Anaheim Regional Transportation Intermodal Center (ARTIC)

2014 AIA TAP / BIM Awards

Project Overview

The Anaheim Regional Transportation Intermodal Center (ARTIC) combines the heritage and civic importance of the grand 19th Century rail stations of the past with the size, scale and complexity of today's modern airport terminals. ARTIC will be a world class transportation gateway to Orange County, California, the 5th most densely populated county in the United States. Each year, Orange County attracts more than 40 million visitors, Anaheim alone attracts more than 20 million visitors annually. ARTIC will link freeways, major arterial roadways, bus, taxi and rail systems, as well as bike and pedestrian pathways in one central location.

ARTIC will serve the transportation needs of a population of more than three million people in 34 cities. The project will include retail spaces, restaurants, ticketing and waiting areas, and will serve as a grand hall for community uses. It will anchor the Anaheim Rapid Connection (ARC), a high-capacity, fixed-guideway transit system. ARTIC will be the southern terminus of the California High Speed Rail which will link the State's southern and northern urban centers. This mixed-use location will support four million square feet of office, commercial and institutional development and 520 residential units. Future development opportunities include revenue generation that repays local grant funds, Public/Private Partnership (P3) opportunities, economic benefits such as employment and sales tax revenue, and Transit Oriented Development (TOD) and mixed land use development.
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ARTIC by the Numbers
- Size of terminal - 67,880 square feet
- Size of site - 16 acres
- Parking spaces -1,082
- Expected daily boardings - 10,330
- Number of transportation modes - 10
- Annual Metrolink riders - 540,000
- Annual Orange County Visitors - 40 million
- Number of jobs created - 5,000
- ETFE square feet - 200,000
- Projected Cost - $188 million (US dollar)

Architect's Statement

The Anaheim Regional Transportation Intermodal Center (ARTIC) is a world-class, iconic gateway for Orange County's transportation systems, including auto, bus and rail systems as well as future street car and high-speed trains.

ARTIC presents itself to the region in a dramatic fashion with its signature sculptural shape. The structural simplicity of local airship hangars, and the great halls of historic rail stations like Grand Central Station, inspired the design of this catenary-shaped station. High-tech translucent ETFE polymer pillows infuse the grand hall with a lightness and transparency.

The use of BIM was crucial in clearly communicating this iconic design to the clients, the public, and assisting the project team in developing the complex form, geometry and function into reality.

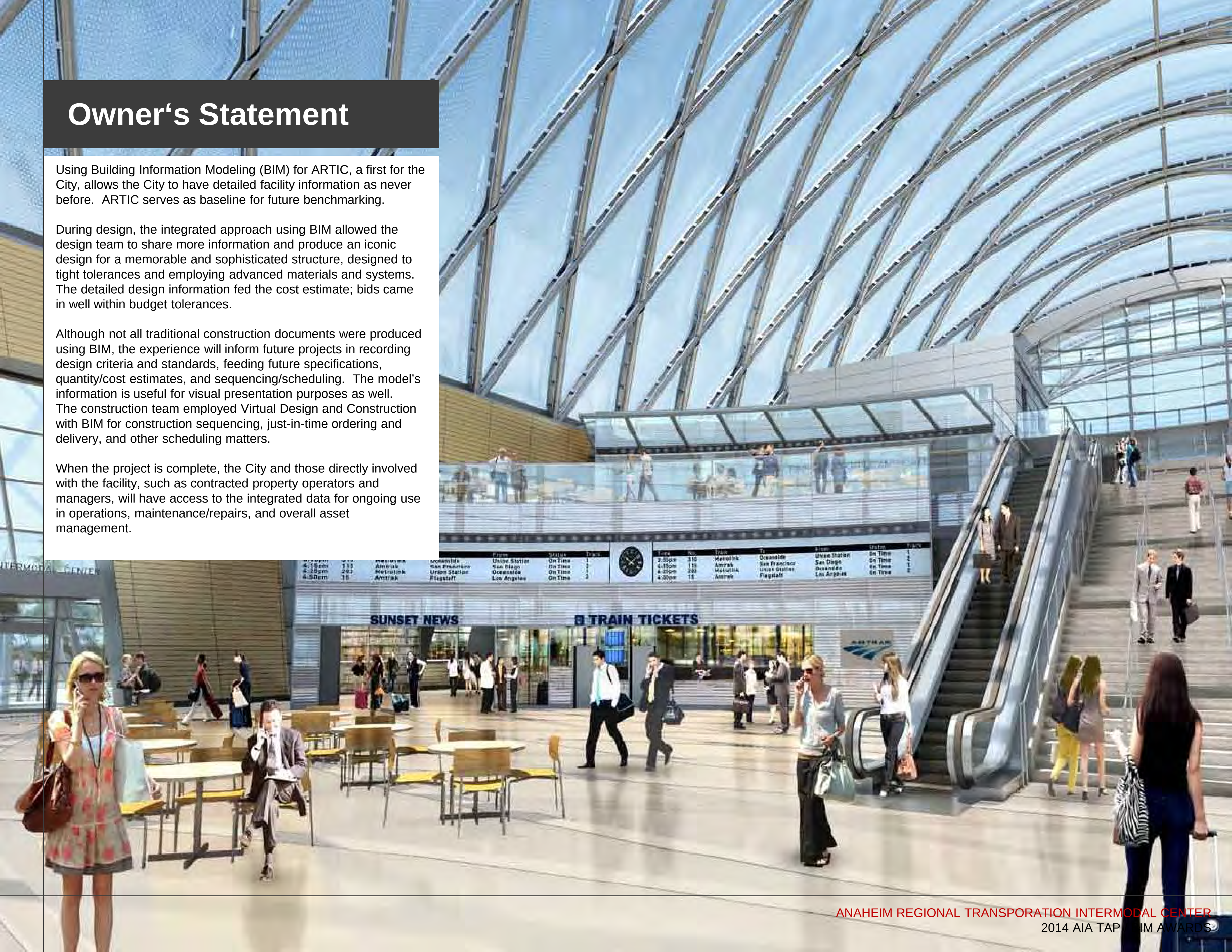
Utilizing Revit, Rhino and CATIA as the primary software along with Navisworks for pre-construction clash detection, the project team was able to produce 3D-printed study models, analyze pedestrian and vehicular traffic to ensure safe path of travel, confirm sustainable strategies to achieve LEED platinum certification, as well as delivering coordinated documents in a compressed timeline and maintaining design intent well into construction. The greatest benefit of BIM utilization on the ARTIC project is the coordination efficiency achieved during design and construction.

Contractor’s Statement

The BIM model was very significant to the general contractor and our sub-contracting community. The different styles and requirements of design could not be built without the BIM analysis and model.

Due to the complexities of the project utilizing GeoGrid dimensions, it would be impossible to coordinate locations without a model. The fabrication of the structural steel was designed with complex compound curves and the only means to fabricate this material is by the use of a model. Once fabricated the only means to erect with the tolerances was by using the geopoints. The as built model is the only way to accomplish this task.

Interior of the building had to be managed and coordinated as we typically do with a model. The main difference is working with the exterior perimeter of the building where we move from GeoGrid to standard dimensions. This could not be accomplished without a model.



Owner's Statement

Using Building Information Modeling (BIM) for ARTIC, a first for the City, allows the City to have detailed facility information as never before. ARTIC serves as baseline for future benchmarking.

During design, the integrated approach using BIM allowed the design team to share more information and produce an iconic design for a memorable and sophisticated structure, designed to tight tolerances and employing advanced materials and systems. The detailed design information fed the cost estimate; bids came in well within budget tolerances.

Although not all traditional construction documents were produced using BIM, the experience will inform future projects in recording design criteria and standards, feeding future specifications, quantity/cost estimates, and sequencing/scheduling. The model's information is useful for visual presentation purposes as well. The construction team employed Virtual Design and Construction with BIM for construction sequencing, just-in-time ordering and delivery, and other scheduling matters.

When the project is complete, the City and those directly involved with the facility, such as contracted property operators and managers, will have access to the integrated data for ongoing use in operations, maintenance/repairs, and overall asset management.

BIM Responsibilities

Architect: authors design model for coordination
Structural Engineer: authors design model; reviews coordination model
MEP Engineer: authors design model; reviews coordination model
Enclosure Engineer: authors design model and geometry model; reviews coordination model
Construction Manager: manages BIM coordination; performs model-based estimating
Plumbing Subcontractor: authors coordination and fabrication model
HVAC Subcontractor: authors coordination and fabrication model
Electrical Subcontractor: authors coordination and fabrication model
Steel Subcontractor: authors coordination and fabrication model
Curtain Wall and Metal Panels Subcontractor: authors coordination and fabrication model
Concrete Subcontractor: authors coordination and fabrication model

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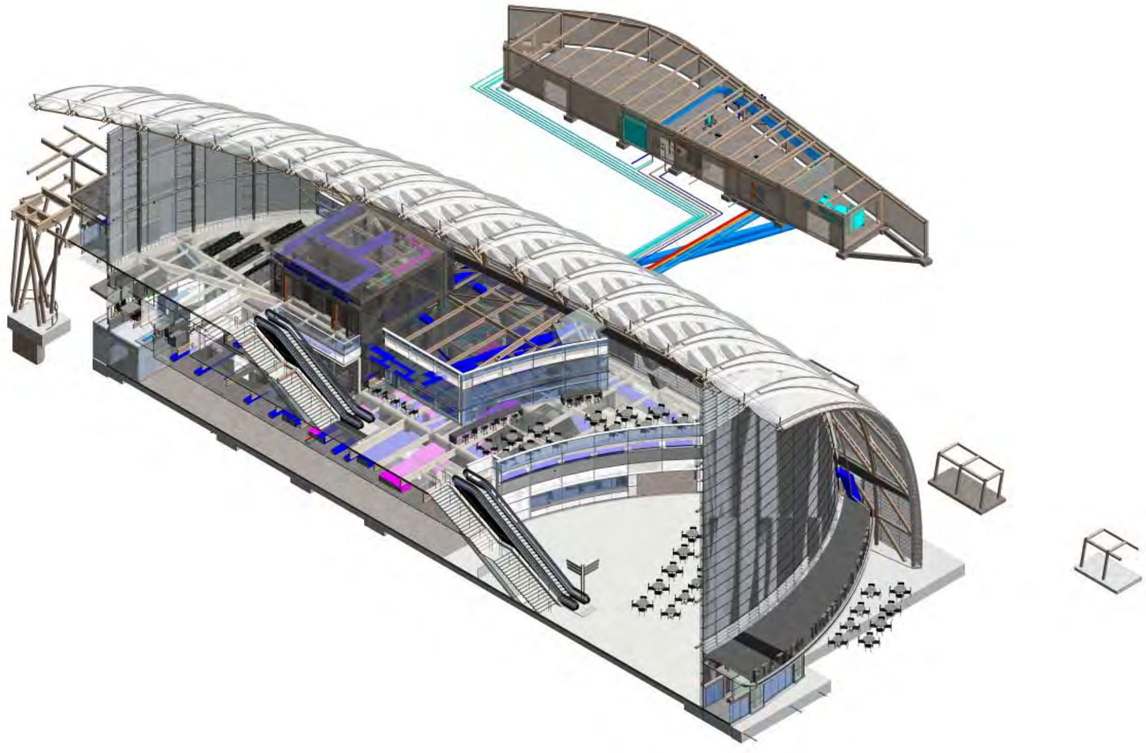
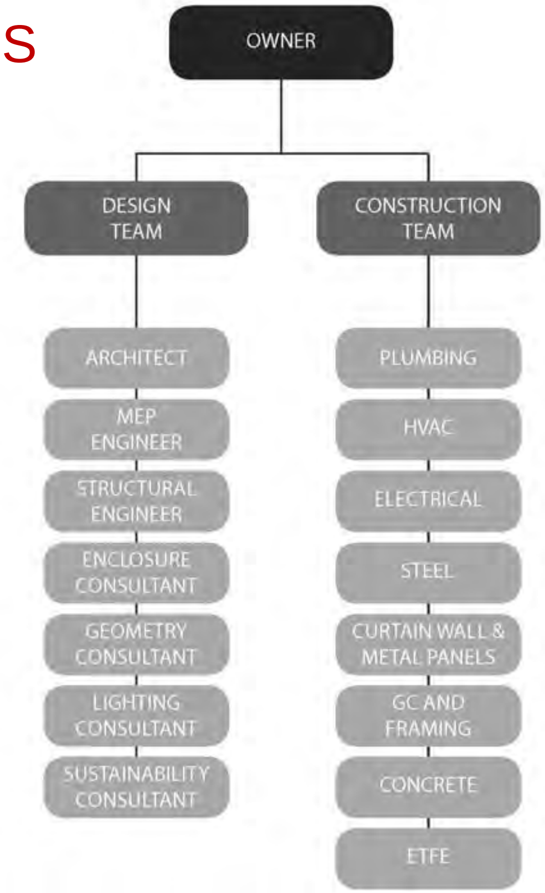


BIM USES

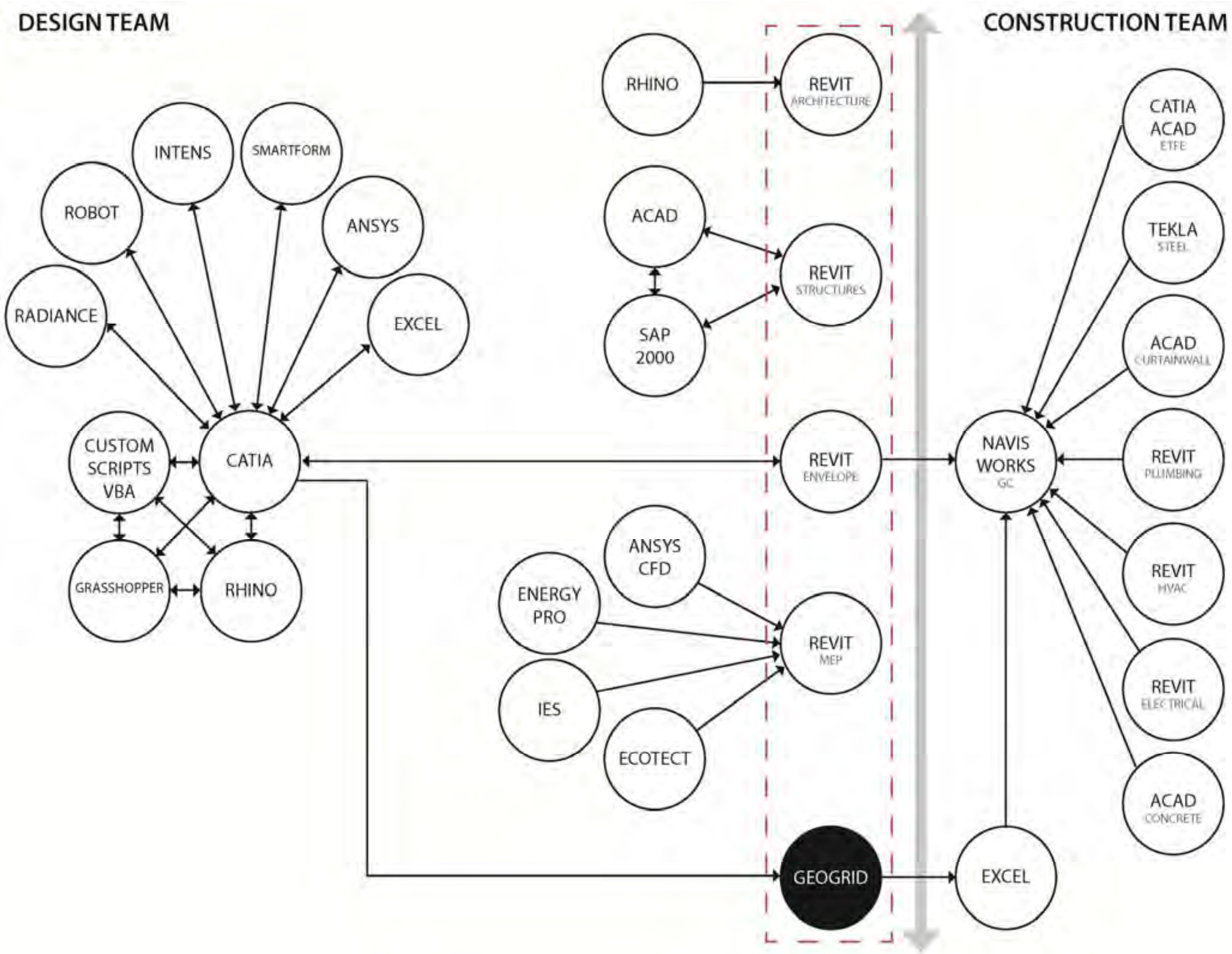
Design Authoring
Design Review
Design Coordination
Energy Analysis
CFD Environmental Simulation
Structural Analysis
Lighting Analysis
Cost Estimation
Programming
Clash Detection
Space Planning
Construction Sequencing

Data Exchange Diagram

ROLES



INFORMATION EXCHANGES

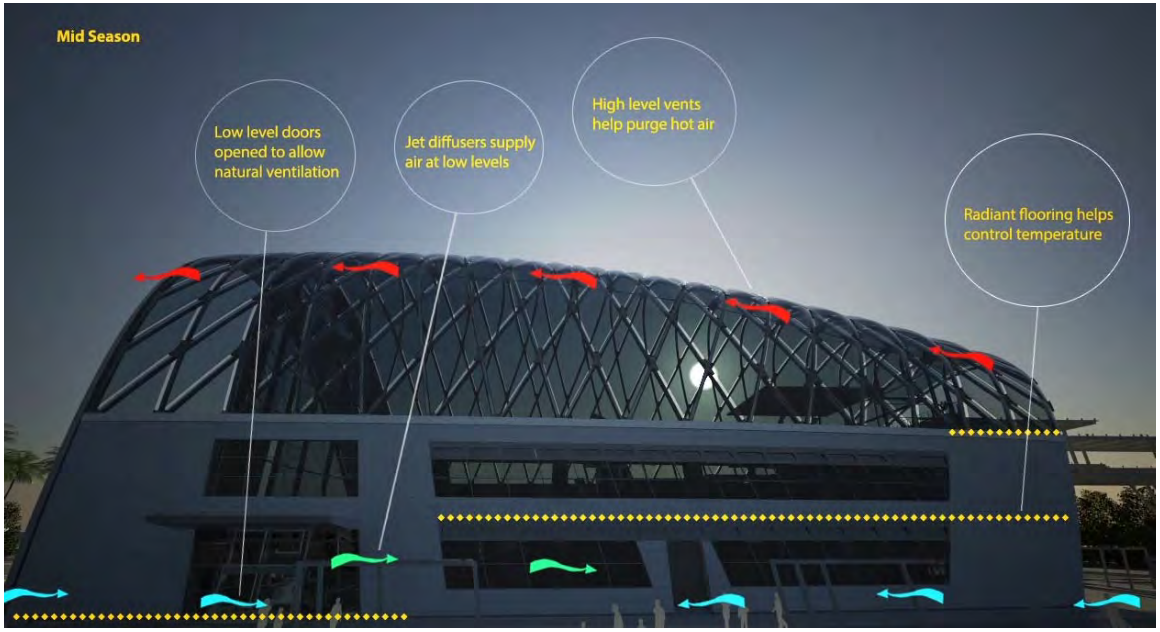


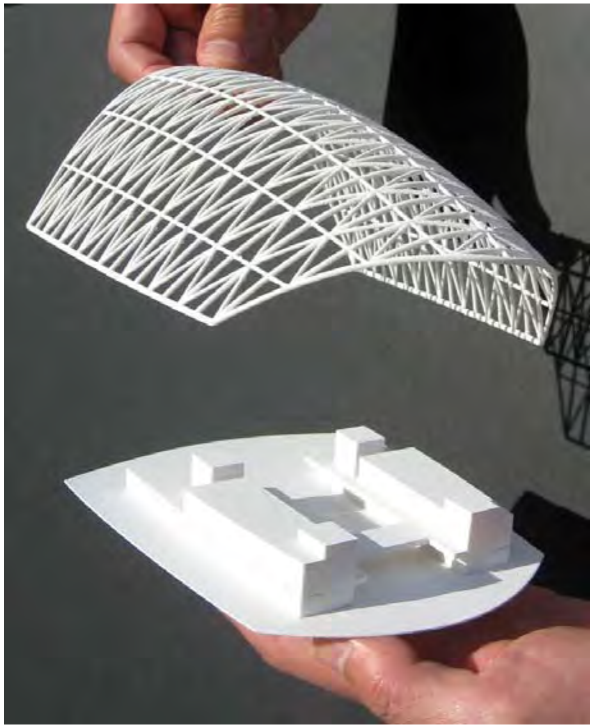
Design Visualization

In this project, the complexity and scale of the design and execution required a very diverse skill set. Achieving the project goals within budget was the feat of a large group of designers and technical experts.

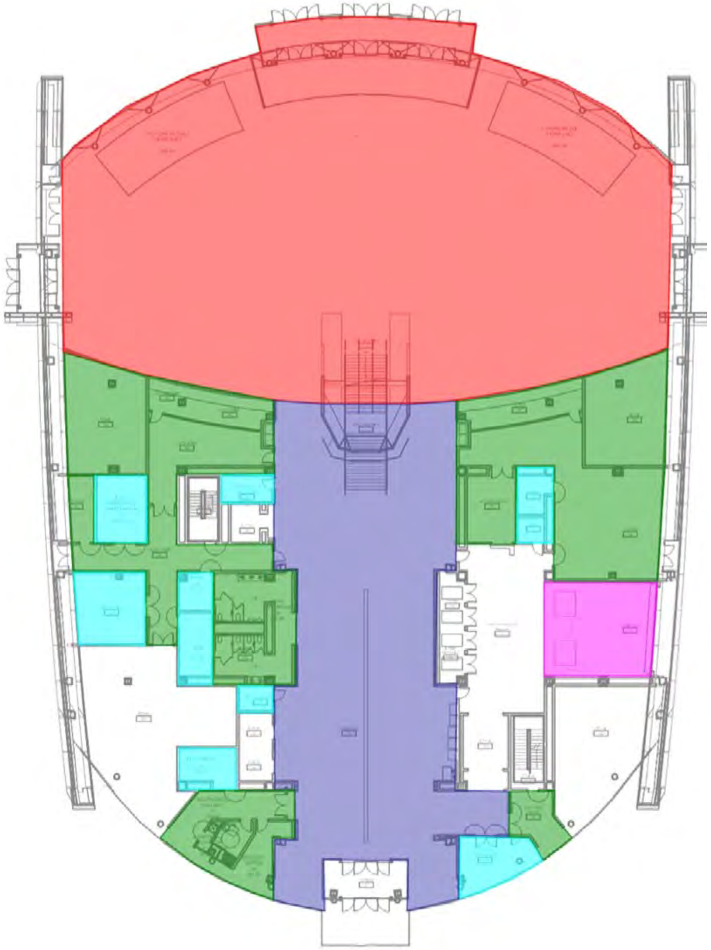
Design Visualization

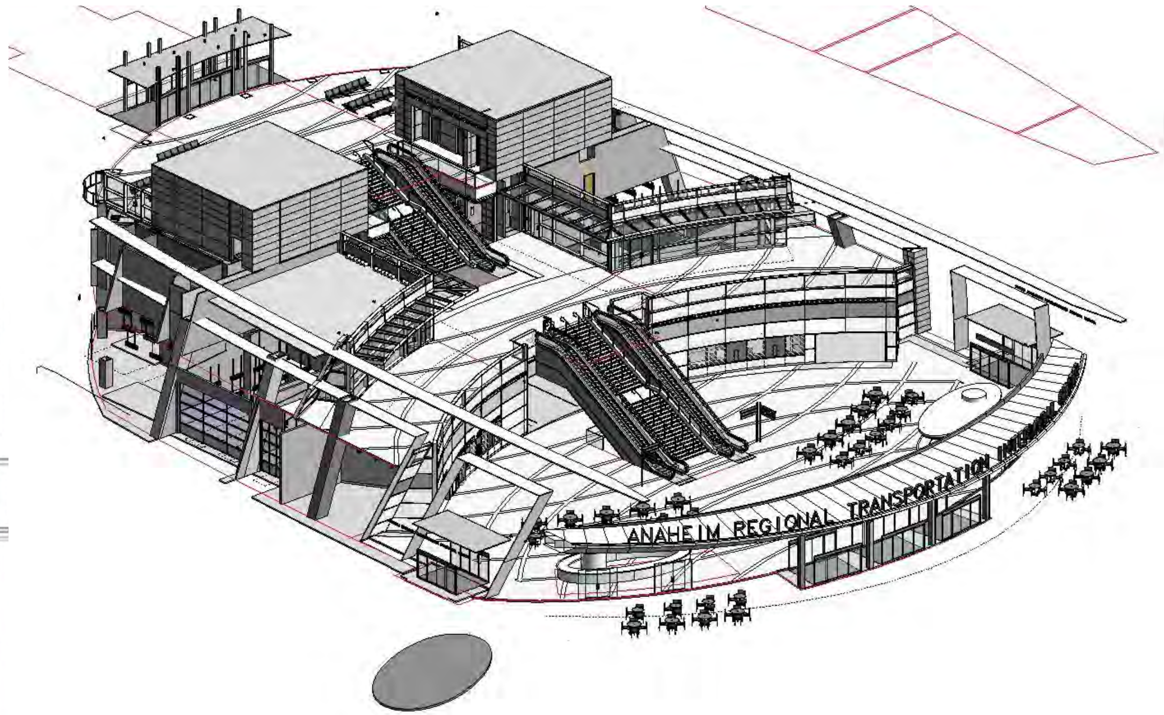
BIM models and animations were used to convey performance features to the design team and owner. 3D printing was exploited for physical verification of concepts.





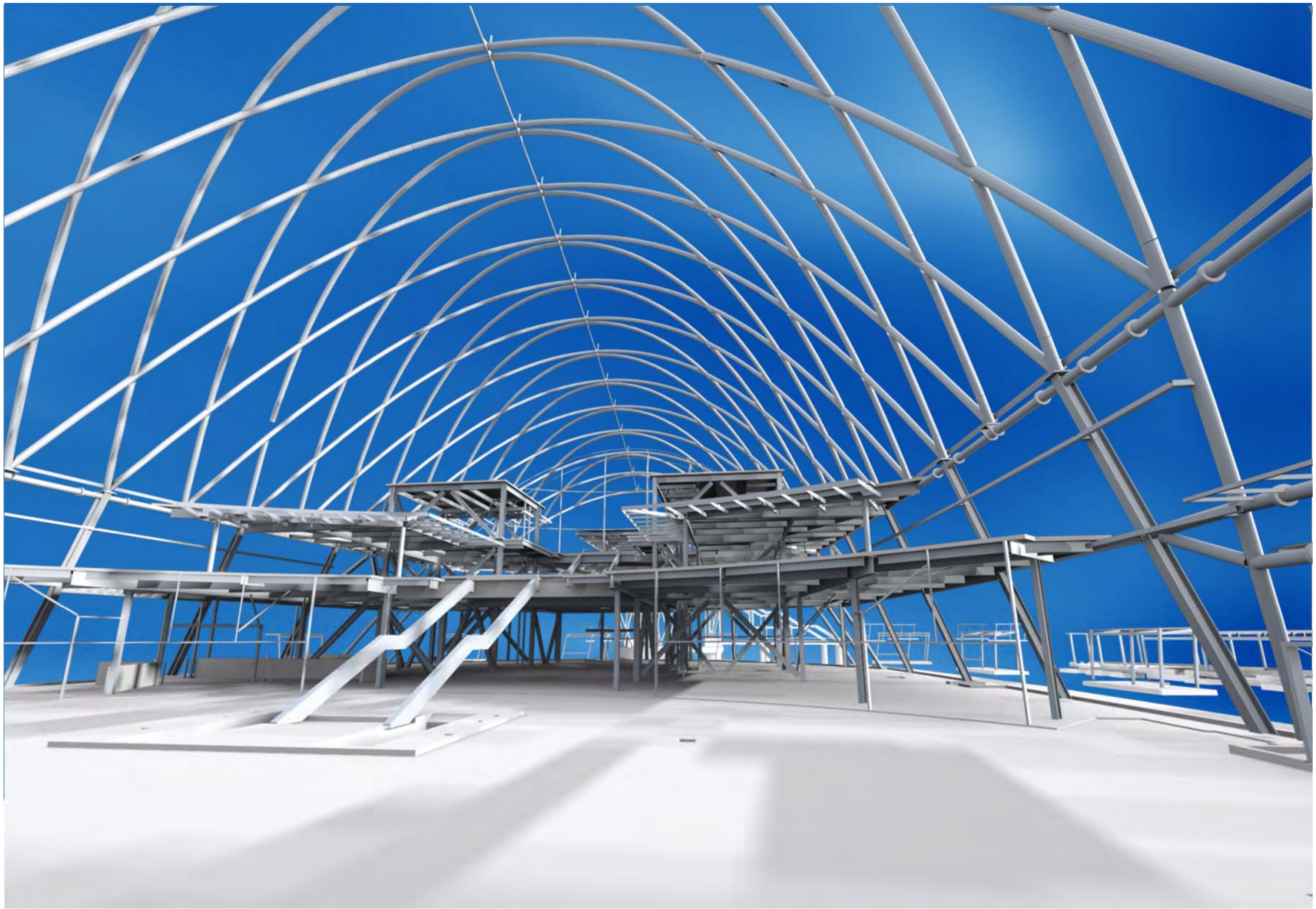
Programming





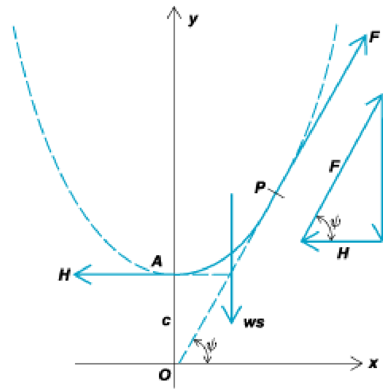
Structural Engineering

The ARTIC shell structure consists of diagonal grid of steel arches forming a complex diagrid building envelope. The geometry of the Shell, which affects both the structural efficiency of the building and its aesthetics, was developed jointly by the architect and structural engineers.



Diagrid Development

Design of the Shell 3D geometry were defined by formulas in Excel, then translated into CAD to form a 2D catenary profile that was used to generate a torus. The torus was trimmed to shape a building envelope as established by the architect. To form a diagonal grid pattern of the Shell, the envelope was cut by a series of planes.



$$Y = A\left(\cosh\frac{X}{L}C - 1\right)$$

$$X = \frac{L}{C}\left[\cosh^{-1}\left(1 + \frac{Y}{A}\right)\right]$$

$$\text{Where, } A = \frac{f_c}{\frac{Q_b}{Q_t} - 1} = 68.7672$$

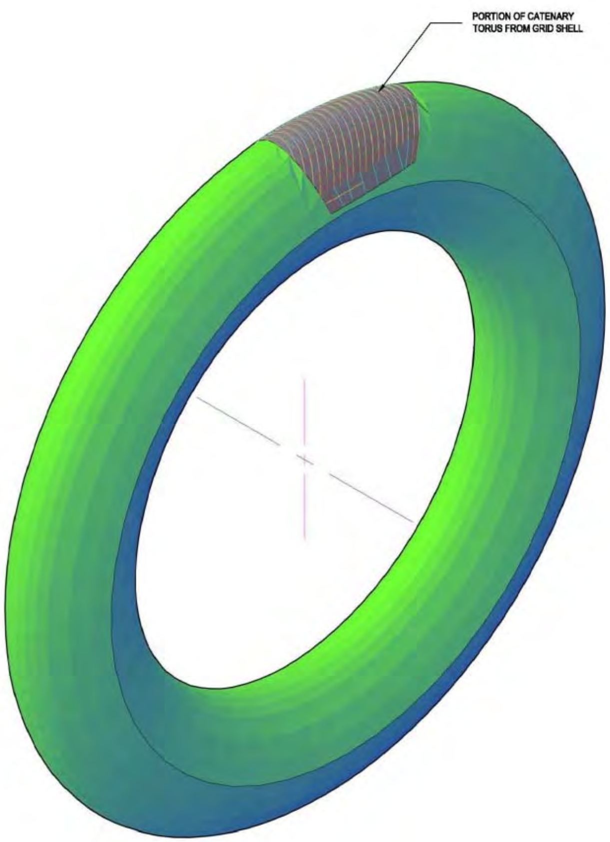
$$C = \cosh^{-1}\frac{Q_b}{Q_t} = 3.0022$$

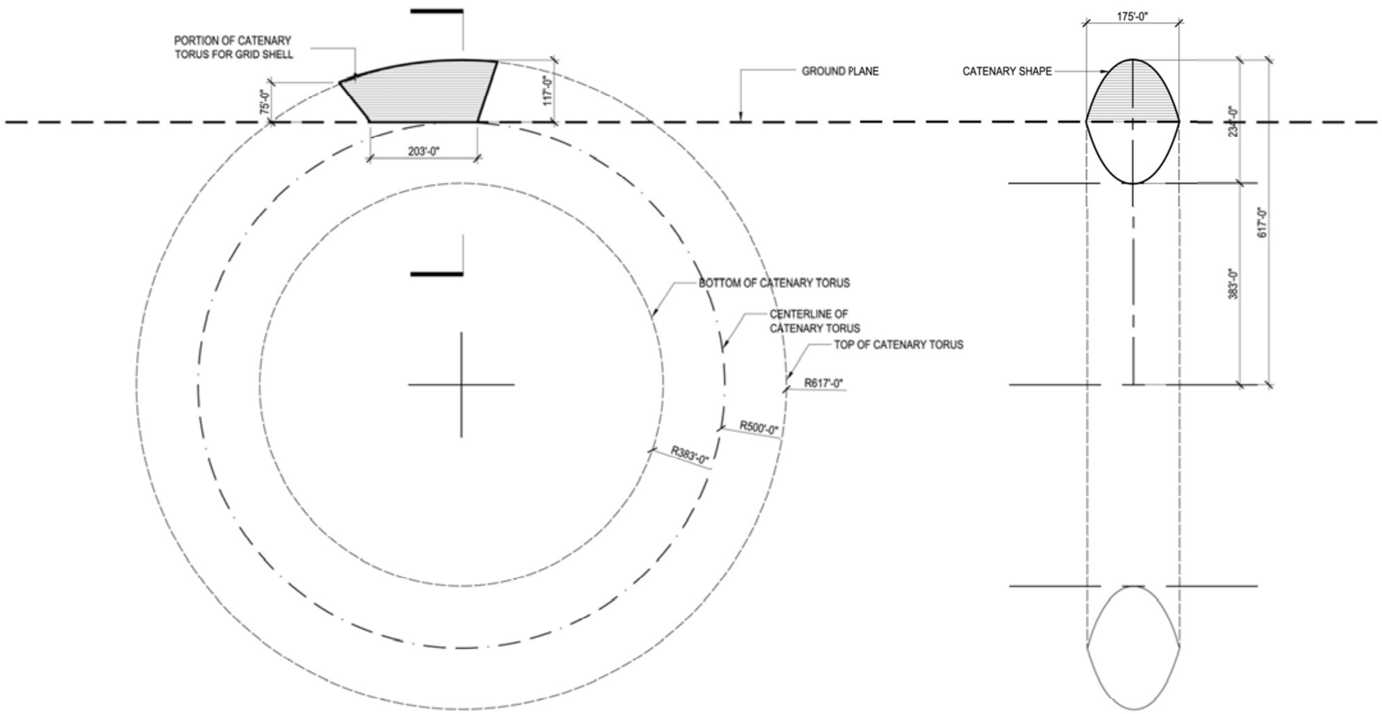
f_c = Max. Ht. of Centroid = 625.0925

Q_b = Max. X-Sec. @ Arch Base = 1262.6651

Q_t = Min. X-Sec. @ Arch Top = 125.1406

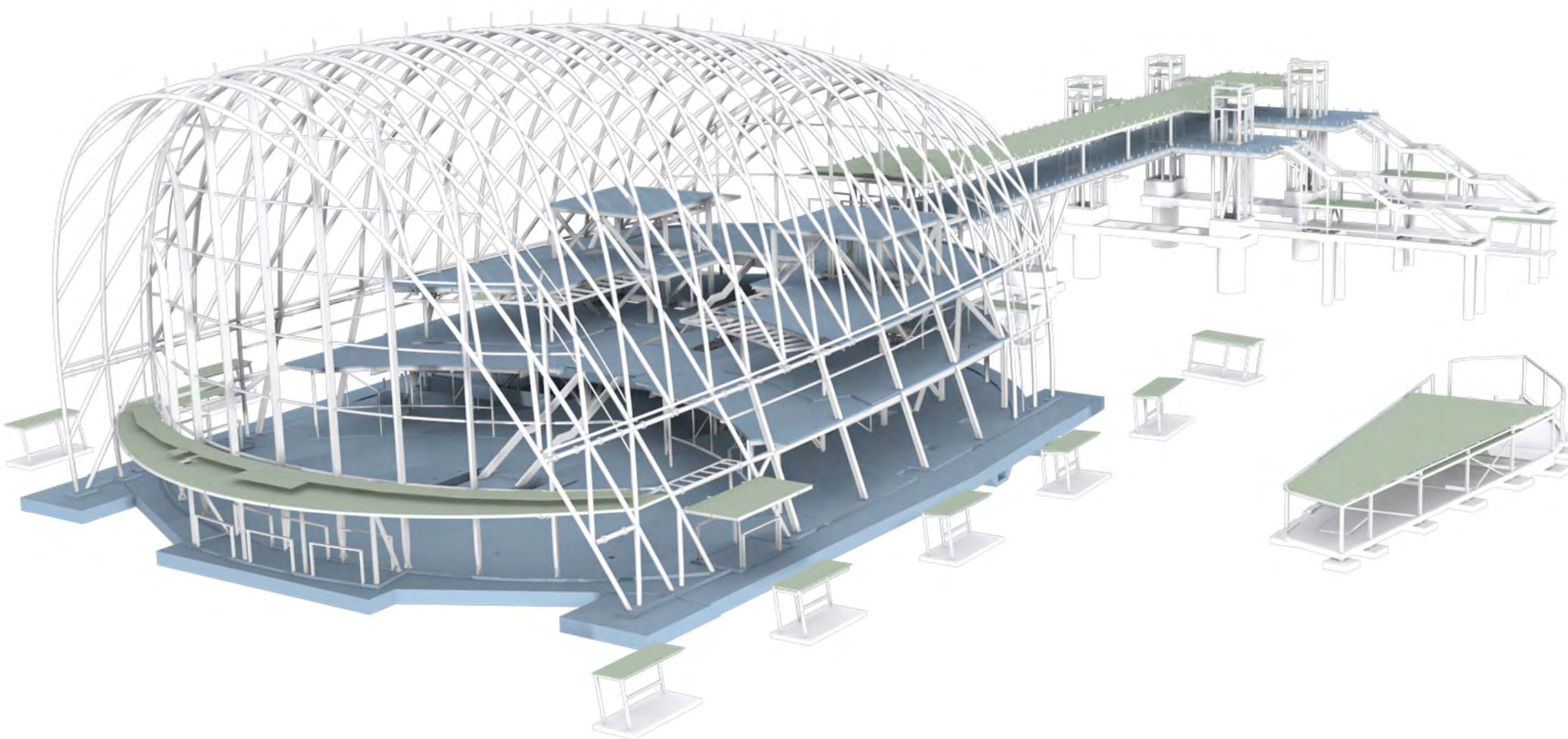
L = Half of Centroid @ Arch Base = 299.2239





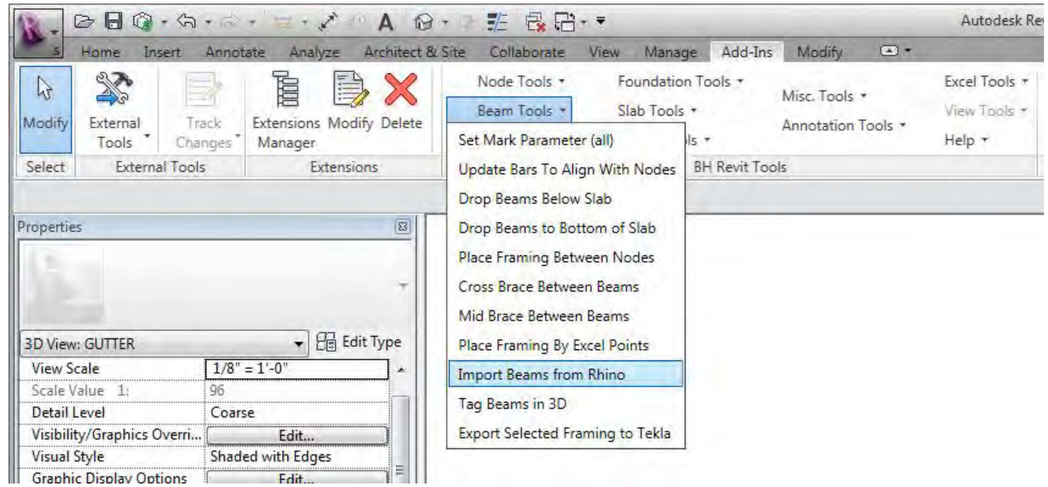
Structural Engineering

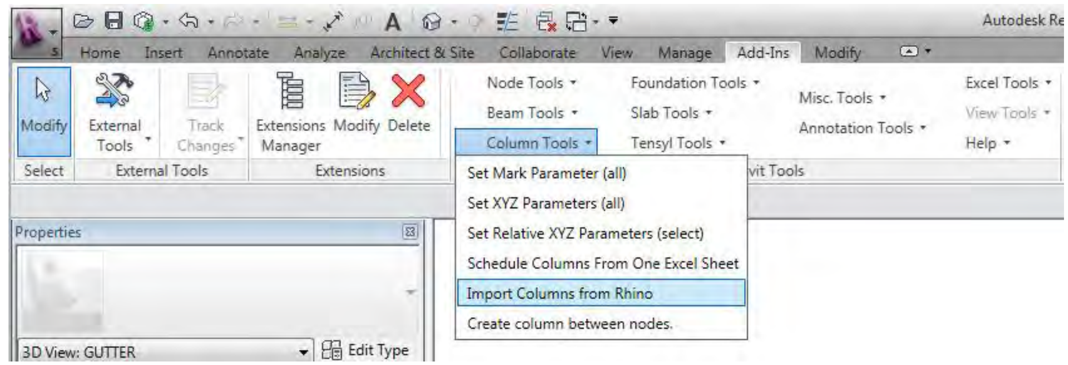
A structural analysis model in SAP2000 was used to analyze the structural system to predict its responses and to determine internal forces, stresses, and deformations. Non-linear buckling analyses were performed to verify buckling stability of the structure as a whole.

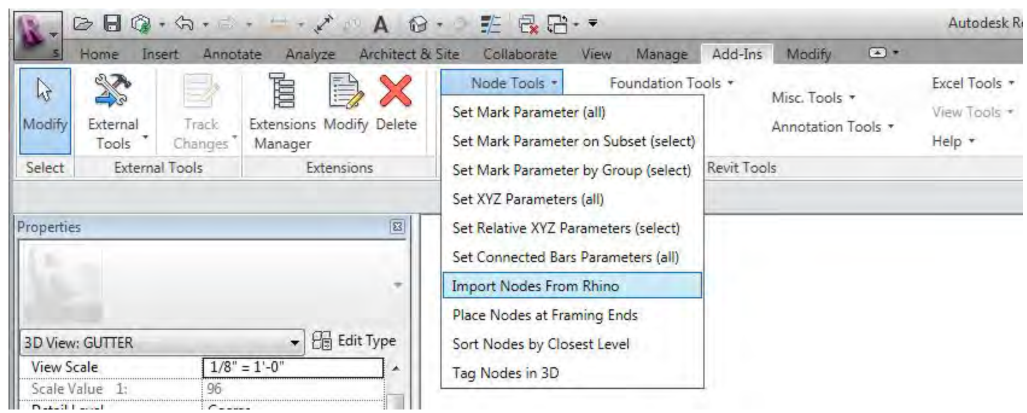


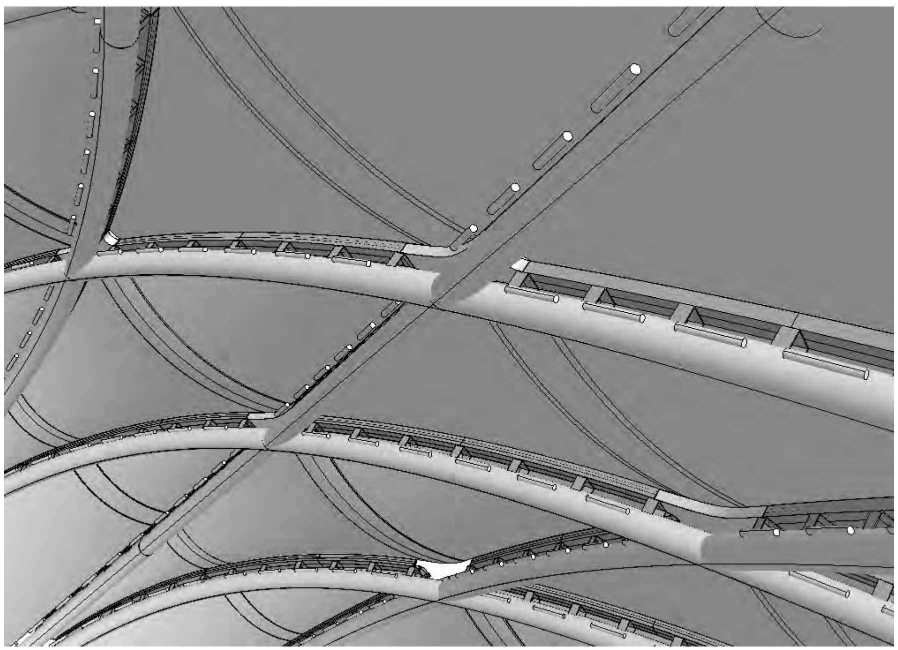
Custom Interoperability Tools

The enclosure/geometry consultant used proprietary tools to generate geometry in multiple formats suitable for their purpose.



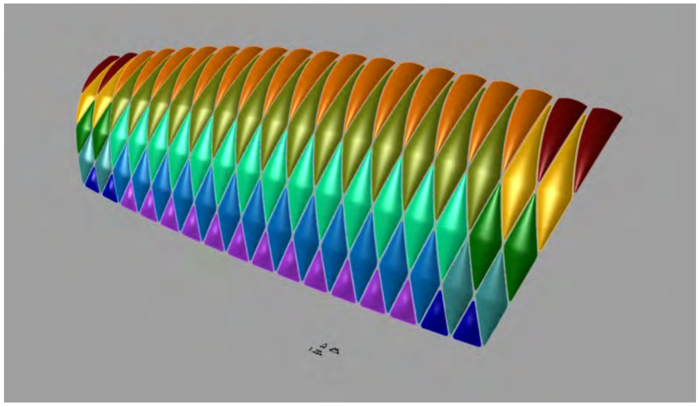


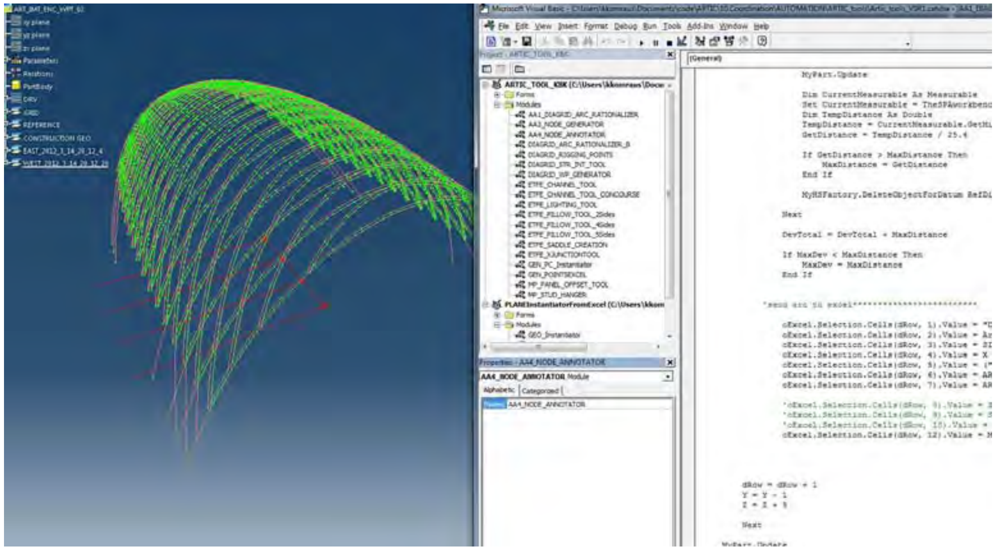


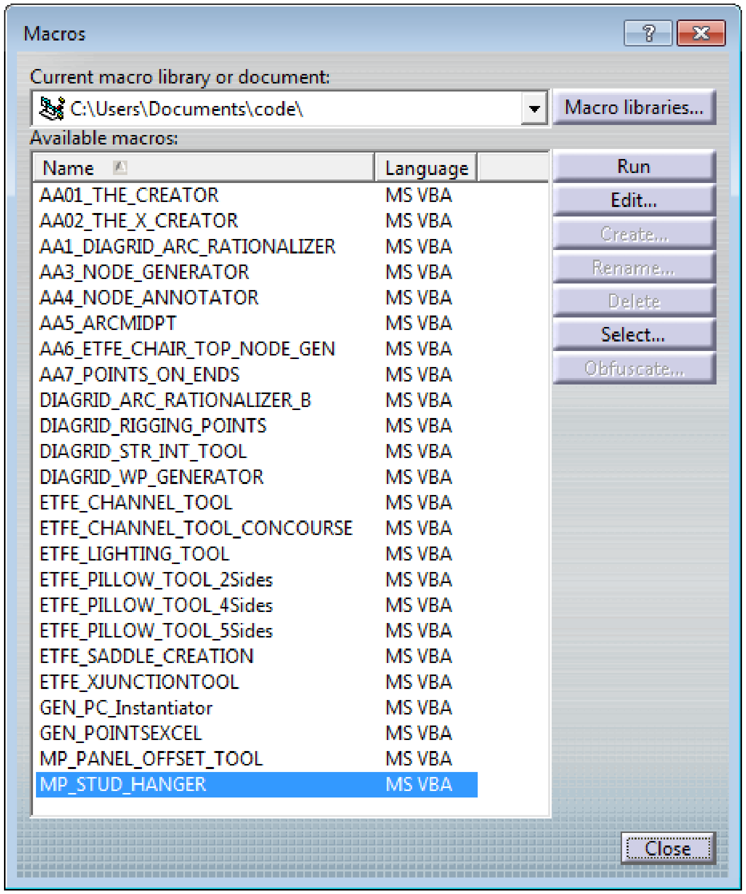


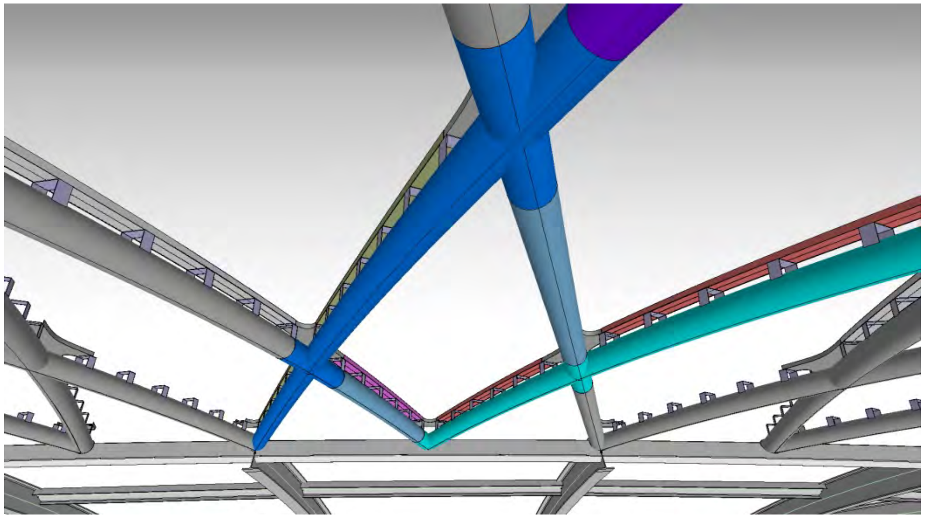
Custom Scripting for Automated Modeling

Due to the volume of components in the enclosure system , custom scripts were written to automate modeling. A "Geometric DNA" was defined and coded, this allowed multiple design iterations in minutes which traditionally would have taken weeks to model manually.





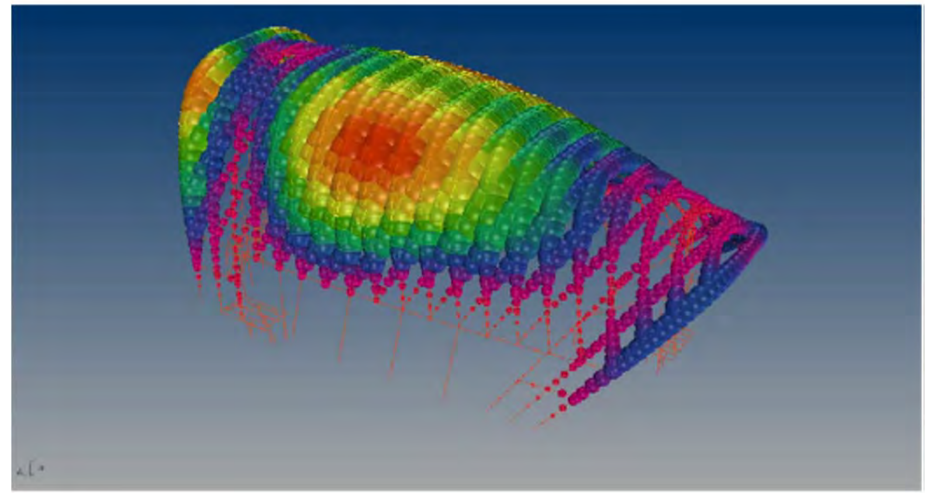


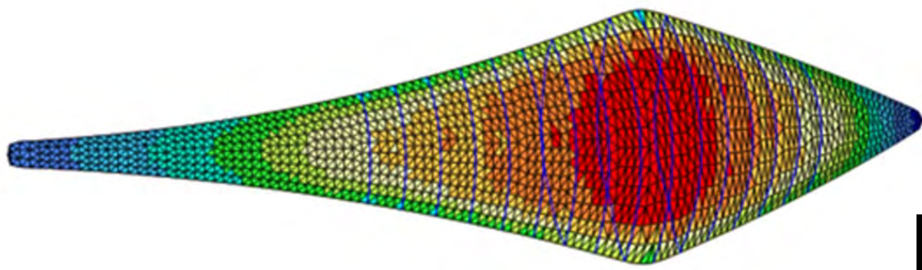


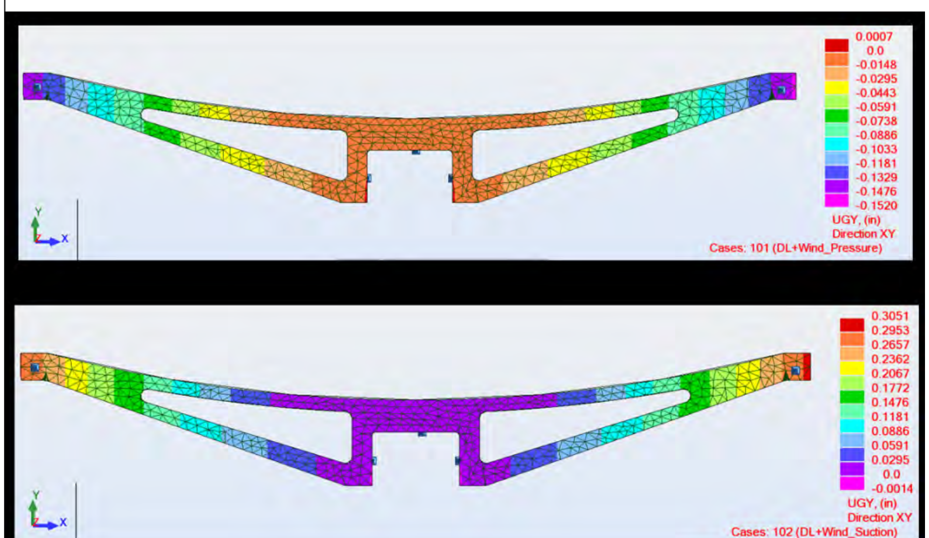
Structural Analysis visualization

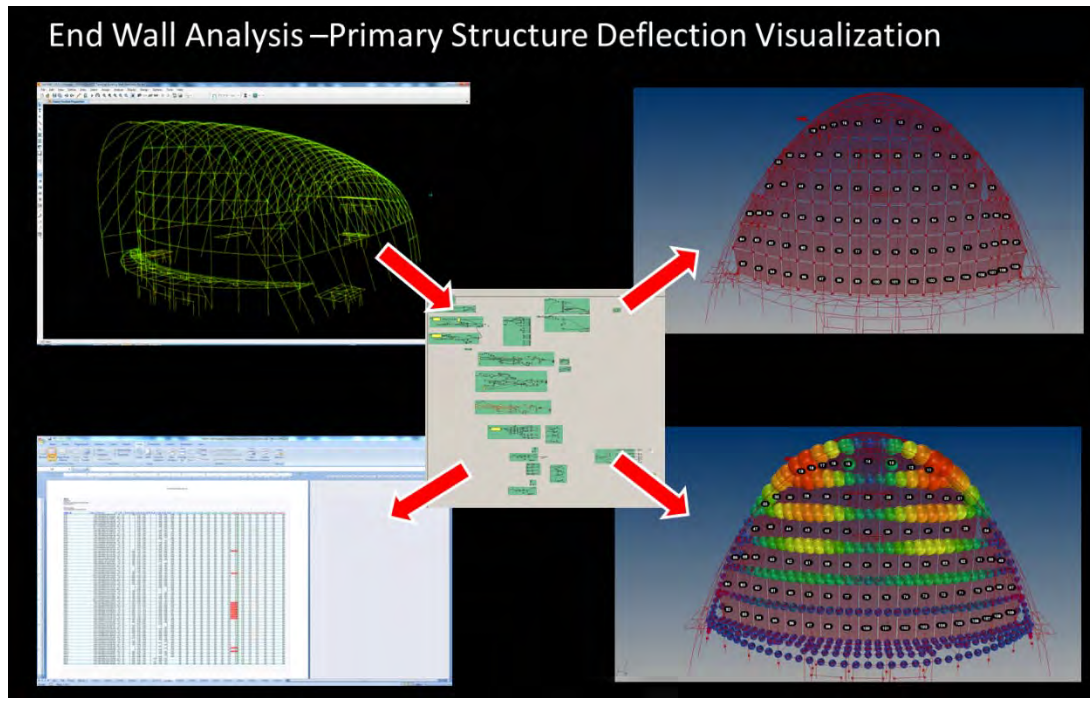
The enclosure team used many analytical tools to study the various components and element types, often employing proprietary tools to quickly parse, visualize and study large quantities of simulation data. Entire systems were modeled to ensure holistic fidelity with integrated systems.

Bubble Deflection Magnitudes



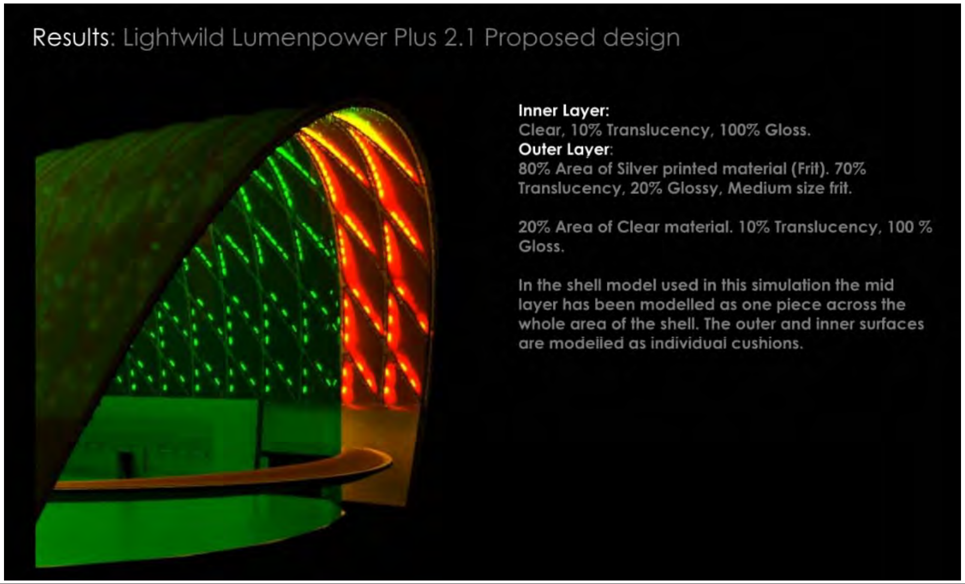




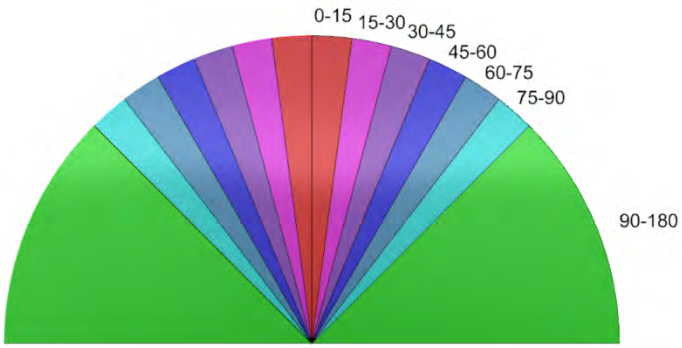


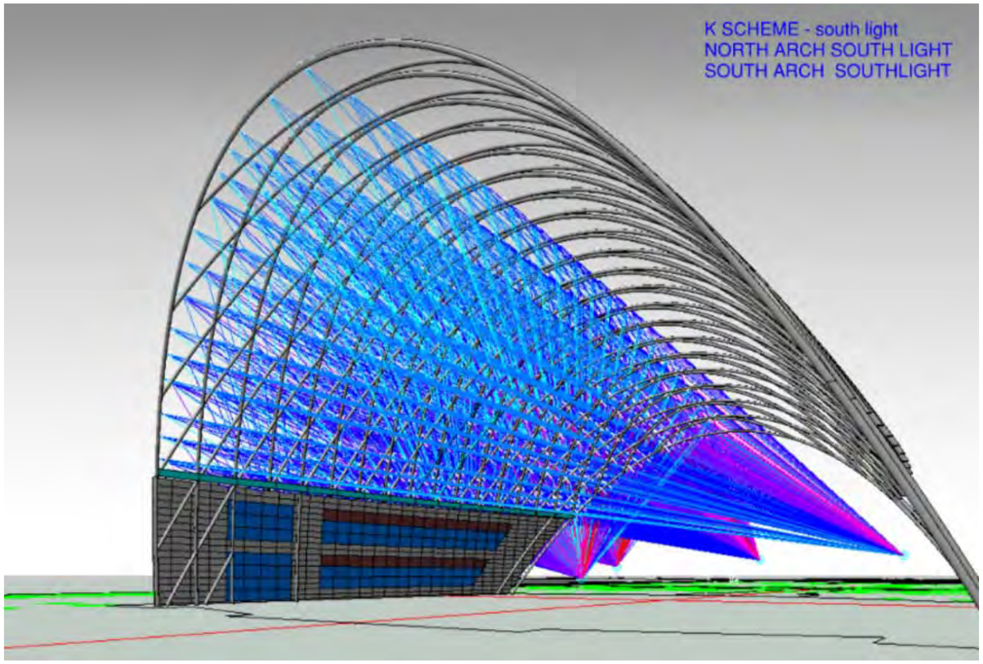
Lighting Simulation

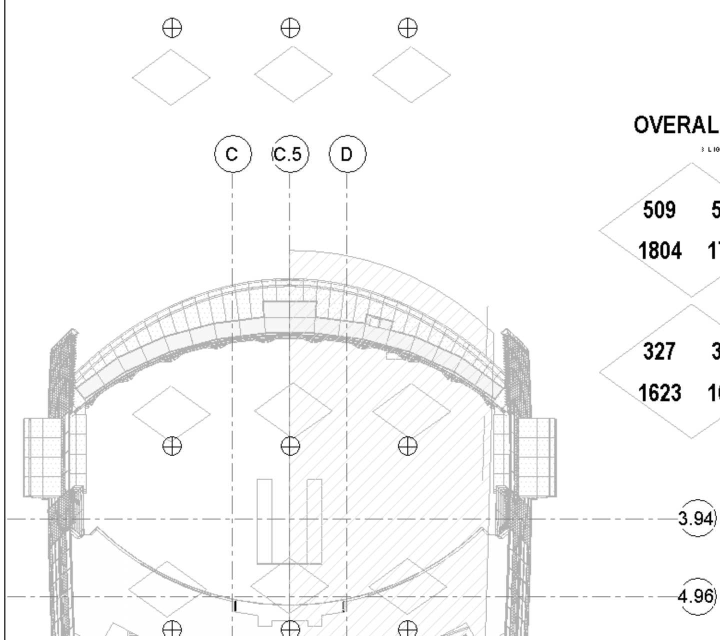
Multiple scientific lighting simulations where performed using BIM models to study performance and to mitigate possible glare issues.



Lighting Simulation

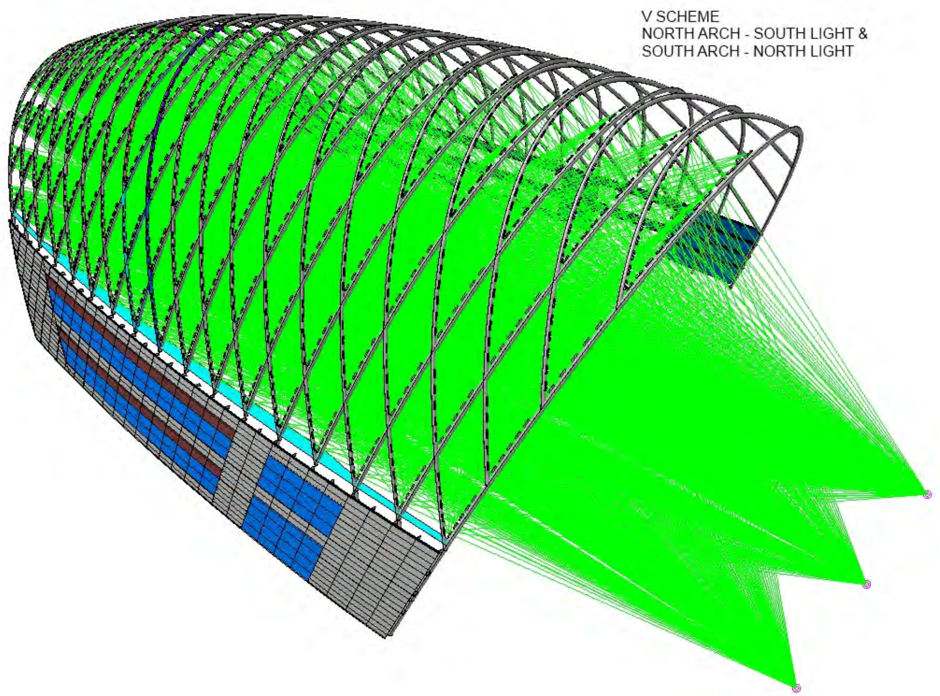






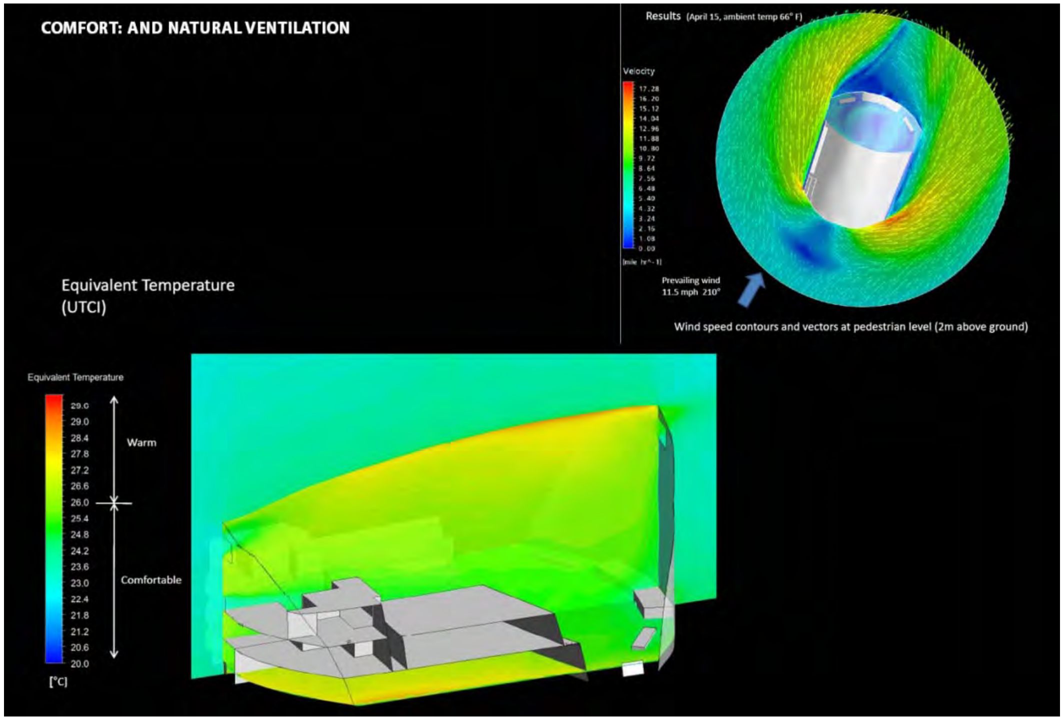
OVERALL RELATIVE SIGHT

509 / 508 1804 / 1796	10 Degree fixture angle
327 / 329 1623 / 1614	25 Degree fixture angle

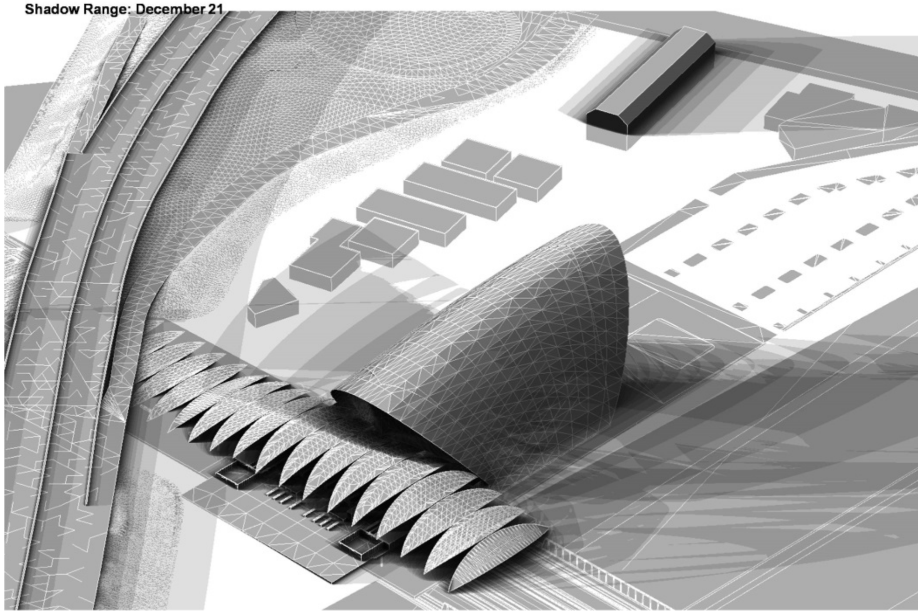


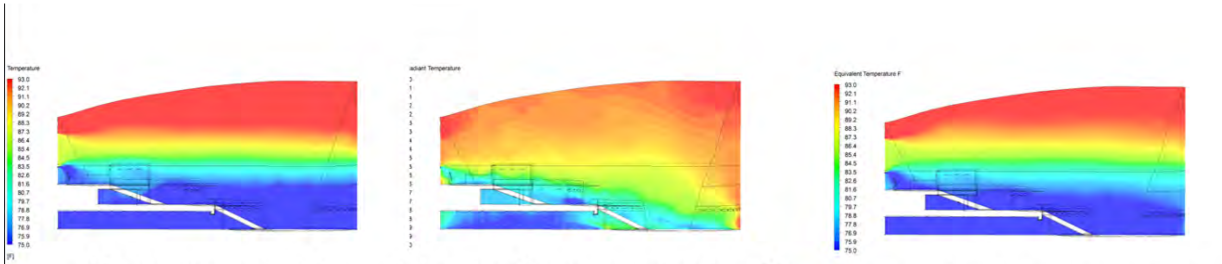
Environmental Simulation

Analytical BIM models were employed for performance simulations of; wind, ventilation, comfort, energy, temperature, daylighting, shade.



Shadow Range: December 21

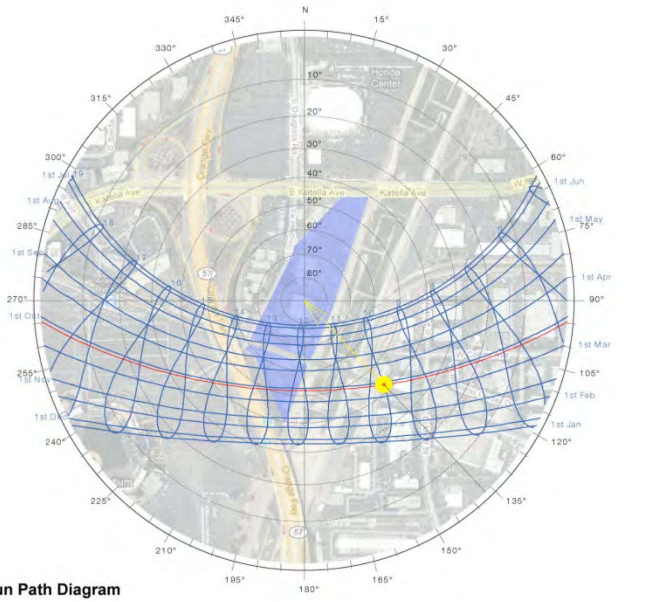




Air temperature °F

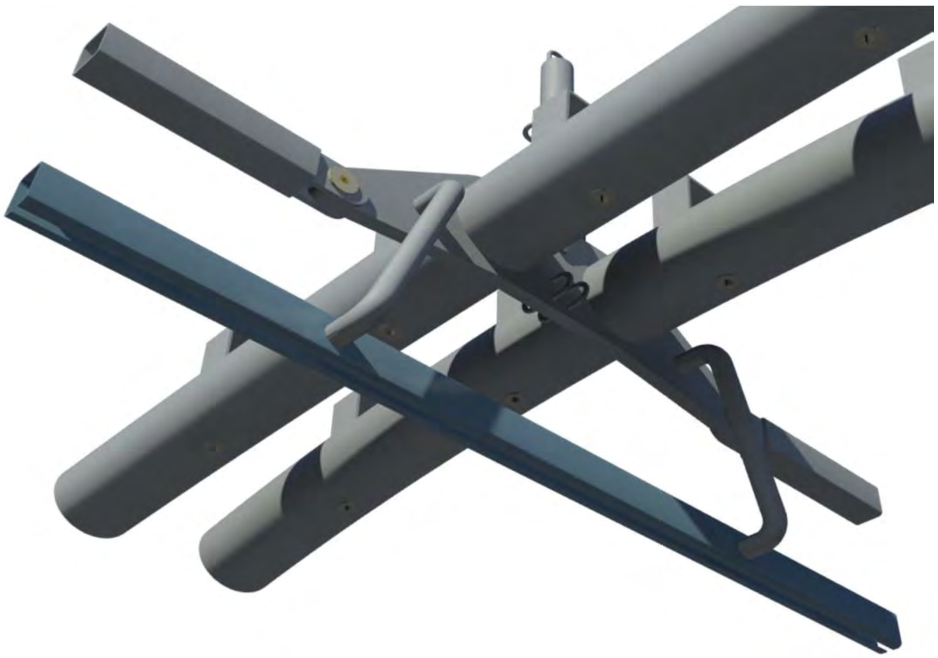
Mean radiant temperature °F

Equivalent temperature °F

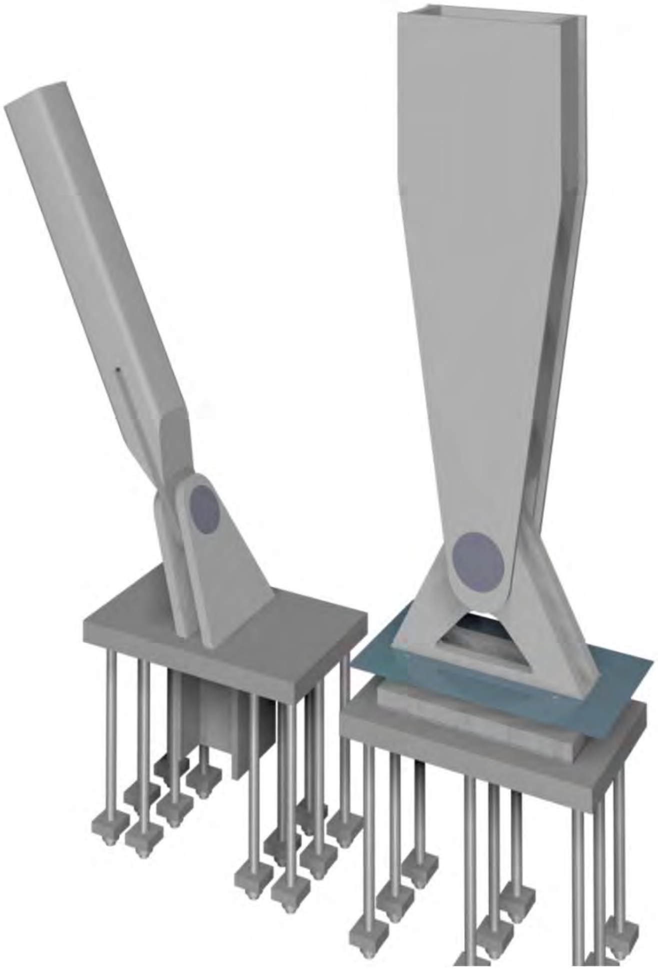


Sun Path Diagram

Structural Detailing

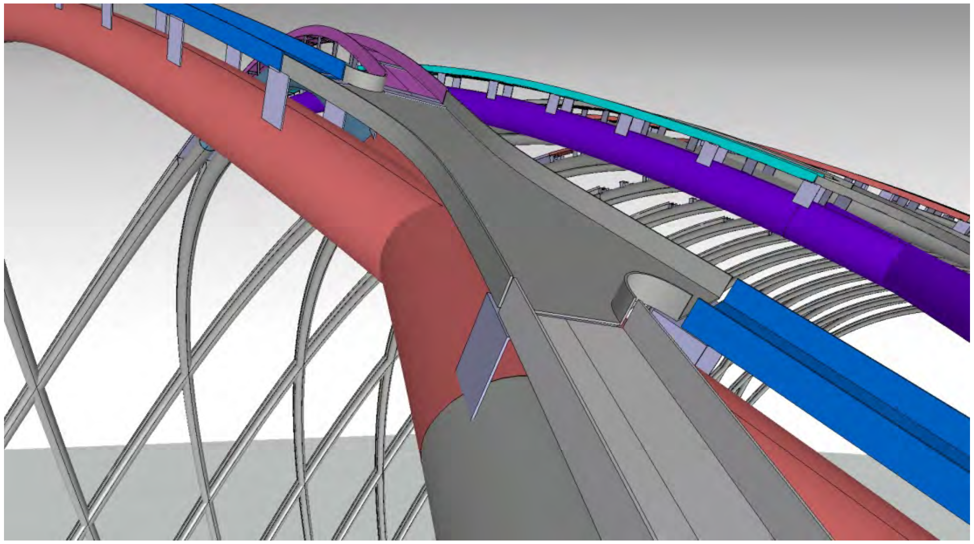


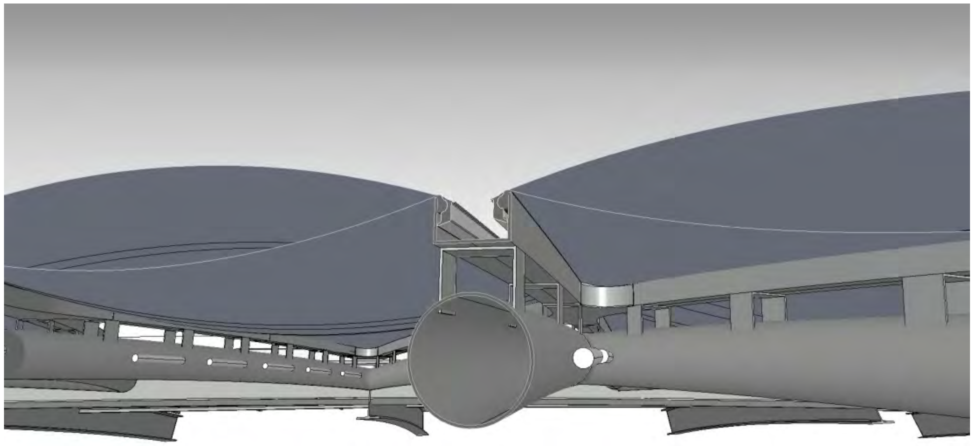
Connection detail at Shell ridge



Connection detail at End wall column base

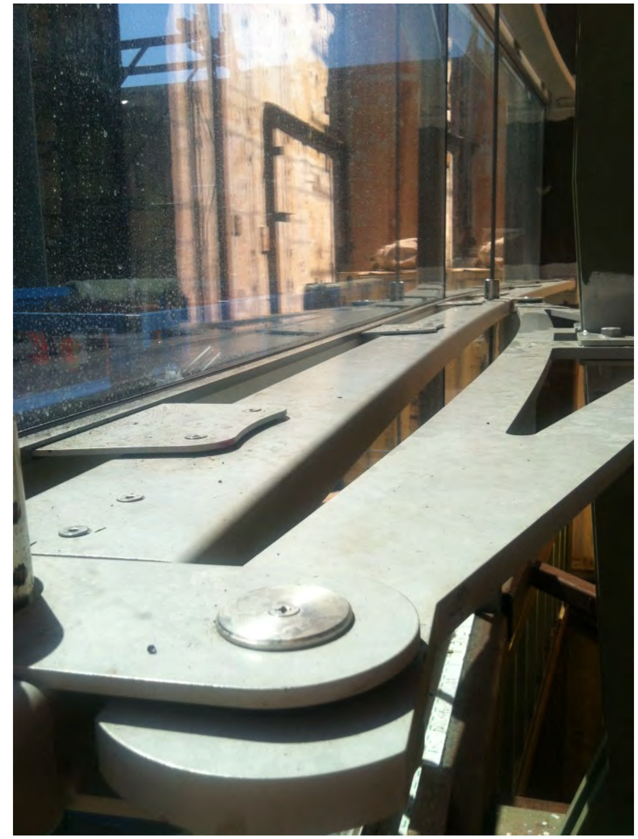
Complex Structure

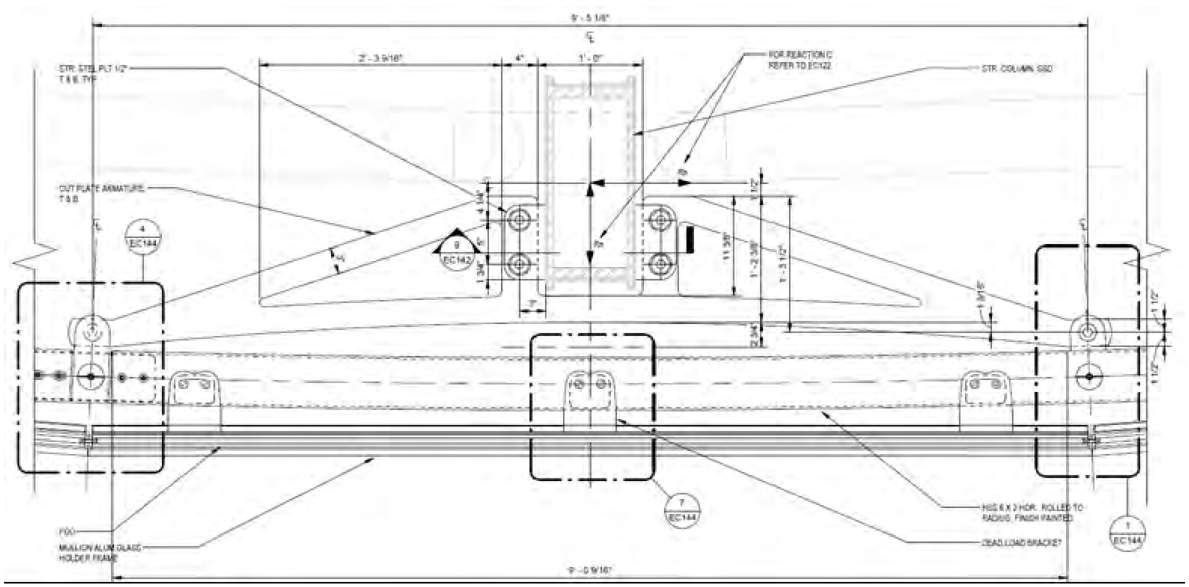




CNC Fabrication

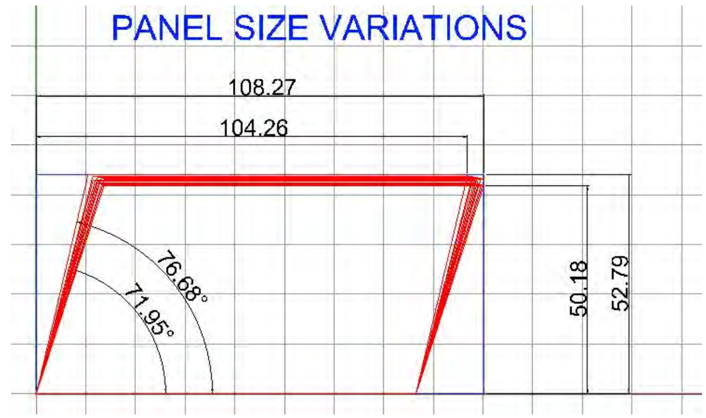
The North and south wall geometry data defines points for the front of glass, armature connection, column location, and secondary steel arcs.

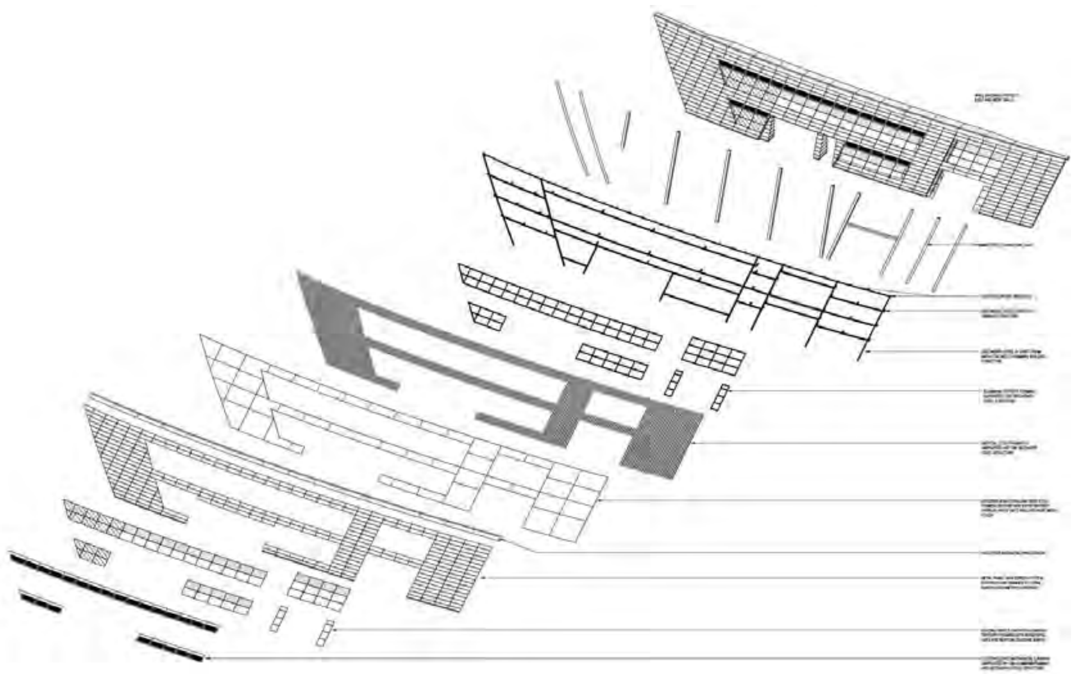


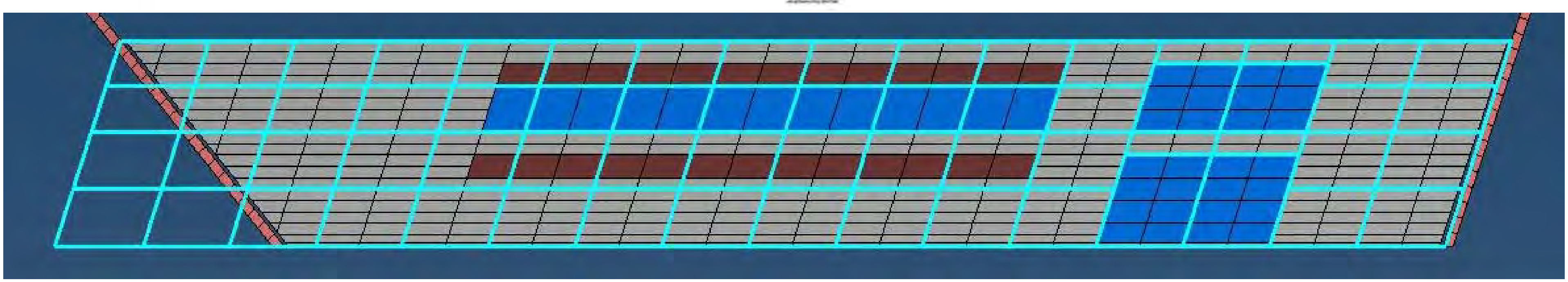


Rationalization and Digital Fabrication

The side walls are defined by a translated polyline surface which defines planar segments. Key points that define geometry for the curtain wall are defined in the geometry data.

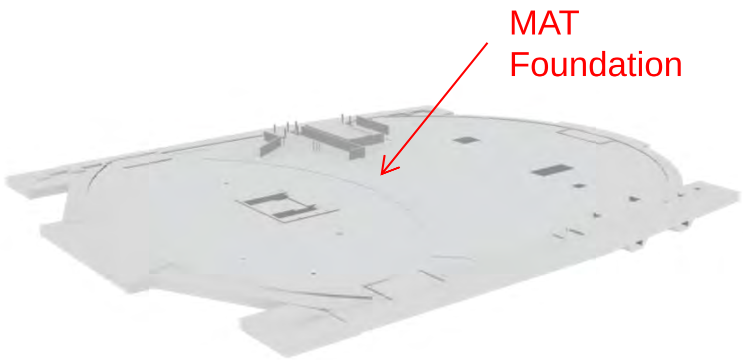




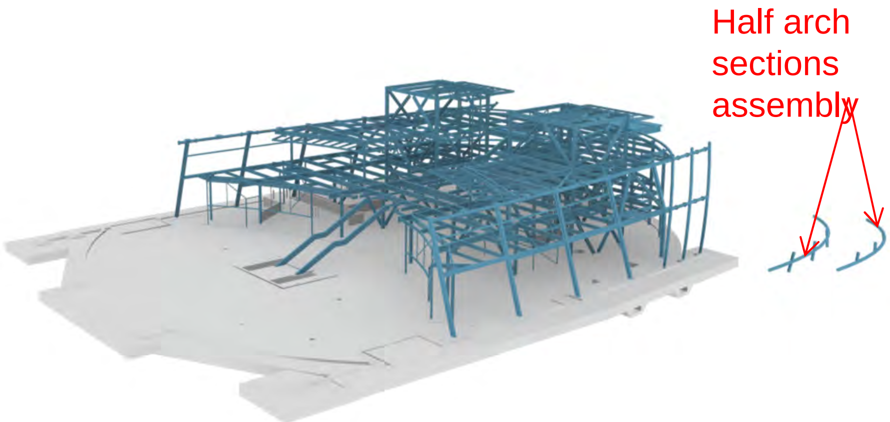


Erection Sequencing

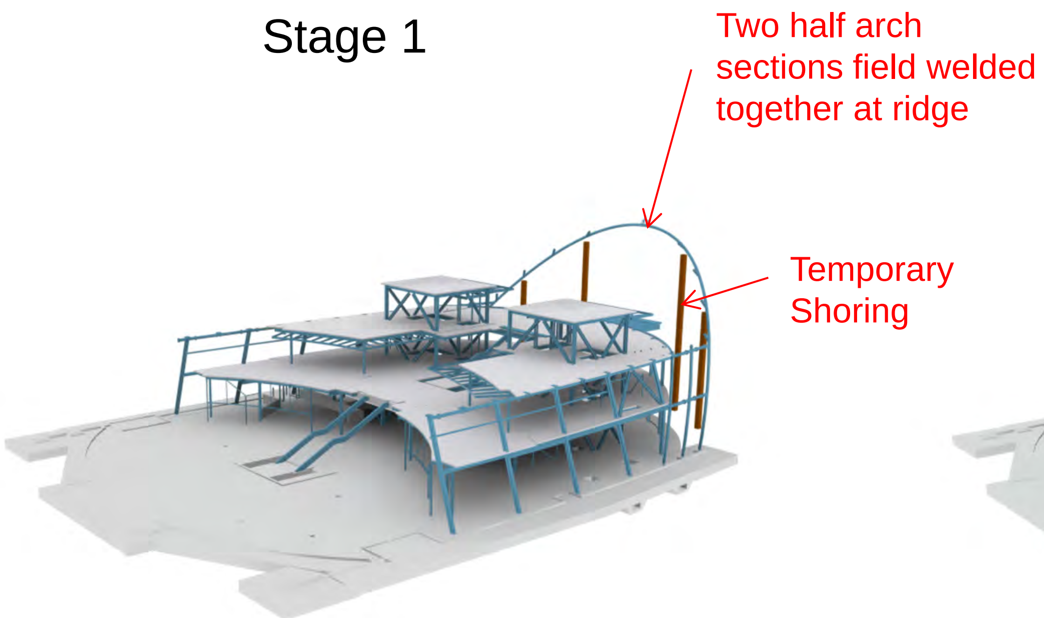
Erection Sequencing



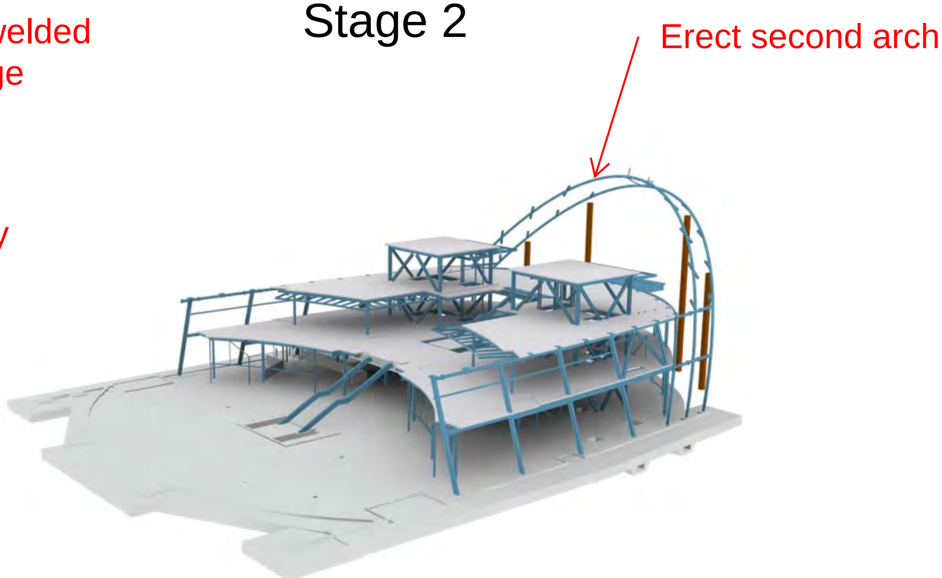
Stage 1



Stage 2

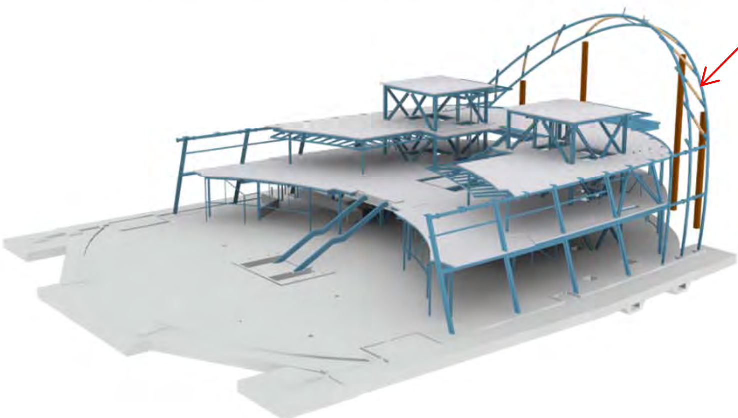


Stage 3

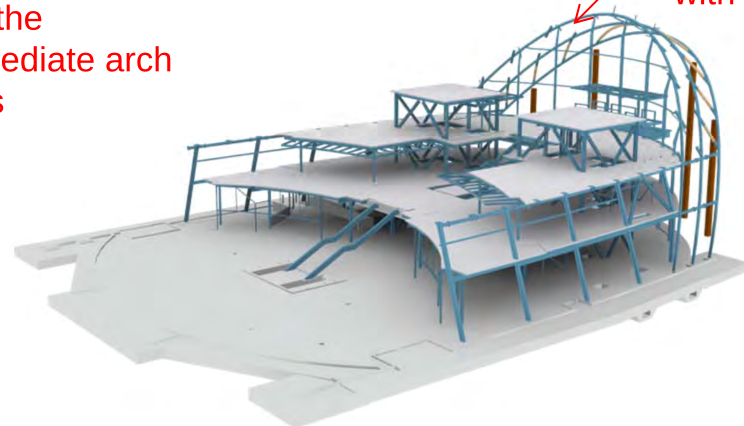


Stage 4

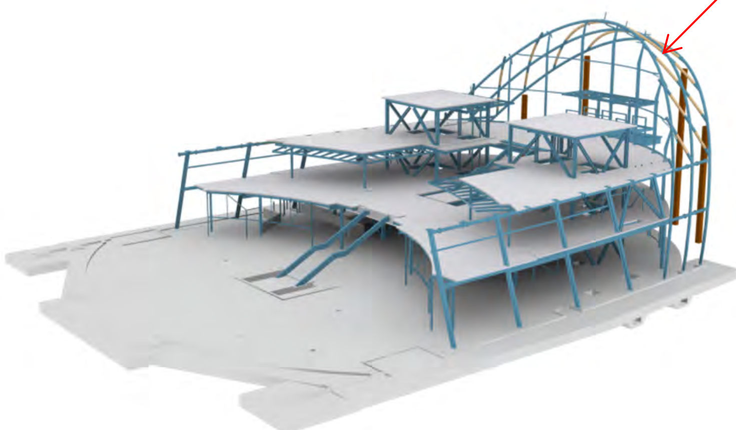
Erection Sequencing

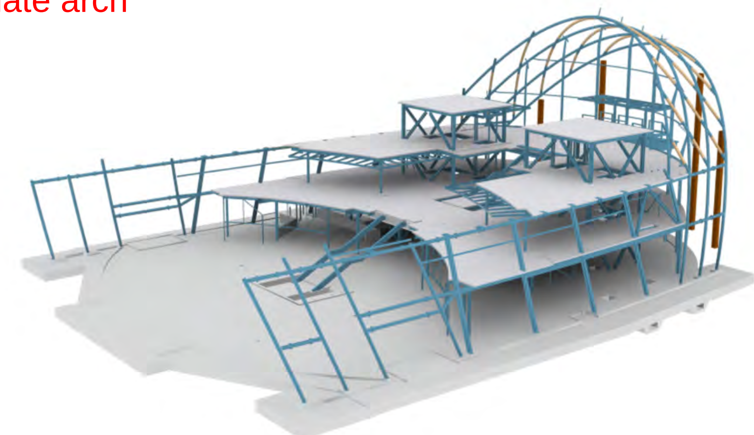


Stage 5



Stage 6

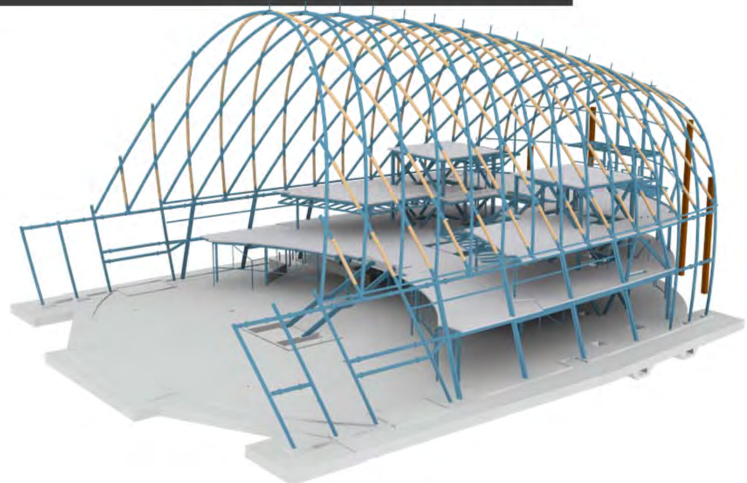




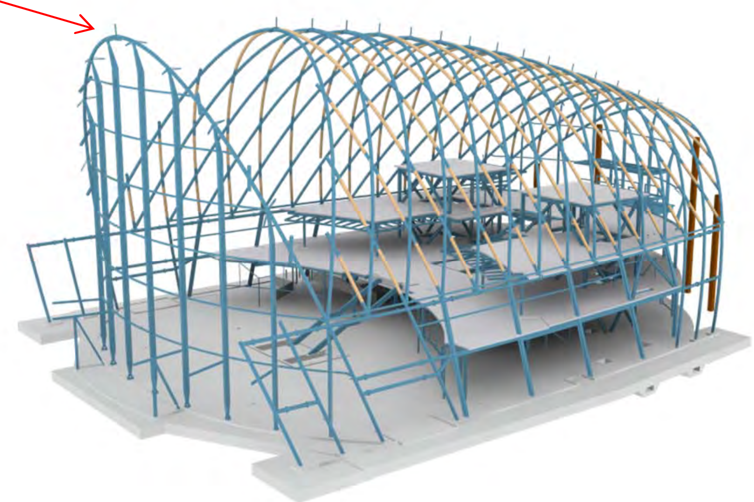
Stage 7

Stage 8

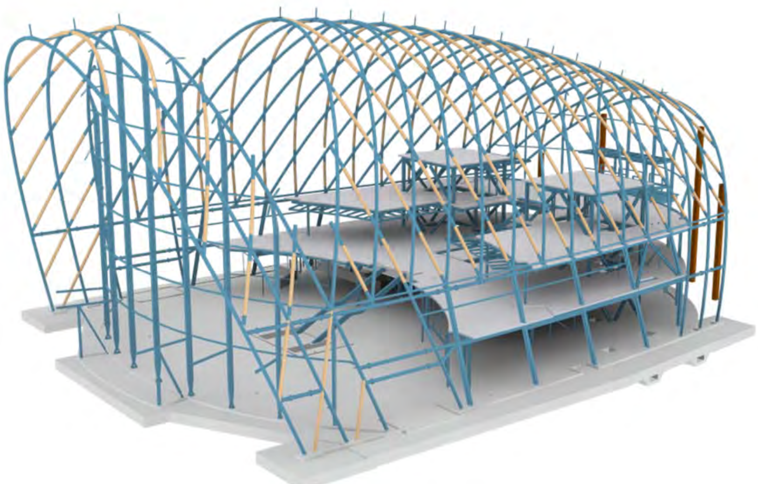
Erection Sequencing



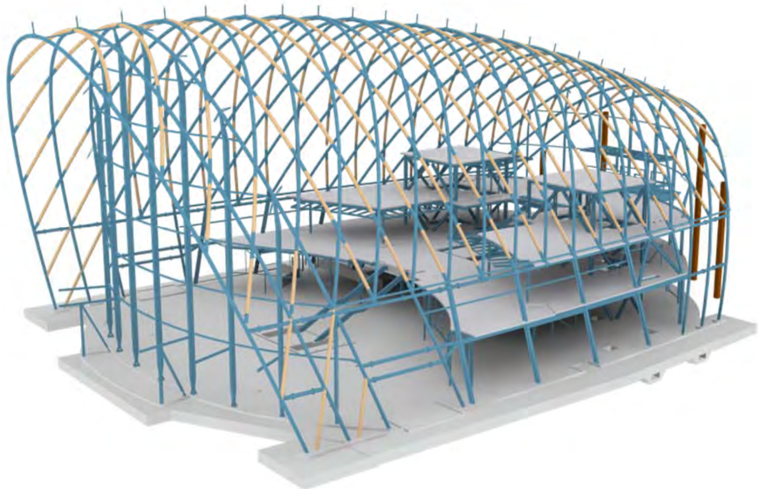
Stage 9



Stage 10

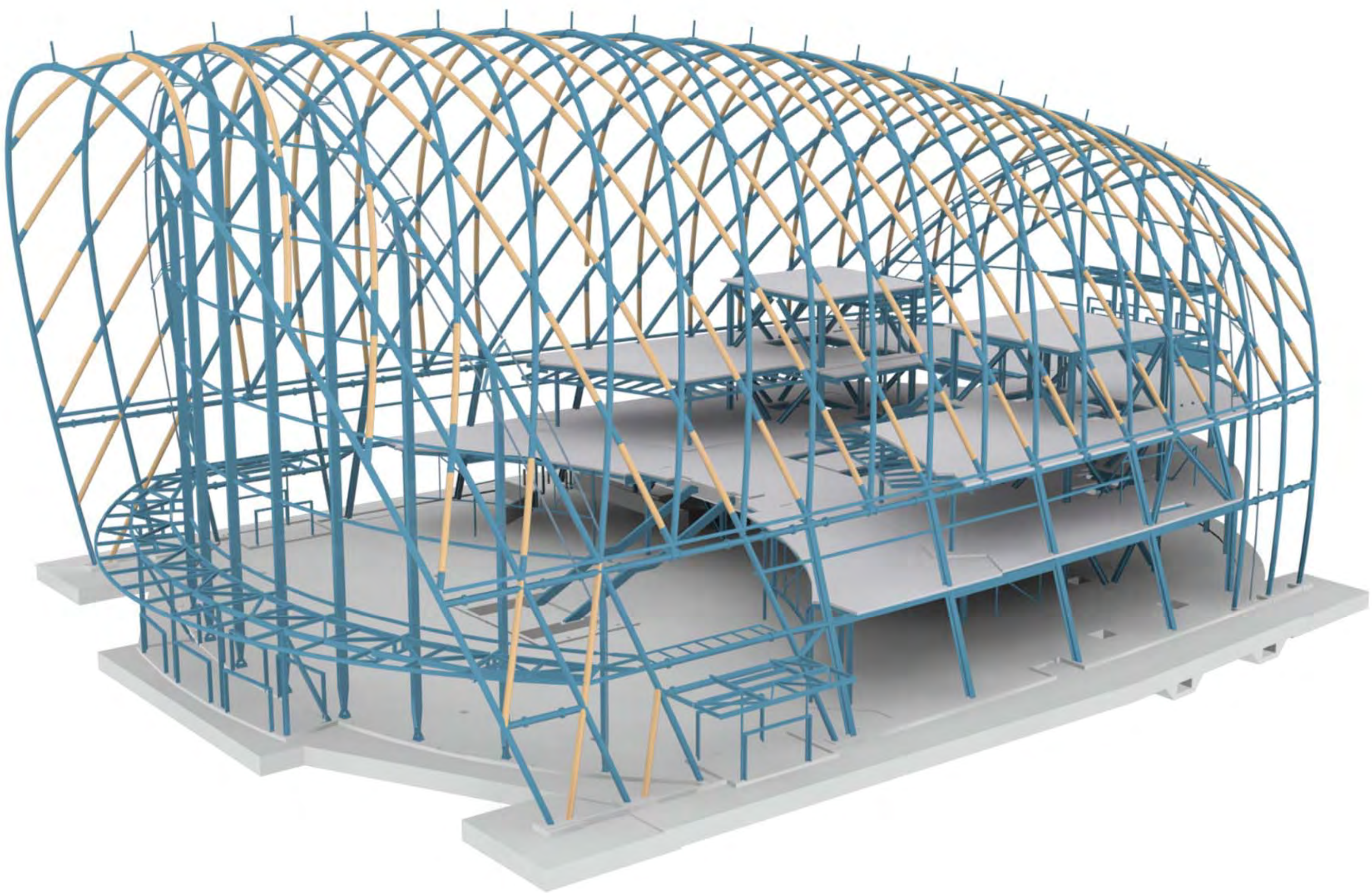


Stage 11



Stage 12

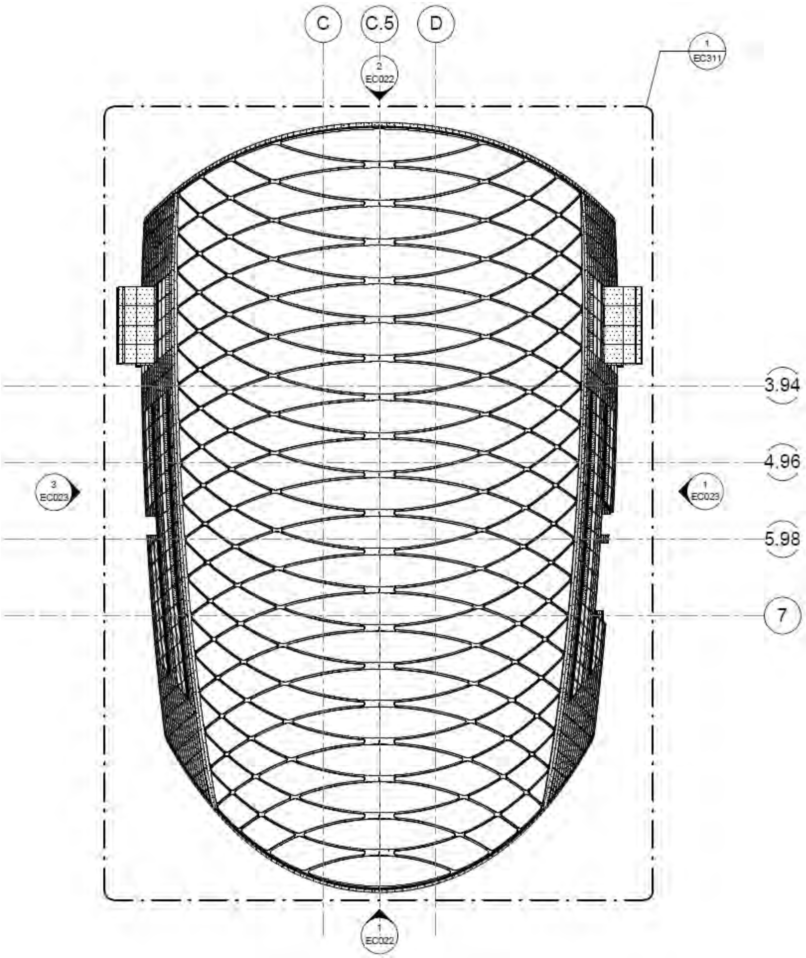
Erection Sequencing

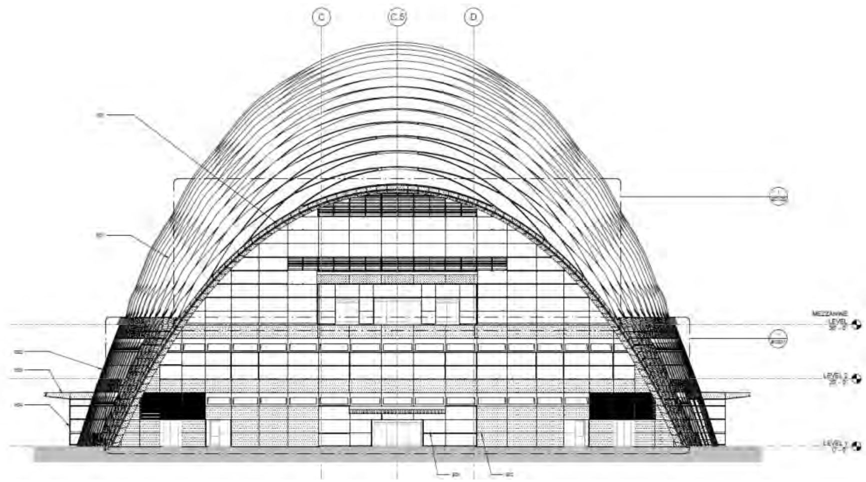


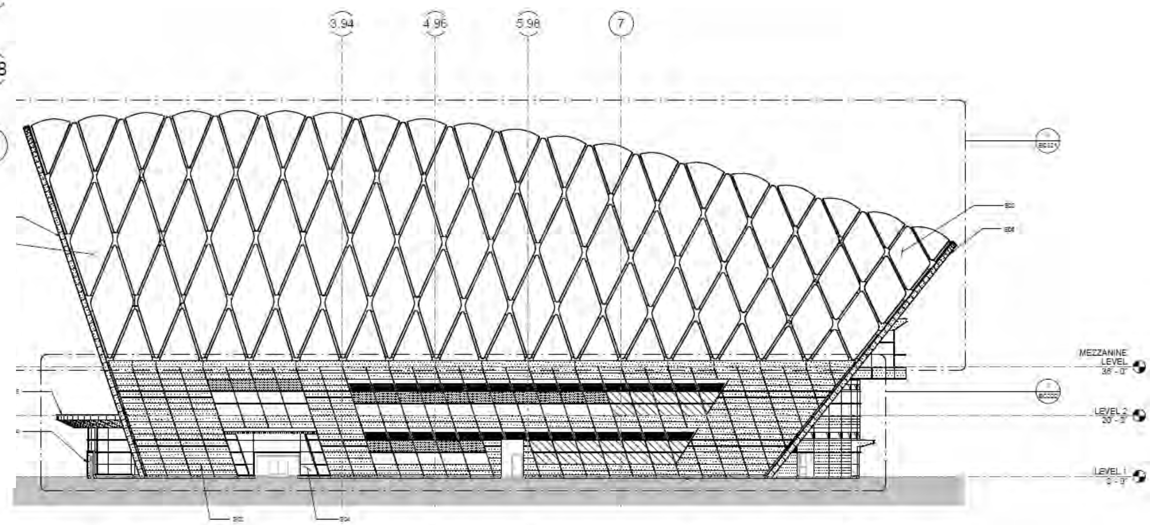
Final Stage

Documentation

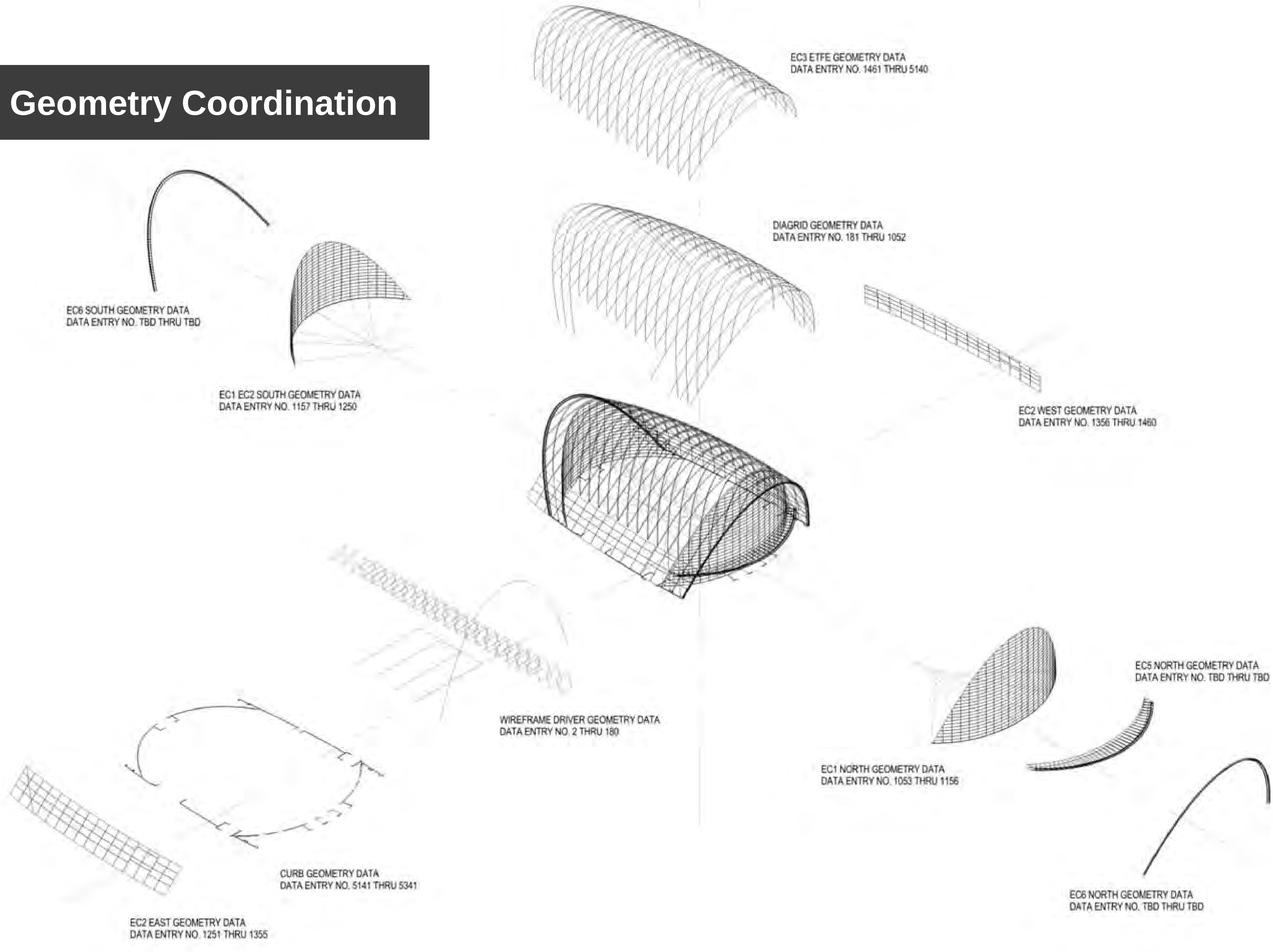
Autodesk told the design team that it was problematic to model this project in Revit.





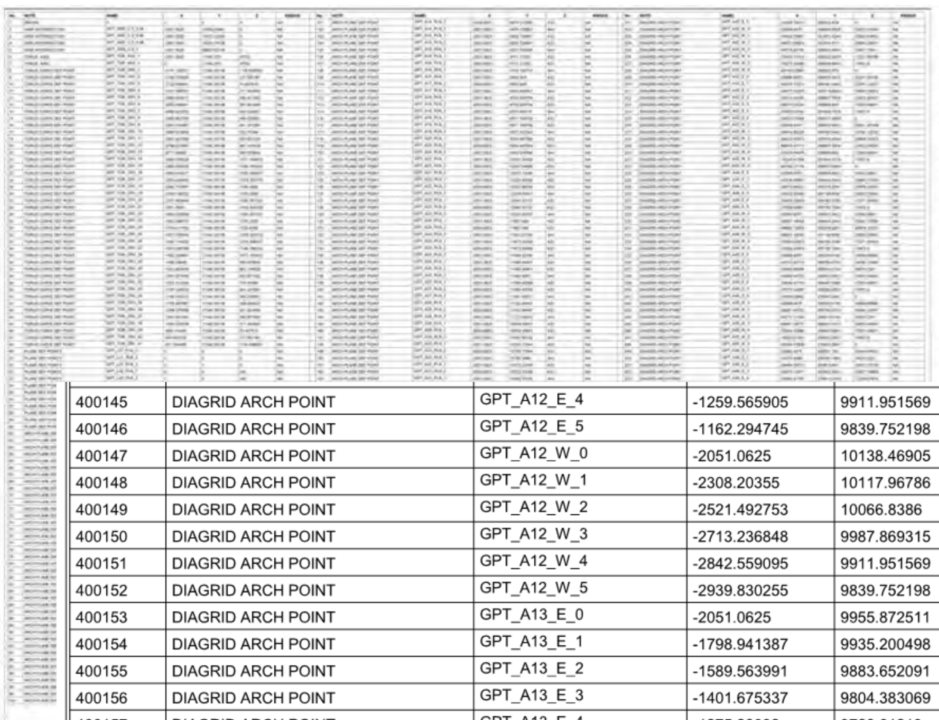


Geometry Coordination



Geometry Coordination

For design control and interoperability all components associated with the complex shell form were coded into what has become known as the “GEOGRID” by the build team. The 3d design was reduced to the simplest geometric elements, points and arcs, to convey exact design dimension to all stake holders while remaining software agnostic. The approach was carried through to confirm as built survey.



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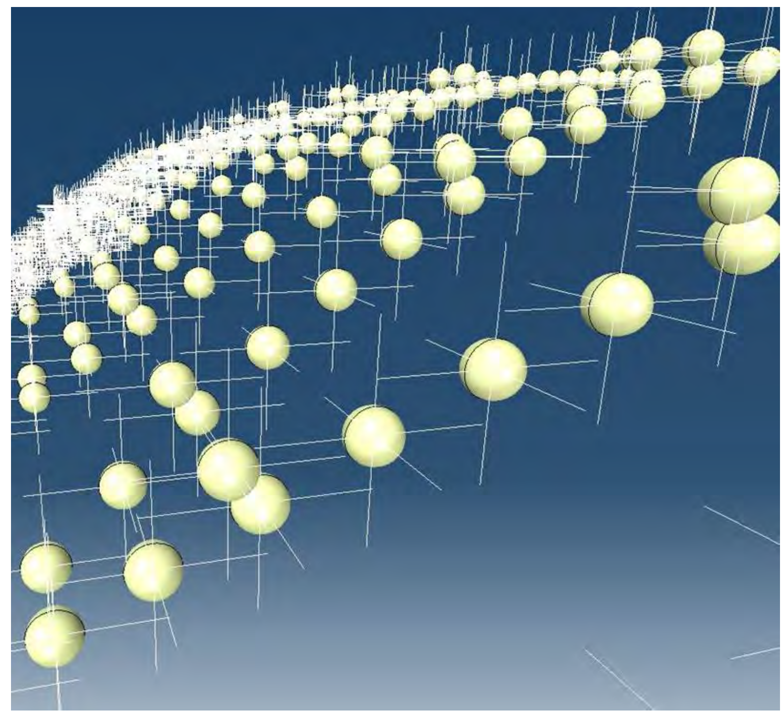
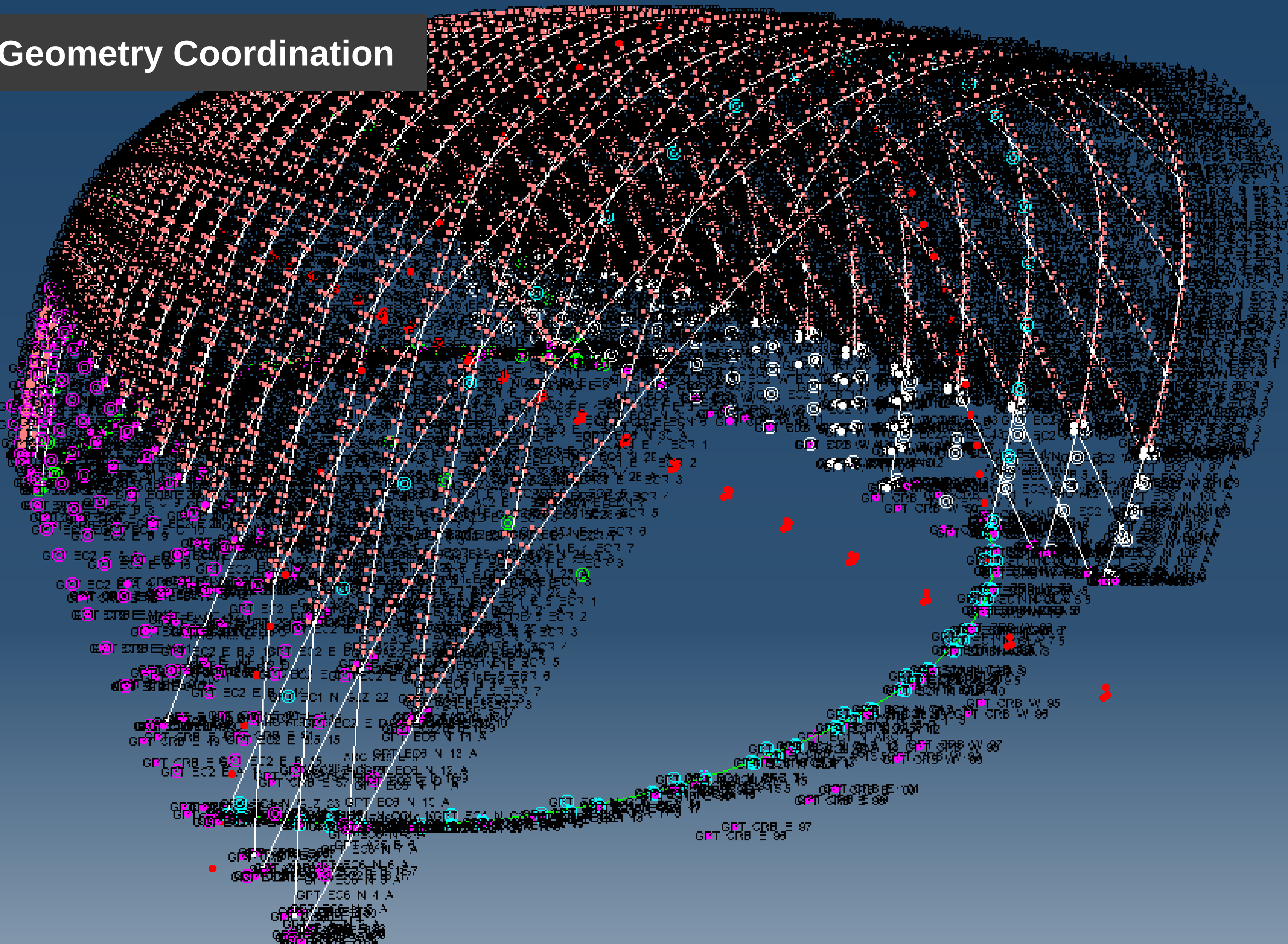
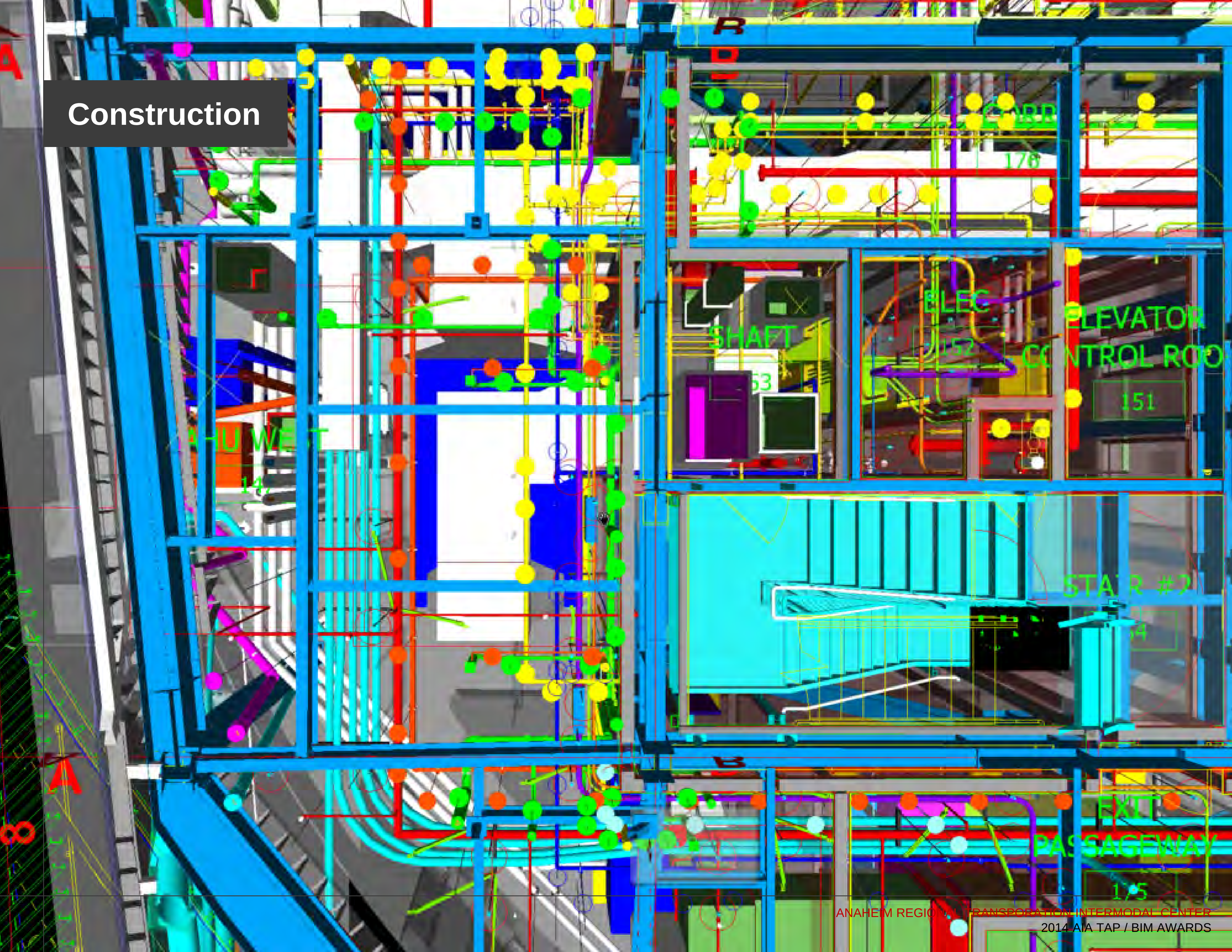


Geometry Coordination

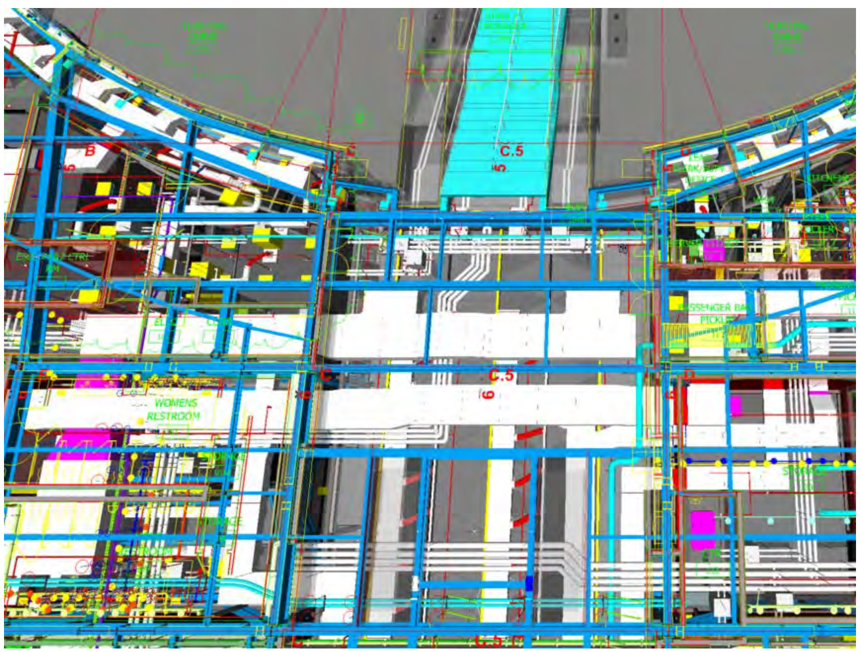


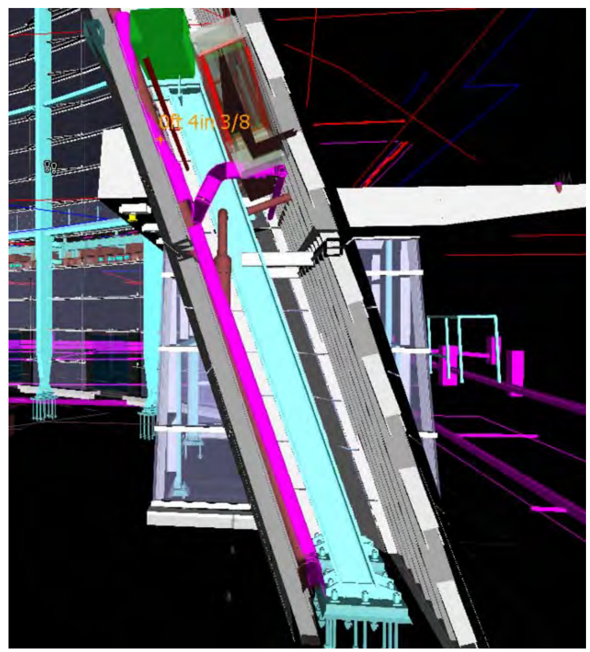
Construction

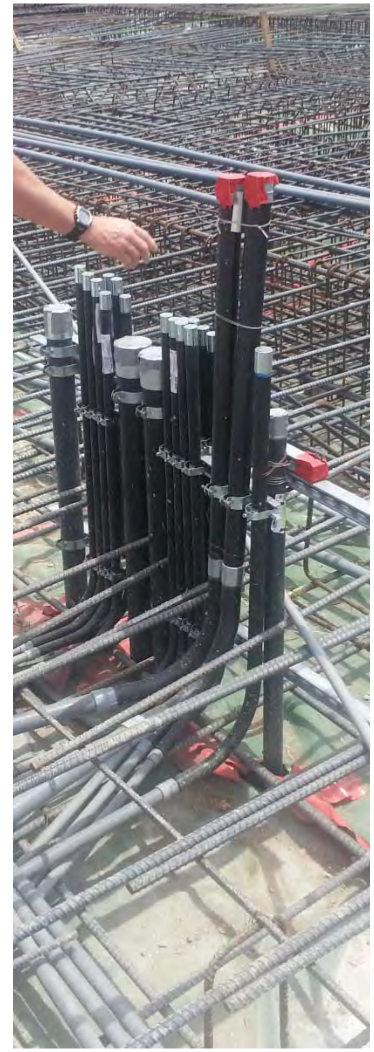


Construction

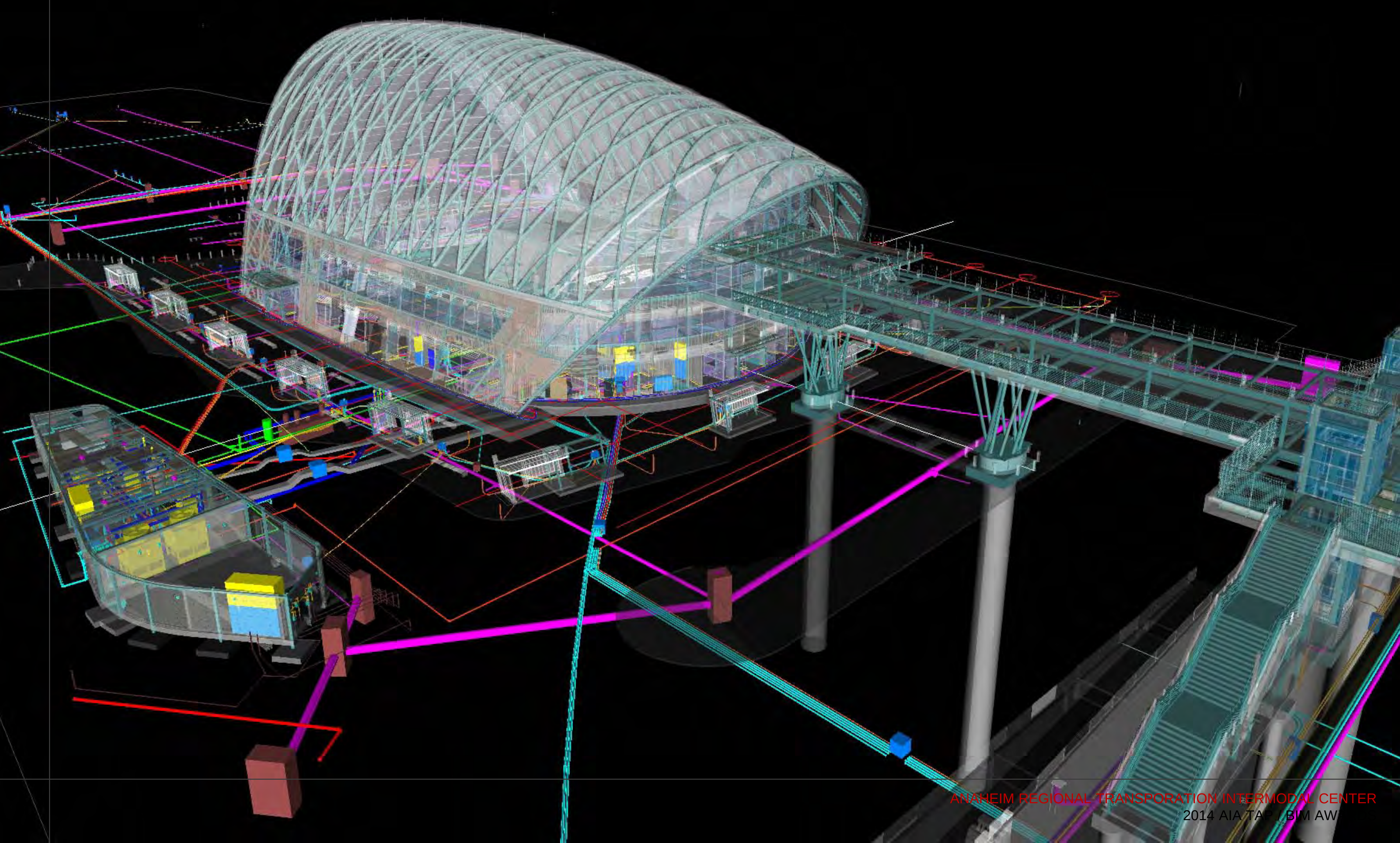
The build team is using BIM in their Virtual Design and Construction process. BIM is used for 3d coordination, visualization, cost estimation, fabrication, clash detection, construction sequencing, field coordination, procurement, and as built documentation.



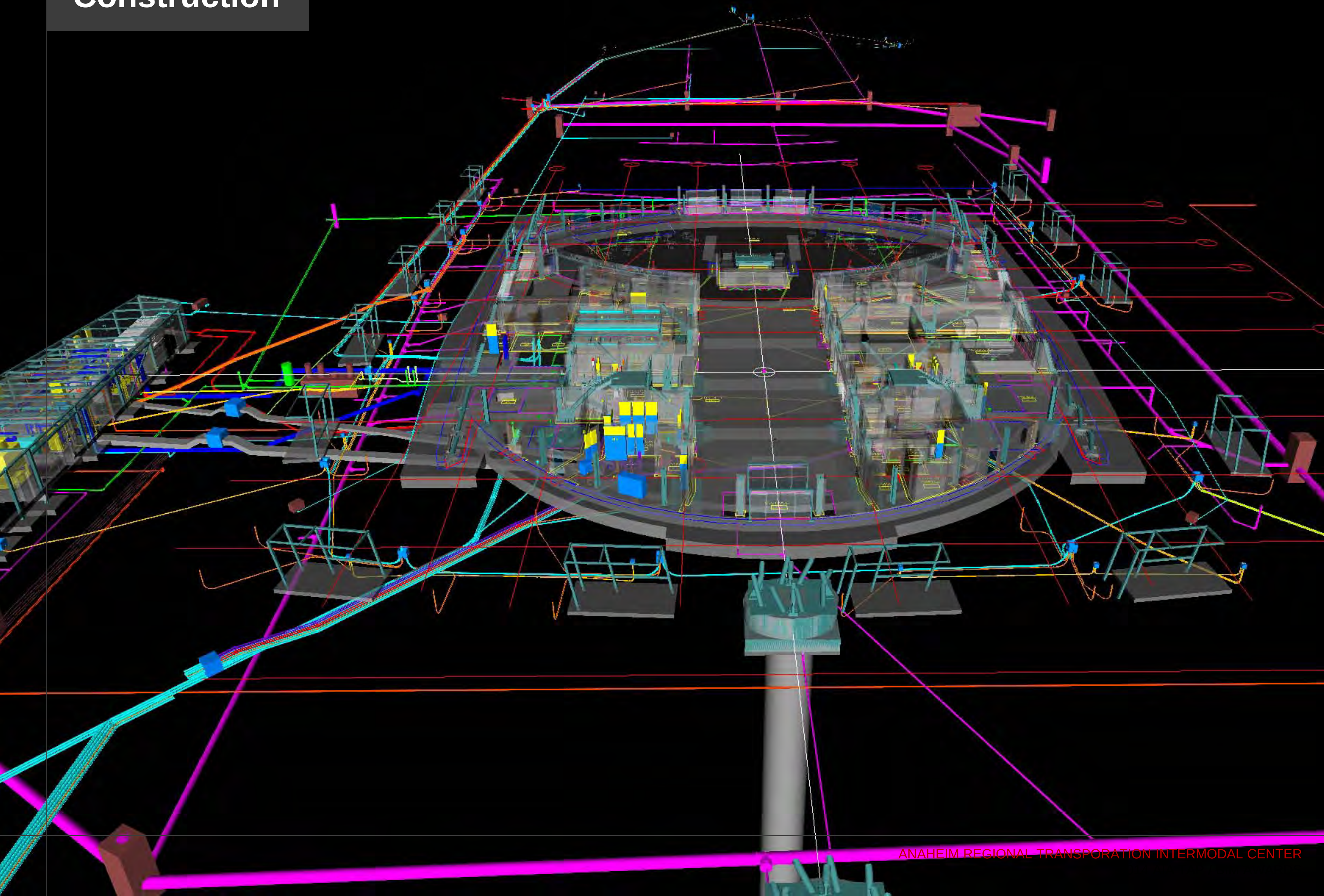




Construction



Construction



BIM Standards

BIM Standards were developed for the design phase through a BIM planning process. The primary models were divided into site, bridge, architecture, structure, MEP, enclosure, and geometry. Each team appointed a BIM coordinator to manage the process for their discipline. The design team designated a 3d process for construction quality assurance.

3D COORDINATION PROCESS:

1. ALL CONTRACTORS WHOSE SCOPE INCLUDES ELEMENTS OF THE EXTERIOR ENCLOSURE WILL BE REFERRED TO BELOW AS THE SHELL ENCLOSURE TEAM. THE SHELL ENCLOSURE TEAM WILL INCLUDE BUT IS NOT LIMITED TO CONTRACTORS INVOLVED WITH THE FOLLOWING ELEMENTS OR TRADE; STRUCTURAL STEEL, ETFE, ROOF, NORTH/SOUTH WALL, METAL PANEL, EAST/WEST WALL, EAST/WEST FRAMING.

2. ALL MEMBERS OF THE SHELL ENCLOSURE TEAM WILL PARTICIPATE IN A 3D COORDINATION PROCESS.

3. THE GENERAL CONTRACTOR WILL DESIGNATE A 3D COORDINATION MANAGER FOR SHELL ENCLOSURE TEAM. IF THE GENERAL CONTRACTOR DOES NOT HAVE THE IN-HOUSE CAPABILITY FOR COMPLEX 3D COORDINATION, THE CONTRACTOR MAY UTILIZE THE SERVICE OF AN OUTSIDE ENTITY TO PROVIDE THIS SERVICE.

4. EACH SHELL ENCLOSURE TEAM MEMBER WILL DESIGNATE A 3D COORDINATOR THAT WILL ACT AS THE TEAM MEMBER'S COORDINATION FACILITATOR.

5. TOGETHER WITH THE SHELL ENCLOSURE TEAM, THE 3D COORDINATION MANAGER WILL DEVELOP A 3D EXECUTION PLAN APPROPRIATE TO THE COMPLEXITY OF THE SHELL. THE 3D COORDINATION MANAGER WILL CONDUCT A WORKSHOP WITH ALL SHELL ENCLOSURE TEAM STAKE HOLDERS TO DEVELOP THE 3D EXECUTION PLAN. THE 3D EXECUTION PLAN WILL DEFINE MODELING, SCOPE AND LOD REQUIREMENTS FOR SHELL ENCLOSURE TEAM MEMBERS.

6. EACH SHELL ENCLOSURE TEAM MEMBER WILL BE RESPONSIBLE FOR PRODUCING 3D COORDINATION MODELS IN ACCORDANCE WITH THE 3D EXECUTION PLAN. IF THE SHELL ENCLOSURE TEAM MEMBER DOES NOT HAVE THE IN-HOUSE CAPABILITY TO MEET THE REQUIREMENTS, THE MEMBER MAY UTILIZE THE SERVICE OF AN OUTSIDE ENTITY TO PROVIDE THIS SERVICE.

7. AS BUILT 3D SURVEY OF PRIMARY DIAGRID STRUCTURE WILL BE PERFORMED BY THE DIAGRID SUBCONTRACTOR AND MADE AVAILABLE TO THE SHELL ENCLOSURE TEAM MEMBERS FOR COORDINATION. ADDITIONAL 3D SURVEY REQUIREMENTS WILL BE DEFINED BY THE 3D EXECUTION PLANNING PROCESS.

8. THE 3D COORDINATION MANAGER WILL PREPARE A 3D GEOMETRIC DRIVER MODEL AND DISTRIBUTE TO ALL SHELL ENCLOSURE TEAM MEMBERS.

9. THE 3D GEOMETRIC DRIVER MODEL WILL BE DEVELOPED FROM THE 3D GEOMETRIC DRIVER DATA DEVELOPED BY THE ENCLOSURE DESIGN TEAM. SEE DRAWINGS GEO100 SERIES FOR DATA.

10. THE 3D COORDINATION MANAGER WILL DEFINE A GEOREFERENCED SHELL ORIGIN AND WILL MAINTAIN THIS DATUM THROUGHOUT THE COORDINATION PROCESS. THE SHELL ORIGIN WILL BE DEFINED AS 0, 0, 0 IN THE 3D GEOMETRIC DRIVER MODEL. THE SHELL ORIGIN WILL BE DEFINED IN X, Y, AND Z DIMENSIONS IN A CAD FILE REFERENCING PROJECT WORLD COORDINATION DATUM.

11. WORKING UNITS, UNLESS OTHERWISE SPECIFIED, SHALL BE IN DECIMAL INCHES.

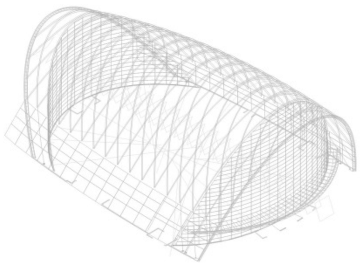
12. THE 3D COORDINATION MANAGER WILL DESIGNATE A 3D COORDINATION EXCHANGE MODEL FORMAT, CAPABLE OF COMBINING ALL TEAM MODELS IN A SINGLE VISUAL AND DIMENSIONAL SPACE FOR COORDINATION REVIEW. THE 3D COORDINATION EXCHANGE MODEL FORMAT MUST BE CAPABLE OF DIGITAL EXCHANGE, WITH LOSSLESS ACCURACY, OF INFORMATION FROM SHELL ENCLOSURE TEAM MEMBERS OF; SYSTEM DESIGN, VIRTUAL PROTOTYPE, AS BUILT CONDITION AND FABRICATION 3D DIGITAL DOCUMENTATION.

13. ALL SHELL ENCLOSURE TEAM MEMBERS WILL SUBMIT 3D COORDINATION MODELS IN THE DESIGNATED 3D COORDINATION EXCHANGE MODEL FORMAT. EACH SHELL ENCLOSURE TEAM MEMBER WILL MAINTAIN THEIR RESPECTIVE MODEL DEVELOPMENT FILES AS SOLE AUTHOR.

14. THE 3D COORDINATION MANAGER WILL COMBINE AND DISPLAY ALL 3D COORDINATION MODELS FOR USE DURING COORDINATION MEETINGS, ONLINE MEETINGS, WORKSHOPS AND ON SITE COLLABORATION.

15. AS BUILT 3D MODELS PREPARED BY SUBCONTRACTORS WILL BE COORDINATED AND DISTRIBUTED BY THE 3D COORDINATION MANAGER. THE FOLLOWING MODELS WILL BE PREPARED: DIAGRID STRUCTURE, ENCLOSURE PRIMARY STRUCTURE, ENCLOSURE SECONDARY STRUCTURE, AND FRAMING

16. WITH EACH REVISION TO THE 3D COORDINATION MODELS THE 3D COORDINATION MANAGER SHALL ISSUE NOTIFICATION TO EACH SHELL ENCLOSURE TEAM MEMBER.



3D COORDINATION DEFINITIONS:

1. SHELL ENCLOSURE TEAM - ALL CONTRACTORS INVOLVED IN THE CONSTRUCTION OF THE MAIN TERMINAL SHELL ENCLOSURE AND PRIMARY STRUCTURAL STEEL DIAGRID.

2. 3D COORDINATION MANAGER – PRIME COORDINATION FACILITATOR.

3. 3D COORDINATOR – SUBCONTRACTOR COORDINATION FACILITATOR.

4. 3D EXECUTION PLAN – COORDINATION PLAN DEVELOPED BY CONSENSUS WITH SHELL ENCLOSURE TEAM.

5. GEOMETRIC DRIVER – DATUM GEOMETRY REQUIRED BY ALL TEAM MEMBERS TO DEVELOP 3D COORDINATION MODELS, SYSTEM DETAIL AND SHOP DRAWINGS.

6. 3D GEOMETRIC DRIVER MODEL – 3D MODEL CONTAINING GEOMETRIC DRIVERS.

7. 3D GEOMETRIC DRIVER DATA – GEOMETRIC DRIVER DATA PROVIDED AS POINTS AND ARCS DEVELOPED BY ENCLOSURE DESIGN CONSULTANT.

8. 3D COORDINATION MODEL: 3D MODEL CONTAINING GEOMETRIC REPRESENTATION OF PROJECT ELEMENTS.

9. 3D COORDINATION EXCHANGE MODEL – 3D COORDINATION MODEL IN INTEROPERABLE FORMAT.

10. 3D COORDINATION EXCHANGE MODEL FORMAT – 3D DATA EXCHANGE FORMAT CAPABLE OF DIGITAL EXCHANGE OF 3D GEOMETRY WITH FABRICATION GRADE ACCURACY.

11. AS BUILT 3D COORDINATION MODELS – 3D MODEL CONTAINING SURVEY DATA OF AS BUILT CONDITIONS.

12. SHELL ORIGIN – 0, 0, 0 DATUM POINT FOR 3D COORDINATION MODELS.

13. WIREFRAME GEOMETRY – 3D MODEL ELEMENTS CONSISTING OF POINTS, LINES, ARCS, AND SPLINES.

14. 3D SCAN – MEASUREMENT OF A LARGE NUMBER OF POINTS ON THE SURFACE OF AN OBJECT

15. POINT CLOUD - SET OF VERTICES IN A THREE-DIMENSIONAL COORDINATE SYSTEM THAT REPRESENT THE EXTERNAL SURFACE OF AN OBJECT.

16. LOD – LEVEL OF DETAIL

GEOMETRIC DESCRIPTIONS:

A. **GENERAL SCOPE:**

1. THIS SECTION DEFINES DRIVER AND WIREFRAME GEOMETRY FOR THE MAIN TERMINAL ENCLOSURES. SEE EC000 SERIES DRAWINGS FOR OVERALL SCOPE OF ENCLOSURES AND SEE STRUCTURAL DRAWINGS FOR OVERALL SCOPE OF PRIMARY STRUCTURE.

2. SEE DRAWINGS GEO100 SERIES FOR DATA.

3. ALL DATA POINTS AND RADII ARE DEFINED IN DECIMAL INCHES WITH A MINIMUM 6 DECIMAL PLACES OF ACCURACY.

B. GEOMETRIC DRIVER GEOMETRY:

1. DRIVERS ARE DATUM GEOMETRY REQUIRED BY ALL TEAM MEMBERS TO DEVELOP SYSTEM DETAIL AND SHOP DRAWINGS. DRIVERS ARE DEFINED BY A SERIES OF X, Y, Z POINT DATA AND ARC RADII THAT DEFINE LINES, ARCS, CURVES, AND PLANES.

2. THE SHELL ORIGIN IS LOCATED AT E6067145.7700' N2238939.7371'; IN REFERENCE TO CIVIL DRAWING 7ACXZ01.DWG.

3. THE SHELL X, Y ORTHOGONAL GRID IS ROTATED -19.934 DEGREES FROM TRUE NORTH, DEFINED IN REFERENCE TO THE SHELL CENTERLINE C.5 AS DEFINED IN CIVIL DRAWING 7ACXZ01.DWG.

4. FOUR GRID LINES ARE SPECIFICALLY DEFINED BY THE DIAGRID GEOMETRY, GRIDS 3.94, 4.96, 5.98, AND 7 ARE DEFINED BY DATA POINTS AT THEIR INTERSECTION WITH THE CENTERLINE GRIDLINE C.5

5. THE PRIMARY DESIGN DRIVER FOR THE SHELL IS A TORUS. THE TORUS IS DEFINED BY 41 DATA POINTS THAT DEFINE A SPLINE THAT IS SWEPT AROUND AN AXIS DEFINED BY TWO DATA POINTS.

6. THE SHELL TORUS IS USED TO DEVELOP THE ETFE ROOF GEOMETRY THAT HAS GEOMETRIC RELATIONSHIPS NORMAL AND TANGENTIAL TO THE SHELL TORUS.

7. THE DIAGRID ARCHES ARE PLANAR; THE ARCH PLANES ARE DEFINED BY THREE DATA POINTS EACH.

8. DATUM PLANES ARE DEFINED BY THREE DATA POINTS EACH FOR; SHELL SYMMETRY, AND LEVELS ONE, TWO AND THREE.

C. PRIMARY STRUCTURAL STEEL DIAGRID:
THE PRIMARY STRUCTURAL STEEL DIAGRID IS COMPRISED OF 40 ARCHES RATIONALIZED INTO ARC SEGMENTS. THE DIAGRID ARCH ARC SEGMENTS ARE CONSTRUCTED BY USING TWO CONSECUTIVE DIAGRID ARCH POINTS AND THE DIAGRID ARCH ARC RADIUS AS DEFINED IN THE GEOMETRY DATA.

D. NORTH AND SOUTH WALLS (EC 1 & EC 2):
THE NORTH GLASS WALL WAS DEVELOPED FROM AN OFFSET OF THE INTERSECTION OF ARCH PLANE A03 WITH THE SHELL TORUS SURFACE PROJECTED TO THE XY PLANE. THE GEOMETRY DATA DEFINES POINTS FOR THE FRONT OF GLASS; A POLYLINE THROUGH THESE POINTS EXTRUDED IN THE Z DIRECTION DEFINES THE PLANAR, SEGMENTED DESIGN SURFACE. THE Z LIMIT POINTS DEFINE THE UPPER BOUNDARY OF THE DESIGN SURFACE; A POLYLINE BETWEEN THESE POINTS WILL BE THE TRIM BOUNDARY FOR THE DESIGN SURFACE. THE GEOMETRY DATA ALSO DEFINES IN TWO DIMENSIONS THE CABLE CENTERLINES, COLUMN CENTERLINES, AND SECONDARY STEEL ARCS. THE ORIENTATION OF THE COLUMNS ARE NORMAL TO THE ADJACENT FRONT OF GLASS PLANE, THIS AXIS CAN BE DEVELOPED BY A LINE BETWEEN THE COLUMN CENTER POINT AND THE MIDPOINT OF GLASS PLANE POINT. THE SECONDARY STEEL ARCS ARE FORMED WITH TWO CONSECUTIVE ARC POINTS AND THE RADIUS DEFINED IN THE GEOMETRY DATA.

E. EAST AND WEST WALL (EC 2):
THE EAST AND WEST WALLS DESIGN SURFACE IS DEFINED BY A SCALE TRANSLATION SURFACE; THIS TYPE OF SURFACE HAS PERFECTLY PLANAR SEGMENTS. THE SURFACE IS DEFINED BY A POLYLINE THROUGH POINTS A1 THROUGH A17 TRANSLATED TO POINTS B1 THROUGH E1. PLANES ARE DEFINED BY THE TWO PARALLEL LINES IN THE RESPECTIVE POLYLINE. METAL PANELS WITHIN EACH PLANE WILL FORM IDENTICAL PANELS BY SUBDIVIDING EACH PLANE EVERY TWO FEET IN THE Z DIRECTION AND BY A LINE BETWEEN THE UPPER AND LOWER MIDPOINTS. KEY POINTS THAT DEFINE GEOMETRY FOR THE CURTAIN WALL AND FOR GEOMETRY ON A SOUTHWARD LEANING ANGLE ARE DEFINED BY POINTS IN THE GEOMETRY DATA.

F. ETFE ROOF (EC 3):
THE ETFE CHANNEL ARCS ARE DEFINED BY CREATING A THREE POINT ARC THROUGH THREE CONSECUTIVE ETFE CHANNEL POINTS. THE ETFE ANCHORAGE CHANNELS ARE DEVELOPED BY SWEEPING A PROFILE ALONG THESE ARCS NORMAL TO THE SHELL SURFACE. THE ETFE CHAIR POINTS DEFINE THE TOP CENTER POINT OF EACH ETFE CHAIR; THE ORIENTATION OF THE CHAIR IS DEVELOPED WITH THE TANGENT TO AND THE NORMAL TO THE RESPECTIVE DIAGRID ARCH ARC SEGMENT.

G. CANOPY NORTH (EC 5):
THE NORTH CANOPY TOP SURFACE IS CONSTRUCTED OF FIVE PLANES. THE PANEL JOINT CENTERS ARE DEFINED BY DATA POINTS A-G AT EACH PANEL SEGMENT. INDIVIDUAL PLANAR PANEL SEGMENTS OF THE CANOPY; GUTTER EDGE, NOSE AND UNDERSIDE ARE DEFINED WITH THE GEOMETRY DATA POINTS.

H. FASCIA NORTH AND SOUTH (EC 6):
THE PLANAR SEGMENTED DESIGN SURFACE GEOMETRY OF THE FASCIAS ARE DEFINED BY FOUR DATA POINTS A-D AT EACH THEORETICAL SEGEMENT INTERSECTION.

I. CURB:
THE CURB OUTER GEOMETRY IS DEFINED WITH THE GEOMETRY DATA POINTS; THE WIDTHS ARE DEFINED IN THE ENCLOSURE WALL DETAILS.

SHEET LIST - GEOMETRY SET		
SHEET NUMBER	SHEET NAME	CONFORMED SET
GEO001	GEOMETRY GENERAL NOTES	•
GEO002	GEOMETRY KEY	•
GEO003	GEOMETRY BUILDING ORIGIN	•
GEO004	GEOMETRY BUILDING DESIGN DRIVERS	•
GEO010	GEOMETRY DIAGRID A1-A20 EAST	•
GEO011	GEOMETRY DIAGRID A21-A40 EAST	•
GEO012	GEOMETRY DIAGRID A1-A20 WEST	•
GEO013	GEOMETRY DIAGRID A21-A40 WEST	•
GEO020	GEOMETRY ETFE CHANNEL A1-A20 EAST	•
GEO021	GEOMETRY ETFE CHANNEL A21-A40 EAST	•
GEO022	GEOMETRY ETFE CHANNEL A1-A20 WEST	•
GEO023	GEOMETRY ETFE CHANNEL A21-A40 WEST	•
GEO024	GEOMETRY ETFE CHAIR A1-A20 EAST	•
GEO025	GEOMETRY ETFE CHAIR A21-A40 EAST	•
GEO026	GEOMETRY ETFE CHAIR A1-A20 WEST	•
GEO027	GEOMETRY ETFE CHAIR A21-A40 WEST	•
GEO030	GEOMETRY CURB NORTH	•
GEO031	GEOMETRY CURB SOUTH	•
GEO040	GEOMETRY EAST	•
GEO041	GEOMETRY EAST INTERIOR	•
GEO042	GEOMETRY EAST SECONDARY STRUCTURE	•
GEO043	GEOMETRY EAST GUTTER	•
GEO050	GEOMETRY WEST	•
GEO051	GEOMETRY WEST INTERIOR	•
GEO052	GEOMETRY WEST SECONDARY STRUCTURE	•
GEO053	GEOMETRY WEST GUTTER	•
GEO060	GEOMETRY NORTH	•
GEO061	GEOMETRY NORTH CANOPY	•
GEO062	GEOMETRY NORTH FASCIA	•
GEO070	GEOMETRY SOUTH	•
GEO071	GEOMETRY SOUTH FASCIA	•
GEO101	GEOMETRY DATA 01	•
GEO102	GEOMETRY DATA 02	•
GEO103	GEOMETRY DATA 03	•
GEO104	GEOMETRY DATA 04	•
GEO105	GEOMETRY DATA 05	•
GEO106	GEOMETRY DATA 06	•
GEO107	GEOMETRY DATA 07	•
GEO108	GEOMETRY DATA 08	•
GEO109	GEOMETRY DATA 09	•
GEO110	GEOMETRY DATA 10	•
GEO111	GEOMETRY DATA 11	•
GEO112	GEOMETRY DATA 12	•
GEO113	GEOMETRY DATA 13	•
GEO114	GEOMETRY DATA 14	•
GEO115	GEOMETRY DATA 15	•
GEO116	GEOMETRY DATA 16	•
GEO117	GEOMETRY DATA 17	•
GEO118	GEOMETRY DATA 18	•
GEO119	GEOMETRY DATA 19	•
GEO120	GEOMETRY DATA 20	•
GEO121	GEOMETRY DATA 21	•
GEO122	GEOMETRY DATA 22	•
GEO123	GEOMETRY DATA 23	•
GEO124	GEOMETRY DATA 24	•
GEO125	GEOMETRY DATA 25	•
GEO126	GEOMETRY DATA 26	•
GEO127	GEOMETRY DATA 27	•
GEO128	GEOMETRY DATA 28	•
GEO129	GEOMETRY DATA 29	•
GEO130	GEOMETRY DATA 30	•
GEO131	GEOMETRY DATA 31	•
GEO132	GEOMETRY DATA 32	•
GEO133	GEOMETRY DATA 33	•
GEO134	GEOMETRY DATA 34	•
GEO135	GEOMETRY DATA 35	•

Grand total: 66

CONTRACT DOCUMENTS - FOR CONSTRUCTION
PERFORMANCE SPECIFICATION – DEFERRED APPROVAL

Anaheim Regional Transportation Intermodal Center (ARTIC)

2014 AIA TAP / BIM Awards