

# Lean Construction Institute

Building Knowledge in Design and Construction

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# Leveraging Virtual Design and Construction for Lean Project Delivery through Integrated Steel Design



June 2009 / Lean Design Forum

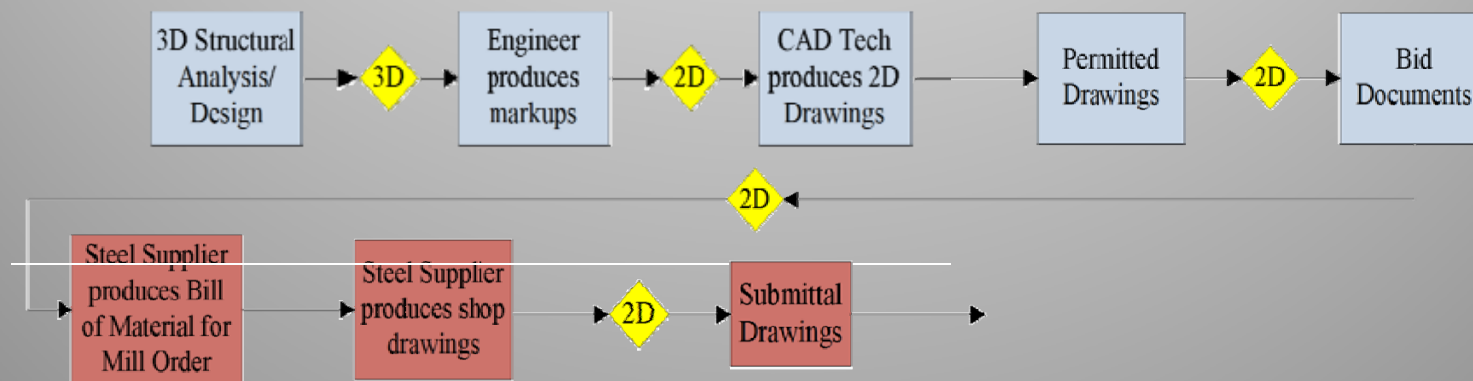
Ronald E. Migliori, S.E.  
Buehler & Buehler Structural Engineers, Inc.

June 18, 2009



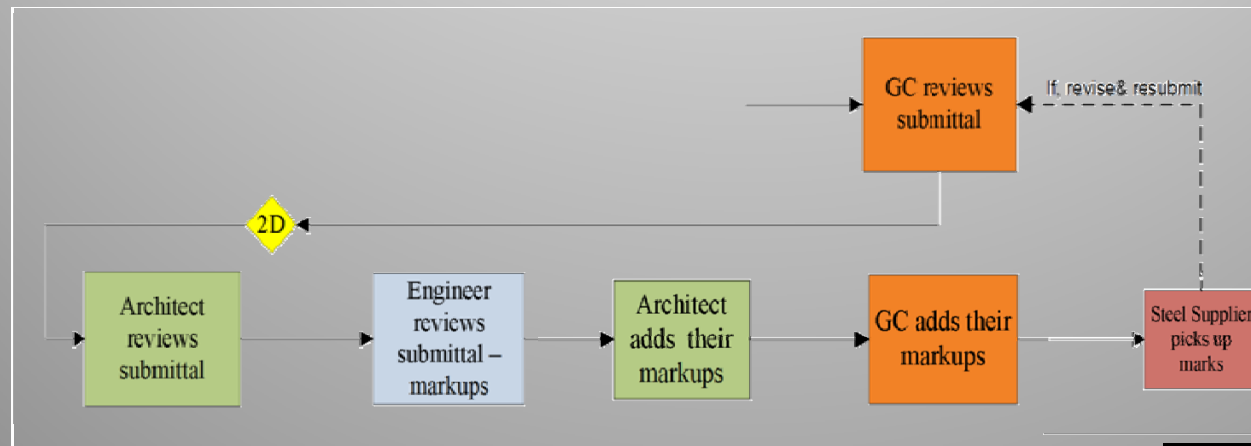
# Background / Current State

- Results of 3-D Engineering Design Software interpreted to 2-D drawings
- 2-D permitted drawings interpreted to output 2-D steel shop drawings
- Multiple sets of 2-D steel shop drawings



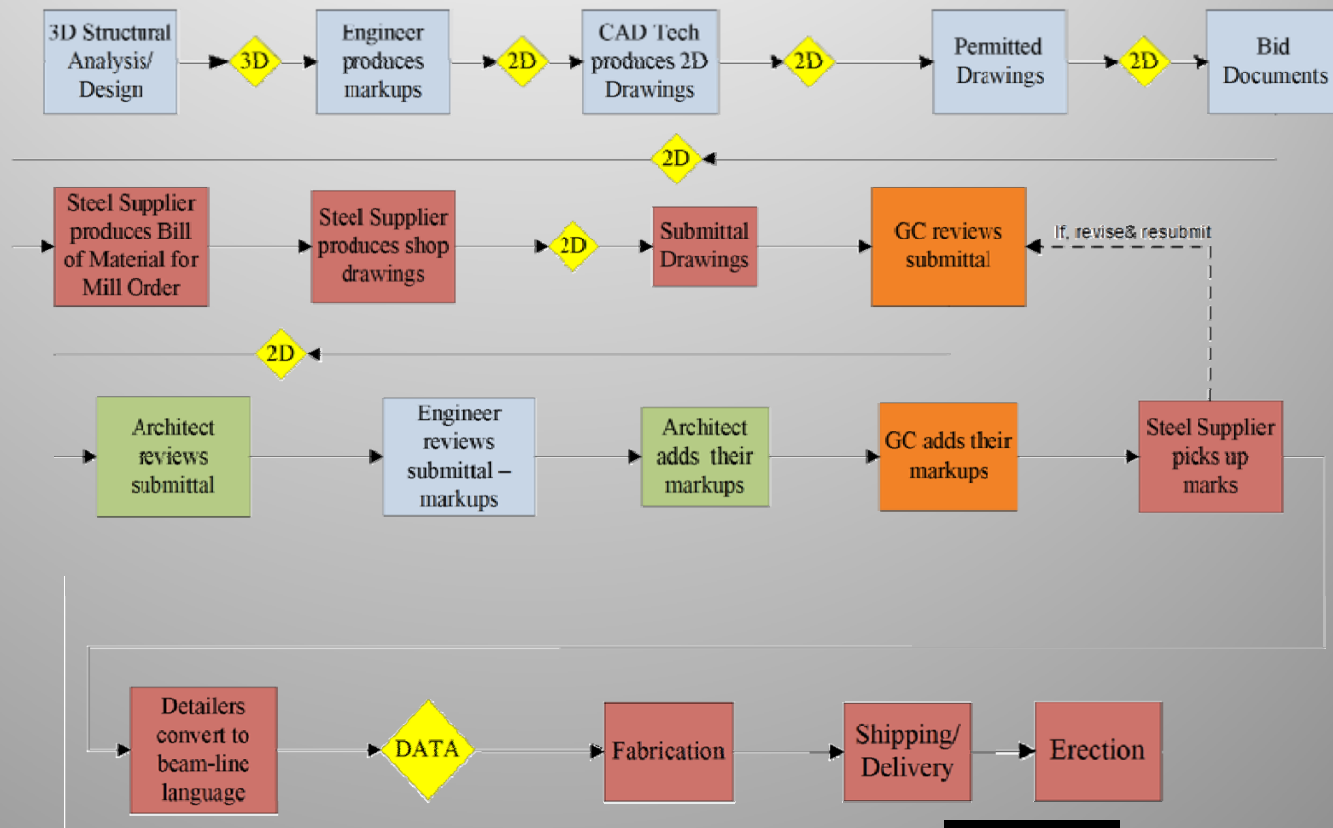
# Background / Current State

- Shop Drawings reviewed by General Contractor, Architect and Structural Engineer
- Mark-ups transferred to multiple sets and returned to supplier
- Marks are picked up by Steel Supplier. If revise and resubmit, multiple shop drawing sets are resubmitted to go through the review process again



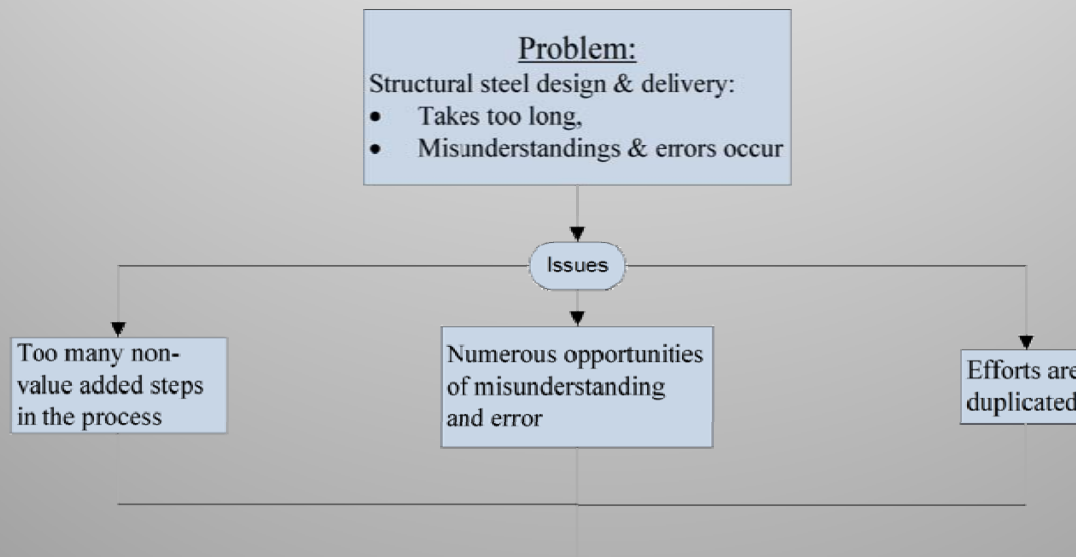
# Background / Current State

- Steel detailers convert shop drawings to beam-line language
- Fabrication
- Shipping
- Erection

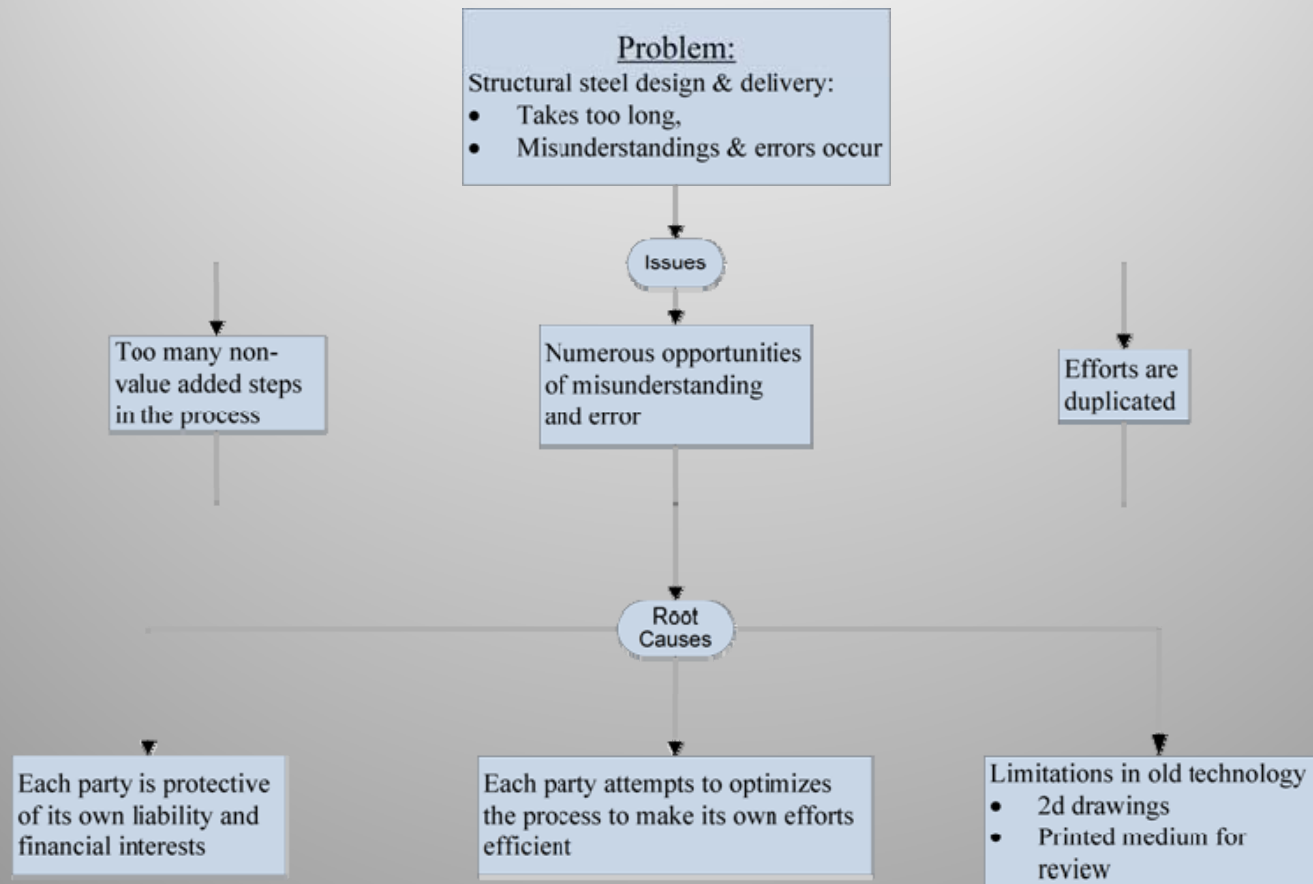


# Problem Statement

- How can structural steel be delivered in a more efficient manner, in a shorter period, and with less errors?

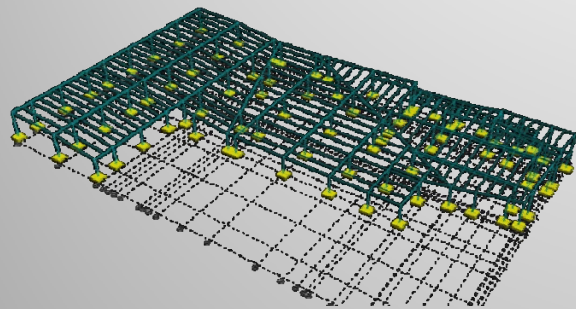


# Problem Statement

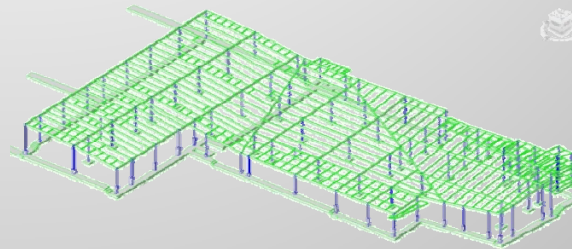
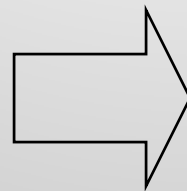


# Proposed Solution

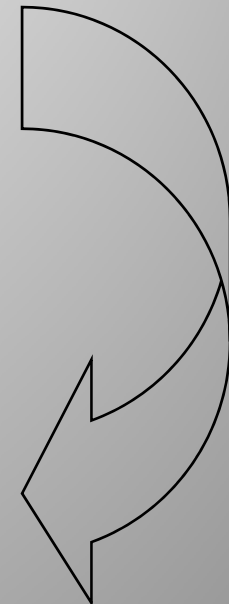
- Use 3-D technology to provide a DIRECT process



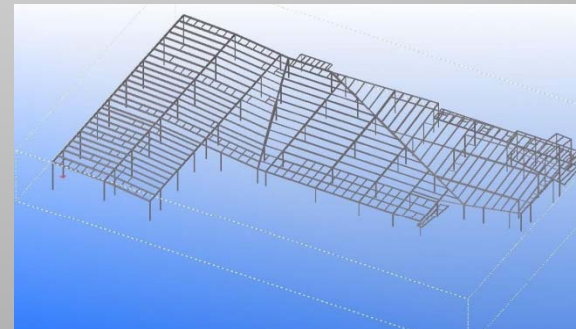
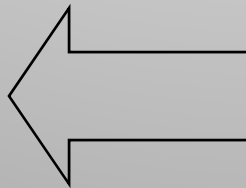
3D Steel Analysis



3D Design Model



Beam Line Communication



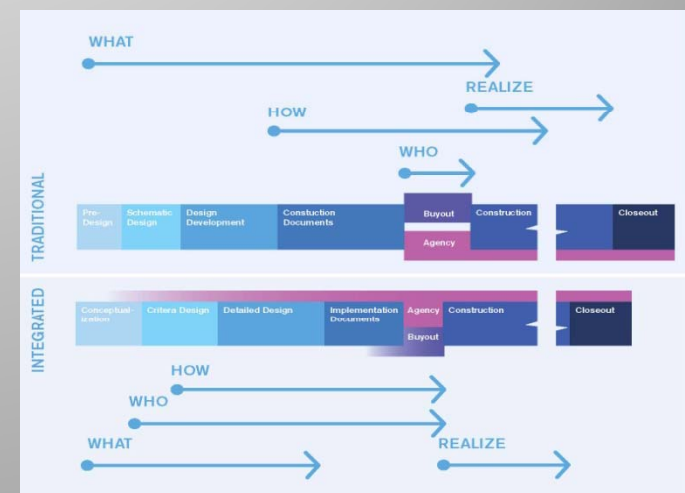
3D Steel Shop Drawing Model





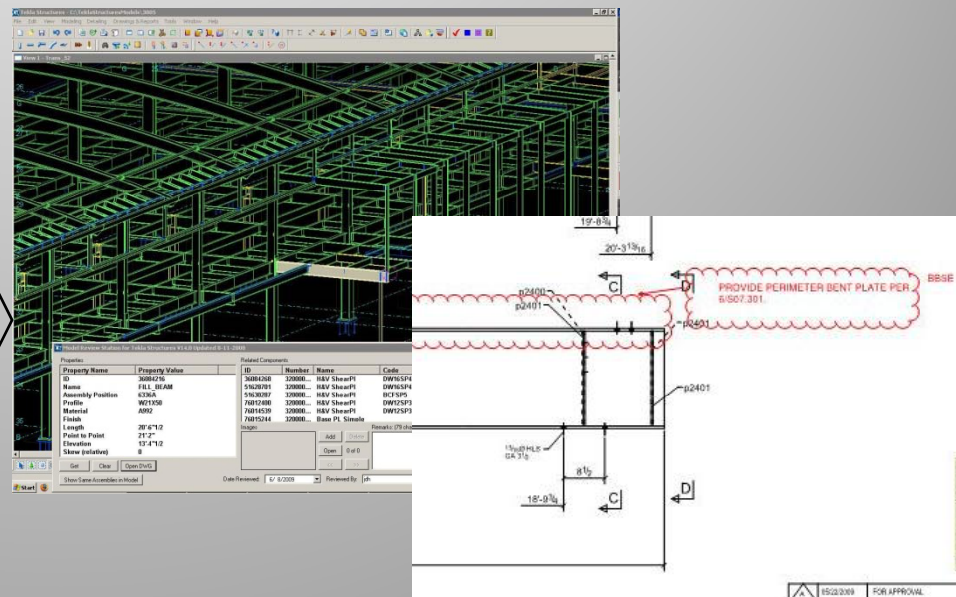
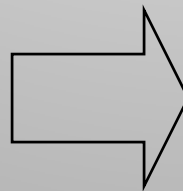
# Proposed Solution

- Develop a team atmosphere and trust through any of the following:
  - Integrated Project Delivery (IPD)
  - Integrated Form of Agreement (IFOA)
  - Design/Build (D/B) relationship based on trust



# Proposed Solution

- Eliminate non-value added steps in the process:
  - All partners review shop drawings in a paperless 3D format
  - Eliminate interpretation steps by promoting interoperability of 3D software



From

To

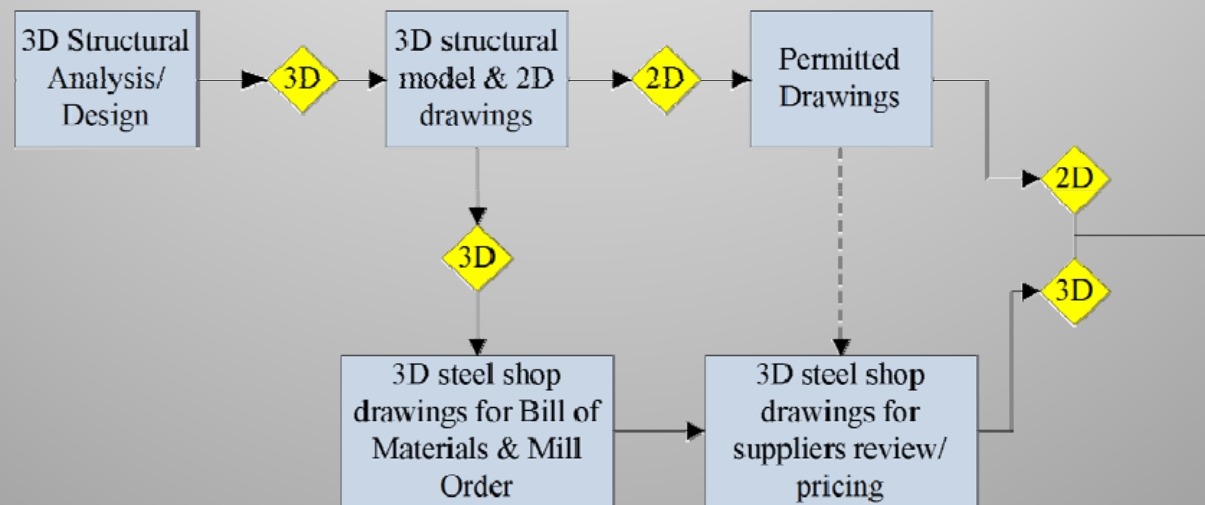


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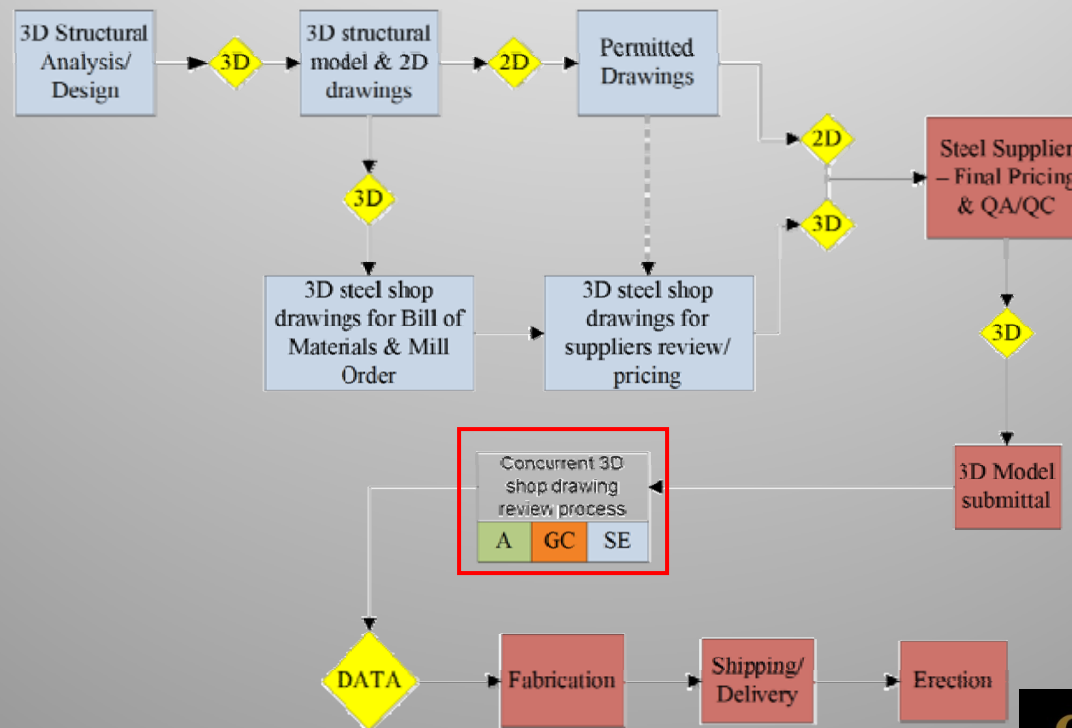
# Future State

- Structural Engineers are integrated into the preparation of the steel shop drawings
- Agency review is in parallel with model and detailing preparation



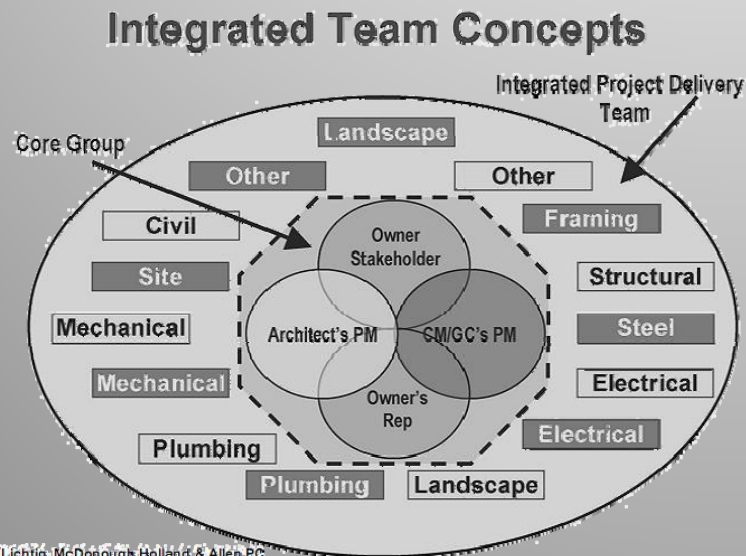
# Future State

- Establish a direct process of 3D communication between parties and software
- Electronic, concurrent, review and markup by all parties of a 3D detailing model

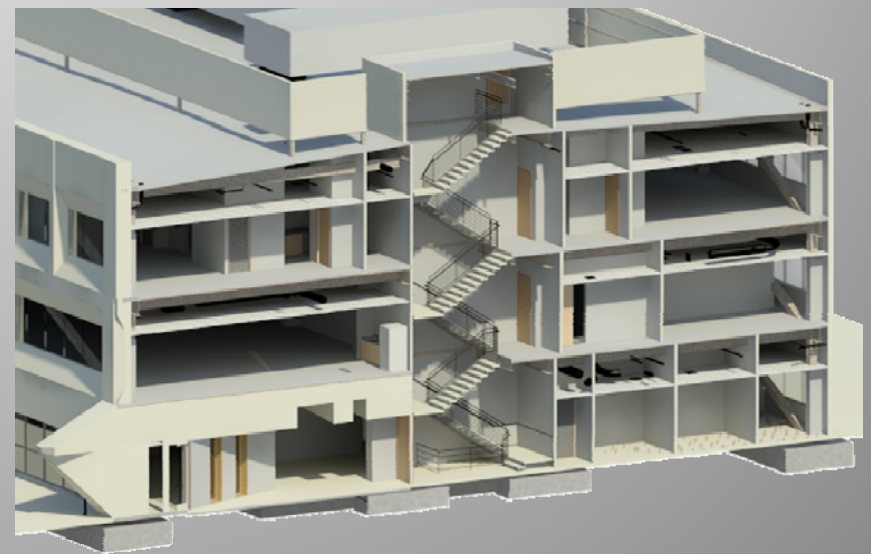


# Implementation Plan

- Establish an Integrated Team through contractual arrangements or other methods
- Determine the 3-D BIM strategy and responsibility of each team member
- Discuss software needs of the steel supplier to ensure operability

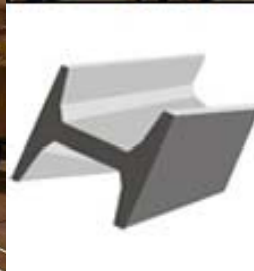
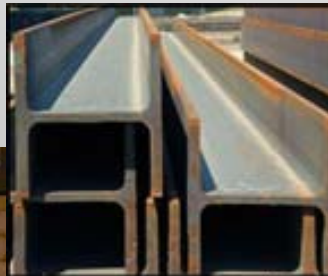


Source: Will Lichtig, McDonough, Holland & Allen PC



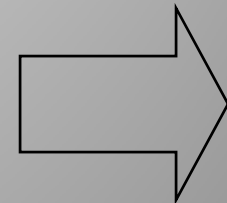
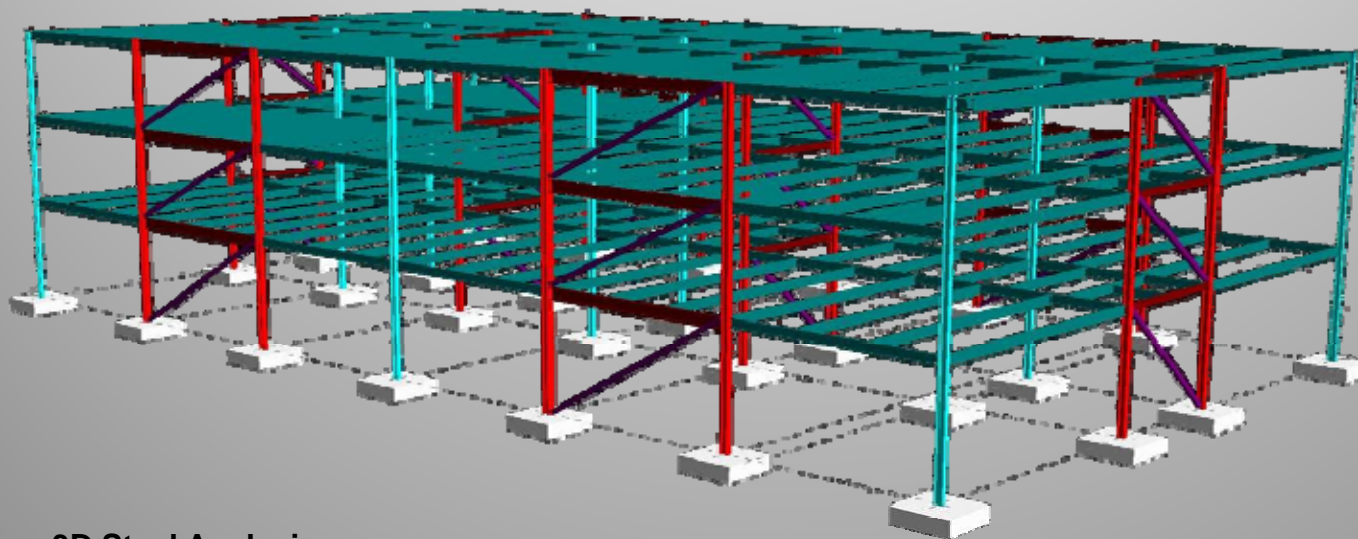
# Implementation Plan

- Discuss the fabricator's special detailing preferences
- Verify or arrange for staff training and license procurement
- Create the appropriate procurement batch sizes to optimize the process



# ISD Benefits

- Integrated Steel Design (ISD) integrates the structural design, the design documentation, steel detailing / shop drawings, and the fabrication

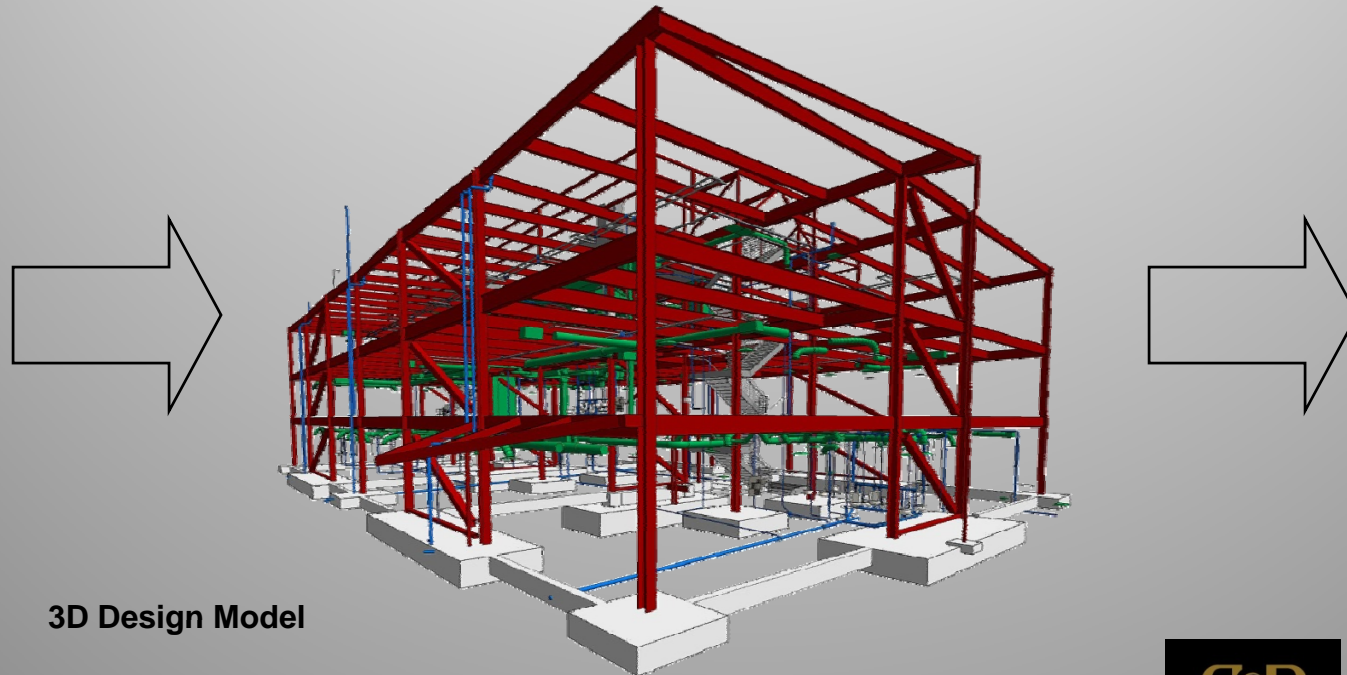


3D Steel Analysis



# ISD Benefits

- Provides 3-D documents for exceptional coordination with other trades and disciplines
- Reduces errors in interpretation of documents



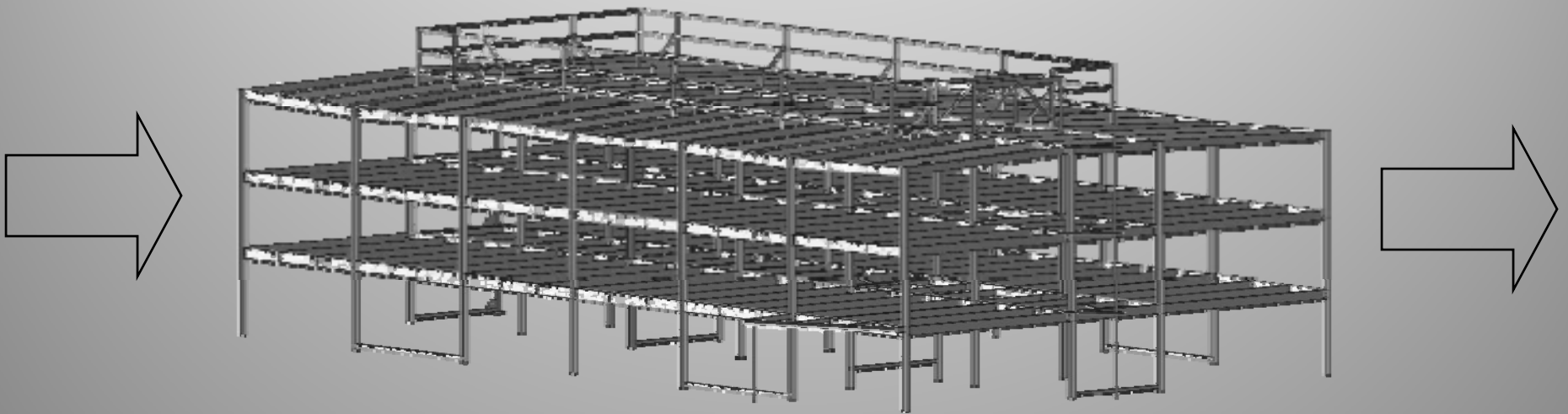
3D Design Model





# ISD Benefits

- Direct Digital Exchange (DDE) can be implemented by the Structural Engineer from the design model to the steel precision model
- Electronic paperless shop drawing review

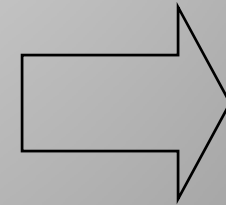
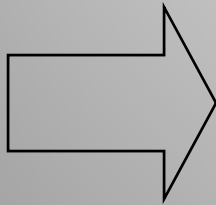


3D Steel Shop Drawing Model



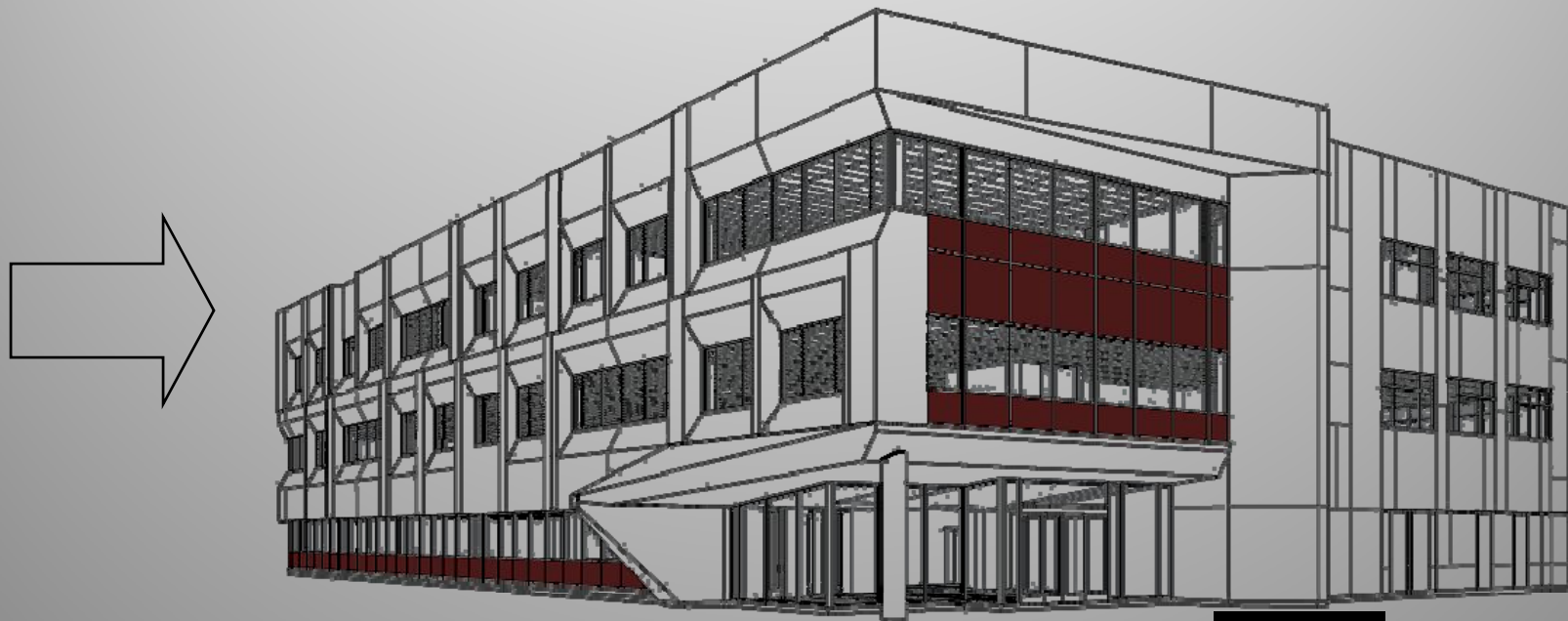
# ISD Benefits

- Allows for early procurement of materials
- Reduces overall delivery schedule for structural steel



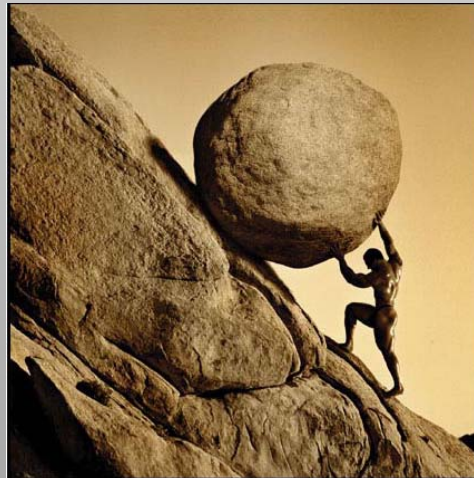
# ISD Benefits

- Minimize RFIs / troubleshooting communications
- Integrates secondary steel members for the support of cladding and curtain walls



# Challenges

- ISD works best in an IPD, IFOA or design/build format
- Steel supplier must be willing to participate in the integrated process
- Team members must be adept at the latest 3-D software, their interoperability, and understand their limitations



# Follow Up

- Monitor the:
  - Delivery time from design to erection
  - Design time and cost
  - Number of structural steel RFI's
  - Steel erection fit up
  - Submittal review time
  - Number of documented errors

THE FUTURE LOOKS BRIGHT

