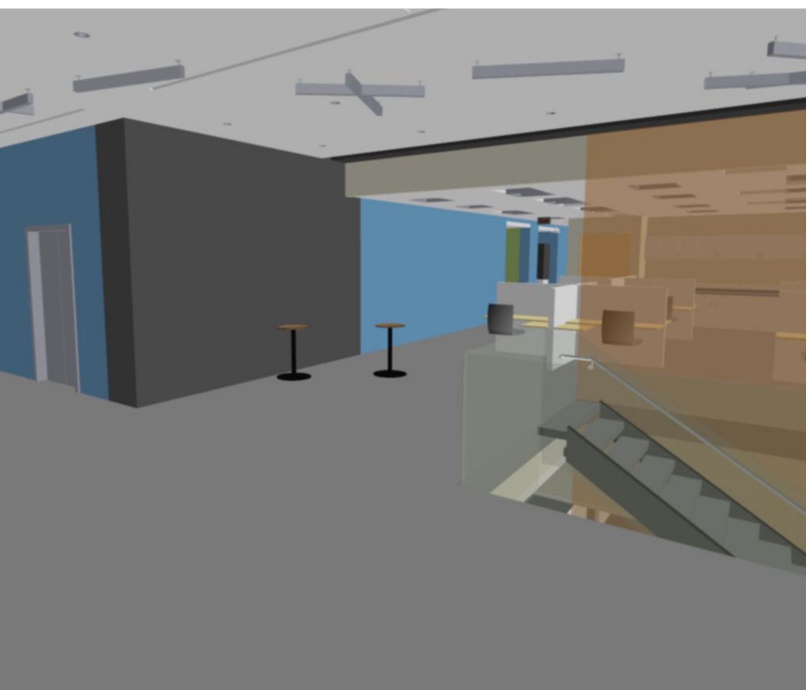
INFORMATION EXCHANGES

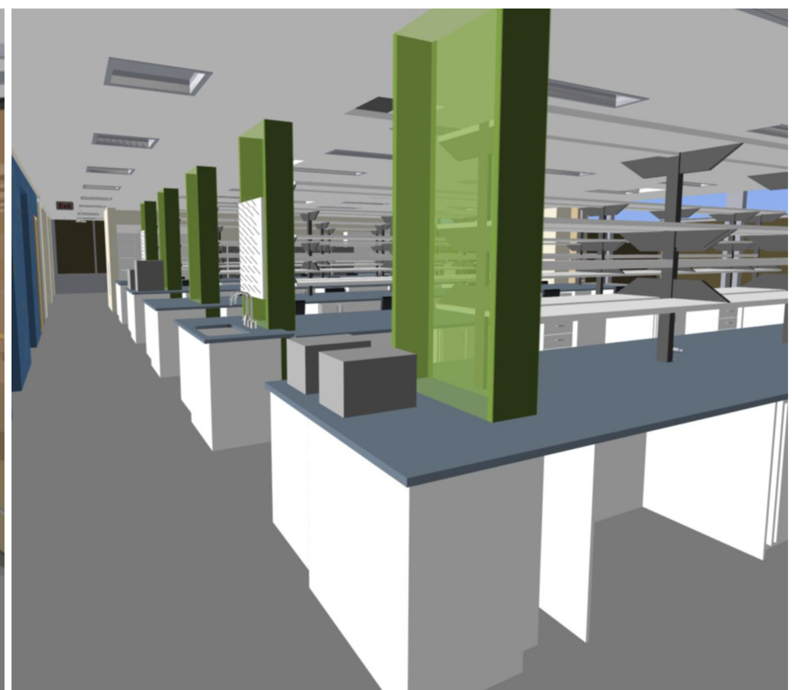


THROUGHOUT THE ENTIRE PROJECT THE BIM WAS UPDATED CONTINUOUSLY BY THE PROJECT TEAM



REAL-TIME VISUALIZATION



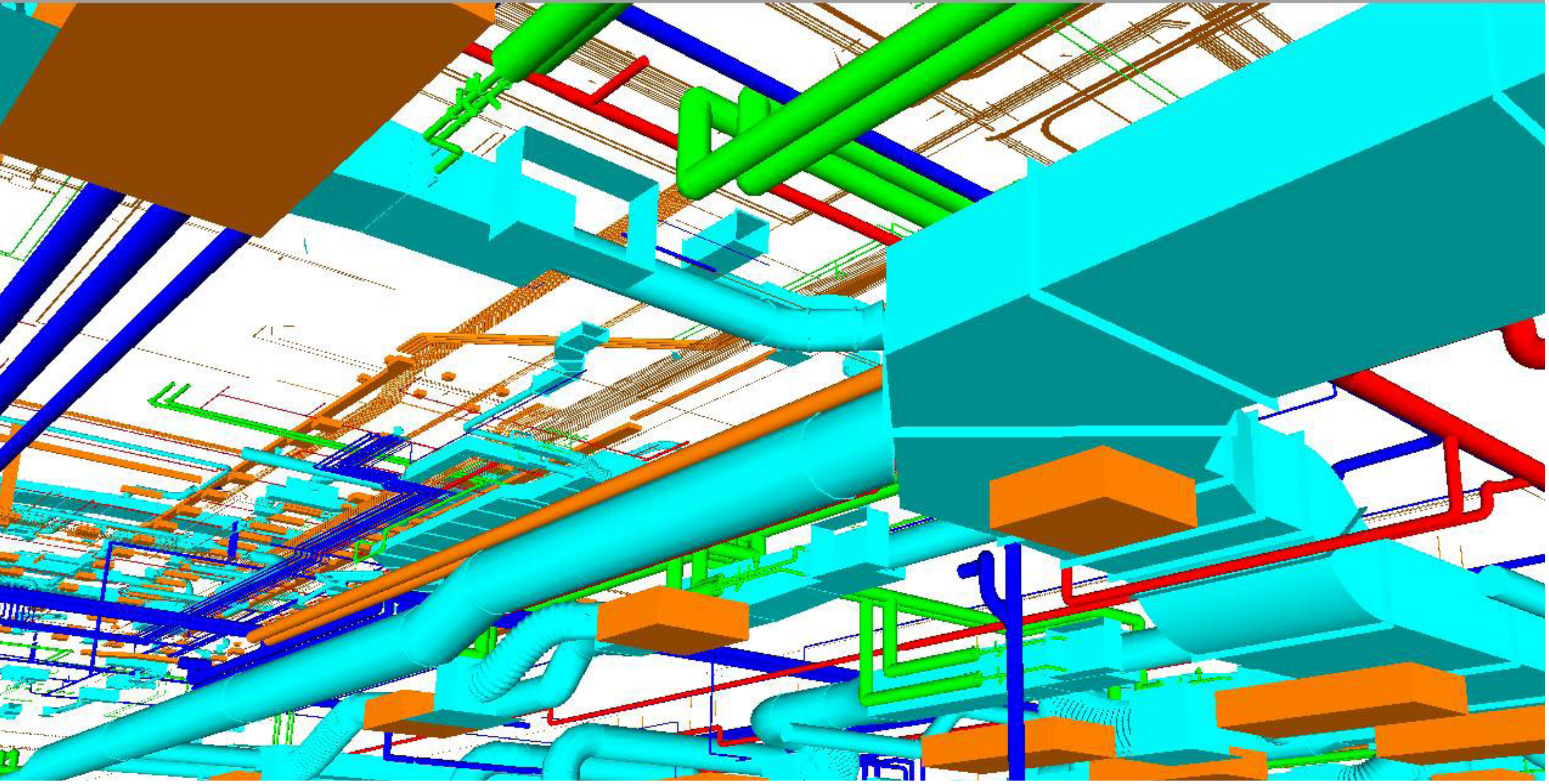


1 DESIGN AUTHORING & VISUALIZATION

This laboratory tenant improvement used BIM from beginning of Schematic Design through project completion. The design team modeled the existing building based on as-built drawings. Having this detailed as-built model as a base for a complex project, both in scope and program, proved invaluable in documentation, design, and sustainability goals. Throughout the design of the project, the client's programmatic needs changed multiple times. The BIM program's parametric capabilities allowed the design team to quickly adapt and maintain coordinated documentation.

The project team utilized rendering tools for visualization of many key design components, such as communicating the feature stairs, multipurpose room, coffee bars, soft seating areas, and lobby. During an employee retreat, the owner's representative and contractor conducted a 3-D walkthrough for the employees. This not only gave the staff the opportunity to bring forth any concerns and questions regarding the design but also helped minimize impact to the construction schedule.

A variety of program elements changed throughout the project. Through the use of BIM, the design team was able to quickly generate design options for the client, which saved time and minimized delays to the schedule. The project team also developed parametric families for the owner-furnished lab equipment. This allowed for the creation of hundreds of individual family types and the ability to track their location within the project. Finally, design models were shared with the project team and consultants via a common file-sharing site creating instantaneous access to updated designs and changes.

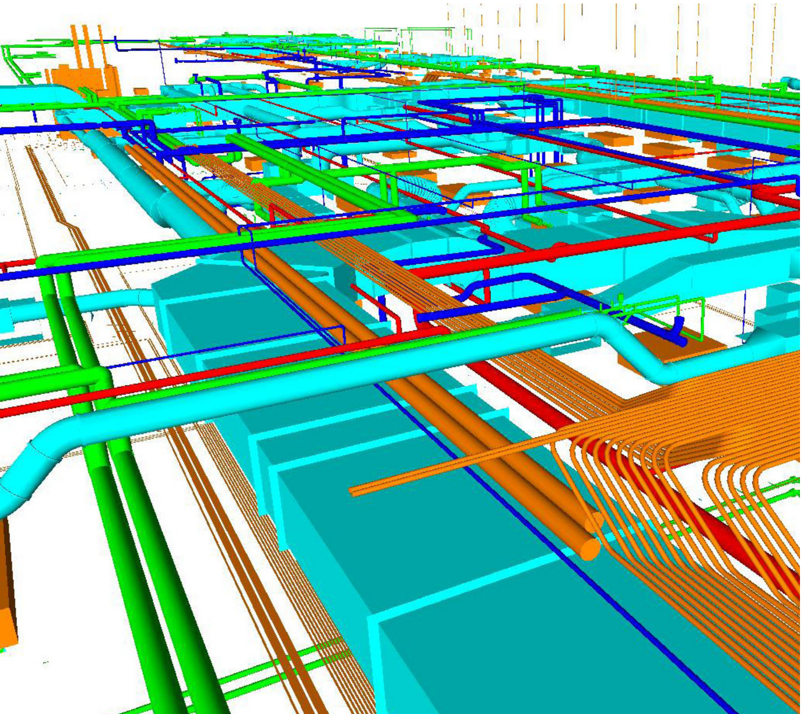


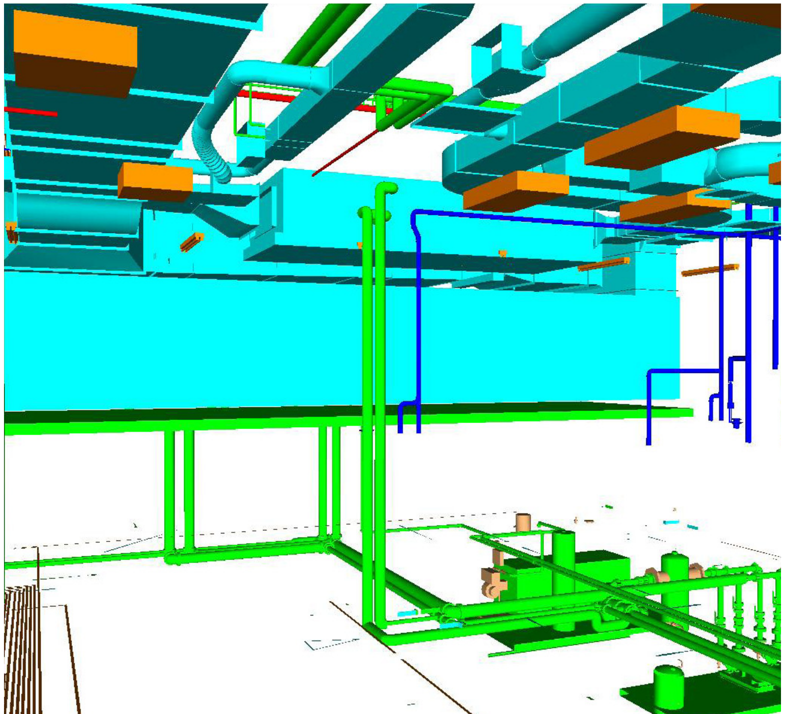
2 SYSTEM COORDINATION

It was important to coordinate the MEP systems before and during construction to better manage the complex nature of the lab TI project. Further complicating the process, existing mechanical and electrical systems had to be shared with another tenant during demolition and construction.

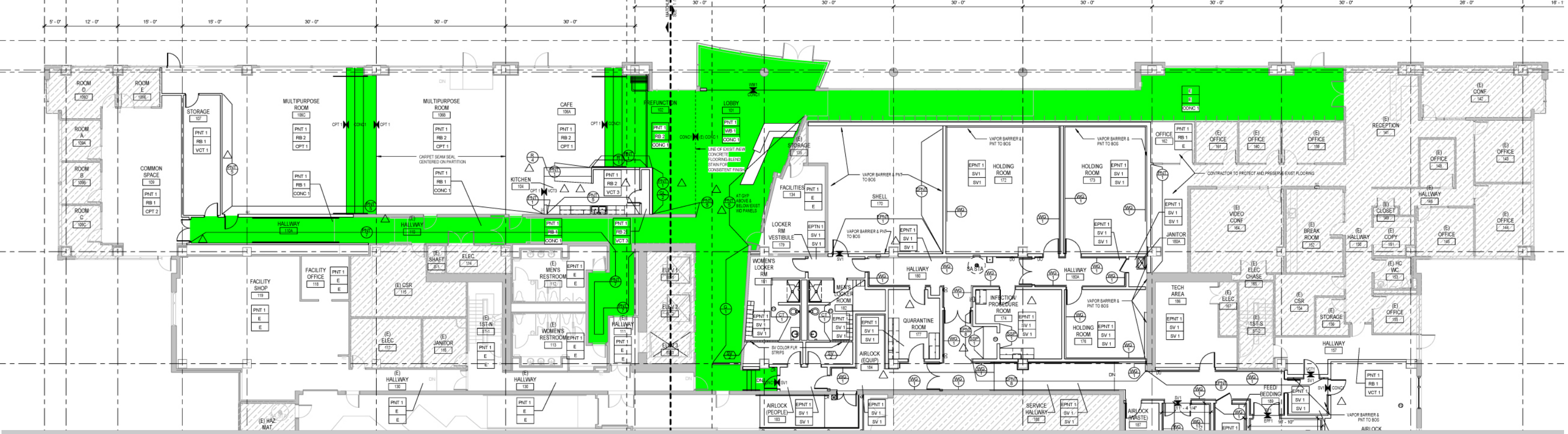
The project team was able to detect and resolve nearly 2000 model clashes before construction started. Subcontractors and the design team met on-site for a series of intense and thorough coordination meetings, which translated into a direct reduction in the total number of RFI's issued during construction, saving the project both time and money.

MEP CLASH DETECTION

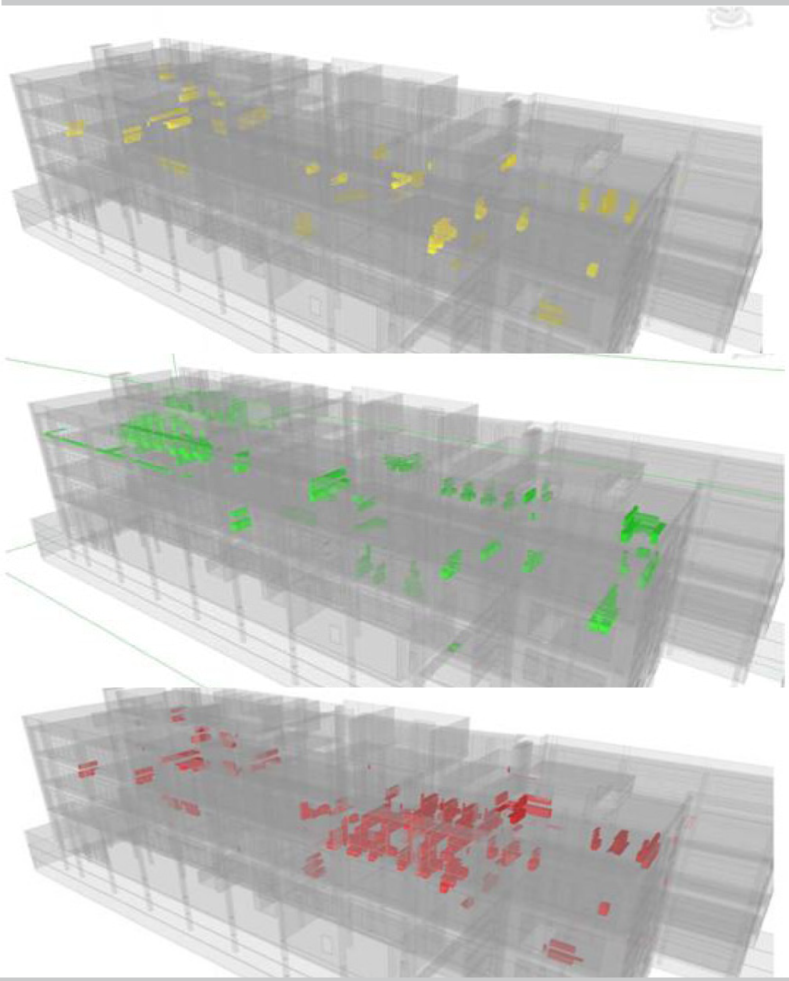




THE PROJECT TEAM WAS ABLE TO DETECT AND RESOLVE NEARLY 2000 CLASHES BEFORE CONSTRUCTION STARTED



QUANTITY TAKE-OFFS - STAINED CONCRETE



GROUND LEVEL	Counter Top w Sink Hole: 7'	1	2.67	5.67	2.5	14.175
LEVEL 04	Counter Top w Sink Hole: 7'	1	2.67	6	2.5	15
GROUND LEVEL	Counter Top: 6'	1	3	6	2.5	15
LEVEL 03	Counter Top_no backsplash: 30" deep	1	3	6.5	2.5	16.25
LEVEL 03	Counter Top_no backsplash: 30" deep	1	3	6.5	2.5	16.25
LEVEL 04	Counter Top_no backsplash: 21" deep	1	3	9.5	1.75	16.625
LEVEL 04	Counter Top_no backsplash: 6'	1	3	7.6	2.5	19
GROUND LEVEL	Counter Top: 6'	1	3	7.9	2.5	19.75
LEVEL 03	Counter Top_no backsplash: 6'	1	3	8.22	2.5	20.55
LEVEL 03	Counter Top: 6'	1	3	8.25	2.5	20.625
LEVEL 03	Counter Top: 10'	1	3	9.16	2.5	22.9
LEVEL 03	Counter Top_no backsplash: 30" deep	1	3	9.17	2.5	22.925
GROUND LEVEL	Counter Top: 6'	1	3	9.5	2.5	23.75
LEVEL 04	Counter Top_no backsplash: 10'	1	3	10	2.5	25
LEVEL 03	Counter Top: 10'	1	3	10.43	2.5	26.075
LEVEL 03	Counter Top: 6'	1	3	11	2.5	27.5
LEVEL 03	Counter Top_no backsplash: 6'	1	3	11	2.5	27.5
LEVEL 03	Counter Top: 6'	1	3	11.75	2.5	29.375
LEVEL 04	Counter Top w Sink Hole: 7'	1	2.67	11.78	2.5	29.45
LEVEL 03	Counter Top: 6'	1	3	11.78	2.5	29.45
LEVEL 03	Counter Top-Island: 10'	1	3.08	6	5	30
LEVEL 03	Counter Top-Island: 10'	1	3.08	6	5	30
LEVEL 03	Counter Top-Island: 10'	1	3.08	6	5	30
LEVEL 03	Counter Top-Island: 10'	1	3.08	6	5	30
LEVEL 04	Counter Top: PROTEOMICS	1	3	12.52	2.79	34.9308
LEVEL 03	Counter Top w Sink Hole: 7'	1	2.67	14	2.5	35
LEVEL 04	Counter Top w Sink Hole: 7'	1	2.67	14.11	2.5	35.275
GROUND LEVEL	Counter Top_no backsplash: 24" deep	1	3	18	2	36
LEVEL 03	Counter Top w Sink Hole: 7'	1	2.67	14.47	2.5	36.175
LEVEL 04	Counter Top-Island: 10'	1	3.08	9.92	5	49.6
LEVEL 04	Counter Top: 6'	1	3	20.59	2.5	51.475
LEVEL 04	Counter Top-Island: 10'	1	3.08	10.44	5	52.2
LEVEL 04	Counter Top-Island: 10'	1	3.08	10.44	5	52.2
LEVEL 04	Counter Top-Island: 10'	1	3.08	10.44	5	52.2
LEVEL 04	Counter Top-Island: 10'	1	3.08	12.94	5	64.7
LEVEL 04	Counter Top-Island: 10'	1	3.08	12.94	5	64.7
LEVEL 04	Counter Top-Island: 10'	1	3.08	12.94	5	64.7
LEVEL 04	Counter Top: PROTEOMICS	1	3	27.5	2.79	76.725
LEVEL 04	Counter Top: PROTEOMICS	1	3	27.5	2.79	76.725
LEVEL 04	Counter Top: PROTEOMICS	1	3	27.5	2.79	76.725
LEVEL 04	Counter Top-Island: 10'	1	3.08	28	5	140
LEVEL 04	Counter Top-Island: 10'	1	3.08	28	5	140
LEVEL 04	Counter Top-Island: 10'	1	3.08	28	5	140
LEVEL 04	Counter Top-Island: 10'	1	3.08	28	5	140
LEVEL 04	Counter Top-Island: 10'	1	3.08	28	5	140
LEVEL 04	Counter Top-Island: 10'	1	3.08	28	5	140
LEVEL 04	Counter Top-Island: 10'	1	3.08	28	5	140
						5713.1

LEED DOCUMENTATION

3 QUANTITY TAKE-OFFS

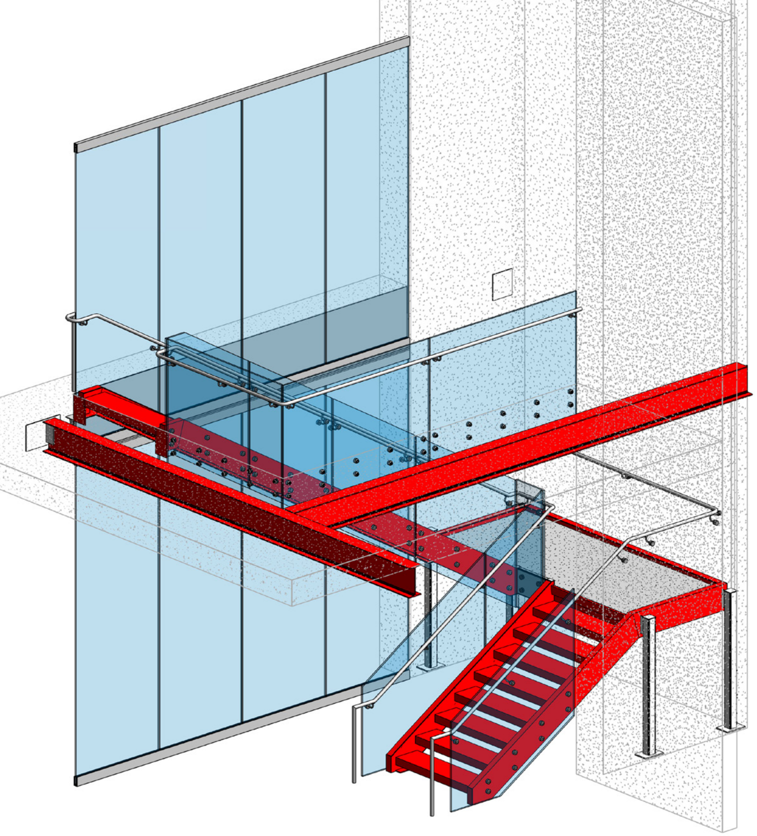
During the middle of an aggressive schedule, the stained concrete scope had yet to be finalized by the owner. The contractor utilized the design model to quickly and accurately quantify and estimate the scope of work during successive design iterations. With the use of material schedules and custom floor plan views, we were able to turn over estimate options to the client in half the time it would have taken to do this traditionally.

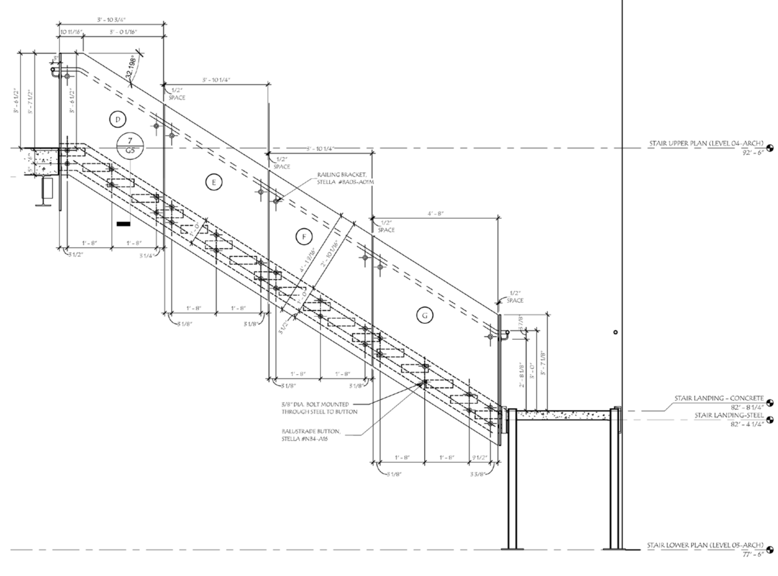
LEED DOCUMENTATION

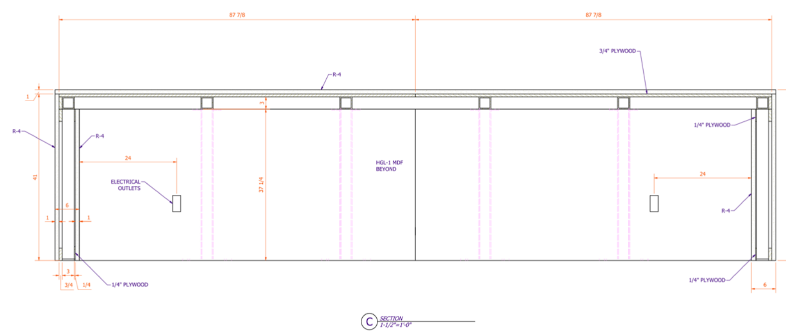
The team has pursued (and anticipates achieving) LEED Platinum, an unusual and ambitious certification for a laboratory TI project. As such, every LEED credit was critical, including the "Building Reuse – Maintain Interior Nonstructural Components" credit. It required significant reuse of existing non-shell, non-structural components, and entailed intensive backup documentation accounting for the surface area of all wall partitions, casework, floors, and ceilings.

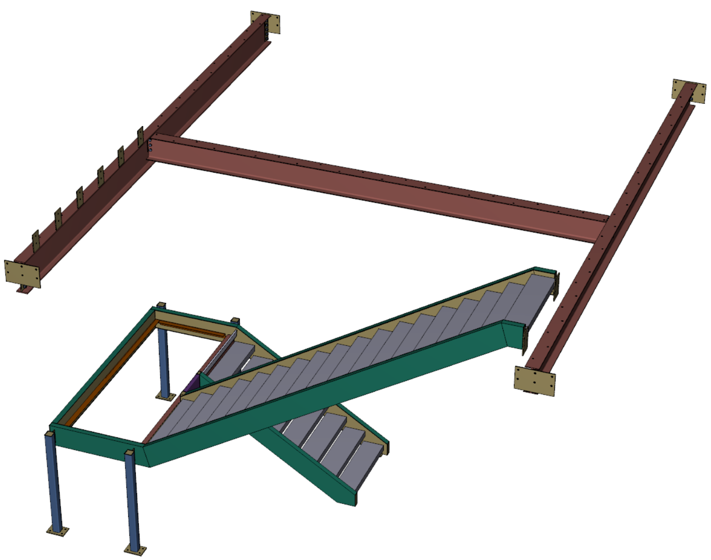
The contractor used phases and filters to develop custom 3-D views of the design model corresponding to the LEED phase categories, and generated custom schedules from those views. These schedules were exported to a spreadsheet, where the surface areas were calculated and summarized for LEED backup documentation. Screen-shots of the 3-D views were also used as documentation.

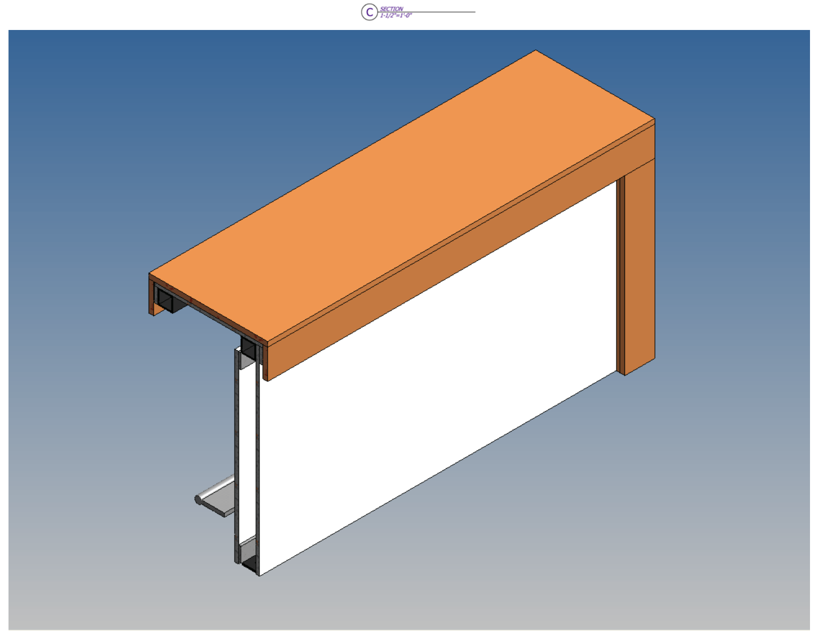
By relying on BIM to quantify the materials reused, the team accurately accomplished the LEED documentation in two hours, what would have otherwise taken days or weeks to measure and document manually.









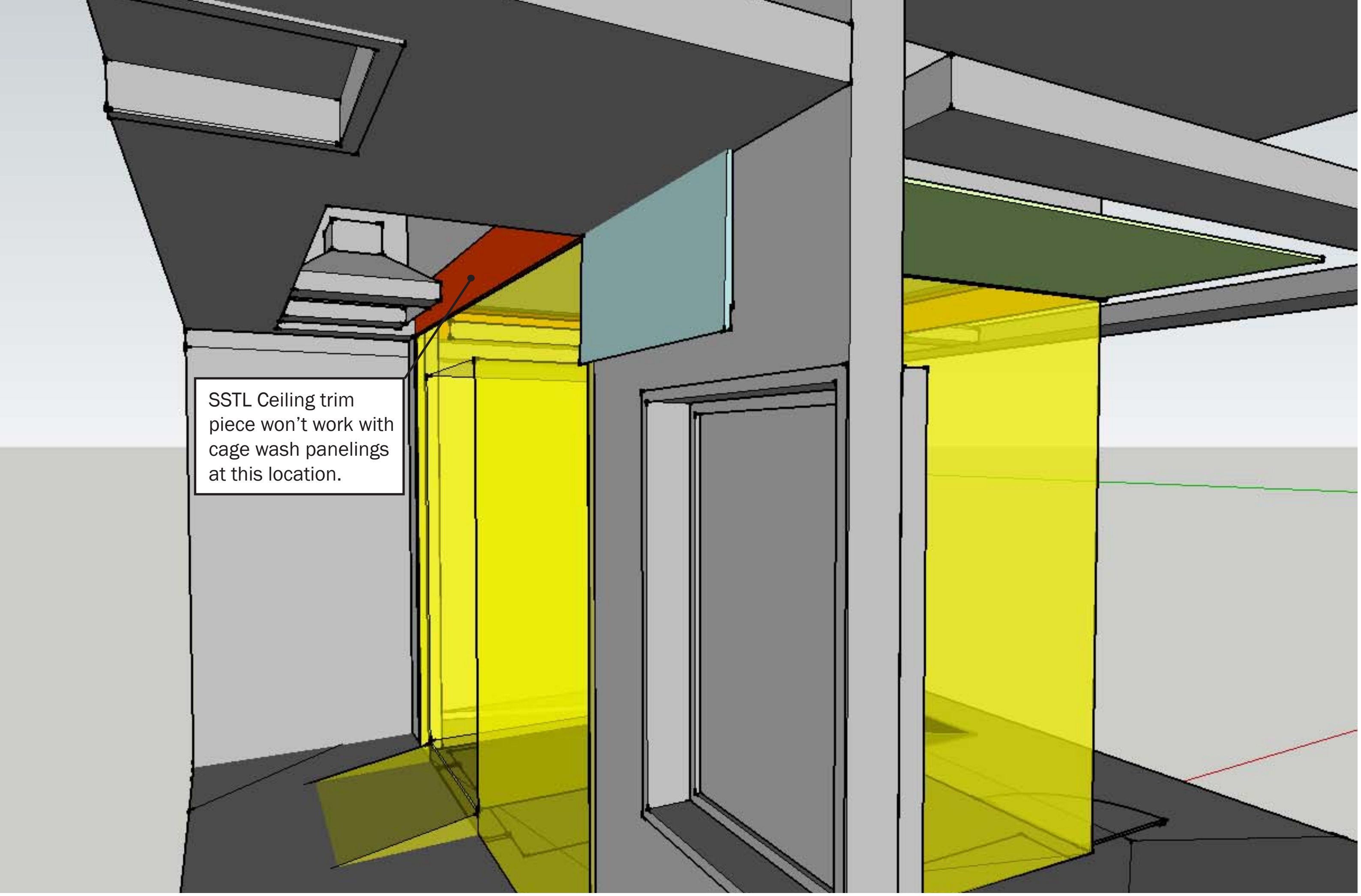


4 SHOP DRAWINGS

Many of the subcontractors' shop drawings were drawn and reviewed in 3-D, enabling the design team to review models to efficiently make comments and redlines. In the case of the millwork shop drawings, modeling the details helped cut the review process time by as much as 50%.

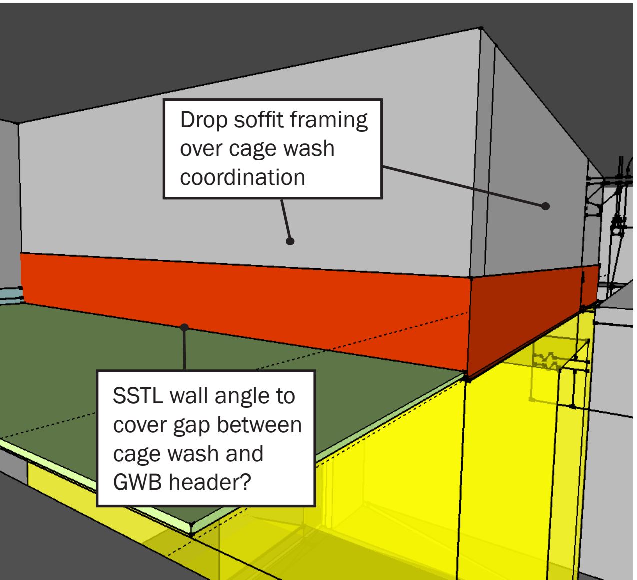
The steel fabricators used a detailing program which offered the highest level of automation available in 3-D steel detailing with unparalleled connection design intelligence and high-quality drawing production abilities. The details, submaterial, and erection drawings were automatically generated from the 3-D model, saving time on shop drawings.

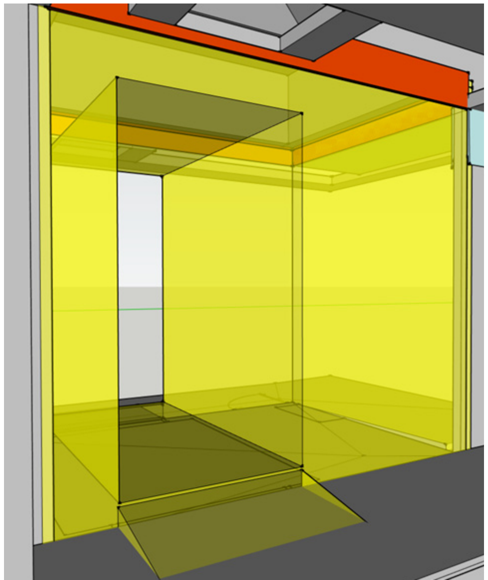
MODELING THE DETAILS HELPED CUT THE REVIEW PROCESS TIME BY AS MUCH AS 50%

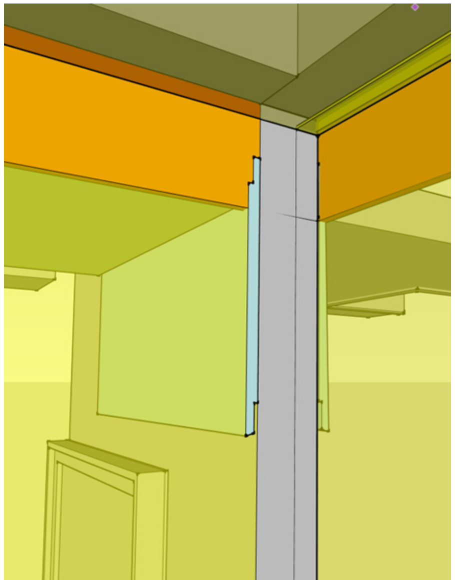


5 CONSTRUCTABILITY REVIEW

Based on 2-D details from the architect, the contractor used 3-D modeling tools to recreate the clean and soiled cage rack washer rooms. This model was used as a collaboration tool to help clarify design intent. The 3-D visualization of the model was deemed to be an effective way to communicate with the architect and end user. We were able to finalize unresolved material transitions that occurred within the design and develop construction details, which accelerated decision-making and kept construction moving forward.





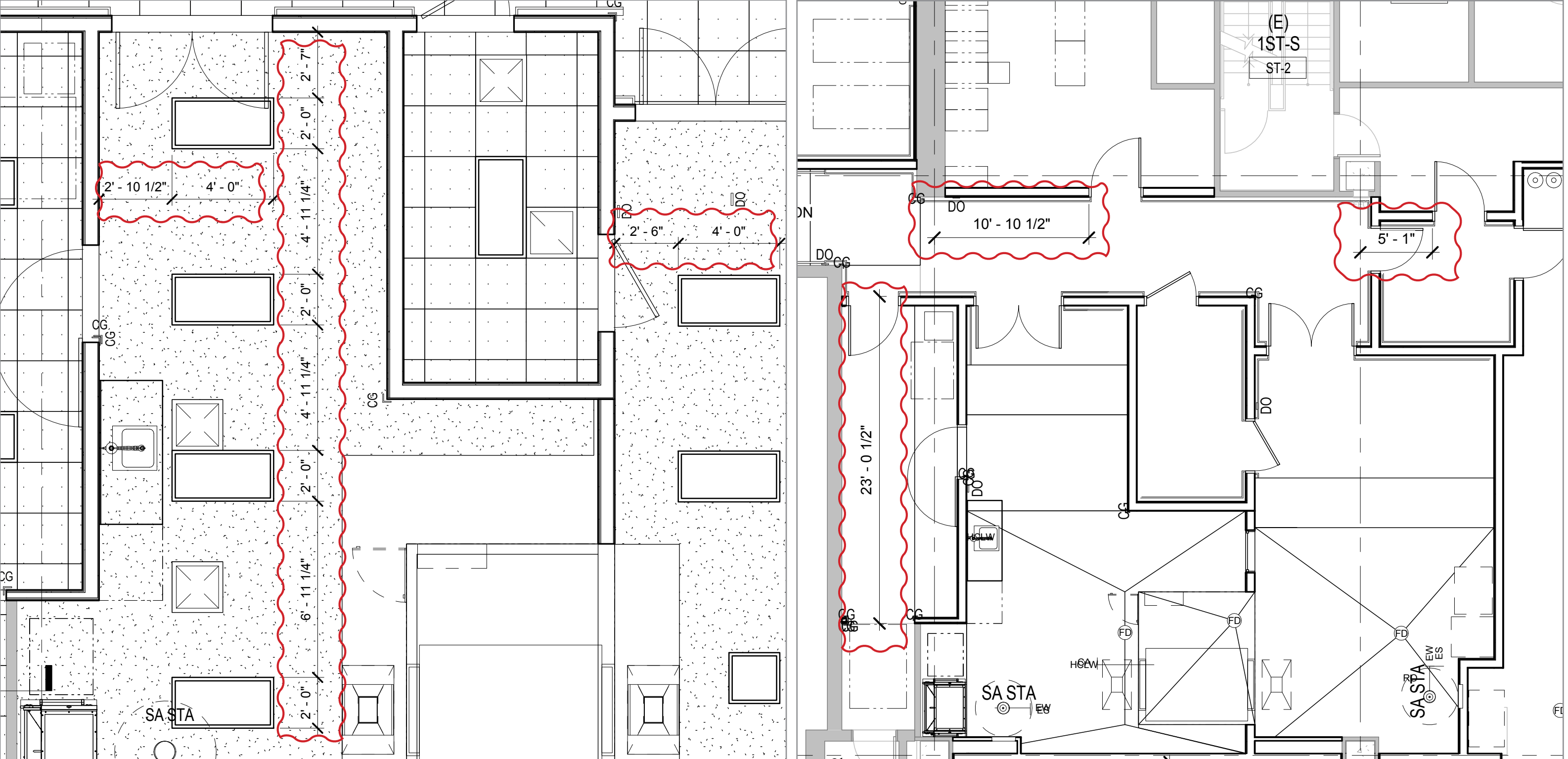


WE WERE ABLE TO FINALIZE UNRESOLVED MATERIAL TRANSITIONS, WHICH KEPT CONSTRUCTION MOVING FORWARD

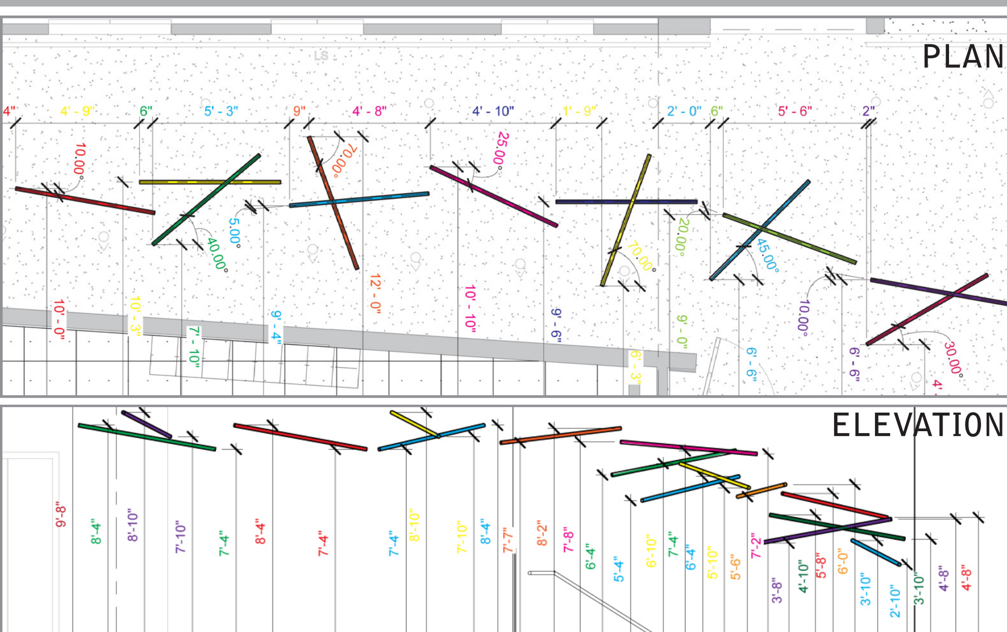
6 LAYOUT DRAWINGS

The architect developed a parametric family that allowed special "light-saber" fixtures to be individually oriented in plan and elevation, and set at different heights. This model was used for analysis to ensure fixtures would not collide with one another during a seismic event. Various colored diagrams were developed to coordinate with the entire project team on the placement of this complex light layout. These layout drawings were used as a precise field communication tool for the electricians.

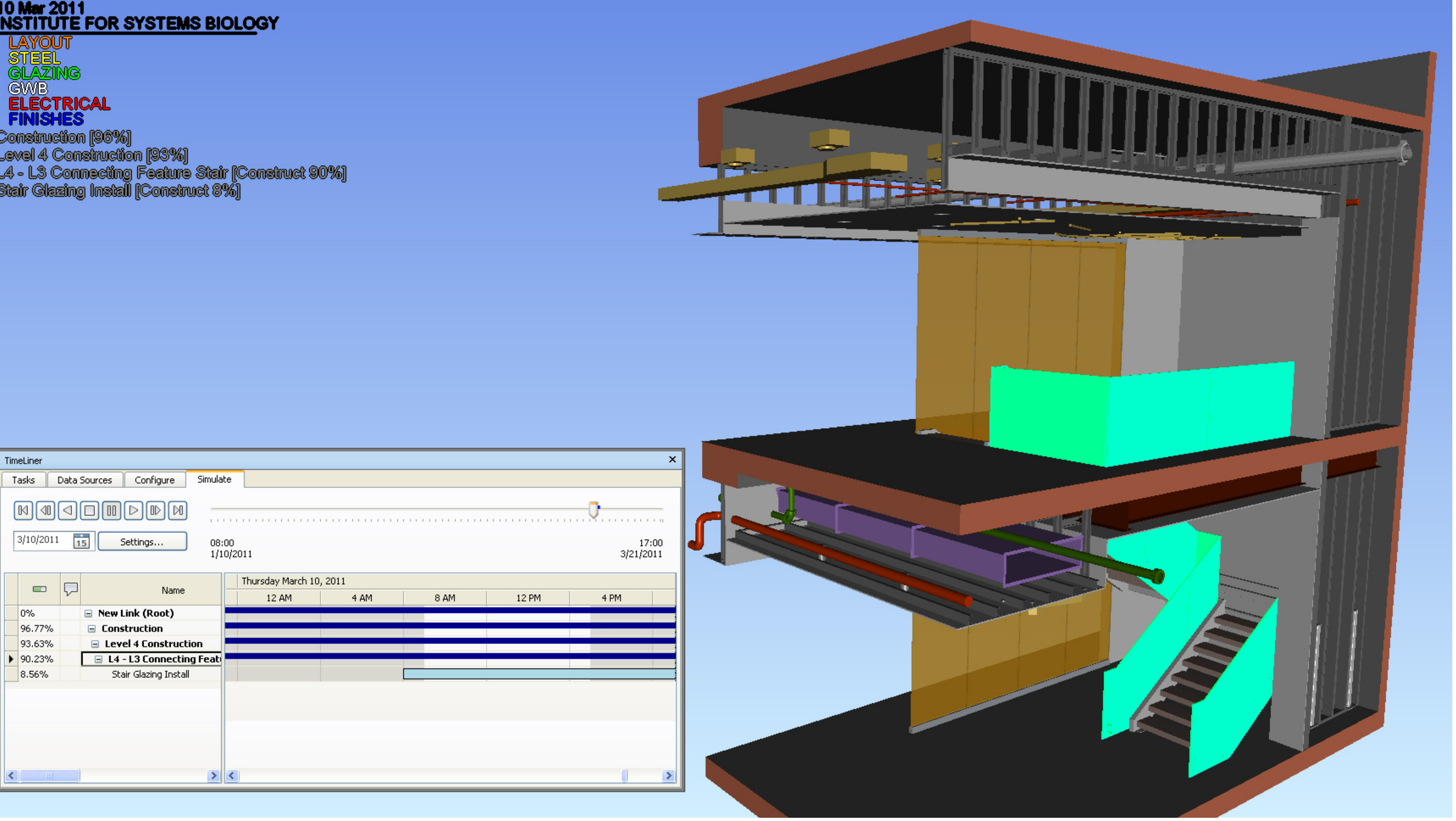
During the construction phase, the owner decided the vivarium needed to be turned over one month sooner than originally planned. To achieve this accelerated schedule, the contractor utilized BIM for generating custom wall, ceiling, and lighting layout drawings. The layout time was cut by 75% because information went directly from the model to the field. Without this capability, the team could not have met the clients required completion date.



VIVARIUM - CUSTOM LAYOUT DRAWINGS



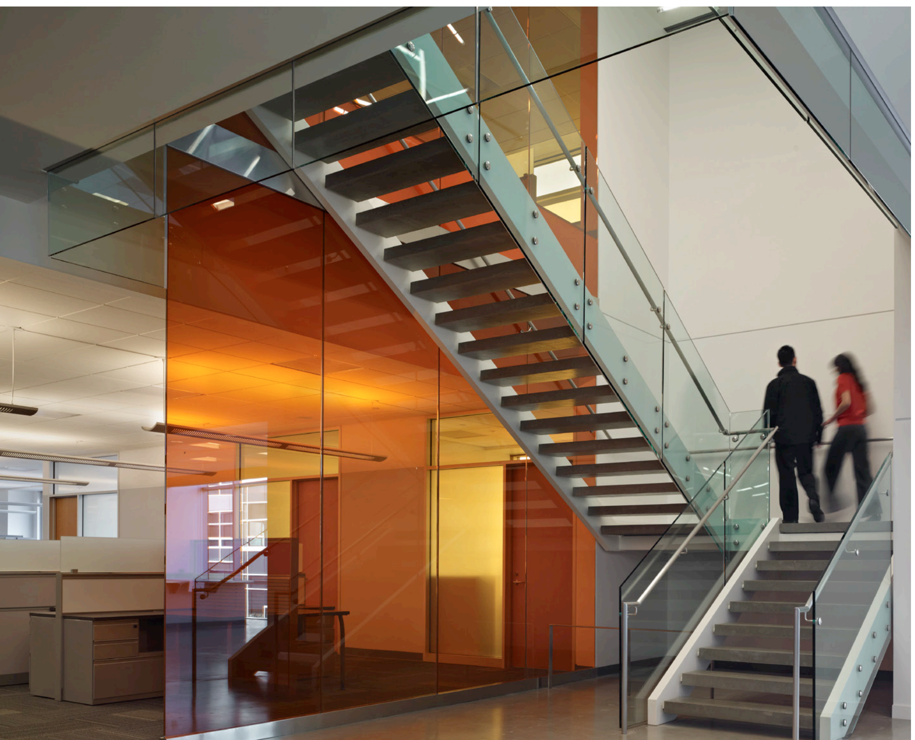
"LIGHT-SABER" FIXTURES - CUSTOM LAYOUT DRAWINGS



7 4-D SEQUENCING

The project team used 4-D visualization during construction to help determine trade sequencing and maintain quality control of a complex set of architectural feature stairs. We coordinated the detailing of the stairs by integrating models from the subcontractors and detailers with the background design model. The complex nature of the stairs and its immediate context required unorthodox sequencing, in which field welds had to take place directly adjacent to already-installed feature glass.

This led to an intense study of the means and methods to solve the problem. We used 4-D visualization to study, optimize, and communicate the sequencing of the work with the detailers and labor crews. By relying on 4-D, the project team performed the necessary layout and installation flawlessly and on schedule.



BY RELYING ON 4-D, THE PROJECT TEAM PERFORMED THE NECESSARY LAYOUT AND INSTALLATION FLAWLESSLY AND ON SCHEDULE

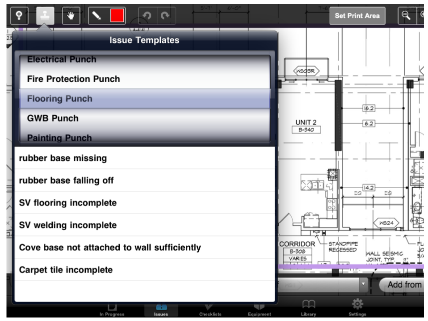
WE MITIGATED THE RISK AND EXECUTED FLAWLESSLY USING AR AS A TOOL TO GET THE RICHEST SET OF BIM DATA IN THE HANDS OF THE PEOPLE WHO NEEDED IT MOST.

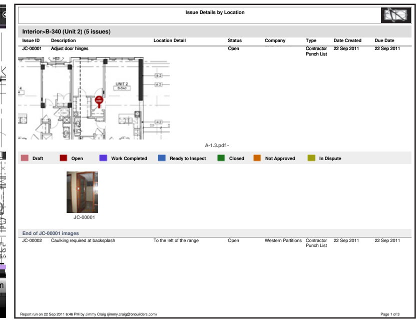
8 AUGMENTED REALITY

During construction, the contractor brought BIM onto the jobsite, where its direct access by field personnel had significant impact on construction schedule and costs. Specifically, we used “Augmented Reality” (AR) technology, which co-locates digital and physical data in a single medium. This innovative use of BIM enabled field crews to intuitively explore the model in context, at full scale.

The complex feature stairs required careful communication and understanding of construction means and methods. The contractor used the model with AR tools so that craft workers could literally get their heads into a complex detail by simply walking around with a ruggedized tablet that overlaid co-located BIM geometry in real time.

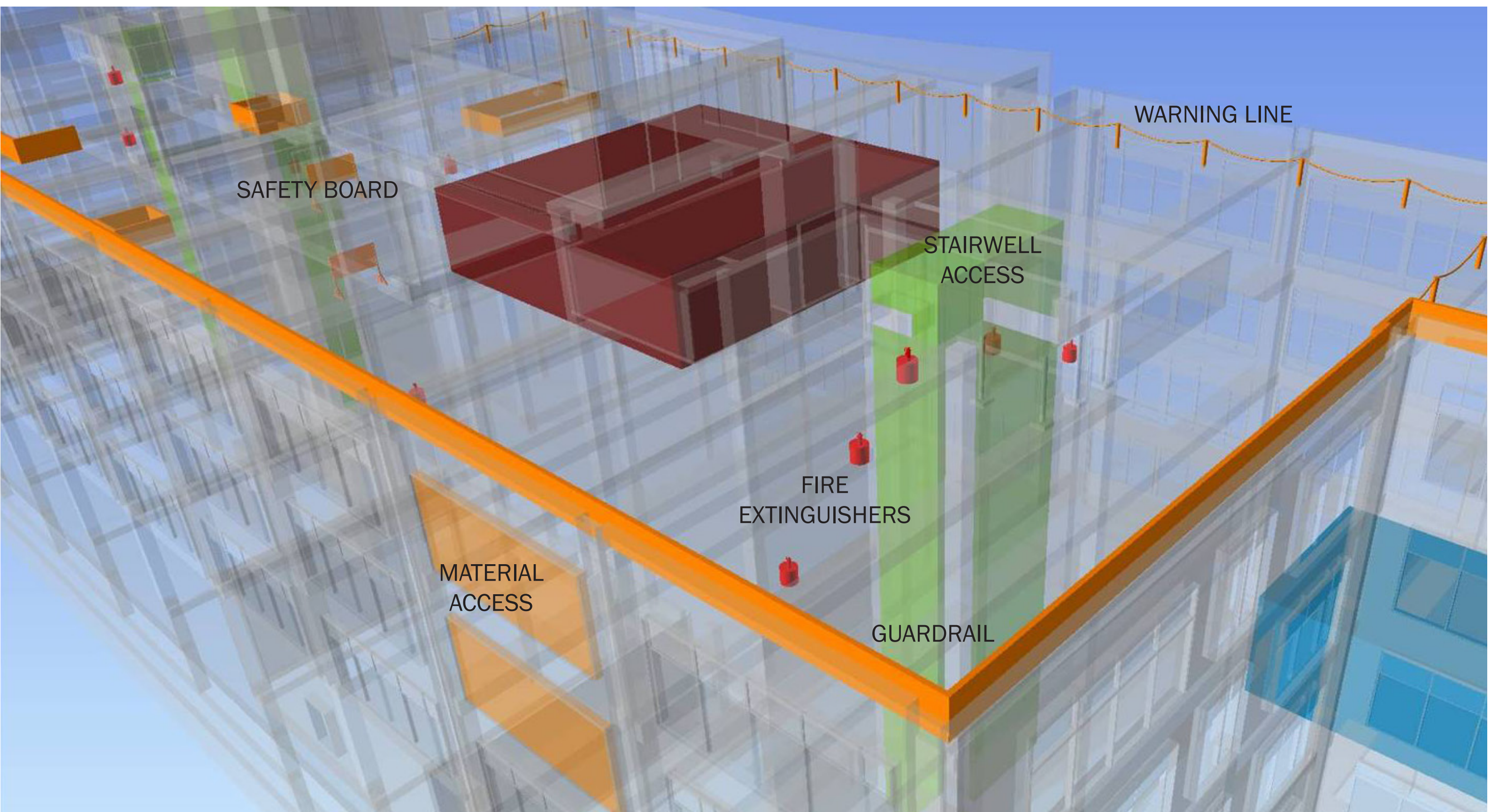
The value of AR to the project team was immediate. From the owner, to the architect, to the contractor, and of course, to the detailers and craft workers, everyone understood the proposed design intent and gained the confidence required to perform the work. In a complex project, where even the slightest layout or installation error could prove costly, we mitigated the risk and executed the work flawlessly using AR as a tool to get the richest set of BIM data in the hands of the people who needed it most.





9 QUALITY CONTROL

Field management software was utilized at the job site to increase the efficiency of quality control, safety audits, completion lists, and punch lists. This on-line software application was taken into the field by crews with tablet computers loaded with corresponding models and drawings. We coordinated with key subcontractors to ensure foremen managed issues using the online project server. In addition, the project architect partnered with the contractor to electronically manage the punch list using the same tools. The implementation of BIM and field management software on tablet computers allowed us to identify more quality issues than ever before on a project, and resolve them faster.

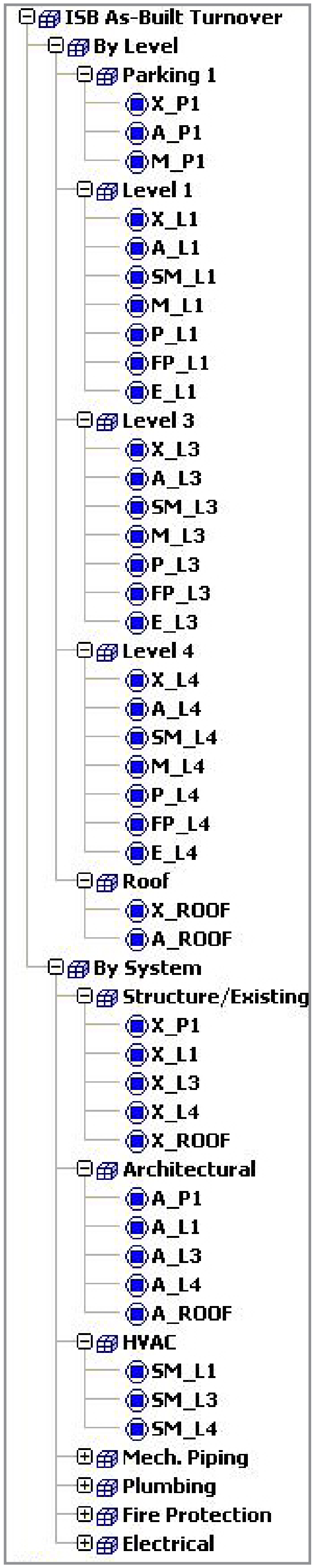


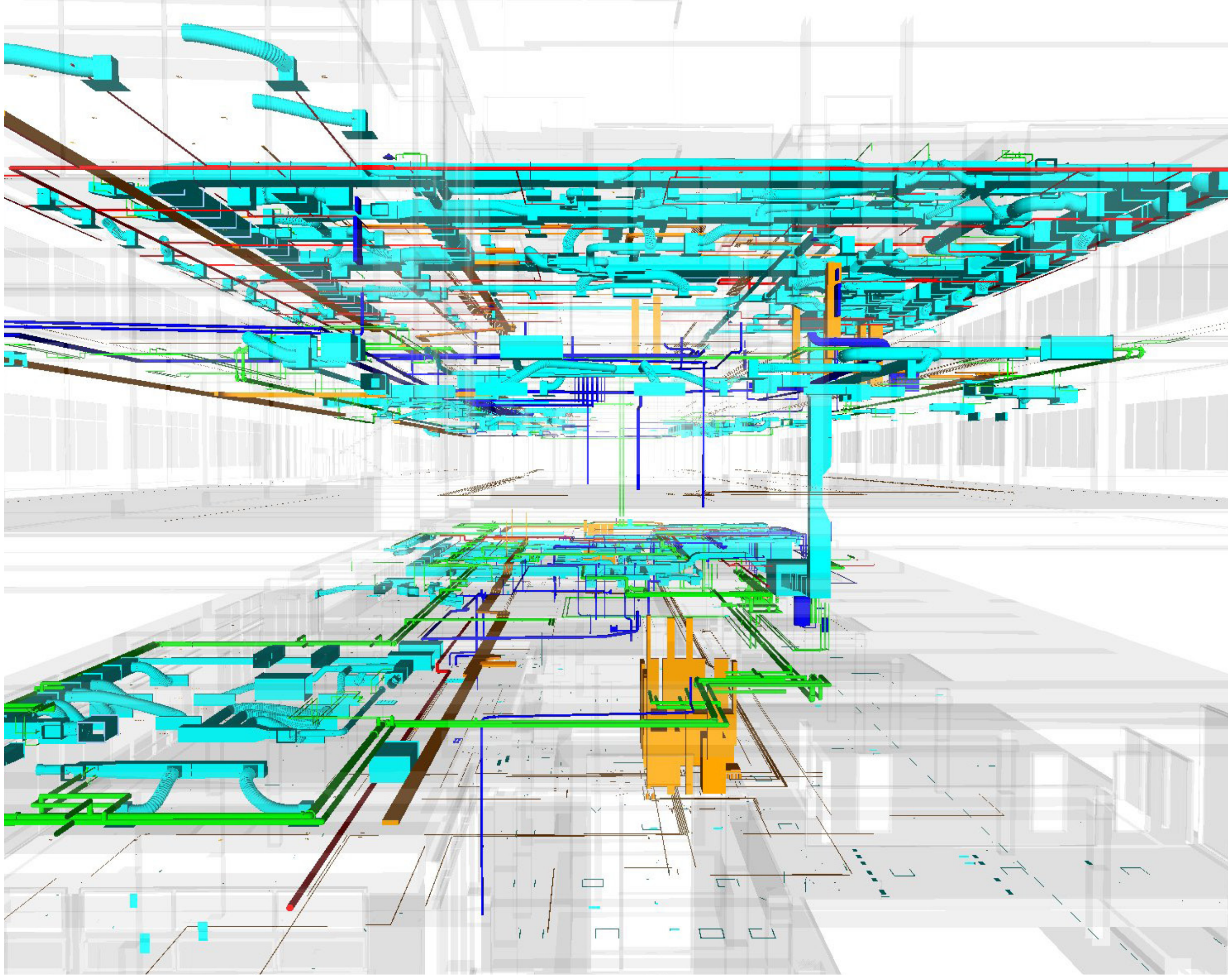
SAFETY

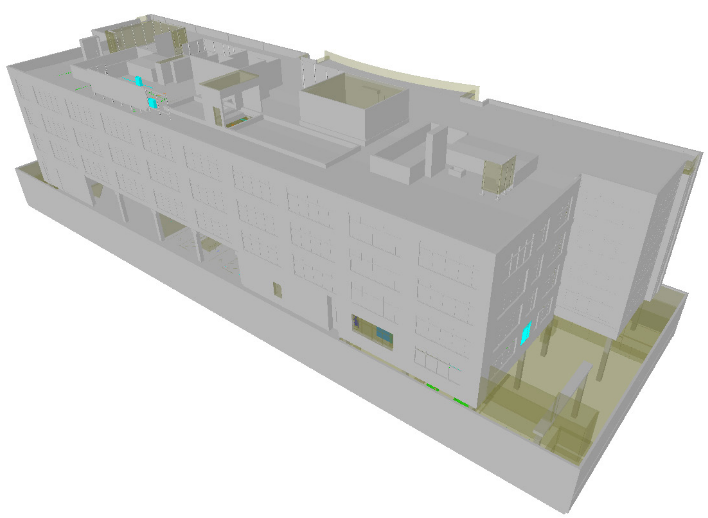
BIM assisted the team in understanding and communicating safety issues as well. The contractor used the design background model to plan and emphasize areas of concern in the site-specific safety plan. Illustrations generated from the safety model were used at safety orientations for all project team members to more effectively communicate site-specific hazards. This innovative use of BIM in construction proved valuable to the team to safely plan potentially hazardous work on the roof of the building, and contributed to a project free from injuries.

10 AS-BUILT DOCUMENTATION

Throughout the entire project the BIM was updated continuously by the project team. In addition, all subcontractors submitted finalized as-built models of their respective scopes. This provided us a great opportunity to compile an accurate and complete model for the end user. This visual aid assisted the owners' facility management team in being able to quickly and effectively understand their building inside and out.







THIS VISUAL AID ASSISTED IN BEING ABLE TO QUICKLY AND EFFECTIVELY UNDERSTAND THEIR BUILDING INSIDE AND OUT

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