



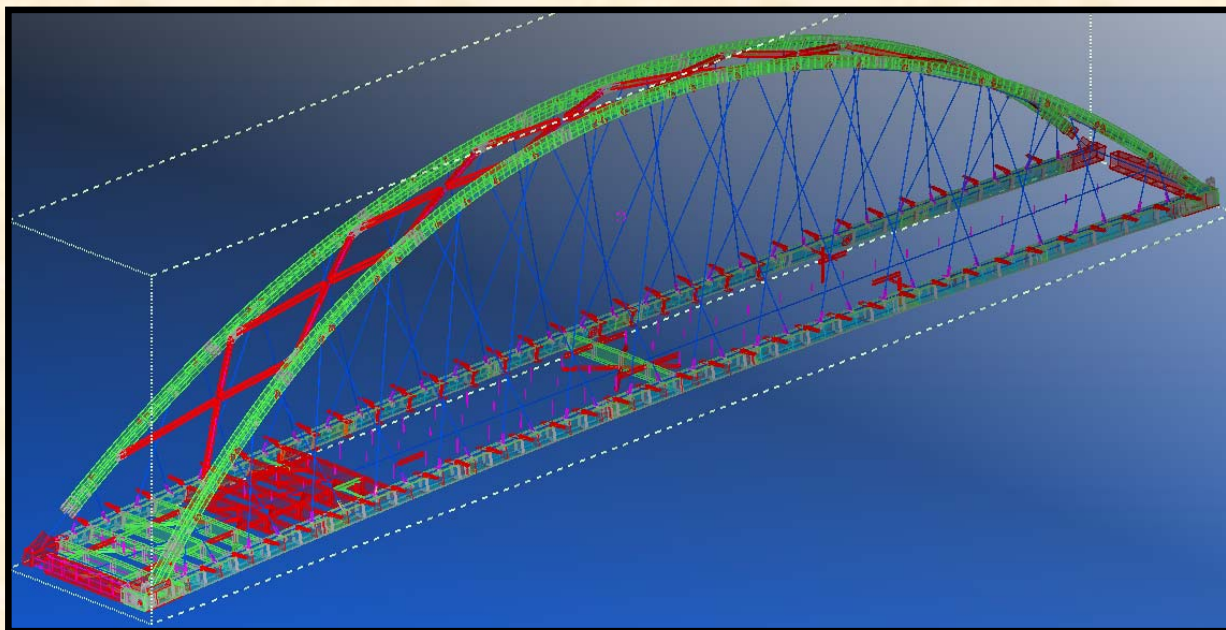
BRIDGE ENGINEERING CENTER

Workshop on 3D Design and Modeling for Highway Structures

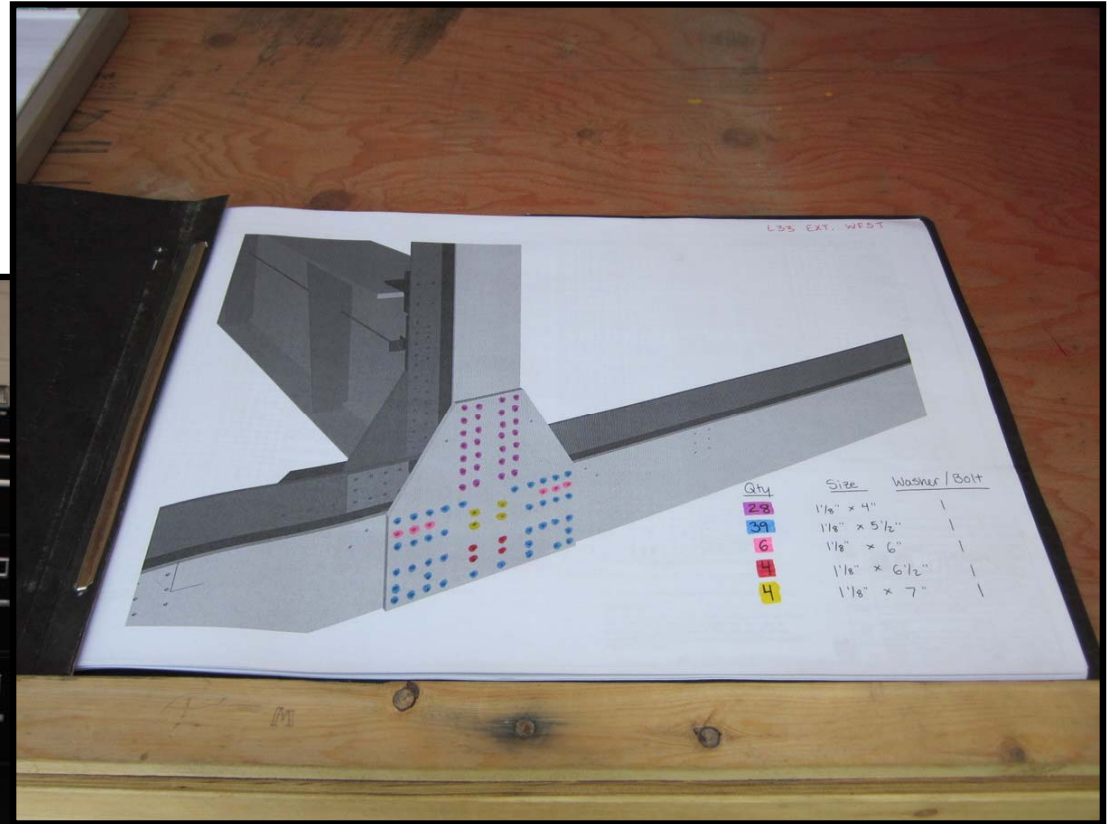


BrIM in Structural Steel Fabrication: Current Uses, Benefits and Potential

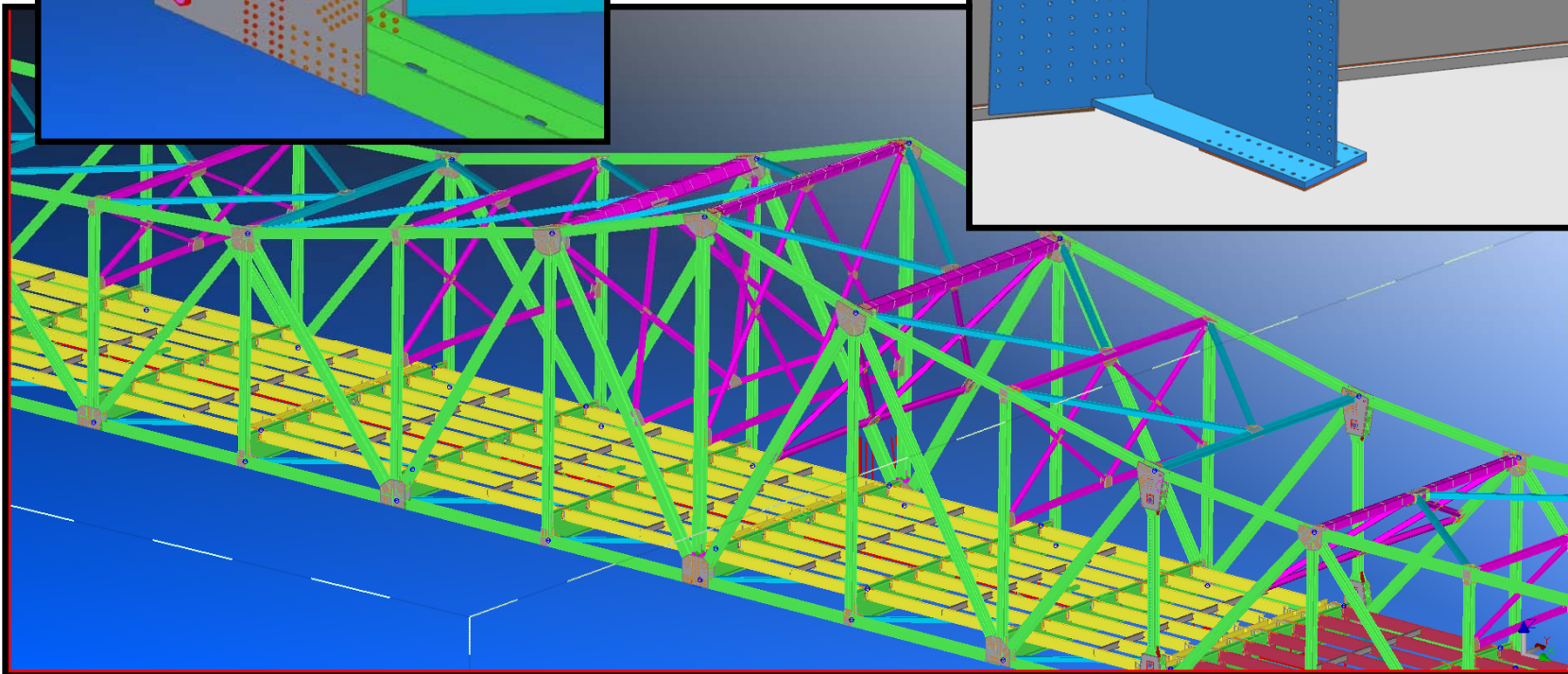
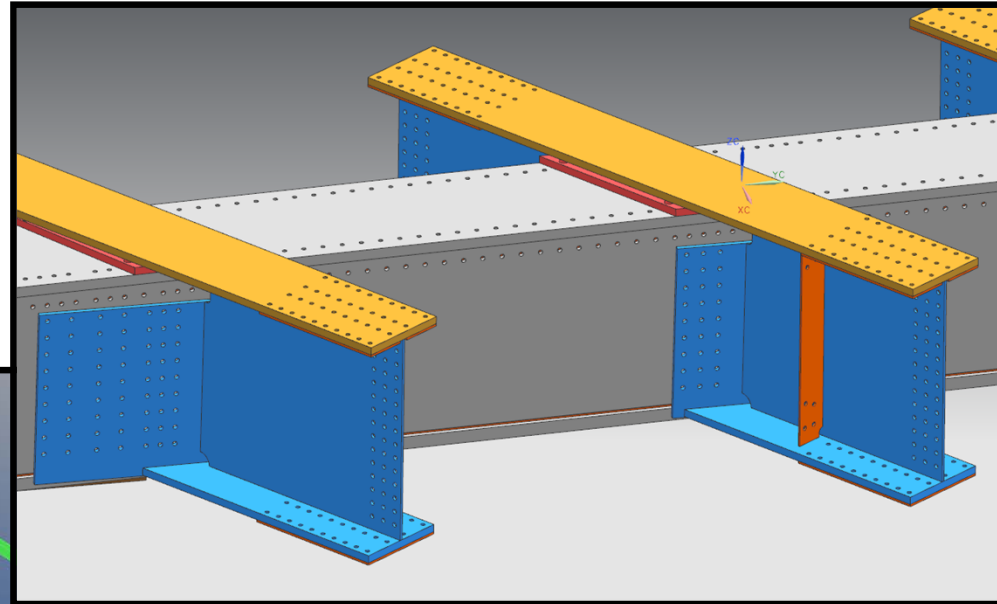
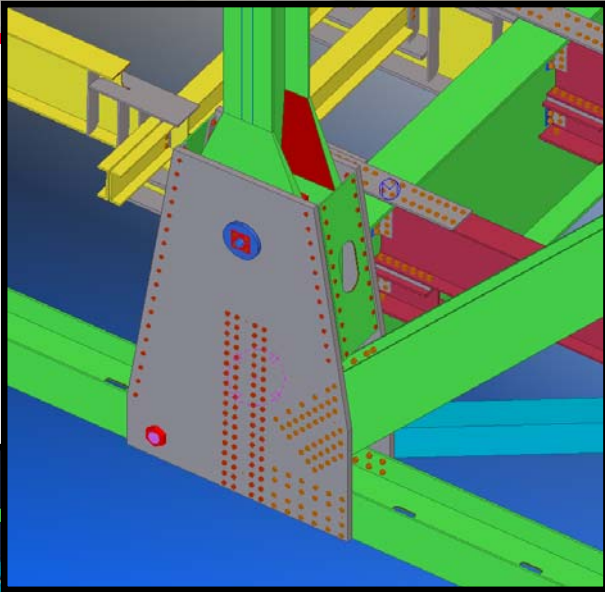
April 15, 2015



Traditional “BrIM” in Steel Fabrication

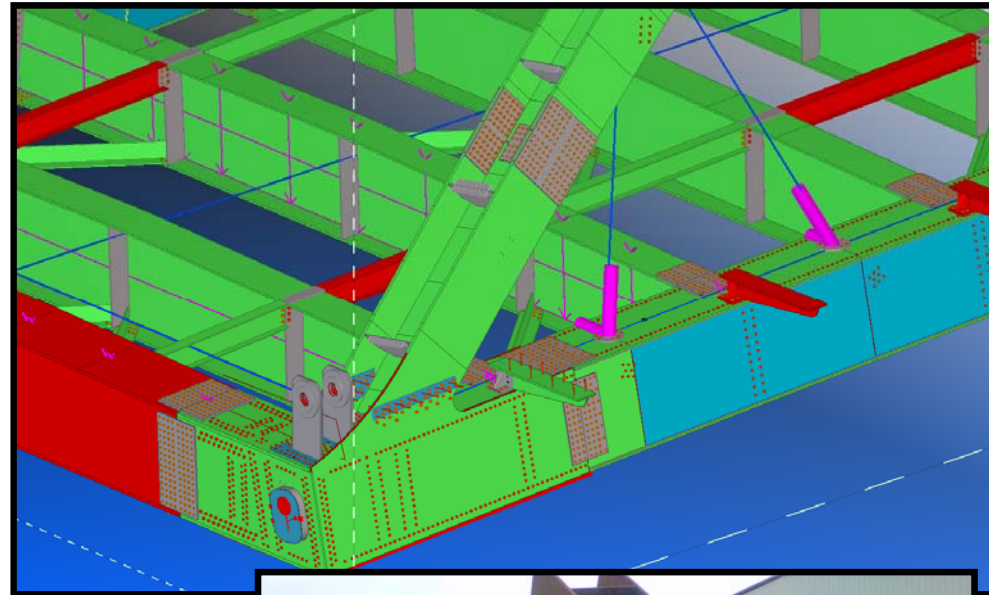


Current BrIM in Steel Fabrication



Current Uses of BrIM

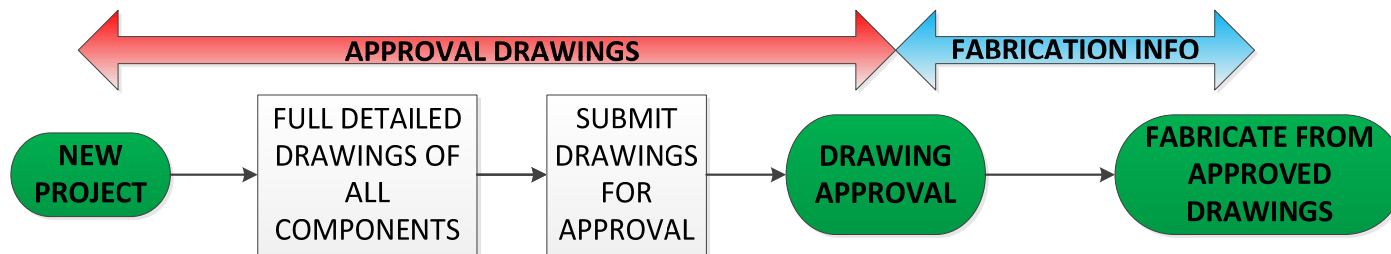
- Generation of Shop Drawings, Fab Data & CAM Files
- Fabrication Planning
- Fit Verification and Clash Detection
- Data Warehouse for Fabrication Documentation (RFIs, QC Data)
- Steel Erection Planning
- PROJECT DATA for LIFE CYCLE!



BrIM and Shop Drawings

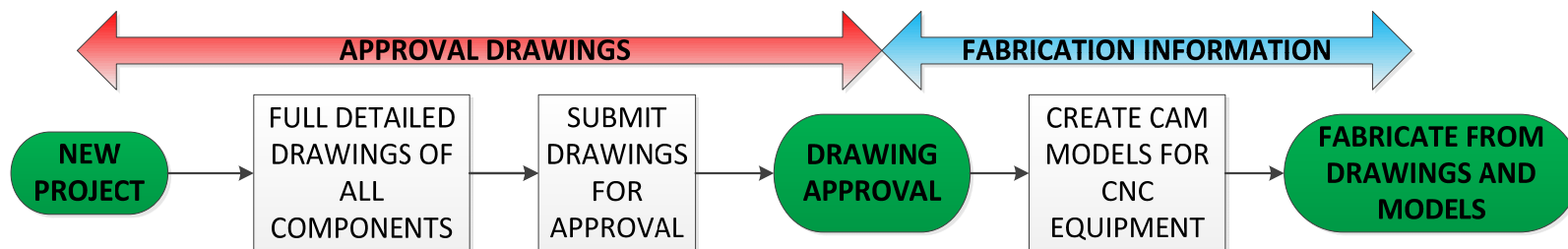


SHOP DRAWING TO FABRICATION FLOW - TRADITIONAL



DRAWINGS
GOVERN!

SHOP DRAWING TO FABRICATION FLOW - WITH ADVENT OF CNC EQUIPMENT

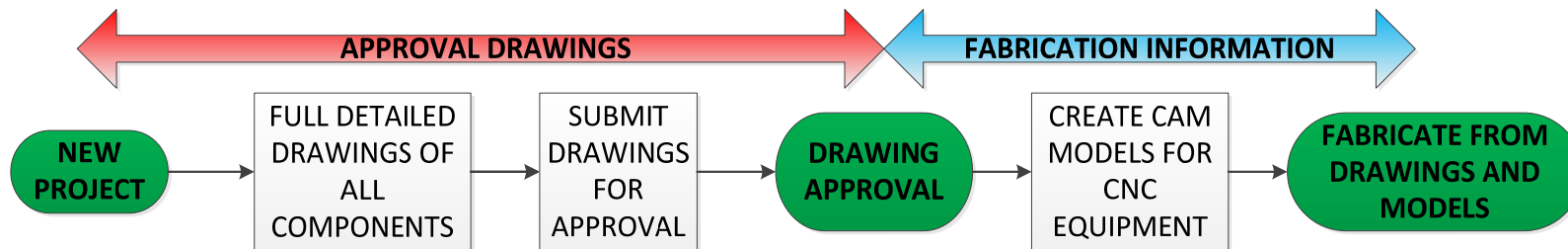


DRAWINGS
GOVERN, BUT
MODELS/DATA
USED

BrIM and Shop Drawings

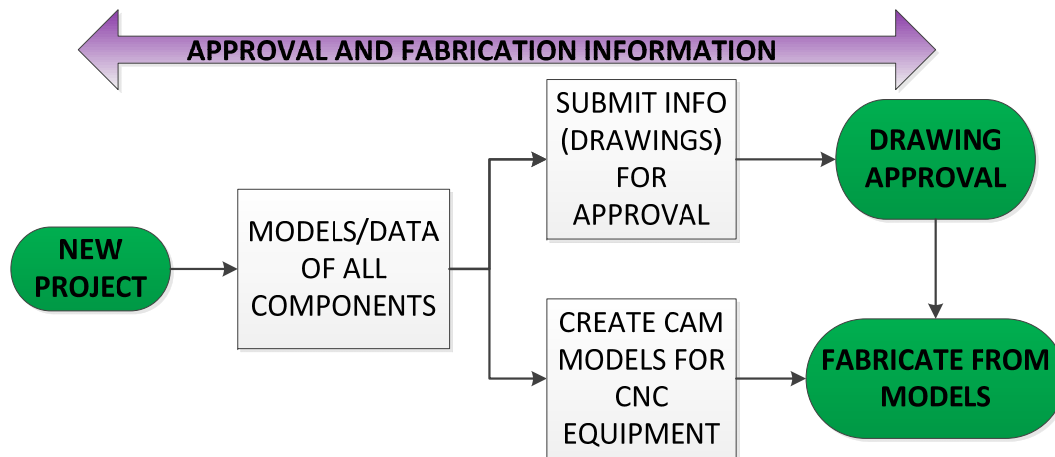


SHOP DRAWING TO FABRICATION FLOW - WITH ADVENT OF CNC EQUIPMENT



DRAWINGS
GOVERN, BUT
MODELS/DATA
USED

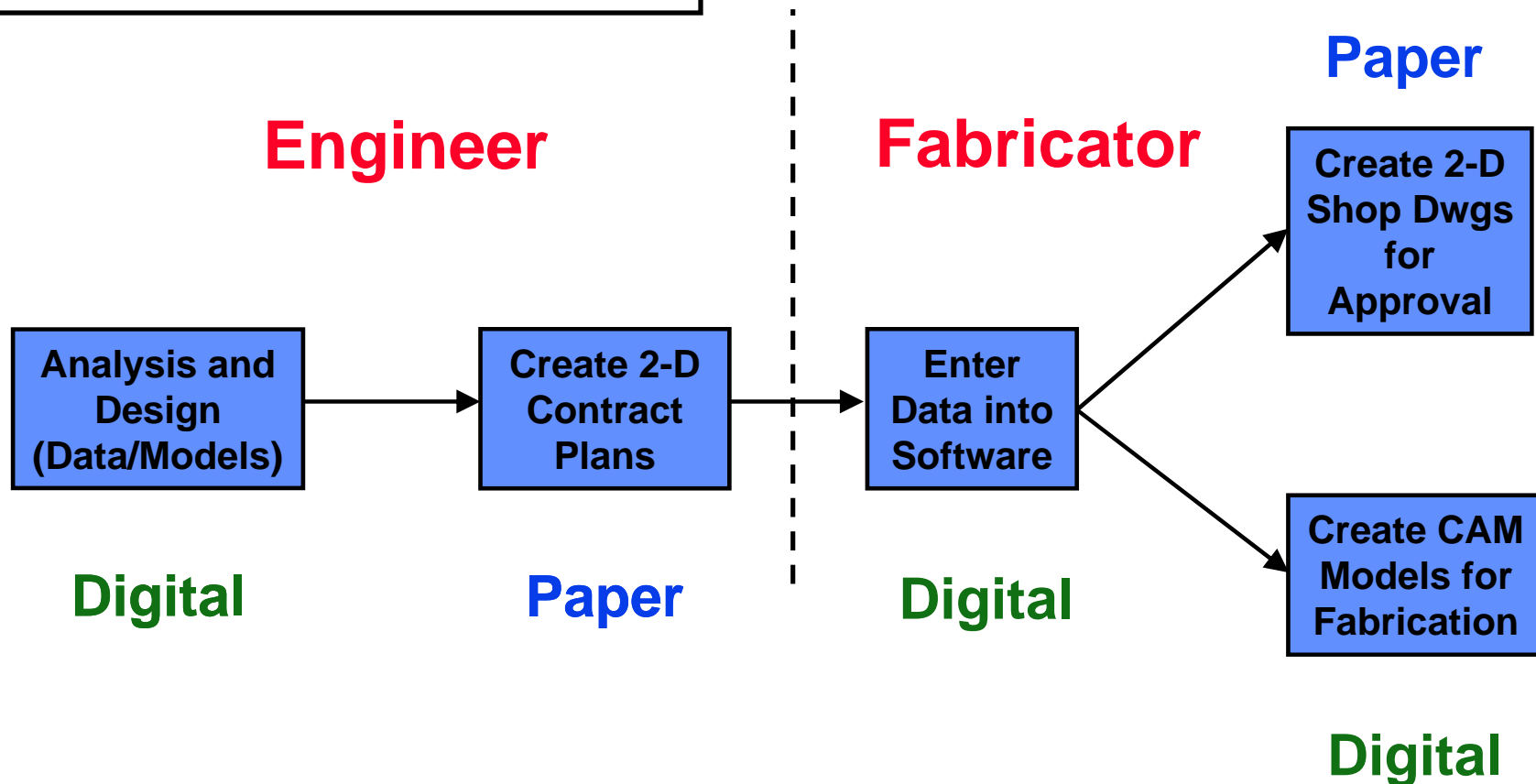
SHOP DRAWING TO FABRICATION FLOW - WITH FULL UTILIZATION OF BrIM AND CNC EQUIPMENT



MODELS/DATA
GOVERN!

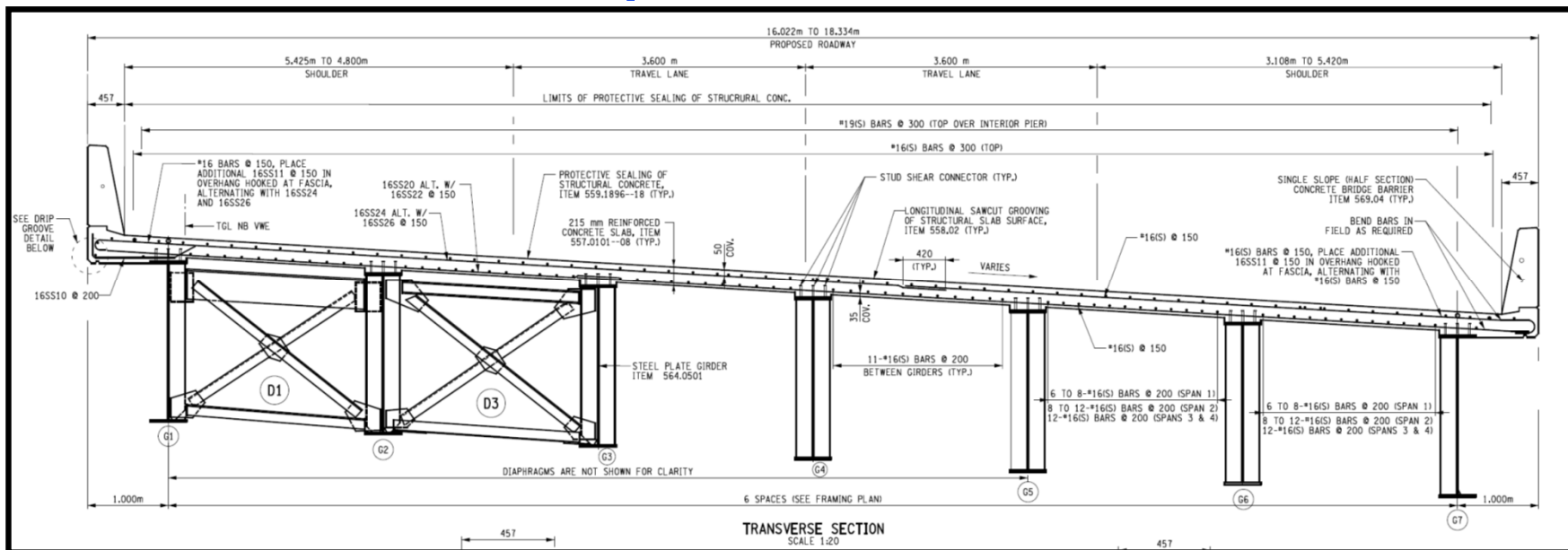
BrIM and Design Interaction

Traditional Workflow



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

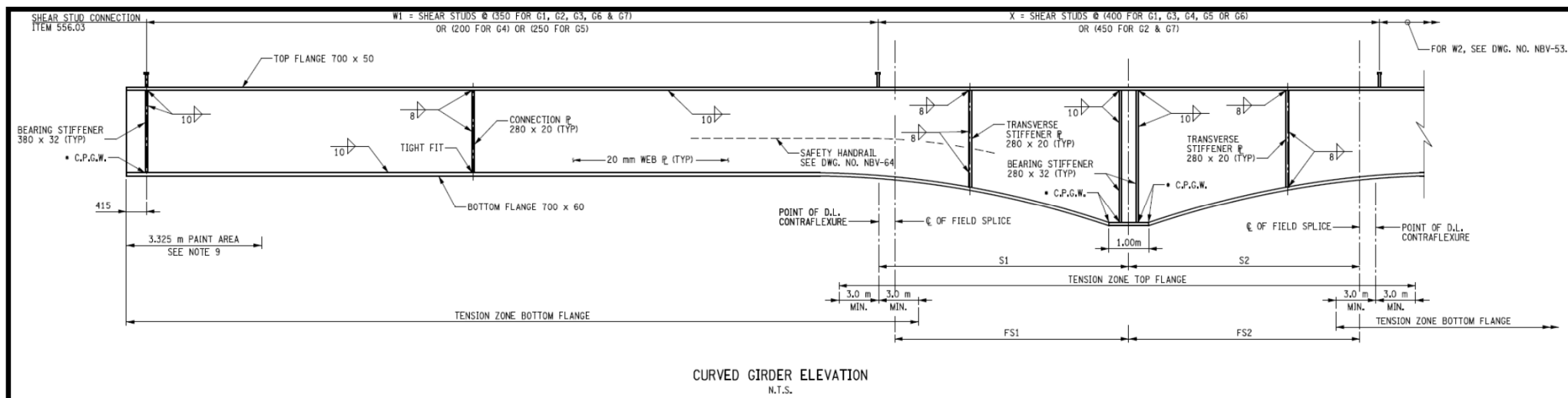


Project: NYSDOT Kew Gardens Interchange, Contract 2A

BrIM and Design Interaction



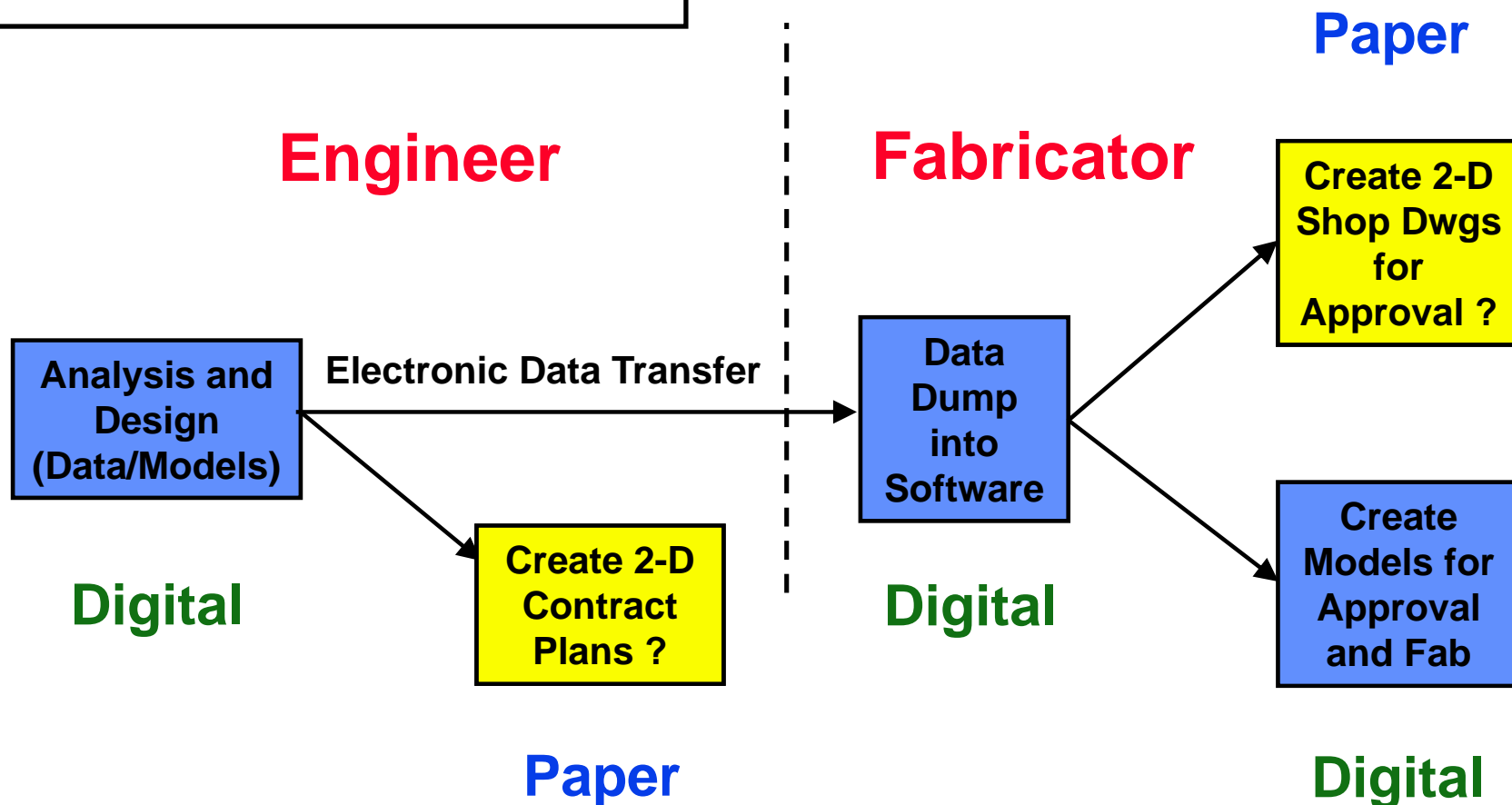
- **Design Data Transfer – Member Properties**
 - Steel Member Sizes, Shapes
 - Size Transition Locations
 - Material Specifications



Project: NYSDOT Kew Gardens Interchange, Contract 2A

BrIM and Design Interaction

Preferred Workflow

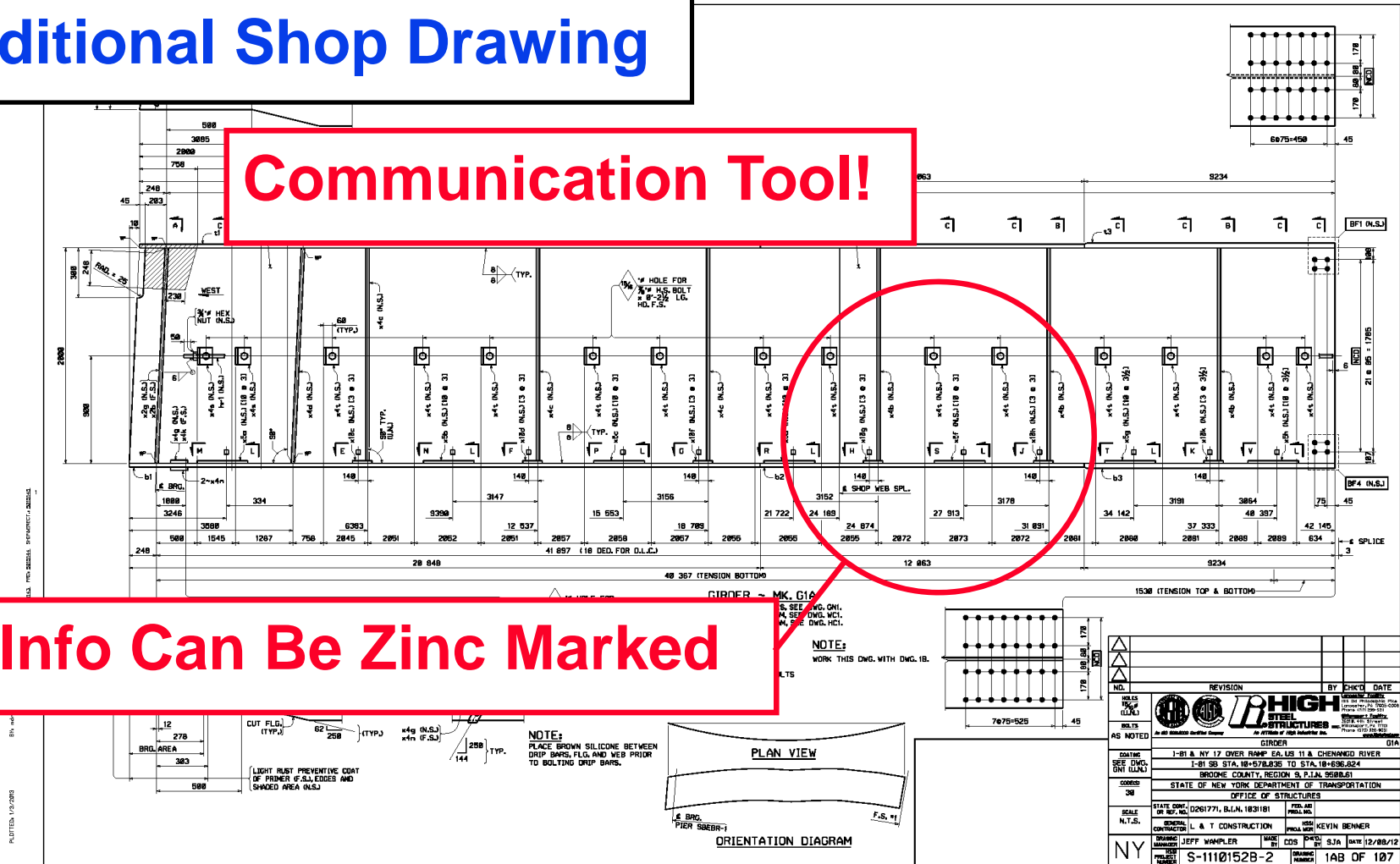


BrIM and Fabrication

Traditional Shop Drawing

Communication Tool!

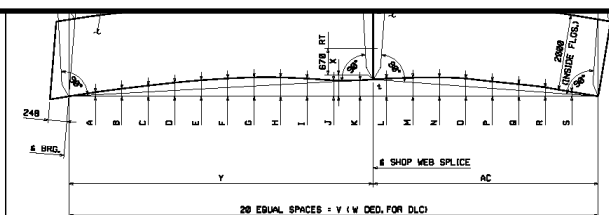
Info Can Be Zinc Marked



BrIM and Fabrication

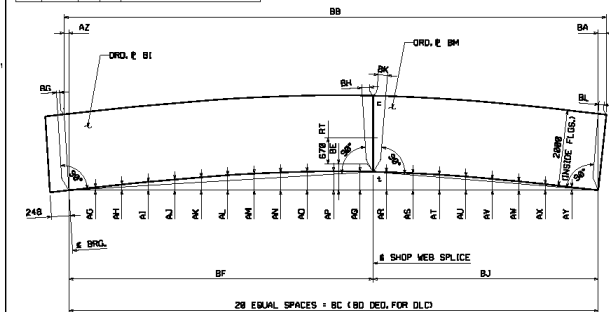


Current Transfer of CAM Data



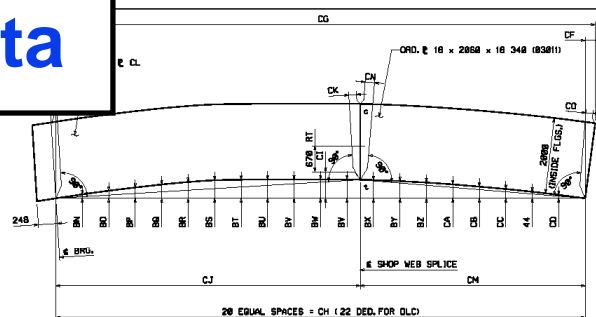
MARK	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
G1A	18	19	25	32	38	42	45	44	42	38	35	32	28	21	10	10	10	10	10	10	10	10	10	10	10	10	10	10
G2A	14	27	39	52	62	70	76	80	82	81	80	79	76	71	63	53	42	30	16	4	42	811	41	589	28	68	24	839

MARK	AC	AD	AE	AF
G1A	17	556	5	6
G2A	17	558	9	7



MARK	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH			
G3A	18	36	53	68	82	96	105	113	118	120	115	100	83	67	52	38	24	10	1	18	42	143	42	124	19	117	24	239	9	18	
G4A	24	46	67	88	105	122	138	148	155	161	163	159	146	138	112	81	70	49	24	8	22	42	238	42	268	21	161	24	238	5	10
G5A	25	48	71	95	116	135	156	168	181	177	168	155	140	128	107	78	54	26	8	25	43	236	43	285	22	173	24	638	16	14	
G6A	32	63	93	117	147	178	194	214	229	232	287	198	178	147	126	93	64	32	2	31	43	268	43	292	22	215	24	738	15	17	

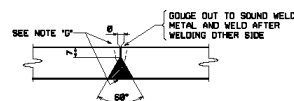
MARK	BI	BJ	BK	BL	BM
G3A	18	2068	24	468	83877
G4A	18	2068	24	558	83884
G5A	18	2068	24	558	83882
G6A	18	2108	25	558	83881



MARK	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH	CI	CJ	CK	CL		CM	CN			
G5A	27	51	74	94	111	123	127	127	128	129	124	117	187	94	79	63	23	13	23	42	473	42	437	126	24	337	18	18 × 2888 × 24 748 (23883)	18	188	14
G7A	18	35	51	71	88	103	117	129	137	138	132	123	112	89	82	64	22	14	21	42	841	42	886	135	24	538	11	18 × 2868 × 25 068 (23005)	18	258	15

MARK	CO
G5A	9
G7A	6

Transferred Electronically



TYPICAL WEB PLATE SPLICE
FOR WEB PLATES 13 mm TO 58 mm THICK 18-L2c-S1

NOTE 'C'
GRIND THE WELDS FLUSH IN THE AREAS TO BE TESTED AND FOR THE FULL DEPTH OF WEB ON G1A, G1B, G1C (F.S.) AND G5A, G5B, G5C (N.S.). ALL OTHER WELDS MAY HAVE A MAXIMUM REINFORCEMENT OF 3 mm.

NOTES:
FOR GENERAL, SHOP NOTES, SEE DRAWING GNI.
ALL WEB PLATES REQUIRE CHARPY V-NOTCH TEST.
NEGATIVE CAMBER ORIGINATES INDICATE CURVE IS BELOW BASELINE.
THE LETTERS 'A' & 'B' AT WEB SPLICES INDICATE TENSION AND COMPRESSION EDGES AT SPLICES.
RT INDICATES RADIOGRAPHIC TESTING FOR 1/3 OF THE WEB DEPTH AT TENSION EDGE.

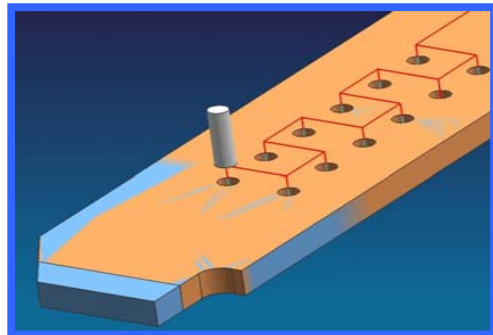
NO.	REVISION	BY	CHKD	DATE
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BrIM and Fabrication

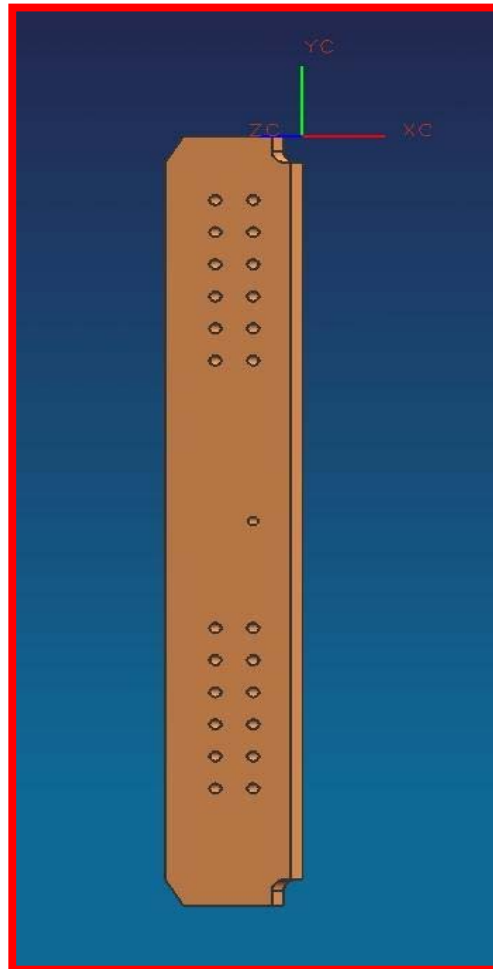
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File Edit Search 3D-Edit Options Window Help
N5 (P228A.MC)
N10 (P228A.MC)
N15 G90
N20 G40
N25 G70
N30 G02 X0.0 Y0.0
N35 M19
N40 M37T3
N45 M37T4
N50 B.105 DIA. TORCH
N55 (P228A.MC)
N60 G00 X.000 Y.625
N65 M17
N70 M03
N75 G40X0.105
N80 G41
N85 G01 X.014 Y1.025 F12.0
N90 X.105 Y1.053
N95 G03 X1.476 Y2.016 R.013 J1.5
N100 G01 X13.53 Y27.813
N105 X28.401 Y2.196
N110 G03 X28.396 Y.75 R.368 J3.929
N115 G01 X32.939
N120 Y0.0
N125 X1.495
N130 G03 X.014 Y1.025 I1.495 J1.125
N135 G40
N140 M05
N145 M18
N150 M19
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N165 (CYCLE TIME = 10.4 MINUTES)
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CNC Code

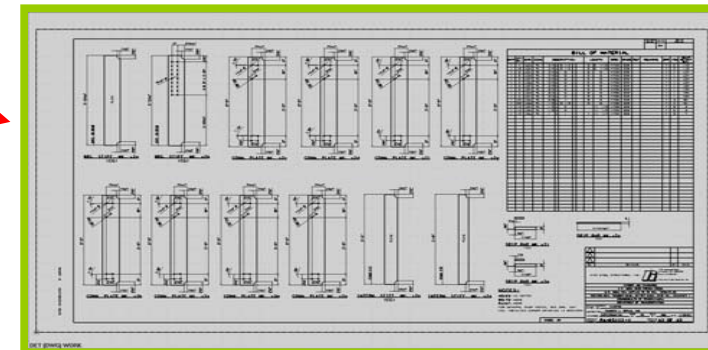


CAM Toolpath



Part Model

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



CAD Drawings

SHIP	QTY	MARK	COMP	DESCRIPTION	LENGTH	SPEC	GRADE	TEST	REMARKS	APP	DATE	REVISION
1	4	-20	PL	3/4" X 9' X 2"	5	5	1/10	A709	SDM		2	118
2	10	-20	PL	3/4" X 8' X 2"	5	5	1/10	A709	SDM		2	118
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BrIM and Fit Verification/Assembly



Traditional Assembly

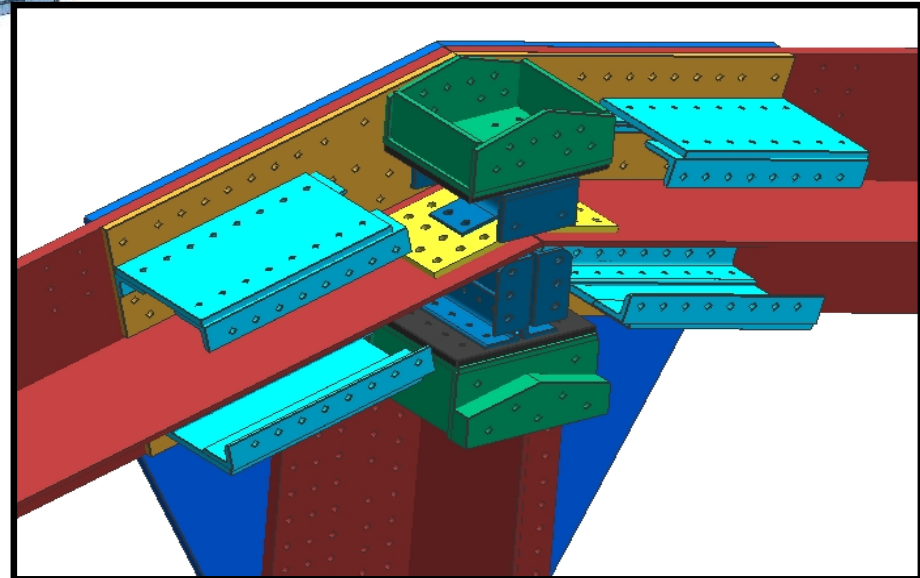
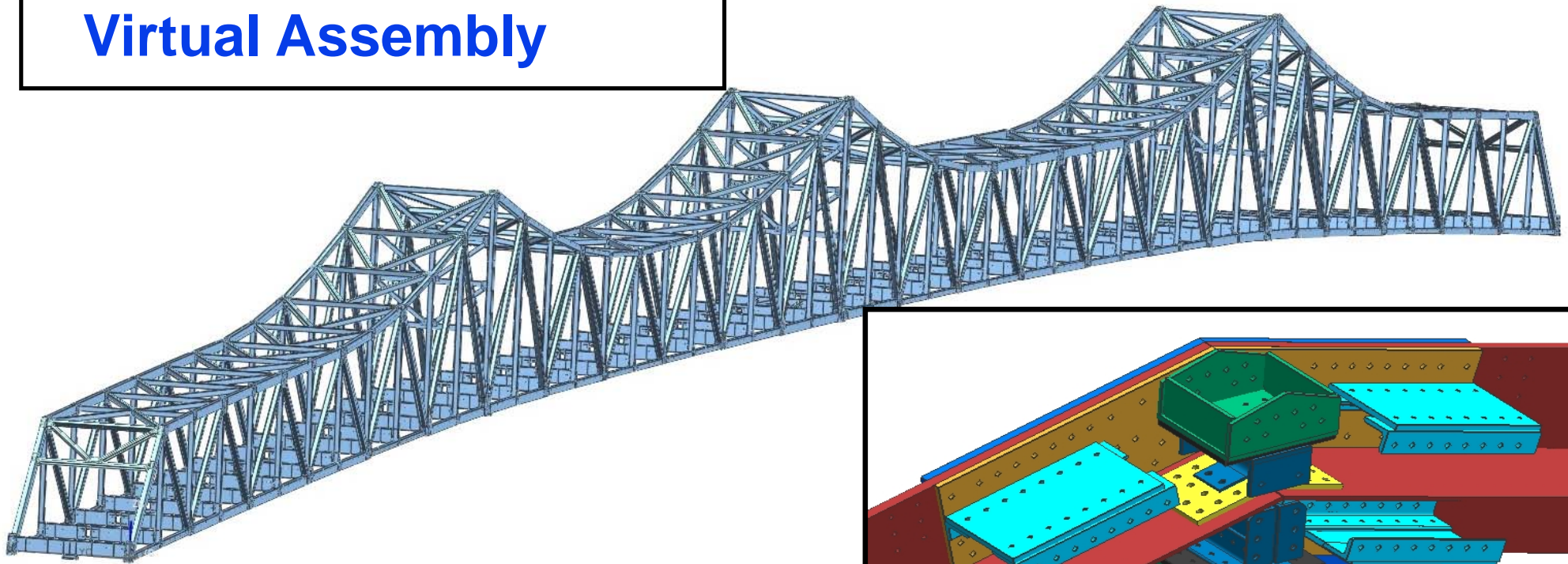
- Labor Intensive
- Time Consuming
- Costly



BrIM and Fit Verification/Assembly



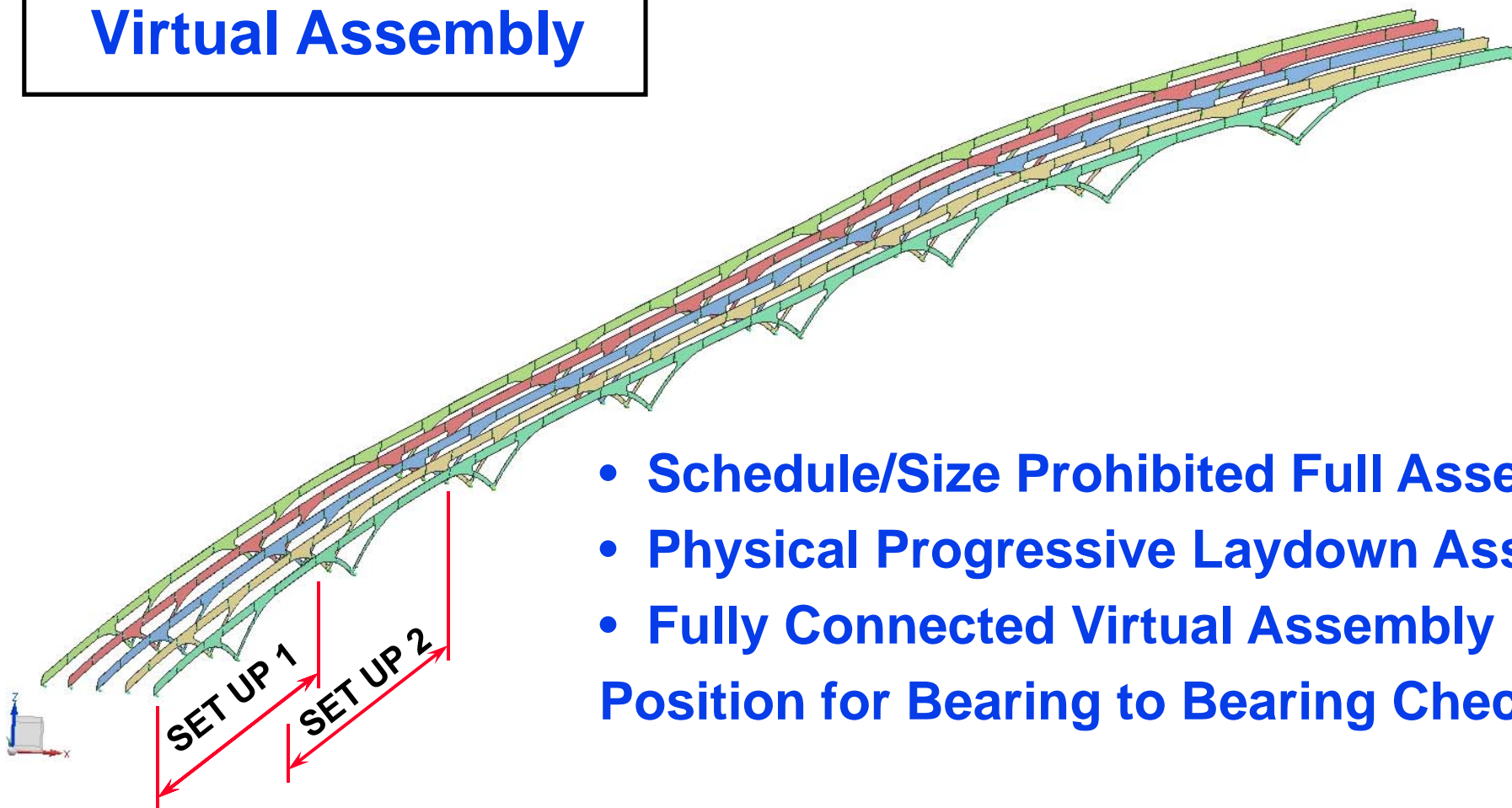
IN Milton Madison Truss Virtual Assembly



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

BrIM and Fit Verification/Assembly

Physical Assembly avoids
issues here, **BUT**
Virtual Assembly can
achieve same result



Case Study - SR 22/322 over I-81



May 9, 2013

LOCAL NEWS

High Steel Structures awarded PennDOT contract for emergency replacement of bridge at I-81 Interchange



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.

Courtesy: WPMT43

Project Timeline



- 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)

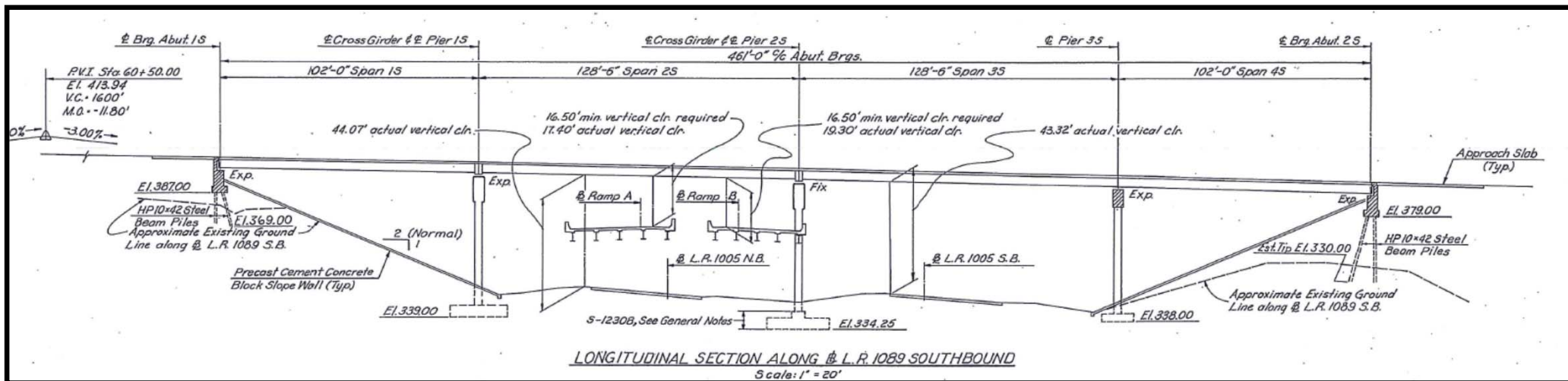
13½ Wks NTP to Erected – HOW?



365 tons Structural Steel

4 Spans

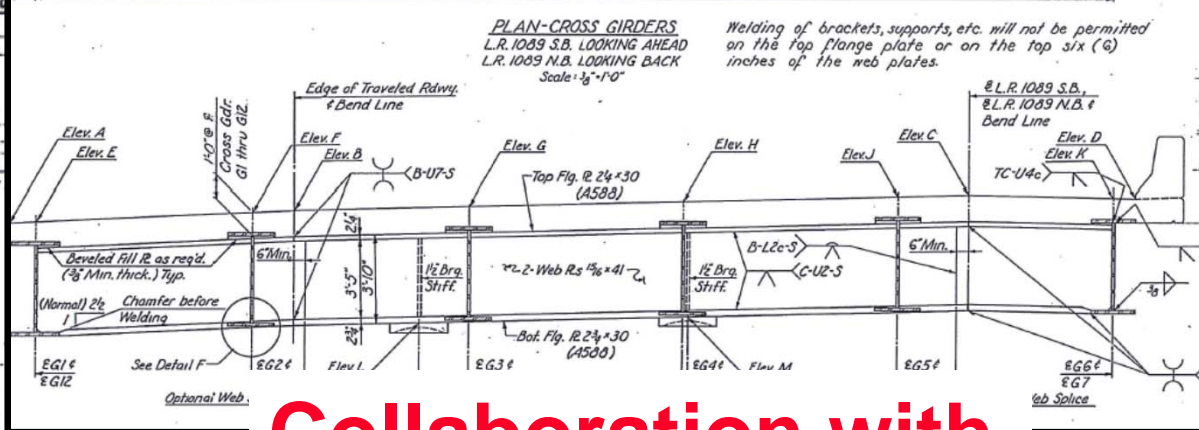
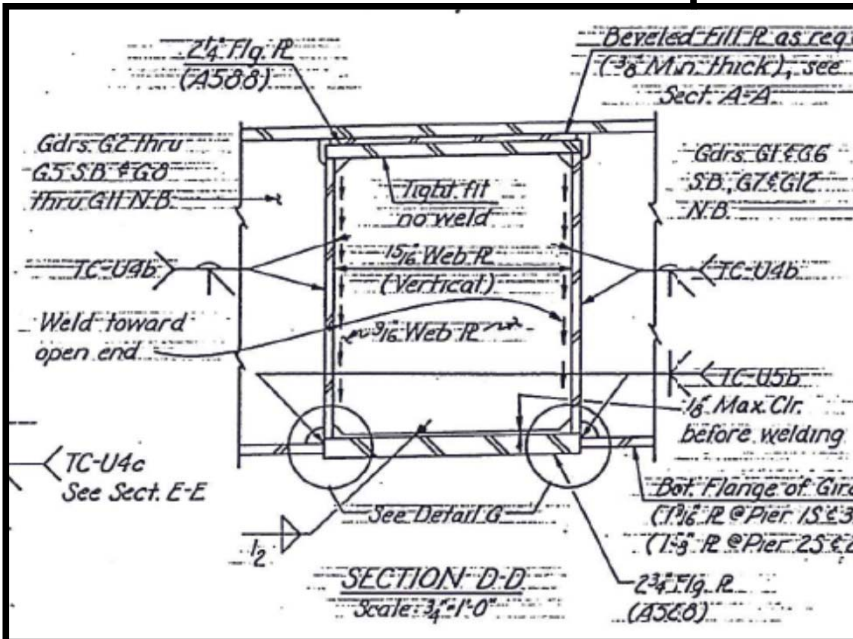
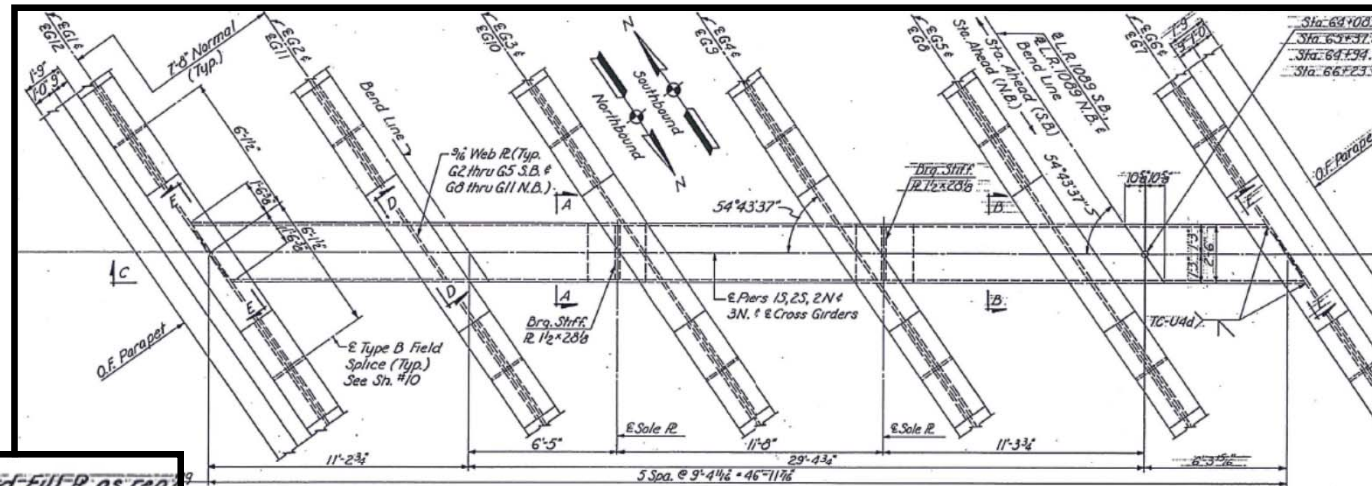
461 feet Total Length



13½ Wks NTP to Erected – HOW?



6 Gdr Lines
2 Box Gdrs
Skewed Conns

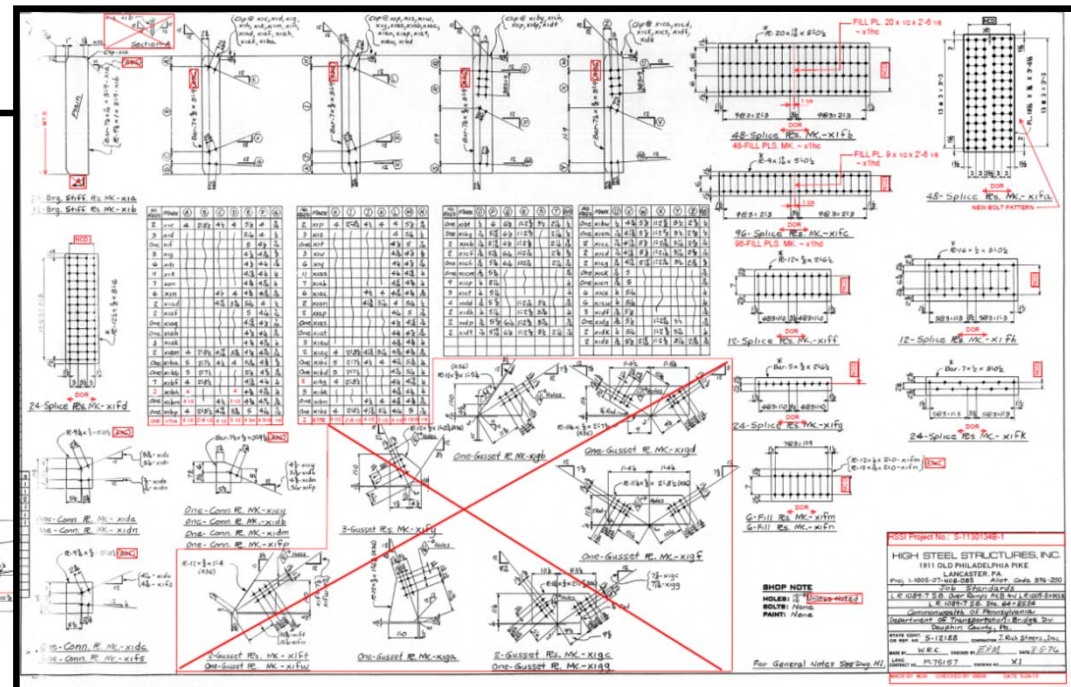
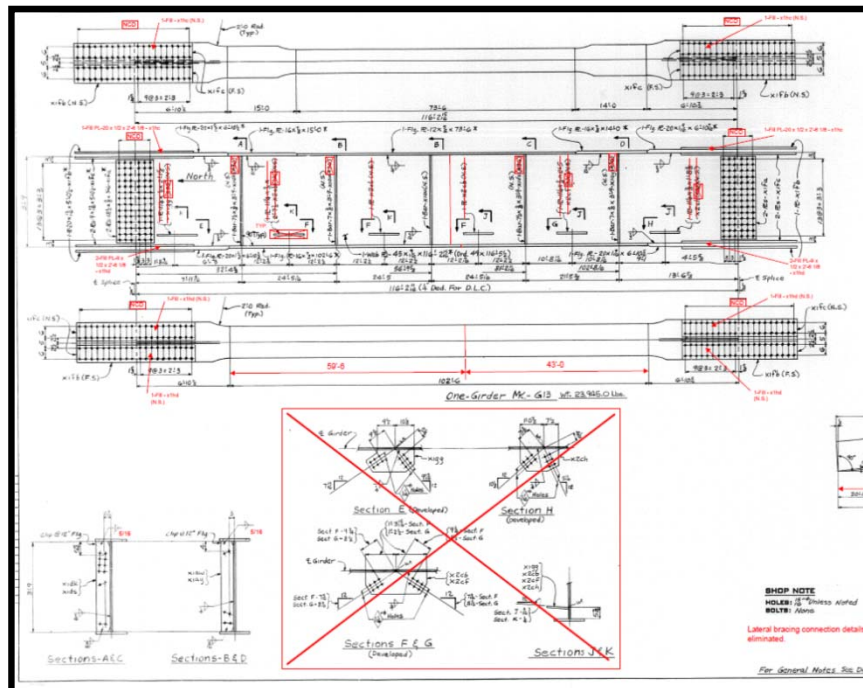


Collaboration with
New Processes

Longitudinal Girders

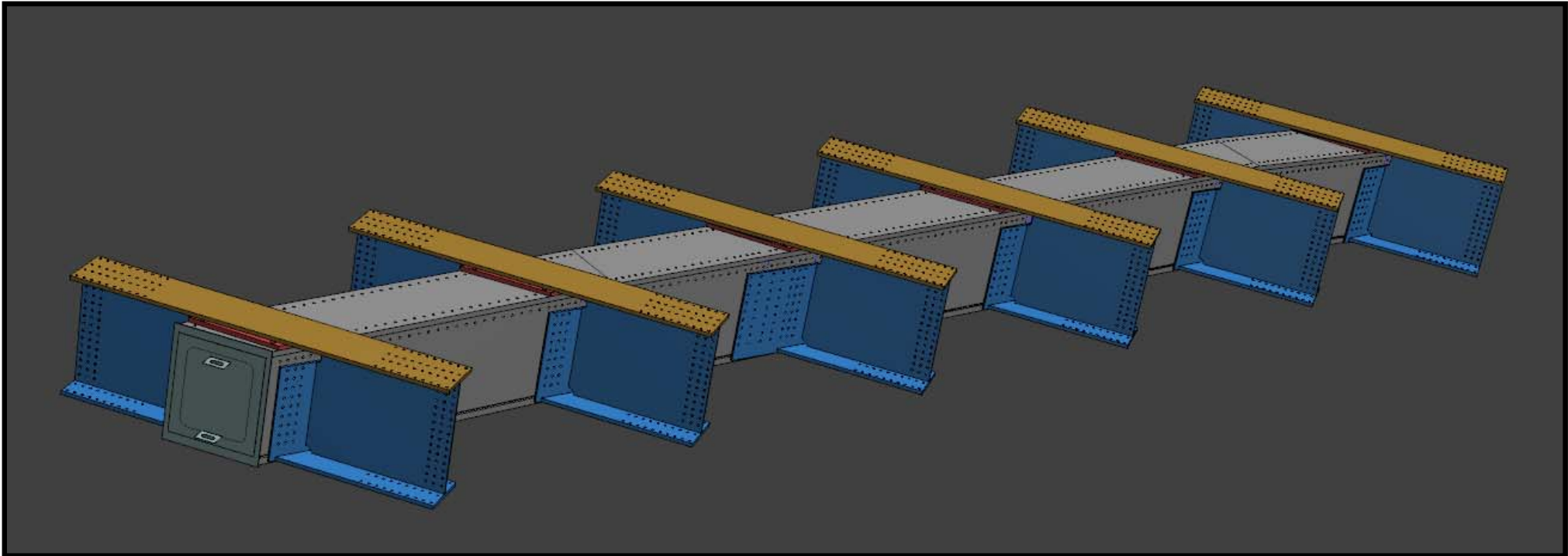


- **Expedited Shop Drawing Production & Review**
 - **Direct Communication—PennDOT, Gannett Fleming, HSSI**
 - **Redline Markup of Existing Shop Drawings; Partial Subs**
 - **Current Weld Practices**



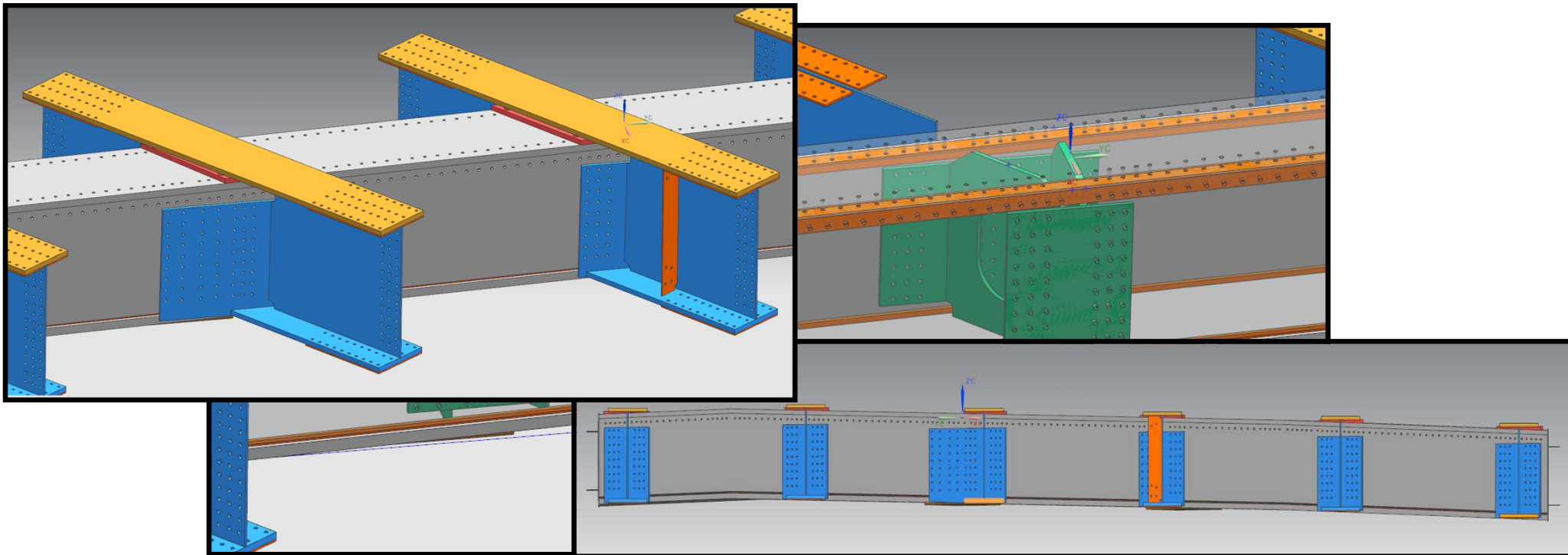
Transverse Box Girders

- **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

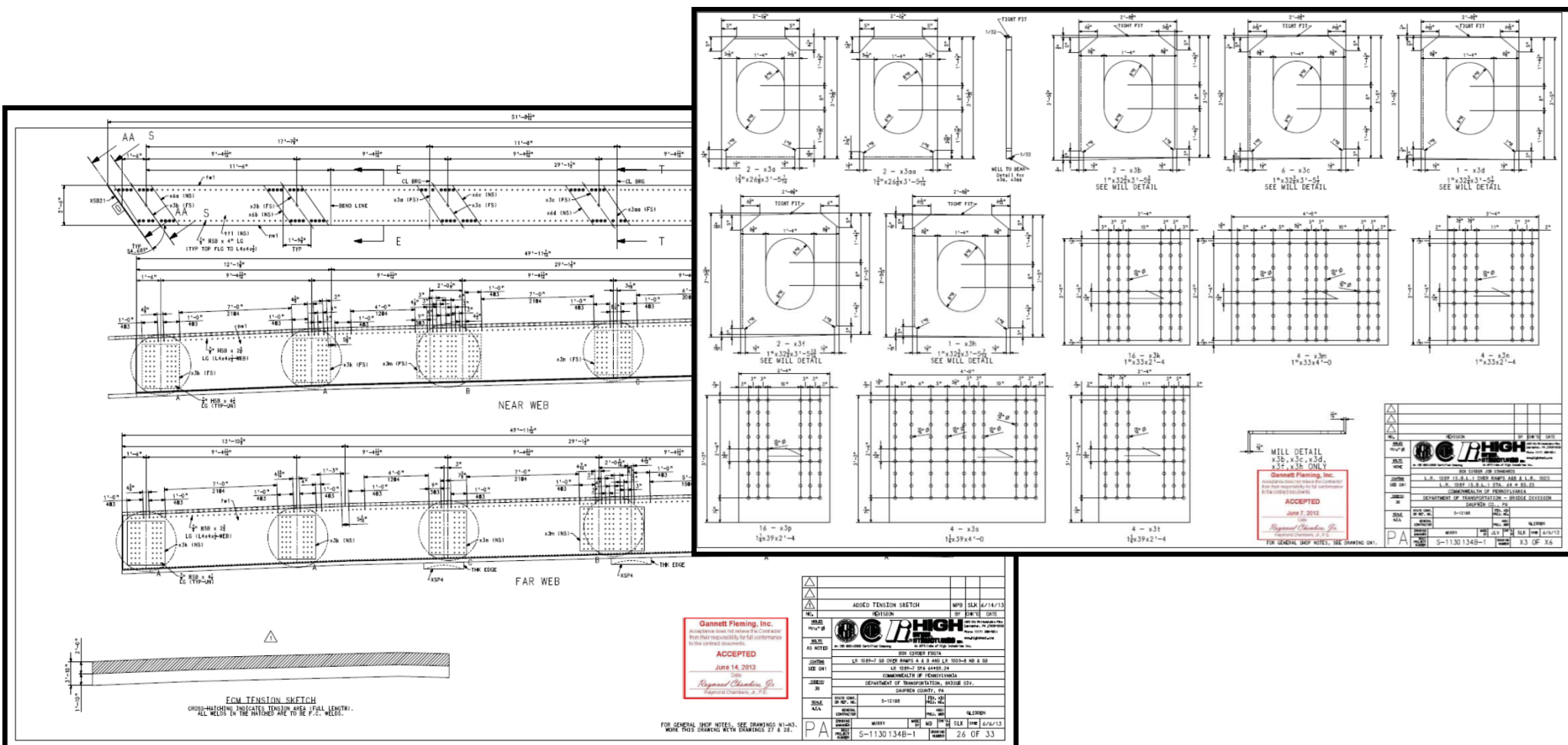
- On-Site Review/Approval of Model
 - Development of Design Changes
 - Investigation/Resolution of Design/Detail Issues, Req'mts
 - Model Drives CNC Equipment and Drawings



Transverse Box Girders



- **Fabrication Drawing Approval Directly Followed**



Fabrication – Girder Stubs



Fabrication – Box Girders

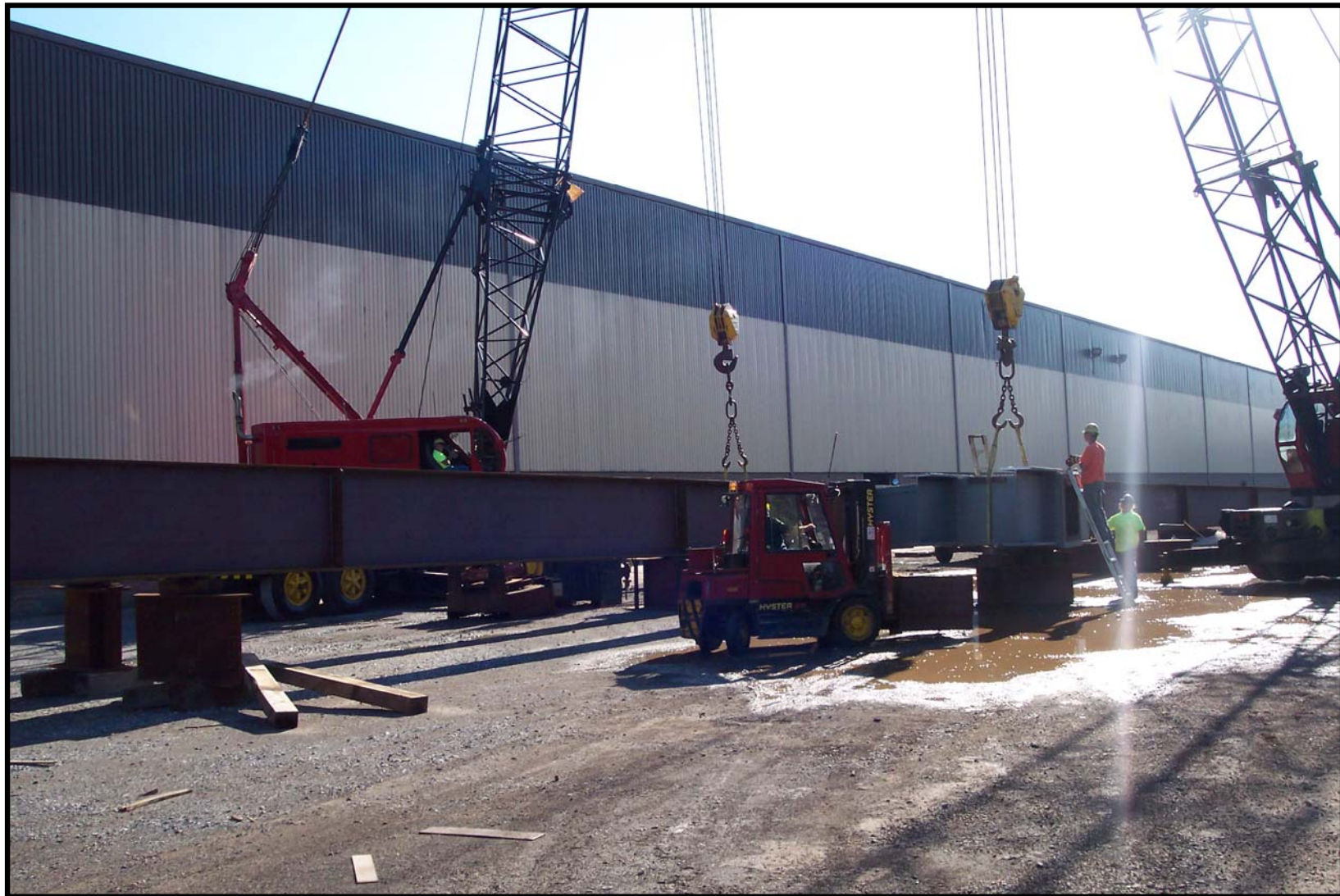


Fabrication – Box Girders



Yard Assembly

iHIGH
STEEL
STRUCTURES INC.
An Affiliate of High Industries Inc.



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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



COOPERATION

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!

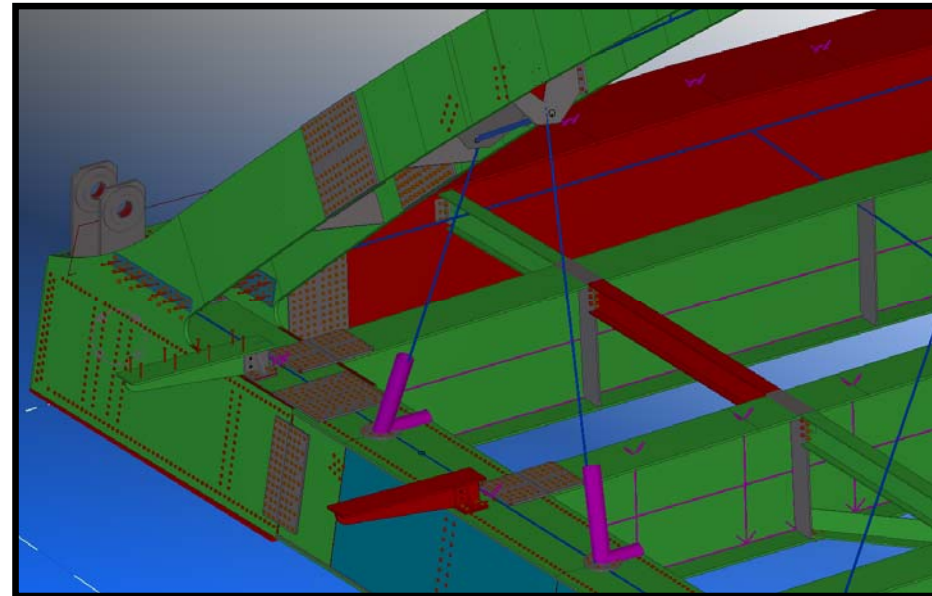


Courtesy:
PennDOT

BrIM Benefits in Steel Fabrication



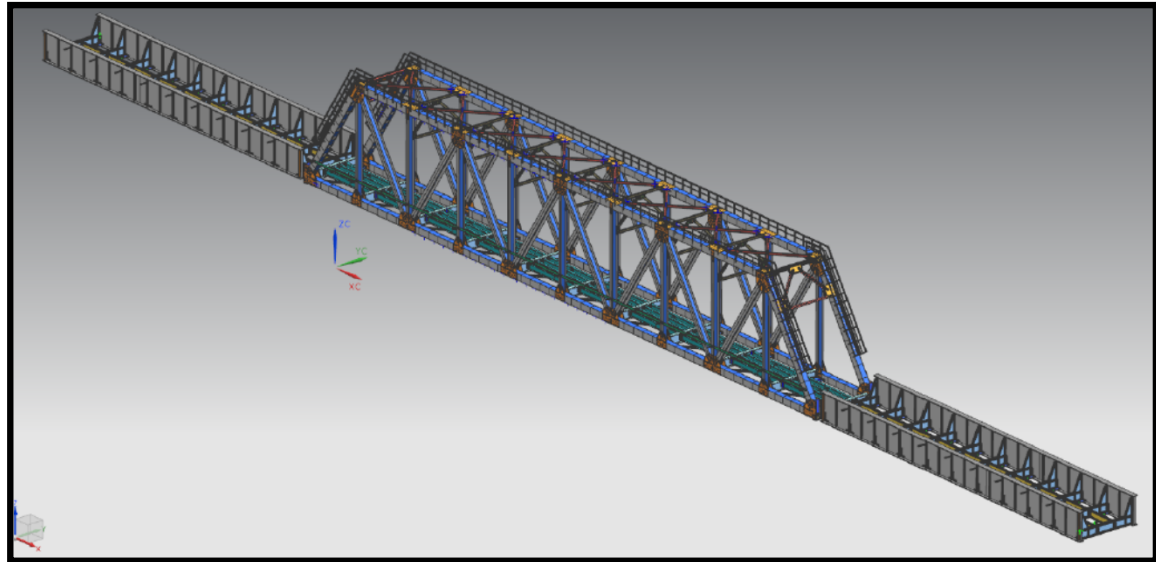
- Optimizes Workflow thru Design – Detailing – Fabrication – Field
- Minimizes Errors due to:
 - Manual Data Transfer
 - Detailing Misfits
- Provides One Source for Data
 - Shop Drawings / RFIs
 - Fabrication Documentation
 - QC Records
- Eliminates Redundant or Manual Efforts
 - Manual Programming and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



BrIM Potential in Steel Fabrication

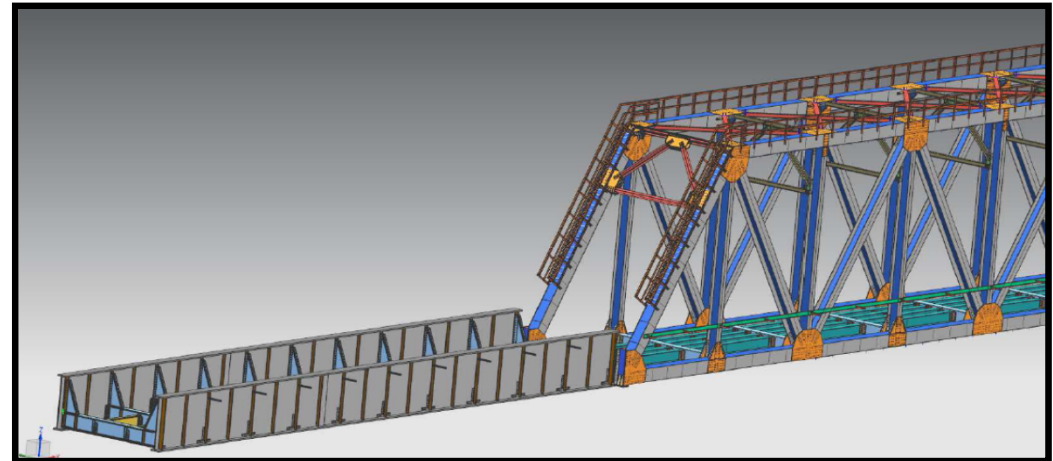


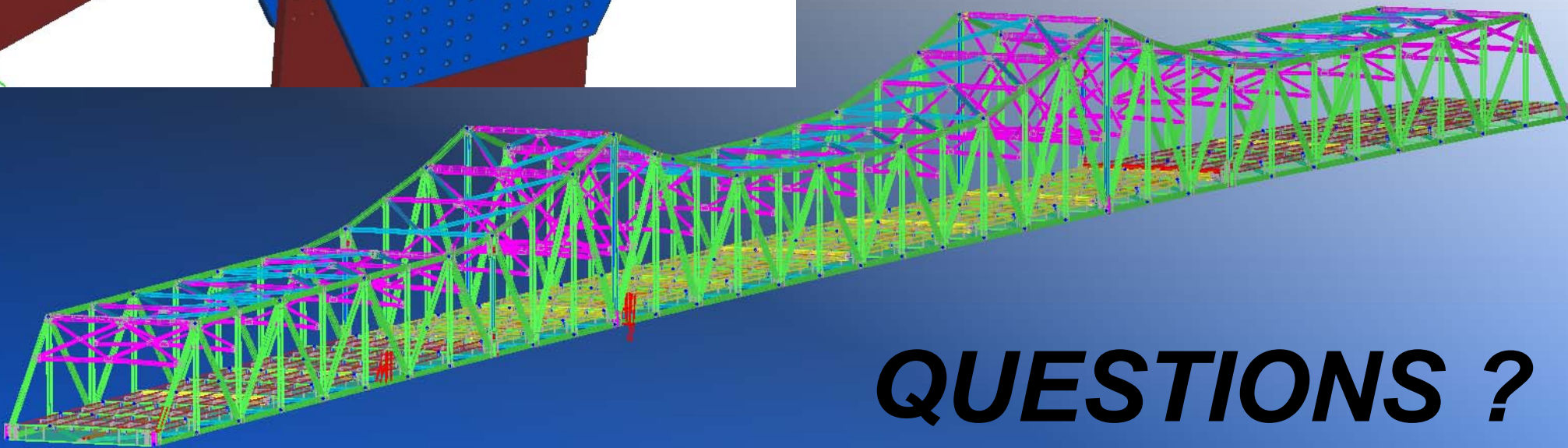
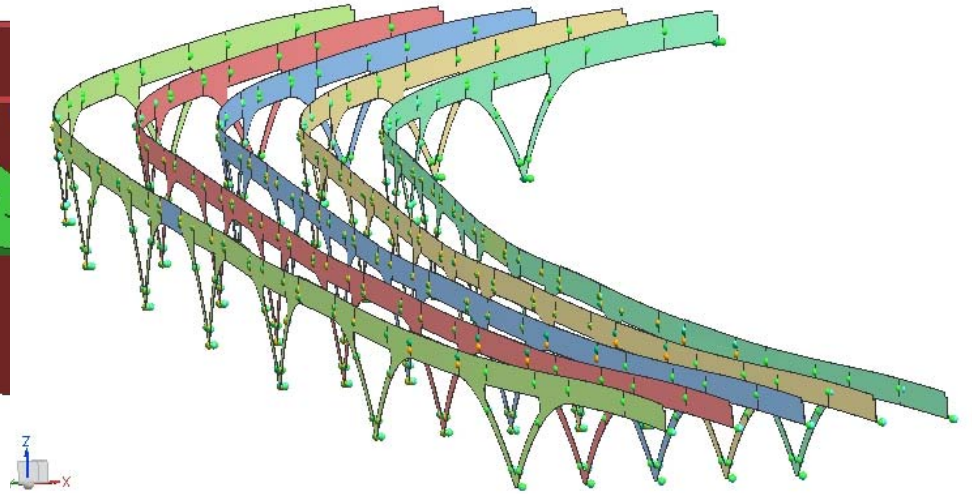
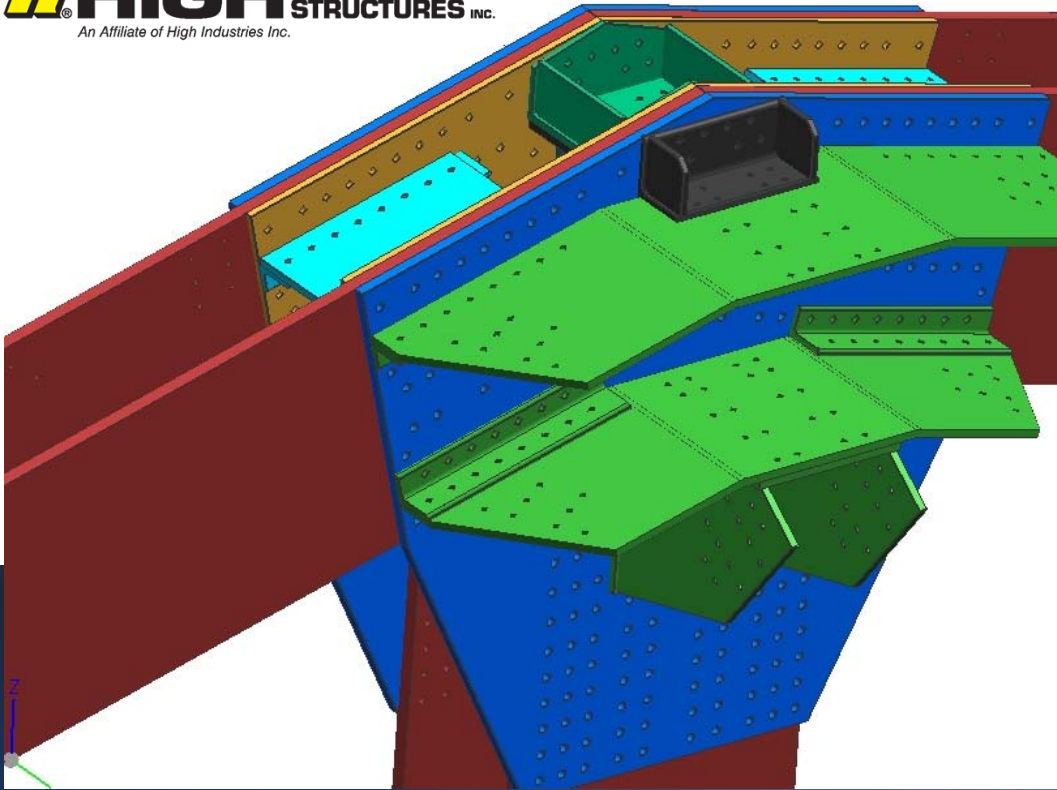
- **Transfer of Data between Engineer & Fabricator**
 - Useable format needed for both
- **Fabrication Approval Process**
 - Use of Models; Fewer Dwgs
- **Virtual Assemblies**
- **Erection Planning**
- **Project Info Warehouse**
 - Fabrication Details
 - Fabrication QC Docs
 - As-Built Docs
 - Maintenance / 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 ?