



BIM

In Construction

Presentation at Northern Virginia NAIOP seminar on BIM - Thursday, March 6, 2008

Alexander V. Zolotov Alex.Zolotov@ClarkConstruction.com

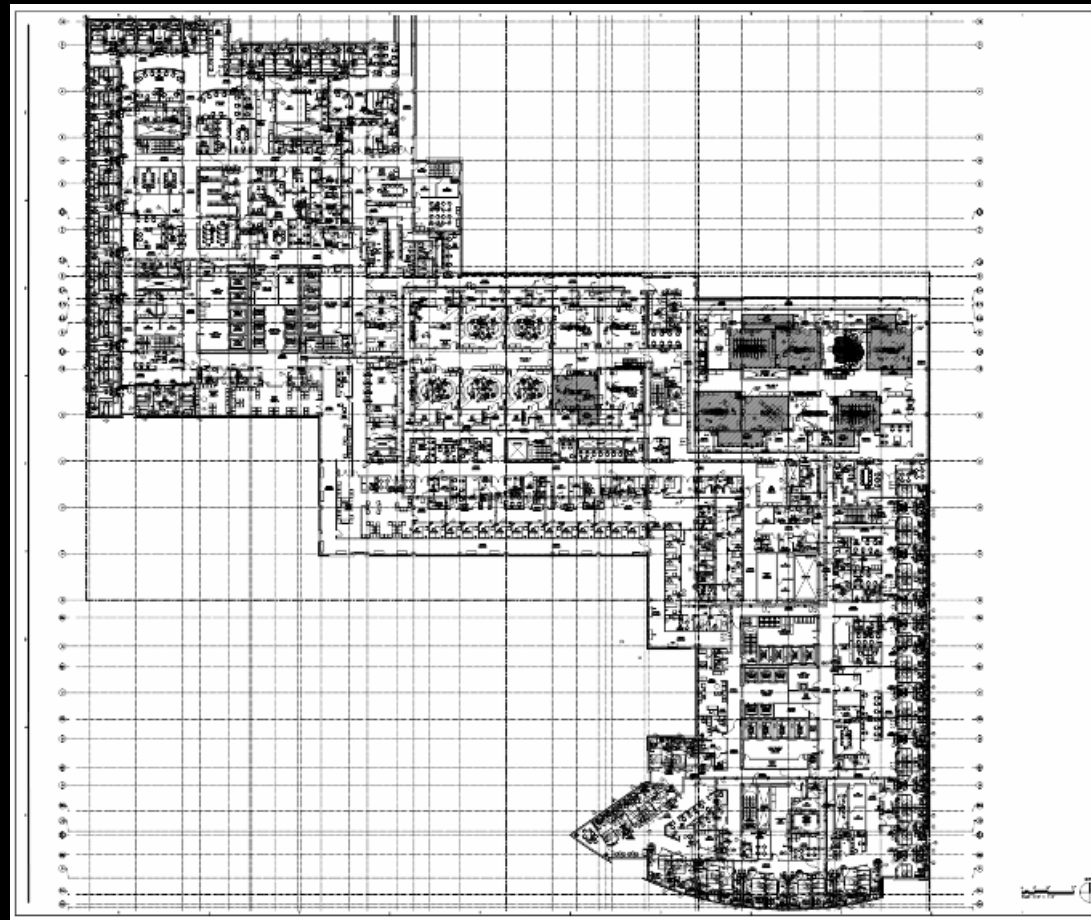


Benefits of BIM for Construction

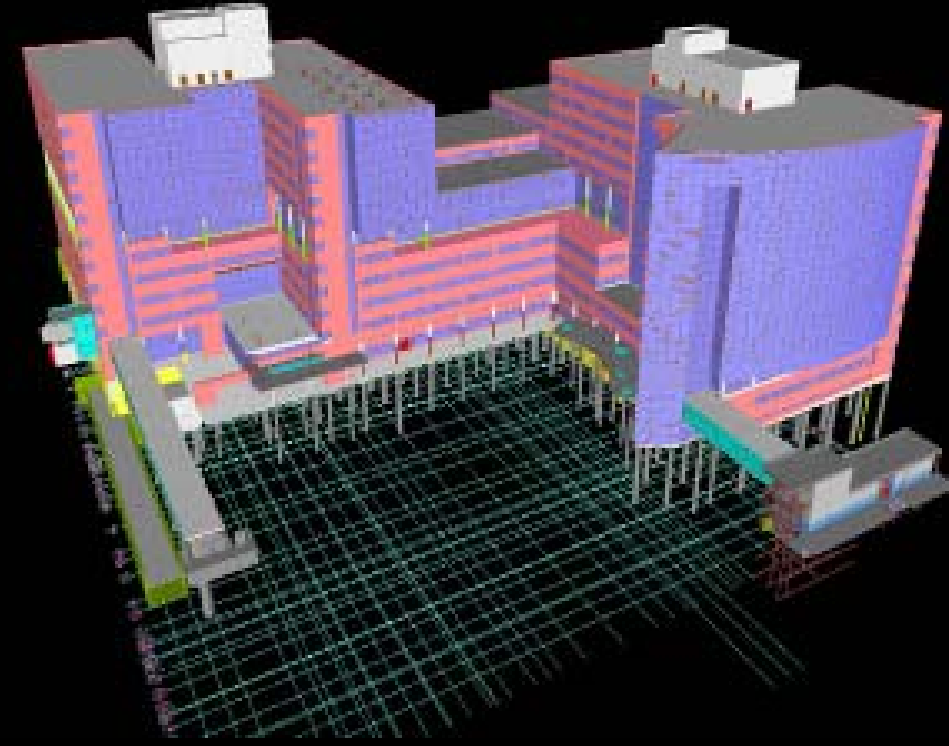
Effective tool for:

- coordination and constructability reviews
- achieving fast-track schedules and staying within budget
- more reliable planning and budgeting
- more dynamic, real-time value analysis and decision-making

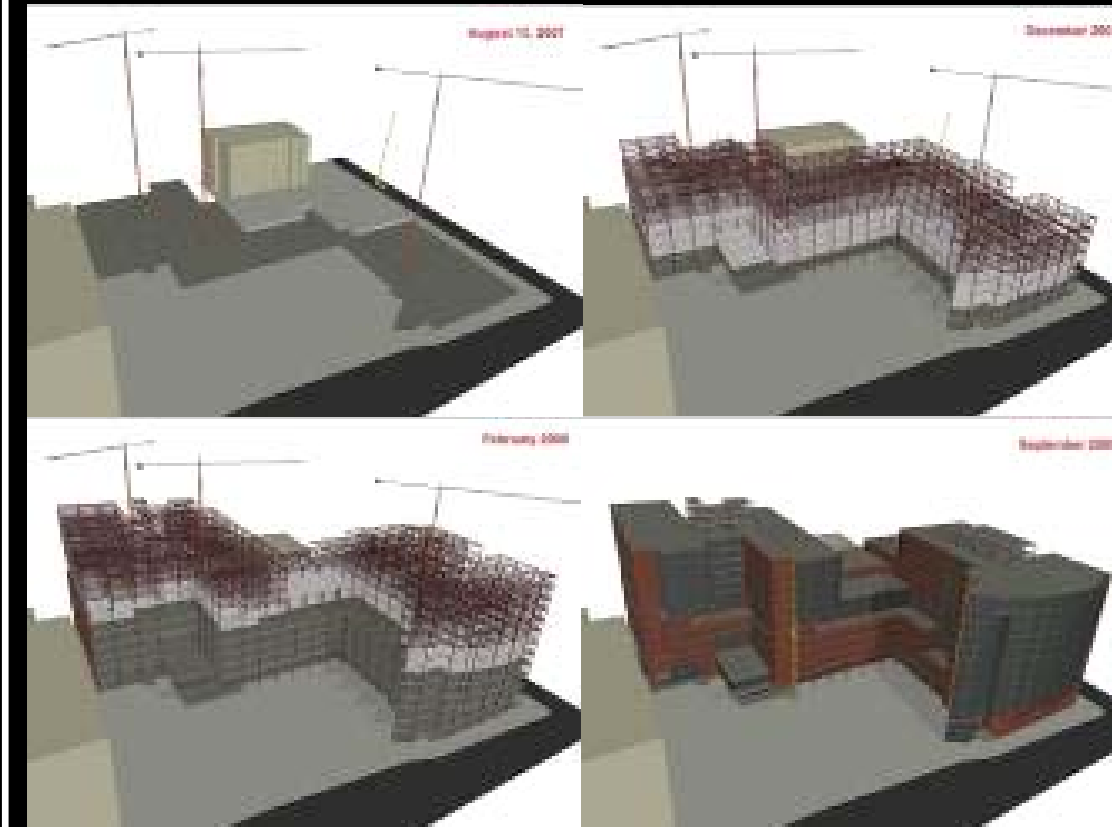
Model Evolution



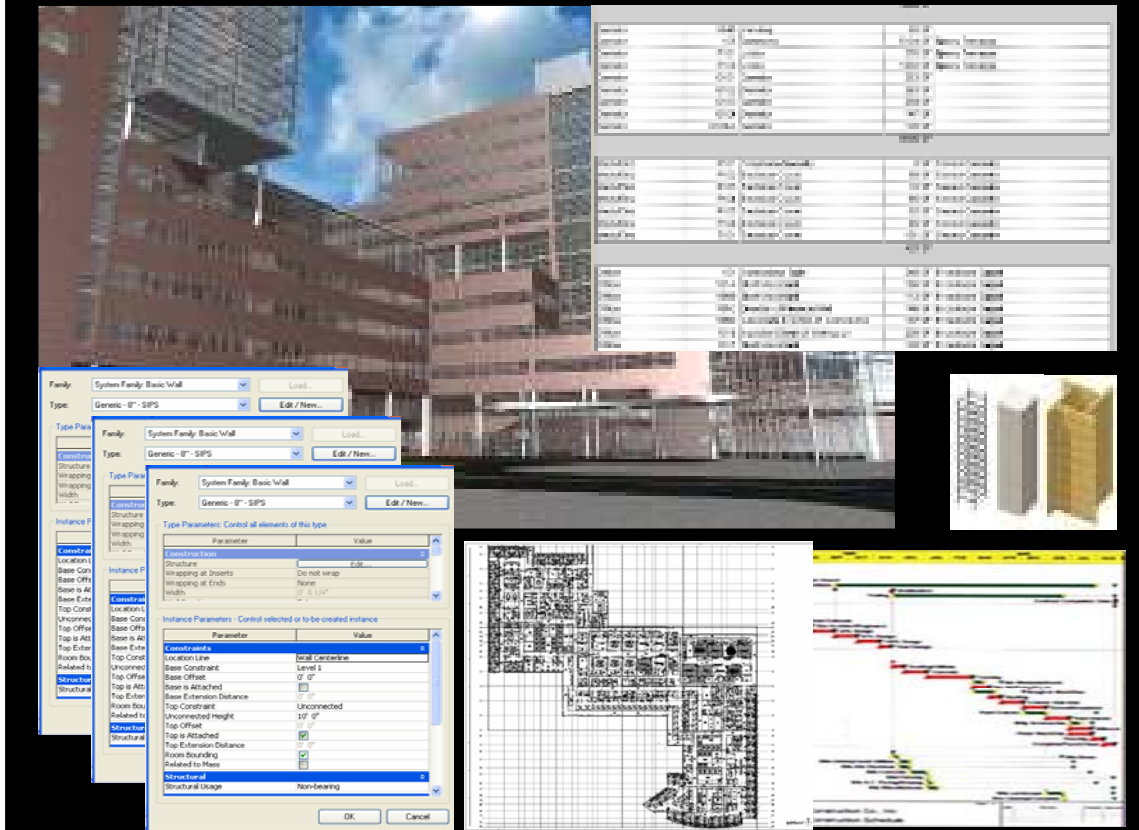
2D Model
*(Provides
diagrammatic
representation of
space and details)*



3D CAD Model
*(Adds 3D perspective
of physical
components)*

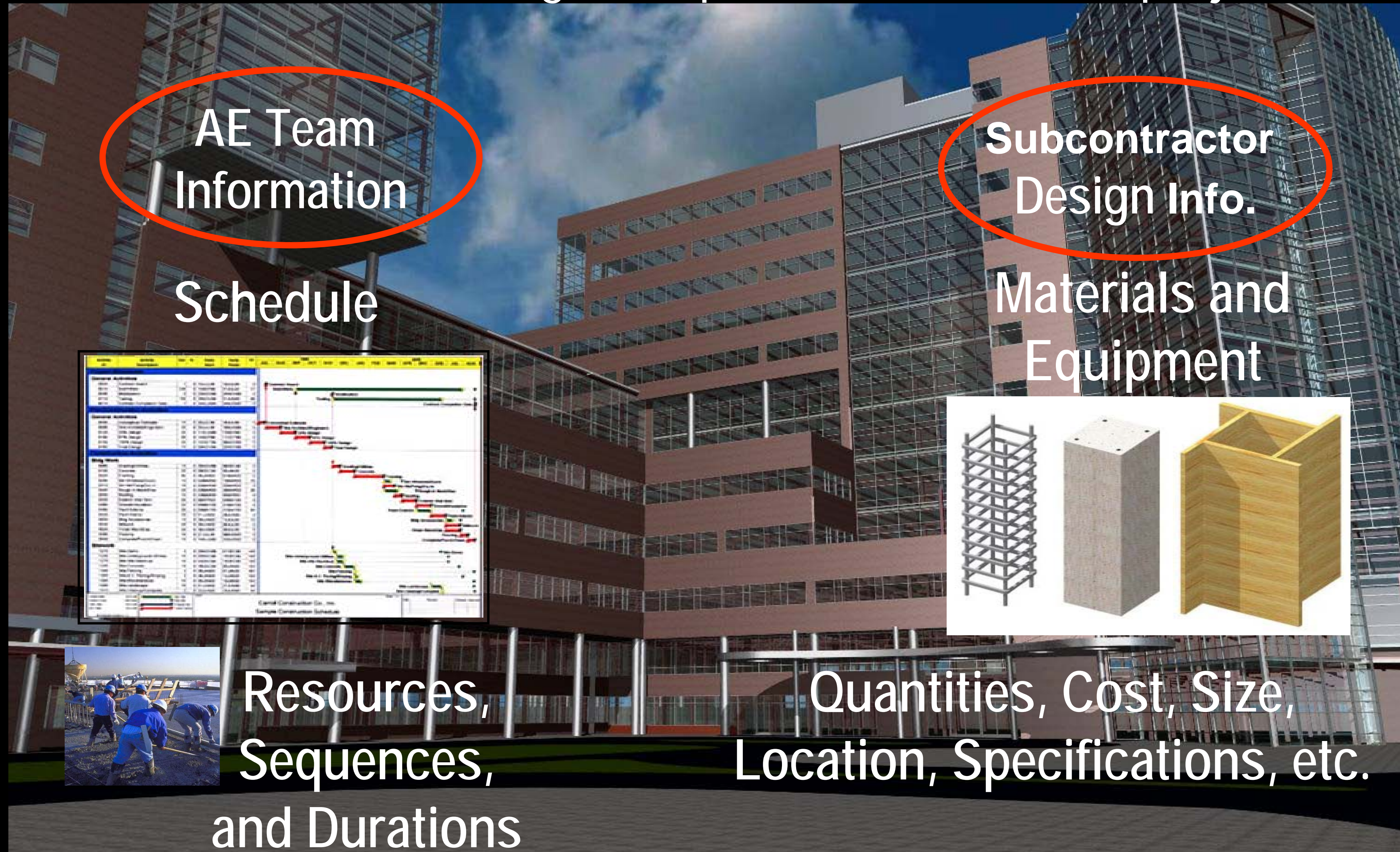


4D CAD Model
*(Adds time dimension
for construction
process visualization)*



BIM
*(Adds attribute
information, e.g., cost,
material properties,
etc.)*

Building Information Model (BIM) is a data-rich intelligent representation of the project.



BIM in Practice

- DC Ballpark
 - Fast-track design and construction
- The Johns Hopkins Hospital New Clinical Building
 - Coordination of complex healthcare project with multiple systems in tight ceiling space
 - 4-D Schedule analysis
- Downtown Office Building
 - Unique coordination challenges
- GMU VI
 - Quantity extraction and budgeting

BIM Implementation by General Contractors

Coordination Visualization Models

- Steel Coordination
- 3D MEP Spatial Coordination
- Unique Project Challenges

Scheduling

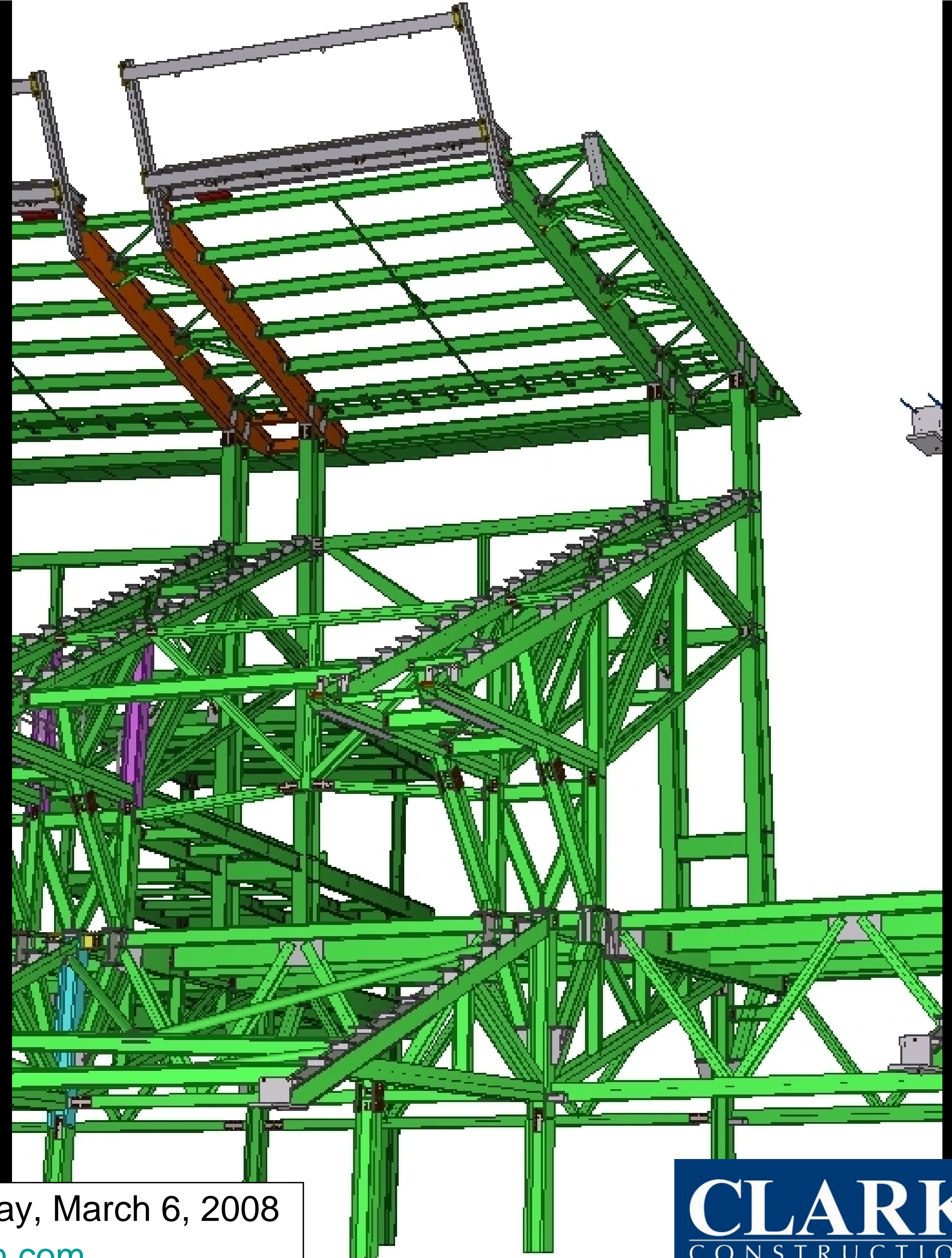
- 4D Models for Analysis and Communication

Estimating

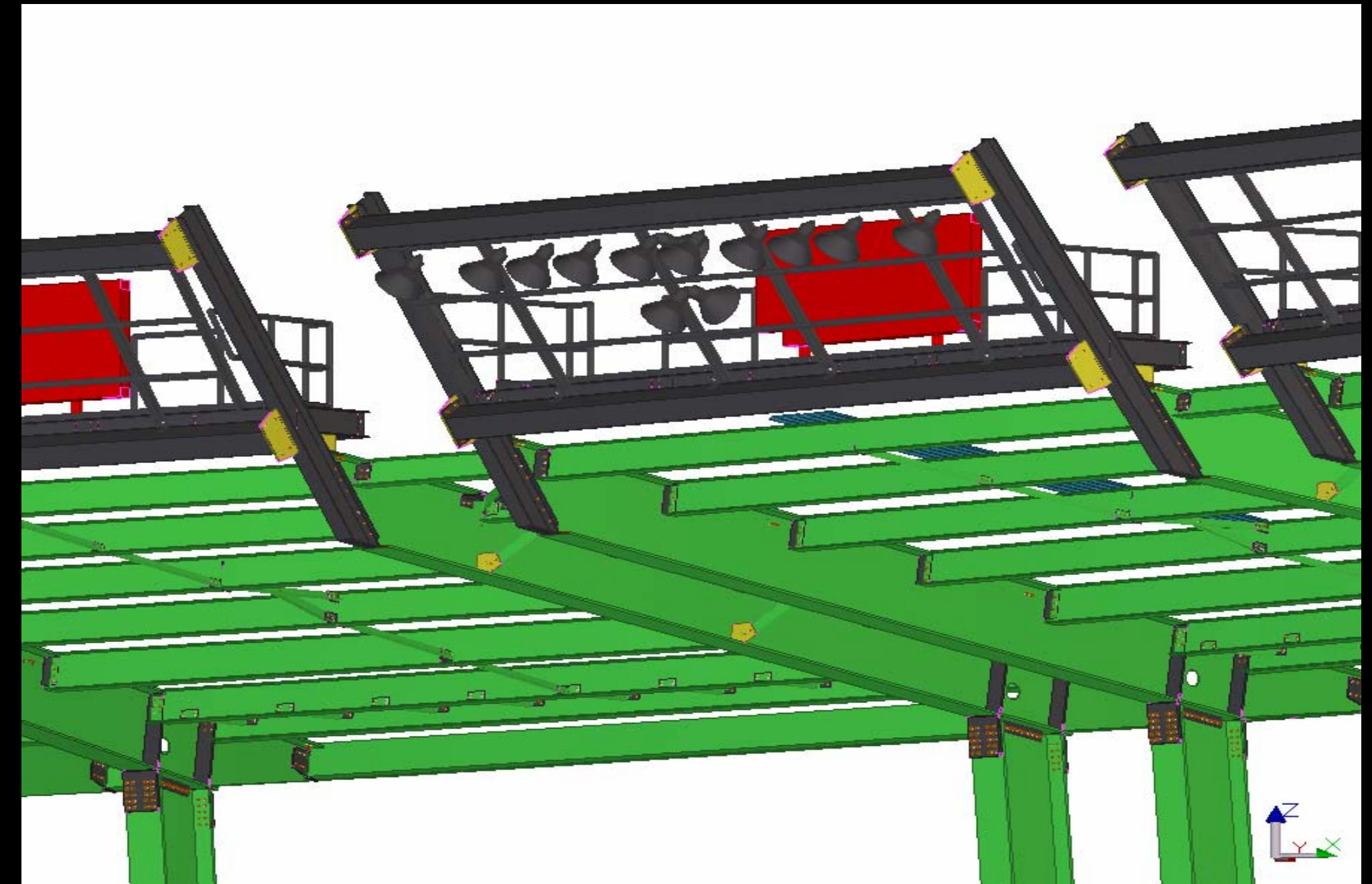
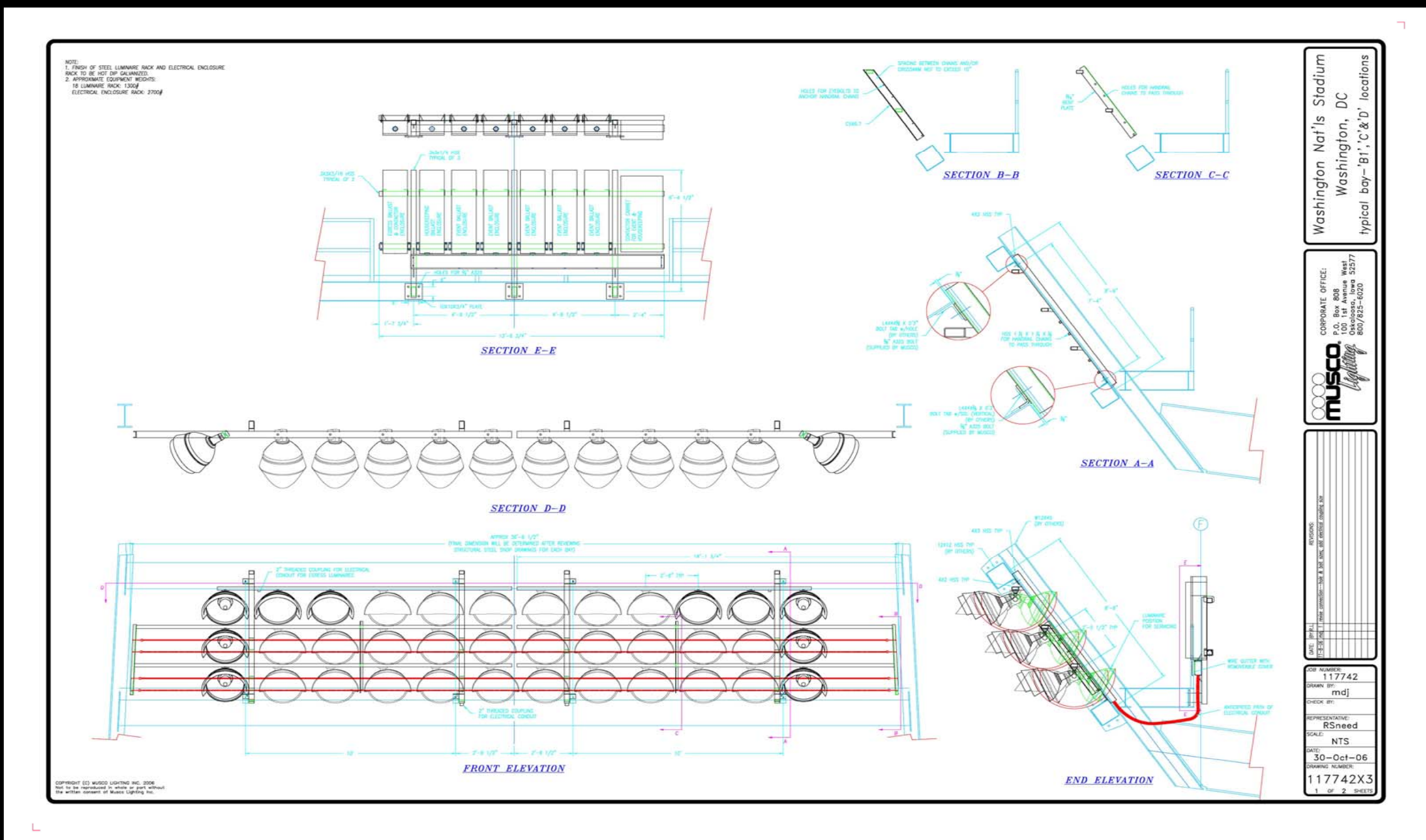
- Automated quantity take-off

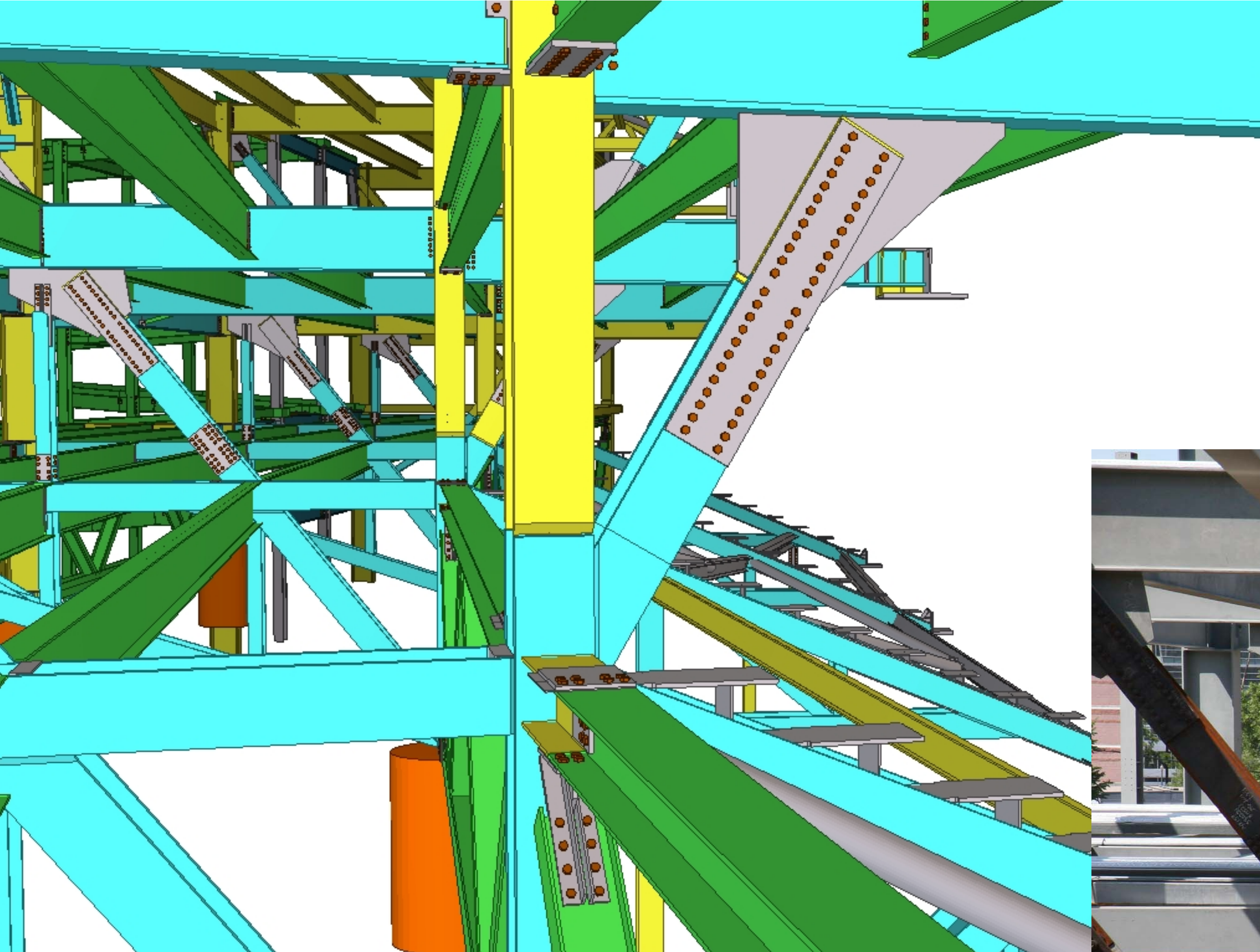
DC Ballpark – Steel Model

- Design Build HOK/Devroux & Purnell – Clark/Hunt/Smoot
- Fast track (23 month) – Tight site – No room for error
- 8,000 tons of steel – 41,000 seats
- 3D Steel Model by
ReStl/Thornton Tomasetti – Mt. Enterprises – Banker Steel
 - cutting 2 month from schedule
 - almost 90% decrease of RFIs
- First Major League facility to seek LEED certification



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- **3D MEP Spatial Coordination**
- Unique Project Challenges

Scheduling

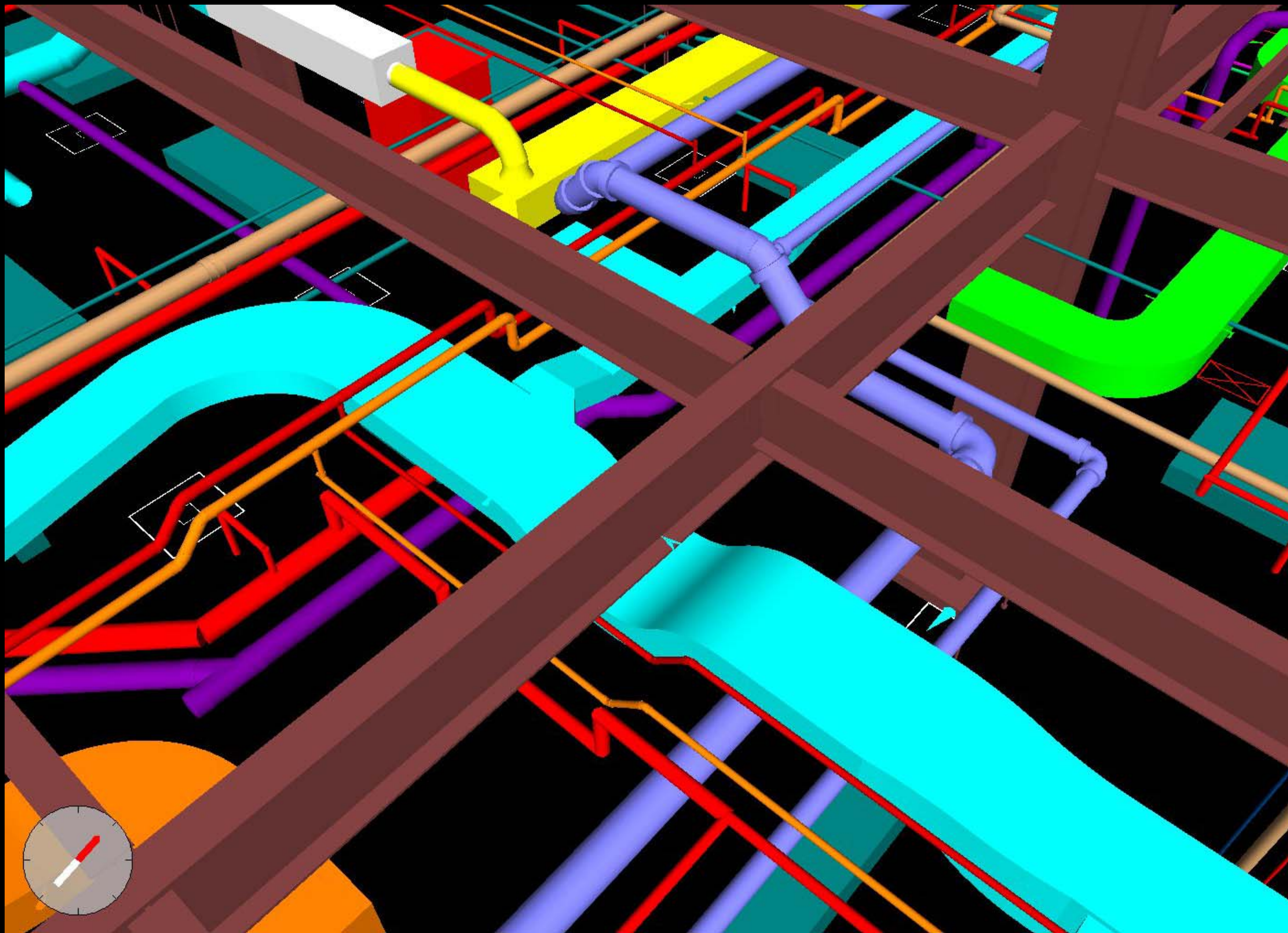
- 4D Models for Analysis and Communication

Estimating

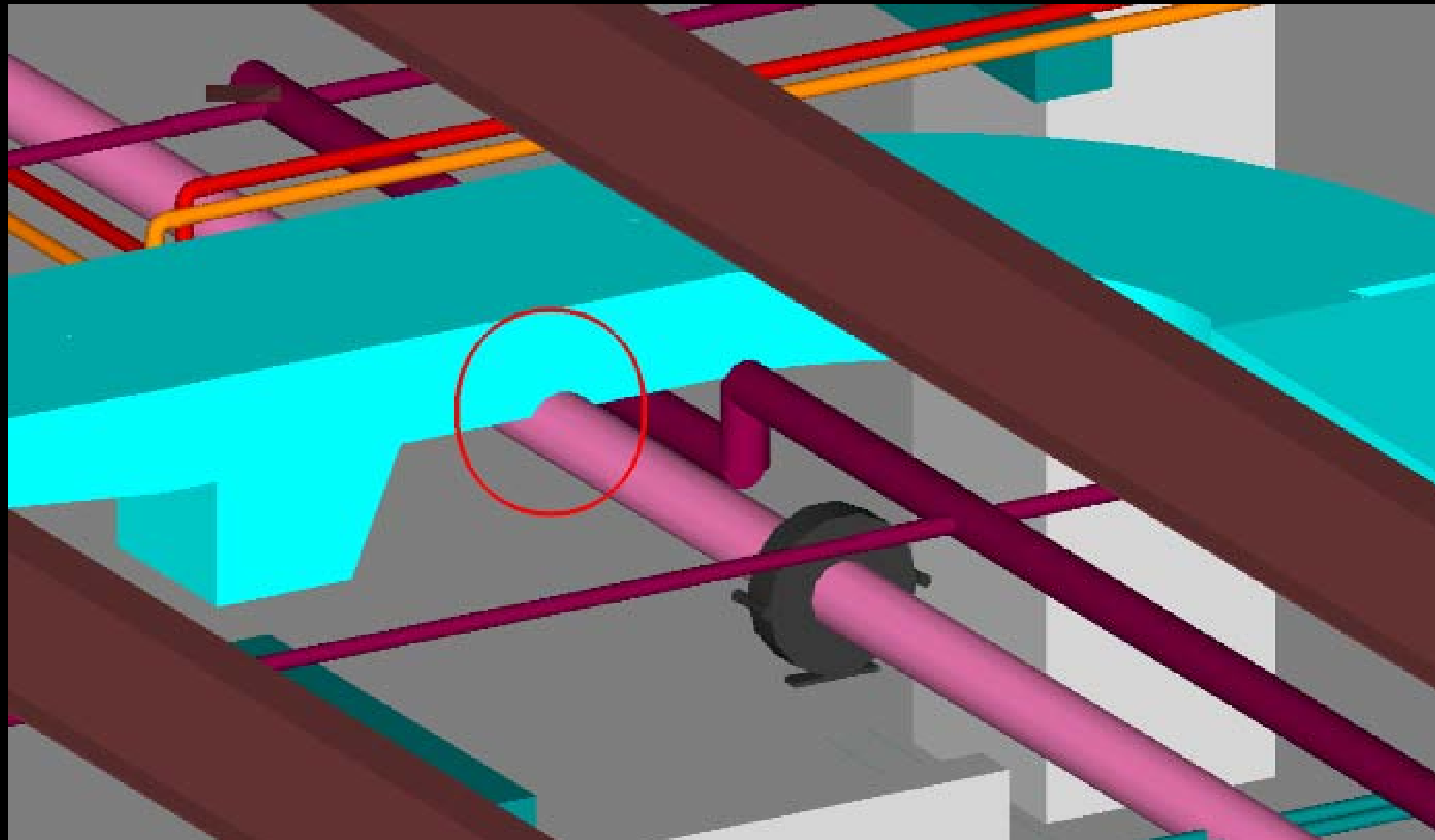
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JHH - 3D MEP Spatial Coordination

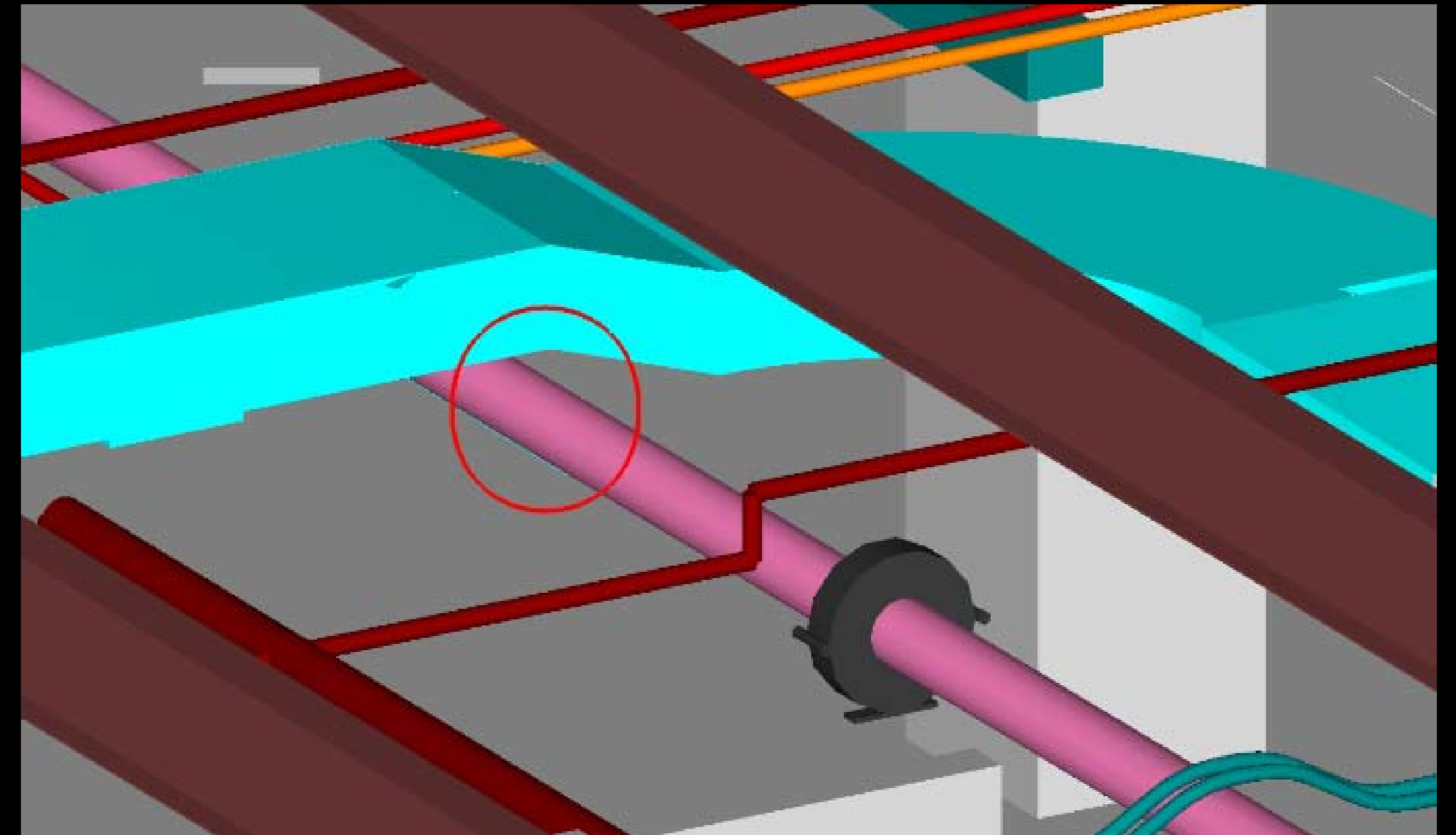
- Perkins+Will / BR+A / Thornton Tomasetti – Clark / Banks
- Adult Cardiovascular – Critical Care & Children's Critical Care
 - 1.5 million sq ft
 - 560 beds (355 adult, 205 pediatric)
 - 33 operating rooms
 - 42 radiological suites
 - 96 emergency treatment areas
- Complex MEP systems
 - 25,000 lf of Steam and Condensate Piping
 - 22,000 lf of Chilled Water Piping
 - 155,000 lf of Hot Water Piping
 - 234,000 lf of Domestic Water Piping
 - 176,000 lf of Waste and Vent Piping
 - 1,703,364 lf of Electrical Conduit



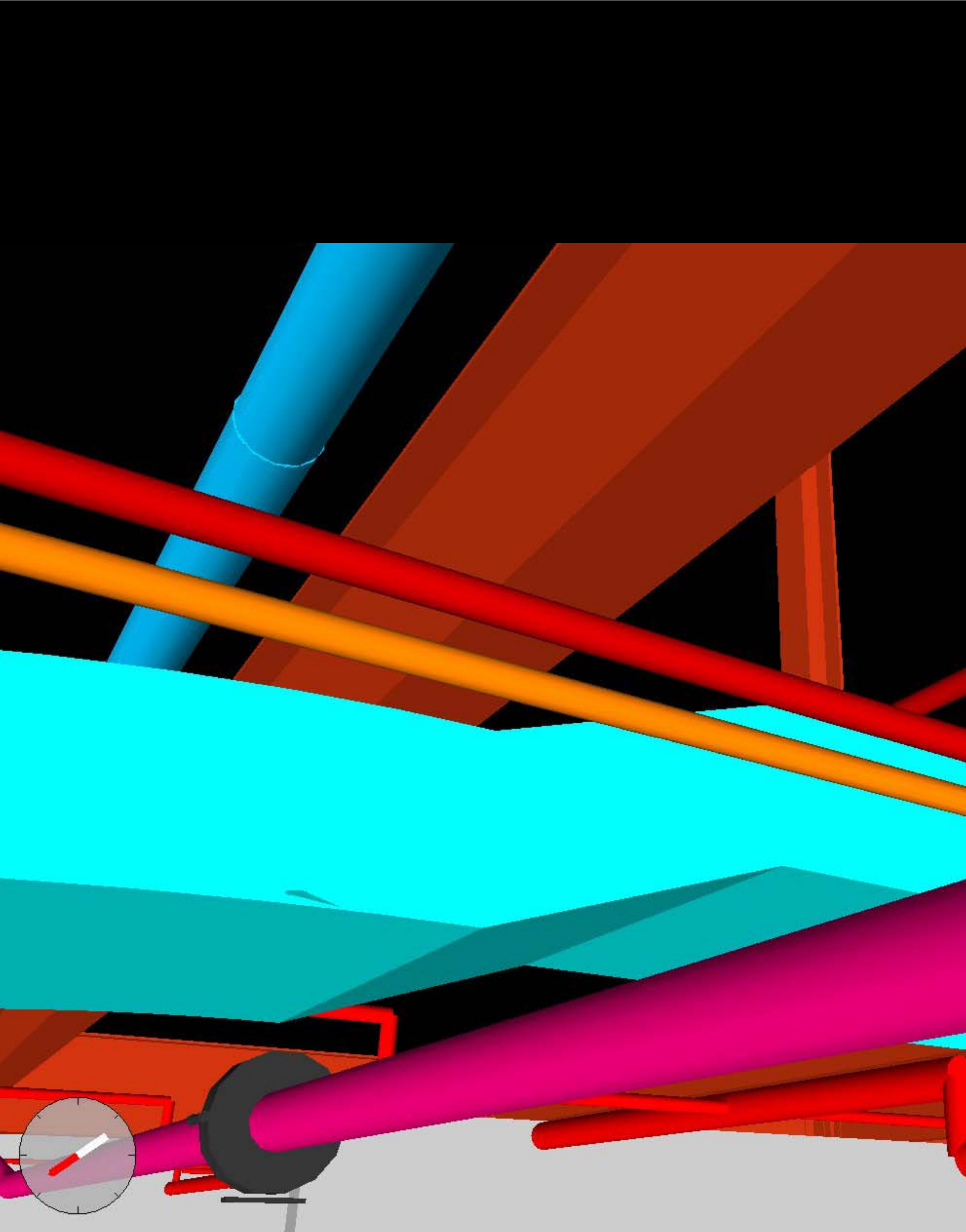
Clash Examples

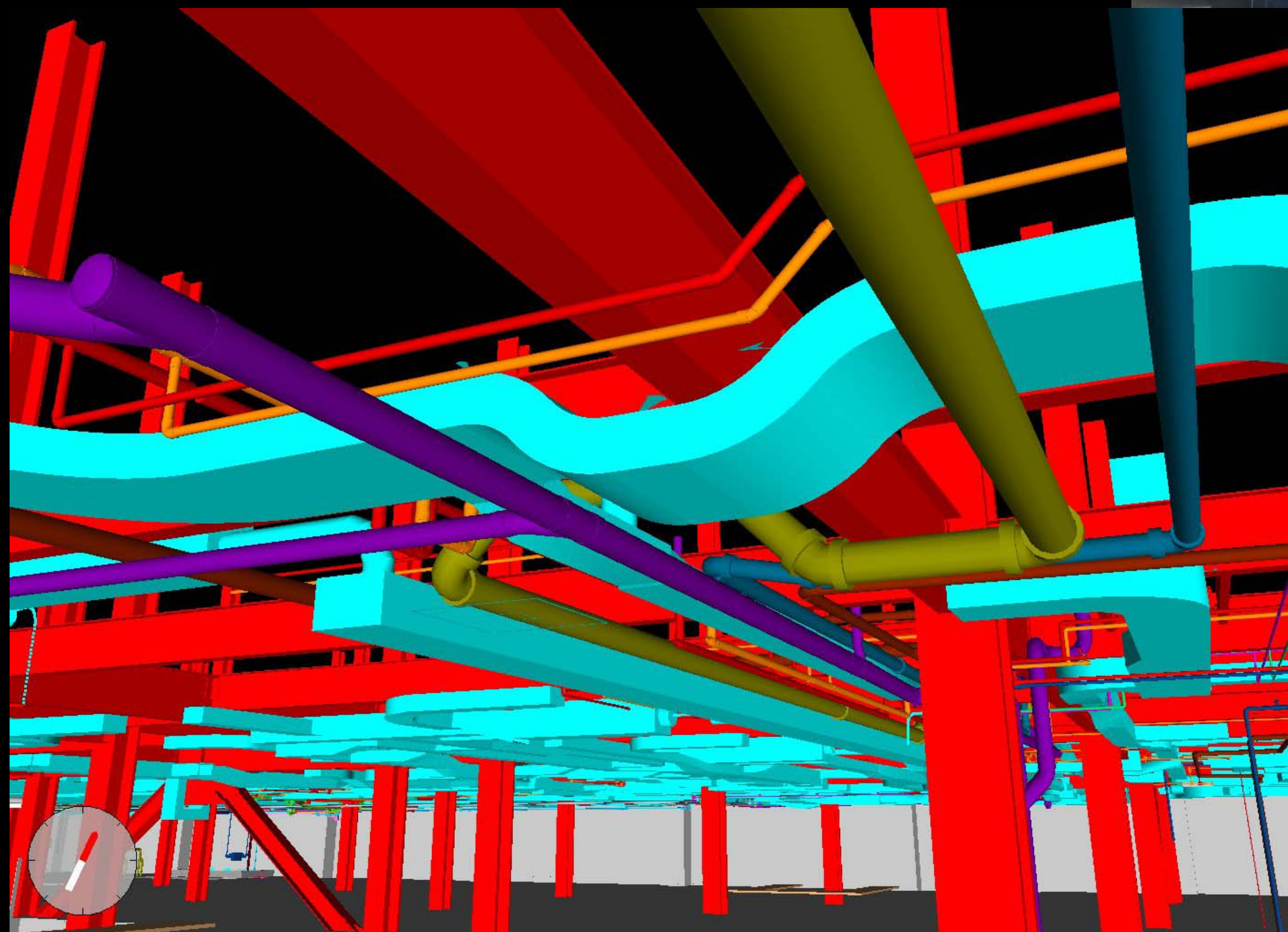


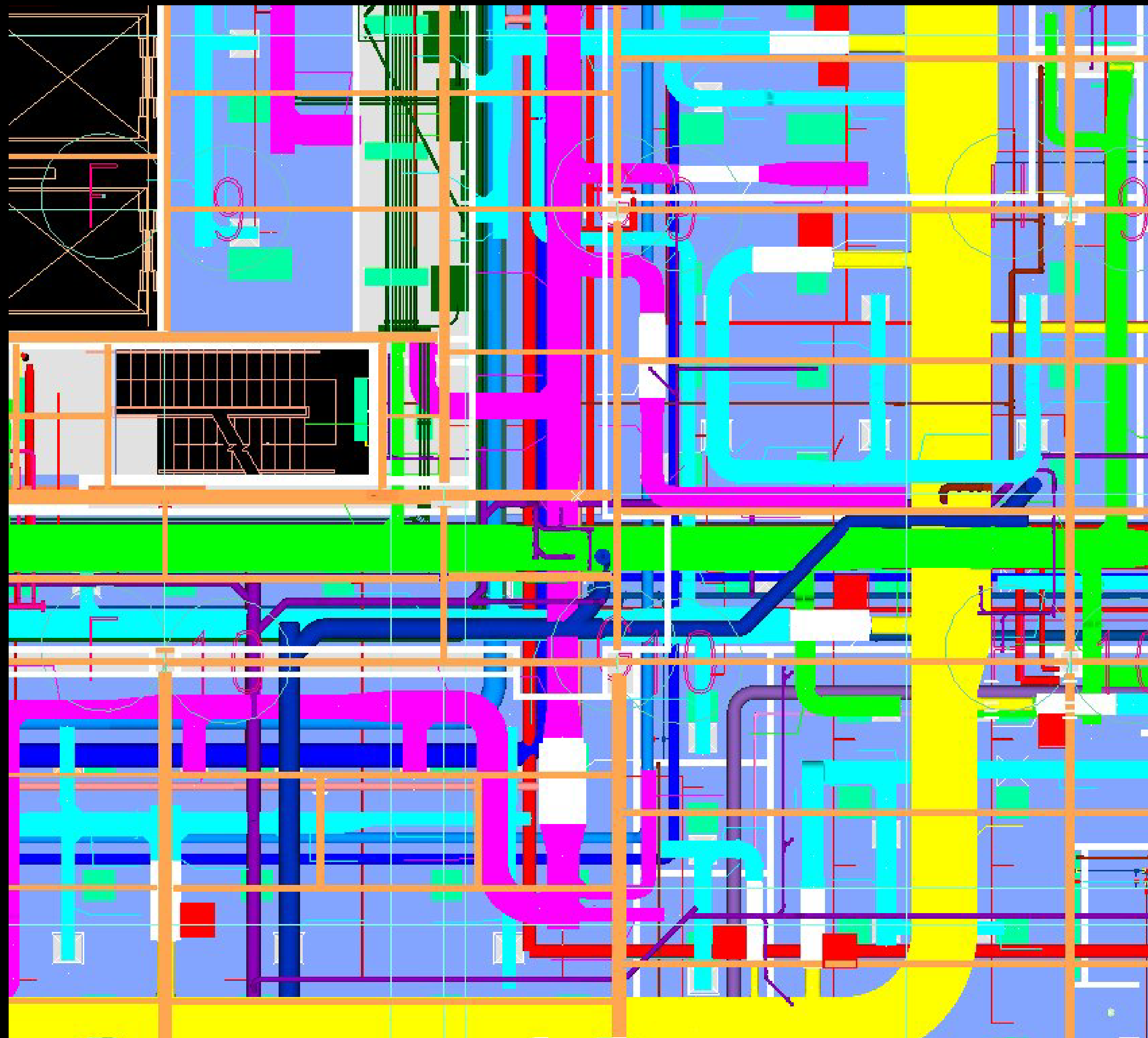
First Run



Second Run

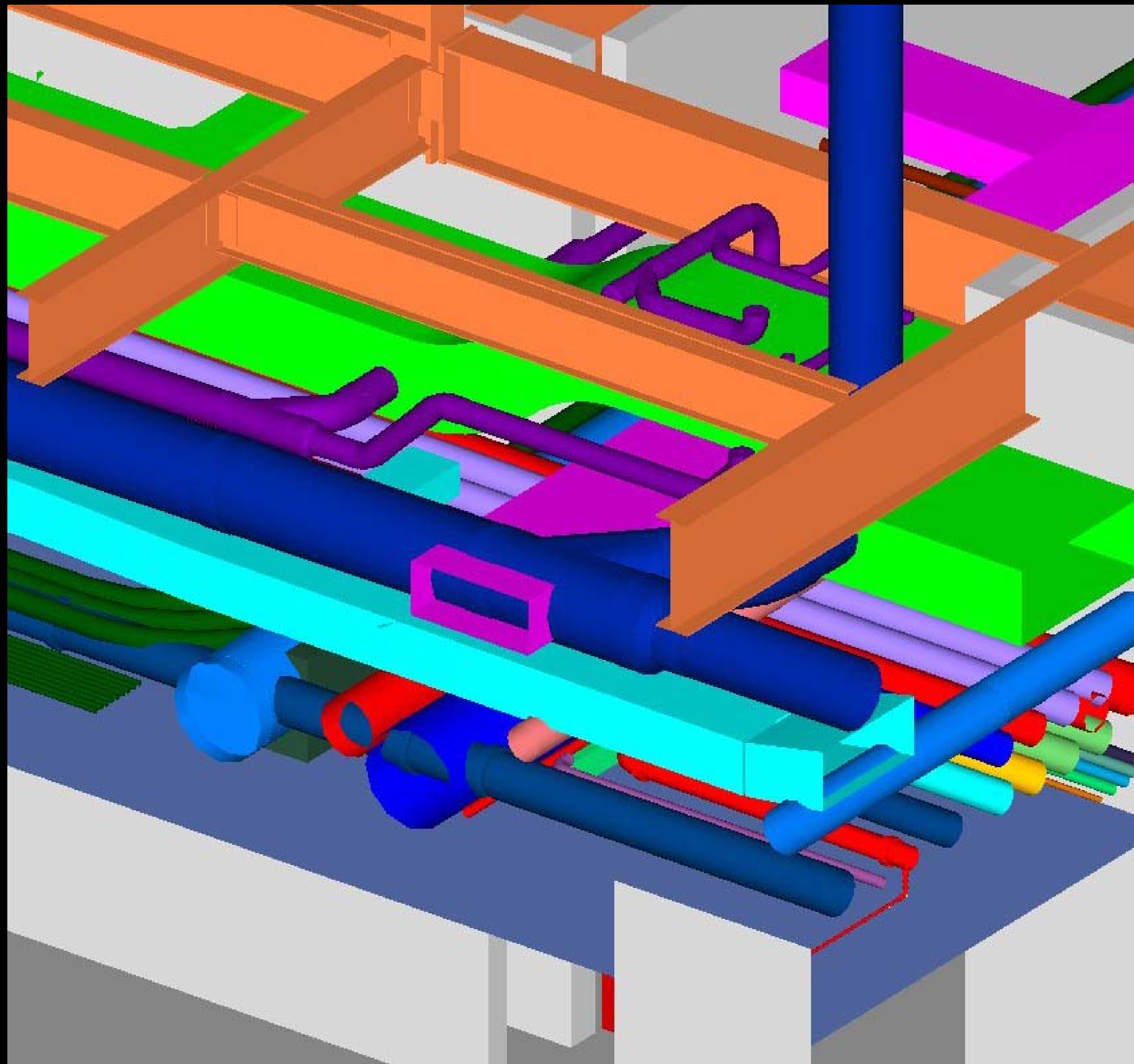






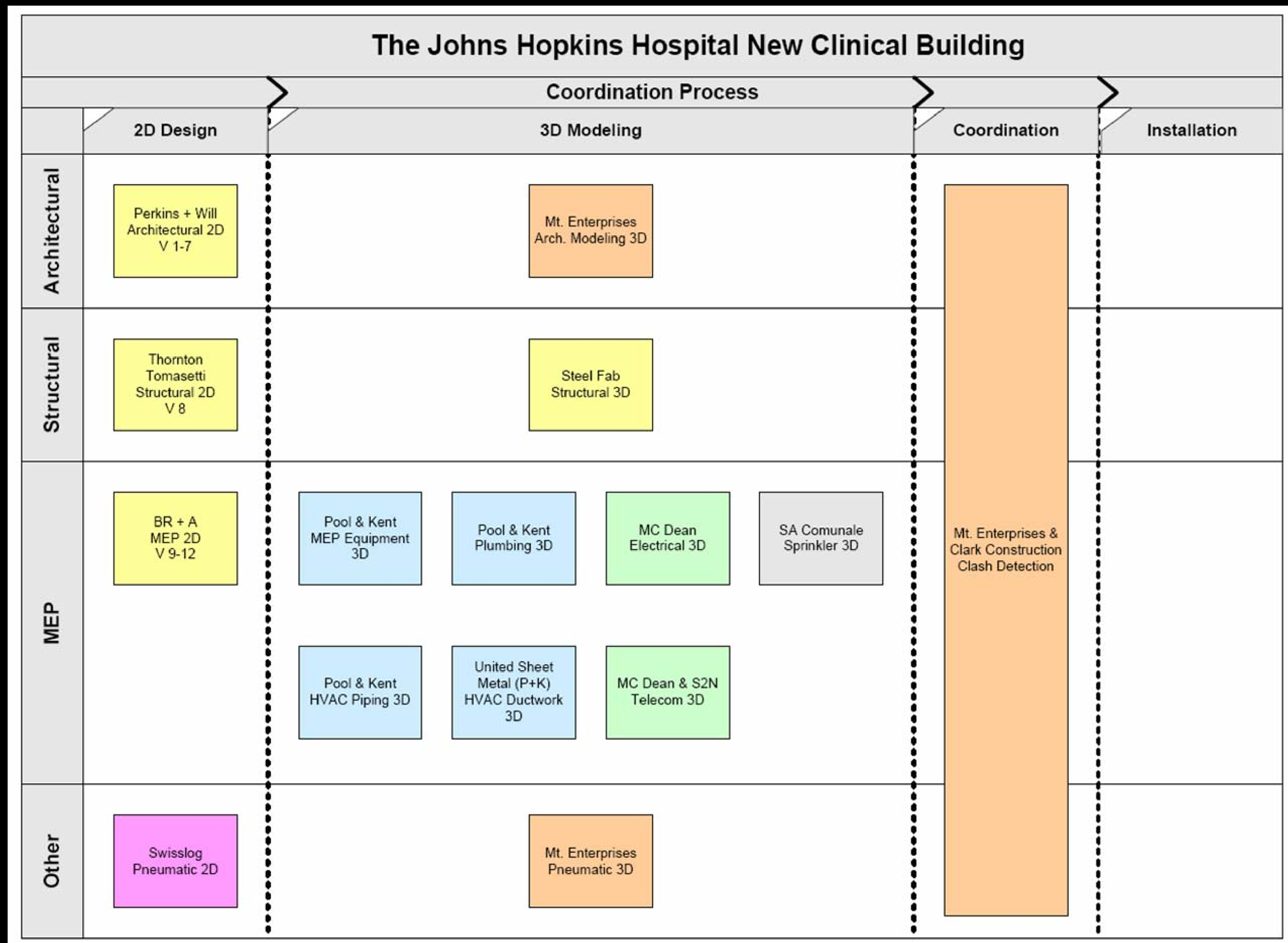
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- **Unique Project Challenges**

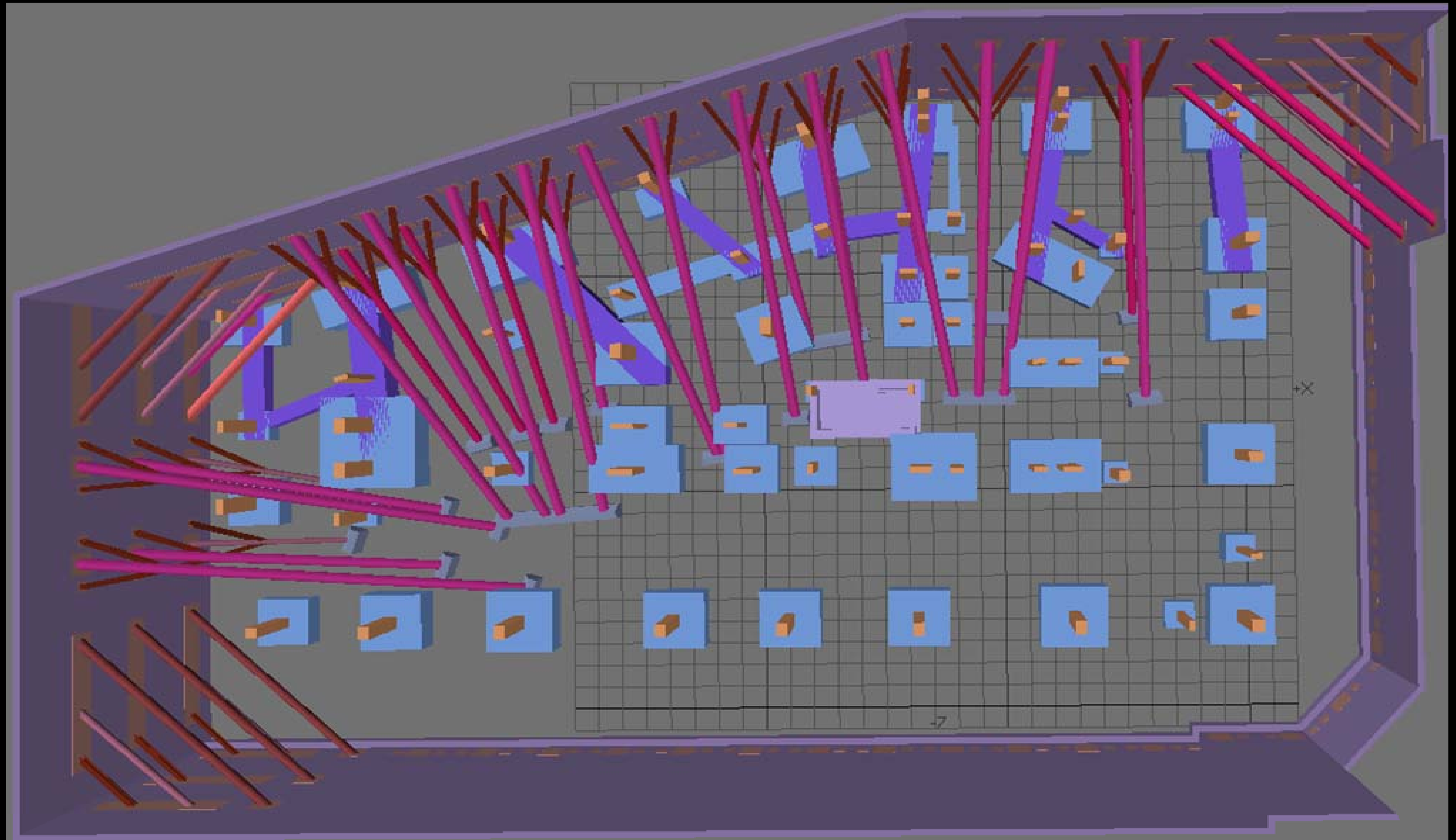
Scheduling

- 4D Models for Analysis and Communication

Estimating

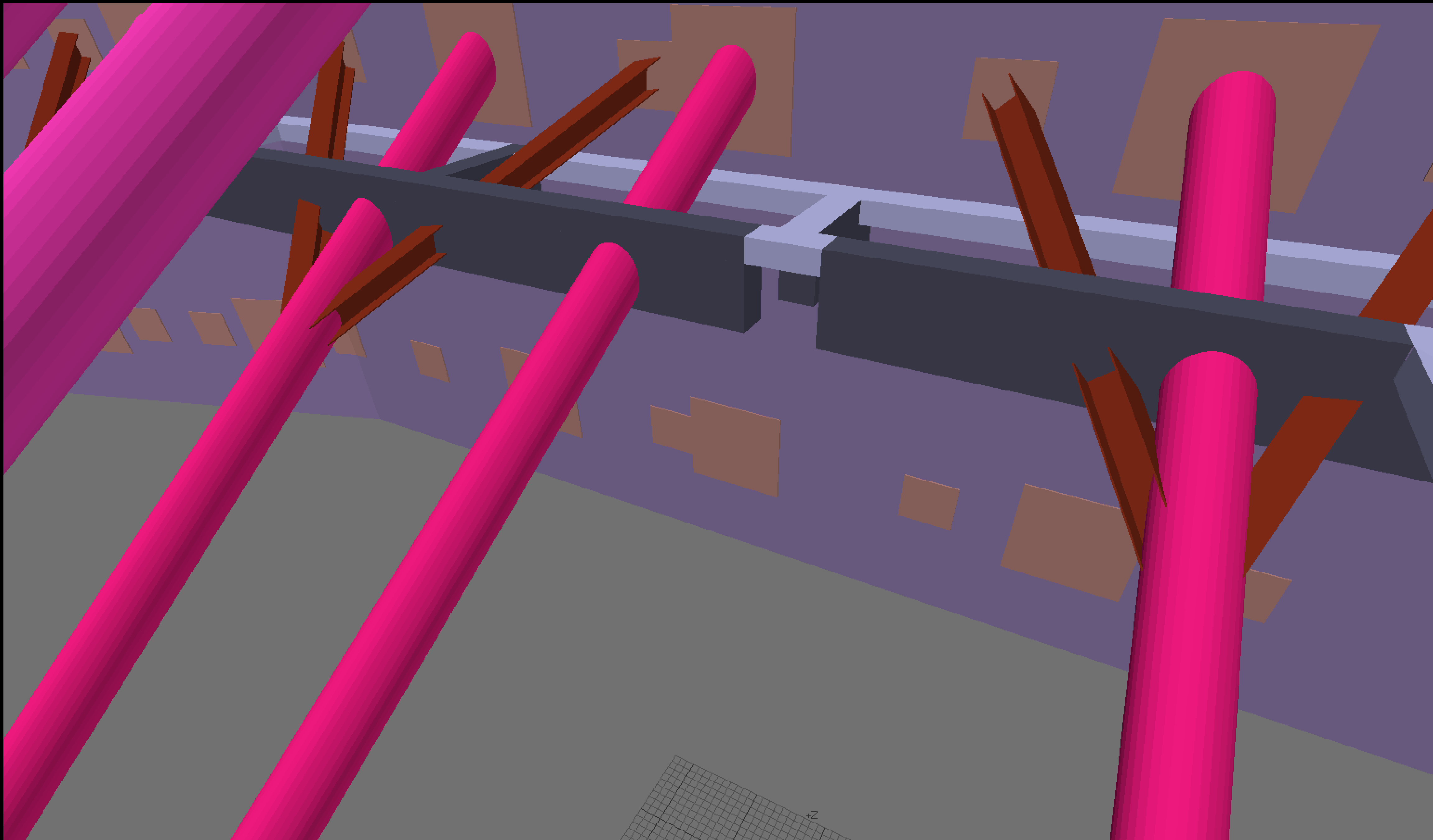
- Automated quantity take-off

Office Building, Washington, DC



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Johns Hopkins Hospital

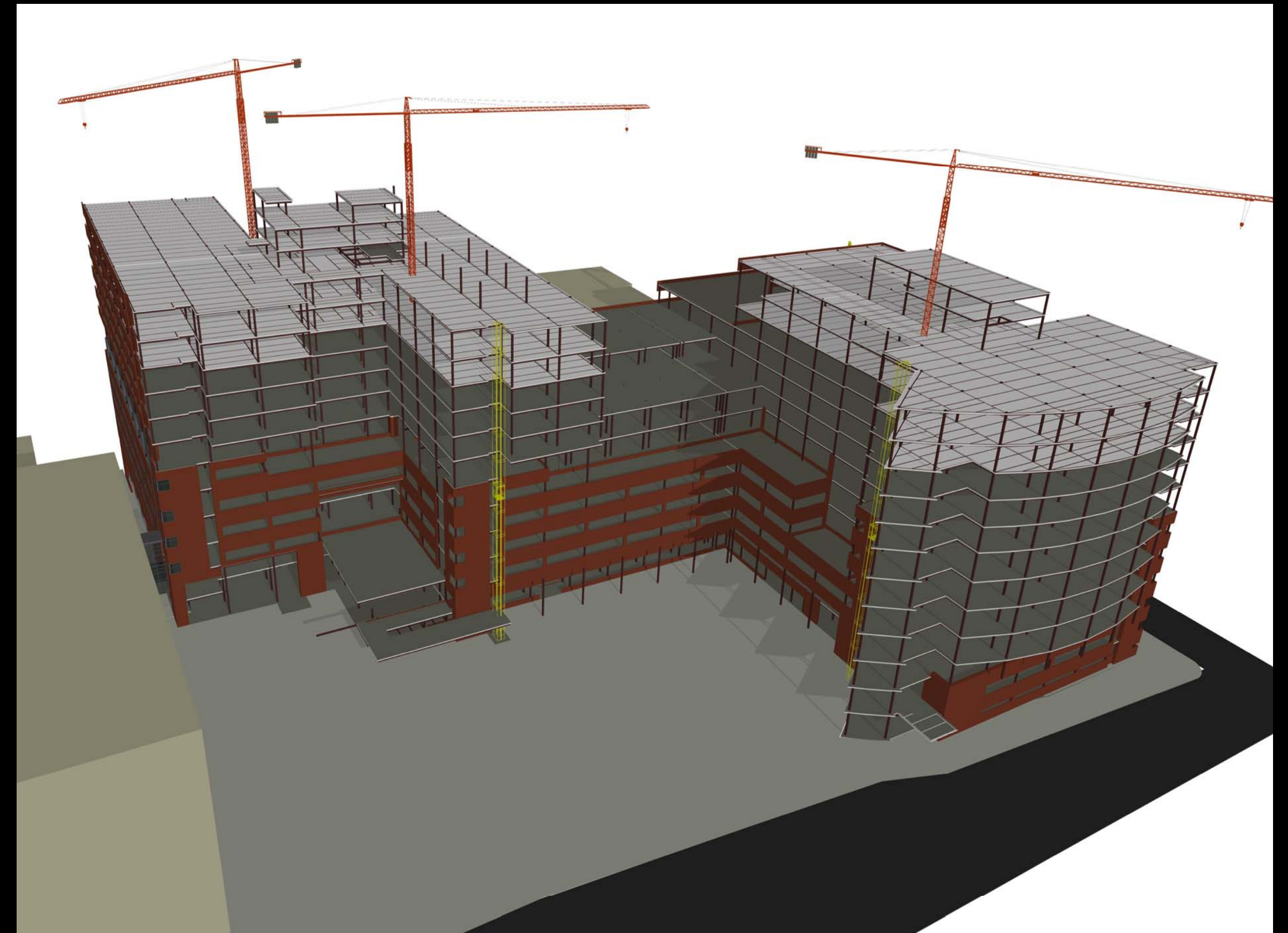


Merge 3D Model with Schedule (4D Model)

Primavera Project Planner - [6100]

File Edit View Insert Format Tools Data Window Help

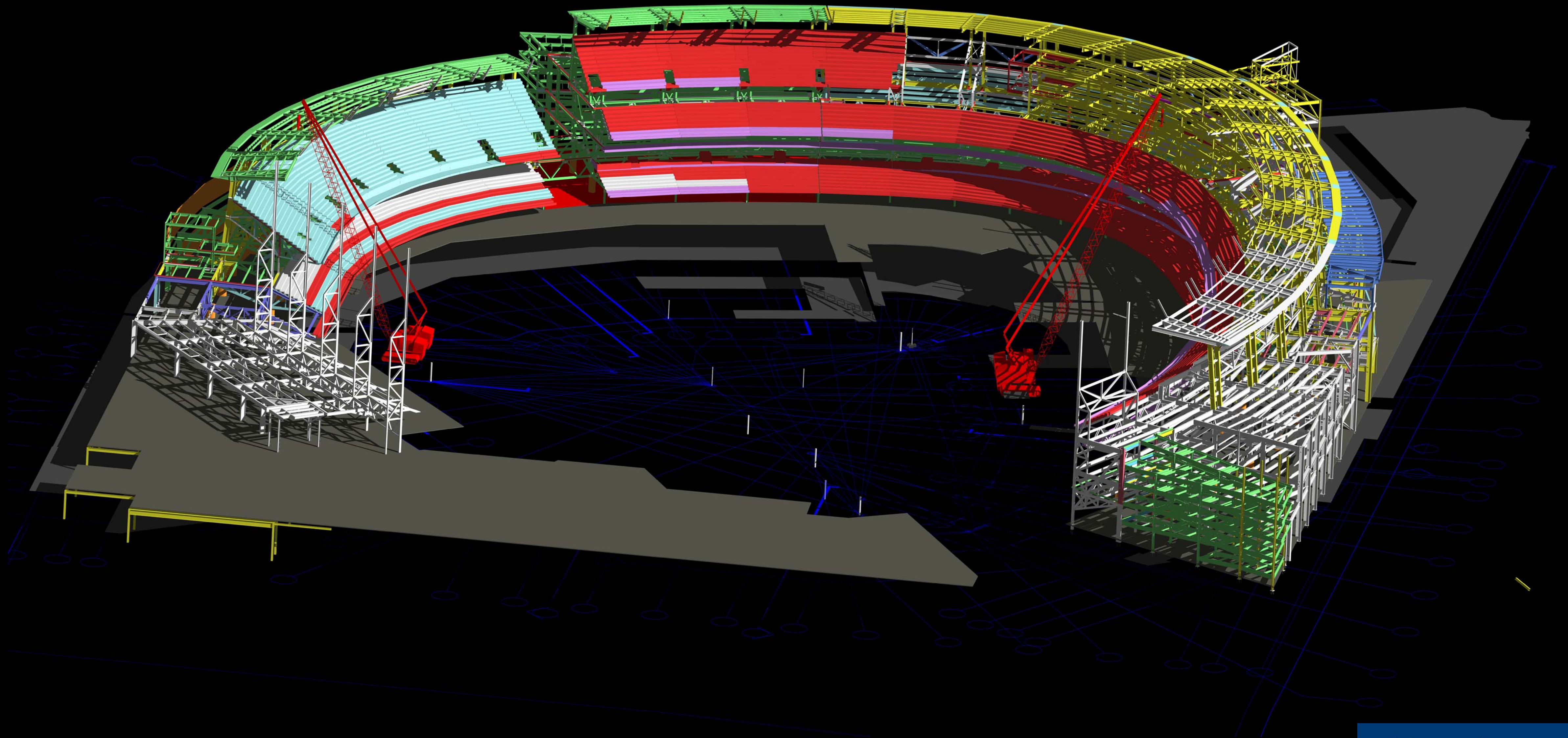
Activity ID	Activity Description	Orig Dur	Rem Dur	% Comp	Early Start	Early Finish
MAIN CONCOURSE STRIP / REMOVE FORMWORK						
CNMN0108	Area 1 Main Concourse Strip Remove	20	0	100	23AUG06A	29SEP06A
CNMN0118	Area 2 Main Concourse Strip Remove	20	0	100	27SEP06A	19OCT06A
CNMN0128	Area 3 Main Concourse Strip Remove	25	21	16	25OCT06A	30NOV06
CNMN0138	Area 4 Main Concourse Strip Remove	15	15	0	17NOV06	11DEC06
CNMN0148	Area 5 Main Concourse Strip Remove	20	20	0	21DEC06	19JAN07
CNMN0168	Area 7 Main Concourse Strip Remove	10	10	0	29JAN07	09FEB07
CNMN0178	Area 8 Main Concourse Strip Remove	35	35	0	12FEB07	30MAR07
CNMN0198	Area 10 Main Concourse Strip	20	20	0	02APR07	27APR07
STEEL COLUMN ENCASEMENTS						
CNCB0010	Area 1 Pour Steel Col Encasements	3	3	0	06NOV06	08NOV06
CNCB0020	Area 2 Pour Steel Col Encasements	3	3	0	22NOV06	28NOV06
CNCB0030	Area 3 Pour Steel Col Encasements	3	3	0	20DEC06	22DEC06
CNCB0040	Area 4 Pour Steel Col. Encasements	3	3	0	08JAN07	10JAN07
CNCB0050	Area 5 Pour Steel Col. Encasements	3	3	0	02APR07	04APR07
CLUB LEVEL						
CONCRETE OF METAL DECK						
CNCB0110	Area 2 Club Level Concrete on Metal	15	15	0	16JAN07	05FEB07
CNCB0100	Area 1 Club Level Concrete on Metal	15	15	0	18JAN07	07FEB07
CNCB0120	Area 3 Club Level Concrete on Metal	15	15	0	05MAR07	23MAR07
CNCB0160	Area 7 Club Level Concrete on Metal	15	15	0	11APR07	01MAY07
CNCB0130	Area 4 Club Level Concrete on Metal	15	15	0	18APR07	08MAY07
CNCB0140	Area 5 Club Level Concrete on Metal	15	15	0	14JUN07	05JUL07
SUITE LEVEL						



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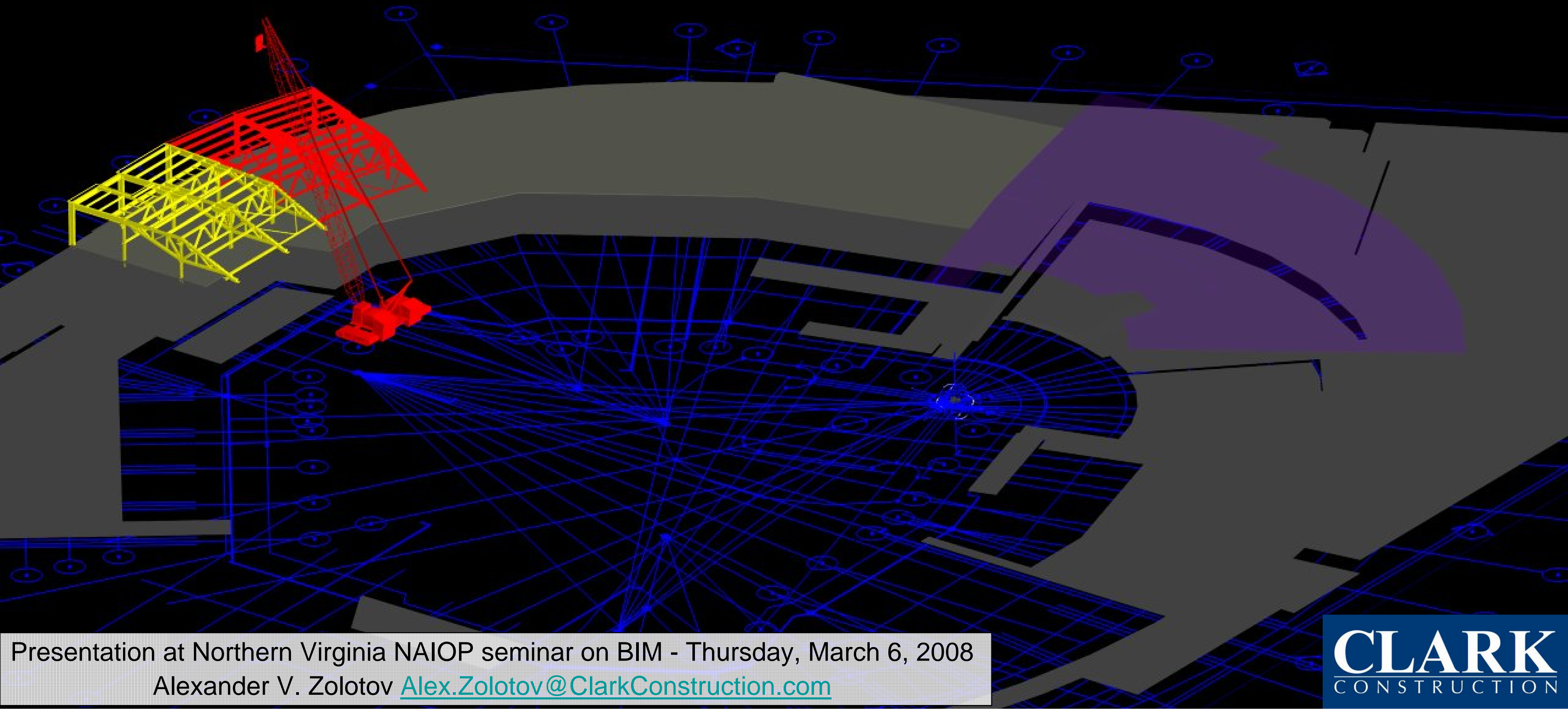
4D at DC Ballpark



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Sunday 10/15/2006 Day=13 Week=2 (of Simulation)

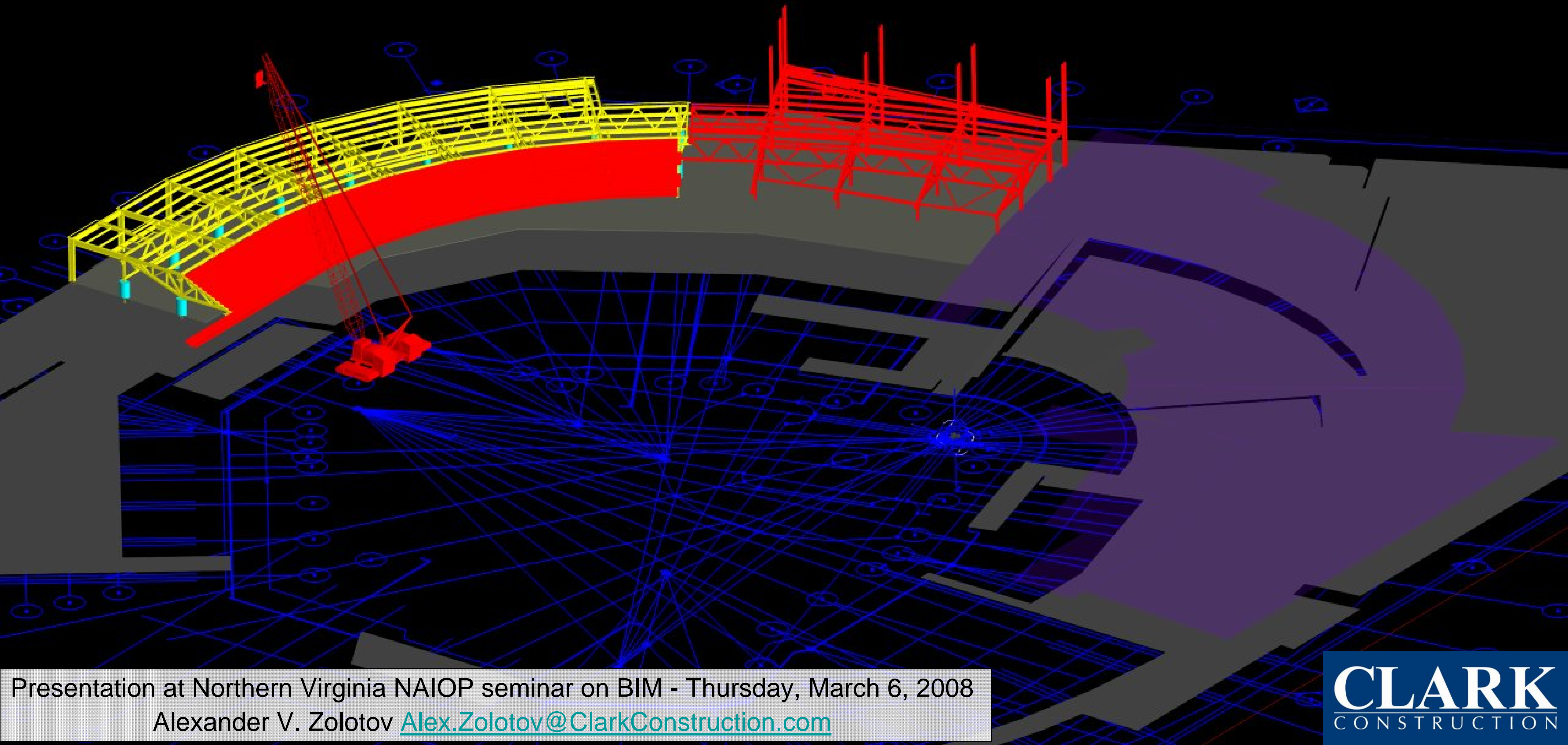


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Thursday 11/9/2006 Day=38 Week=6 (of Simulation)

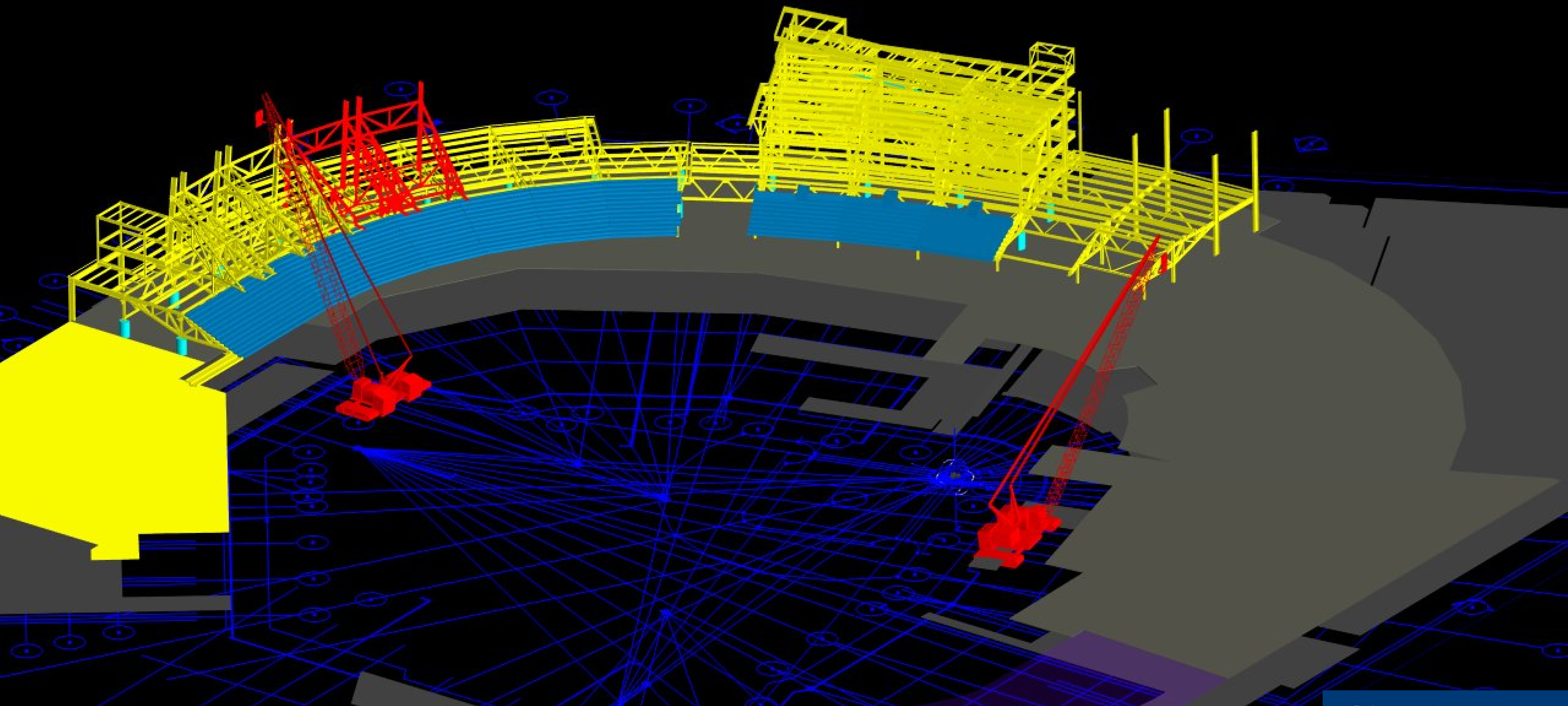


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Wednesday 12/20/2006 Day=79 Week=12 (of Simulation)



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Estimating

- **Automated quantity take-off**

Model Costing – GMU VI



Model
Development

QC for Accuracy

Extract
Quantities
& Add Costs

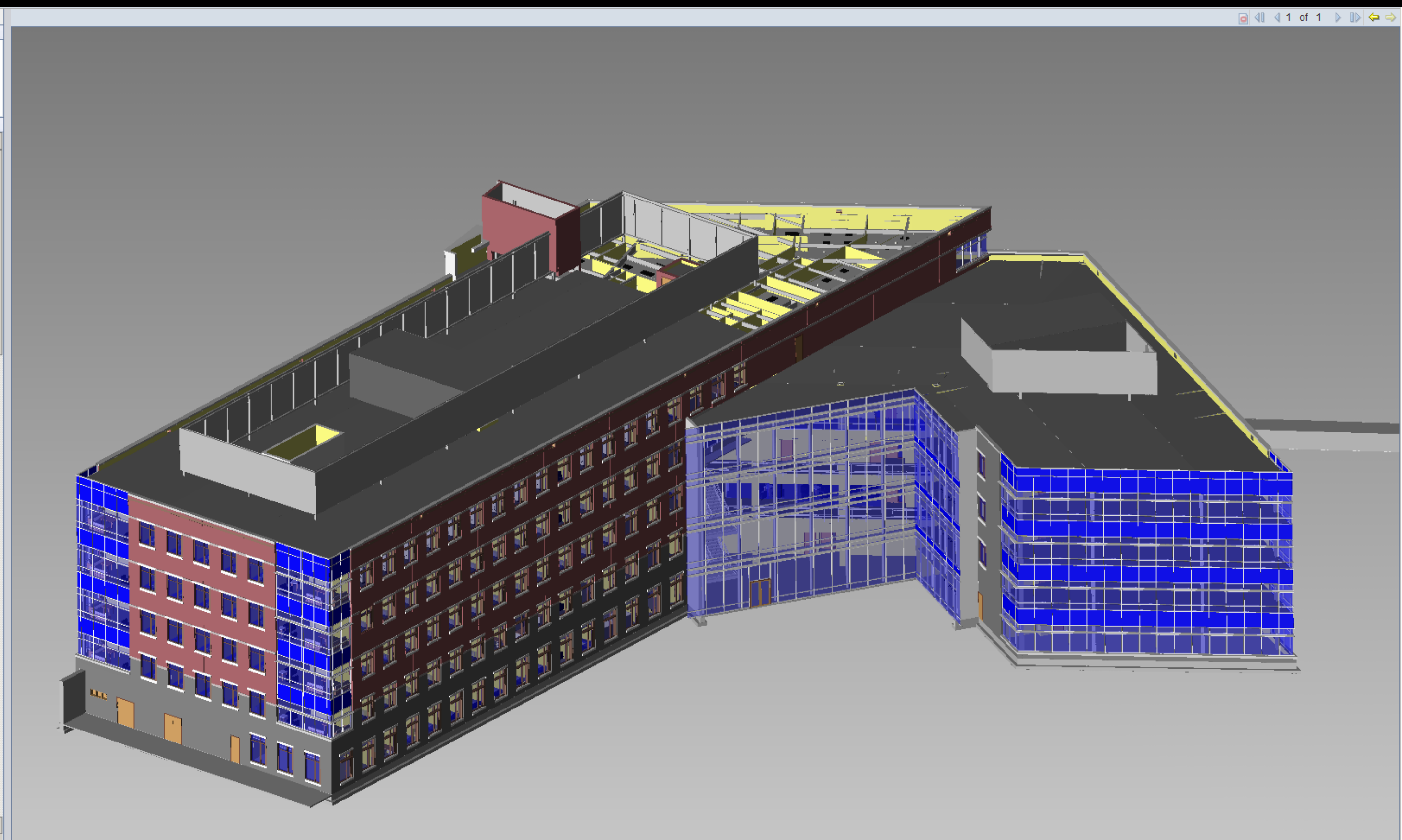
Design & Cost
Feedback

Contents

[1] (null)

Model

- Casework (928)
- Ceilings (286)
- Columns (13)
- Curtain Panels (1234)
- Curtain Wall Mullions (2652)
 - Rectangular Mullion (2652)
- Doors (505)
- Floors (21)
 - Floor (21)
- Furniture (2889)
- Furniture Systems (137)
- Generic Models (18)
- Lighting Fixtures (2699)
- Mechanical Equipment (1)
- Plumbing Fixtures (144)
 - Drinking Fountain-Hi-Lo-3D (9)
 - Sink Kitchen-Double (5)
 - 42" x 21" (5)
 - Sink Kitchen-Double [1004617]
 - Sink Kitchen-Double [1013519]
 - Sink Kitchen-Double [1034025]
 - Sink Kitchen-Double [1087465]
 - Sink Kitchen-Double [3115875]
 - Sink Kitchen-Island (2)
 - Sink Vanity-Round (52)
 - Toilet-Commercial-Wall-3D (57)
 - Urinal-Wall-3D (19)
- Railings (43)
- Ramps (3)
- Roofs (18)
- Specialty Equipment (168)
- Stairs (8)
- Structural Columns (150)
- Structural Framing (1299)
- Wall Sweeps (23)
- Walls (1961)
 - Basic Wall (1954)
 - A-0A2 - Full Height Non Rated Partit
 - A-0A3 - Full Height Non Rated Partit
 - A-1A3 - Full Height 1Hr Partition - 3.6
 - Exterior - GMU AHU (6)
 - Exterior - GMU Brick Fin (2)
 - Exterior - GMU Brick Fin 2 (2)
 - Basic Wall [763608]
 - Basic Wall [2250058]

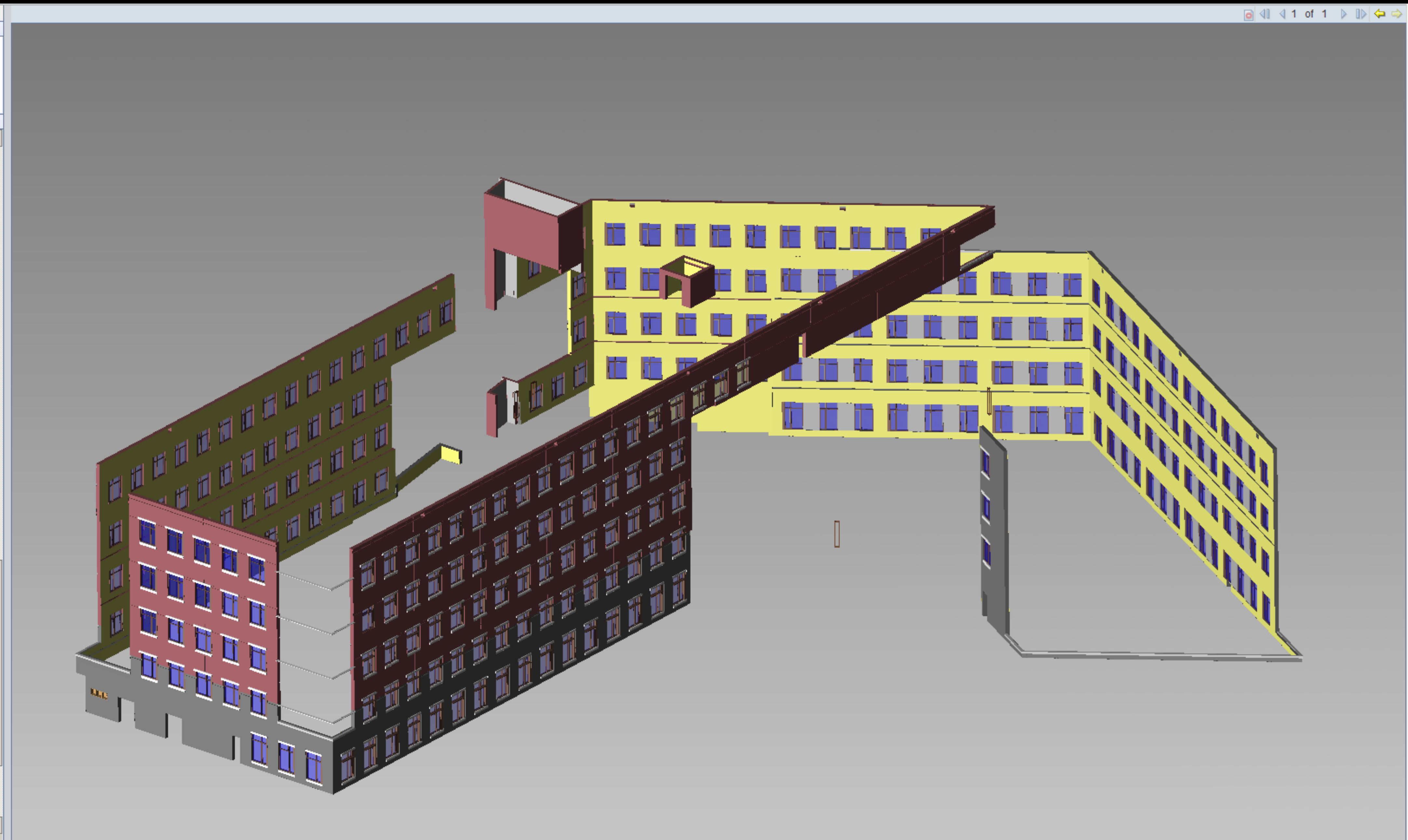


Contents

[1] (null)

Model

- Exterior - GMU Foundation - 36" Cor-
- Exterior - GMU Mtl Panel (8)
- Exterior - GMU Mtl Panel 2 (2)
- Exterior - GMU Mtl Panel Screen (9)
- Exterior - GMU Site Wall 18" (5)
- Exterior - GMU UtiltTunnel - 10" (1)
- Exterior - GMU UtiltTunnel - 8" (4)
- Exterior - GMU UtiltTunnel - 9" (2)
- Foundation - 10" Concrete (4)
- G-0G1-Full Ht Stds Part Ht GB Furr-1
- G-0G2-Full Ht Stds Part Ht GB Furr-2
- Interior - 2A3 (1hr partition, 6 1/8") (4)
- Interior - 2A3A (2hr stair, acoustic, 6
- Interior - 2A6A (2hr stair, acoustic, 8
- Interior - 2J4 (2hr shaft, acoustic, 5 1/
- Interior - A3 (full hght part, 4 7/8") (60)
- Interior - A3A (full hght acoustic part,
- Interior - A6 (full hght part, 7 1/4") (4)
- Interior - A6A (full hght acoustic part,
- Interior - G2 (furring, 3 1/8") (102)
- Interior - G2H (full hght furring, 3 1/8")
- Interior - G3 (furring - 4 1/4") (75)
- Interior - G3H (full hght furring - 4 1/4"
- Interior - G3HA (full hght acoustic furr
- Interior - G6H (full hght furring, 6 5/8")
- Interior - GMU (fur) G-0G2-Full Ht Std
- Interior - GMU (Util Fire) A-1A6 - Full
- Interior - GMU 1/2" GLASS WALL (20
- Interior - GMU FULLHGT PARTN W
- Interior - GMU FULLHGT PARTN W
- Interior - GMU STANDARD PARTIT
- Interior - L2A (plumb chase, 1'-1/2") (
- Interior - L2A (plumb chase, 2'-0") (9)
- GMU Parapet10 (1)
- GMU Parapet3 (1)
- GMU Parapet5 (1)
- GMU Parapet7 (1)
- GMU SILL (1)
- GMU SILL 2 (1)
- GMU SILL 5FLR (1)
- Windows (242)
- GMU SUNSHADE (1)
- GMU SUNSHADE 2 (1)
- GMU SUNSHADE 2 (1)
- GMU SUNSHADE 2 [3289855]



Autodesk Revit Building 9.1 - [GMU Model_clark_02_07_07 - Schedule: Copy of qs-Wall Quantities by Assembly]

File Edit View Modelling Drafting Site Tools Settings Window Help

Plane 3D Move Copy Rotate Array Mirror Group

Demolish Align Split Trim Offset

Headers: Group Ungroup Rows: New Delete Show

Basics

GMU Model_clark_02_07_07 - Project browser

- DOOR LEGEND
- DRAWING ANNOTATIONS
- FILL PATTERNS DRAFTING
- FILL PATTERNS MODEL
- Legend 1
- Legend 2
- Legend 3
- Legend 4
- Legend 5
- Legend 6
- POWER/DATA LEGEND
- RCP Legend
- Z ALL ANNOTATIONS
- Schedules/Quantities
 - 00-WALL AREA
 - Area Schedule (Gross Building)
 - Area Schedule (Rentable)
 - Ceiling Schedule
 - Copy of DD FINISH SCHEDULE 1
 - Copy of DD FINISH SCHEDULE 2
 - Copy of DD FINISH SCHEDULE 3
 - Copy of qs-Wall Quantities by Assembly**
 - DD FINISH SCHEDULE
 - DOOR SCHEDULE
 - DOOR SCHEDULE 2
 - DOOR SCHEDULE 3
 - DOOR SCHEDULE 4
 - DRAWING LIST
 - ELECTRICAL FIXTURE SCHEDULE
 - FINISH SCHEDULE
 - Floor Schedule
 - GMU ASSIGNABLE AREA
 - GMU BY SPACE
 - GMU G. FLOWERS
 - GMU PROGRAM
 - GMU PROGRAM #
 - GMU PROGRAM TEMP
 - GMU ROOM ALL
 - GMU ROOM BCOM EGRESS
 - GMU ROOM BCOM EGRESS (2)
 - GMU ROOM BCOM EGRESS (3)
 - GMU ROOM BCOM EGRESS (4)
 - GMU ROOM BCOM EGRESS (5)
 - GMU ROOM EGRESS LOAD
 - GMU ROOM SCHEDULE
 - GMU SD BCOM (HOK)
 - ISSUE LIST
 - KEYNOTES
 - Panel Schedule
 - qa-Area Schedule (Gross Building)
 - qa-Casework Quantities
 - qa-Ceiling Quantities by Type

View Modelling Drafting Site Construction

Ready

NUM

Copy of qs-Wall Quantities by Assembly

Assembly Code	Assembly Description	Length - Center To Center	Width	Calculated To Butt-End Dimensions	Area	Volume	Wall Type	Wall Assembly
B2010158	Ext. Wall - Brick Veneer w/ Stud	160' - 7 7/16"	1.25		5015.02	6221.63	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	92' - 3 1/4"	1.25		2979.59	3681.48	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	113' - 11 1/8"	1.25		2546.49	3145.48	BR 1	Exterior - GMU Brick on Mtl. Stud
B2010158	Ext. Wall - Brick Veneer w/ Stud	121' - 2 15/16"	1.25		840.89	1038.14	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	17' - 9 1/2"	0.88		261.13	228.48	MT1	Exterior - GMU Mtl Panel
B2010158	Ext. Wall - Brick Veneer w/ Stud	63' - 7 1/2"	0.88		66.19	57.91	MT1	Exterior - GMU Mtl Panel
B2010158	Ext. Wall - Brick Veneer w/ Stud	233' - 8 1/8"	1.25		6084.10	7514.26	BR 1	Exterior - GMU Brick on Mtl. Stud
B2010158	Ext. Wall - Brick Veneer w/ Stud	44' - 5 3/8"	1.25		159.67	192.87	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	19' - 4 1/2"	1.25		36.72	45.90	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	19' - 4 1/2"	1.25		99.30	122.05	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	29' - 6 3/4"	0.96		779.06	746.60		Exterior - GMU Brick Fin
B2010158	Ext. Wall - Brick Veneer w/ Stud	10' - 5 3/8"	0.96		466.90	447.45	BR 2	Exterior - GMU Brick Fin 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	26' - 2 3/8"	0.96		565.90	538.33		Exterior - GMU Brick Fin
B2010158	Ext. Wall - Brick Veneer w/ Stud	153' - 1"	1.25		2184.33	2693.96	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	126' - 10 1/16"	1.25		1800.51	2204.83	BR 1	Exterior - GMU Brick on Mtl. Stud
B2010158	Ext. Wall - Brick Veneer w/ Stud	19' - 5"	1.25		242.55	303.19	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	9' - 4 1/2"	1.25		59.58	72.28	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	6' - 7 7/16"	1.25		32.39	39.93	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	29' - 2 1/8"	1.25		112.11	139.58	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	186' - 4"	1.25		957.73	1156.29	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	74' - 0"	1.25		2042.88	2500.21	BR 1	Exterior - GMU Brick on Mtl. Stud
B2010158	Ext. Wall - Brick Veneer w/ Stud	83' - 4 1/2"	1.25		1141.06	1405.10	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	42' - 2 3/4"	0.63		591.02	369.39		Exterior - GMU AHU
B2010158	Ext. Wall - Brick Veneer w/ Stud	20' - 5 1/2"	0.63		236.98	148.11		Exterior - GMU AHU
B2010158	Ext. Wall - Brick Veneer w/ Stud	42' - 2 3/4"	0.63		519.06	324.41		Exterior - GMU AHU
B2010158	Ext. Wall - Brick Veneer w/ Stud	20' - 5 1/2"	0.63		229.74	143.59		Exterior - GMU AHU
B2010158	Ext. Wall - Brick Veneer w/ Stud	49' - 5 1/2"	0.46		653.33	299.44	MT 2	Exterior - GMU Mtl Panel Screen
B2010158	Ext. Wall - Brick Veneer w/ Stud	23' - 0 1/2"	0.46		303.89	139.28	MT 2	Exterior - GMU Mtl Panel Screen
B2010158	Ext. Wall - Brick Veneer w/ Stud	10' - 3 1/2"	0.96		168.00	161.00	BR 2	Exterior - GMU Brick Fin 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	7' - 1"	0.88		383.20	335.30	MT1	Exterior - GMU Mtl Panel
B2010158	Ext. Wall - Brick Veneer w/ Stud	9' - 9 11/16"	0.88		582.33	496.78	MT1	Exterior - GMU Mtl Panel
B2010158	Ext. Wall - Brick Veneer w/ Stud	41' - 11 3/4"	0.63		591.02	369.39		Exterior - GMU AHU
B2010158	Ext. Wall - Brick Veneer w/ Stud	20' - 5 1/2"	0.88		251.47	220.03	MT2	Exterior - GMU Mtl Panel 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	41' - 11 3/4"	0.63		515.98	322.49		Exterior - GMU AHU
B2010158	Ext. Wall - Brick Veneer w/ Stud	20' - 5 1/2"	0.88		243.78	213.31	MT2	Exterior - GMU Mtl Panel 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	18' - 0 13/16"	1.25		945.88	1182.35	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	12' - 2 11/16"	1.25		17.67	21.60	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	78' - 7 15/16"	1.25		103.04	128.80	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	9' - 11"	1.25		104.22	130.28	BR 1	Exterior - GMU Brick on Mtl. Stud
B2010158	Ext. Wall - Brick Veneer w/ Stud	10' - 2 1/2"	1.25		95.29	115.69	BR 1	Exterior - GMU Brick on Mtl. Stud
B2010158	Ext. Wall - Brick Veneer w/ Stud	9' - 11"	1.25		92.56	115.69	BR 1	Exterior - GMU Brick on Mtl. Stud
B2010158	Ext. Wall - Brick Veneer w/ Stud	10' - 2 1/2"	1.25		35.63	42.11	BR 1	Exterior - GMU Brick on Mtl. Stud
B2010158	Ext. Wall - Brick Veneer w/ Stud	46' - 9 3/16"	0.46		630.29	288.88	MT 2	Exterior - GMU Mtl Panel Screen
B2010158	Ext. Wall - Brick Veneer w/ Stud	3' - 2 1/16"	0.46		36.17	15.93	MT 2	Exterior - GMU Mtl Panel Screen
B2010158	Ext. Wall - Brick Veneer w/ Stud	22' - 11 1/4"	0.46		303.86	138.62	MT 2	Exterior - GMU Mtl Panel Screen
B2010158	Ext. Wall - Brick Veneer w/ Stud	1' - 11 11/16"	1.25		10.40	13.00	SB 1	Exterior - GMU Cast Stn on Mtl. Stud 2
B2010158	Ext. Wall - Brick Veneer w/ Stud	6' - 4 1/2"	0.46		4.20	1.92	MT 2	Exterior - GMU Mtl Panel Screen
B2010158	Ext. Wall - Brick Veneer w/ Stud	23' - 11 1/2"	0.88		347.67	304.21	MT1	Exterior - GMU Mtl Panel

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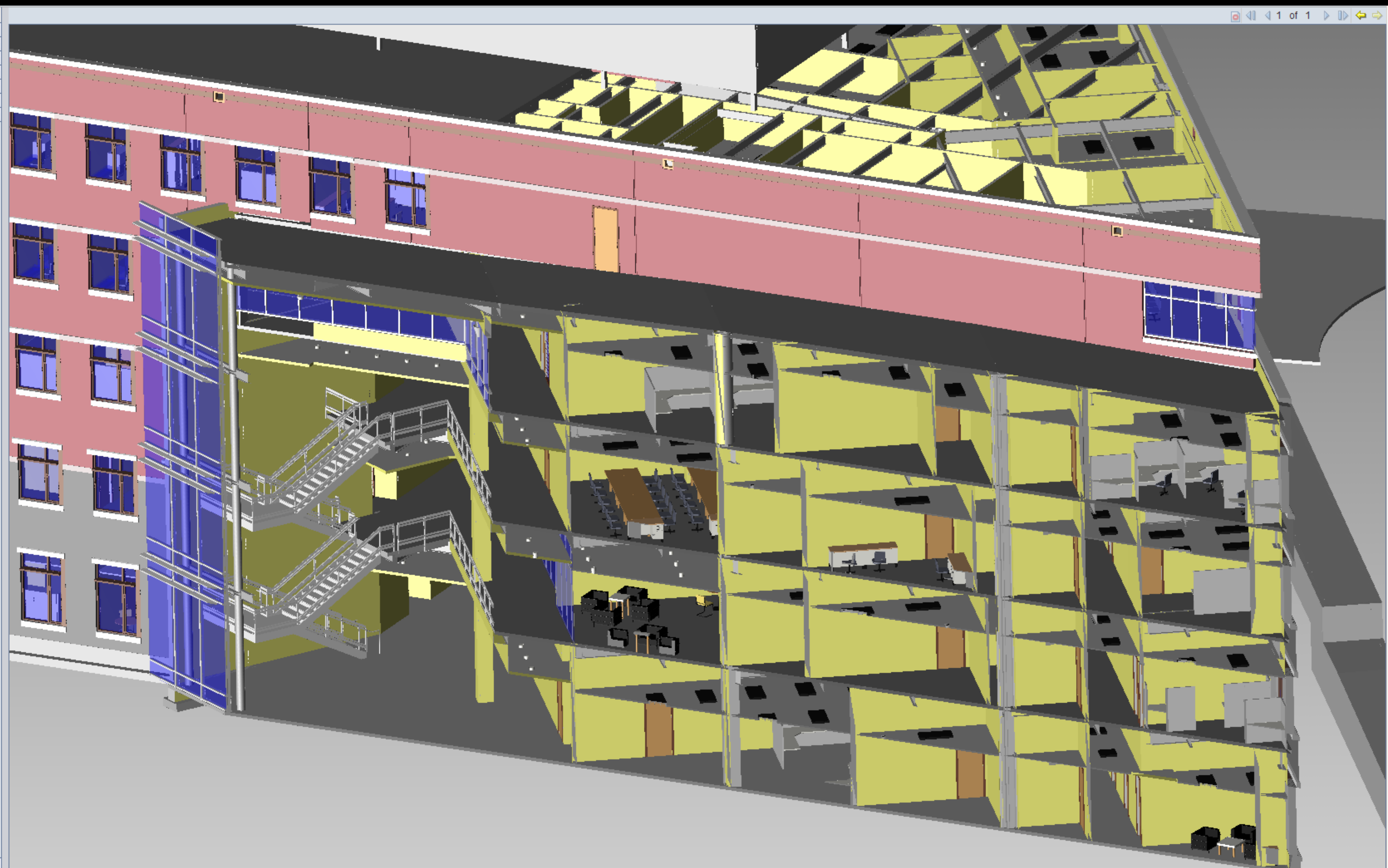
Alexander V. Zolotov Alex.Zolotov@ClarkConstruction.com

Contents
Model
Markups
Properties
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Cross Sections

☒ Cross Sections

- Cross Section 1
- Cross Section 2
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- Cross Section 5
- Cross Section 6

Animations



BIM Implementation

Coordination Visualization Models

- Steel Coordination
- 3D MEP Spatial Coordination
- Unique Project Challenges

Scheduling

- 4D Models for Analysis and Communication

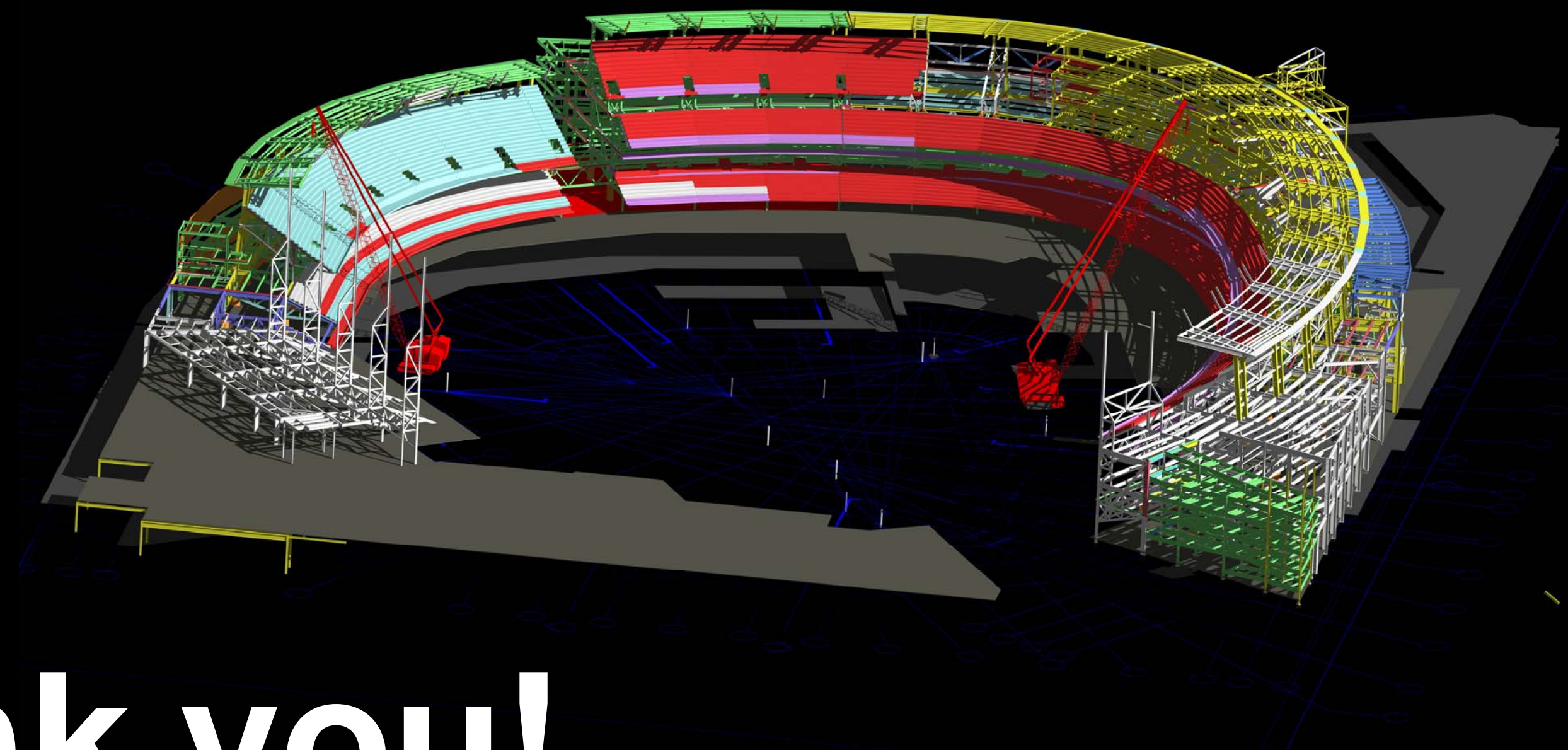
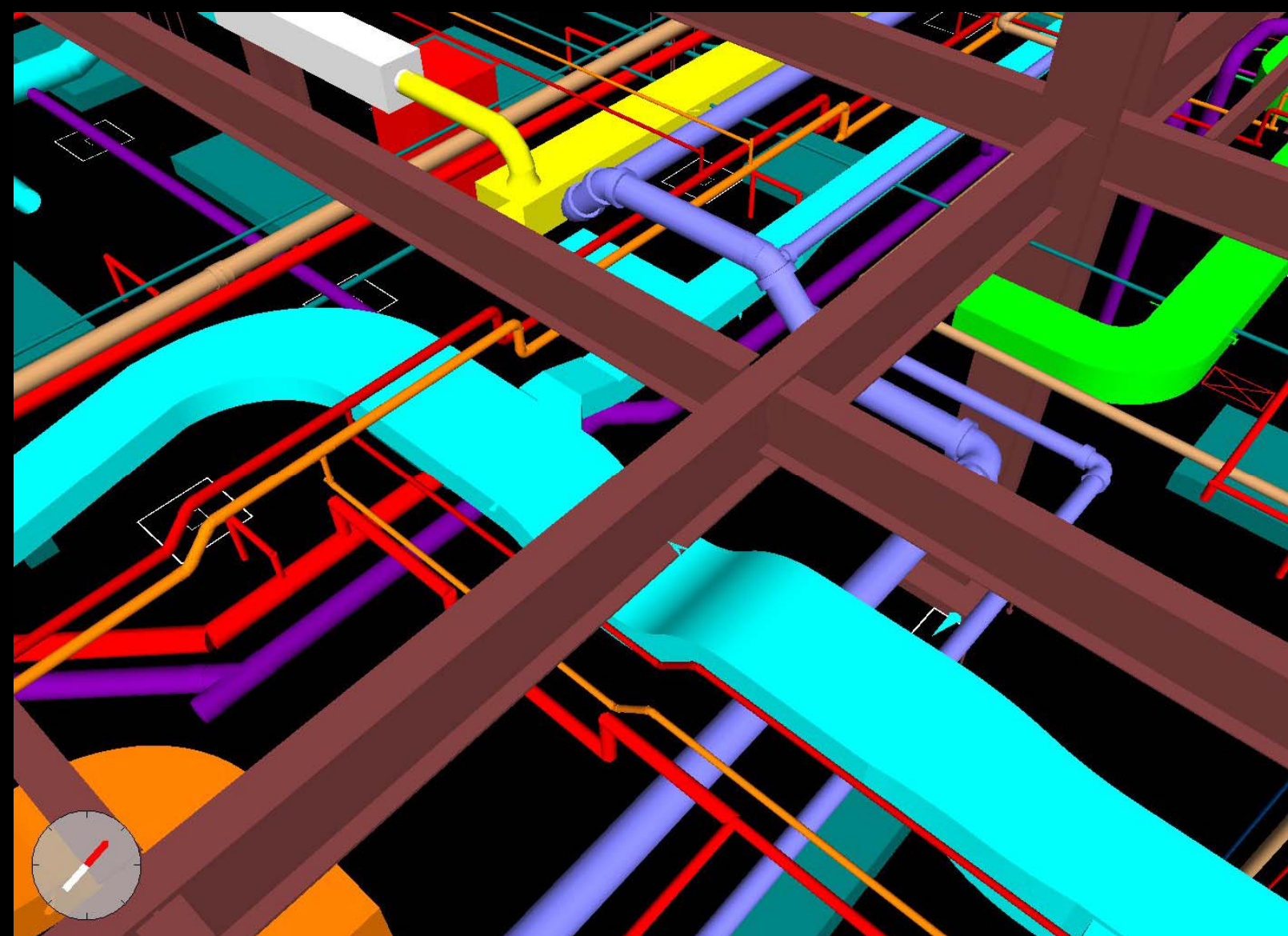
Estimating

- Automated quantity take-off

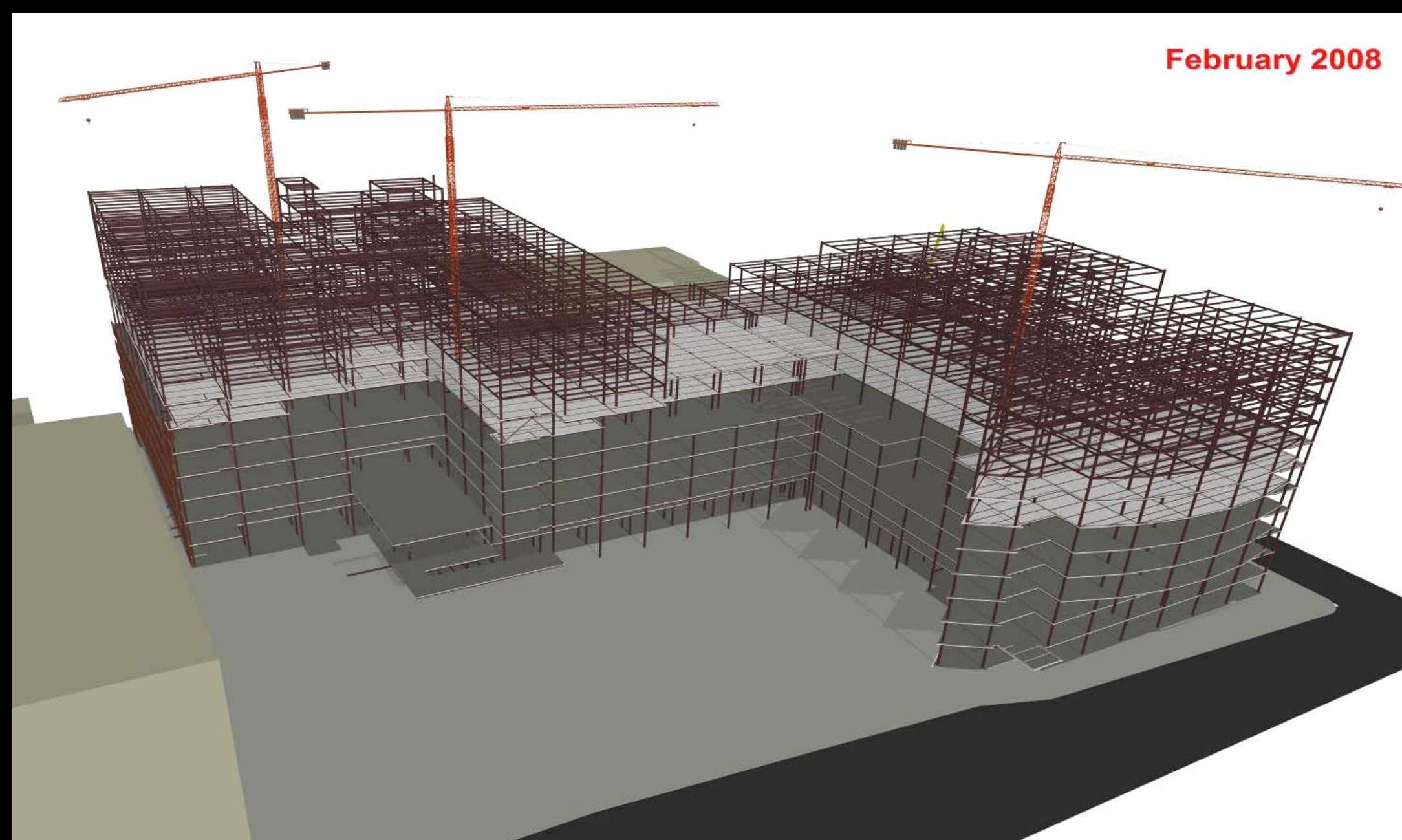
Benefits of BIM

Effective tool for:

- coordination and constructability reviews
- achieving fast-track schedules and staying within budget
- more reliable planning and budgeting
- more dynamic, real-time value analysis and decision-making



Thank you!



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