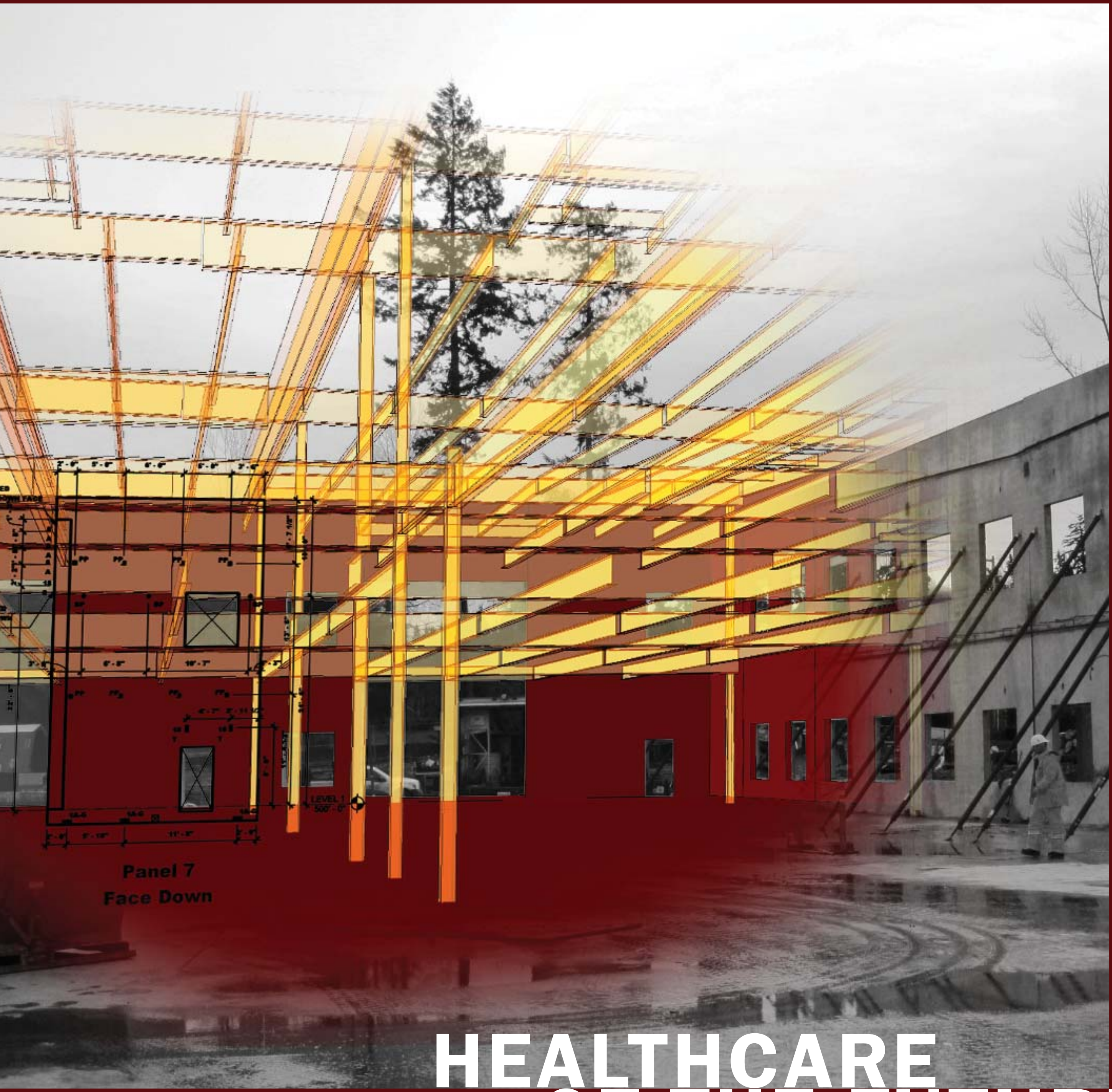
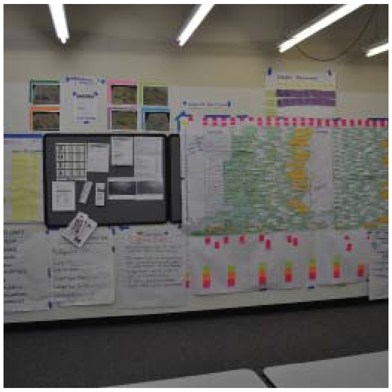
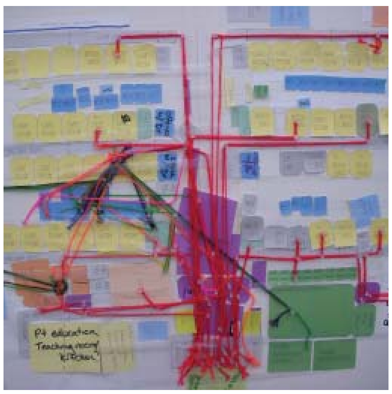


HEALTHCARE OF THE FUTURE

INTEGRATED CARE + FACILITY DESIGN



Lean planning process: building on paper



Lean principle of workplace efficiencies applied to paper model

PROJECT INTRODUCTION | PROGRAM + DESIGN RESPONSE

Built-to-Suit "prototype" Medical Clinic was designed in response to tenant's extensive development and refinement of Lean processes for delivering more efficient, effective and patient-focused healthcare. Applying Lean principles to design and construction delivery of a healthcare facility was assisted by collaborative Building Information Modeling.

A key objective was reducing patient wait time, enabling patients to self-room and bringing services to them. The solution was a scalable pod that supports multiple care services in an efficient, team-focused environment of 14 exam rooms, with space for staff, supplies and equipment. The pod evolved into a patient-care prototype that can be replicated to accommodate demand in any market or geographic area.

Extensive BIM was critical to supporting innovative IPD, lean and sustainable delivery. This is one of the first projects in the country to submit for Gold certification under USGBC LEED 2009 for Healthcare.

DOLPHI-GATOR AFFINITY

COLLABORATIVE DESIGN MODEL

Two design ideas that arose from collaborative design process of tenant, architect and contractor were combined to become the starting point for building the shared model. Waiting room space was reduced by 75%, with each pod capable of serving 8,000-10,000 patients per year.

INTEGRATED PROJECT DELIVERY

Initial intent was to execute a tri-party agreement between Owner, Architect and Contractor. As project was a "build-to-suit" contractual alignment between four parties (including Building Owner), this was not achievable. The program was so specific to Lean principles that building owner allowed tenant to manage design and delivery process. Tenant, architect and contractor agreed to collaborate as if it was true Integrated Project Delivery, including performance incentives for meeting established criteria.

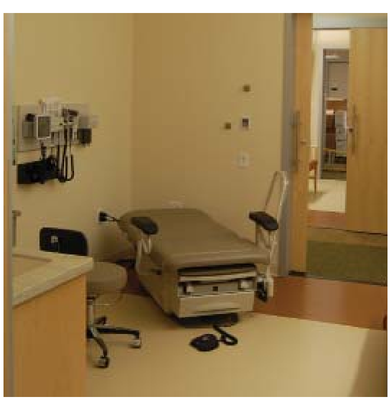
The team spent nearly a year collaborating in a unique design process based on IPD called Integrated Care + Facility Delivery (ICFD) that relied on direct feedback from medical staff, business managers and patients.

The ICFD initiative resulted in a modular prototype for patient-care delivery. Made of pods, the prototype features flexible planning and building systems that are easily modified as patient care, business models, and technology evolve. All program improvements designed and built into the facility were first tested in the ICFD warehouse, and implemented in the built facility.

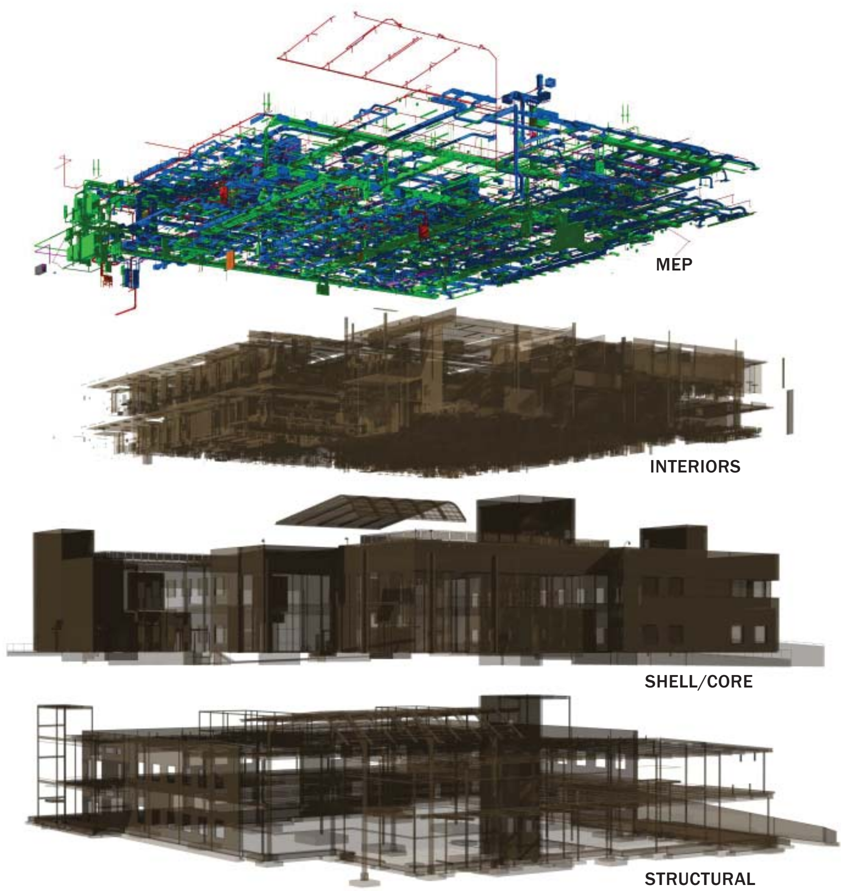

Cardboard Mockup Care Room


Drywall Mockup Care Room


Modeled Care Room


Built Care Room

INTEGRATED MODEL



WAREHOUSE + MOCKUPS

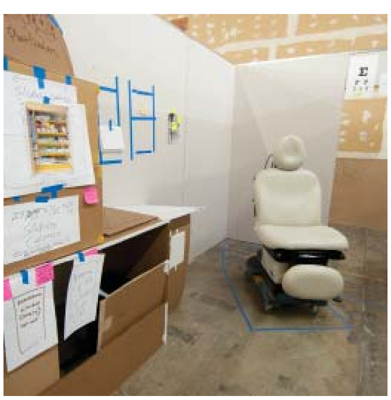
Full-scale cardboard mock-ups were created to work through every detail and practice the new patient care model. Testing ideas with mockups was essential to forward-thinking design. The team reviewed processes for clinic operations and impacts on physical space, then built out spaces with mockups in a 45,000 SF warehouse. The warehouse became a living laboratory, where teams used the spaces, checked assumptions and refined details.

Mockups and BIM worked together. Initial design ideas were developed in BIM, built and modified in cardboard, then revised in the model.

Overhead View of Pod Mockup

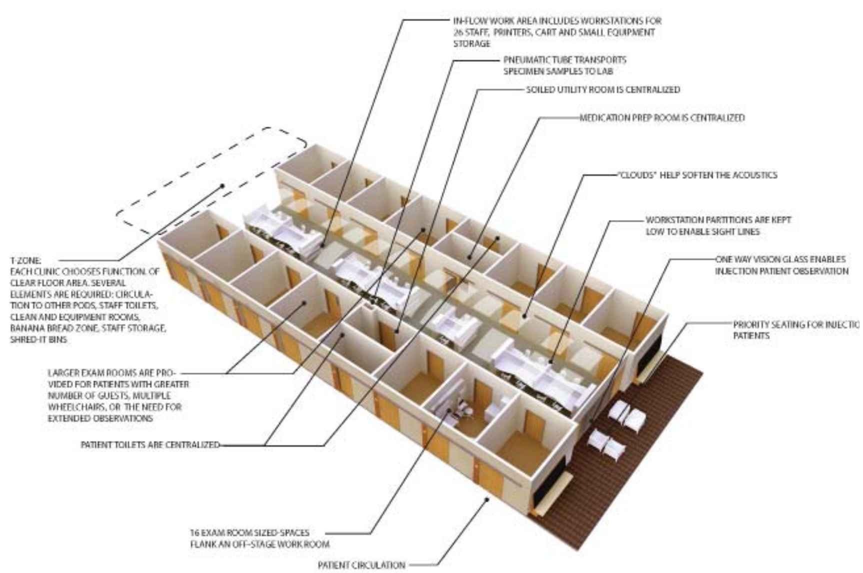
Overhead View of Pod Mockup

Overhead View of Pod

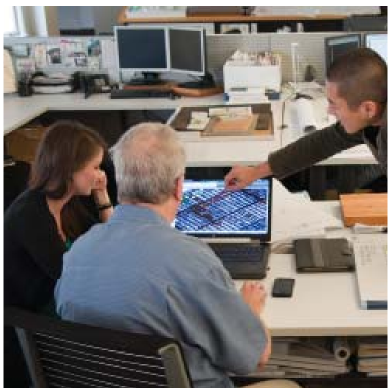


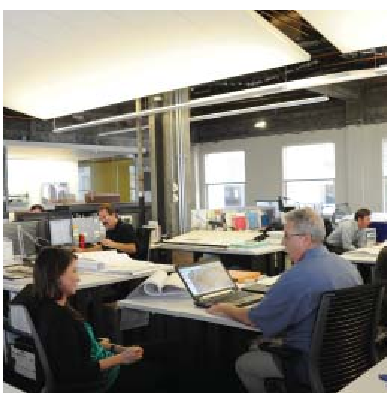
Mockup of Care Room

Revit Model of Pod



Contractor colocation at architect office





Pull-Planning Scheduling with Contractor + Subs

COLOCATION + SHARED MODEL

Construction and design benefited from colocation through preconstruction. Two members of contractor's team located full-time at architect's office during design development and construction document phase for eight months. Key MEP subcontractors colocated at architect's office once a week during construction document phase. Direct contractor engagement with the design model enhanced the construction team's understanding of design intent, added details to enhance constructability, and streamlined design development with instant feedback. Intimate project knowledge facilitated early, thorough, predictable budgets.

The architect collocated on project site one day a week during eleven months of construction. With architect on site, conflicts were addressed and design decisions made in real time using Revit model, eliminating 2D paperwork and continuously maintaining a live model.

Primary Software Utilized:

- SketchUp
- Revit Architecture, Structure and MEP
- CAD Duct
- Navisworks

OVERALL RESULTS FROM IPD/ICFD APPROACH

Early coordination of key stakeholders and all team members provided clear understanding of the project resulting in minimal change requests.

- Minimal CA efforts for Design team – approximately 12 Core/Shell RFIs on a $14M contract. Approximately 10 Tenant Improvement RFIs on a $11M contract.
- Limited Core/Shell Change Orders, related only to expanded site improvements.
- Zero Change Orders for Tenant Improvement.

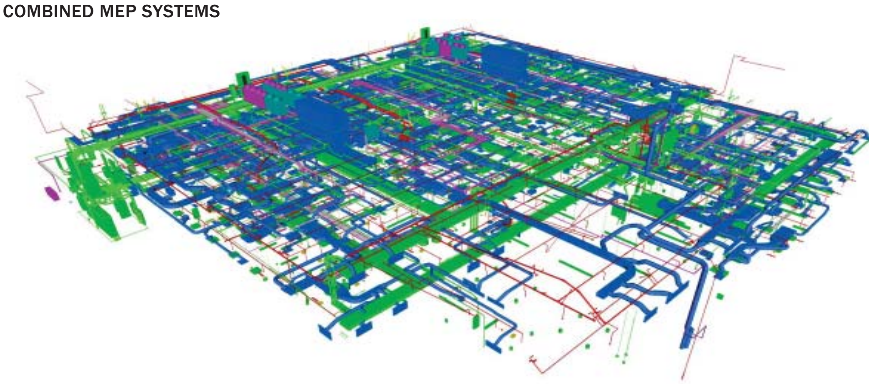
MECHANICAL SYSTEMS DESIGN, SELECTION + COORDINATION

The mechanical engineer translated architect's BIM/Revit model into compatible software format to analyze loads. The model provided quantitative data on volume of different zones and u-values of different exterior wall systems. In response to the plug and play aspects of the pod layout, different system options were analyzed to determine long-term energy efficiency and future flexibility.

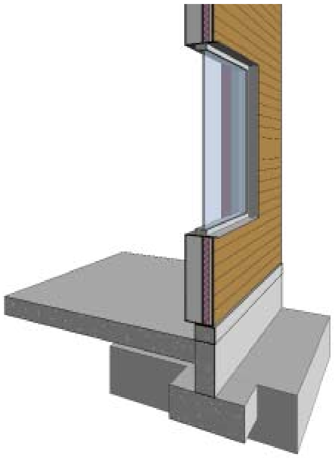
With one "stand alone" MEP system dedicated to each individual pod, shut-downs to accommodate future changes only affect that pod, allowing the rest of the facility to continue to operate.

All major MEP systems were procured under Design-Build contracts, allowing MEP coordination to begin during design. By participating in colocation, MEP designers and detailers worked side-by-side with both the architectural and contractor teams. Full 3D detailing, typically started after issuance of contract documents, was pushed forward into the design phase. This allowed critical conflicts and/or pinch-points to be identified early and resolved thoughtfully. This also allowed the architectural team to identify key design elements to be established and maintained without compromise throughout design and construction.

COMBINED MEP SYSTEMS



MEP SYSTEMS WITHIN BUILDING ENCLOSURE



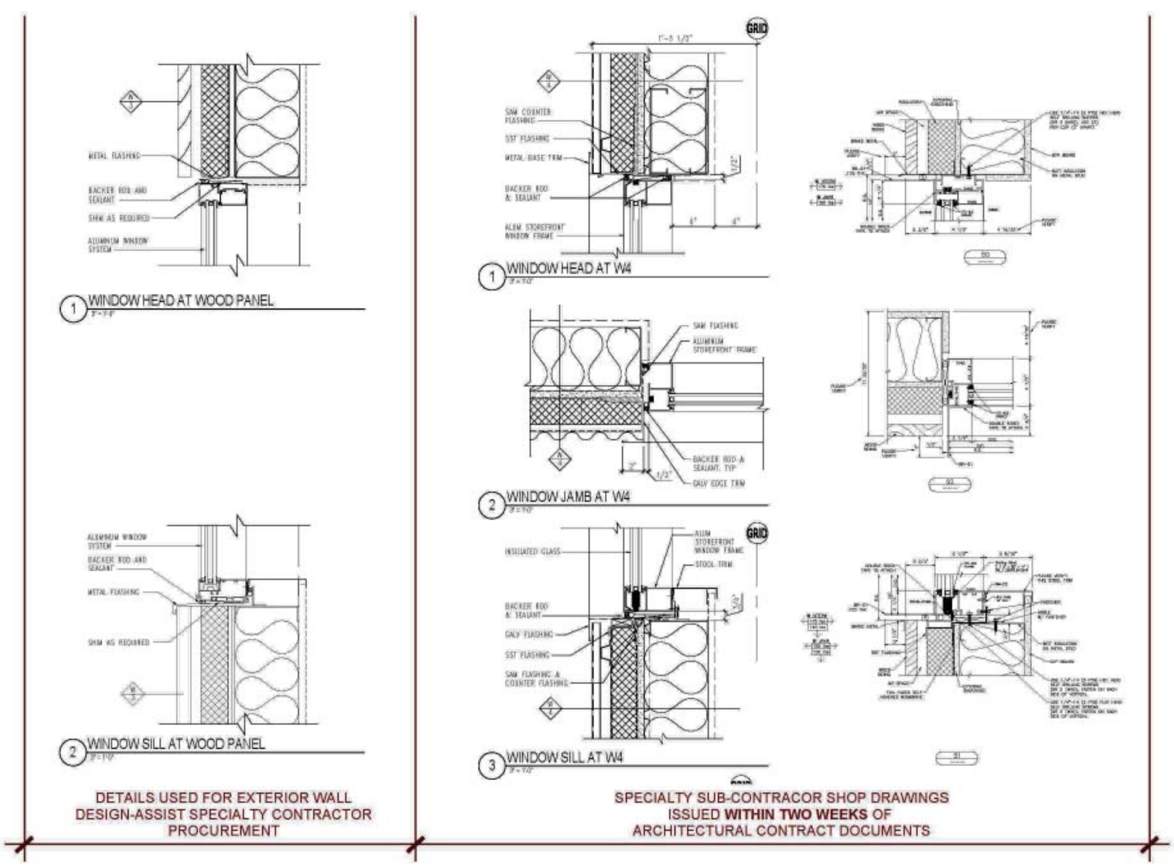
EXTERIOR WINDOW - SECTION PERSPECTIVE

EXTERIOR WINDOW INSTALLATION

DESIGN-ASSIST EXTERIOR WALL DEVELOPMENT

Participating exterior wall specialty contractors included the glazing contractor, the exterior metal-stud wall framing contractor, the architectural metal cladding contractor and general contractor.

Specialty contractors, general contractor and architect reviewed exterior wall detailing at weekly meetings during design. Specialty contractor shop drawings were developed concurrently with architect's exterior wall detailing while the architect incorporated the resolution of design intent into the BIM. This reduced exterior wall details produced by the architect, who focused on design intent by leveraging specialty contractors to develop atypical details. Moreover, working collaboratively clarified scopes and increased coordination prior to construction.



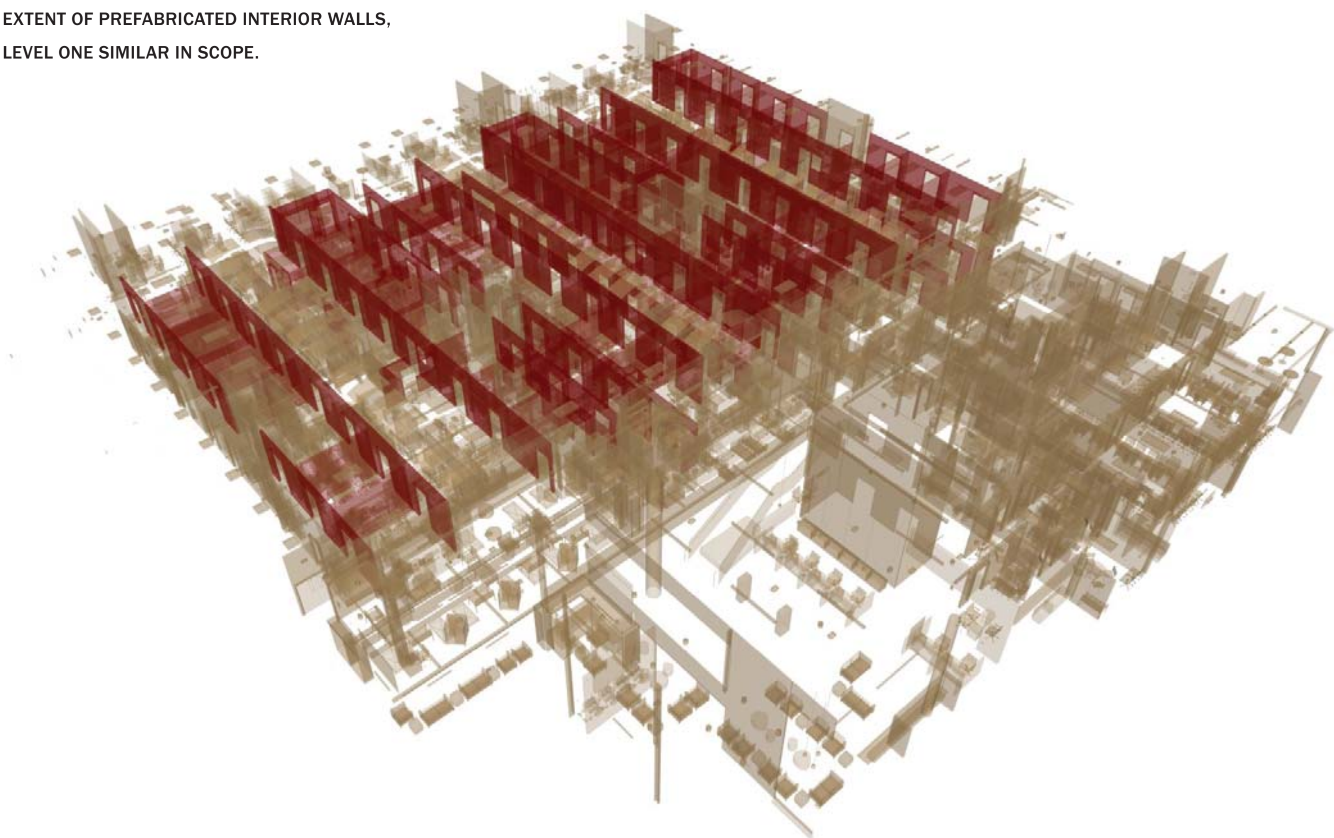
PREFABRICATION + MODELING

BIM facilitated pre-manufacturing of 42 exam rooms complete with all electric and plumbing utilities. Overhead utilities like fire sprinklers, data cable trays and ventilation systems were also pre-assembled in manageable sections, lifted into place and installed in less time than conventional construction. Pre-manufactured walls were assembled quickly on site, connected to the utility supply lines, ready for inspection. The owner plans to use these innovations in future projects.

Time + Cost Savings

- Overall plumbing trades estimate savings of 600 manhours. ROM of $48,000 in total project savings.
- Electrical trades overall estimate savings of approximately 500 manhours. ROM of $42,500 in total project savings.
- Schedule gain of 2 weeks. General Contractor ROM savings: $70,000.

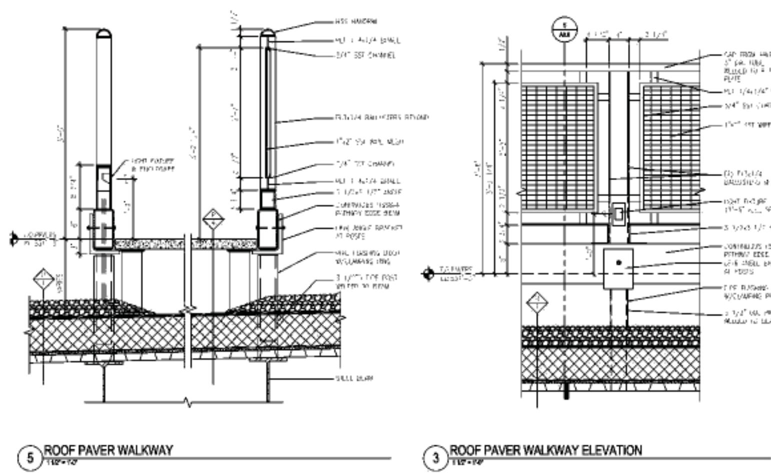
EXTENT OF PREFABRICATED INTERIOR WALLS, LEVEL ONE SIMILAR IN SCOPE.



DIRECT FROM BIM TO FABRICATION

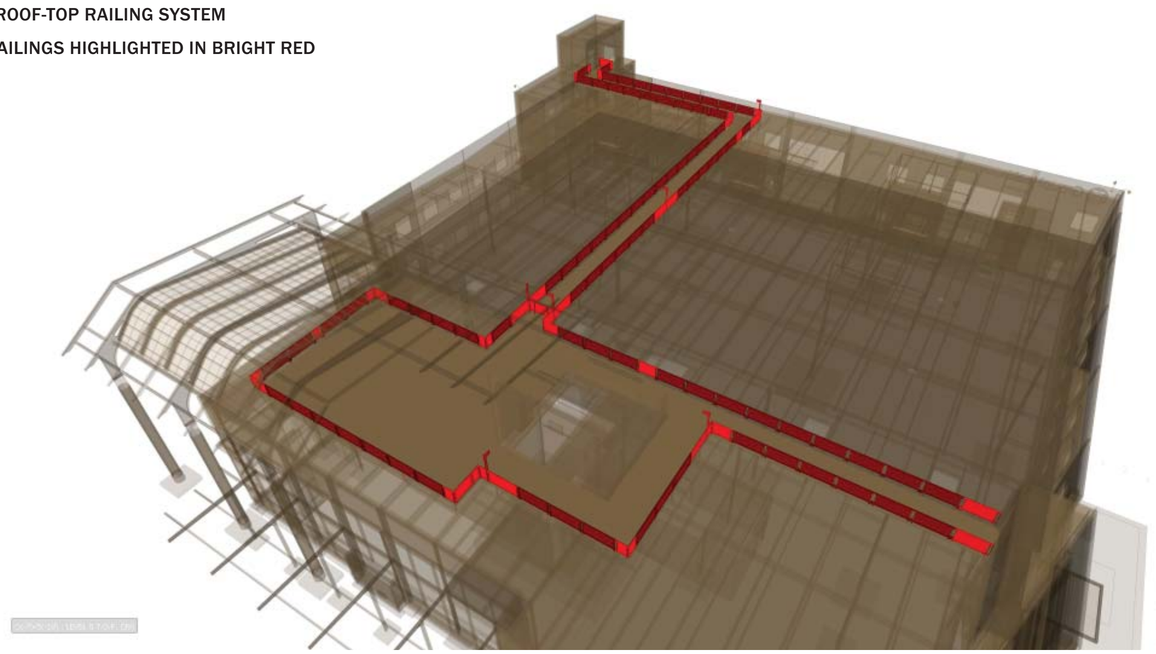
The building contains a roof-top Area of Respite for employee use and to generate LEED credits. Area size required two means of egress by pathways to exit stairs. The typical 6-foot railing module was designed by the architect. From typical railing, the contractor modeled remaining atypical railings, including inside and outside corners, gates, etc. Rather than documenting each unique railing type, the 3D model of the railings was delivered directly to the fabricator, who produced all shop drawings from the model, eliminating detailing by the architect.

ARCHITECTURAL ROOF GUARDRAIL DETAILS



EXTENT OF ROOF-TOP RAILING SYSTEM

ATYPICAL RAILINGS HIGHLIGHTED IN BRIGHT RED



TILT-UP PANEL ERECTION

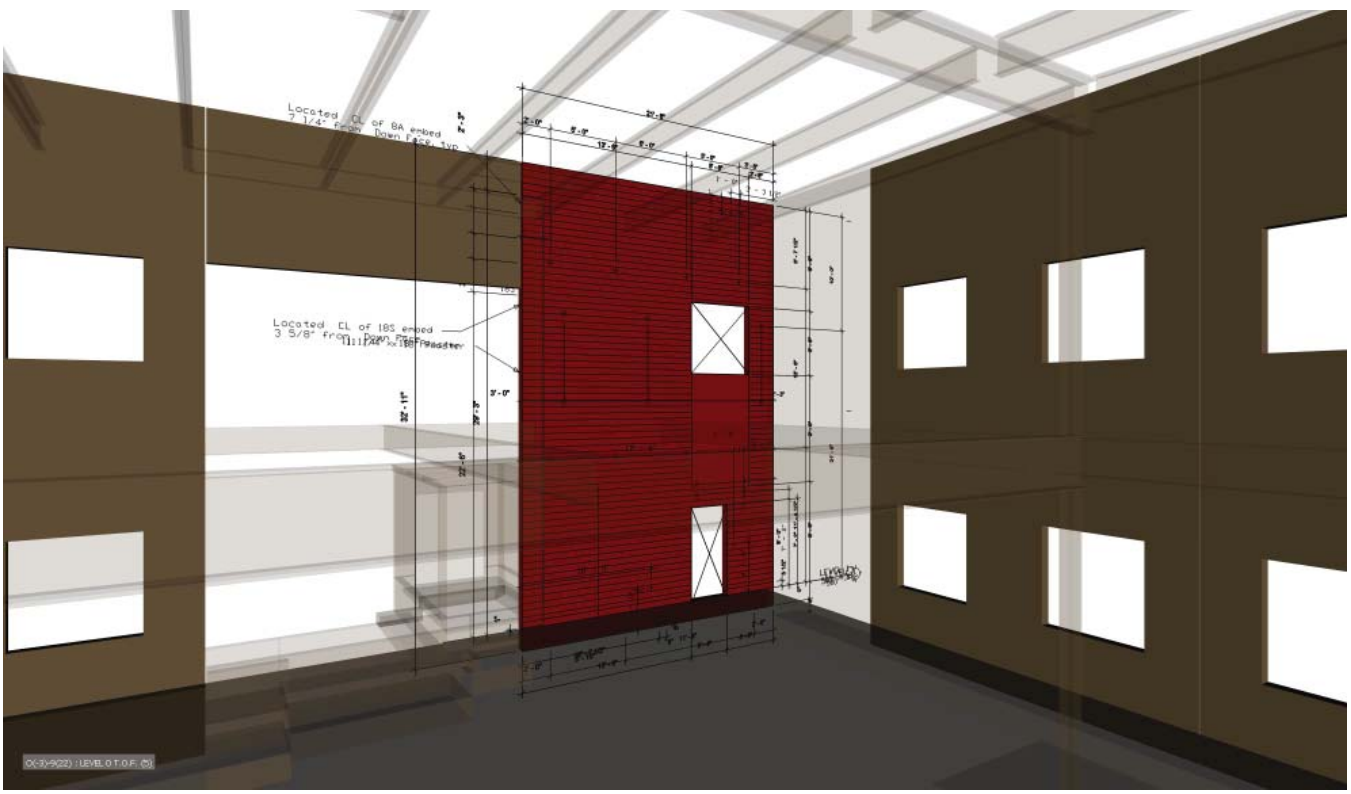
INTEGRATION DRAWINGS FROM BIM

The 3D Model developed collaboratively during design was actively used by the contractor to support construction efforts:

- Coordination of all MEP systems in 3D using clash detection technology.
- Capturing points from the BIM and transferring to the layout team's surveying equipment (robotic total station) for layout in the field.
- Preparing drawings that distill information across multiple CD drawings to a single integrated drawing for field personnel. Drawings ranged from layout of footings and foundations, to concrete tilt-up panels to prefabricated steel stud walls.

These integration drawings are fundamental tools of contractor's day-to-day work flow. Illustrated is one of 22 tilt-up panels. Four drawings were generated for each panel directly from the model. Information incorporated into each drawing included overall panel dimensions and the locations of reveals and extent of architectural finishes on outside panel face; embeds on outside and inside panel faces; and locations of MEP systems. These integration drawings ensured current information was provided in distinct work packages to field personnel with Lean goals of reducing mistakes and increasing efficiency.

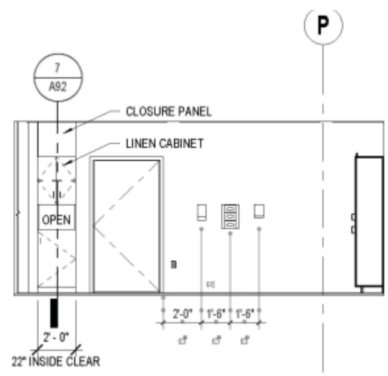
TILT-UP PANEL WITH INTEGRATION DRAWING SUPERIMPOSED



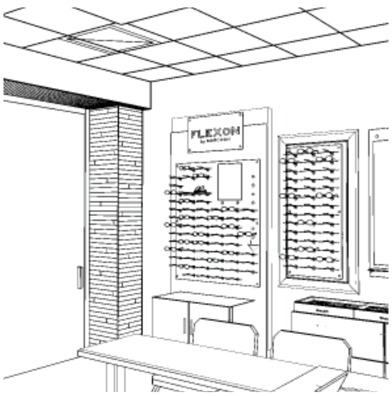
FF+E COORDINATION USING BIM

Every piece of equipment and furniture was individually modeled in the architect's BIM, ensuring accurate item counts and material take-offs. This benefited client and contractor review of ordered items, and provided information for LEED credits. Furniture was modeled early for electrical coordination; floor cores and depressed slabs were established based on workstation and equipment locations. Wall-mounted equipment (such as grab bars, mirrors, and monitors) was modeled for locating backing in the walls. Pass-throughs and fire extinguisher cabinets were modeled to check conflicts with shared walls and plumbing within walls.

FFE coordination continued through Contract Administration. If an item location was moved during construction, it was also moved in the model, checked for any conflict, then relayed back to the contractor. This helped maintain the live BIM model, and activate As-Built drawings for the client.



INTERIOR ELEVATION WITH DIMENSIONS



INTERIOR PERSPECTIVE OF VISION CLINIC

MODELED FF+E

PROJECT TURNOVER

Project Turnover benefited from the IPD process as well. Within two weeks of Substantial Completion, the contractor successfully closed out all punchlist items. Clearly understood design intent for all elements was a major factor in smooth overall completion, allowing final weeks of construction to focus on thorough completion of work in place, without late resolution of items or revisions.

SCHEMATIC DESIGN:
SKETCHUP MODEL

CONTRACT DOCUMENTS + CONSTRUCTION:
BIM (REVIT) MODEL

BUILT FACILITY