

Realizing Complex Design Through BIM

The Louisiana State Museum and Sports Hall of Fame

Location: Natchitoches, Louisiana
Category: A: BIM Excellence
Type: New Construction
Site Area: 36,500 sq. ft.
GSF Total: 27,000 sq. ft.
NAA Total: 18,900 sq. ft.
GSF/NAA Total: 70%
Project Delivery: Design-Bid Build
Site Dev. Costs: \$200,000
Bldg Costs: \$12,200,000
Total Con. Cost: \$200,000
Bldg cost/GSF: \$460.00



Project Background Overview

Overview

The Louisiana State Museum and Sports Hall of Fame (LSMSHF) demonstrates the value that BIM can bring in service of realizing ambitious design, under conventional contractual conditions. As a public project funded by the state, this project used a traditional Design-Bid-Build structure. BIM was introduced by the Architect as part of the design process to model and document the project, in particular the primary atrium and circulation space. As part of their bid documents the Architect introduced a BIM requirement, referencing the AIA E202 BIM Protocol Exhibit, that mandated all bidding contractors and fabricators demonstrate that they could deliver BIM models developed from a LOD 300 to a LOD 400 as part of the review and approval process. The Architect identified a BIM Consultant that they had previously worked with to provide these services on behalf of the bidding contractors. This enabled the BIM Consultant to work alongside the selected fabricator to develop the cast-stone system and the Construction Manager to provide overall BIM coordination for the entire project.

Design

Overlooking the historic landscape of Cane River Lake at the boundary of the Red River valley in North Louisiana, the Architects have embraced this landscape in its design of a 27,000 square-foot museum. Guided by the fluid shapes of the braided corridors of the river channels separated by interstitial masses of land, the firm derived the building's geometry from the area's distinctive geomorphology and aspects of river hydromorphology.

The focus of the interior is the atrium. Clad in light-colored cast-stone panels and presenting an atmosphere of calm and reflection the atrium's organic design will serve as a place for community gatherings and special events, as well as general spatial orientation.

The museum's exterior will be clad in wood planks - a reference to the regions rich timber legacy. The design is informed by the historic nature and materials of the region while presenting a contemporary architectural language to the remarkable city of Natchitoches.

Cast Stone Panel Fabrication

To ensure that the cast stone panels reflected the design intent of the atrium, the fabrication requirements, which included panel thickness, panel tolerances, installation and shop tickets, were built into a complete virtual prototype by the BIM Consultant. This was accomplished by translating the complex surface geometry created in Maya into the robust fabrication modeling platform, Digital Project, where the initial surface geometry was cleaned and repaired. A seaming pattern, developed by the architect as projected line-work, was used to divide the surface geometry into individual panels. This enabled the BIM Consultant to break the overall geometry into regions that allowed different sections of the model to be developed concurrently.

Once individual panels were created from the original surface geometry, the BIM Consultant developed a semi-automated process to generate the panel thickness (4 5/8") required by the fabricators. This presented numerous challenges due to the freeform nature of the base geometry that had to be resolved and verified digitally without altering the original geometric intent. These thickened panel models were used by the panel Structural Engineer and Steel Detailers to design and rationalize the steel support structure that connected the panels back to the base building structure. This involved performing finite element analysis on the cast-stone panels to identify the location of the steel embed connections. Once identified, locations were included in the panel geometry and documented as part of the shop ticket process.

Project Description

Overview

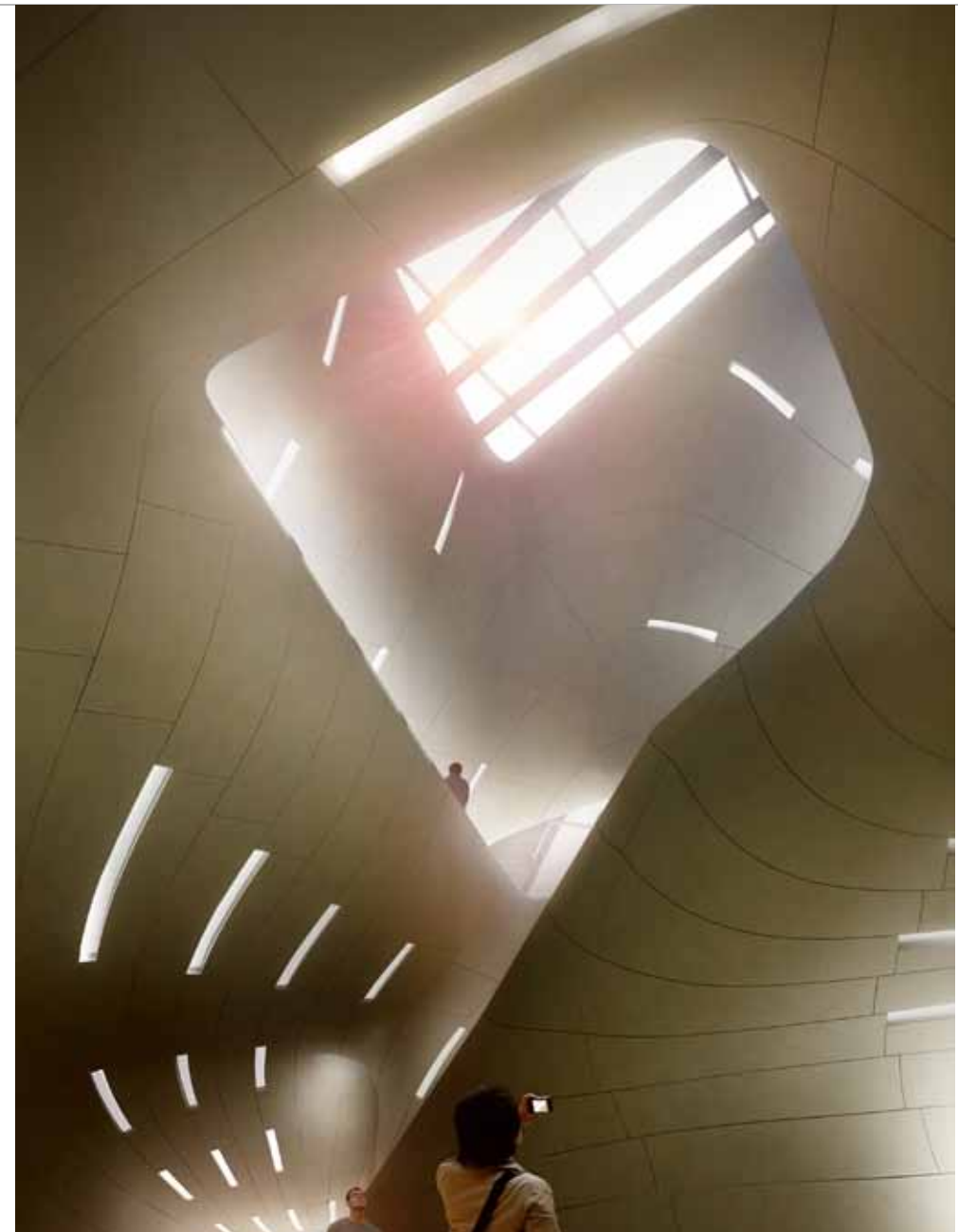
The atrium design was closely integrated with most of the primary building systems and structure, requiring the careful planning and incorporation of these systems into the cast stone panels. Modifications were made to the panel fabrication models in order to account for areas where these systems interacted with the panel geometry. It was critical to perform this process on the digital models since the panels could not be modified once they were created.

Once a virtual prototype of the panel system was completed, the BIM Consultant produced individual fabrication files and shop tickets for over 1,000 unique panels. This documentation included several 3D views of panels to aid the fabricators in identifying panels in the shop, as well as the critical dimensions used to locate the steel embeds. The fabrication models that were created by the BIM Consultant were used to CNC mill foam molds that were used to cast all of the panels.

Project BIM Coordination

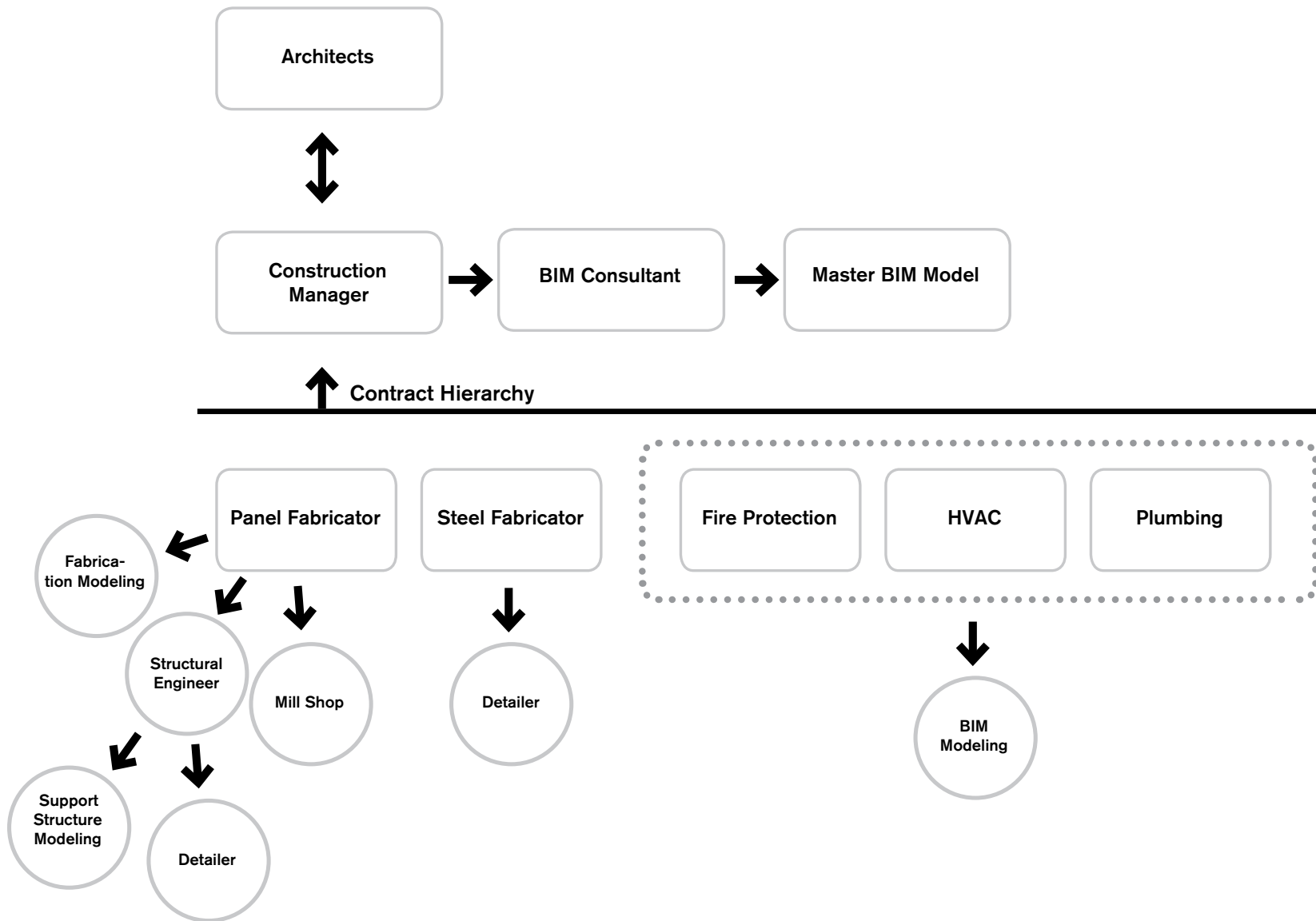
In a separate scope from the panel fabrication, the BIM Consultant was engaged by the Construction Manager (CM) to provide BIM coordination for all trades. The CM was tasked with providing model-based trades coordination for the project as a part of the project BIM requirement. The BIM Consultant was brought on to assist the CM to provide modeling services for electrical, HVAC, sprinkler and architectural trades (pre-cast), as well as running and managing clash, clearance and sequence analysis across the project.

The BIM Consultant worked alongside the CMs in running weekly coordination meetings, using the model as both a web-based issue tracking record as well as a communication tool between the CM and its sub-contractors. This approach enabled experienced construction managers, engineers, fabricators and tradesmen to view their issues in the context of other trades and focus on problem-solving regardless of their 3D capabilities.

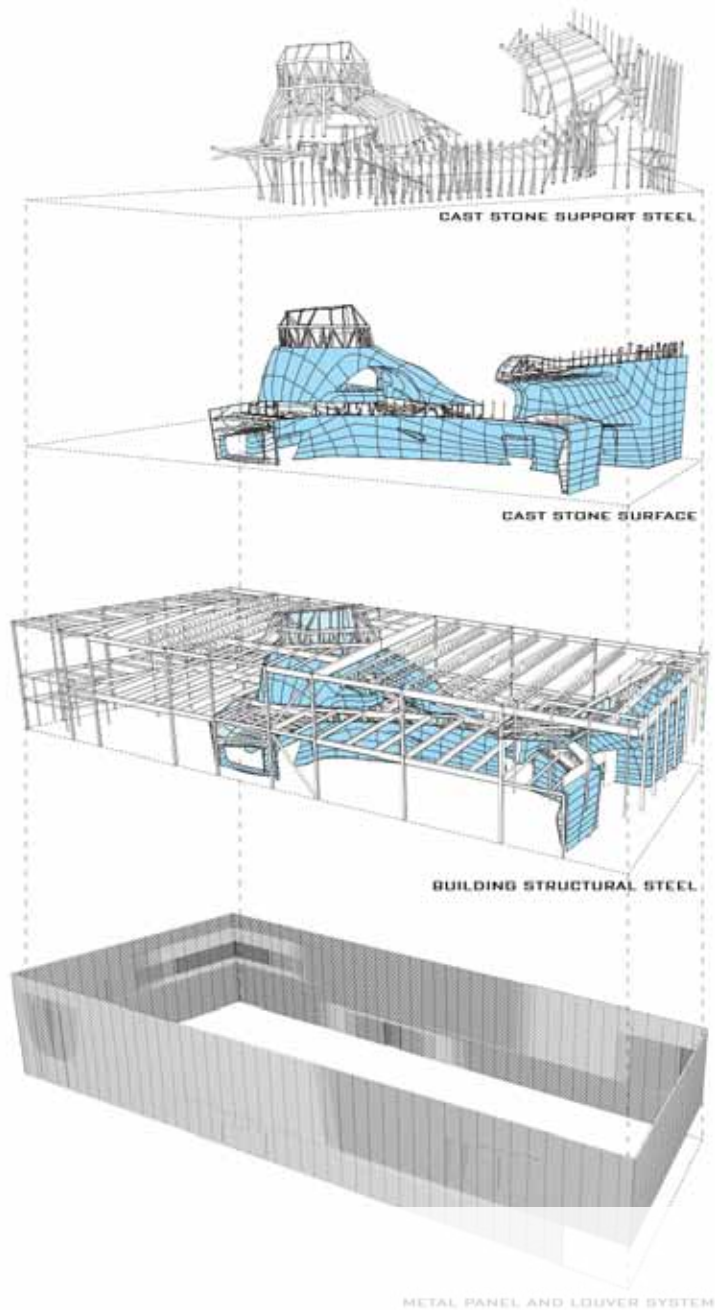


Project Description

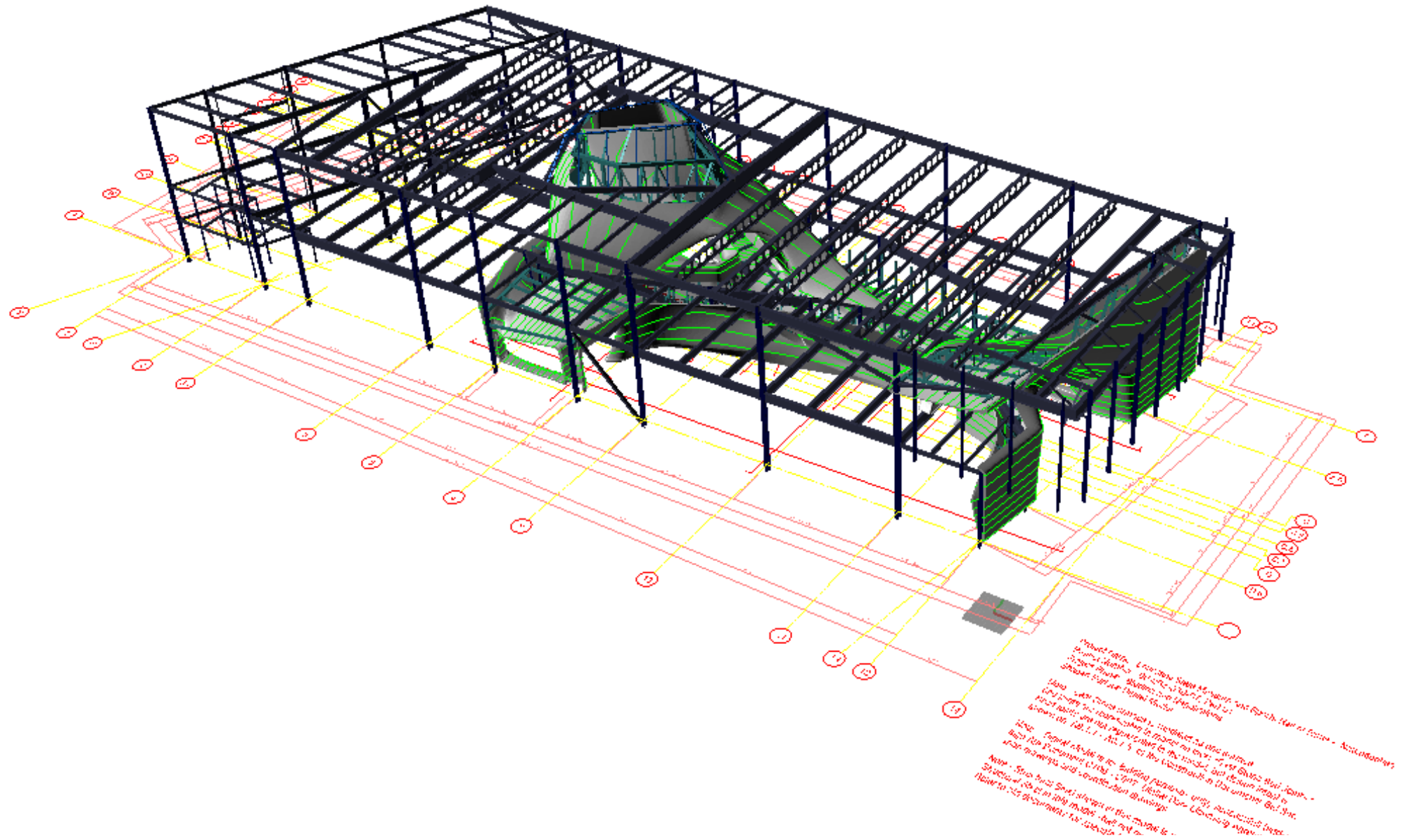
Overview



Team Organization Overview

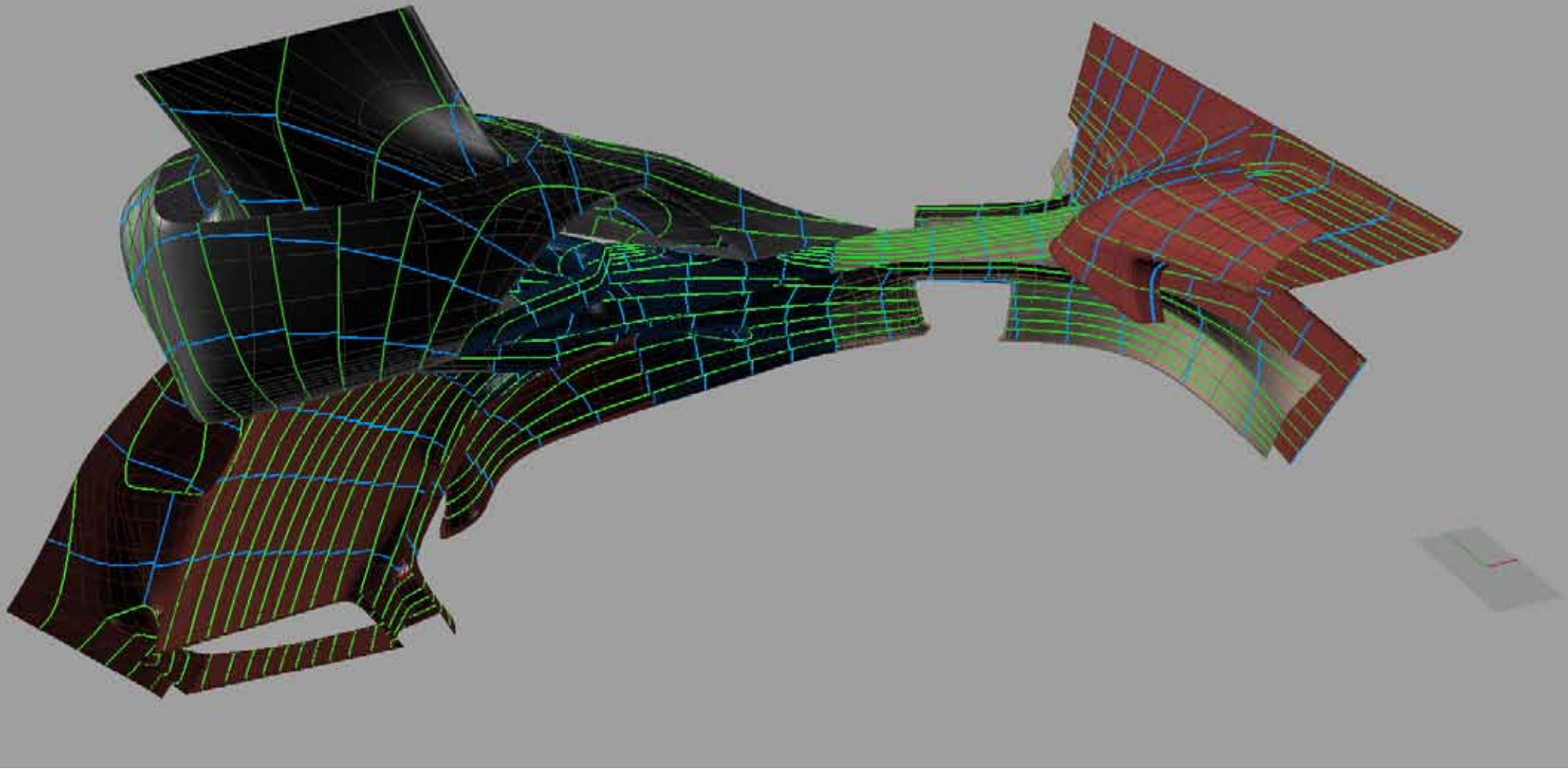


Design Concept
Design

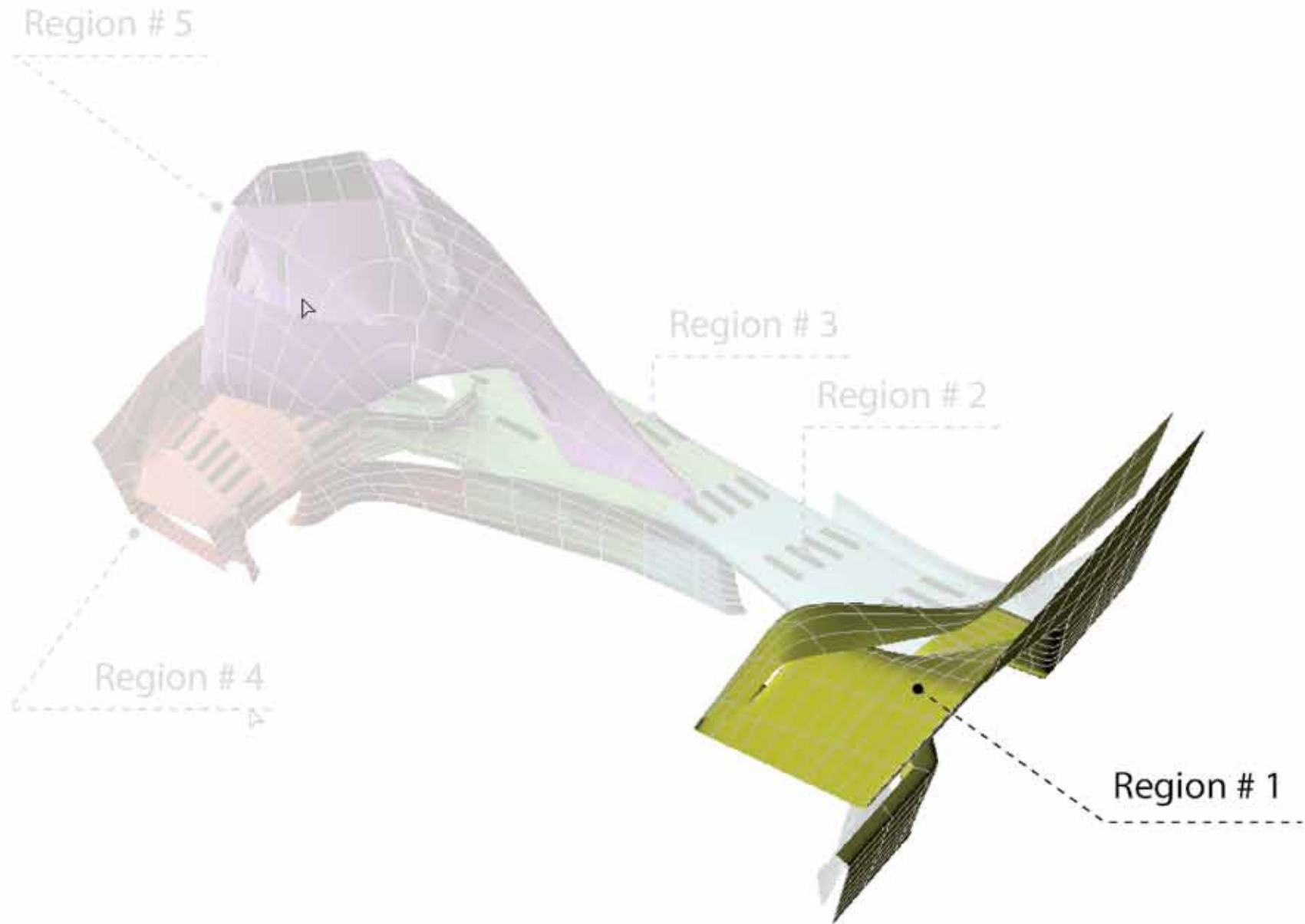


Design Intent Model

Design

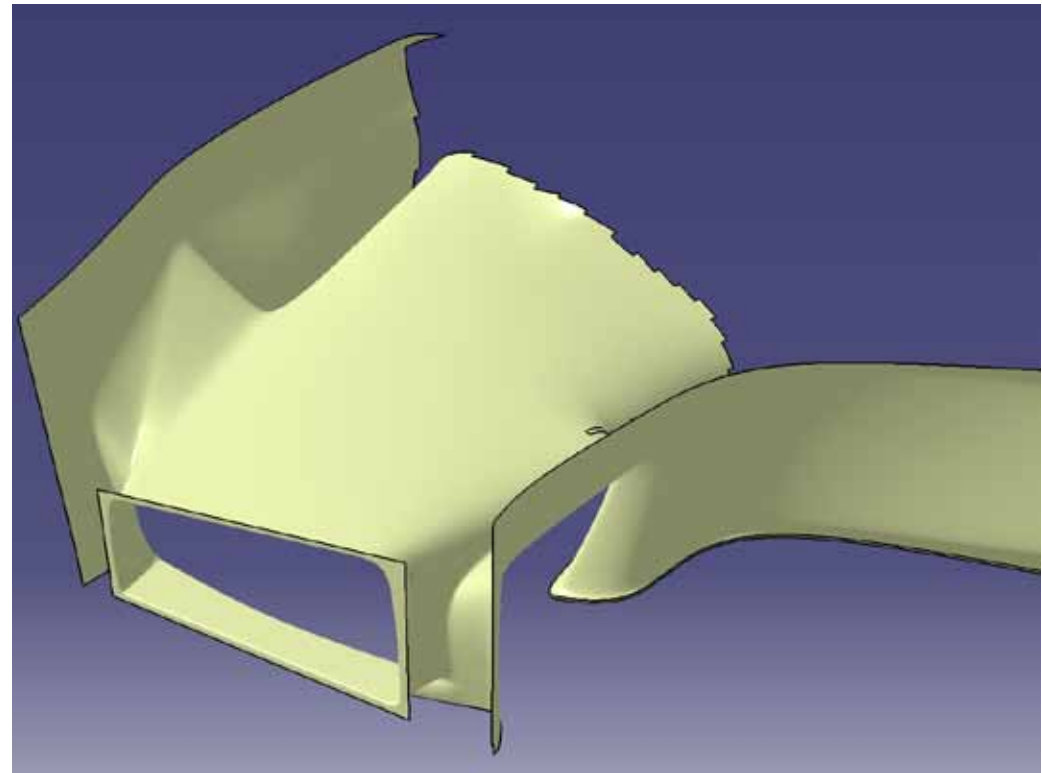
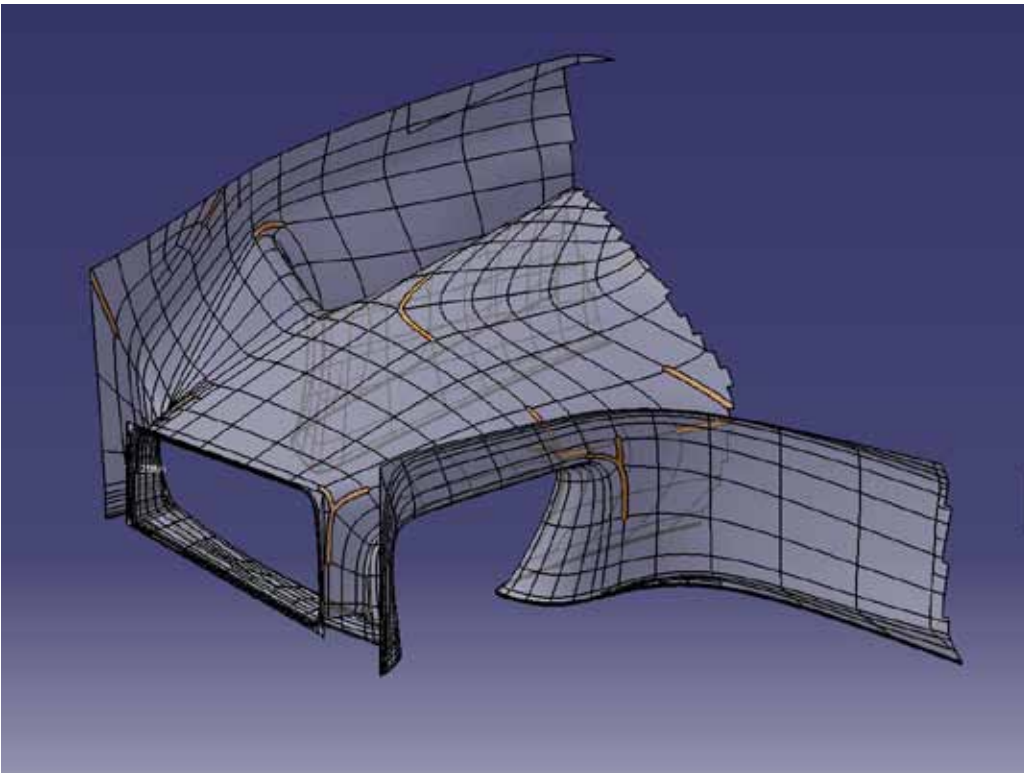


Complex Cast Stone Design Surface Design



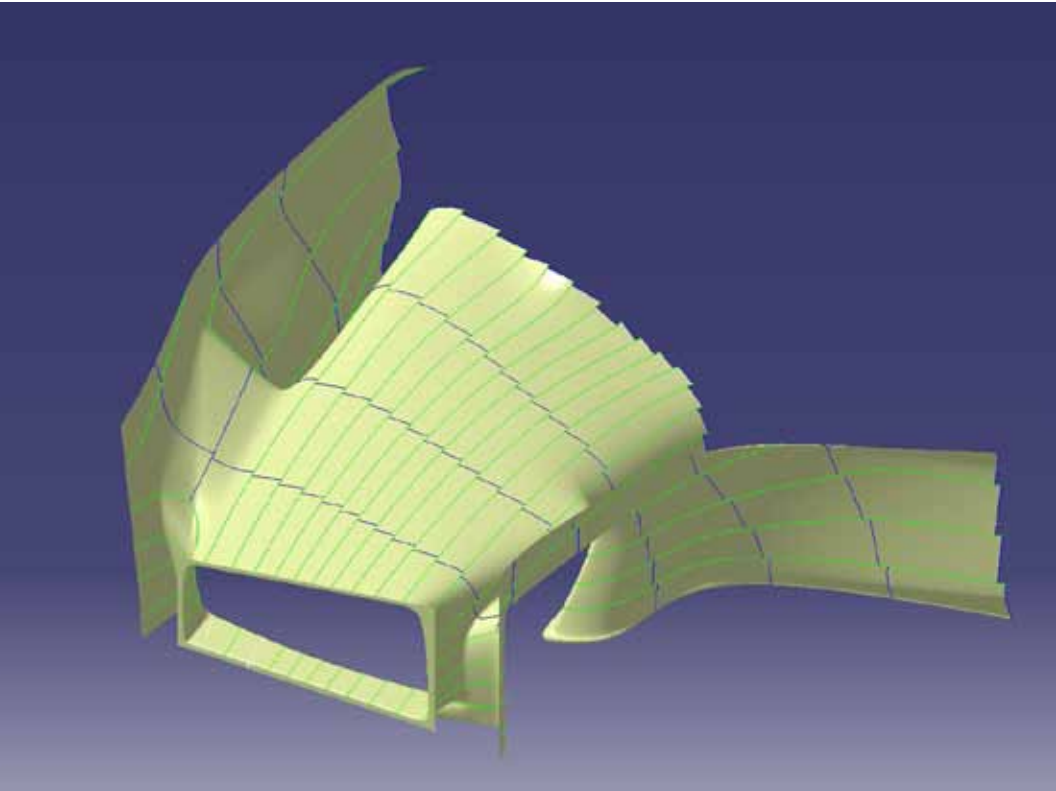
Defining Regions

Cast Stone Panel Fabrication



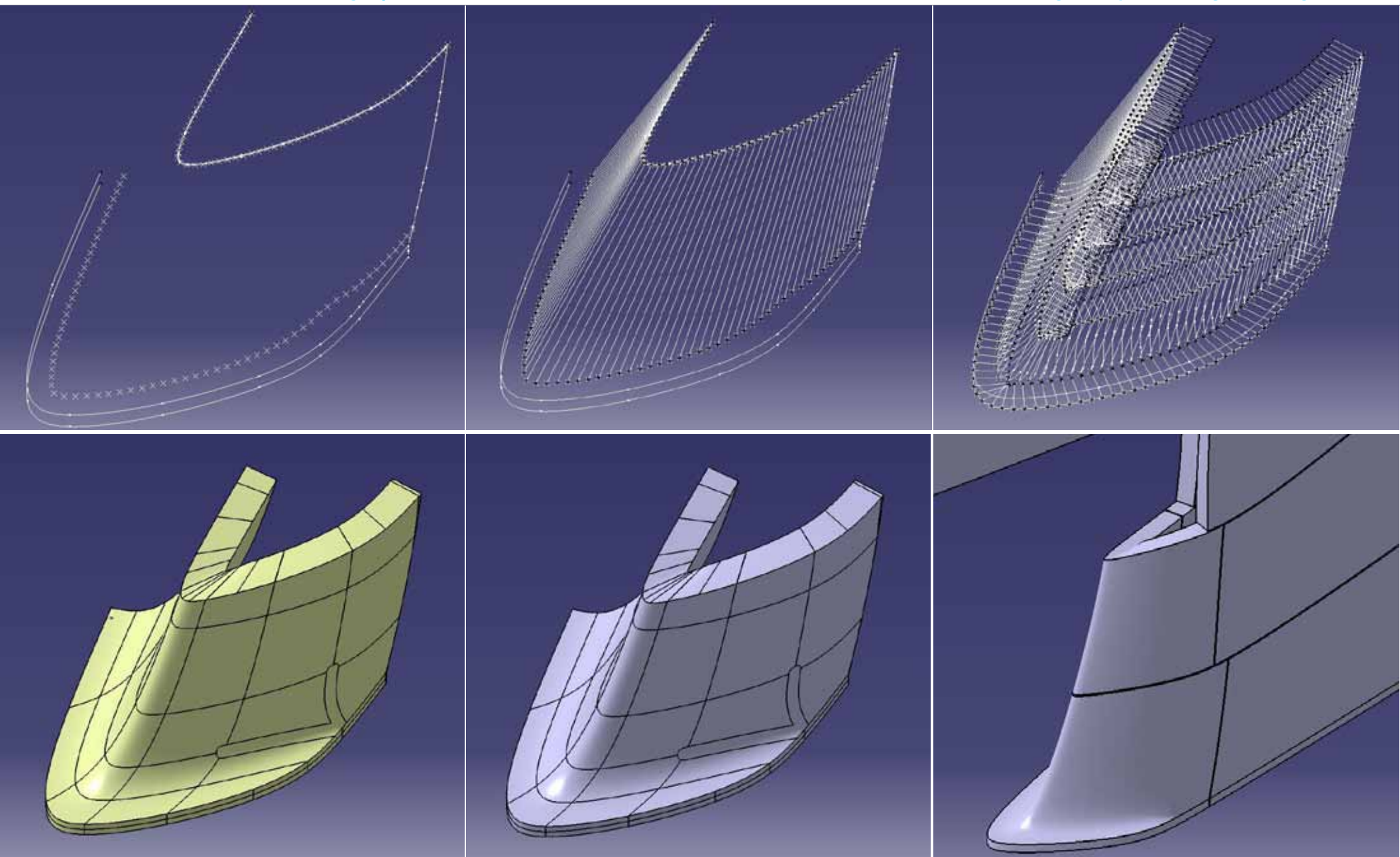
Surface Repair

Cast Stone Panel Fabrication



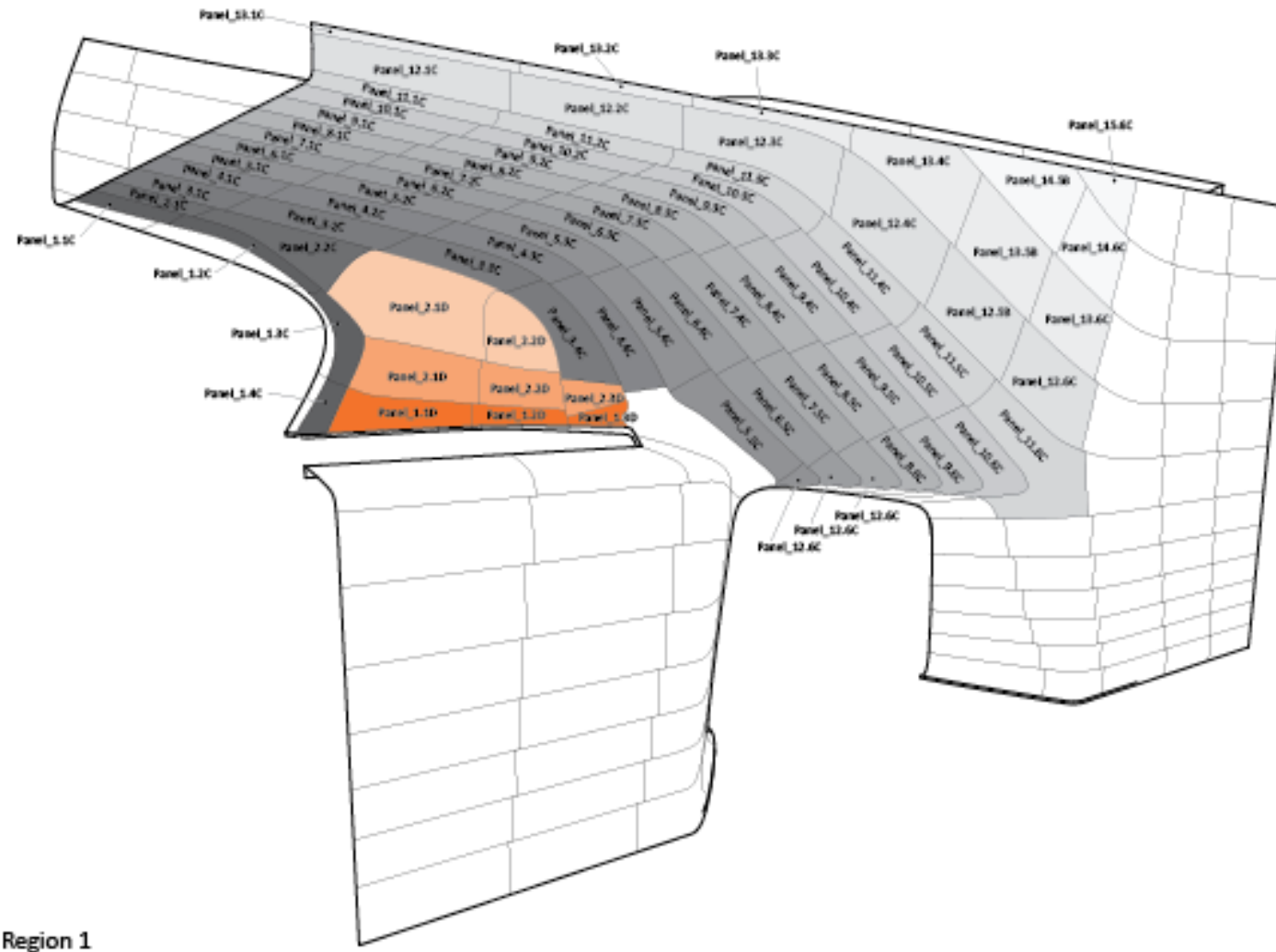
Generating Panel Seams

Cast Stone Panel Fabrication



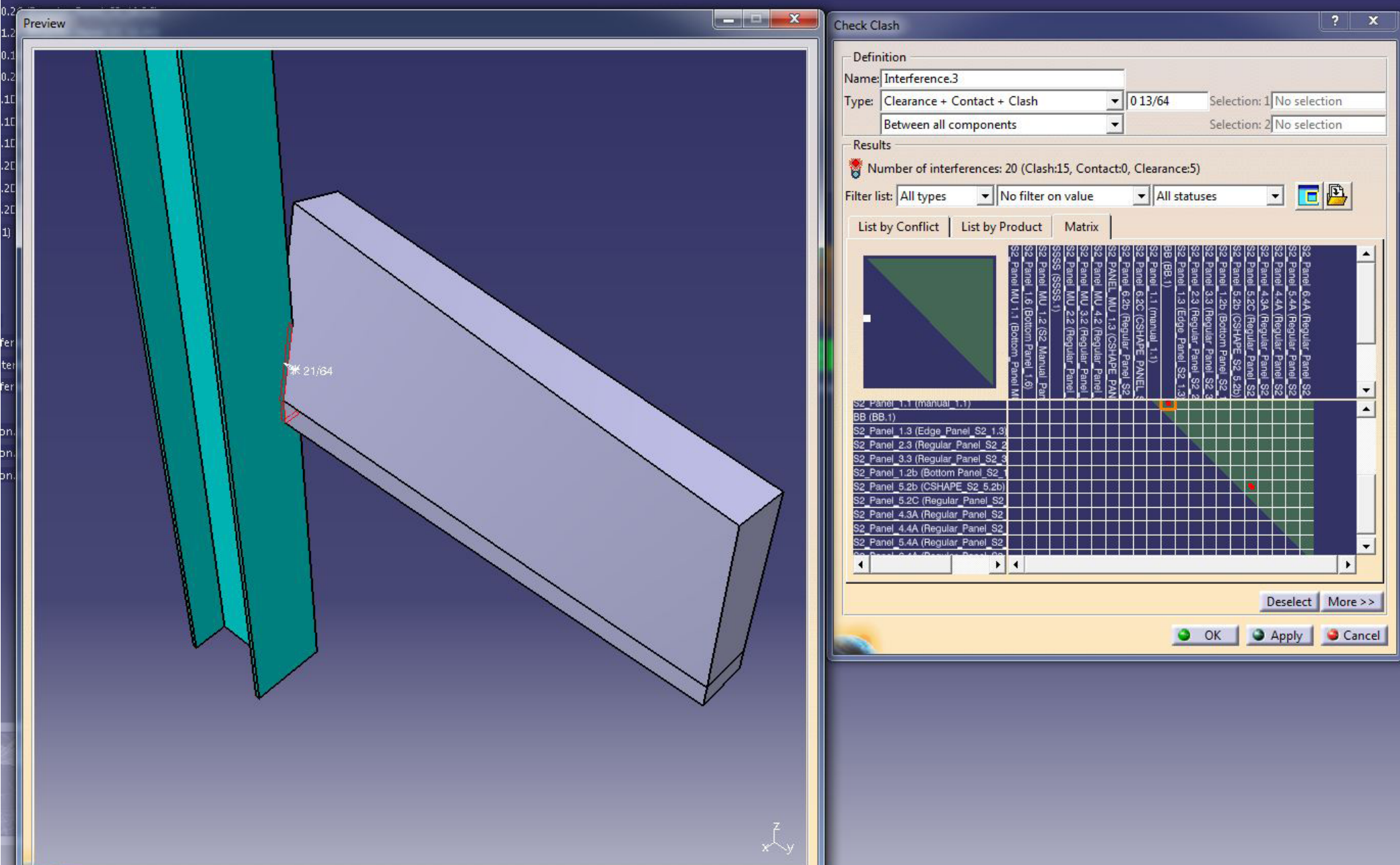
Creating Panel Thickness

Cast Stone Panel Fabrication



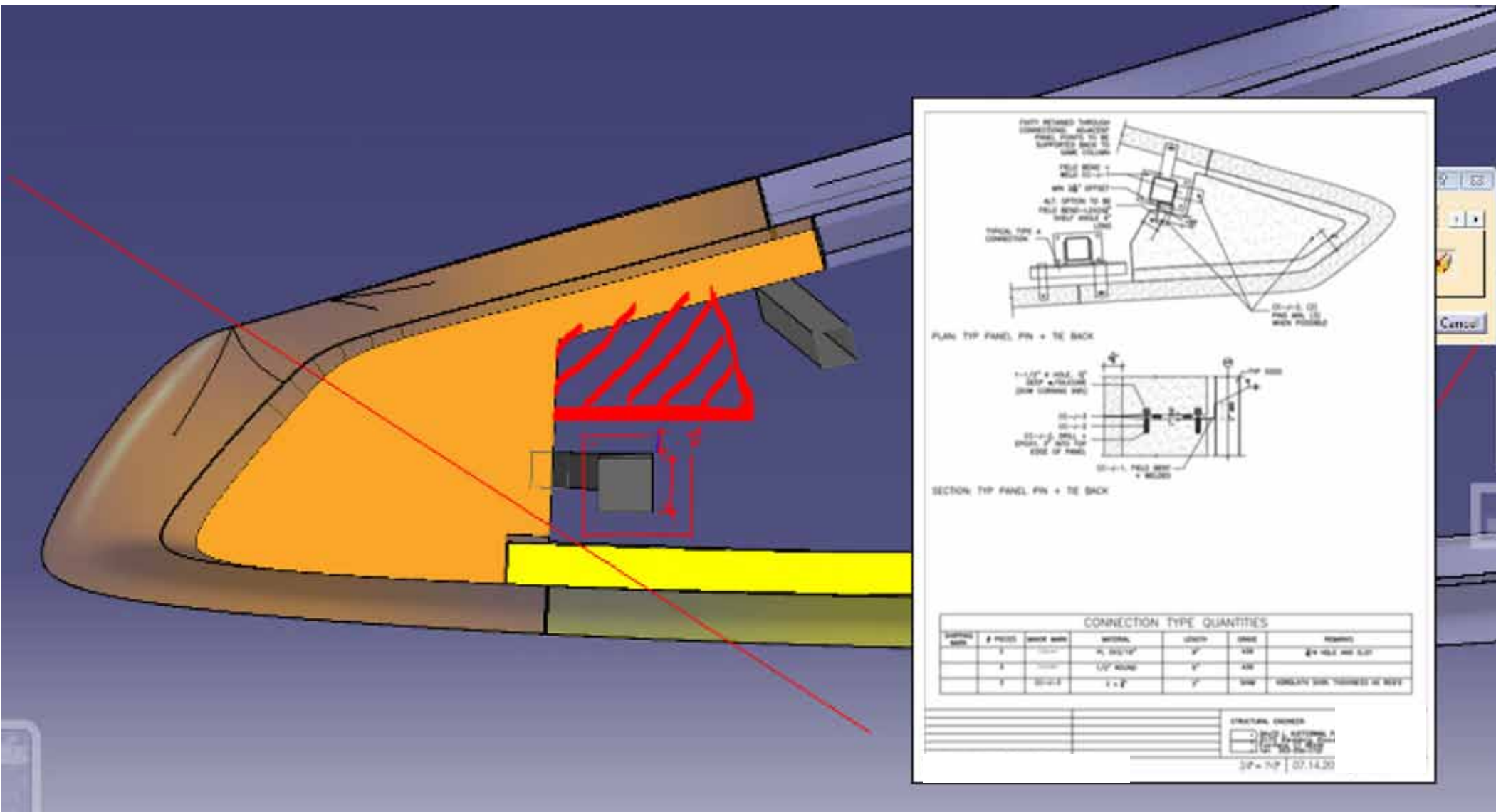
Panel Identification and Naming

Cast Stone Panel Fabrication



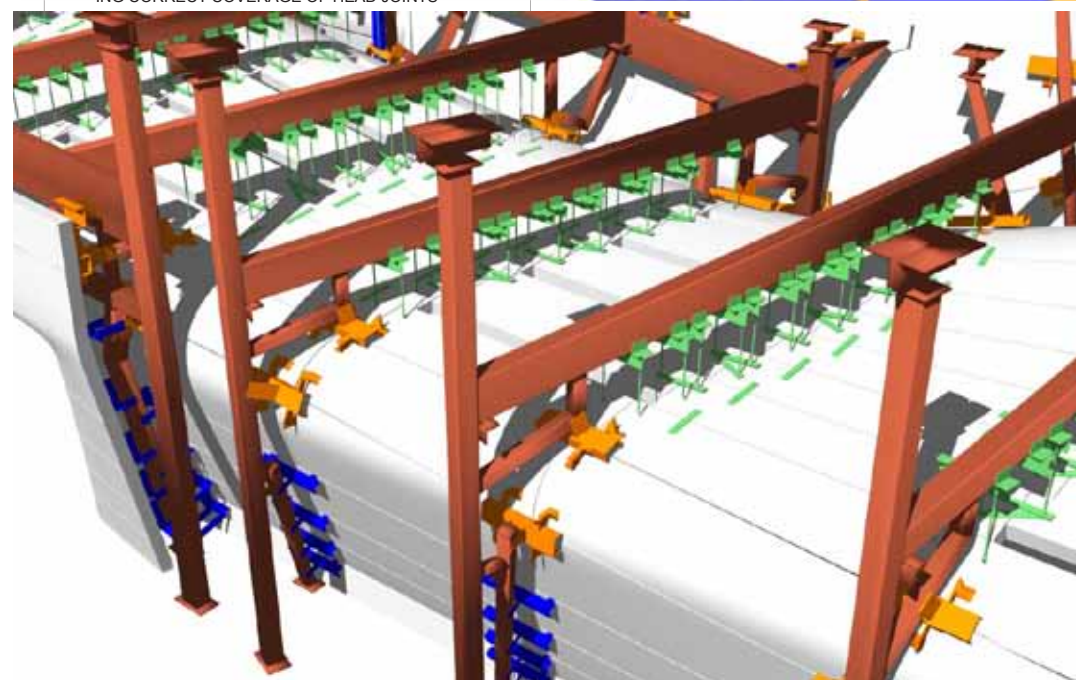
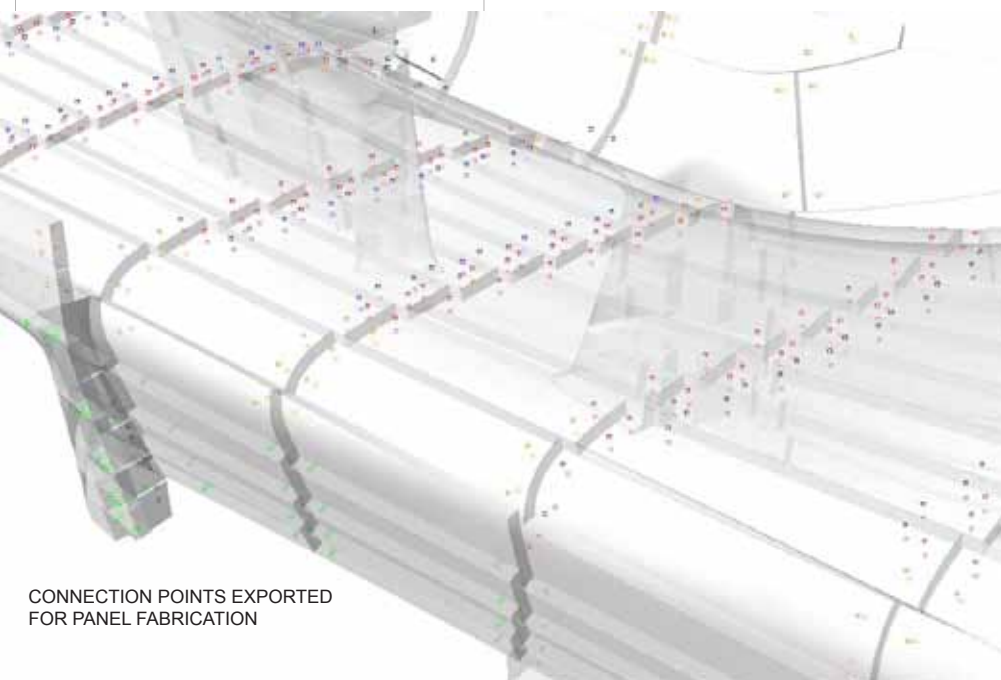
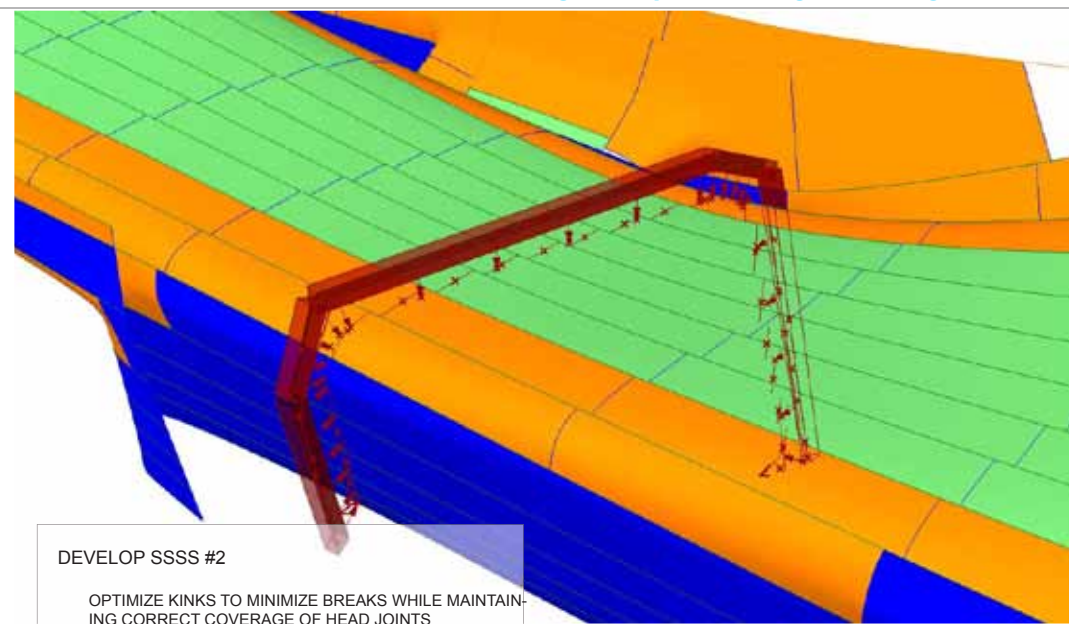
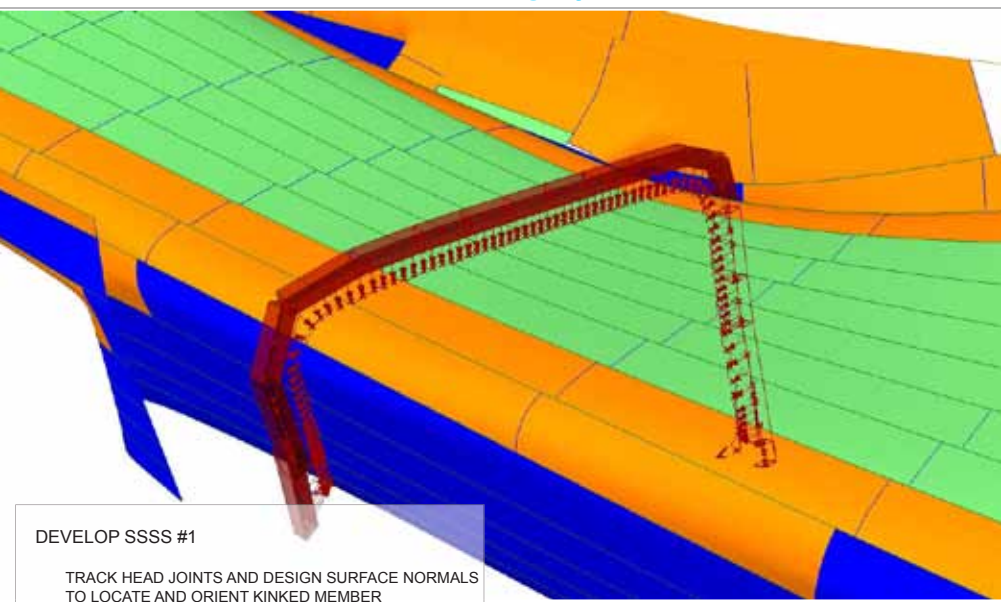
Identifying Conflicts

Cast Stone Panel Fabrication



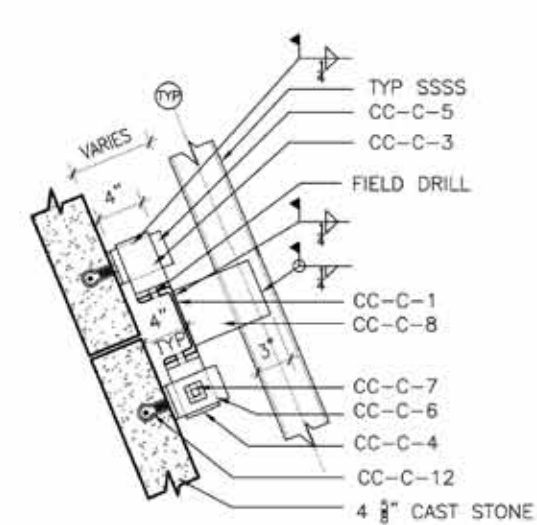
Panel Structural Design

Cast Stone Panel Fabrication

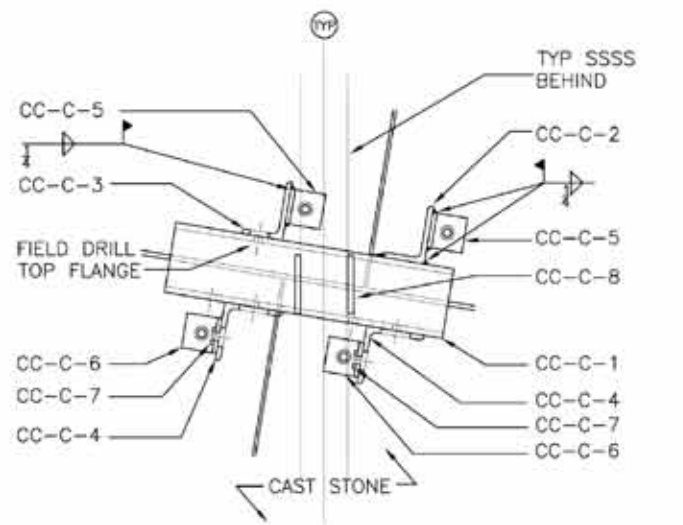


Supporting Structure Design

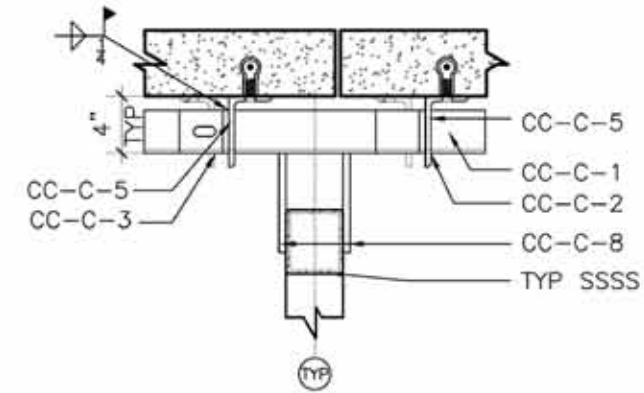
Cast Stone Panel Fabrication



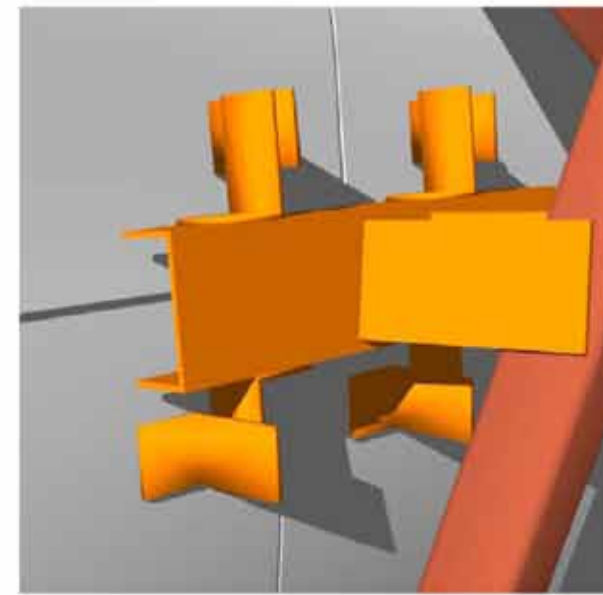
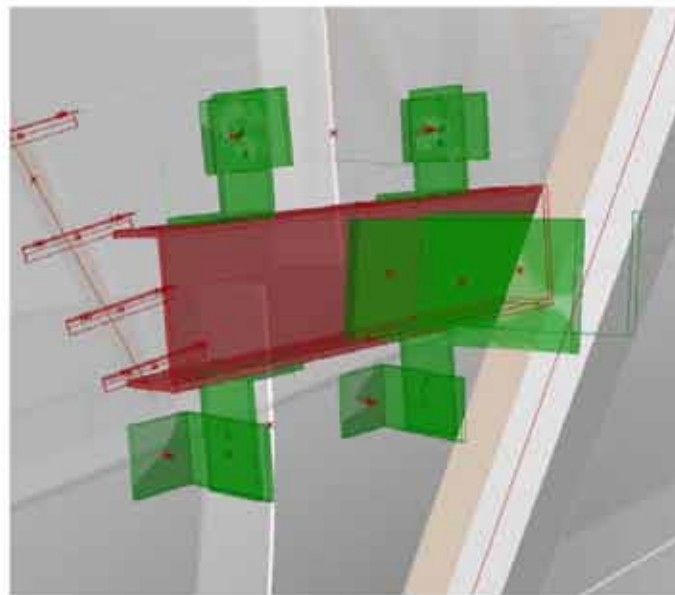
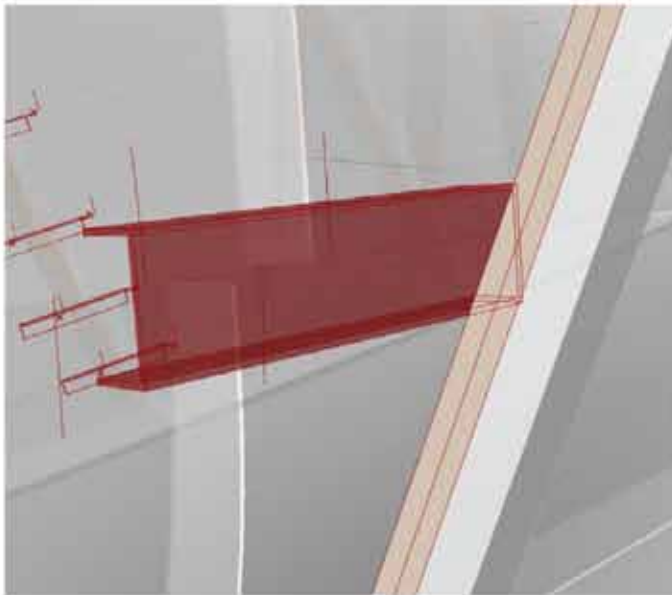
SECTION: TYP CHANNEL CONNECTIONS



REAR ELEVATION: TYP CHANNEL CONNECTIONS

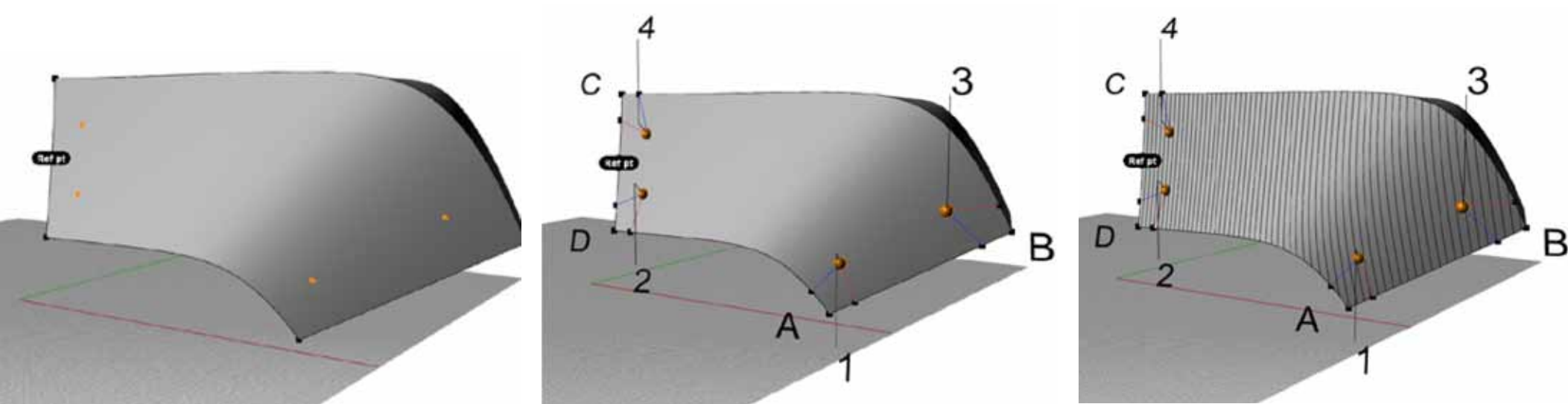


PLAN: TYP CHANNEL CONNECTIONS

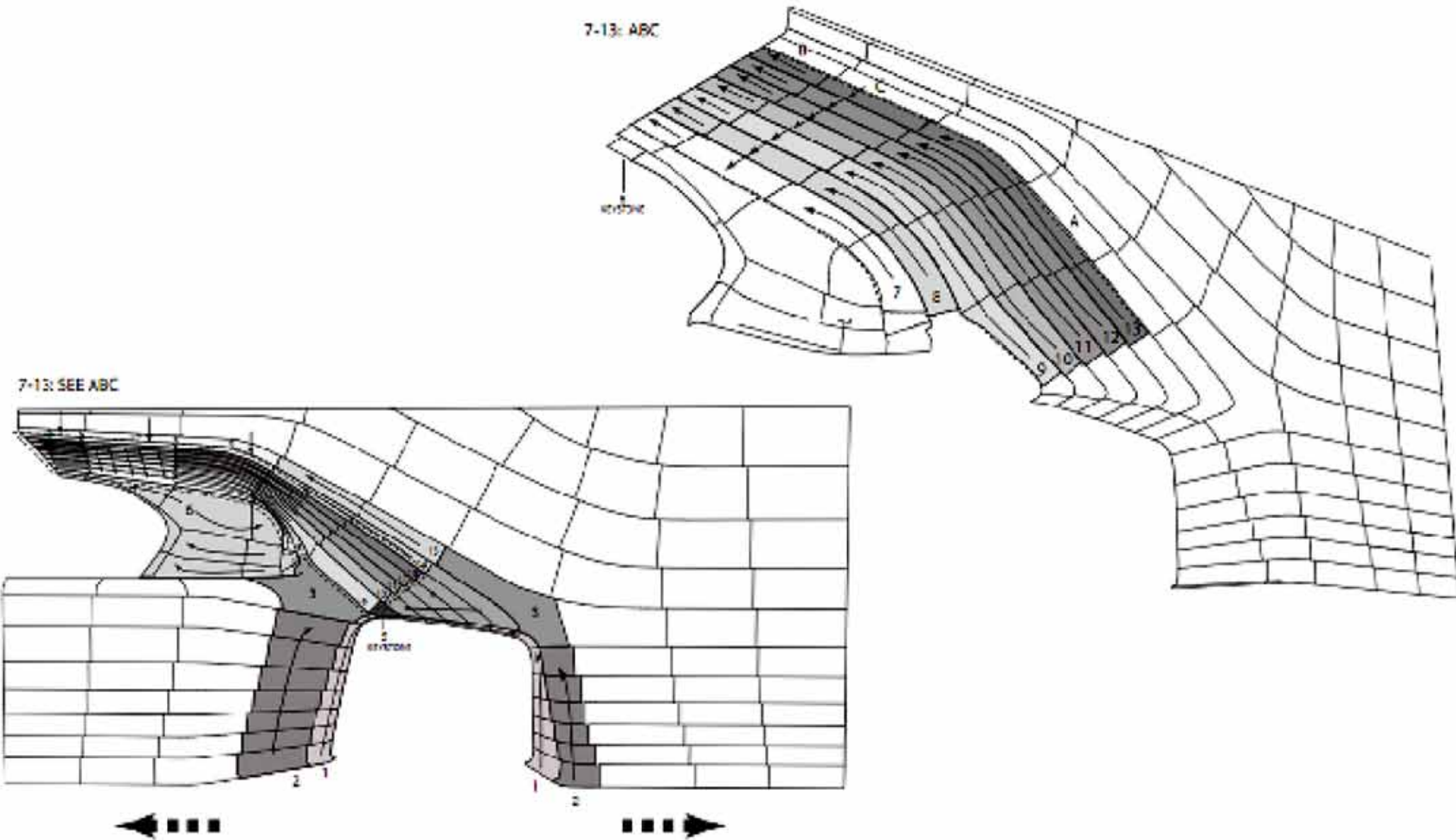


Panel Connection Design

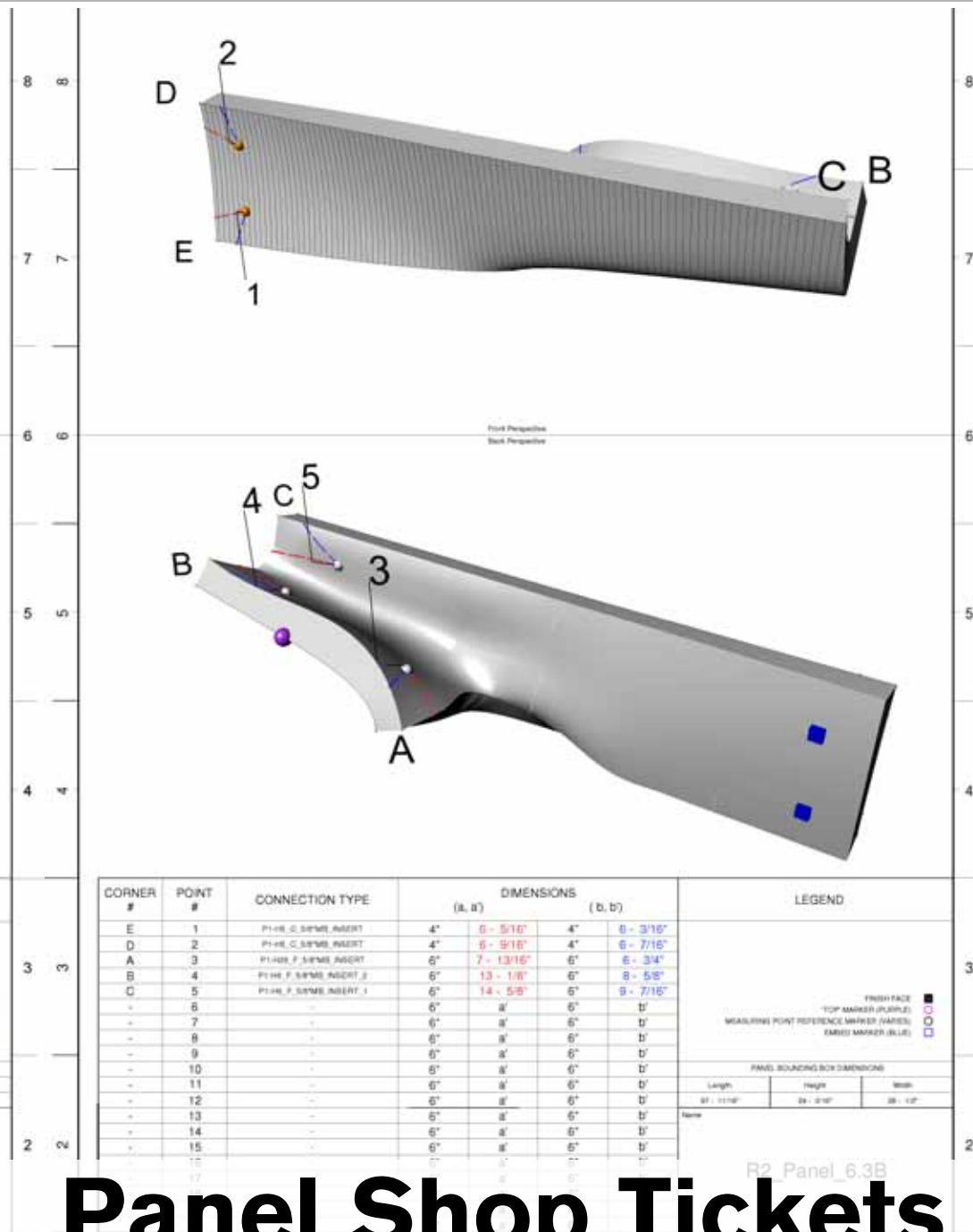
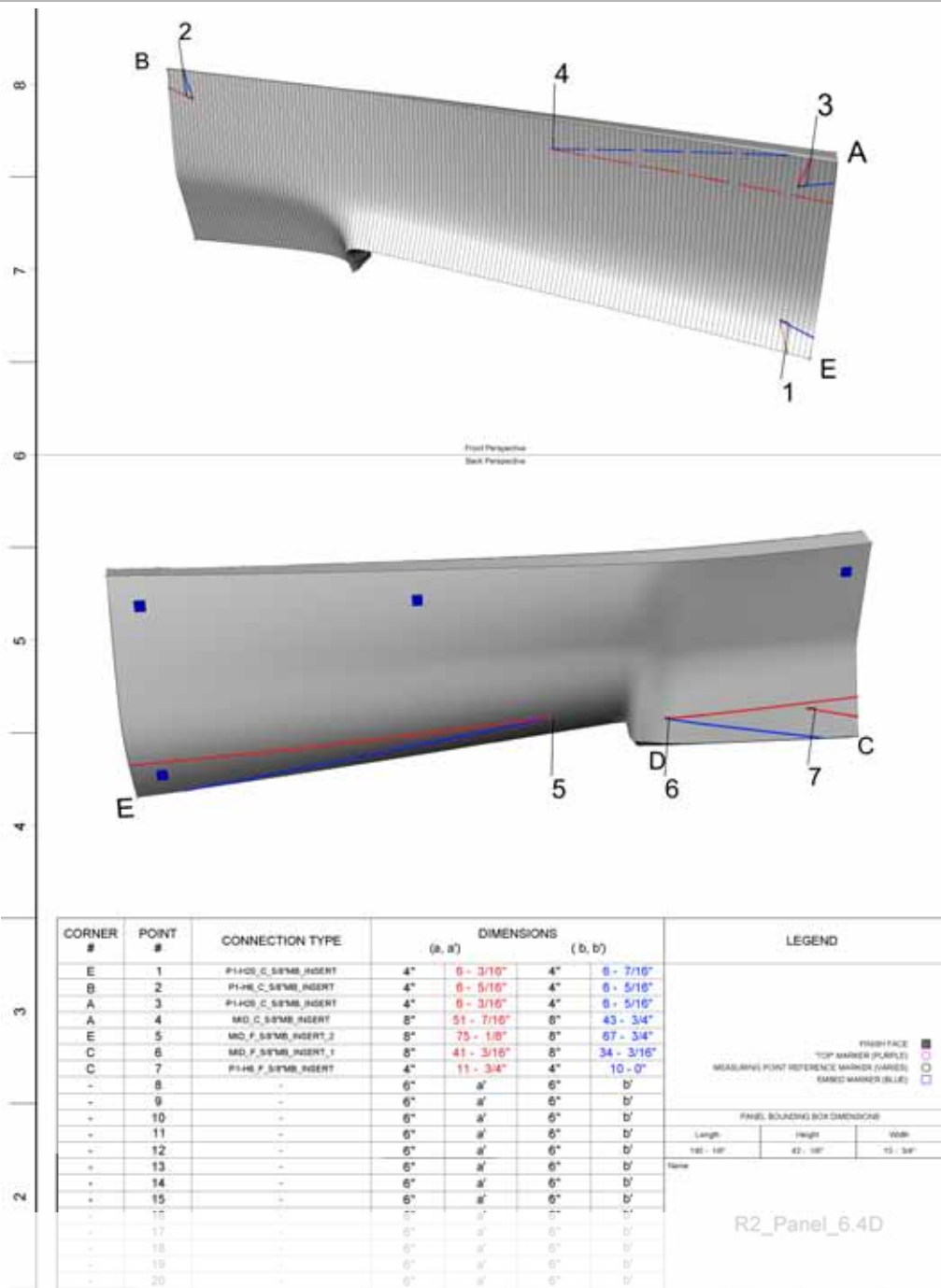
Cast Stone Panel Fabrication



Support Embed Location Cast Stone Panel Fabrication

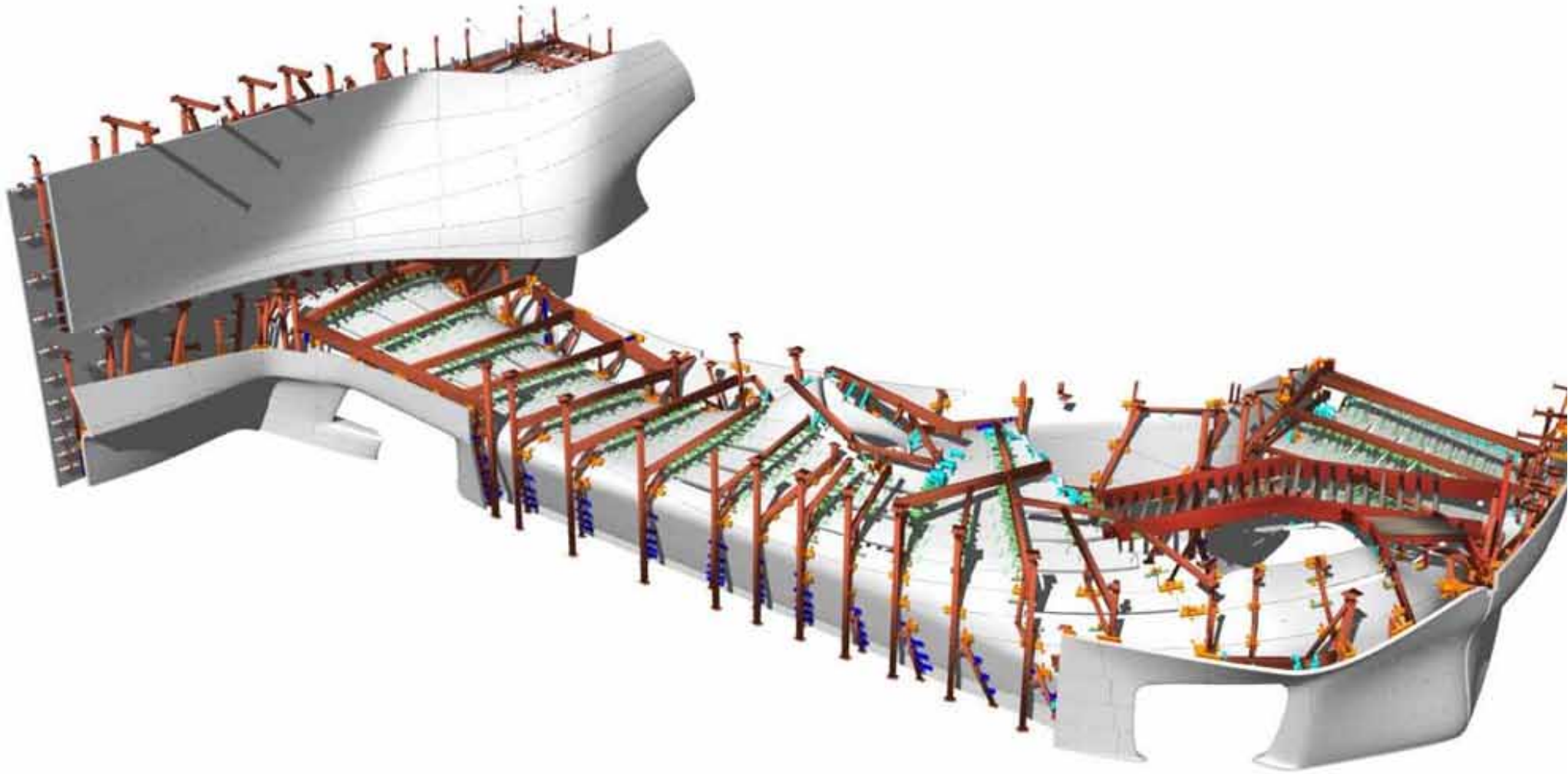


Installation Sequencing Cast Stone Panel Fabrication



Panel Shop Tickets

Cast Stone Panel Fabrication



Complete Panel and Structure Model

Cast Stone Panel Fabrication



Direct Fabrication

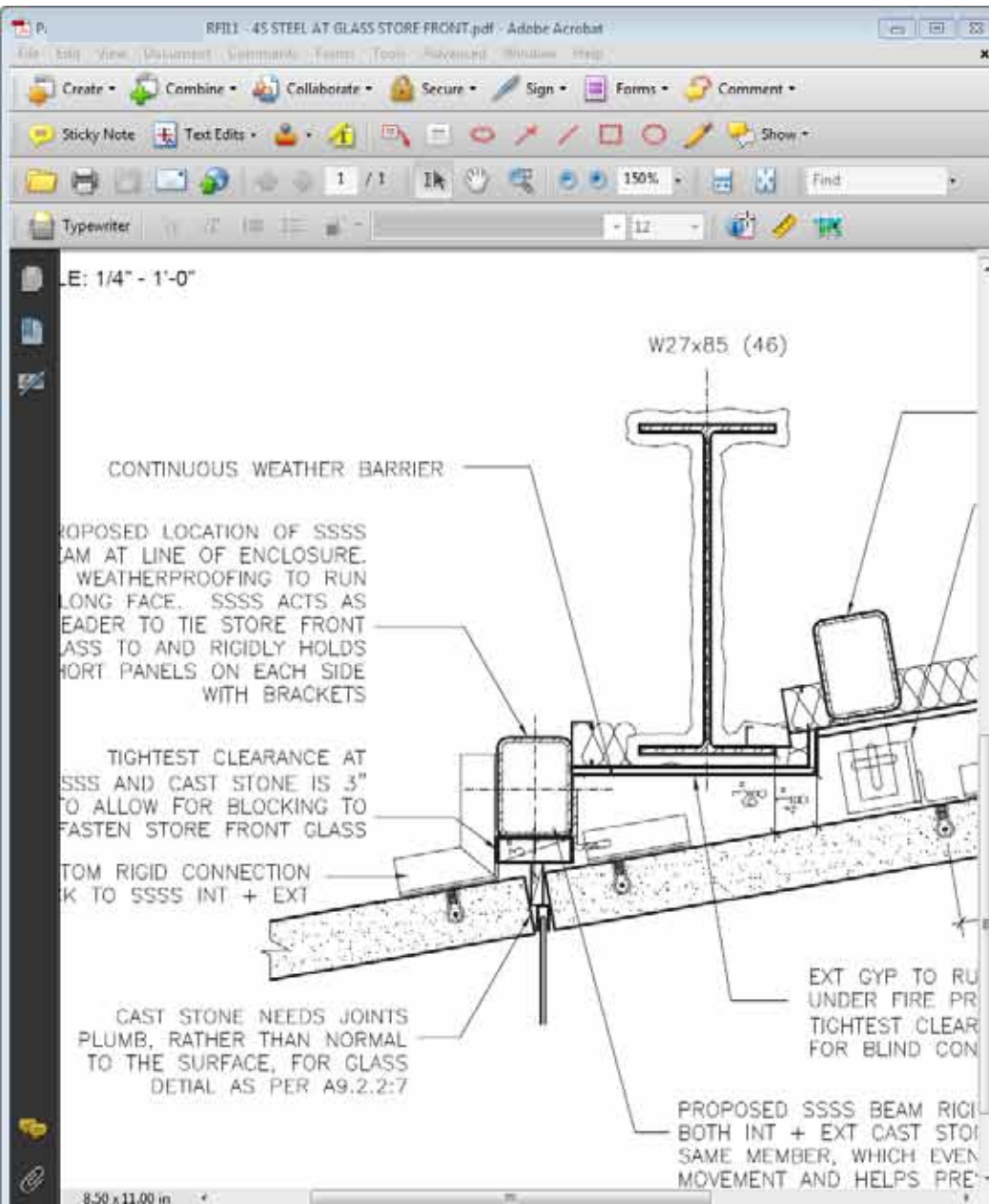
Cast Stone Panel Fabrication



Prepared Molds
Cast Stone Panel Fabrication

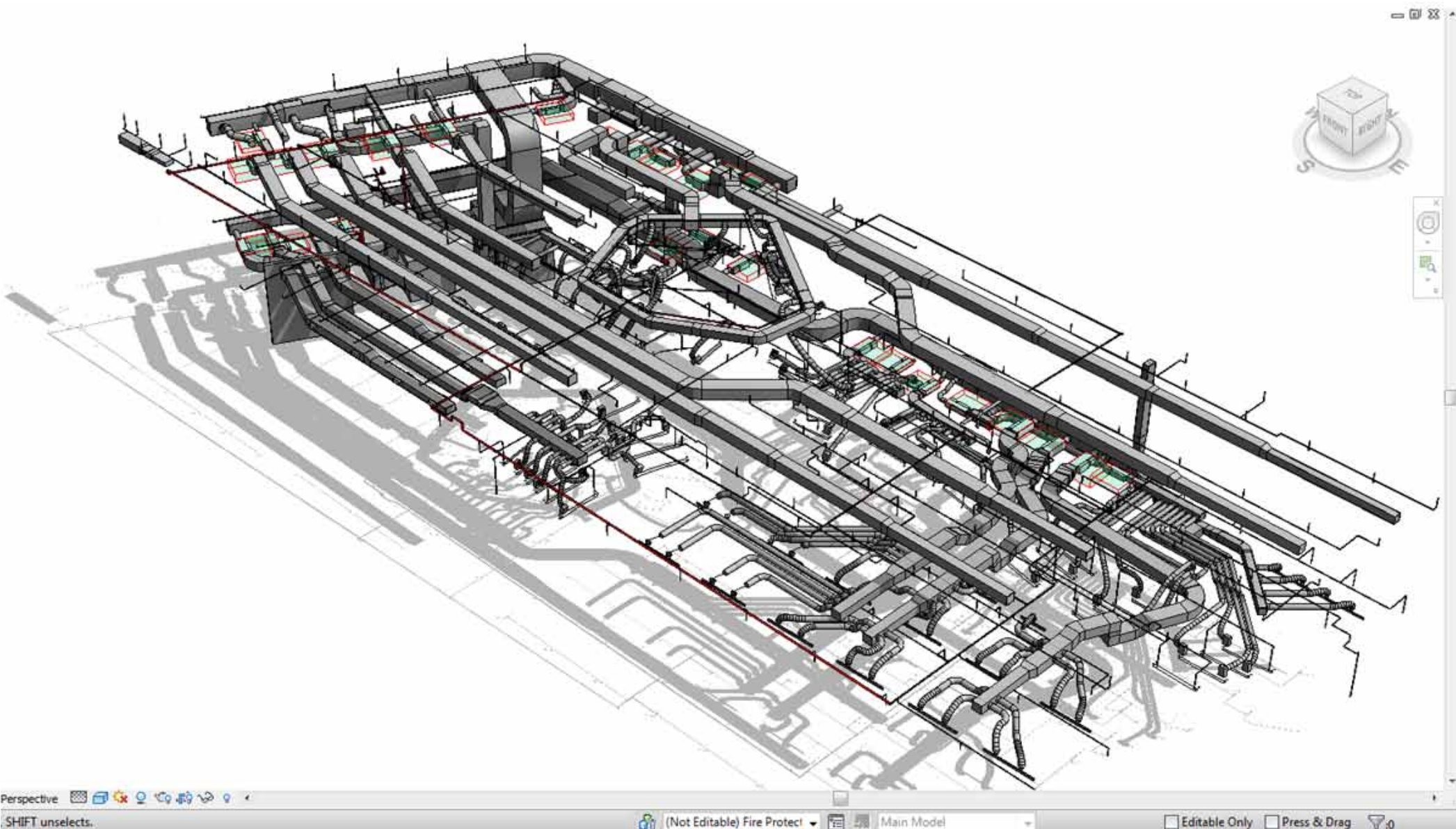


Completed Panel
Cast Stone Panel Fabrication



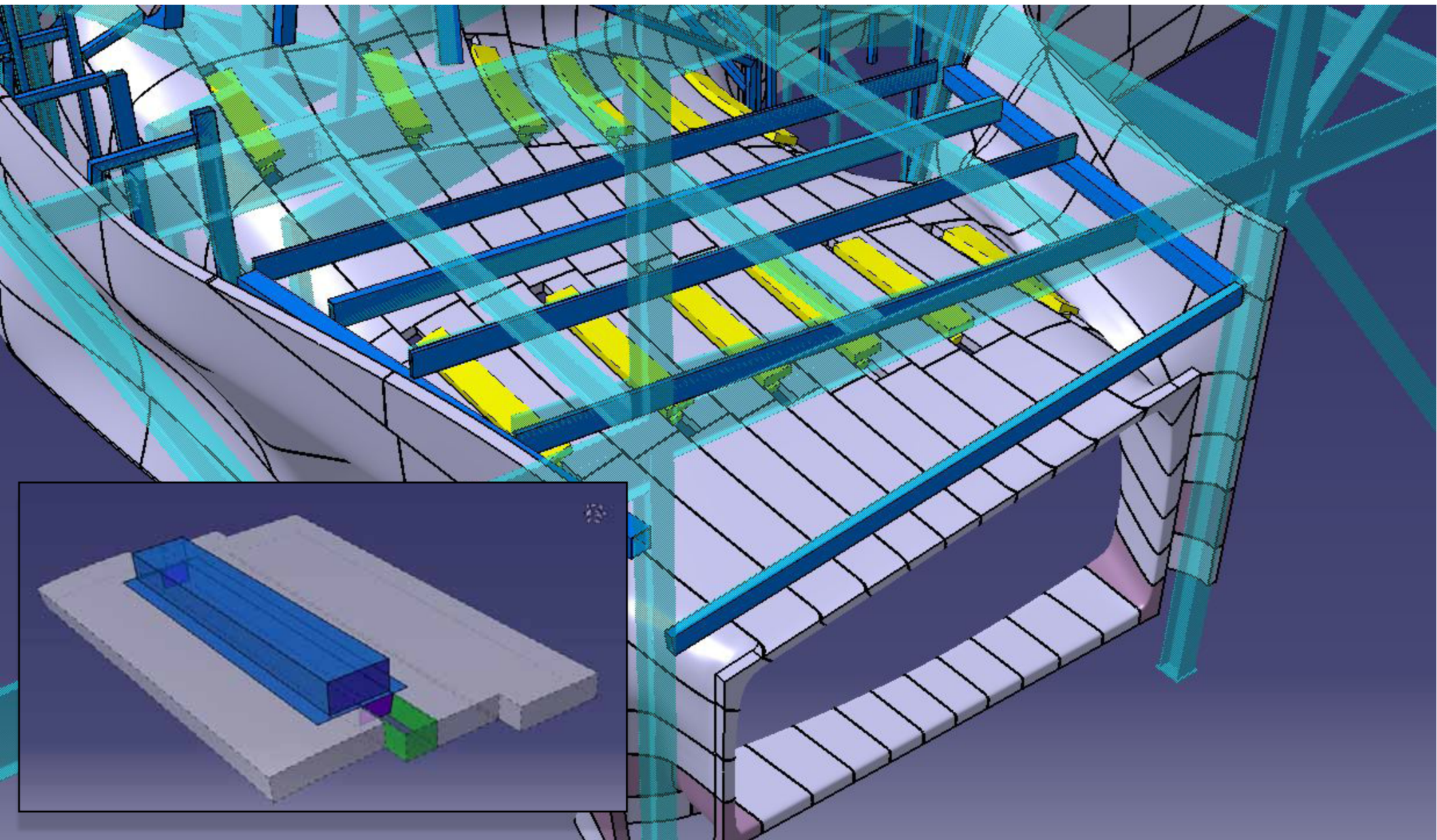
System Integration

Project BIM Coordination



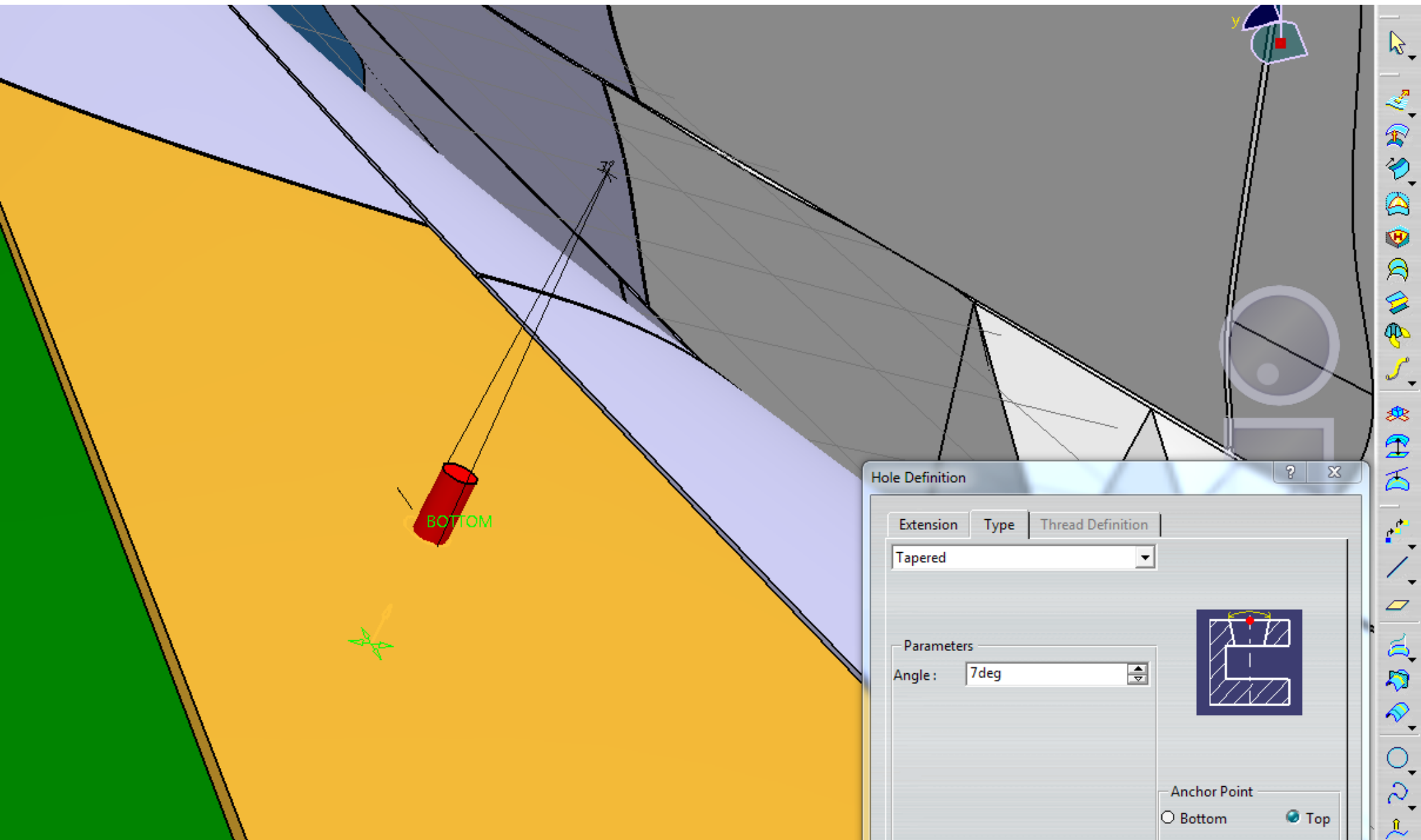
HVAC & Plumbing Systems

Project BIM Coordination



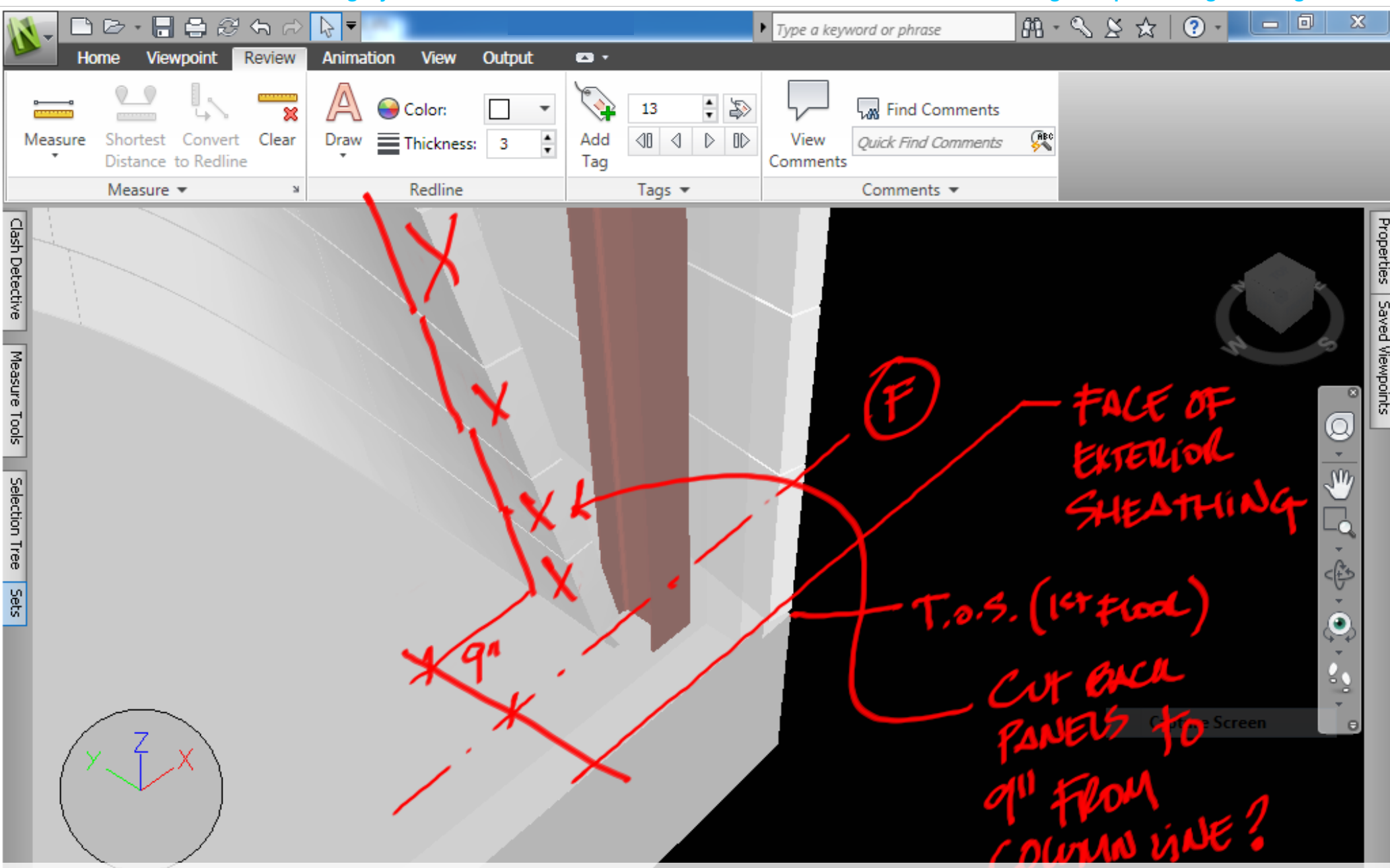
Lighting Systems

Project BIM Coordination



Fire Protection Systems

Project BIM Coordination



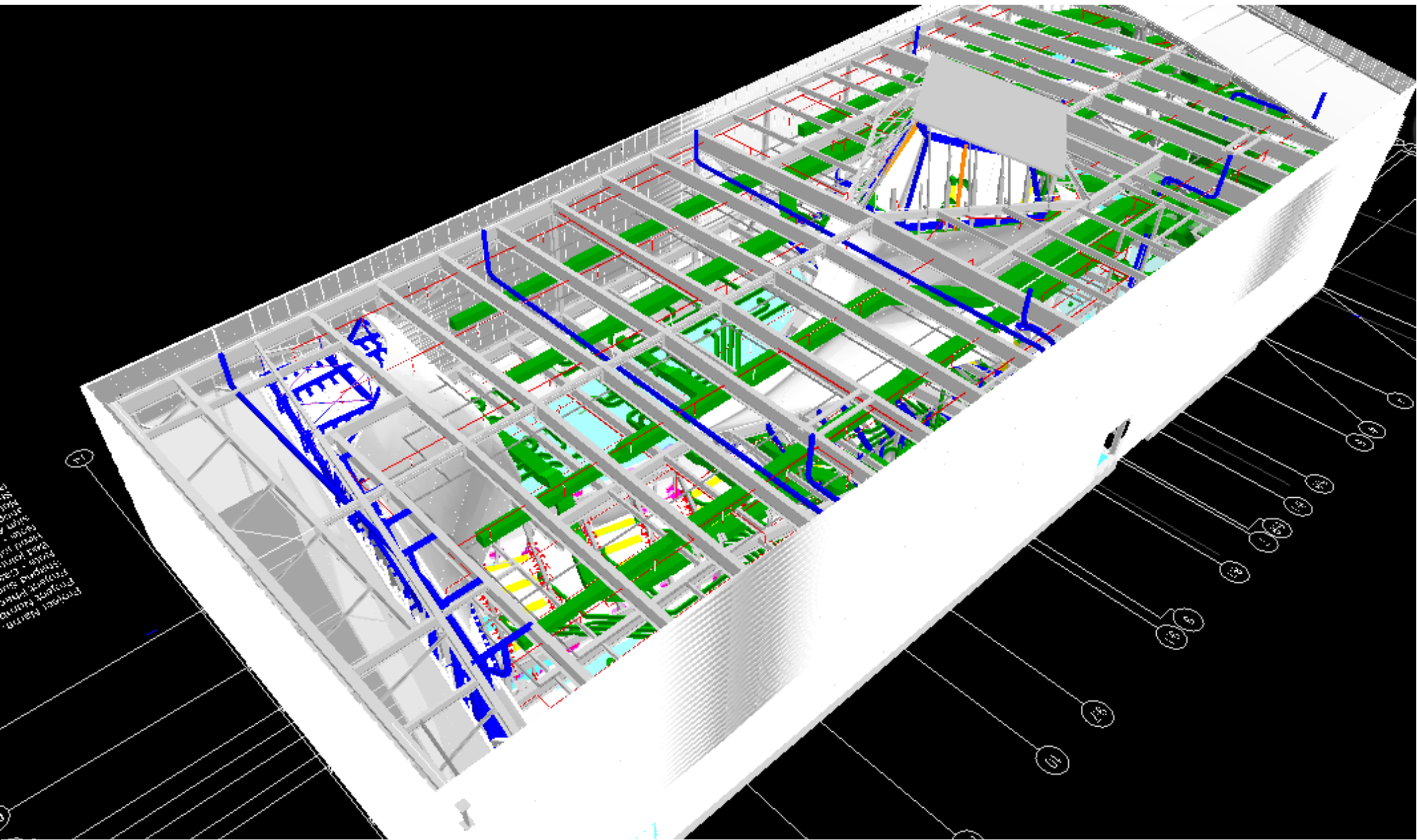
Weekly Web-based Coordination
Project BIM Coordination

The screenshot displays the JIRA web interface for issue tracking. The left sidebar contains filters for Project, Issue Type, Text Search, and Issue Attributes. The main area shows a table of issues with columns for Summary, Priority, Status, Resolution, Links, Assign, Clash to Trade, Images, and Key.

Summary	Pr	Status	Res.	Links	Assign	Clash to Trade	Images	Key
Eliminate extra seam at Region 1 (Phase 2), exterior facade		Open	UNRESOLVED					WELIZATION-47
Clearance Group 01		Closed	Fixed					WELIZATION-46
Clash Group 03		Closed	Fixed					WELIZATION-45
Clash Group 01		Closed	Fixed					WELIZATION-44
Panels labeled in 2 regions in panel key for region 2		Open	UNRESOLVED					WELIZATION-43
Panels R2_Panel1.4B and 1.5B are the same		Open	UNRESOLVED					WELIZATION-42
Impossible to Use Normals at Bench in Region 4		Open	UNRESOLVED					WELIZATION-41

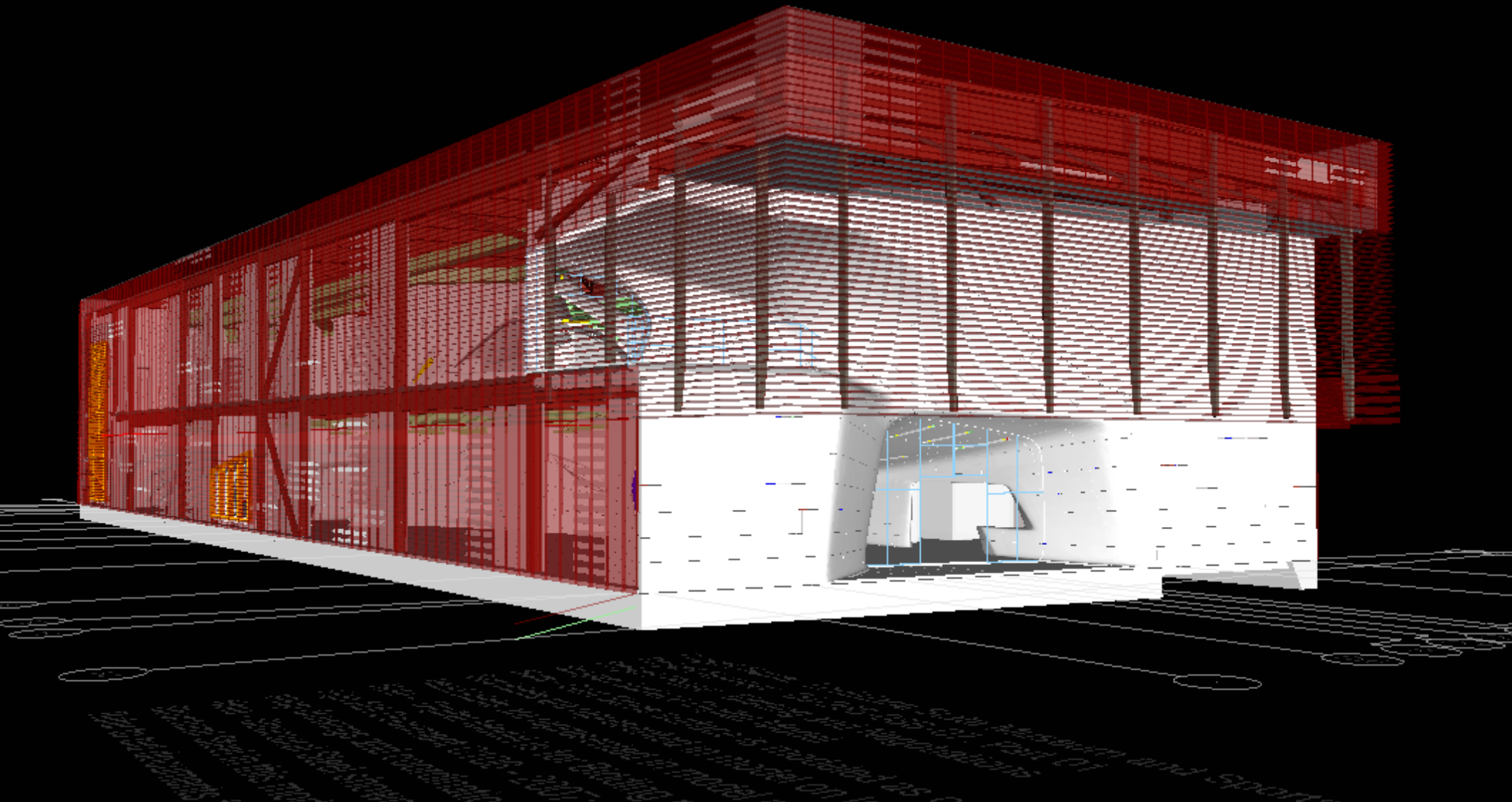
Web-based Issue Tracking

Project BIM Coordination



Composite Coordination Model

Project BIM Coordination



Composite Coordination Model

Project BIM Coordination



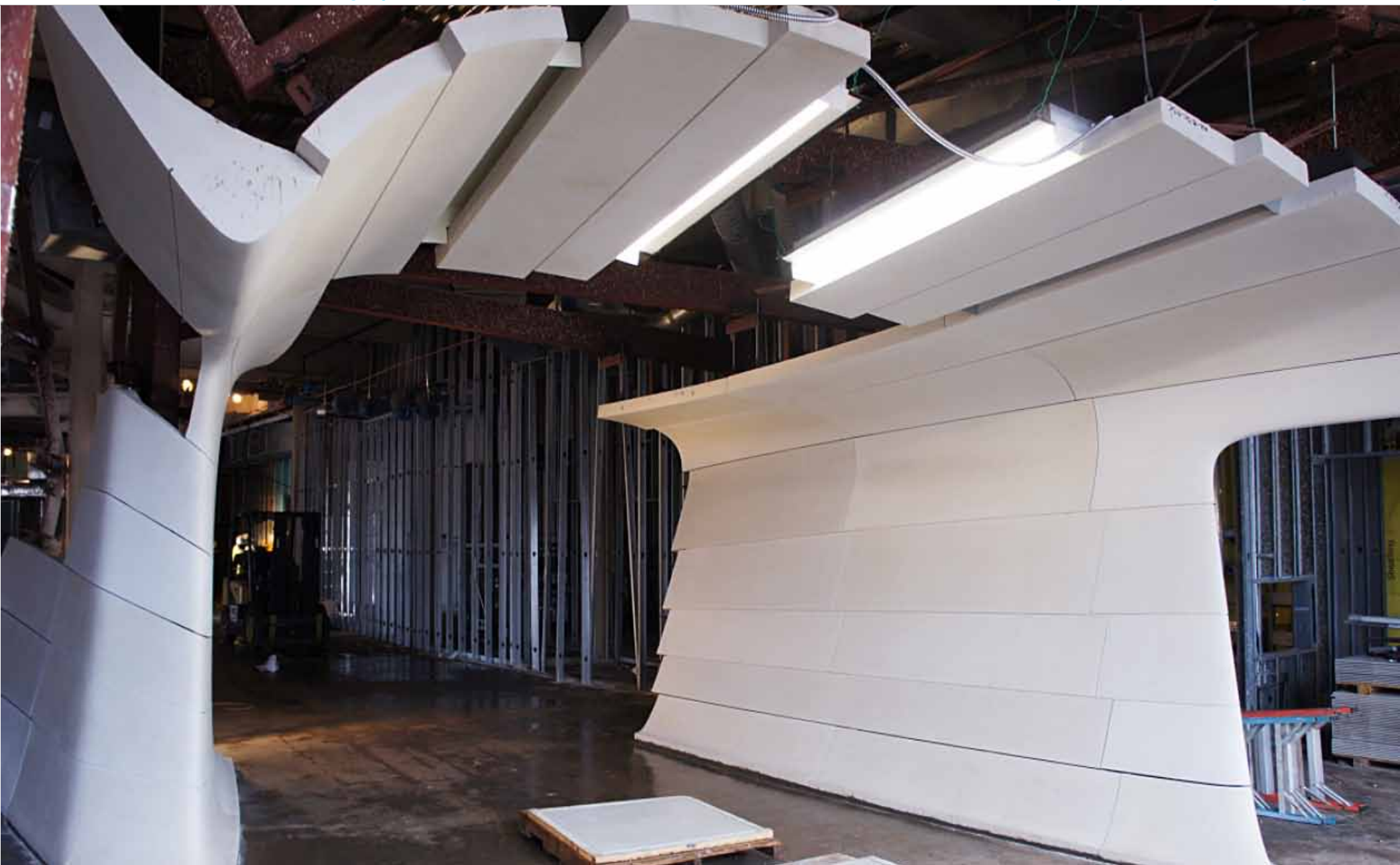
Field Verification and Installation

Project BIM Coordination



Field Verification and Installation

Project BIM Coordination



Field Verification and Installation

Project BIM Coordination



Field Verification and Installation

Project BIM Coordination

