Highlights of Emerging Innovations

NIST Workshop, May 19 2010

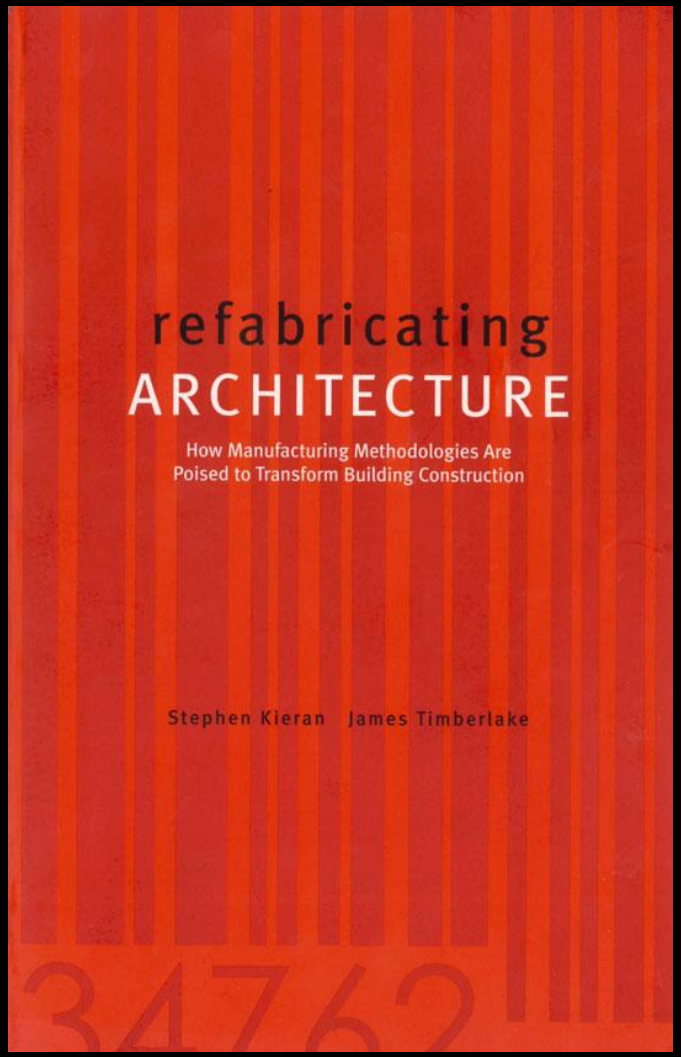
Presented by:

Charles H. Thornton, PhD, PE

Founding Principal, Thornton Tomasetti

Chairman, STRAAM

Thornton Tomasetti



ARCHITECTURE

Preoccupation with image and a failure to look at process has led entire generations of architects to overlook transfer technologies and transfer processes. Kieran and Timberlake argue that the time has come to re-evaluate and update the basic design and construction methods that have constrained the building industry throughout its history. They skillfully demonstrate that contemporary architectural construction is a linear process, in both design and construction, where segregation of intelligence and information is the norm. They convince the reader to look at the automobile, shipbuilding, and aerospace industries to learn how to incorporate collective intelligence and nonhierarchical production structures. Those industries have proven to be progressively economic, efficient, and they yield a higher quality product while the production of buildings stagnates in the methods and practices of the nineteenth century. The transfer they envision is the complete integration of design with the craft of assembly supported by the materials scientist, the product engineer, and the process engineer, all using tools of present information science as the central enabler.

The new architecture will not be about style, but rather about substance—about the very methods and processes that underlie making.

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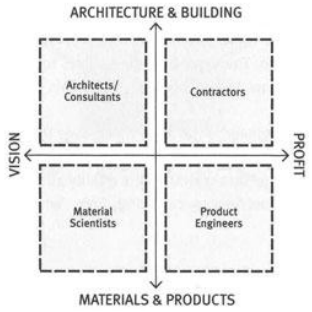
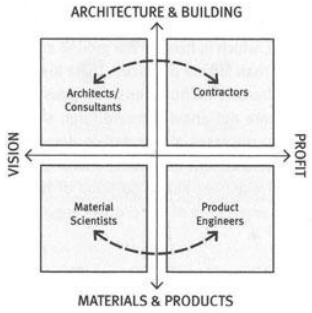
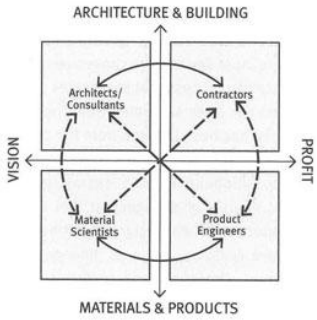


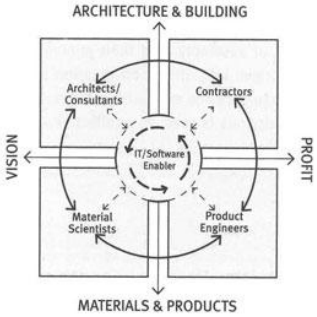
THE STRATIFICATION AND SEGREGATION OF ARCHITECTURE *Current architectural production is typified by stratification of the various components used in designing and implementing a building. As a result, the corresponding disciplines that are responsible for each segregate themselves within the stratified field. There is total self-segregation and no collective intelligence.*



LIMITED COMMUNICATION *There is very little communication in the architectural model between disciplines. What communication does exist is not a true communicative relationship, but rather a hierarchical one in which one party is hired by the other to fulfill a particular role, such as a lighting consultant providing the lighting scheme for an architect.*

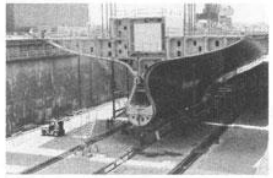


BREAKING OUT OF THE BOX *The four major disciplines need to cross the boundaries established by their traditional roles. All parties must seek a balance between vision and profit. There need to be reciprocal relationships between the developers of materials and products with the implementers and appliers.*



ENABLING COLLECTIVE INTELLIGENCE *An entire new industry that produces communication/collaboration software has made it possible for the various parties involved in a project to have real-time sharing of information. This instantaneous communication allows each party to be aware and involved with the other various disciplines throughout the entire process of a project.*

Airplanes

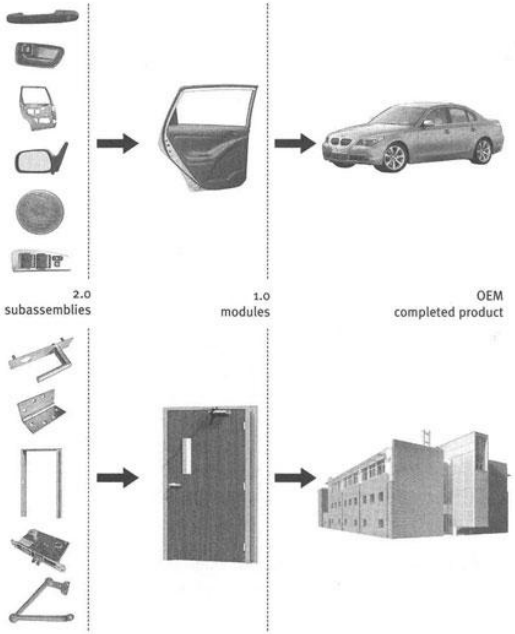


Ships

Cars

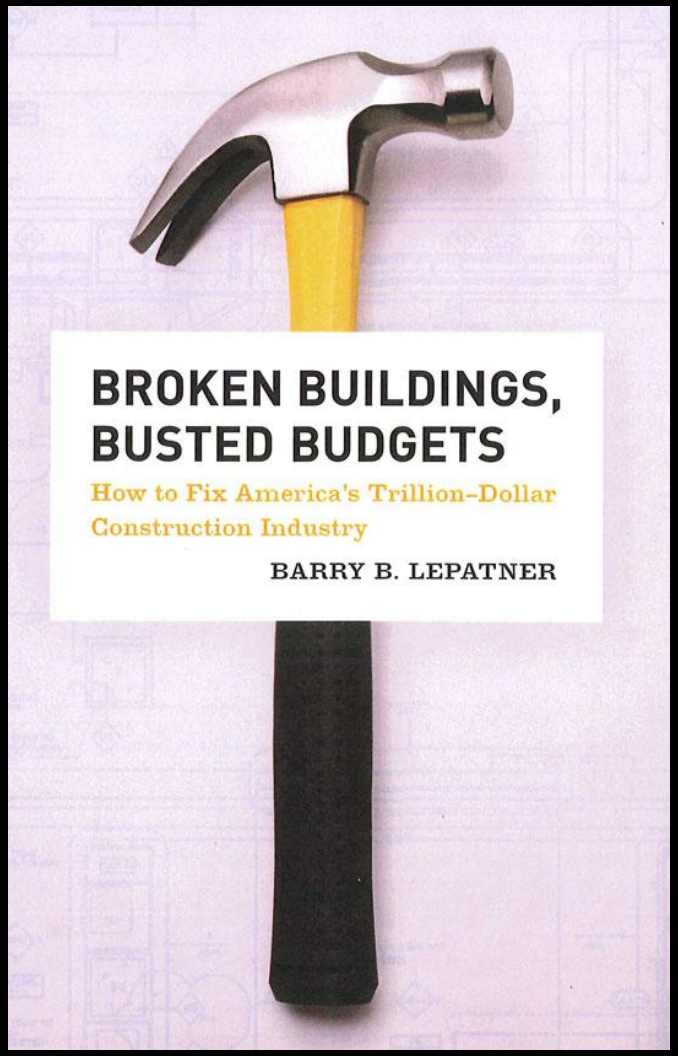
INDUSTRIES WITH INTEGRATED COLLABORATION

PUTTING THE PARADIGM TO THE TEST *Other major industries have already implemented the tools of the new collective intelligence paradigm. They have proven that connectivity Web sites and enabling software aid in speeding up the process of development, while increasing quality and reducing cost. (Images: courtesy Boeing, Kvaerner Philadelphia Shipyard Inc., Magna Steyr.)*



Q = INTEGRATED COMPONENT CONSTRUCTION

IMPROVING THE SUPPLY CHAIN *The automotive industry has determined that expanding the supply chain into a few tiers has improved the quality of the final product and reduced its cost. Instead of having all parts arrive at the final point of assembly, the tiers gradually build up collections of parts to supply modules or integrated component assemblies to the original equipment manufacturer.*



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Modular Manufacturing

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CLO2 Modules

Heavy Rigging, Piping, Instrumentation, & Mechanical

Cianbro.com

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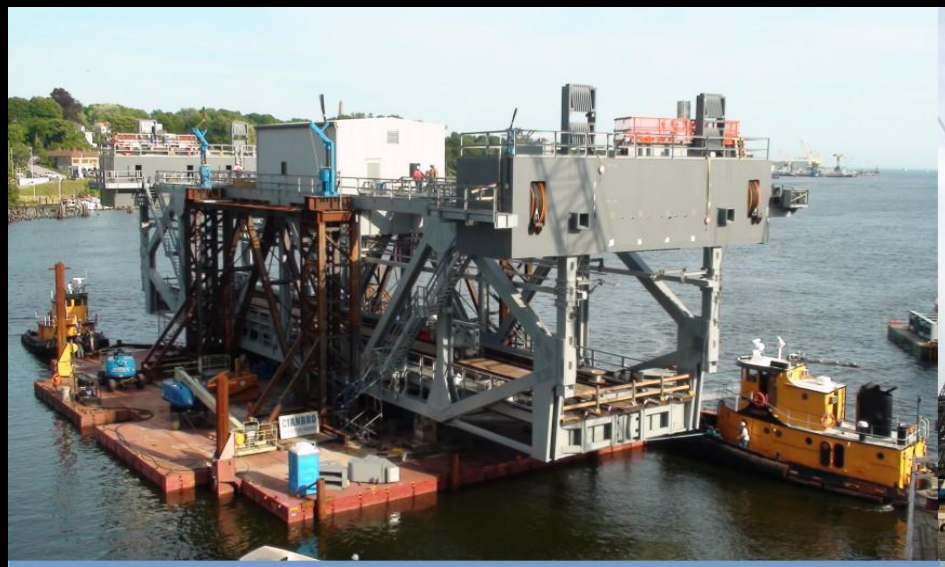
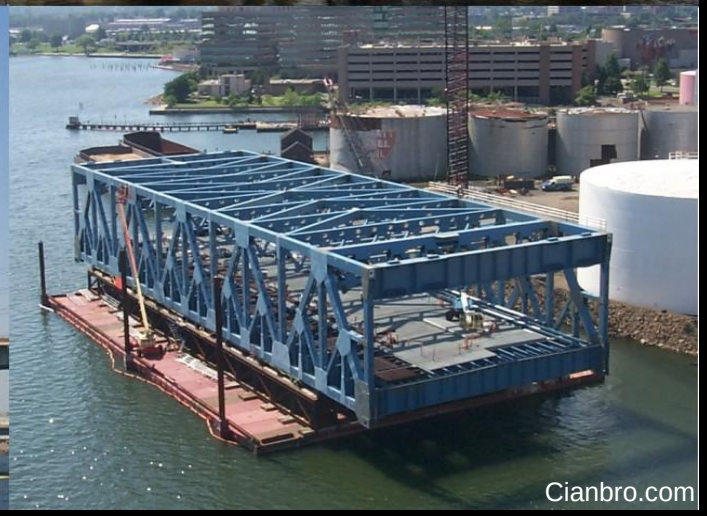
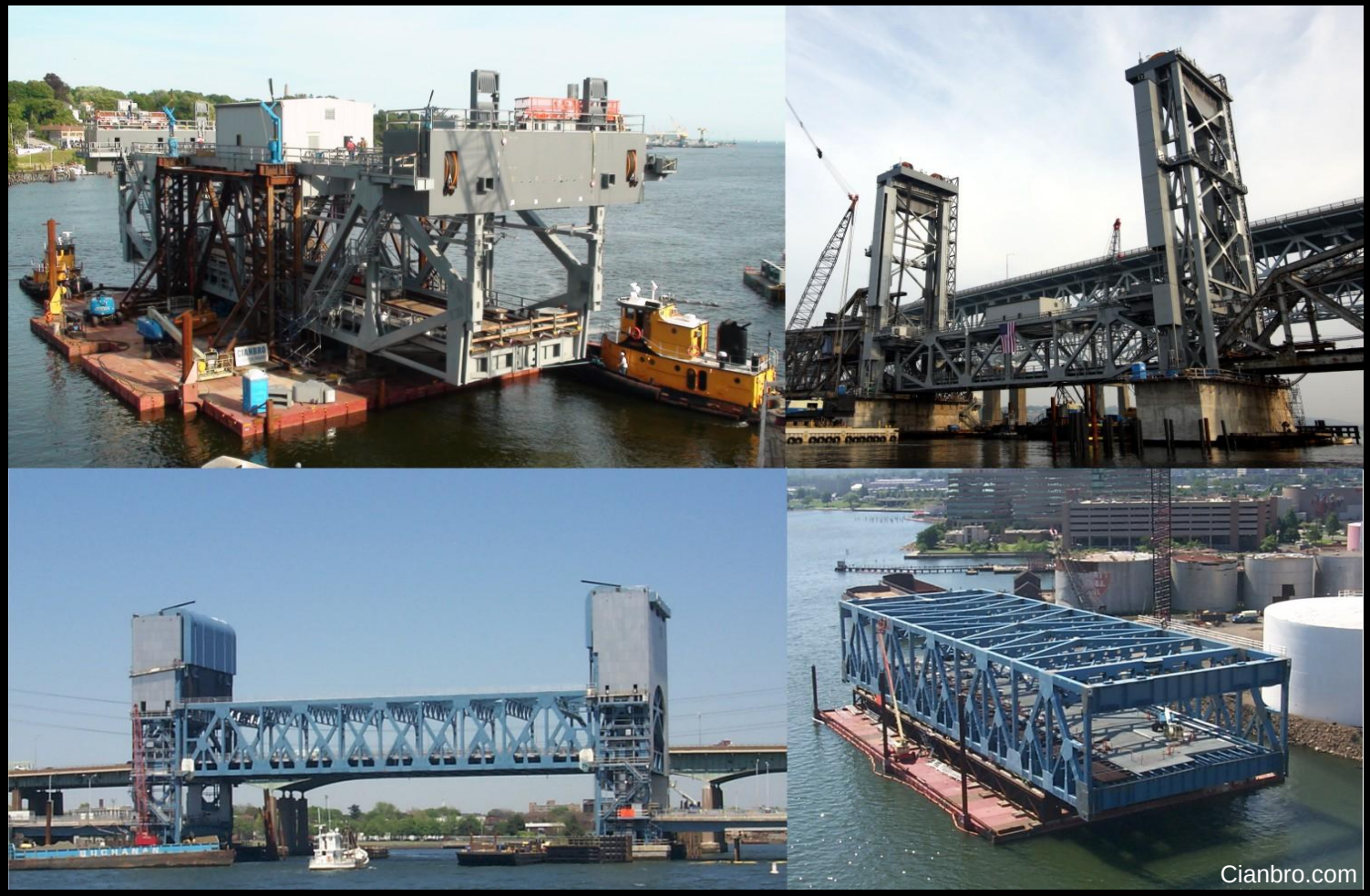
Transportation Modules – Bridges





Offshore Modules – Amethyst

Piping, Mechanical, Electrical, Rigging, Welding, Instrumentation, Painting & Heavy Load Transfers



5,500 Ton Deckbox Land To Barge Transfer

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Manufacturing Modules – Movable Inspection Platforms

Fabrication, Piping, Mechanical, Electrical, Rigging, Instrumentation, Painting & Heavy Load Transfers

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Eastern Manufacturing Facility

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Current Project

Will Make This Largest Refinery in the U.S & in the Top 10 in the World.

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Project Specifics

- Expansion of Port Arthur, TX Refinery
- Will become largest refinery in North America
- Shell/Saudi Aramco owners
- Will increase output from 325k to 600k bbls/day
- 8 billion dollar project

Thornton Tomasetti

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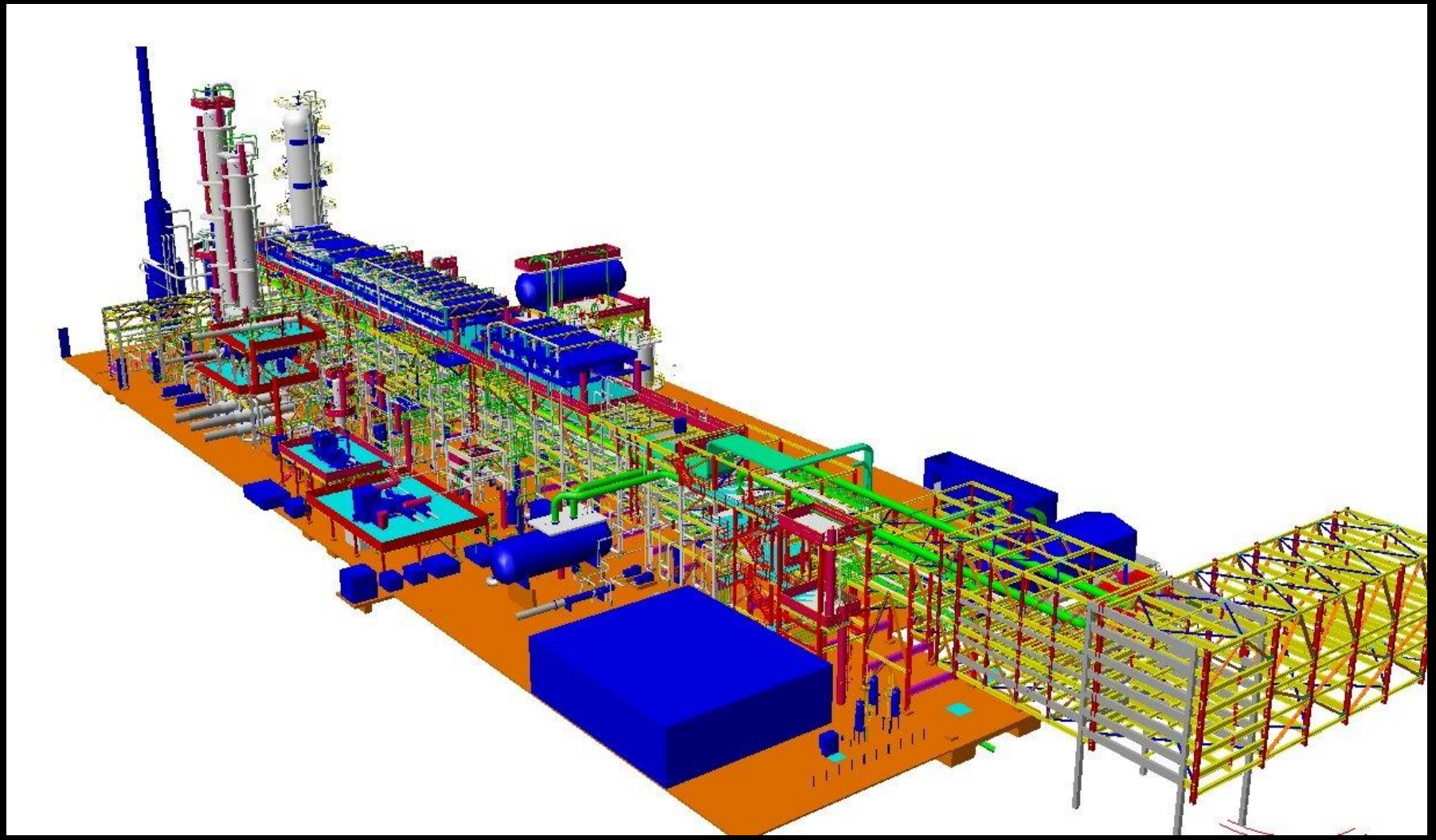
CAT Feed Hydrotreater (CFH)



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Hydrocracker Unit -HCU2

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Refinery Modules

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Module Load Out – March 2009

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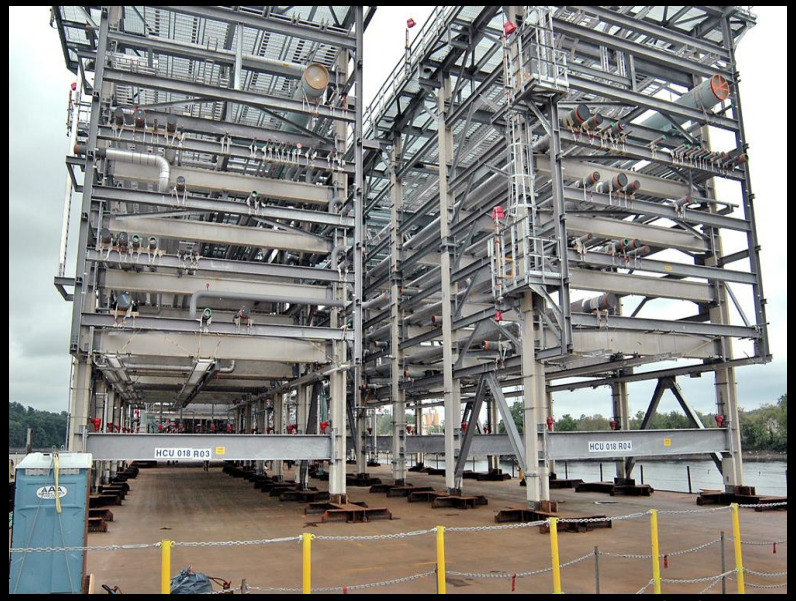

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Barge Shipment

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Prefast Modular Systems - Education

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Chile – ATC Reconnaissance Trip

Adobe

Pumanque

February 27 2010 M8.8 Chile Earthquake

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Chile – ATC Reconnaissance Trip

Unreinforced Brick Masonry

Curico

Photo: Bret Lizundia, Rutherford & Chekene

Highly Rated Restaurant in Guidebook

February 27 2010 M8.8 Chile Earthquake

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Chile – ATC Reconnaissance Trip

Concrete

Damaged Apartment Building, *Santiago, Edificio Central Park*

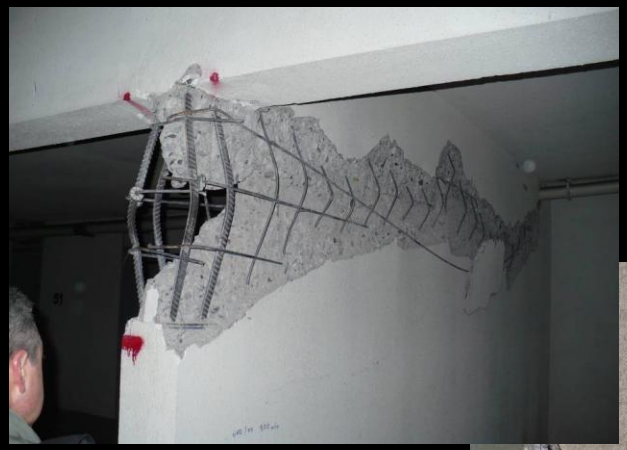

Photo: Bret Lizundia, Rutherford & Chekene

February 27 2010 M8.8 Chile Earthquake

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Chile – ATC Reconnaissance Trip

Unreinforced Brick Masonry

Collapsed Apt Bldg
Maipu, Edificio Don Luis

Photos: Bret Lizundia, Rutherford & Chekene

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Chile – ATC Reconnaissance Trip

Concrete

Photos: Bret Lizundia, Rutherford & Chekene

Collapsed Apt Bldg
Maipu, Edificio Don Tristan

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Chile – ATC Reconnaissance Trip

Concrete

Photos: Bret Lizundia, Rutherford & Chekene

Upper Story Partial Collapse

Concepcion, Edificio O'Higgins

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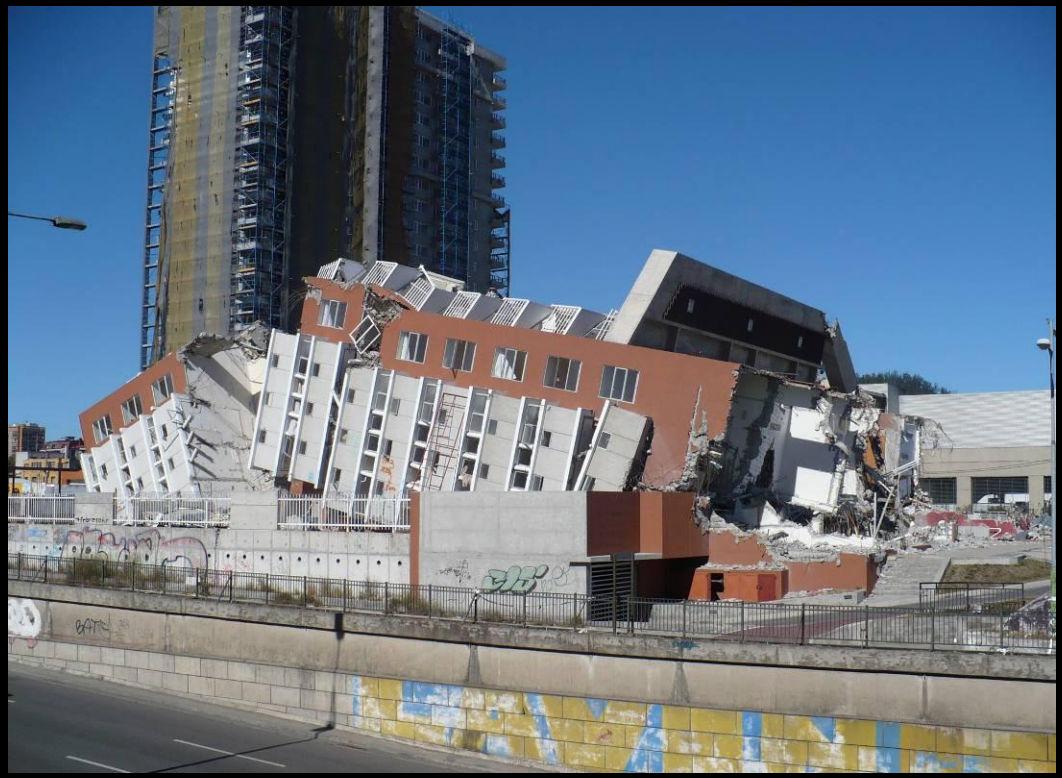
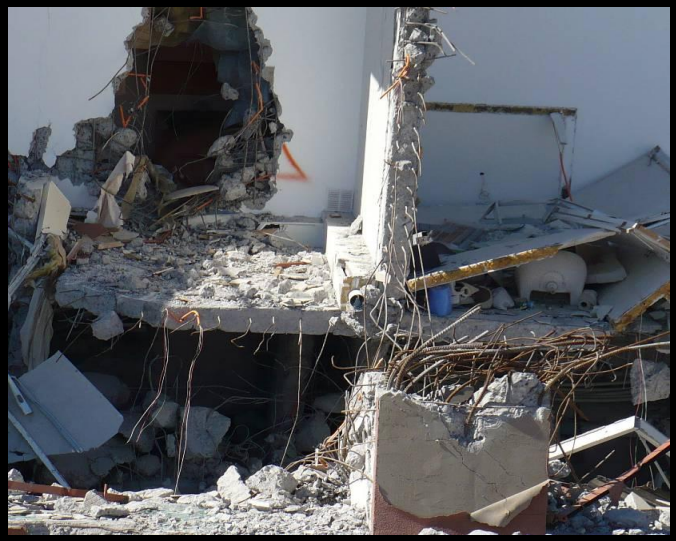
Chile – ATC Reconnaissance Trip

Concrete





Collapsed Apartment Building
Concepcion, Edificio Alto Rio

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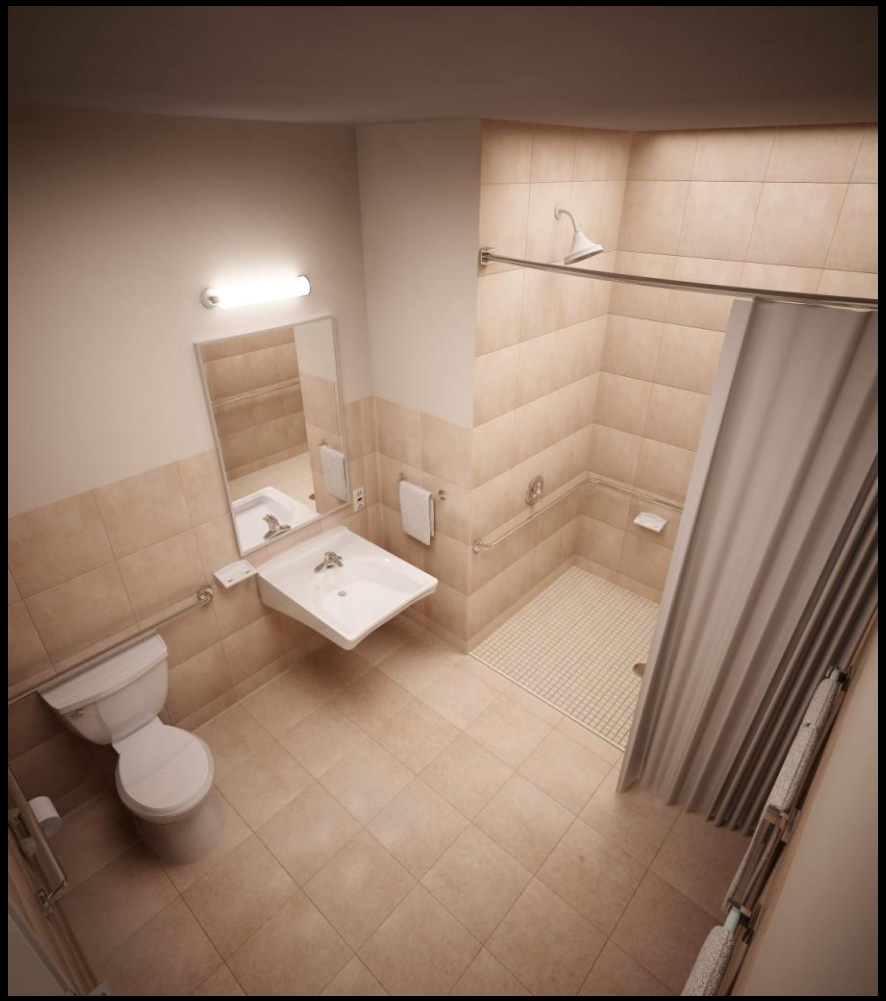
Bathroom Units



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Bathroom Units

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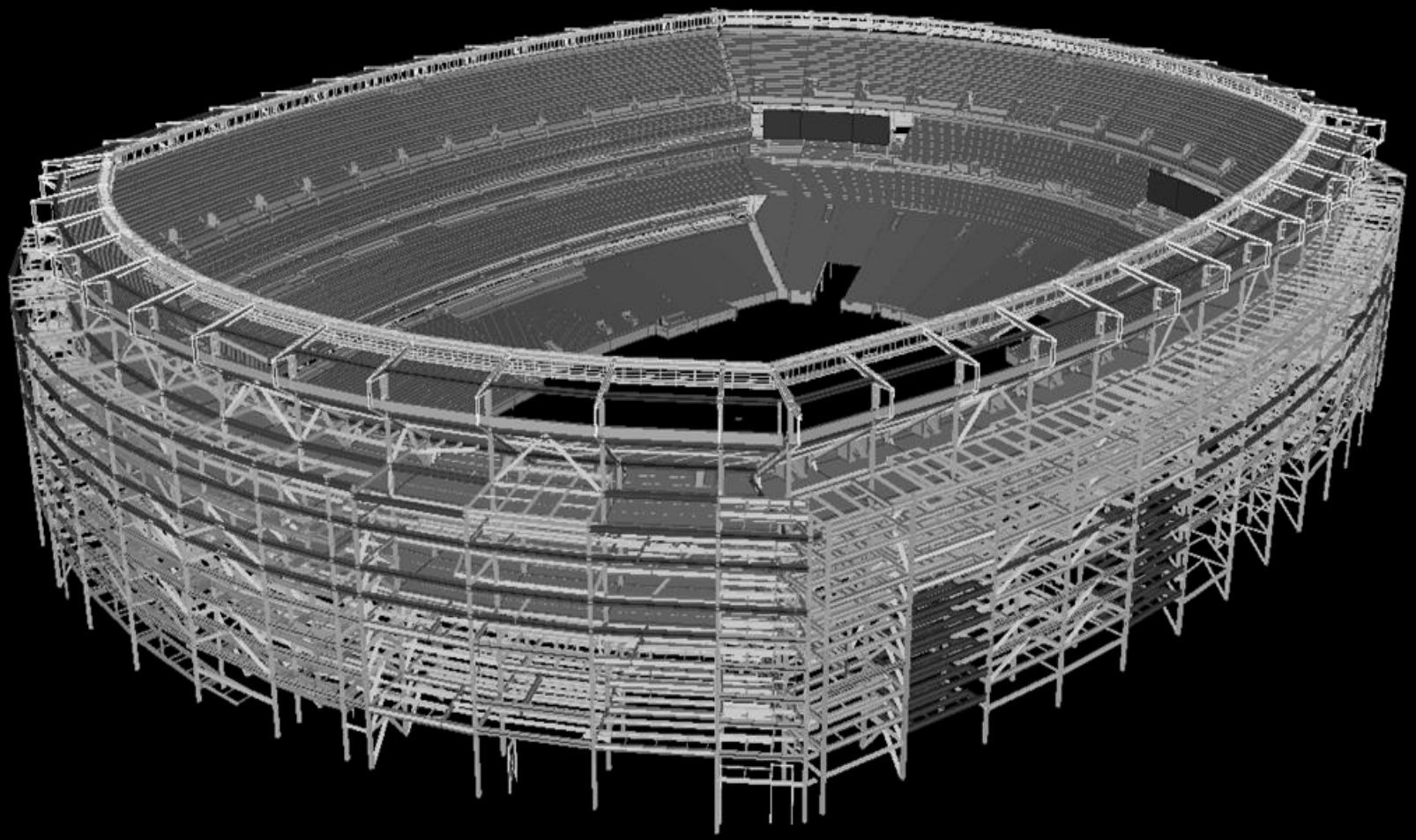
New Meadowlands Stadium

27,000 tons of steel

27 months from Schematic to topping out

Precast modeling for coordination



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New Meadowlands Stadium

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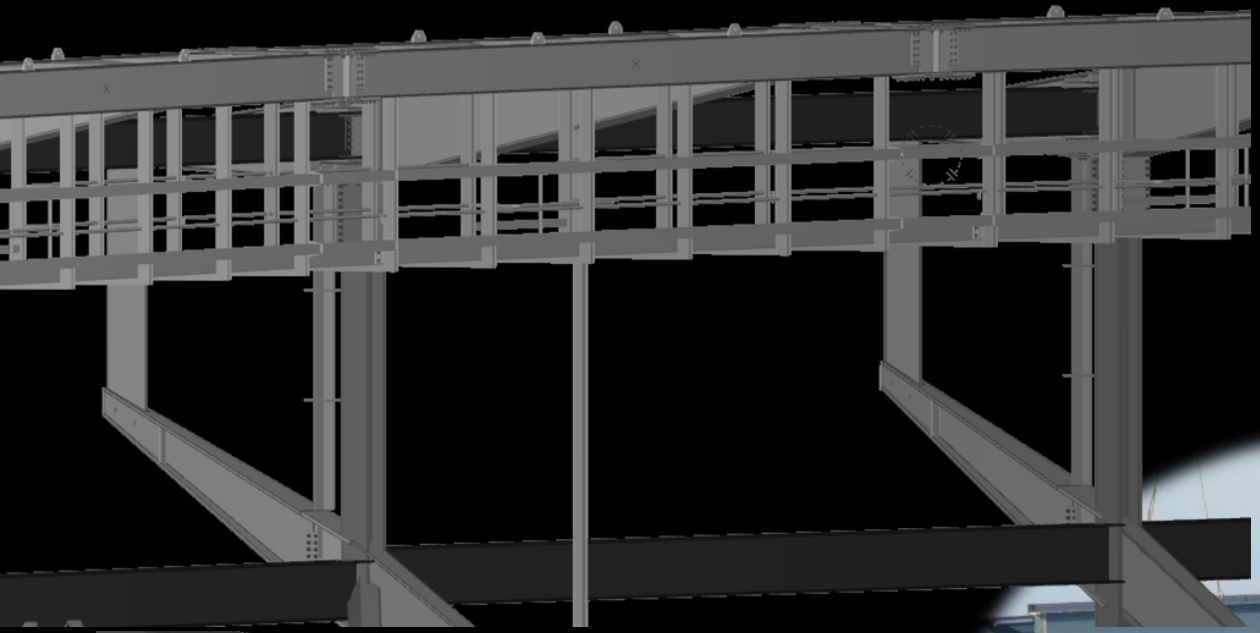

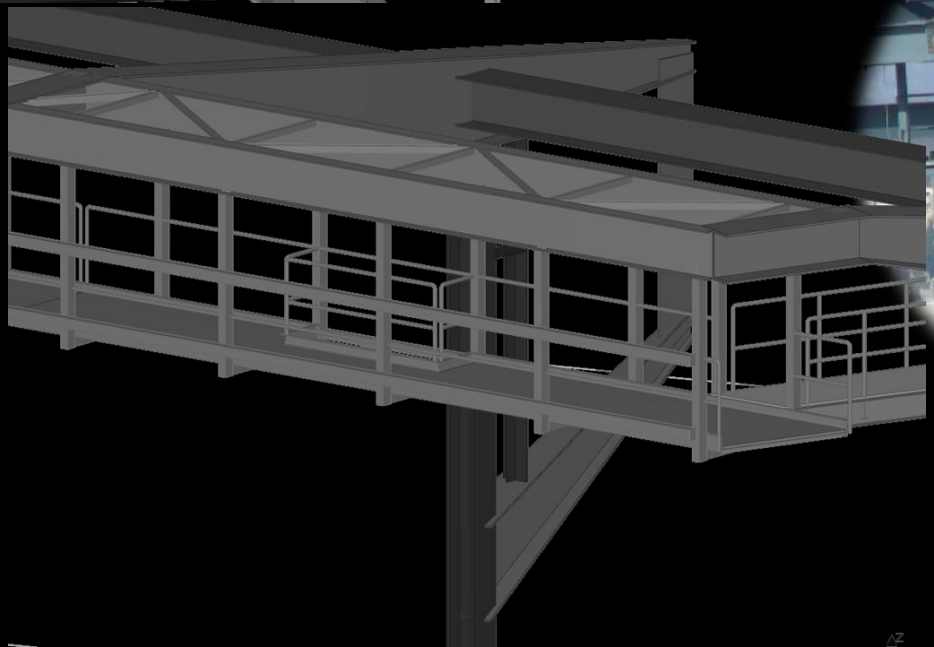

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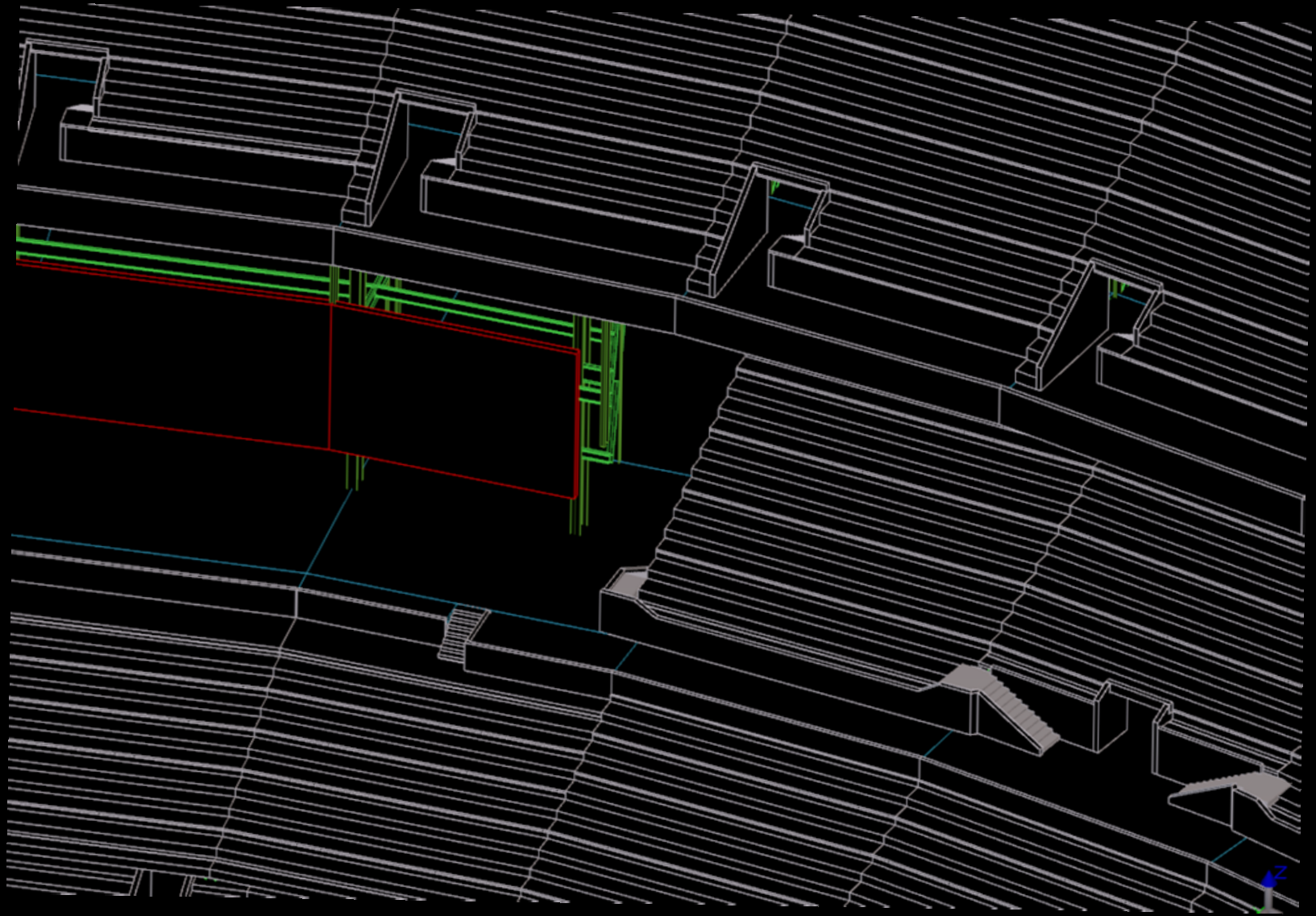
New Meadowlands Stadium



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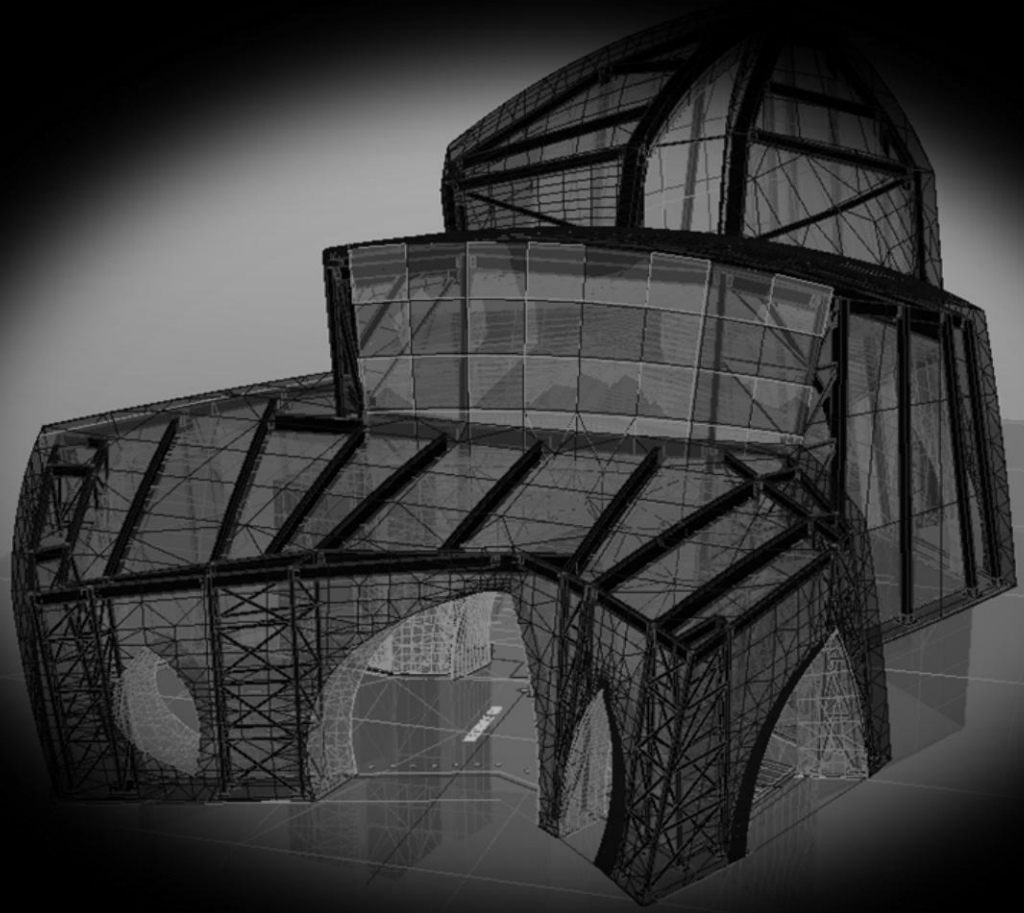
Cathedral of Hope - Interfaith Peace Chapel

- Only 60 tons of steel +/-

  Modeling was the only way to deliver the project



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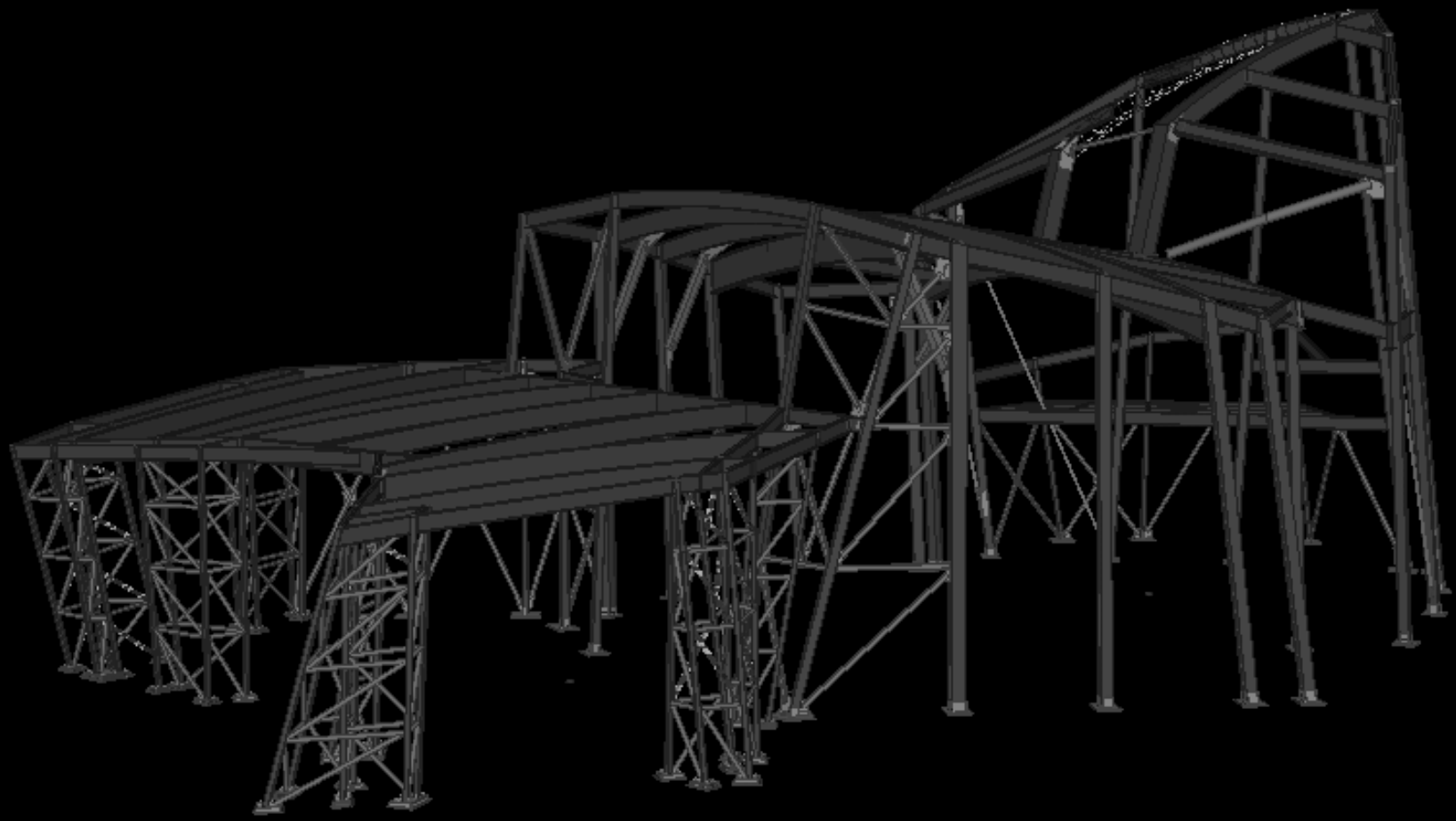
Cathedral of Hope - Interfaith Peace Chapel



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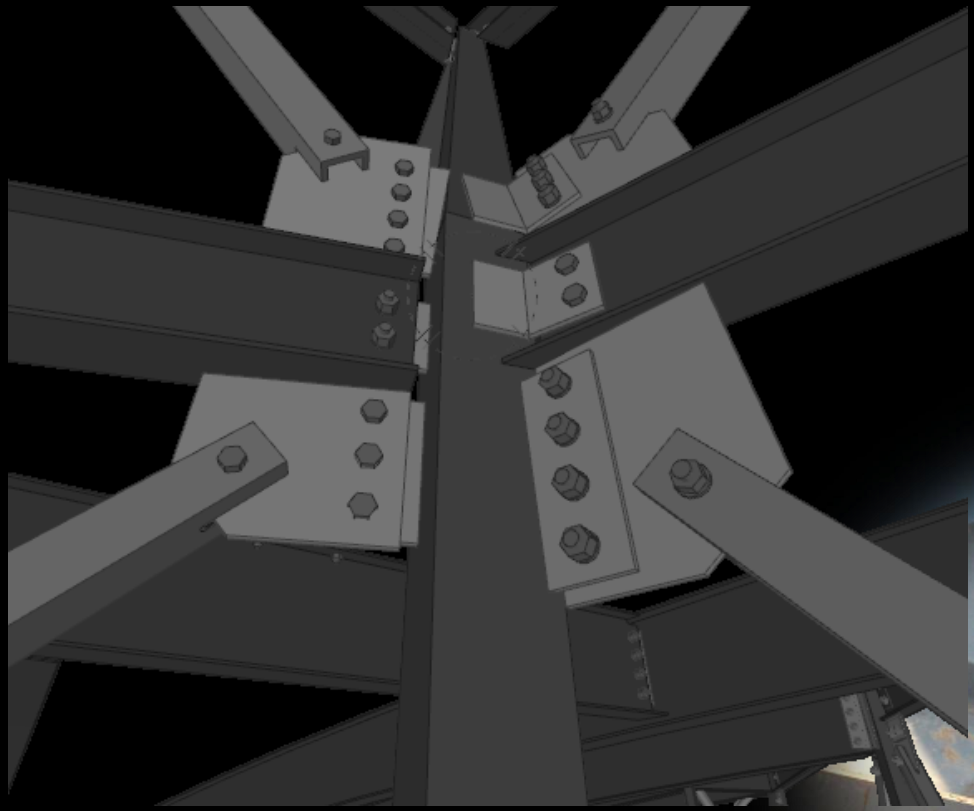

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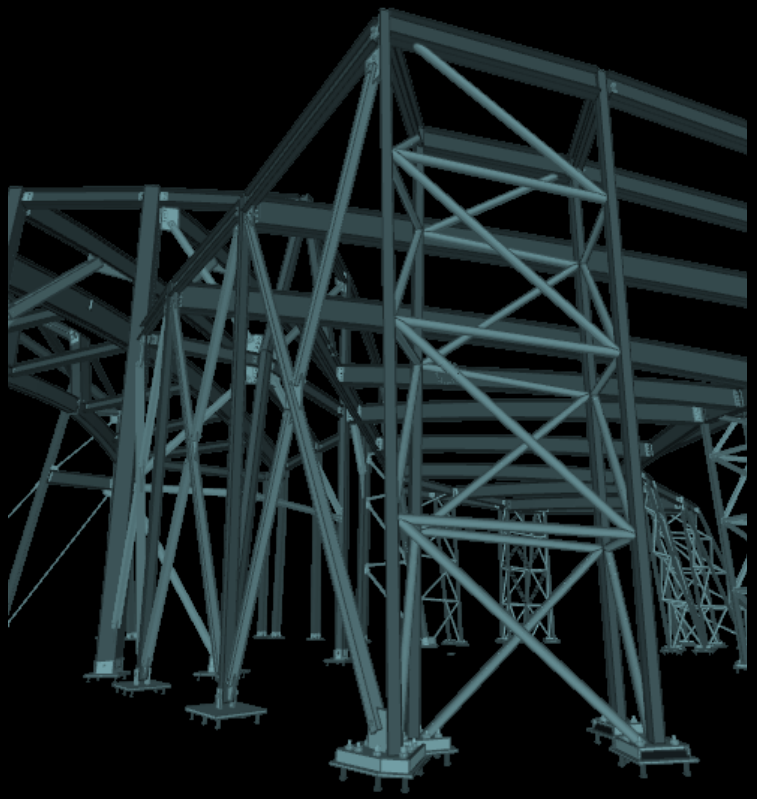

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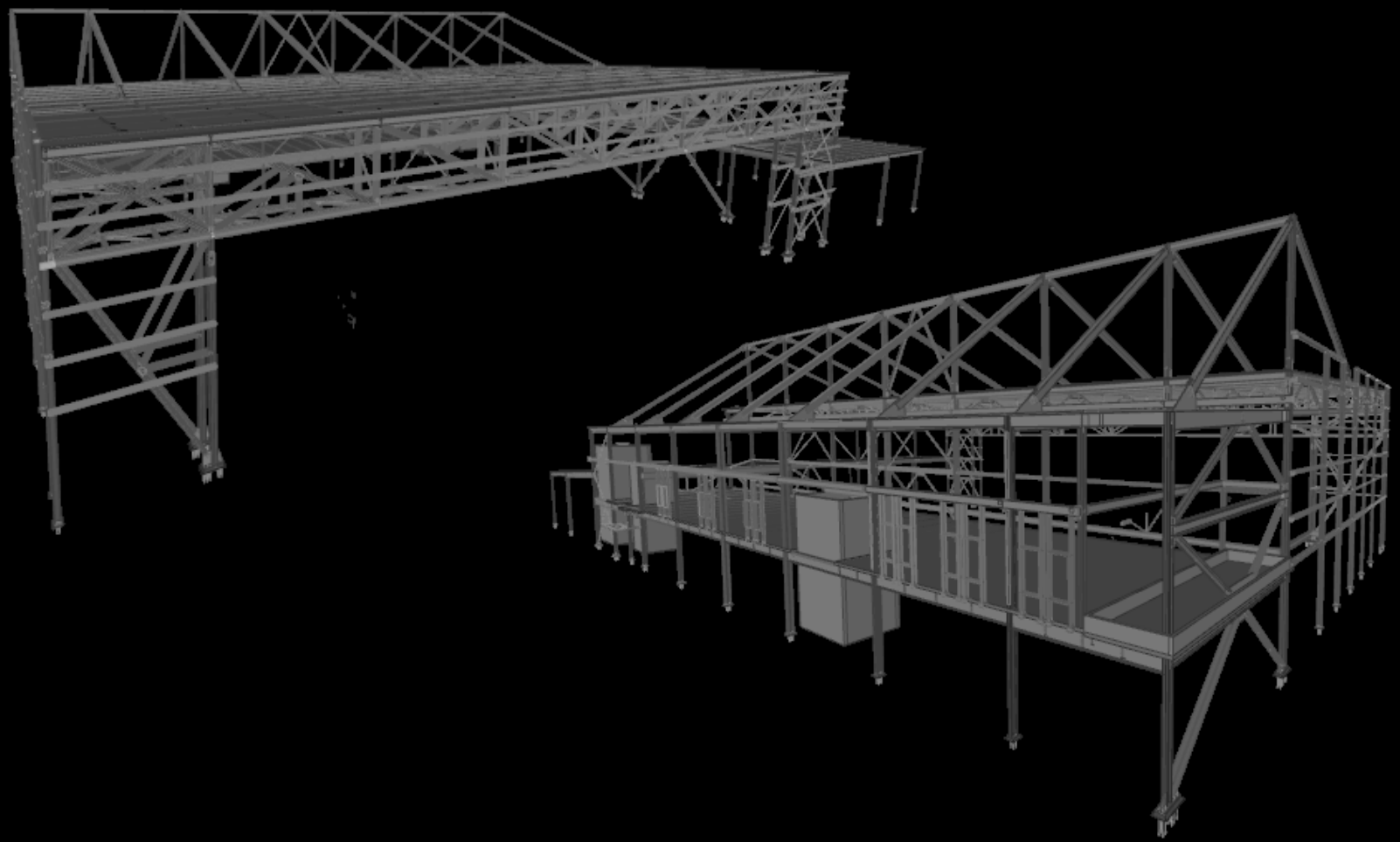
Quantico Hanger

100% Integrated Delivery

Design drawings and shop drawings provided in TEKLA



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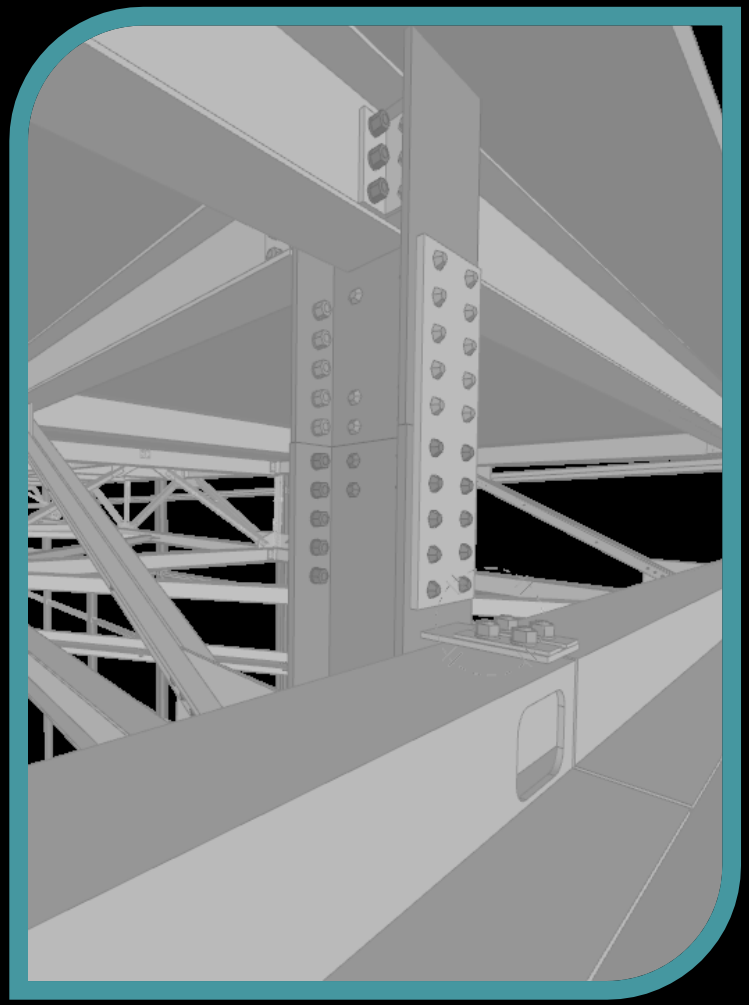

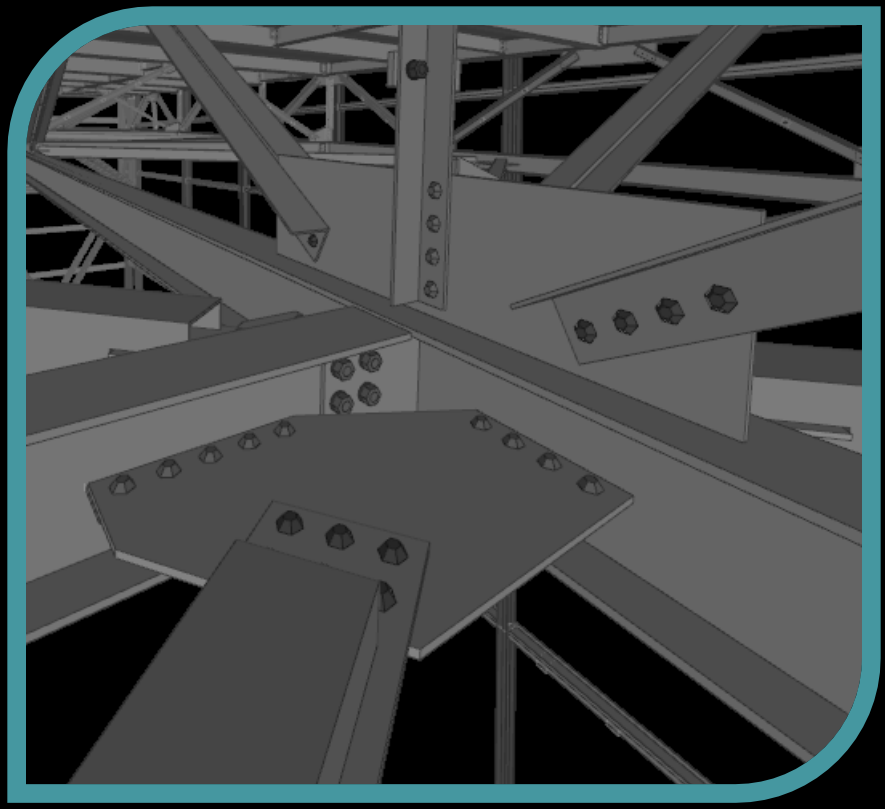

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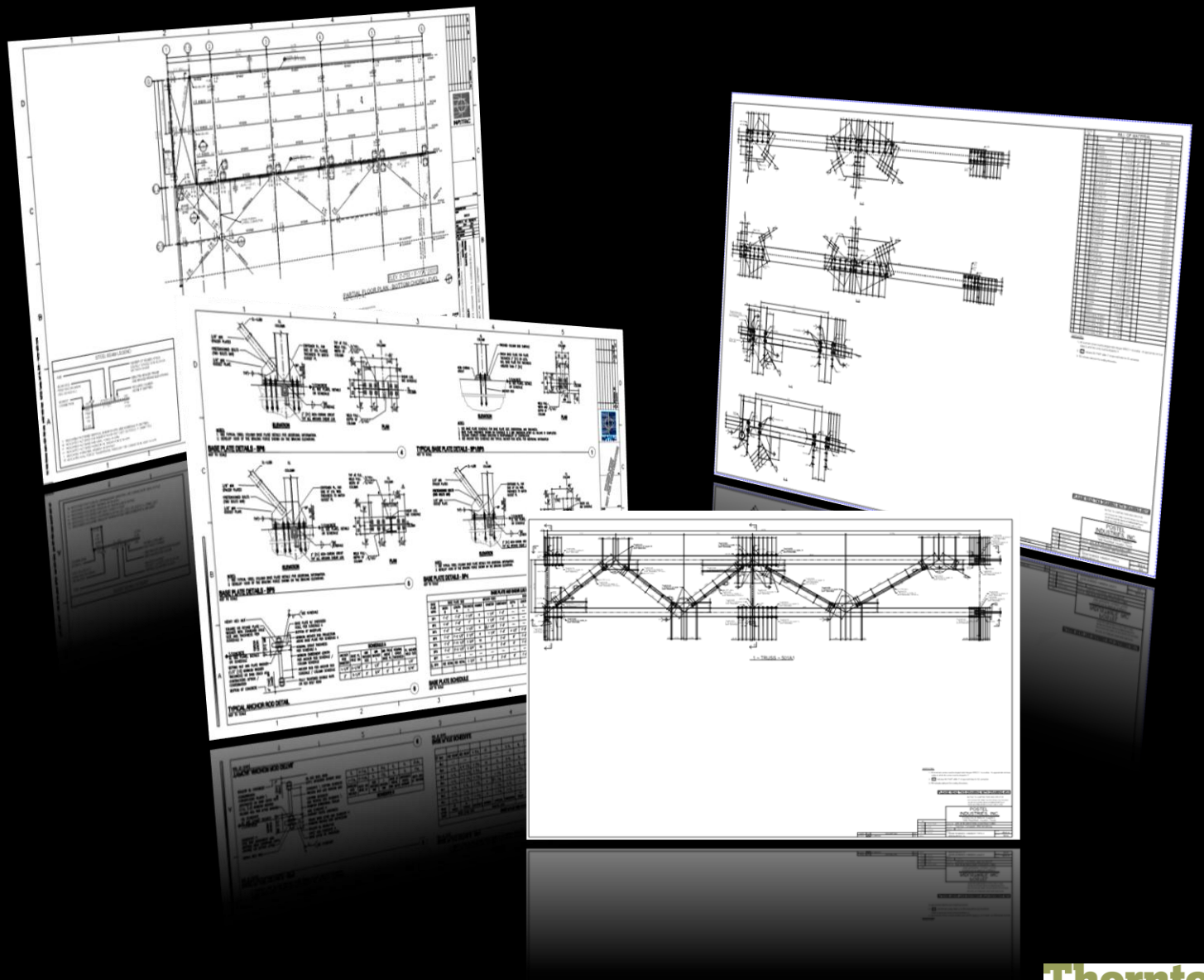

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TTG System

- Just-In-Time
- Pre-Manufacturing
- All 3D Team

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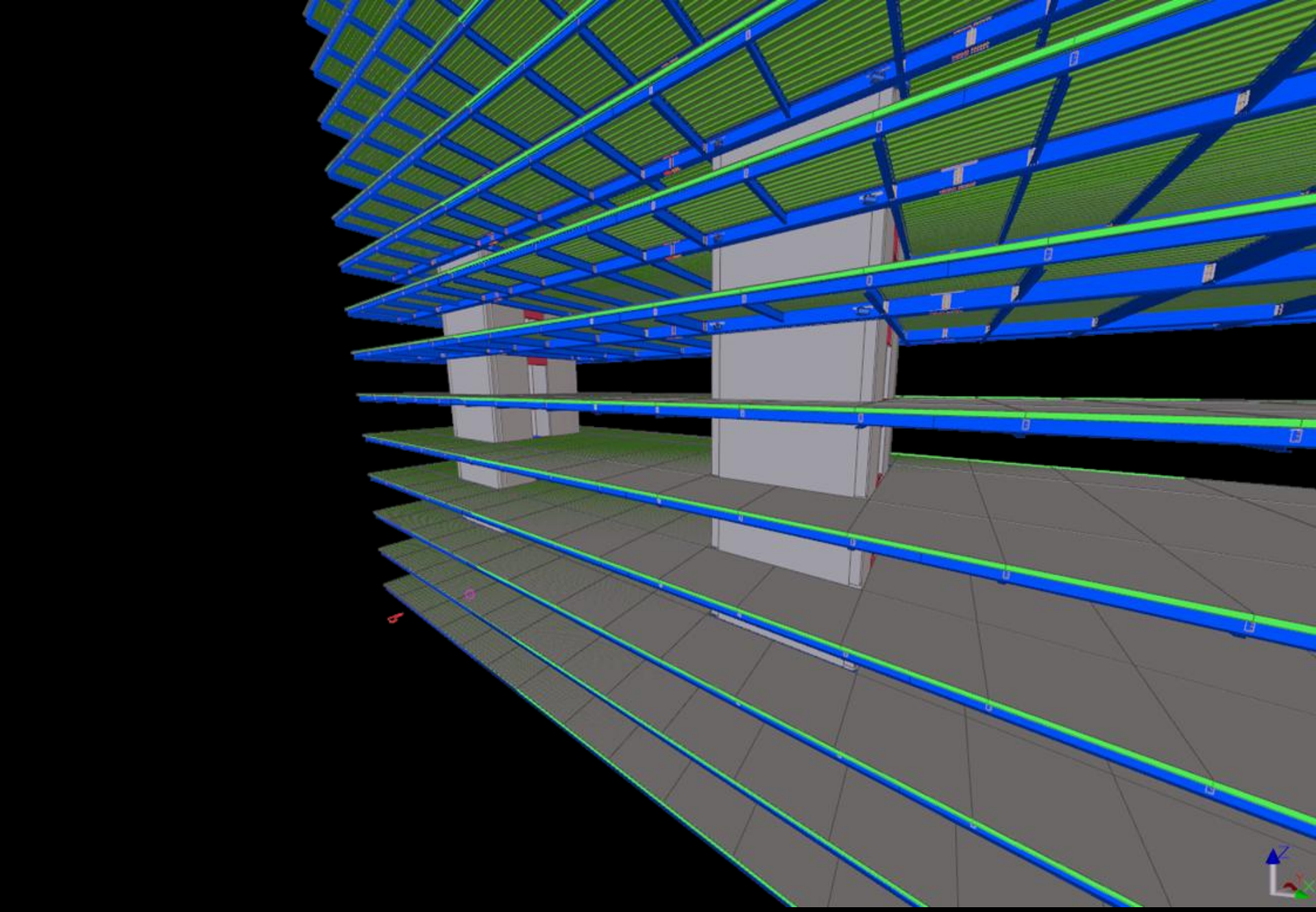

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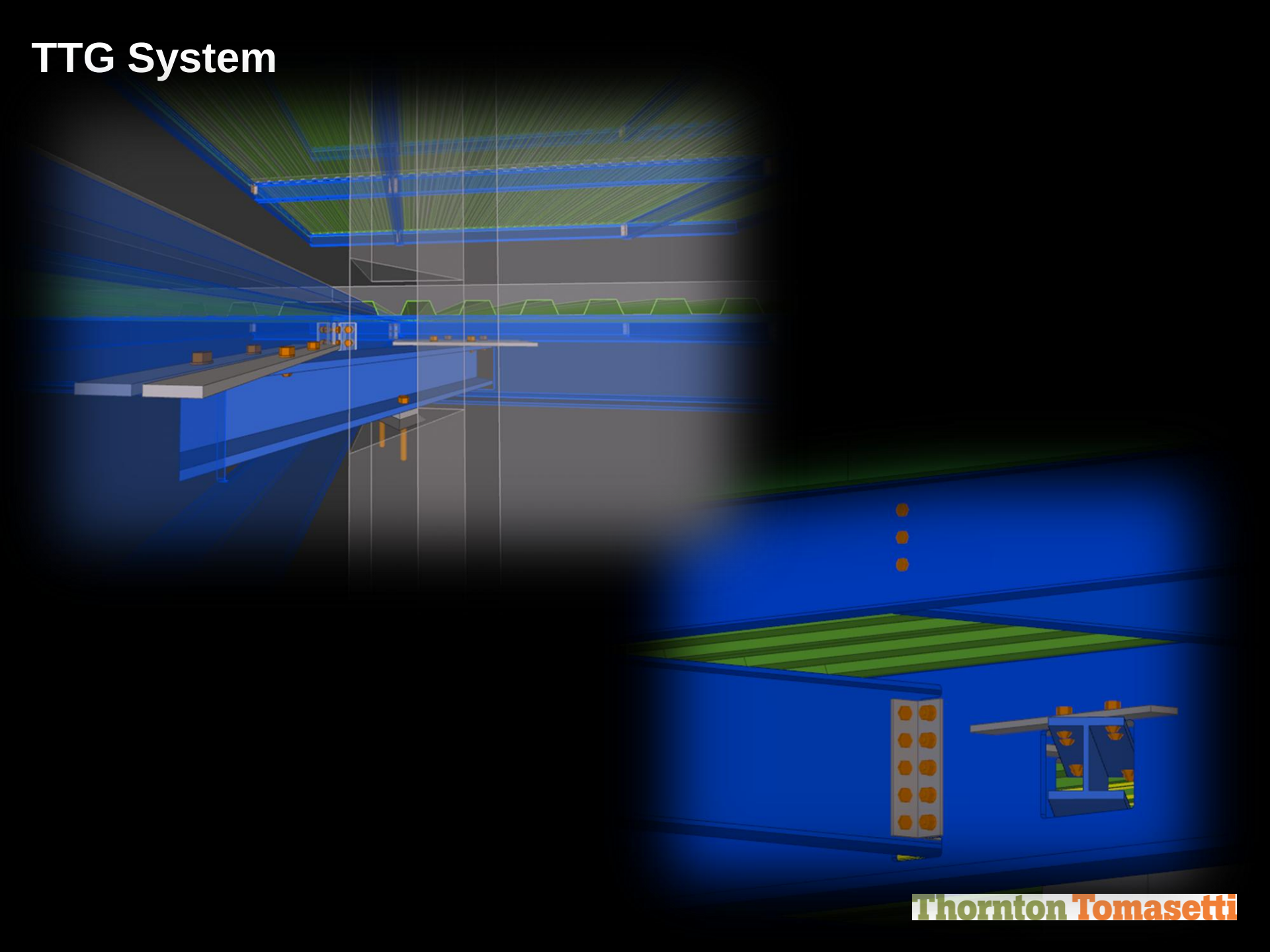

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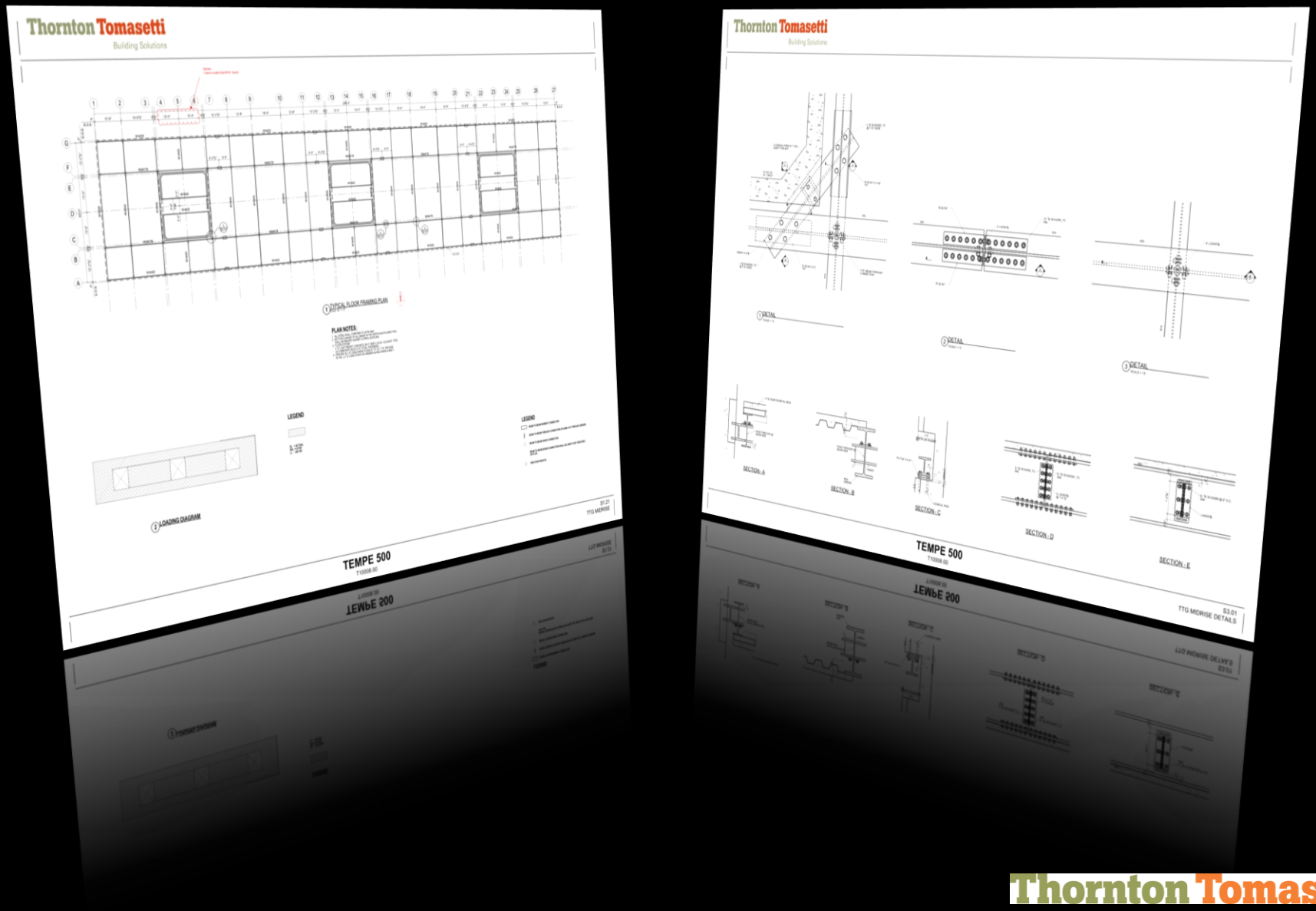

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TTG System

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Automation

Download complex geometries directly from BIM to CNC

to easily and reliably achieve complex geometries

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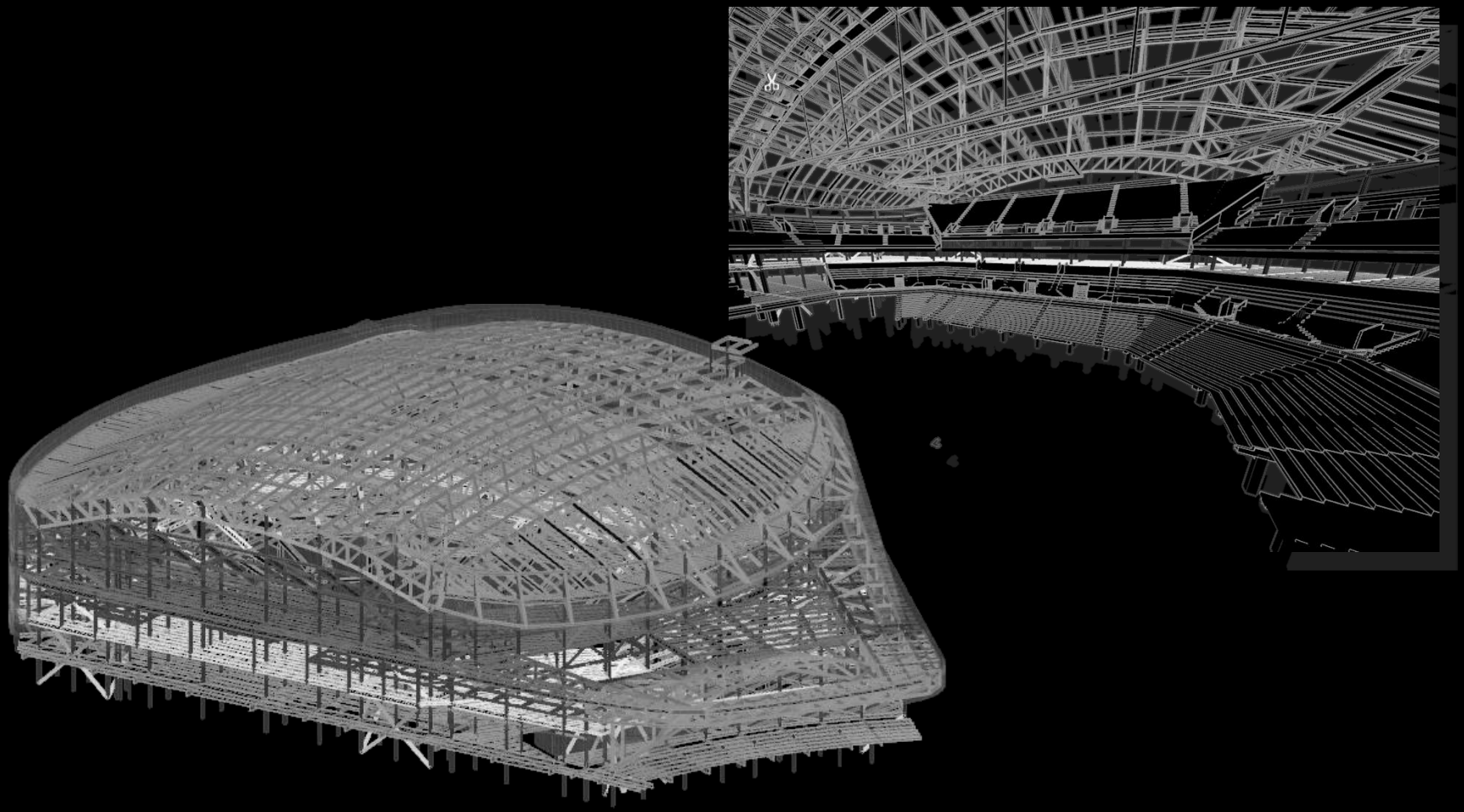
3D Architectural Drawings from REVIT

3D Structural Design drawings and connected model from TEKLA



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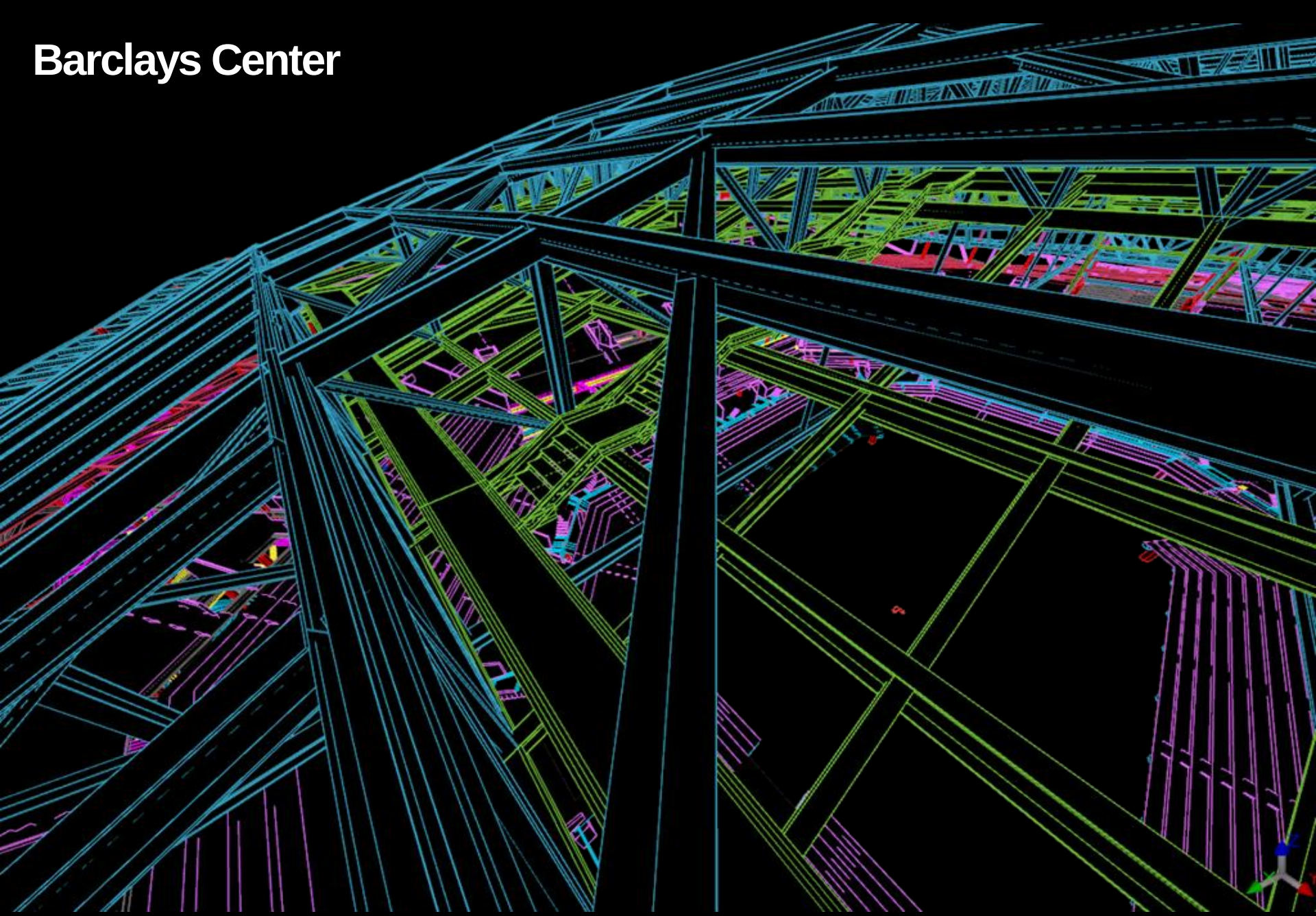

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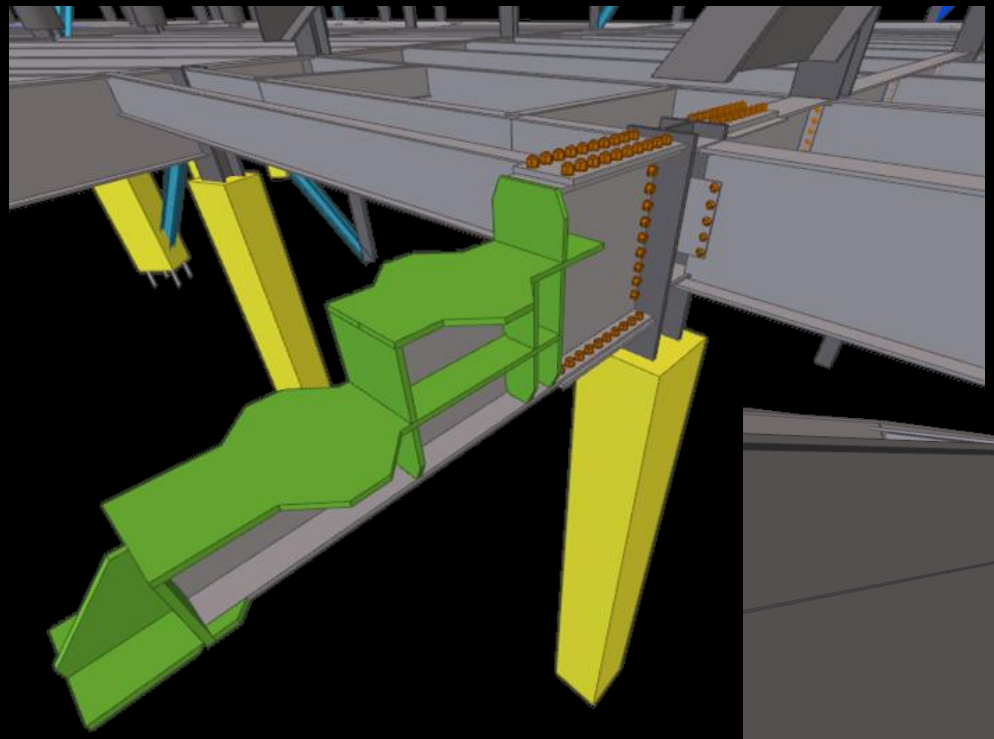

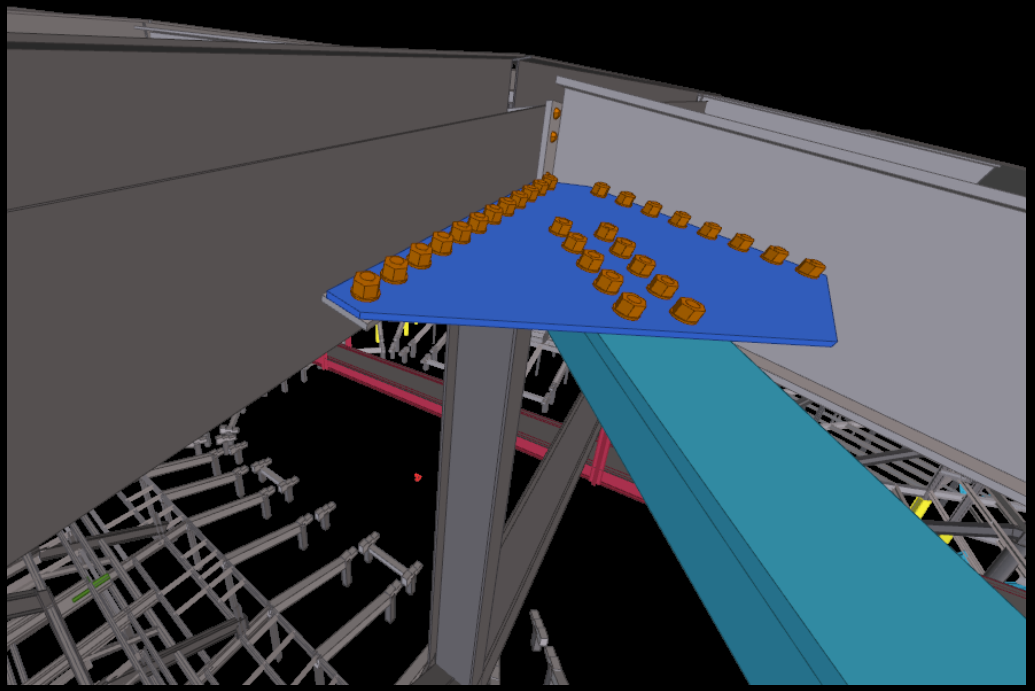

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Prefab Hospital

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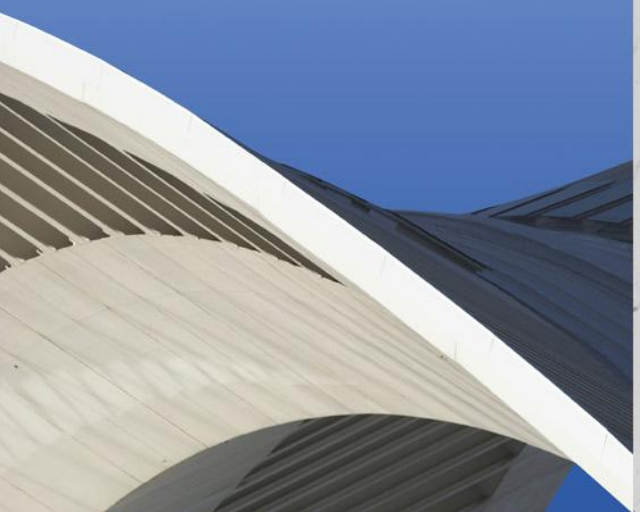
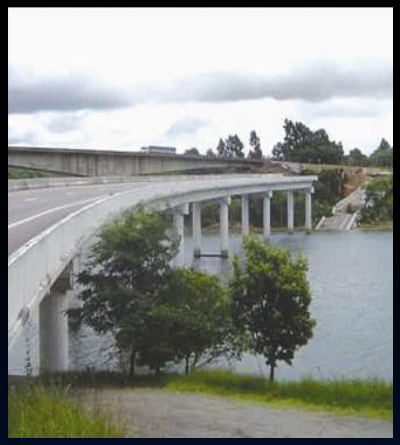
STRAAM™

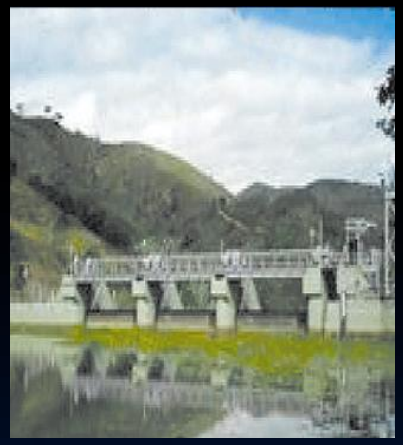
Structural Risk Assessment and Management



Types of Structures



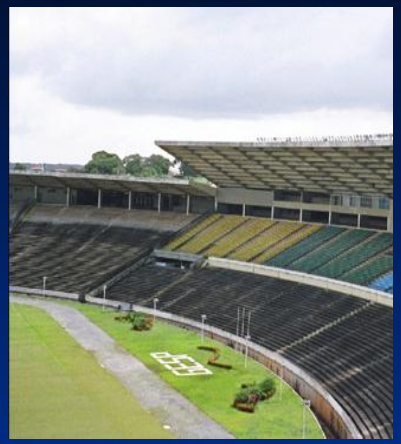
Bridges



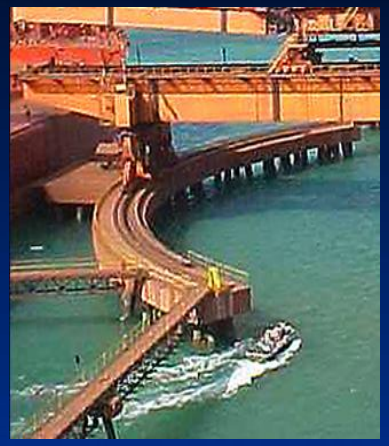
Dams

Tall Buildings

Towers

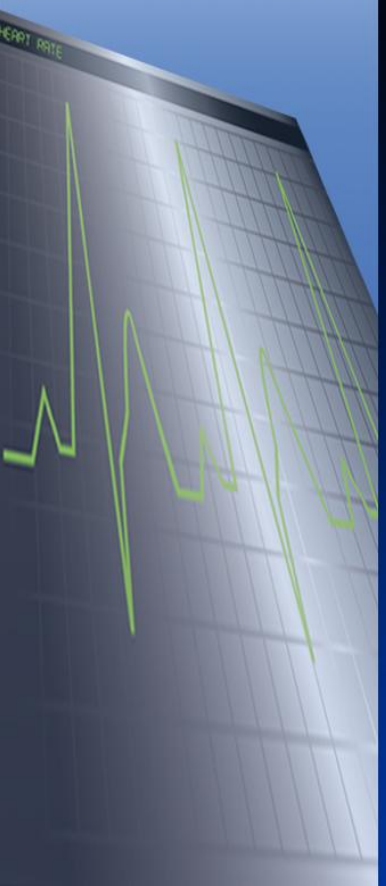


Stadiums



Waterfront &
Offshore Structures

STRAAM™



EKG Analogy

- Technician places electrodes on the patient
- EKG is generated while the patient is at-rest or on a treadmill
- Patient is shown the EKG
- Cardiologist interprets the EKG

STRAAM's Unique System Analysis

- A unique systems analysis based integrity function developed over more than 25 years of full-scale experiments on dams, bridges and buildings.
- Proprietary hardware and software that implement public domain knowledge. Theory is recognized and STRAAM has been able to implement the theory.
- Overcome problems of stationarity, electronic drift and uses ambient vibrations.

STRAAM™

Automated Structural Integrity Assessment System - ASIAS

- 24/7 data acquisition and analysis on-site.
- Data are not transferred off-site.
- Analysis results transferred to off-site web server
- *Automatic* distribution of *information* on reduction in capacity, degradation or imminent collapse warnings.
- *NO* manual analysis

Questions?

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