BrIM in Structural Steel Fabrication: Current Uses, Benefits and Potential

April 15, 2015

Courtesy: HNTB
Traditional “BrIM” in Steel Fabrication
Current BrIM in Steel Fabrication
Current Uses of BrIM

• Generation of Shop Drawings, Fab Data & CAM Files
• Fabrication Planning
• Fit Verification and Clash Detection
• Data Warehouse for Fabrication Documentation (RFIs, QC Data)
• Steel Erection Planning
• PROJECT DATA for LIFE CYCLE!
BrIM and Shop Drawings

SHOP DRAWING TO FABRICATION FLOW - TRADITIONAL

NEW PROJECT ➔ FULL DETAILED DRAWINGS OF ALL COMPONENTS ➔ SUBMIT DRAWINGS FOR APPROVAL ➔ DRAWING APPROVAL ➔ FABRICATE FROM APPROVED DRAWINGS

DRAWINGS GOVERN!

SHOP DRAWING TO FABRICATION FLOW - WITH ADVENT OF CNC EQUIPMENT

NEW PROJECT ➔ FULL DETAILED DRAWINGS OF ALL COMPONENTS ➔ SUBMIT DRAWINGS FOR APPROVAL ➔ DRAWING APPROVAL ➔ CREATE CAM MODELS FOR CNC EQUIPMENT ➔ FABRICATE FROM DRAWINGS AND MODELS

DRAWINGS GOVERN, BUT MODELS/DATA USED
BrIM and Shop Drawings

SHOP DRAWING TO FABRICATION FLOW - WITH ADVENT OF CNC EQUIPMENT

NEW PROJECT → FULL DETAILED DRAWINGS OF ALL COMPONENTS → SUBMIT DRAWINGS FOR APPROVAL → DRAWING APPROVAL → CREATE CAM MODELS FOR CNC EQUIPMENT → FABRICATE FROM DRAWINGS AND MODELS

DRAWINGS GOVERN, BUT MODELS/DATA USED

SHOP DRAWING TO FABRICATION FLOW - WITH FULL UTILIZATION OF BrIM AND CNC EQUIPMENT

NEW PROJECT → MODELS/DATA OF ALL COMPONENTS → SUBMIT INFO (DRAWINGS) FOR APPROVAL → DRAWING APPROVAL → CREATE CAM MODELS FOR CNC EQUIPMENT → FABRICATE FROM MODELS

MODELS/DATA GOVERN!
Traditional Workflow

**Engineer**
- Analysis and Design (Data/Models)
- Create 2-D Contract Plans
- Enter Data into Software

**Fabricator**
- Create 2-D Shop Dwgs for Approval
- Create CAM Models for Fabrication

Digital → Paper → Digital

Paper
BrIM and Design Interaction

- Design Data Transfer - Project Geometry
  - Roadway - Horizontal, Vertical, Cross slopes
  - Span
  - Deck – Thickness, Haunches
  - Structural Steel – Top of Steel Elevations, Camber Data

Project: NYSDOT Kew Gardens Interchange, Contract 2A
BrIM and Design Interaction

- Design Data Transfer – Member Properties
  - Steel Member Sizes, Shapes
  - Size Transition Locations
  - Material Specifications

Project: NYSDOT Kew Gardens Interchange, Contract 2A
BrIM and Design Interaction

Preferred Workflow

Engineer

Analysis and Design (Data/Models)

Create 2-D Contract Plans?

Electronic Data Transfer

Fabricator

Data Dump into Software

Create Models for Approval and Fab

Create 2-D Shop Dwgs for Approval?

Digital

Paper

Digital

Digital
BrIM and Fabrication

Traditional Shop Drawing

Communication Tool!

Info Can Be Zinc Marked
Current Transfer of CAM Data

Transferred Electronically
BrIM and Fabrication

- Parametric 3D models created for girder parts
- One associative part model shared by all disciplines
- Reduces redundant efforts

CNC Code

CAD Drawings

CAM Toolpath

Part Model

BOM
BrIM and Fit Verification/Assembly

Traditional Assembly
• Labor Intensive
• Time Consuming
• Costly
BrIM and Fit Verification/Assembly

IN Milton Madison Truss
Virtual Assembly
BrIM and Fit Verification/Assembly

OH Innerbelt Bridge
Virtual Assembly

- Schedule/Size Prohibited Full Assembly
- Physical Progressive Laydown Assembly
- Fully Connected Virtual Assembly in Position for Bearing to Bearing Check
Physical Assembly avoids issues here, **BUT**
Virtual Assembly can achieve same result
Lancaster County based High Steel Structures is awarded a PennDOT contract to fabricate 365 tons of structural steel for the emergency replacement of the bridge carrying Route 22 eastbound traffic into Harrisburg at the Interstate 81 exit 67 interchange.

The overpass bridge was severely damaged on Thursday, May 9, when a tanker truck loaded with diesel fuel overturned and caught fire causing massive traffic delays in the Harrisburg metro.
• May 09 – Accident Occurred
• May 10 – HSSI Contacted PennDOT to Offer Assistance
• May 23 – NTP from PennDOT
• May 23 – First Material Order placed by HSSI (Webs and Flanges)
• June 03 – All Web & Flange Material Received by HSSI (11 days after NTP)
• June 06 – Start of Fabrication (2 weeks after NTP)
• August 09 – Start of Steel Delivery (11 weeks after NTP)
• August 12 – Start of Steel Erection
• August 26 – Completion of Steel Erection (13-1/2 weeks after NTP)
13½ Wks NTP to Erected – HOW?

365 tons Structural Steel

4 Spans

461 feet Total Length
13½ Wks NTP to Erected – HOW?

6 Gdr Lines

2 Box Gdrs

Skewed Conns

Collaboration with New Processes
Longitudinal Girders

- Expedited Shop Drawing Production & Review
  - Direct Communication—PennDOT, Gannett Fleming, HSSI
  - Redline Markup of Existing Shop Drawings; Partial Subs
  - Current Weld Practices
Transverse Box Girders

- Model Development and Review
  - Long. Gdr – Box Girder Connections Revised
  - Changed CJP Welds to Bolted End Plates
  - Changed Top Flg CJP Welds to Bolted Conn Angles
Transverse Box Girders

- On-Site Review/Approval of Model
  - Development of Design Changes
  - Investigation/Resolution of Design/Detail Issues, Req’mts
  - Model Drives CNC Equipment and Drawings
Transverse Box Girders

• Fabrication Drawing Approval Directly Followed
Fabrication – Girder Stubs
Fabrication – Box Girders
Fabrication – Box Girders
Yard Assembly
Steel Erection

- 15 Calendar Days
- Nighttime over I-81
- 4 Cranes – 150T, 210T, 300T, 500T
Steel Erection – 500T Crane

- Box Girders
- Long. Girders in Pairs
  - No Holding Crane
95 Calendar Days

Fabrication NTP to Complete Steel Erection

Courtesy: PennDOT
95 Calendar Days

Fabrication NTP to Complete Steel Erection

Key Lesson: Challenge Industry Paradigms on each Project!

Courtesy: PennDOT
BrIM Benefits in Steel Fabrication

- Optimizes Workflow thru Design – Detailing – Fabrication – Field
- Minimizes Errors due to:
  - Manual Data Transfer
  - Detailing Misfits
- Provides One Source for Data
  - Shop Drawings / RFIs
  - Fabrication Documentation
  - QC Records
- Eliminates Redundant or Manual Efforts
  - Manual Programming and Fabrication Processes
  - Physical Assemblies for Fit Verification
BrIM Potential in Steel Fabrication

- **Transfer of Data between Engineer & Fabricator**
  - Useable format needed for both

- **Fabrication Approval Process**
  - Use of Models; Fewer Dwgs

- **Virtual Assemblies**

- **Erection Planning**

- **Project Info Warehouse**
  - Fabrication Details
  - Fabrication QC Docs
  - As-Built Docs
  - Maintenance / Inspection / Rating Docs
Where Do We Go From Here???

- Be Open to the Possibilities of BrIM
- Consider the Benefits to You
  - Owner, Engineer, GC
- Promote the Benefits
- Discuss with Owners
- Continue to Participate with Industry
  - AASHTO/NSBA Steel Bridge Collaboration--TG 15 Data Modeling for Interoperability
QUESTIONS ?