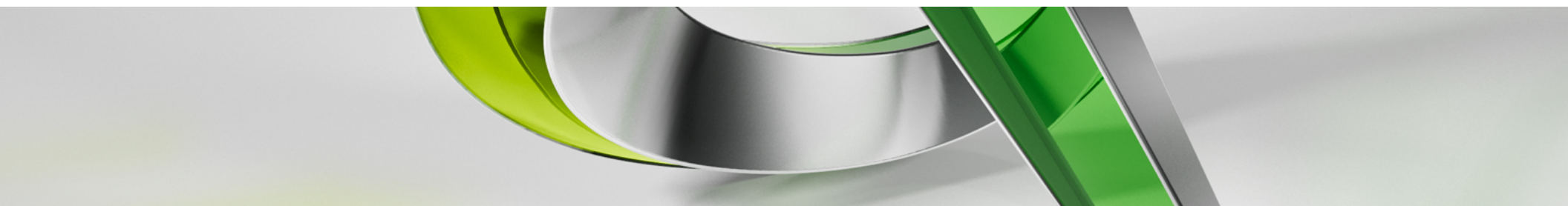




BIM: Best Practices Today and Opportunities Tomorrow

Ben Osborne, PE

Senior Structural Engineer/BIM Manager – Stanley D. Lindsey & Associates



Class summary

Building Information Modeling (BIM) is one of the leading agents of change in the architecture, engineering, and construction industry today. Come learn how BIM is more than just 3D drafting, and see some ways you can incorporate it into your workflow. We will show some of the simple benefits that all BIM users can enjoy, discuss how BIM can help your business, and preview some of the latest and upcoming technologies.

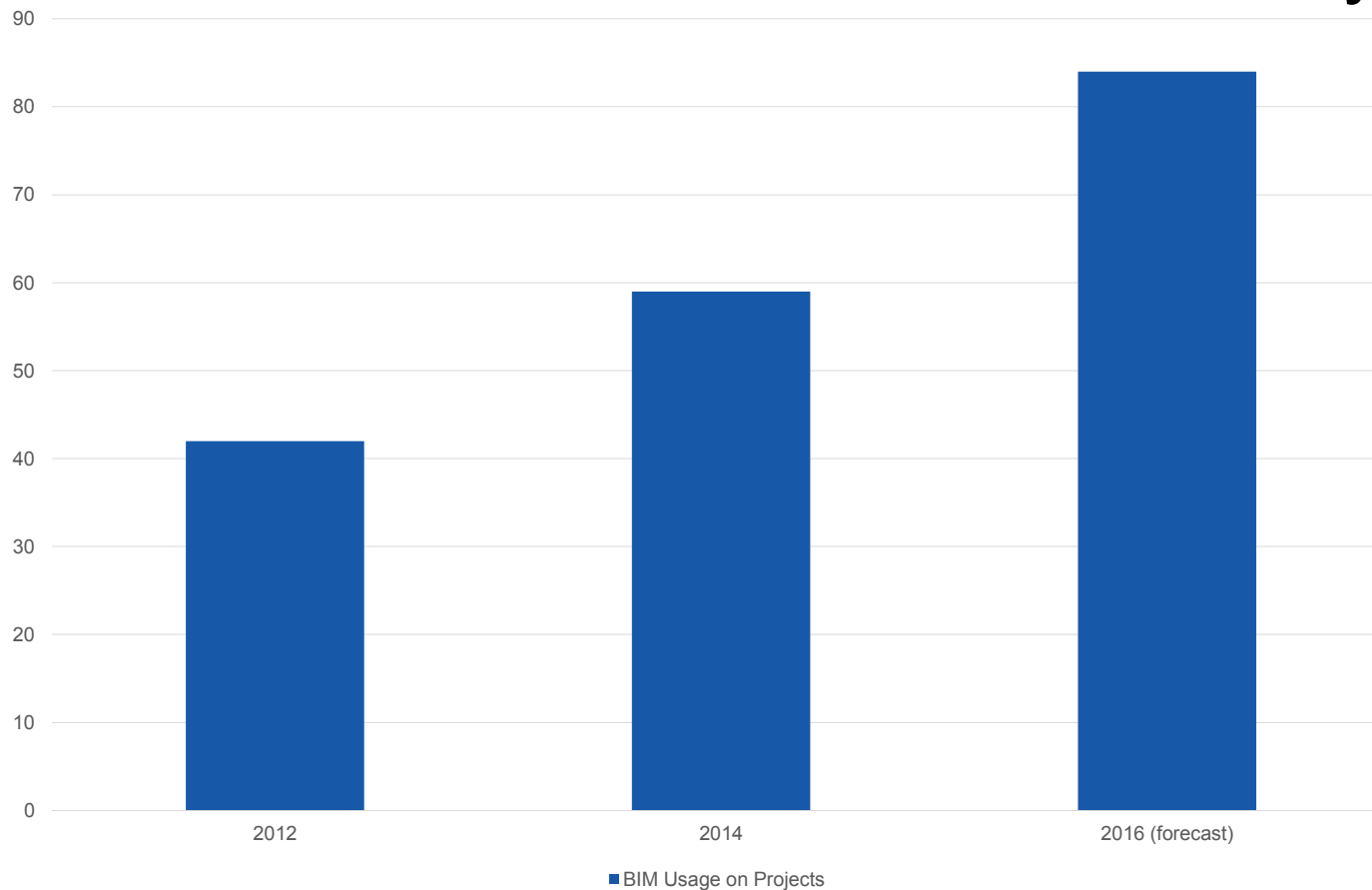
Key learning objectives

At the end of this class, you will be able to:

- Identify industry trends and understand how that may impact the future
- Understand how BIM changes the way you work
- Learn how to identify ways that embedded data can improve your internal processes
- Learn how downstream partners can capitalize on information delivered in your BIM

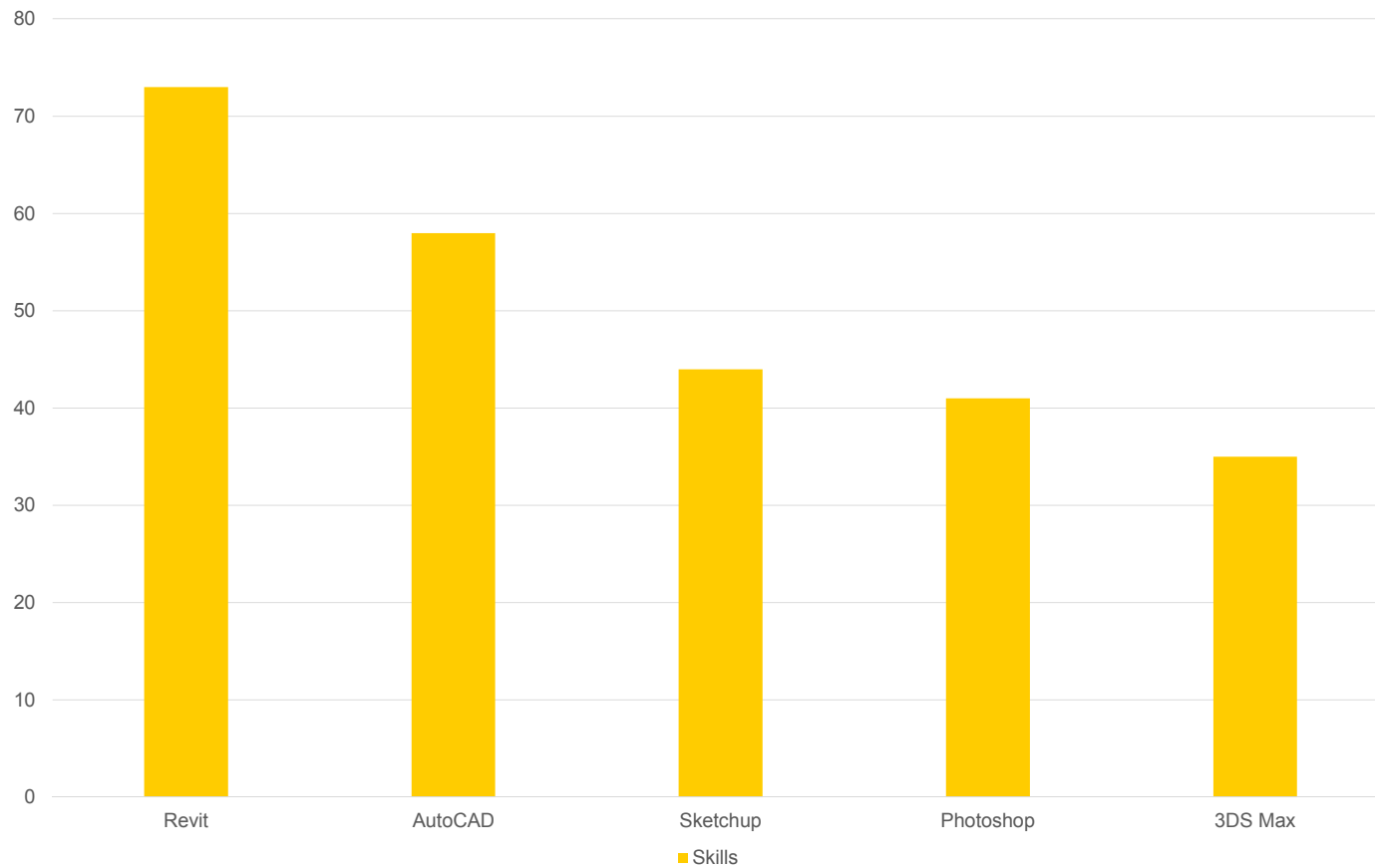
State of BIM Adoption in Building Design

2014 McGraw Hill Owner BIM Survey



State of BIM Adoption in Design Firms

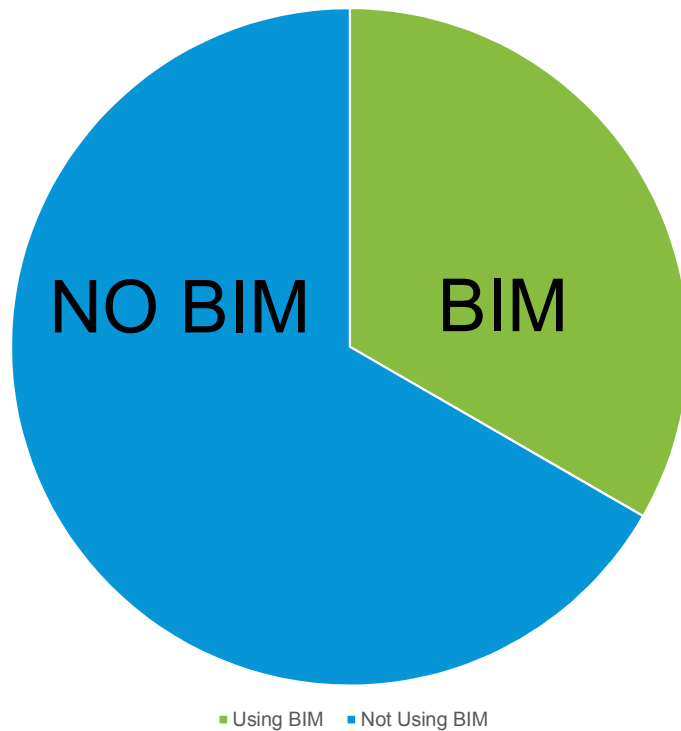
2014 Black Spectacles Survey of Top 50 Design Firms



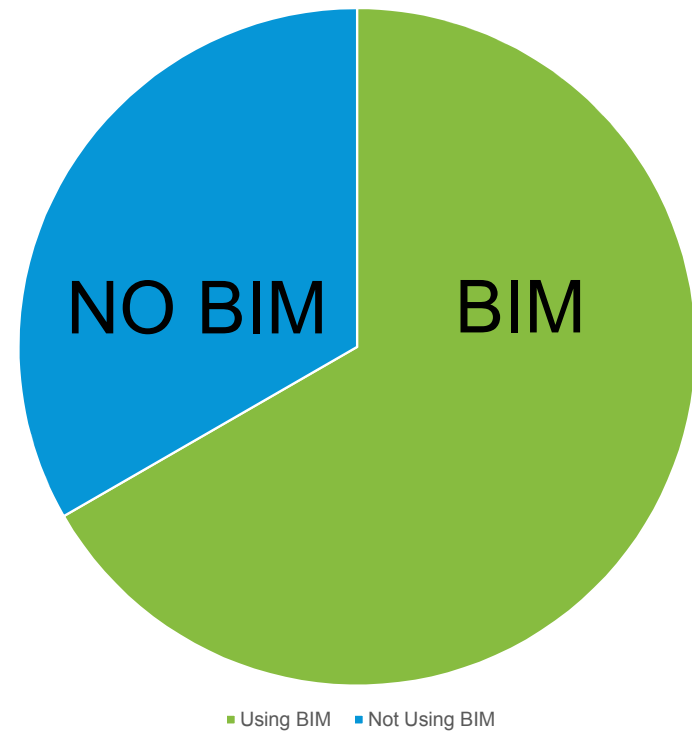
State of BIM Adoption in Structural Engineering

CASE/SEI BIM SURVEYS

2008 SE BIM USAGE



2014 SE BIM USAGE



Current And Future Trends Affecting AEC

Trends Transforming AEC Industry



Technology
Proliferation



Collaborative
Project Teams



BIM Mandates



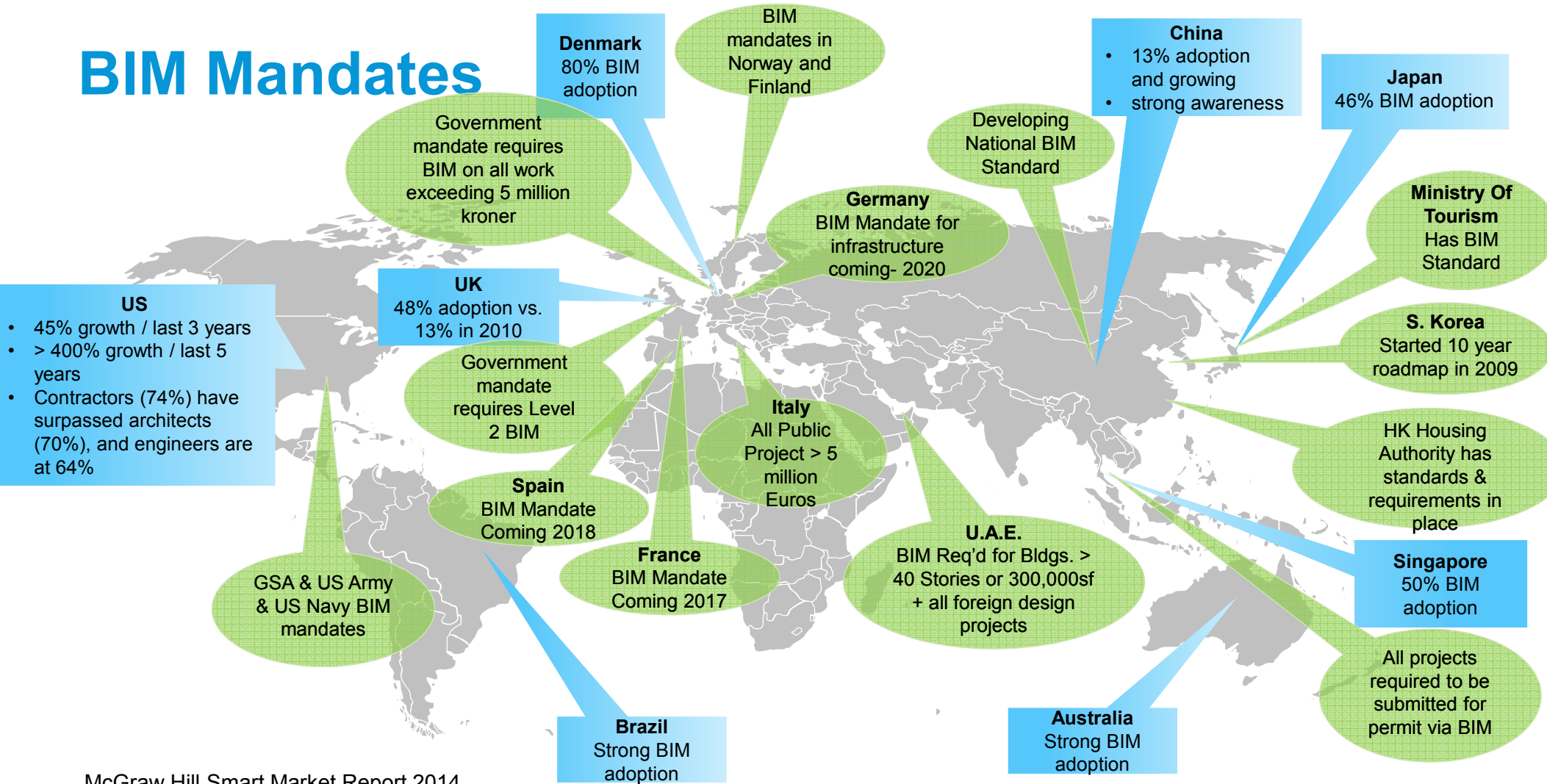
Parametric & Computational Design



Prefabrication



BIM Mandates



McGraw Hill Smart Market Report 2014
National BIM Report 2016 from NBIS

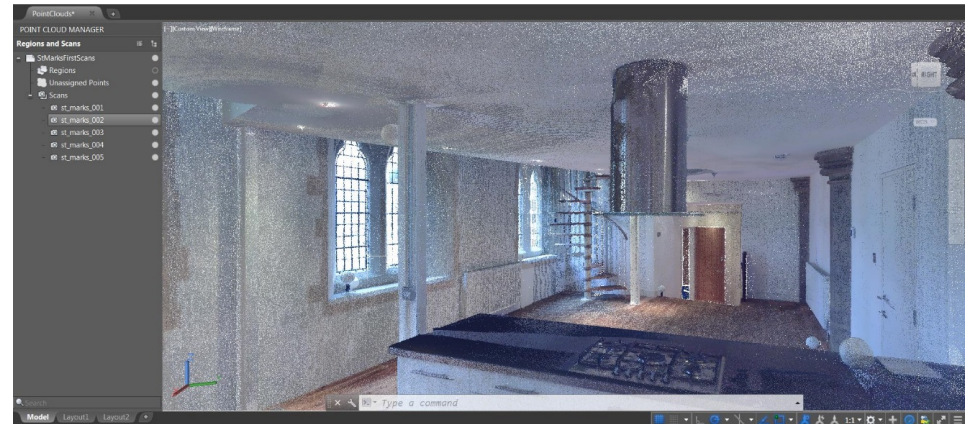


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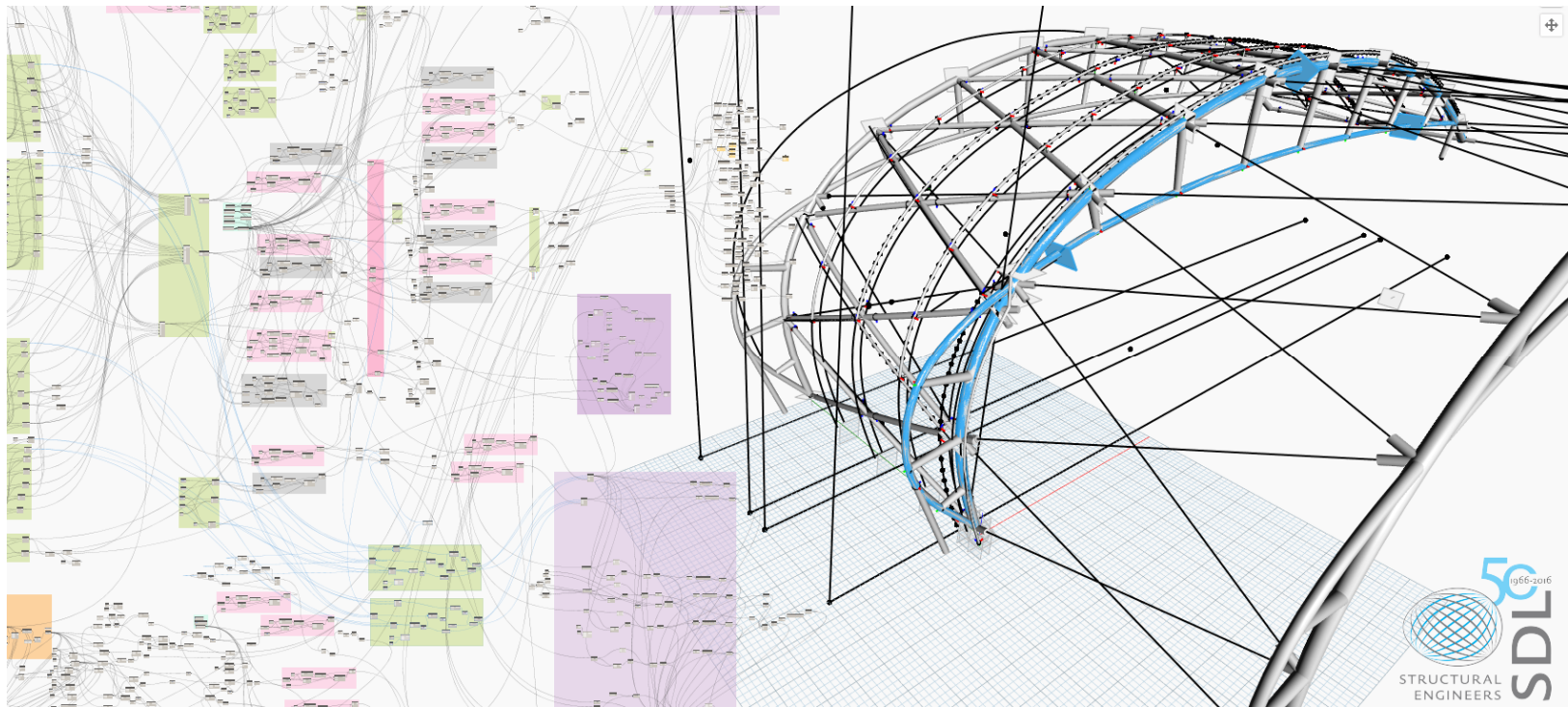
Construction Technology

- Augmented Reality
- Reality Capture
- Immersive Working



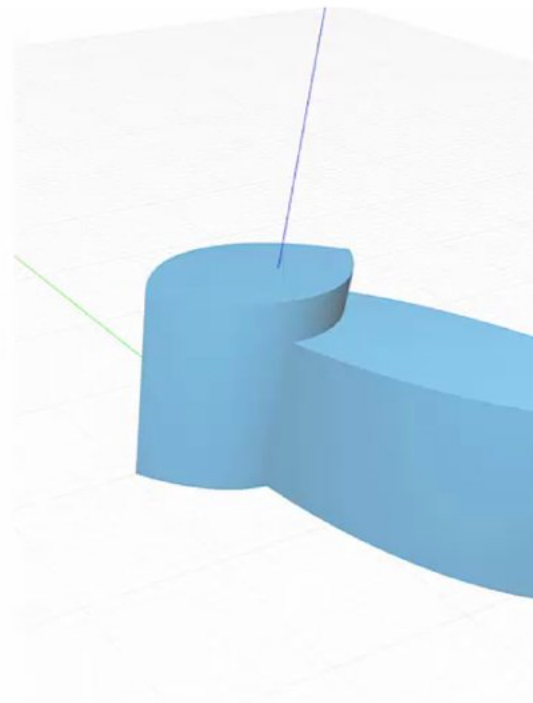
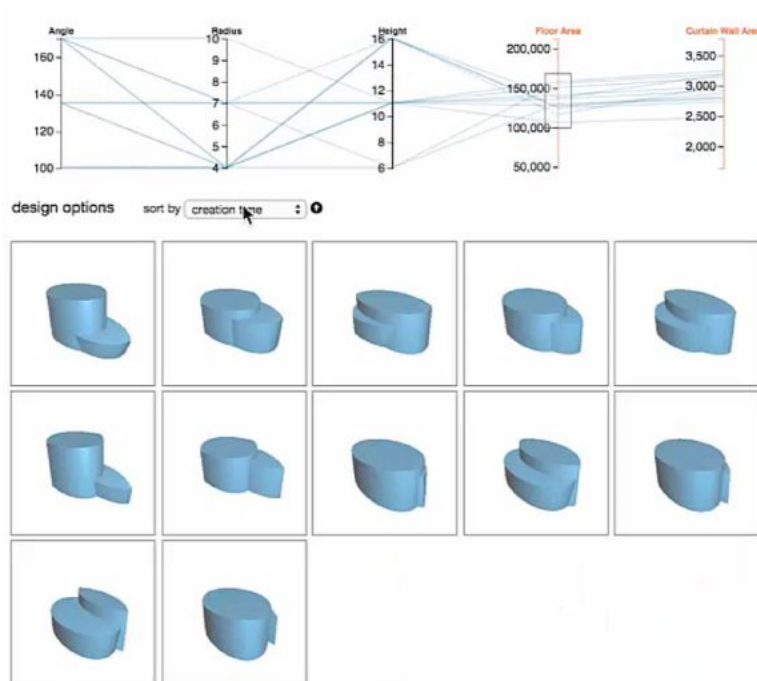
Computational Design

- Apply Algorithmic Behaviors & Logic to model
- Computationally test many outcomes



Computational Design

- Explore more design alternatives
- Coordinate across the design team
- Integrate structural analysis and design with BIM

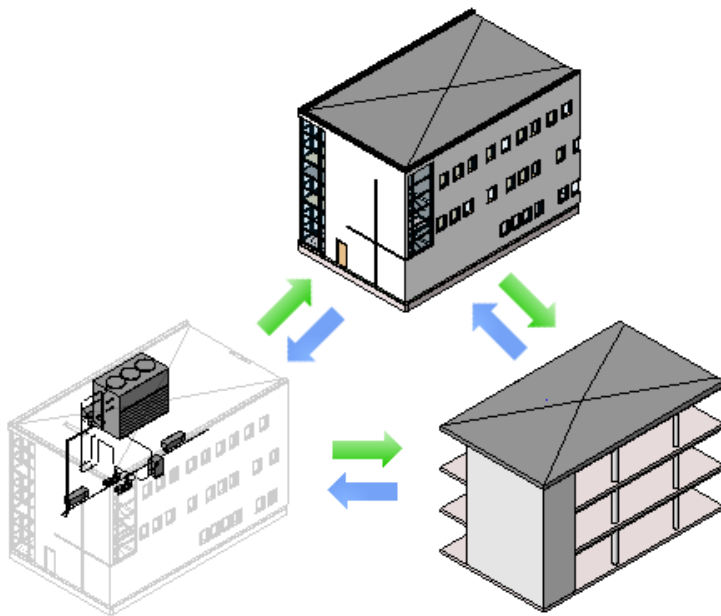


Collaborative Teams



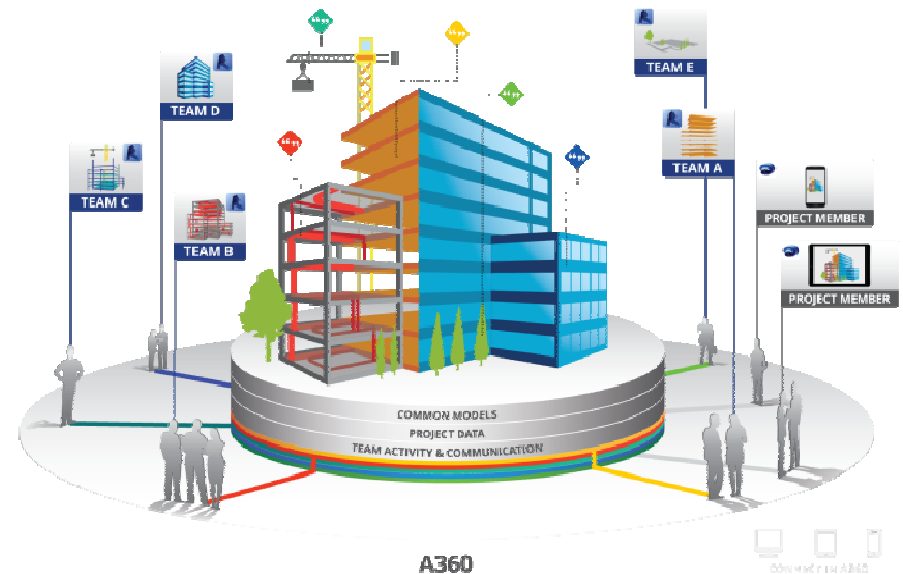
Collaboration & Interoperability

Model Sharing



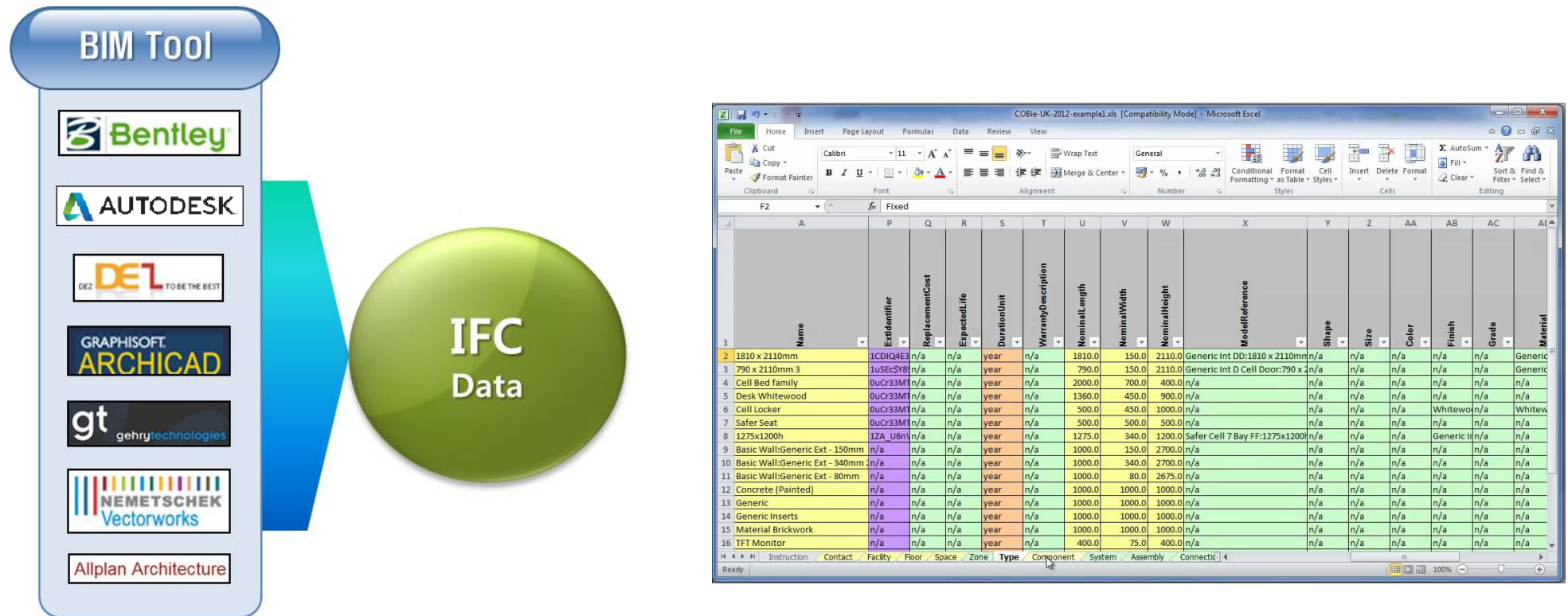
Typical Revit

Co-Authoring



Collaboration For Revit (C4R)

Collaboration & Interoperability



IFC – Geometry & Data

COBie – Non-Geometric Data

Prefabrication



Prefabrication



MWF

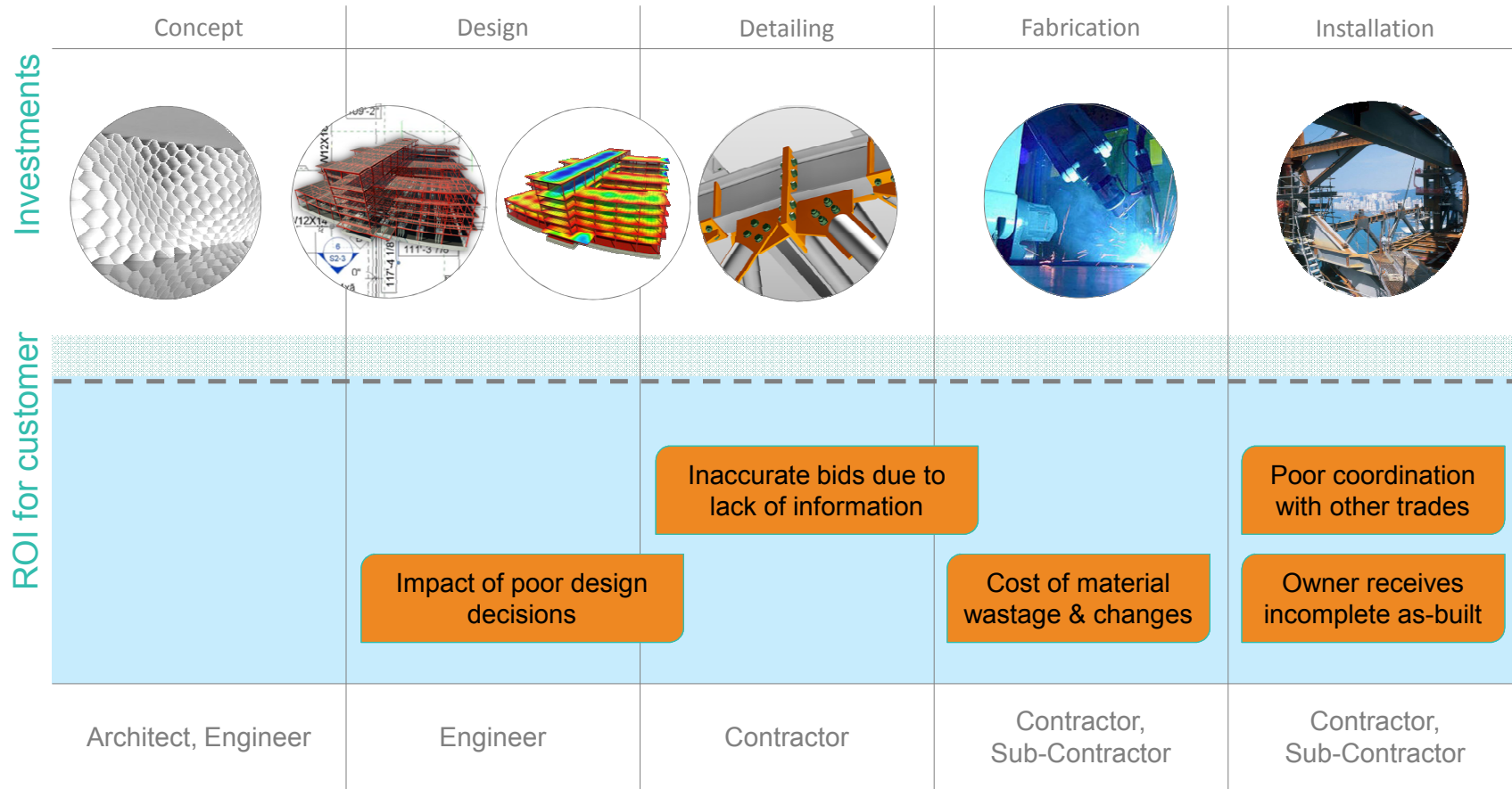


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3D BIM vs 2D CAD Work Comparison

Structural Engineering | BIM Workflow

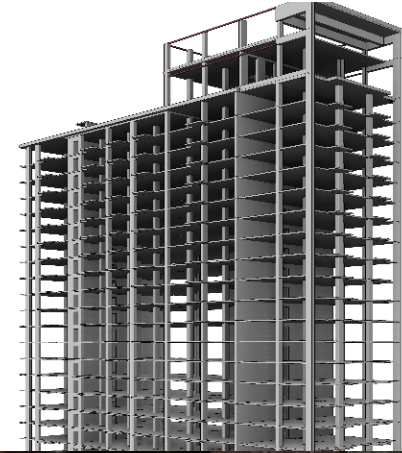


How does BIM change how we work?



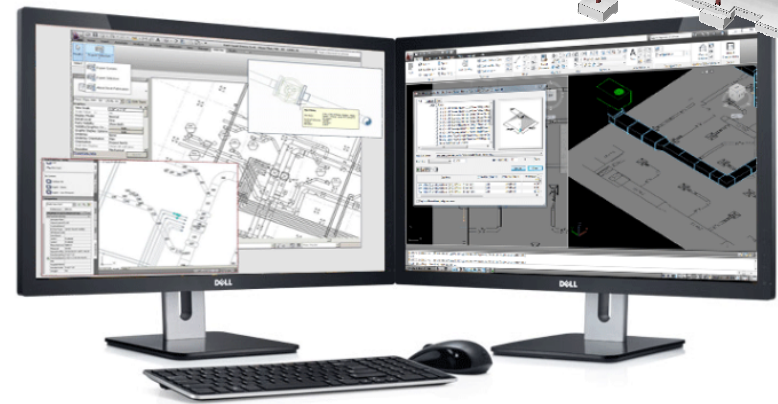
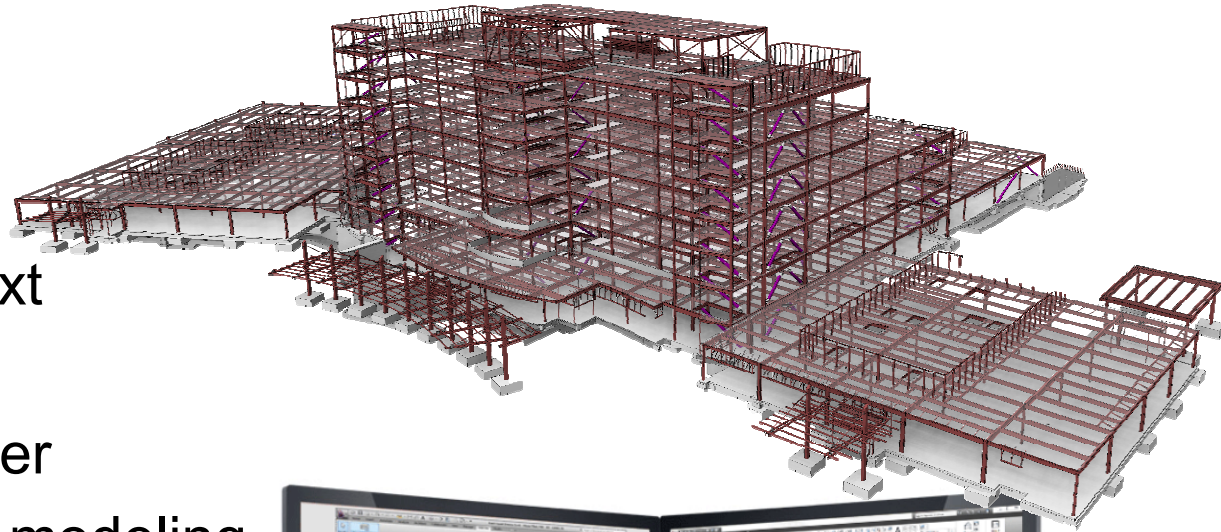
What is the Deliverable?

- Paper Drawings still primary legal deliverable
 - Day-to-day?



Model Based Drawing Production

- 2D CAD
 - Visually Coordinated
 - Drawing = lines and text
- 3D Cad/Modeling
 - Coordination gets easier
 - This Is B_M – building modeling
- B|M
 - Benefits of 3D + **I**nformation
 - Data-Driven Documentation



Courtesy:
1966
SDI
STRUCTURAL
ENGINEERS

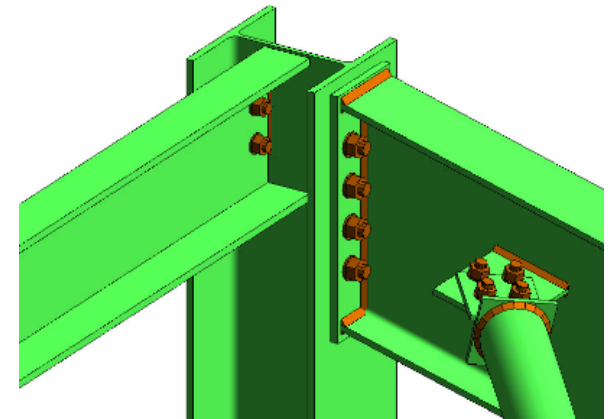
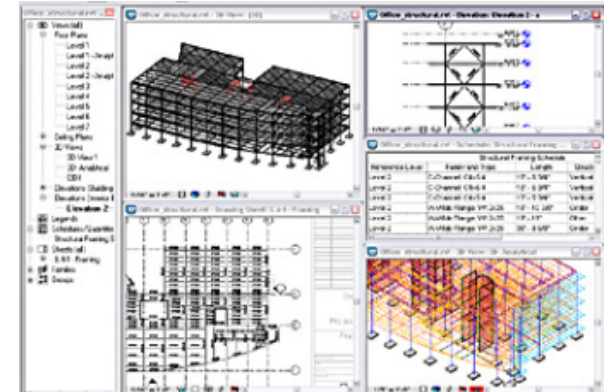


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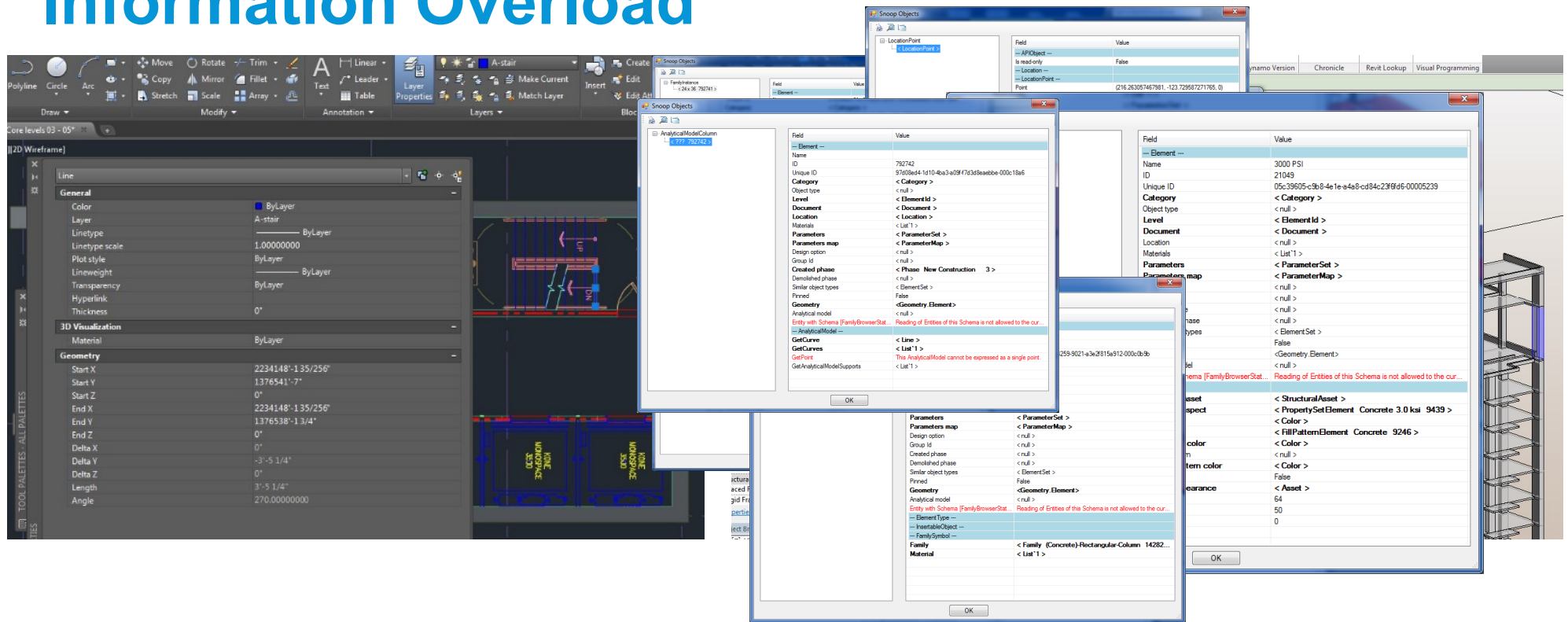
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Modeling vs Drafting

- Which Leads/Follows?
 - Outcome – Documentation
 - Documentation – Outcome
- Is BIM is more work than CAD?
 - Front-Loaded Work
 - Less time Later

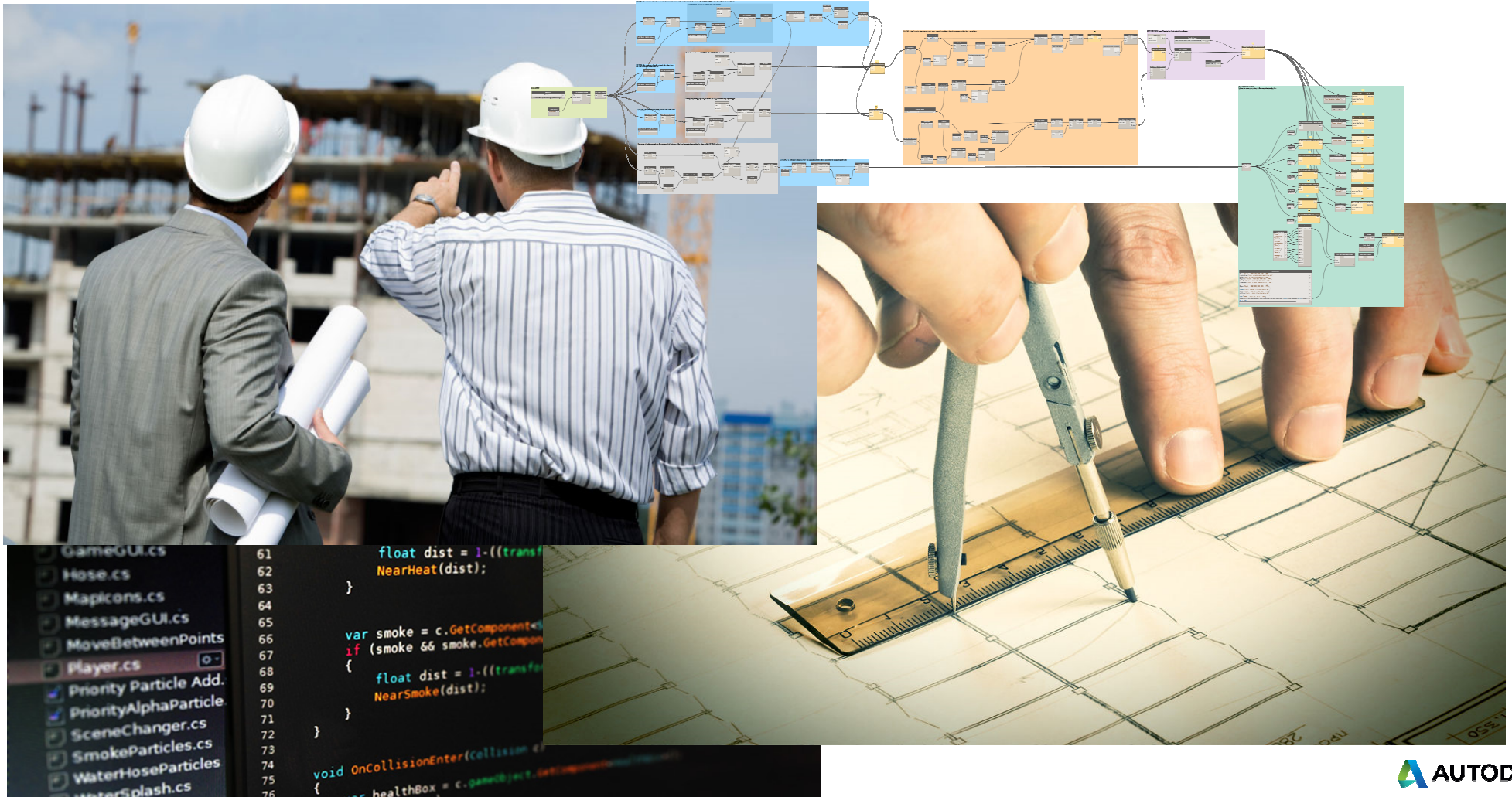


Information Overload

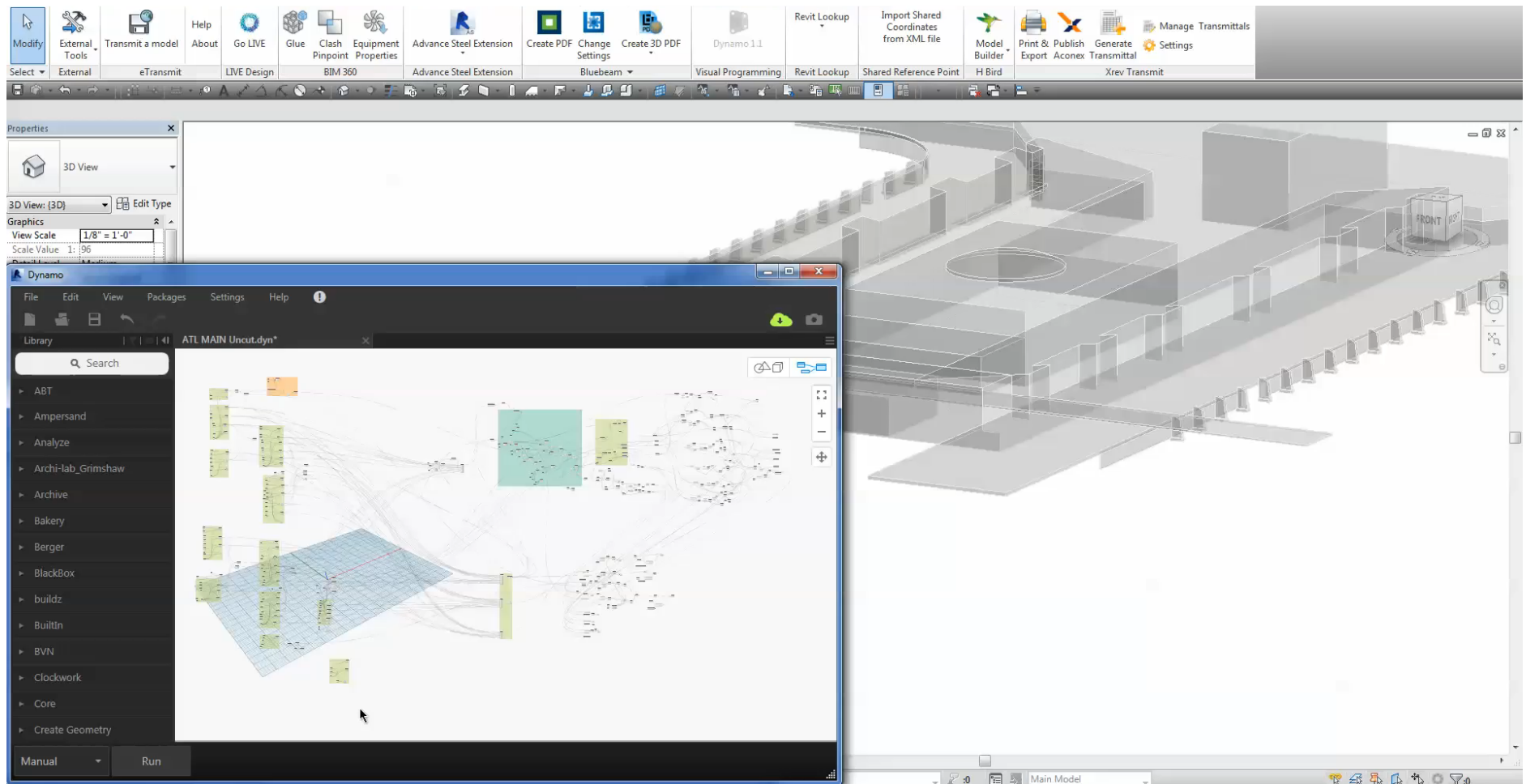


As an industry, we author, deliver, and use more information than ever before. We must learn to efficiently create and digest all this additional information.

Programming and Scripting



Parametric Model Creation via Scripting



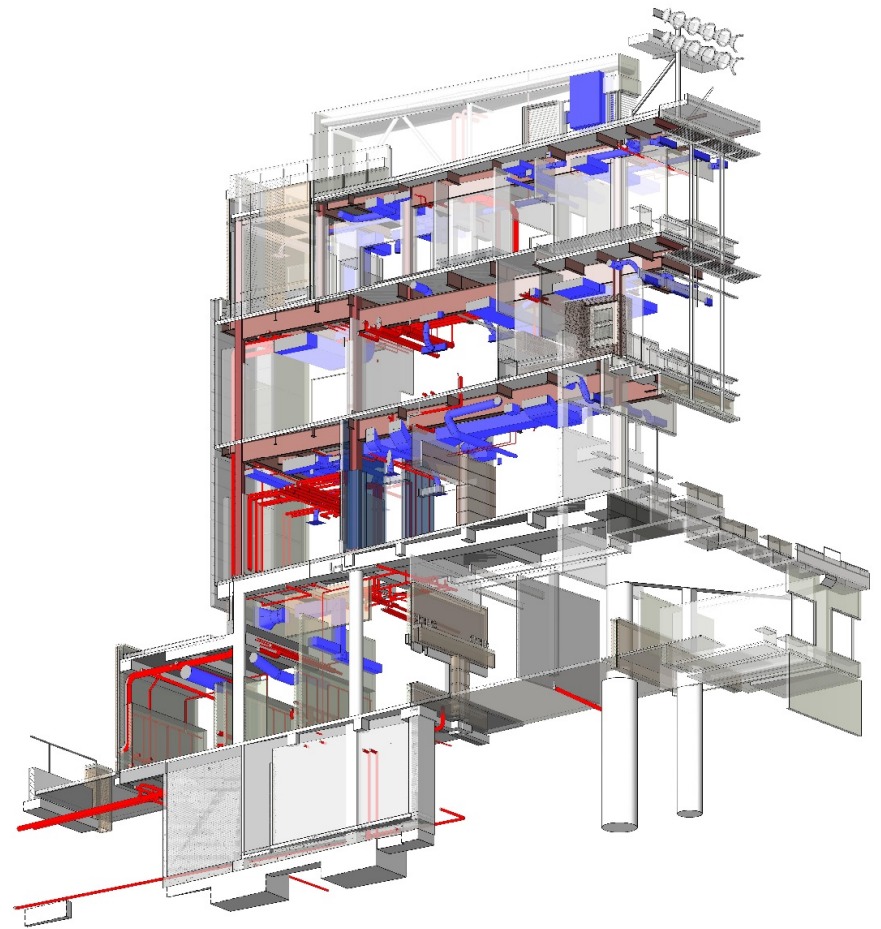
Courtesy:
SDI
STRUCTURAL
ENGINEERS
1966



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Multi-discipline Collaboration



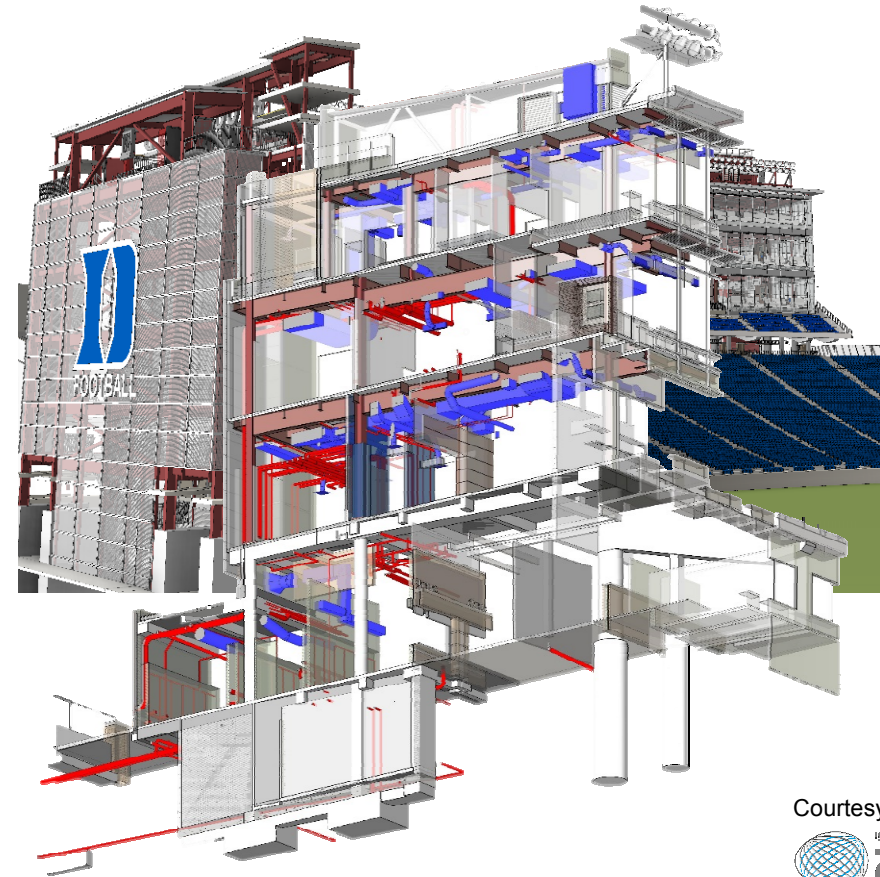
Multi-discipline Collaboration – Linking models

■ PROS

- Connected but Protected...
- Separate analytical from design
- Unique objects for unique purpose
- Insulated from architectural process “iterations”

■ CONS

- Speed of Coordination
- Model Overlap Confusion
- Less access to other's Data



Courtesy:
SDI
STRUCTURAL
ENGINEERS
1966



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Multi-discipline Collaboration – Linking models



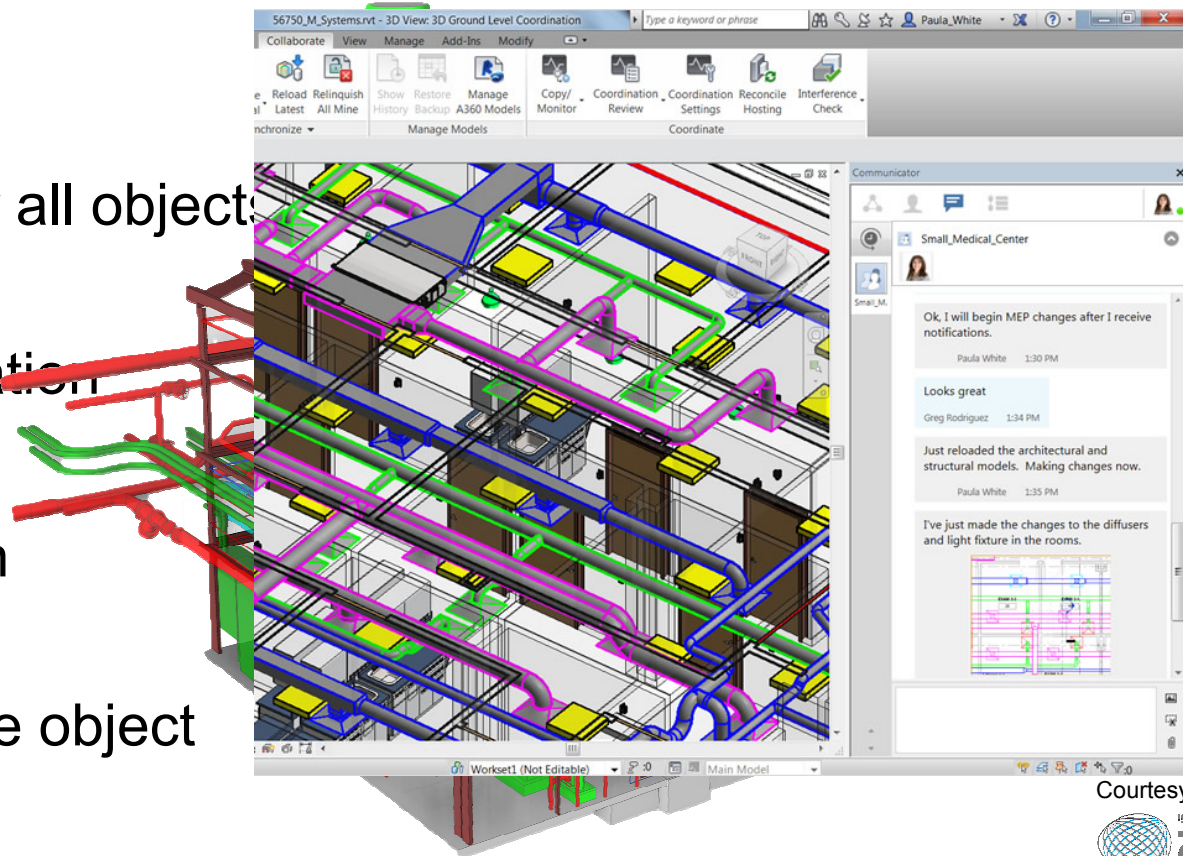
Multi-discipline Collaboration –Single Shared Model

■ PROS

- Single point of truth for all objects
- Contractor friendly
- Current design information

■ CONS

- Lots of Communication
- Trust is needed....
- Multiple authors for one object



Courtesy:



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Multi-discipline Collaboration – Single Shared Model



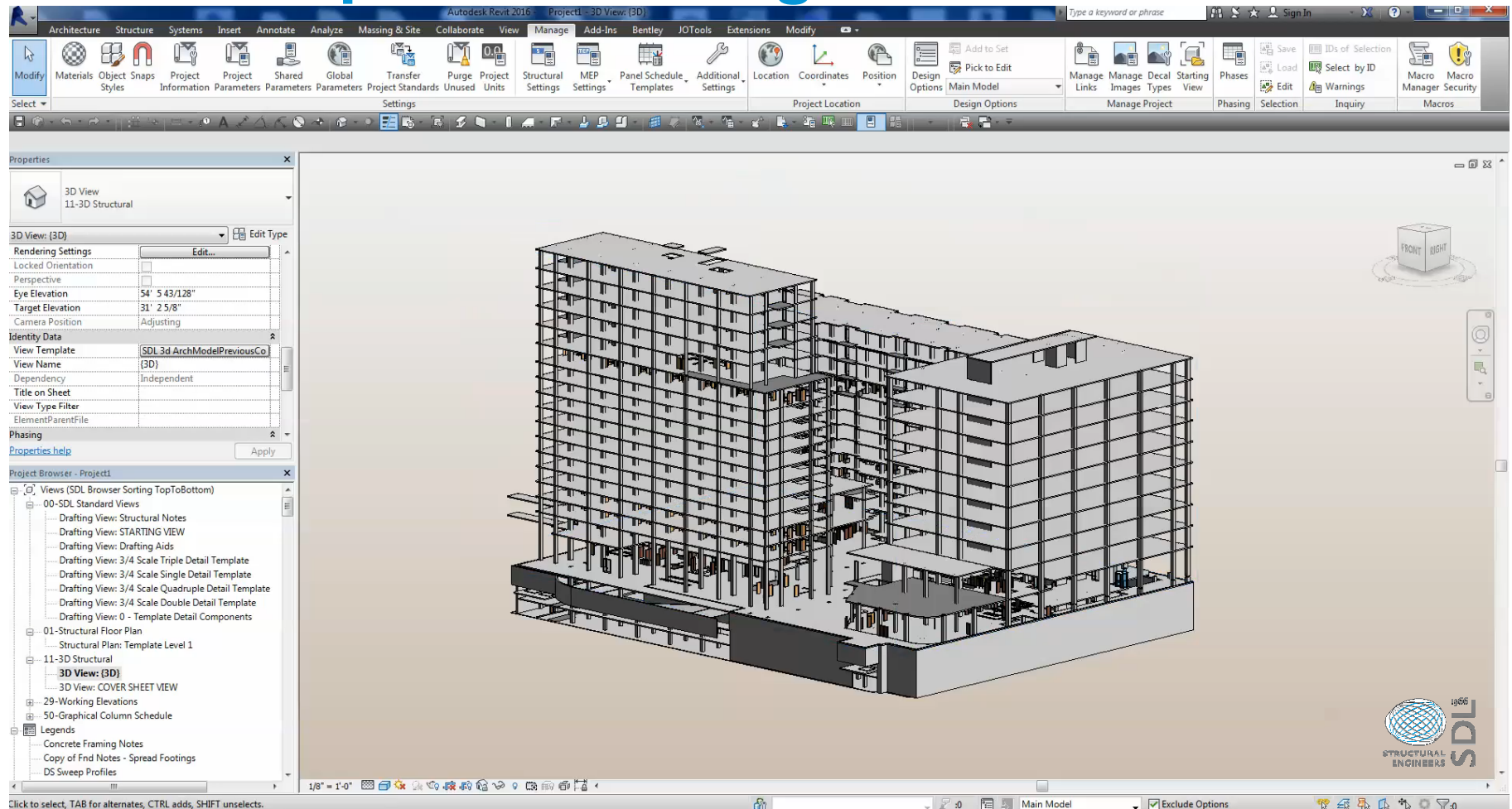
Staffing requirements

- BIM = Software, Process, and People
- New Skillsets Needed
 - Train
 - Hire
- Who's in Charge?
- Number Of Staff Required?

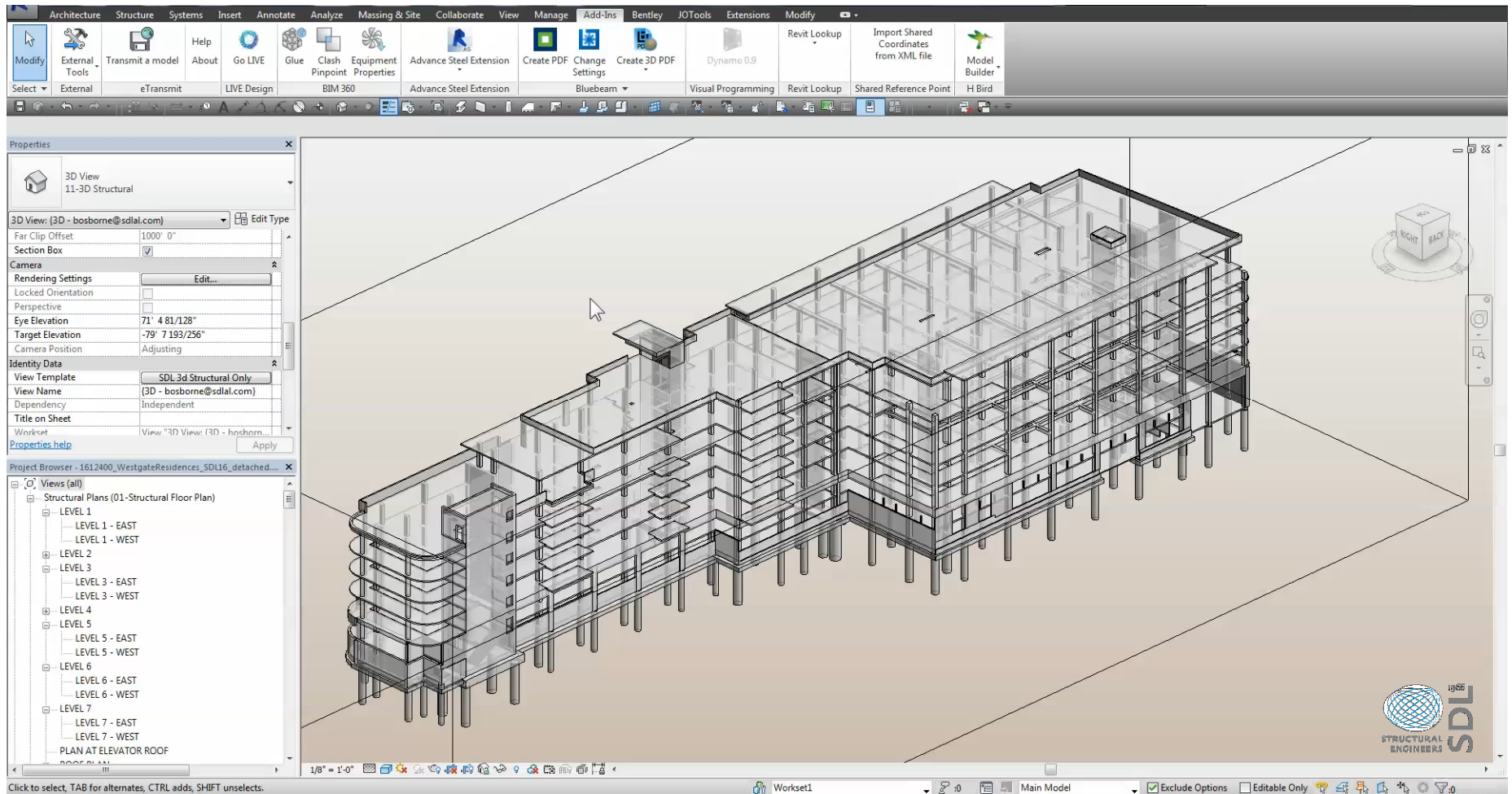


Using BIM to Improve Your Internal Work Processes

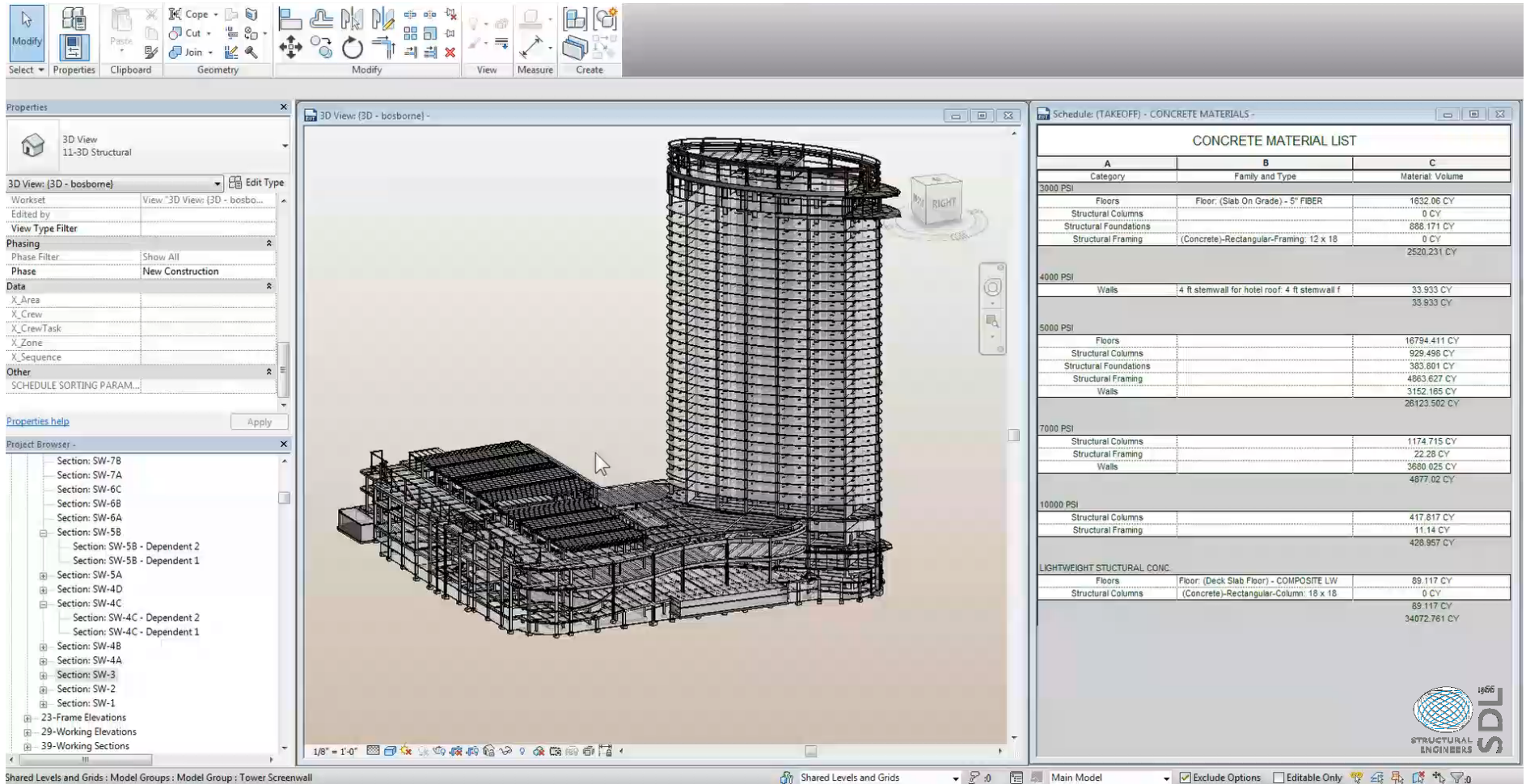
Model Comparison/Change Detection



Automated Creation of Floor Openings



Material Takeoffs and Visual Checks



The screenshot displays the Autodesk software interface, specifically the 3D View (3D - bosborne) window. The central 3D model shows a complex building structure with a tall, cylindrical tower and a lower, rectangular base. The interface includes a Properties panel on the left, a Project Browser on the bottom left, and a Schedule (TAKEOFF) - CONCRETE MATERIALS window on the right.

Properties Panel:

- 3D View: 11-3D Structural
- 3D View: (3D - bosborne)
- View Type Filter: Show All
- Phase: New Construction
- Data: X_Area, X_Crew, X_CrewTask, X_Zone, X_Sequence
- Other: SCHEDULE SORTING PARAM...

Project Browser:

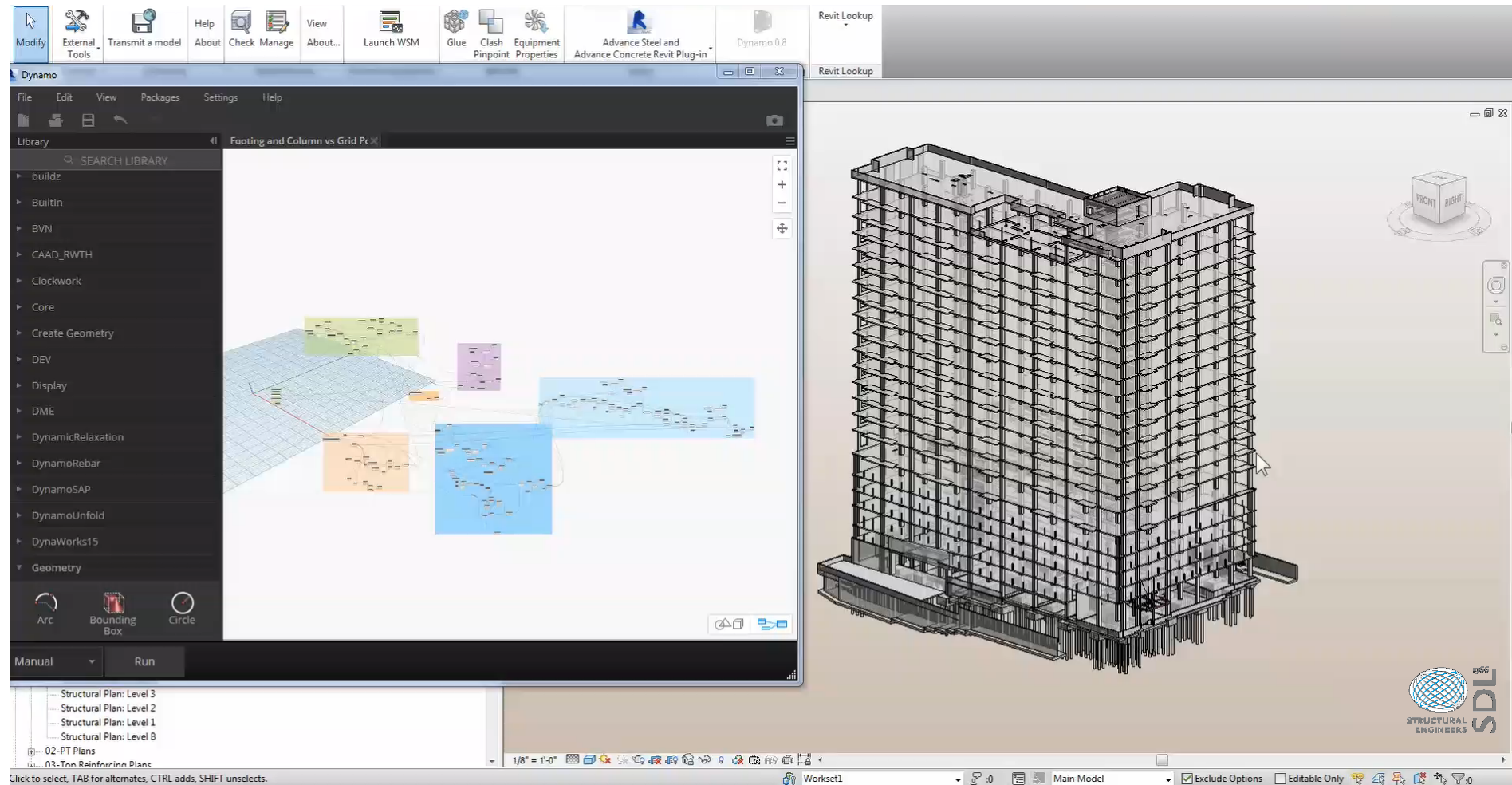
- Section: SW-7B
- Section: SW-7A
- Section: SW-6C
- Section: SW-6B
- Section: SW-6A
- Section: SW-5B
 - Section: SW-5B - Dependent 2
 - Section: SW-5B - Dependent 1
- Section: SW-5A
- Section: SW-4D
- Section: SW-4C
 - Section: SW-4C - Dependent 2
 - Section: SW-4C - Dependent 1
- Section: SW-4B
- Section: SW-4A
- Section: SW-3
- Section: SW-2
- Section: SW-1
- 23-Frame Elevations
- 29-Working Elevations
- 39-Working Sections

Schedule (TAKEOFF) - CONCRETE MATERIALS:

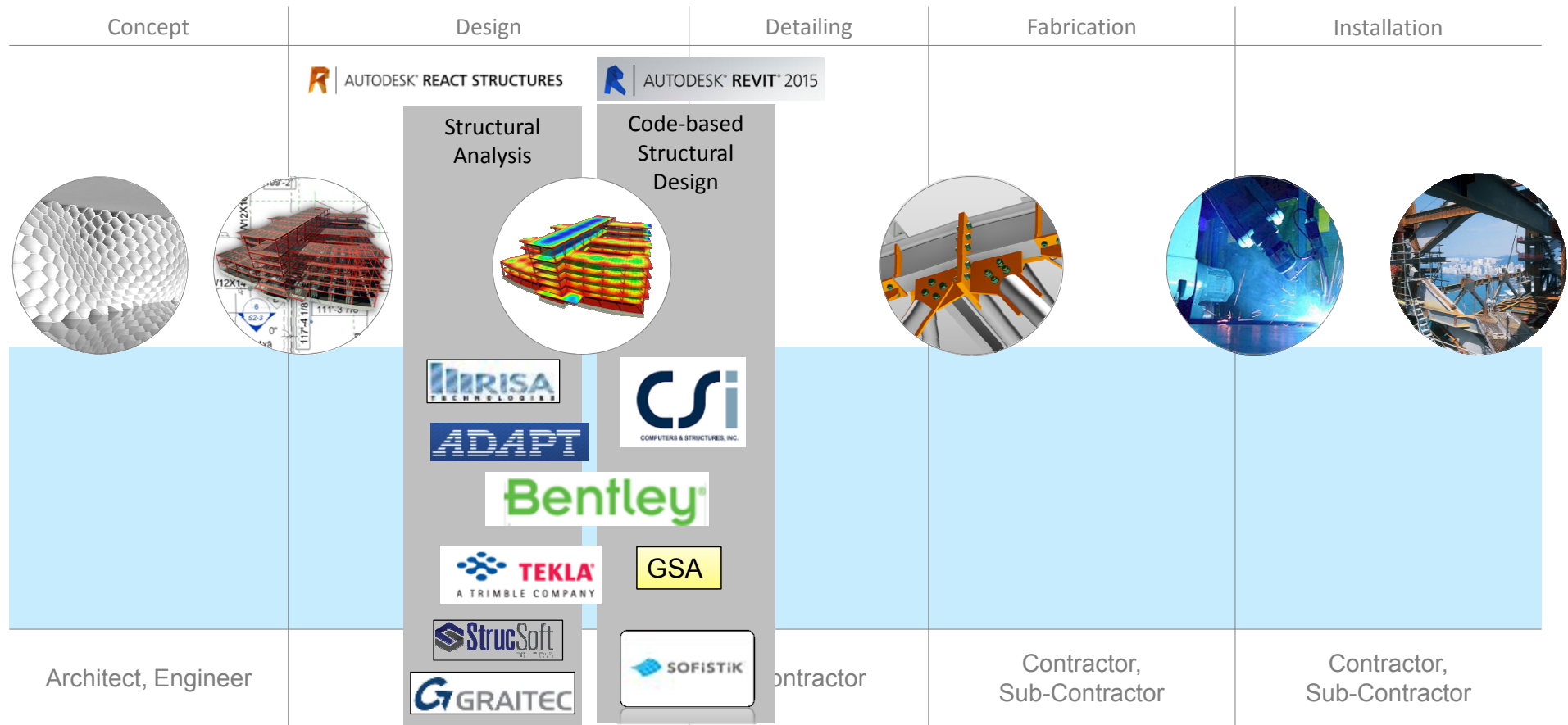
CONCRETE MATERIAL LIST		
A	B	C
Category	Family and Type	Material Volume
3000 PSI		
Floors	Floor: (Slab On Grade) - 5" FIBER	1632.06 CY
Structural Columns		0 CY
Structural Foundations		888.171 CY
Structural Framing	(Concrete)-Rectangular-Framing: 12 x 18	0 CY
		2520.231 CY
4000 PSI		
Walls	4 ft stemwall for hotel roof: 4 ft stemwall f	33.933 CY
		33.933 CY
5000 PSI		
Floors		16794.411 CY
Structural Columns		929.496 CY
Structural Foundations		383.601 CY
Structural Framing		4863.627 CY
Walls		3152.165 CY
		28123.502 CY
7000 PSI		
Structural Columns		1174.715 CY
Structural Framing		22.28 CY
Walls		3680.025 CY
		4877.02 CY
10000 PSI		
Structural Columns		417.817 CY
Structural Framing		11.14 CY
		428.957 CY
LIGHTWEIGHT STRUCTURAL CONC.		
Floors	Floor: (Deck Slab Floor) - COMPOSITE LW	89.117 CY
Structural Columns	(Concrete)-Rectangular-Column: 18 x 18	0 CY
		89.117 CY
		34072.761 CY

Footer: Shared Levels and Grids: Model Groups: Model Group: Tower Screenwall

Column Placement vs Grid Intersections

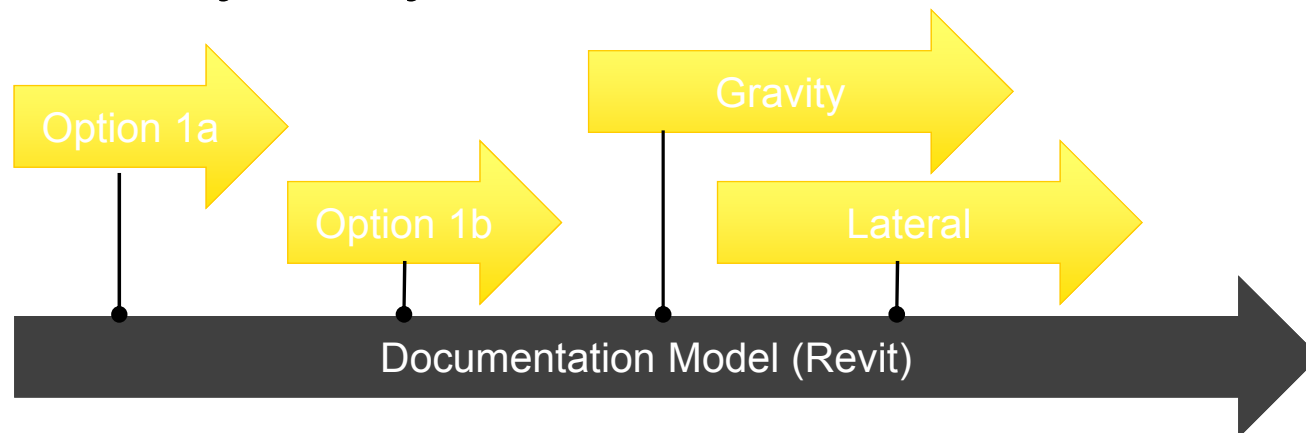


Structural Analysis Ecosystem of Partners

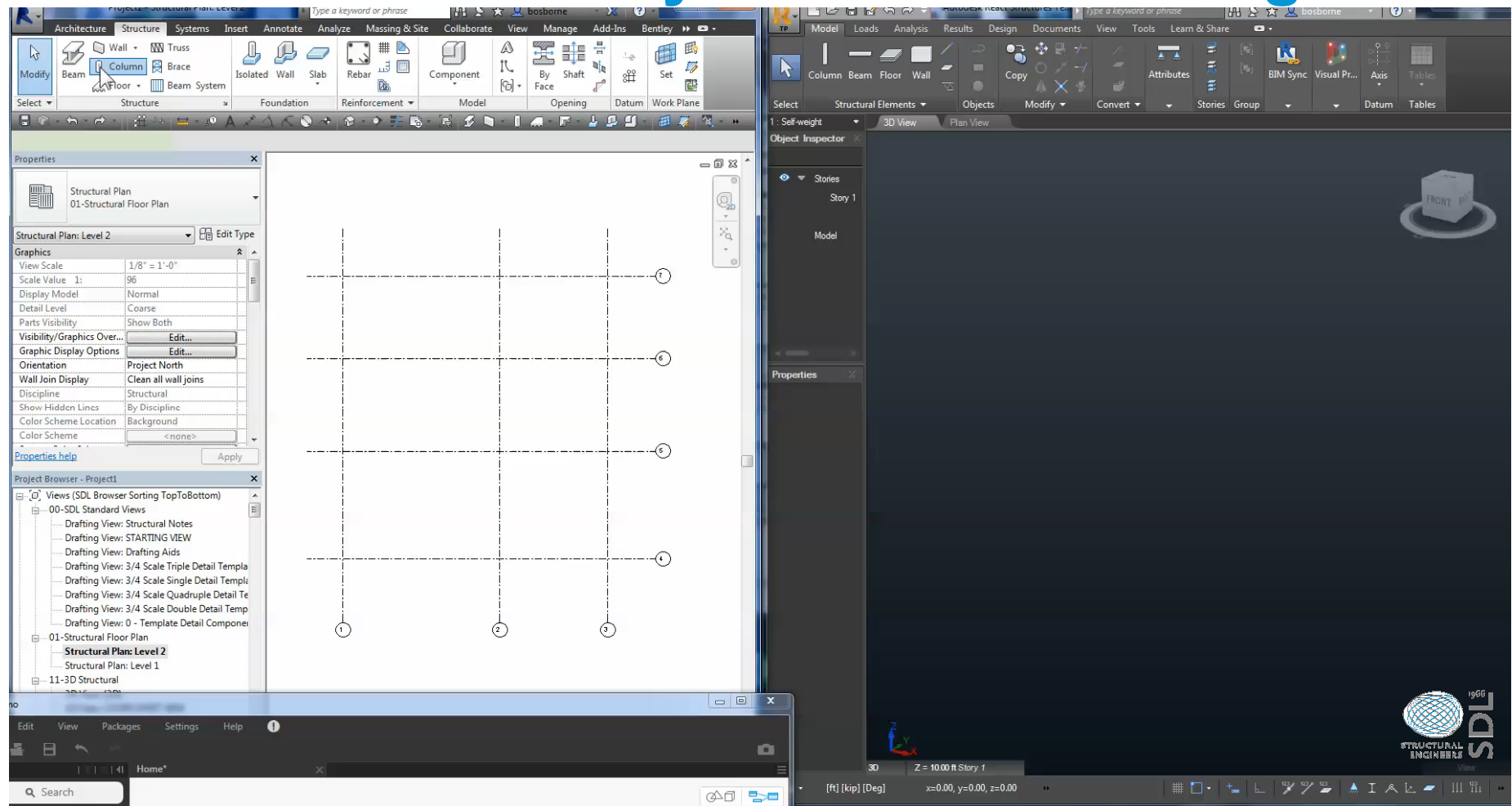


Structural Analysis and Design – Current Challenges

- Synchronization impacted by
 - major bay and framing changes
 - Schedules and details not live to plans
 - Many analysis models but one documentation model



Documentation/Analytical Model Linking

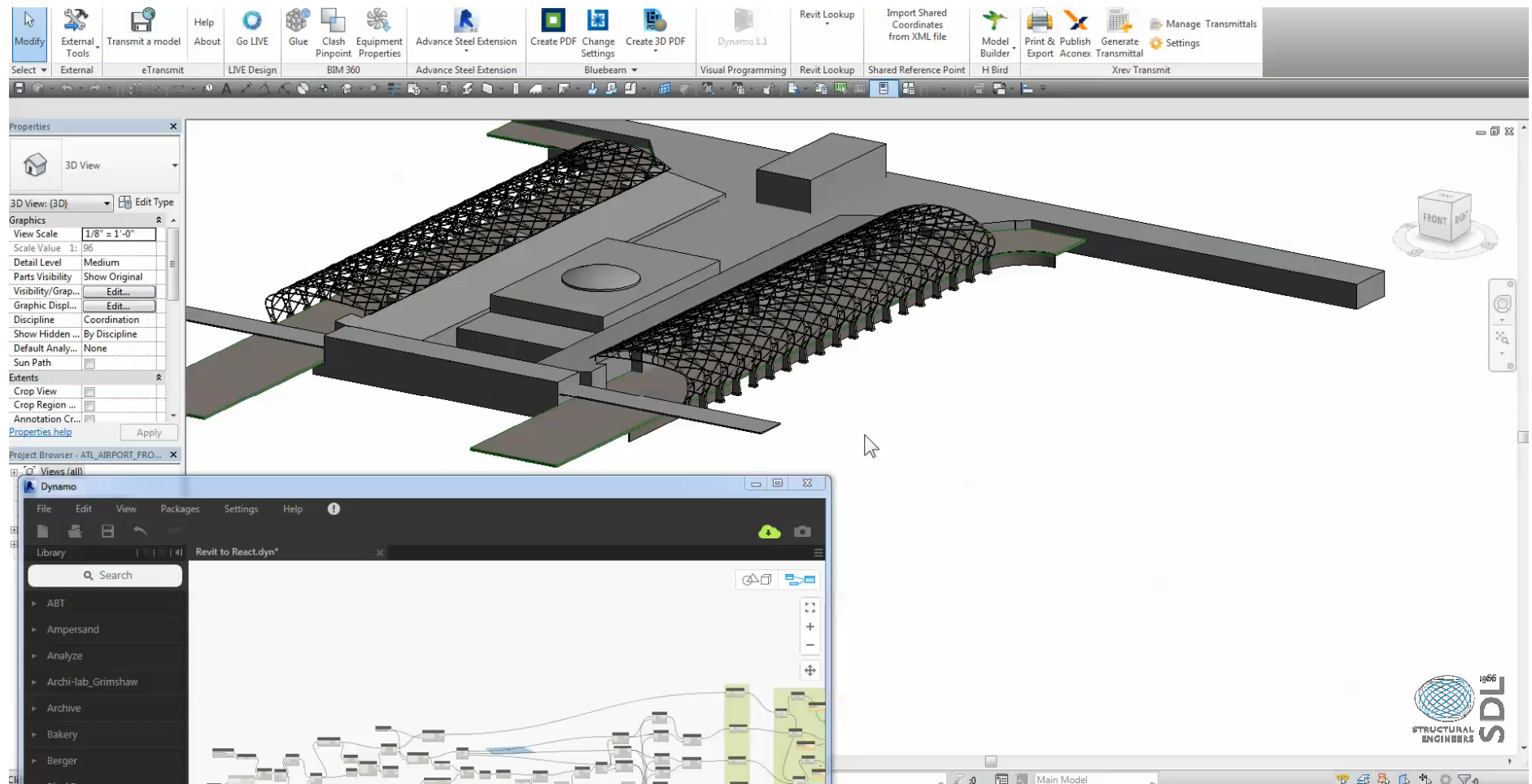


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Documentation/Analytical Model Linking

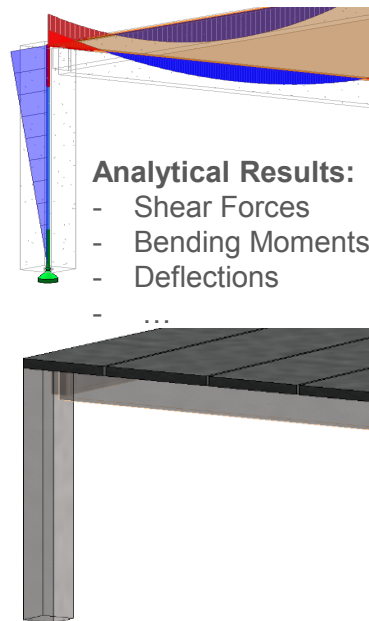


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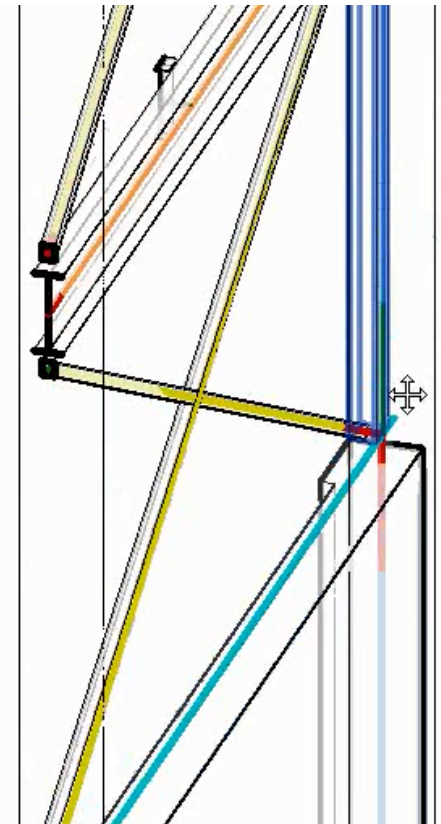
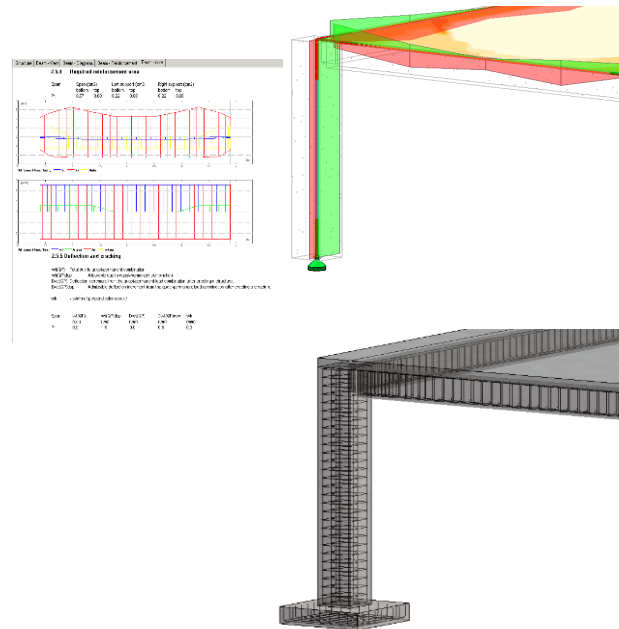
Structural Analysis and Design – Current Challenges

- Analytical vs Physical/Documenta not the same



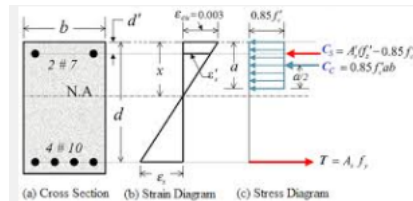
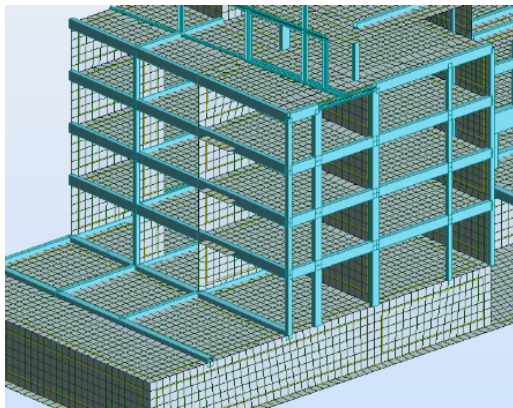
Analytical Results:

- Shear Forces
- Bending Moments
- Deflections

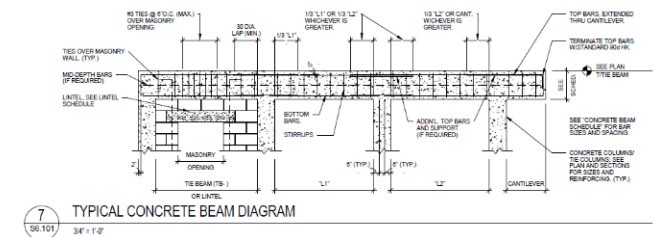
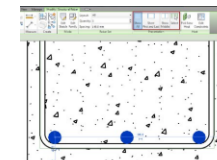


Structural Analysis and Design – Current Challenges

- Most analysis software link to BIM but...
 - Limited to geometry, material and reactions
 - Analysis results still require human “interpretation”



BAR SIZE DESIGNATION*	WEIGHT (LBS/FOOT)	BAR DIAMETER (INCHES)	CROSS-SECTION AT 12" C.C.
#3	0.376	0.375	0.11
#4	0.668	0.500	0.20
#5	1.043	0.625	0.31
#6	1.502	0.750	0.44
#7	2.044	0.875	0.60



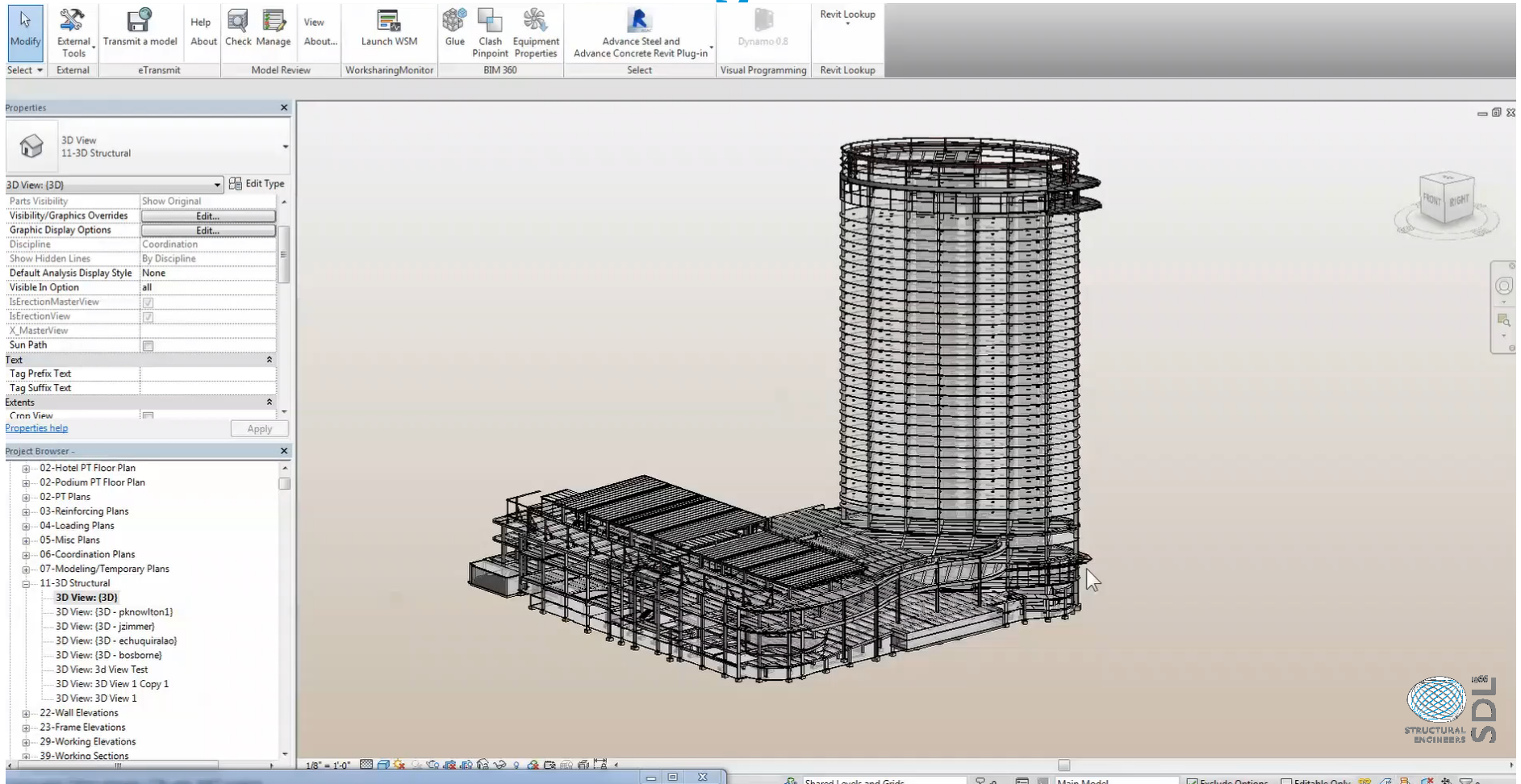
Structural Analysis and Design – Current Solutions

- Create links from Excel to Revit via Dynamo.
 - Engineers enter data into Excel
 - Dynamo connects Excel to Revit model



- Benefits:
 - Bypass the traditional drawing markups
 - Engineering decisions feed directly back into Revit

Excel Beam Reinforcing transfer to Revit Beams



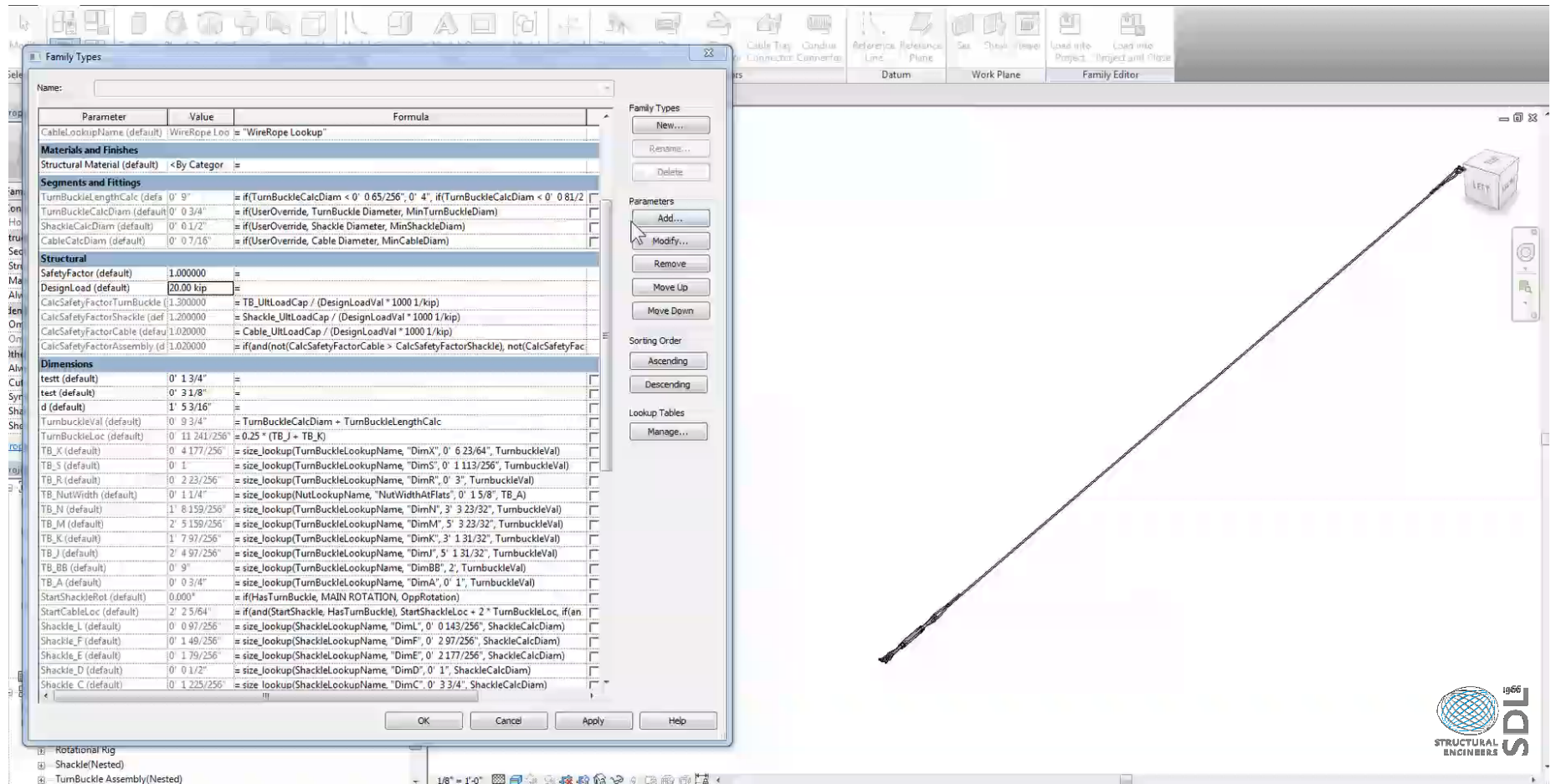
Beam Reaction Smoothing and Checking

The screenshot displays the SD-Analyzer software interface. The main window shows a 3D perspective view of a multi-story building frame structure. The left sidebar contains the 'Properties' and 'Project Browser' panels. The 'Project Browser' lists various structural components, including columns, beams, and walls. The right sidebar displays the 'Schedule: Wide Flange Beam Reaction Schedule - 215...' table.

Wide Flange Beam Reaction Schedule - 215...

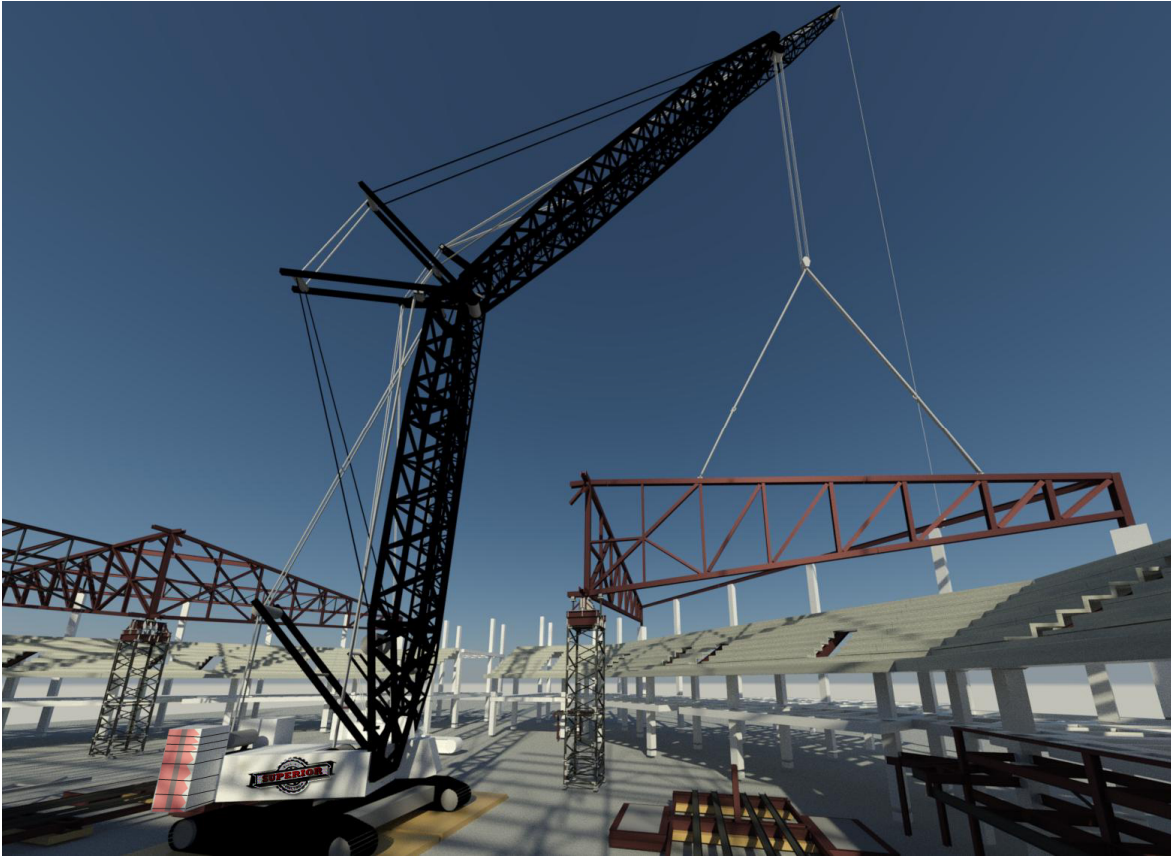
Type	Start Reaction - Tot	End Reaction - Tot	Reaction Check
W21x44	23.15 kip	30.00 kip	
W21x44	30.00 kip	20.00 kip	
W27x84	116.14 kip	130.00 kip	
W21x44	23.15 kip	30.00 kip	
W27x84	116.14 kip	130.00 kip	
W21x44	30.00 kip	20.00 kip	
W21x44	23.15 kip	30.00 kip	
W16x31	26.87 kip	30.00 kip	
W16x31	17.72 kip	30.00 kip	
W16x31	30.00 kip	30.00 kip	
W24x55	60.00 kip	50.00 kip	
W24x55	54.20 kip	65.00 kip	
W16x31	24.73 kip	30.00 kip	
W24x55	50.00 kip	60.00 kip	
W24x55	60.00 kip	65.00 kip	
W21x50	45.32 kip	50.00 kip	
W16x31	26.54 kip	30.00 kip	
W21x50	50.00 kip	50.00 kip	
W21x50	45.69 kip	50.00 kip	
W16x31	25.75 kip	30.00 kip	
W21x50	50.00 kip	50.00 kip	
W21x50	46.06 kip	50.00 kip	
W24x55	54.82 kip	65.00 kip	
W16x40	38.75 kip	35.42 kip	
W24x55	90.00 kip	68.82 kip	
W14x22	9.53 kip	9.53 kip	
W21x50	50.00 kip	50.00 kip	
W24x55	90.00 kip	71.15 kip	
W24x55	60.00 kip	65.00 kip	
W21x50	46.03 kip	50.00 kip	
W16x31	37.88 kip	40.00 kip	
W21x50	50.00 kip	50.00 kip	
W21x50	46.03 kip	50.00 kip	
W16x31	40.00 kip	30.00 kip	
W21x50	50.00 kip	50.00 kip	
W21x50	46.03 kip	50.00 kip	
W24x55	54.82 kip	65.00 kip	
W16x31	24.62 kip	40.00 kip	
W24x55	82.00 kip	90.00 kip	
W10x12	1.65 kip	1.40 kip	
W10x12	1.65 kip	1.40 kip	
W21x50	50.00 kip	50.00 kip	
W24x55	64.42 kip	65.66 kip	
W24x55	60.00 kip	65.00 kip	

Embedding Design Checks into Families



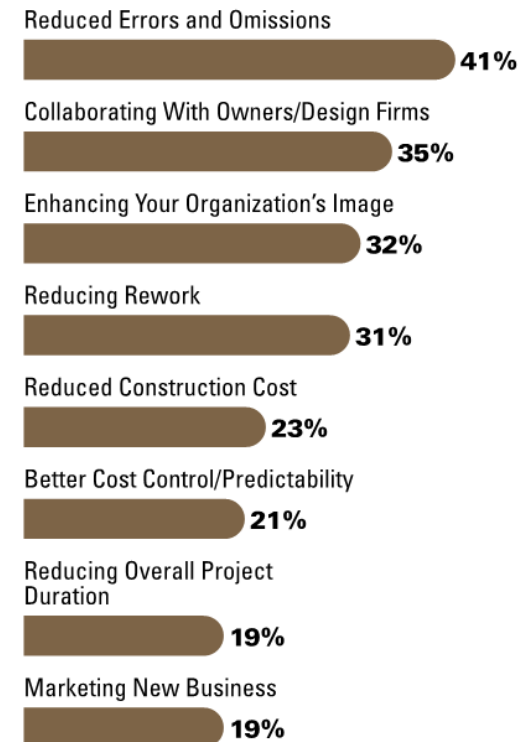
How Others Use Your BIM

Why the Contractor wants to use BIM



Contractors Citing BIM Benefit as Among Top Three for Their Company

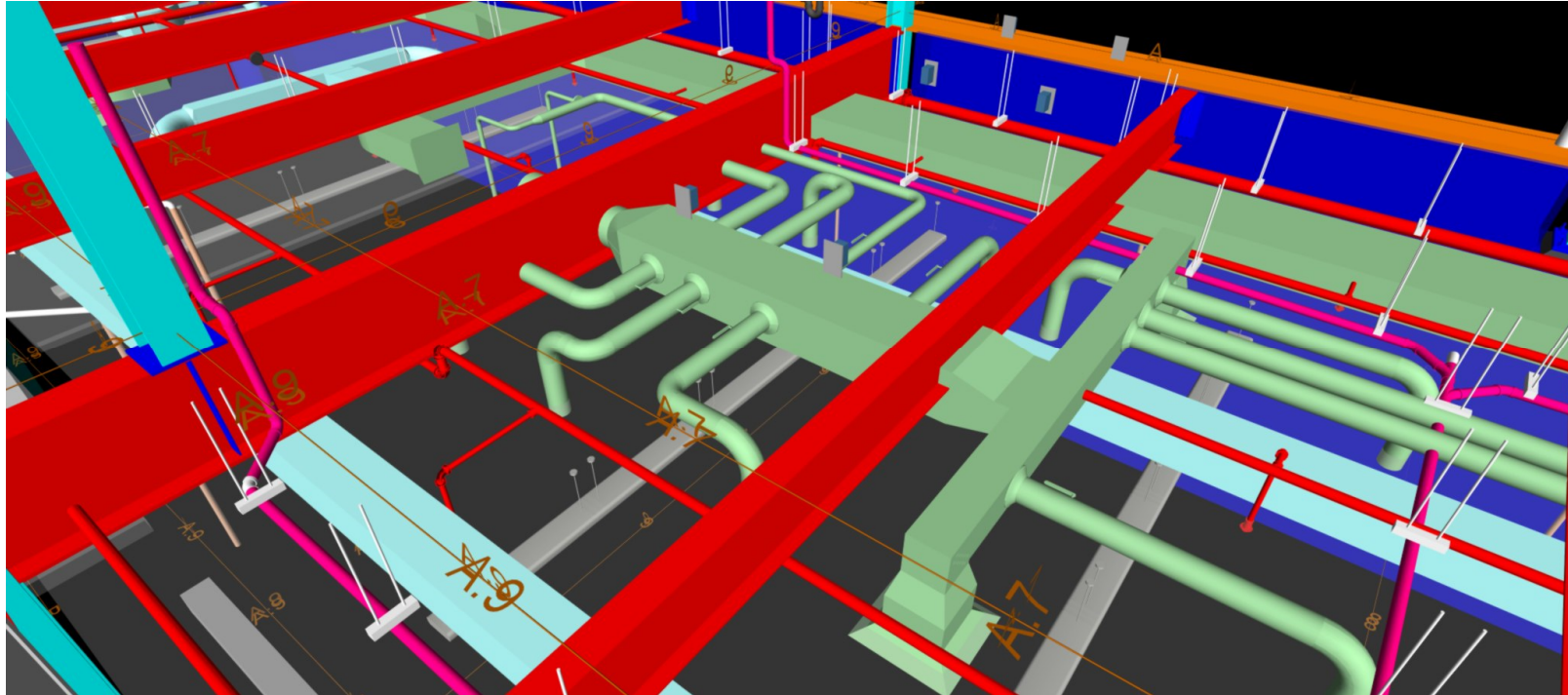
Source: McGraw Hill Construction, 2013



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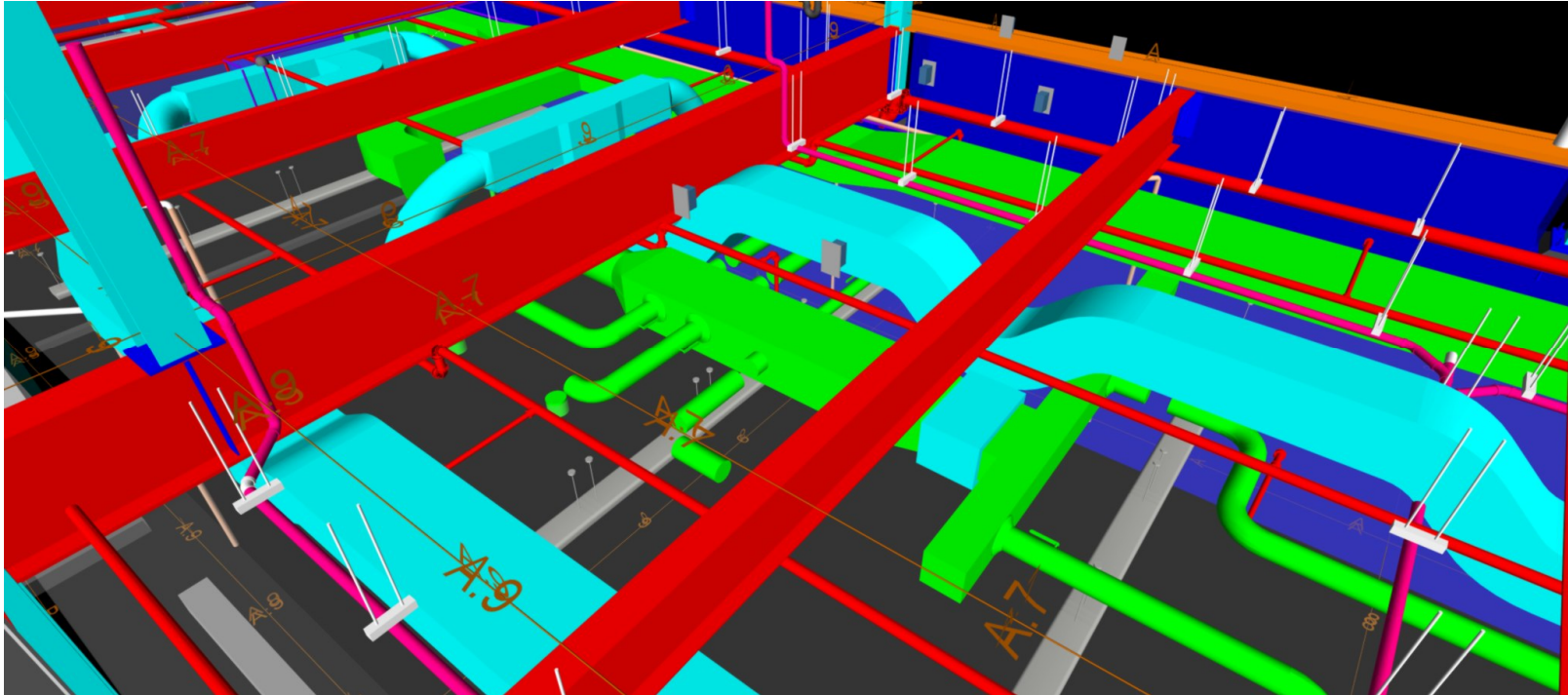


Constructability Checking



BIM does not happen in a vacuum.

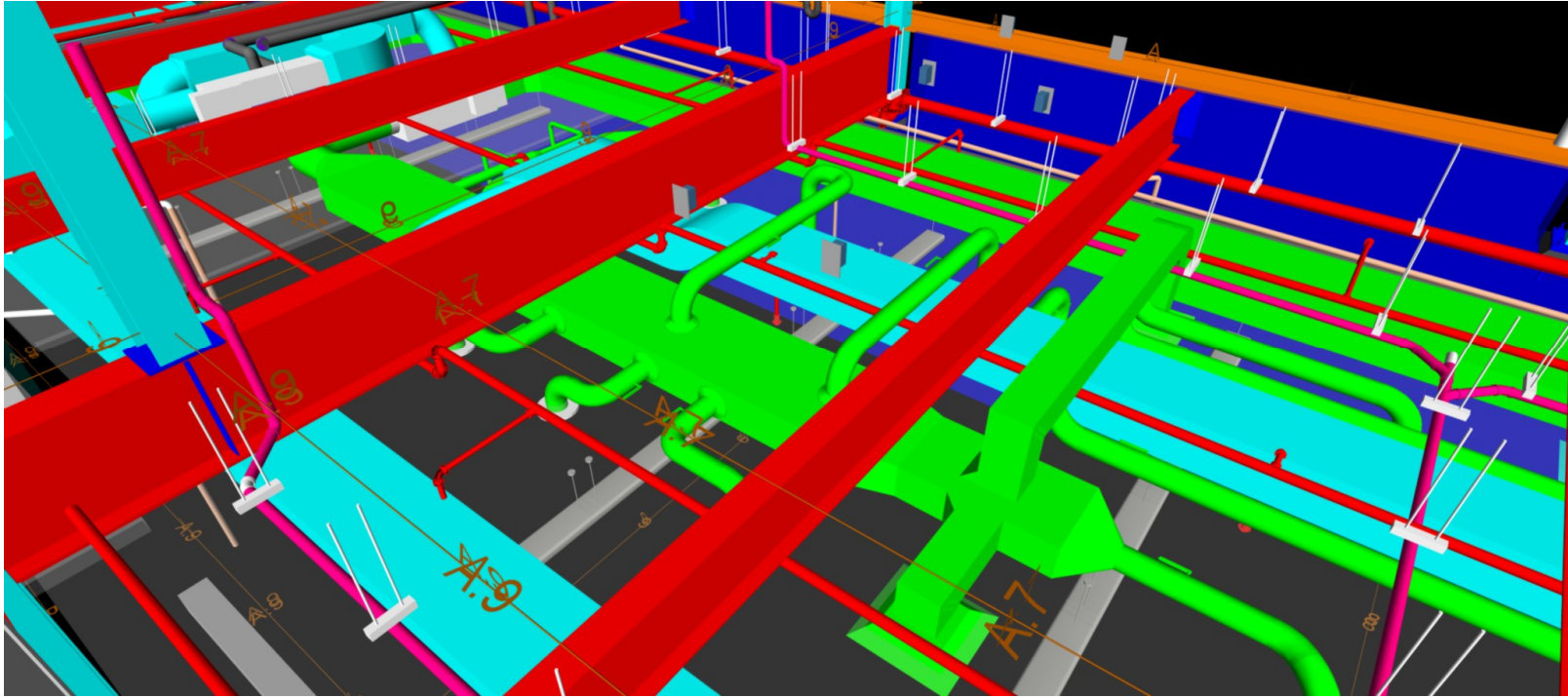
Constructability Checking



BIM does not happen in a vacuum. We must pay attention to each other as failure to coordinate can be costly and embarrassing.



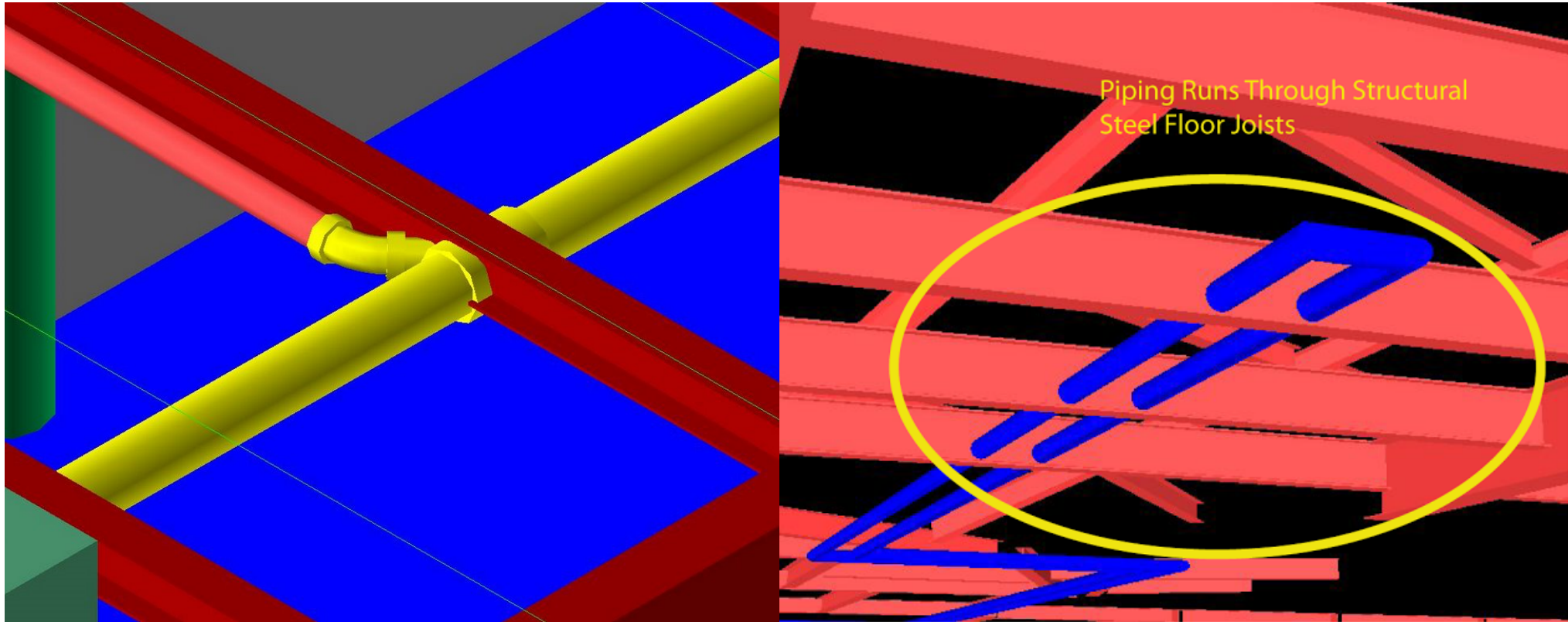
Constructability Checking



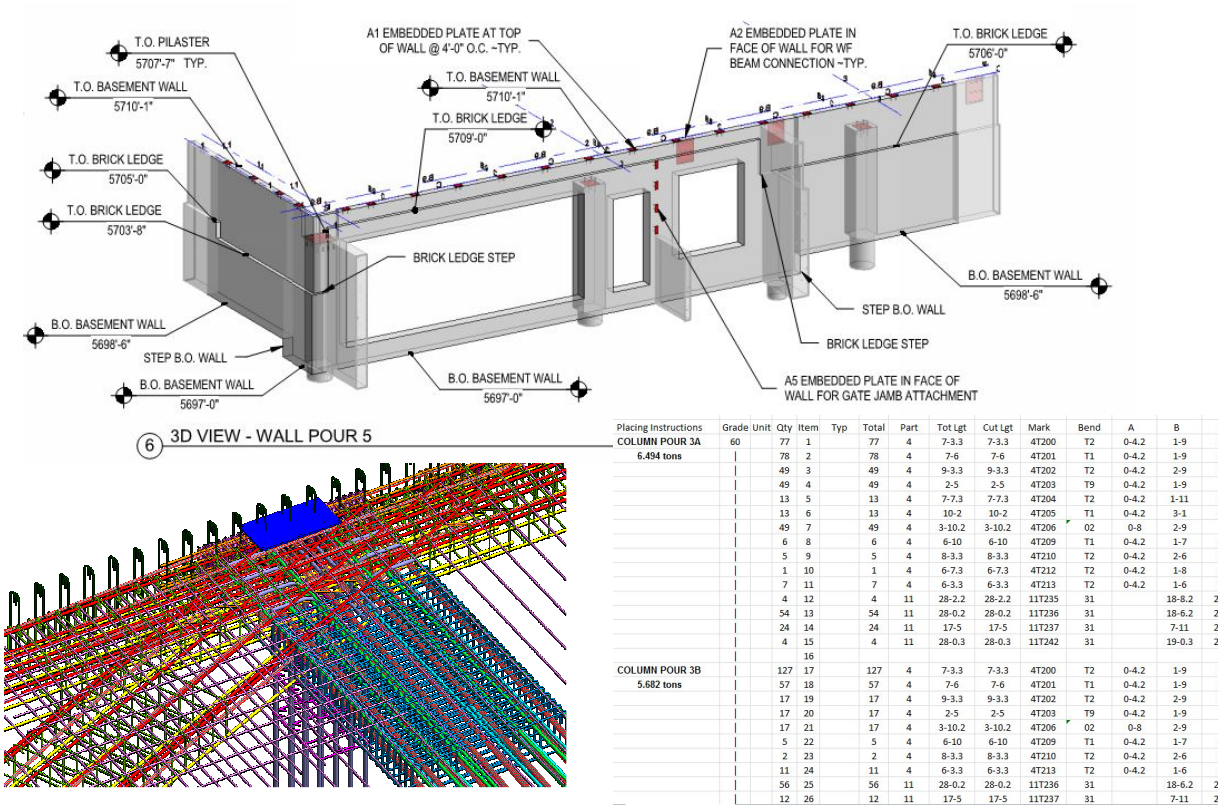
BIM does not happen in a vacuum. We must pay attention to each other as failure to coordinate can be costly and embarrassing. The Contractor will find our failures.



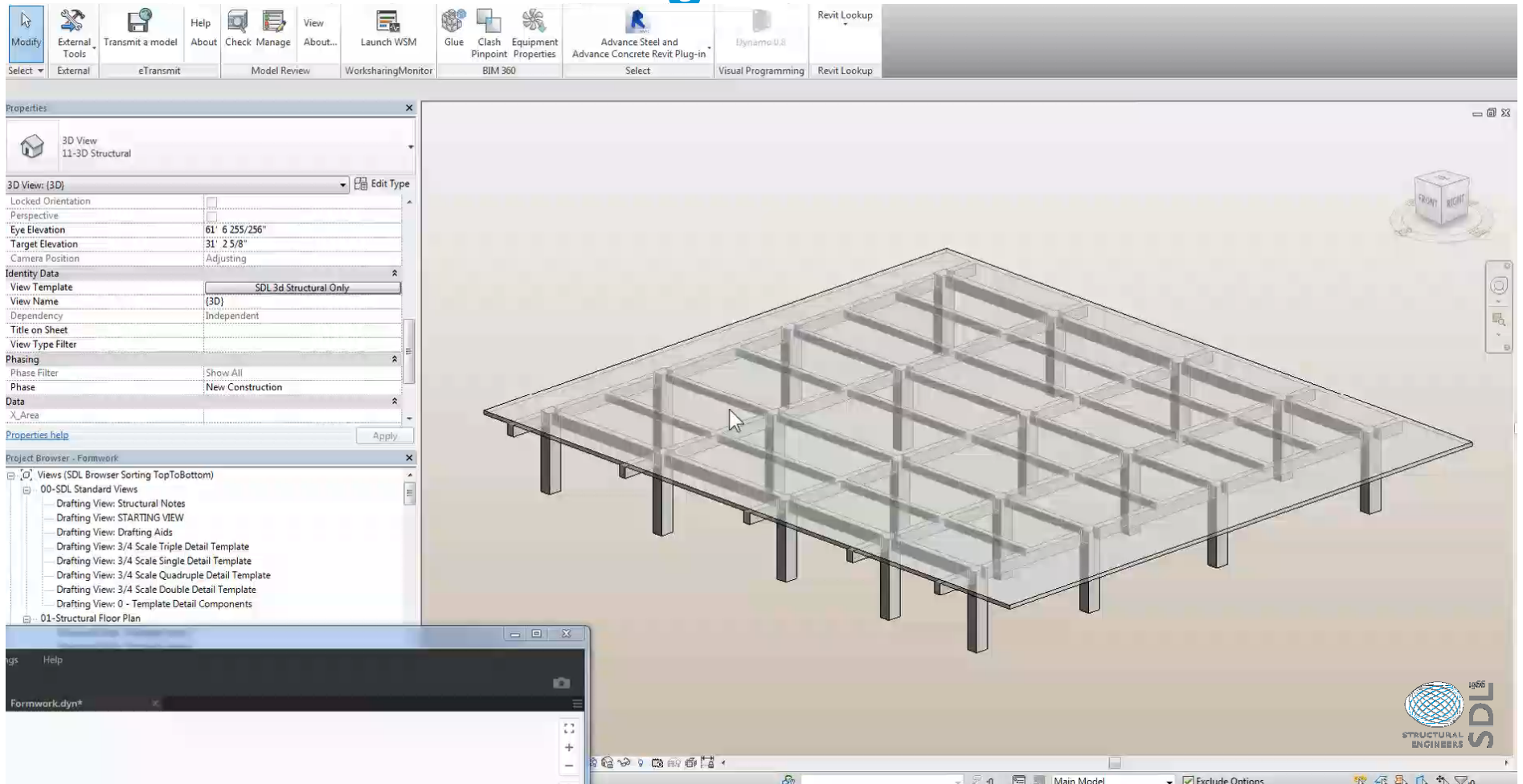
Spatial Coordination Sequencing Planning Estimation



Concrete and Reinforcement Detailing

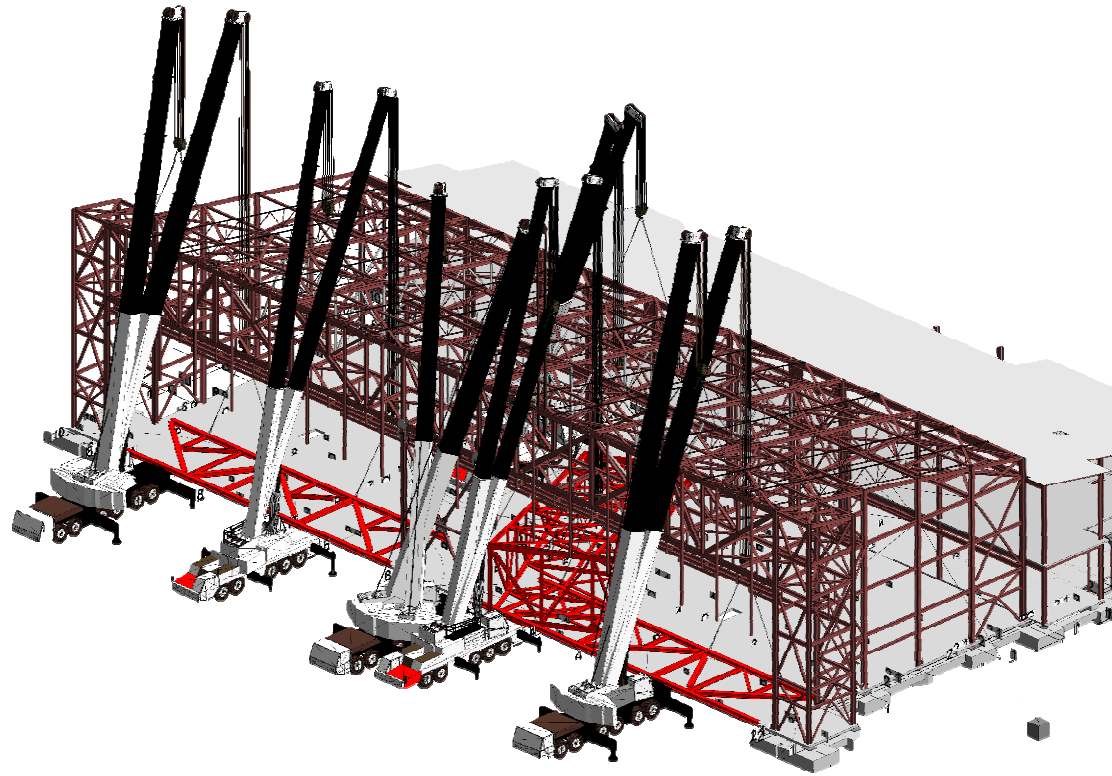
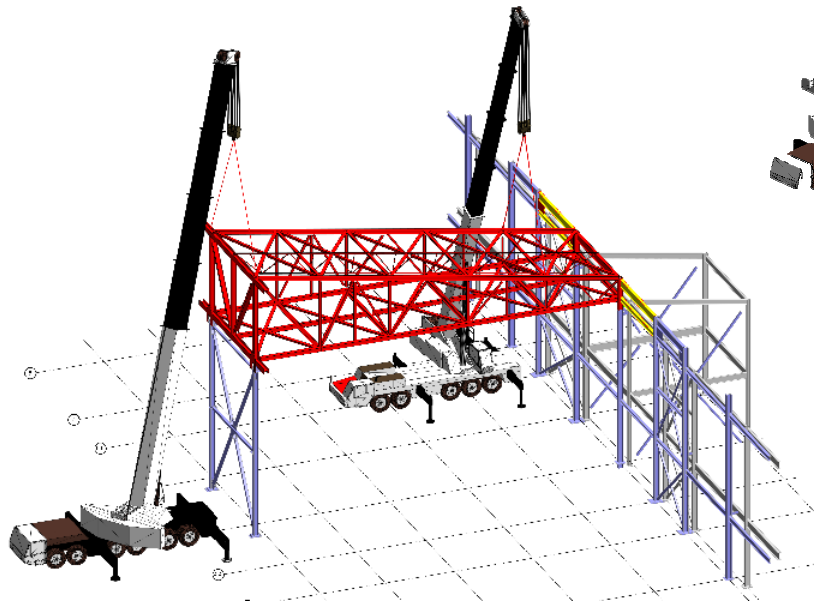


Construction Planning: Formwork Estimation



Erection Engineering

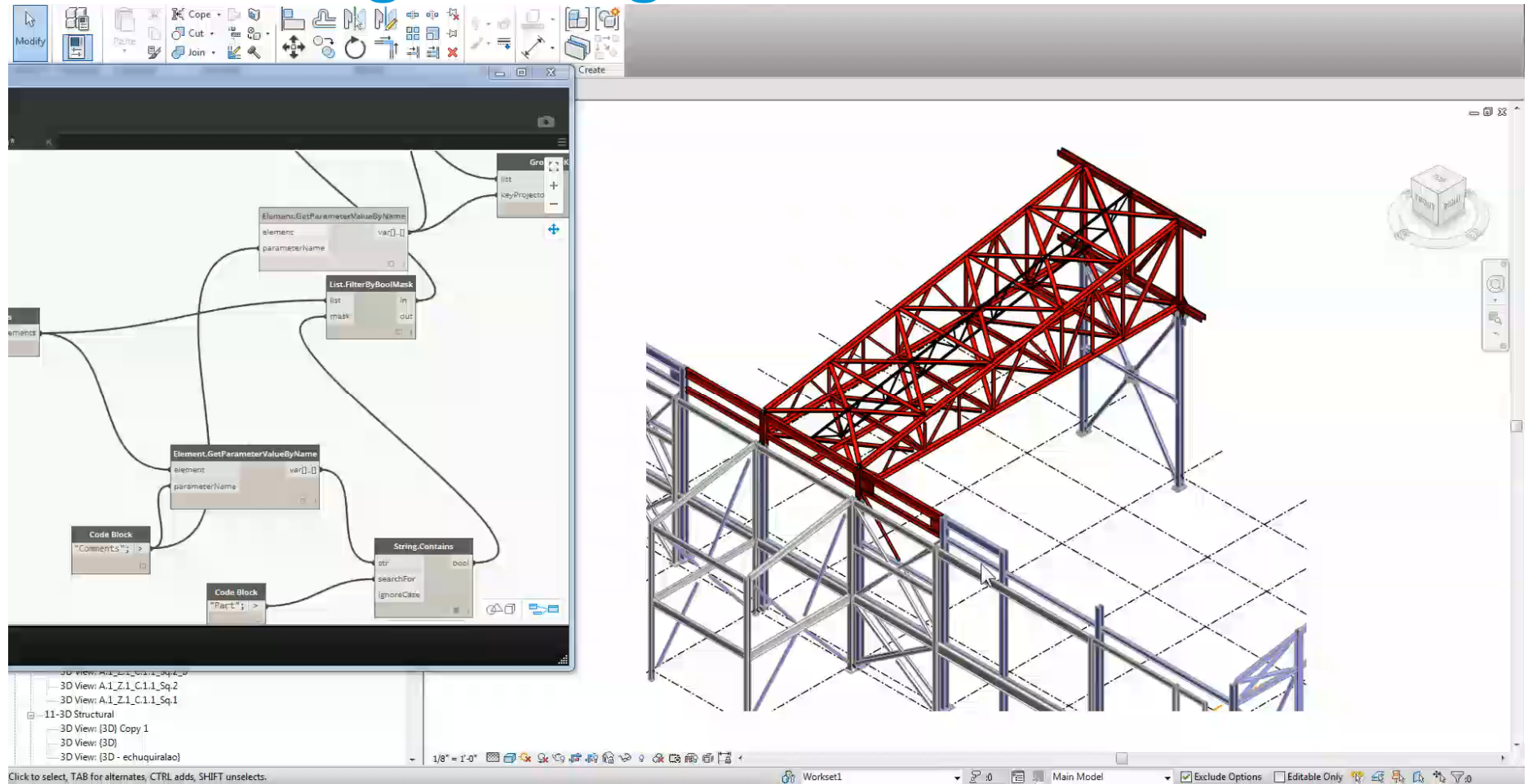
- Sequencing/Staging
- Shoring/Bracing
- Stability
- Crane Critical Lifts



Courtesy:



Erection Engineering: CG Estimation



Courtesy:
SDI
STRUCTURAL
ENGINEERS
1966



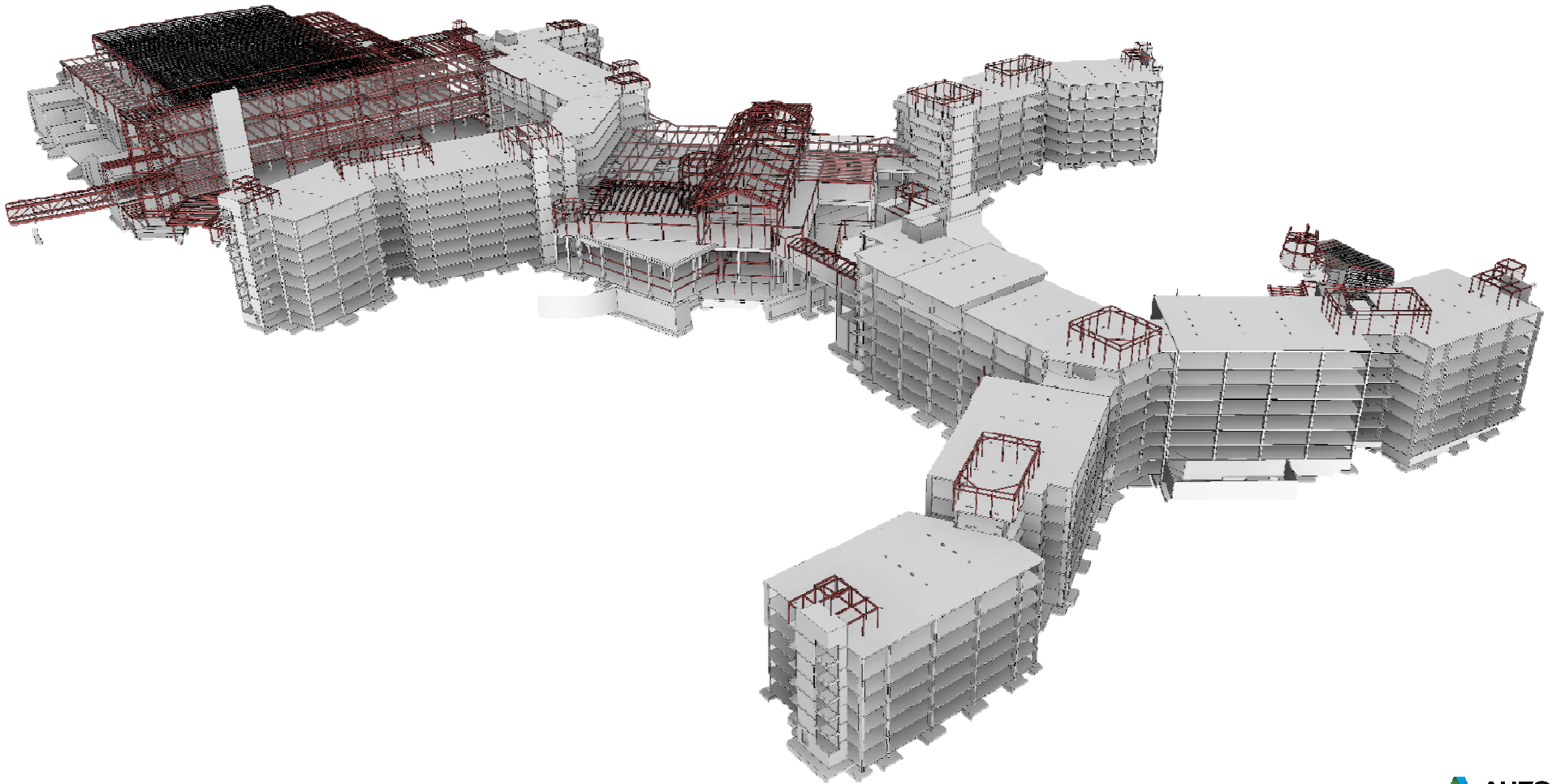
AUTODESK UNIVERSITY 2016

AUTODESK.

Your BIM Future

- Potential for new revenue streams
- Potential to be a more valuable partner to life cycle of bldg.
- Potential to differentiate yourself/firm
- Potential to become more efficient

Questions?



How did I do?

- Your class feedback is critical. Fill out a **class survey** now.
- Use the AU mobile app or fill out a class survey online.
- Give feedback after each session.
- AU speakers will get feedback in real-time.
- **Your feedback results in better classes and a better AU experience.**





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