Walk-in Slide: AU 2014 Social Media Feed

1. Click on the link below, this will open your web browser

http://aucache.autodesk.com/social/visualization.html

2. Use “Extended Display” to project the website on screen if you plan to work on your computer. Use “Duplicate” to display same image on screen and computer.

MSF 7134: Transformational Workflows in BIM to Structural Fabrication

David Bleiman

CEO of Rutherford + Chekene, Structural and Geotechnical Engineers, San Francisco CA

Class summary

- The rebar industry is highly fragmented where the design, detailing, fabrication and installation processes are not as integrated as with other trades such as the structural steel industry. In this presentation, structural engineers and detailers will learn how the industry can transform itself to design and deliver reinforced concrete structures with greater savings and quality to the owner by engaging structural engineers as the bridge between design, fabrication and construction.

Key learning objectives

At the end of this class, you will be understand:

- What BIM to Fabrication means for the concrete industry
- How BIM to Fabrication for rebar creates value
- Tools available for creating content
- Business models for BIM to Fabrication

State of the Industry

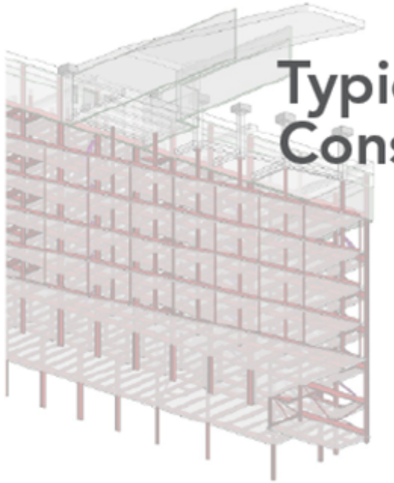
BIM to Fabrication Workflow Roadmap

Complex
Organic
Geometries

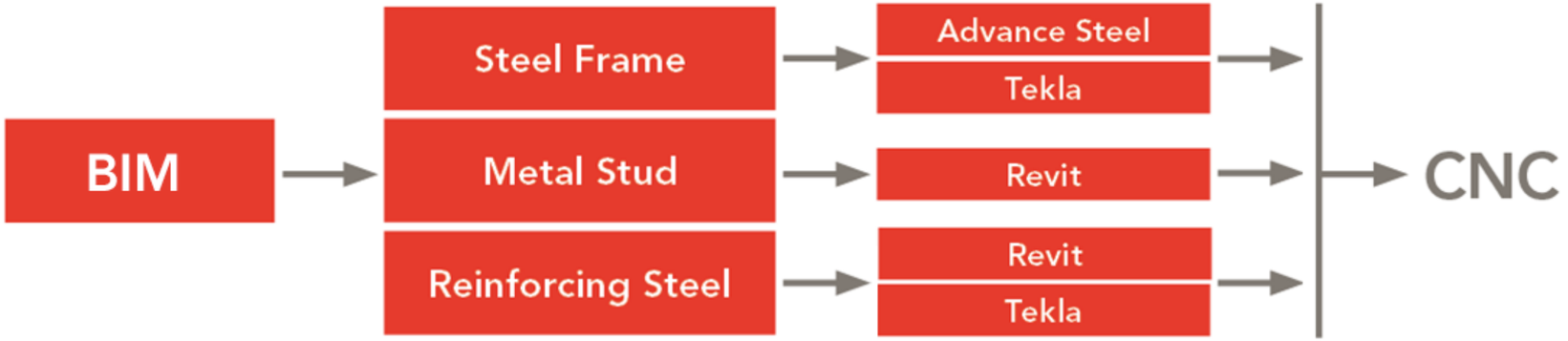
Design	Geometry	Analysis	
Grasshopper	Rhino	Strand 7	CNC
Dynamo	Revit	Robot	

State of the Industry

BIM to Fabrication Workflow Roadmap

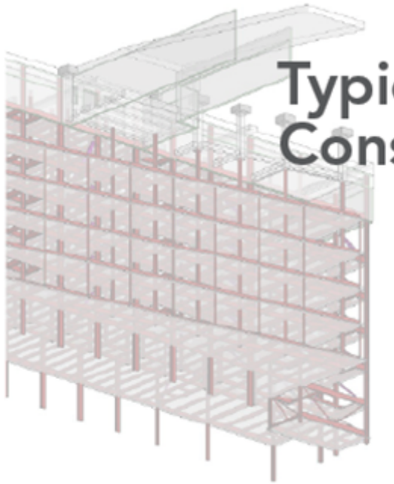


Typical Construction

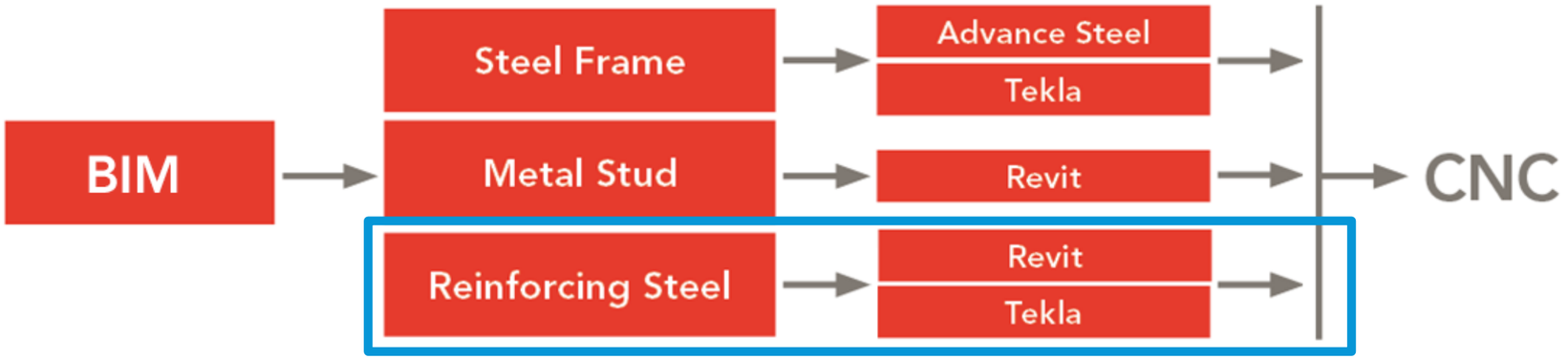


State of the Industry

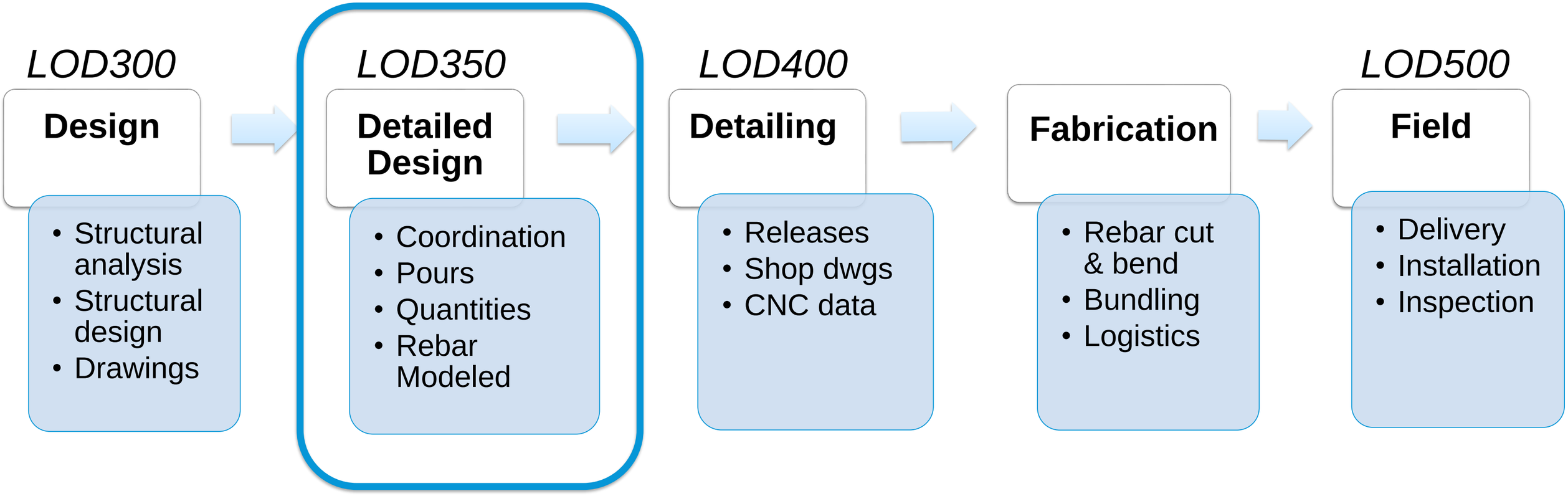
BIM to Fabrication Workflow Roadmap



Typical Construction



Concrete workflows



Agenda for Presentation

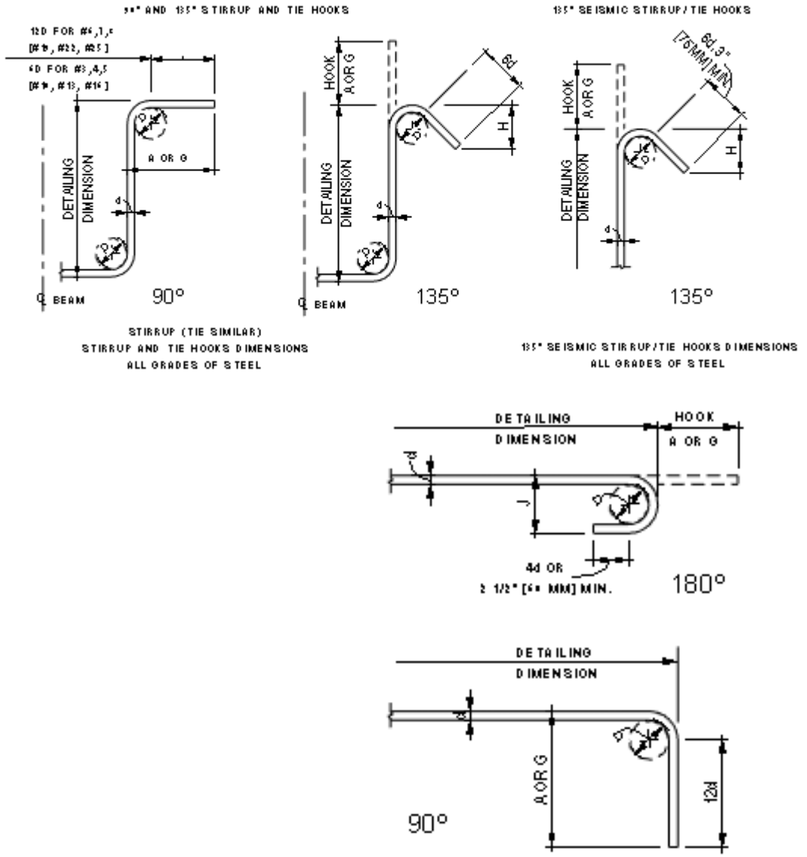
1) BIM to Fabrication Defined
2) Value of BIM to Fabrication
3) Tools for Modeling Rebar
4) Implementation by Delivery Methods

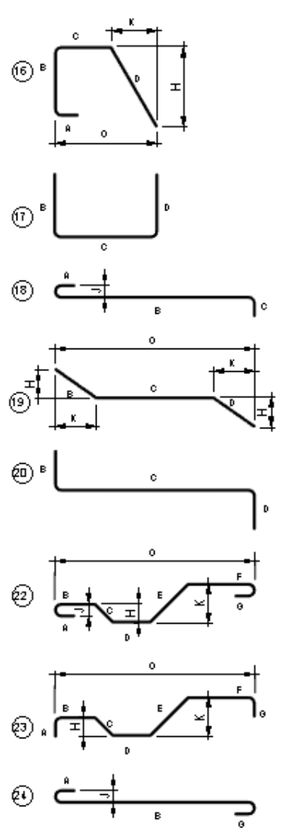
1) BIM to Fabrication Defined

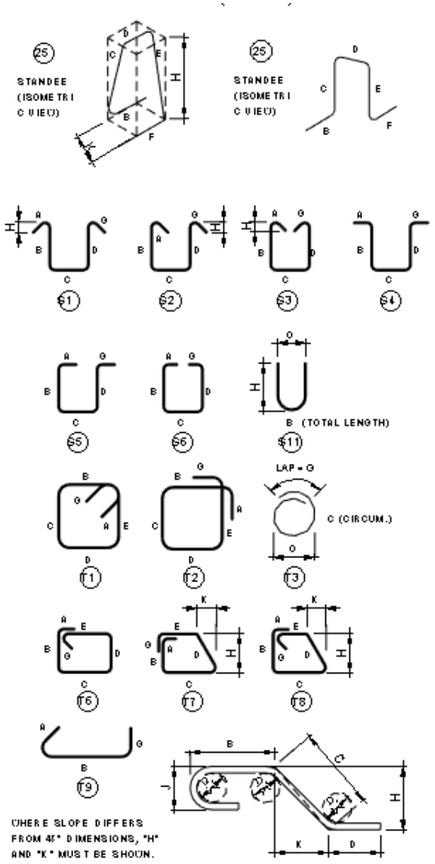
BIM to Fabrication Defined

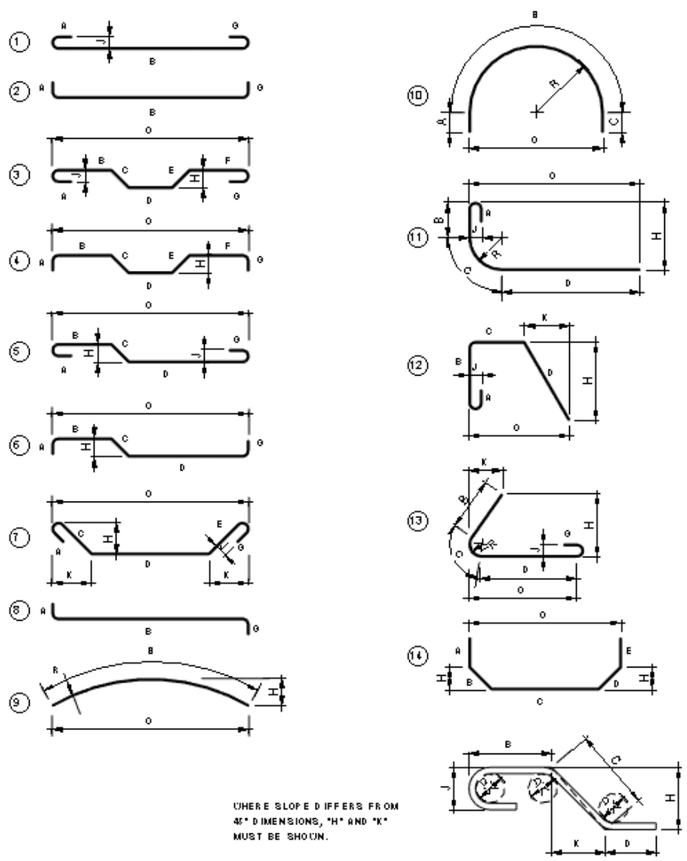
- Rebar is modeled with families that have parameters needed for fabrication:

ACI STANDARD BAR DEFINITIONS



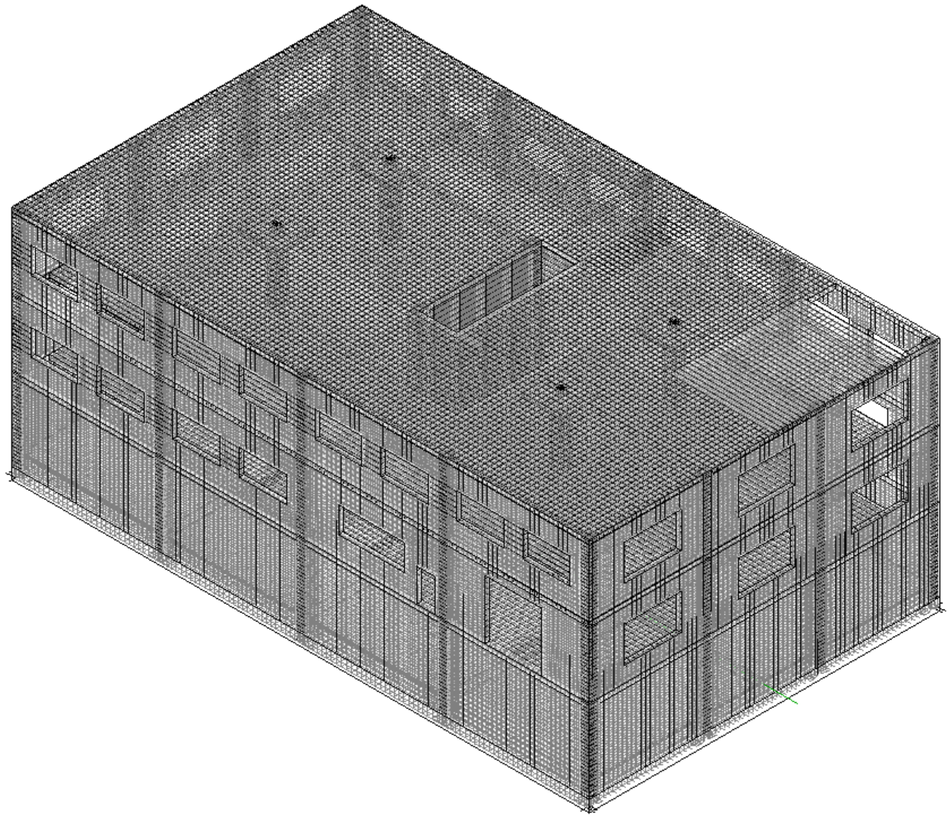


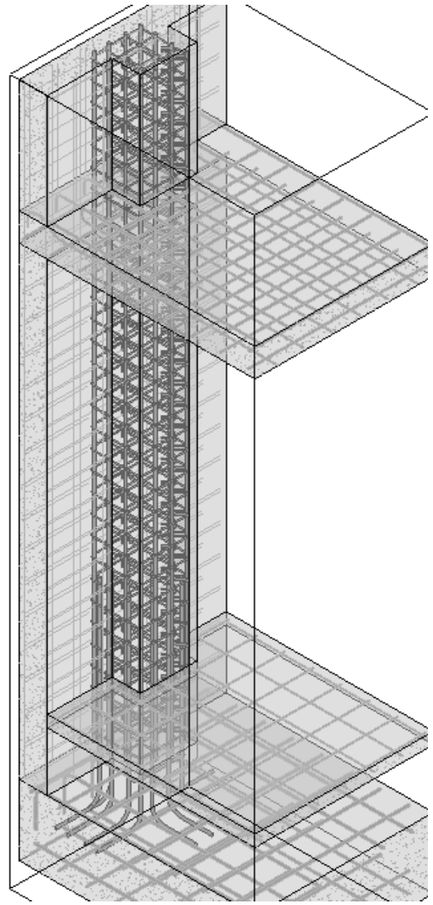

STANDEE (ISOMETRIC VIEW)
STANDEE (ISOMETRIC VIEW)
B (TOTAL LENGTH)
LAP = G
C (CIRCUM.)
WHERE SLOPE DIFFERS FROM 45° DIMENSIONS, "H" AND "K" MUST BE SHOWN.

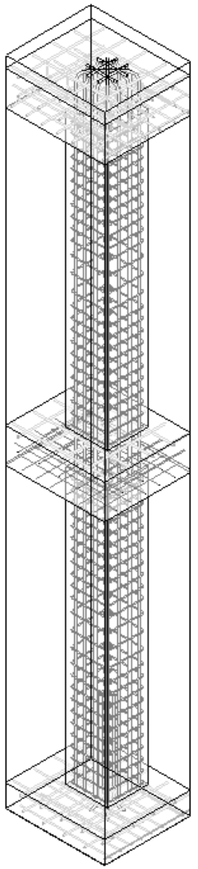

WHERE SLOPE DIFFERS FROM 45° DIMENSIONS, "H" AND "K" MUST BE SHOWN.

BIM to Fabrication Defined

- Models are dimensionally accurate and *essential* rebar in project is modeled







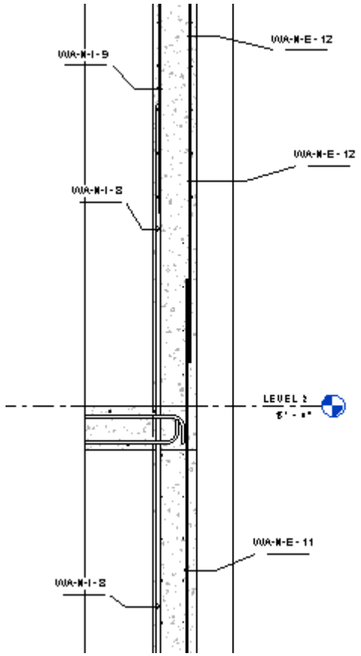
1) BIM to Fabrication Defined

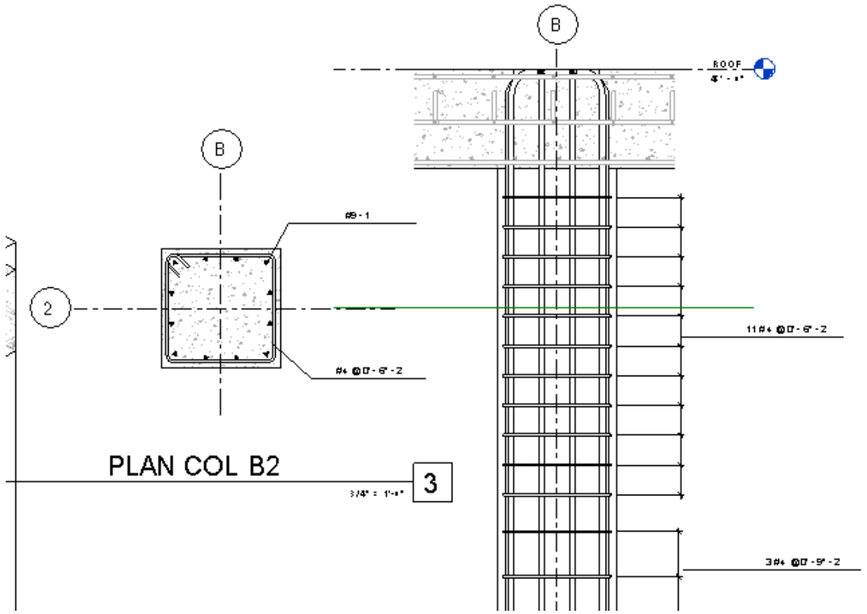
- Models are constructed based on standard construction sequences
  - Construction Joints and Pour Sequences are realistic to standard of practice

1) BIM to Fabrication Defined

- Rebar fabrication schedules can be exported as data to drive fabrication

Partition	Rebar Numb	Type	Pour Mark	Bar Length	Shape	Count	Spacing	Quantity	Hook At End	Hook At Start	A	B	C	D	E
COL-L2-B2	1	#9	19 - Interior C	31' - 4"	Standard - 2	12		1	Standard Hook - 90 deg.	None	0' - 0"	30' - 0"	0' - 0"	0' - 0"	0' - 0"
COL-L2-B2	2	#4	19 - Interior C	7' - 10"	Stirrup - T1	4	0' - 6"	11	Stirrup/Tie - 135 deg.	Stirrup/Tie - 135 deg.	0' - 0"	1' - 10"	1' - 10"	1' - 10"	1' - 10"
COL-L2-B2	2	#4	19 - Interior C	7' - 10"	Stirrup - T1	2	0' - 9"	3	Stirrup/Tie - 135 deg.	Stirrup/Tie - 135 deg.	0' - 0"	1' - 10"	1' - 10"	1' - 10"	1' - 10"





2) Value of BIM to Fabrication

2) Value of BIM to Fabrication
Current Practice

- Challenges in Construction Documents
  - Uncertainty quantities
  - Missing details
  - Change Orders

2) Value of BIM to Fabrication
Current Practice

- Bar placement sequences are not resolved prior to work in field
  - Unresolved congestion result in
    - RFIs
    - Field delays
    - Poor quality pours

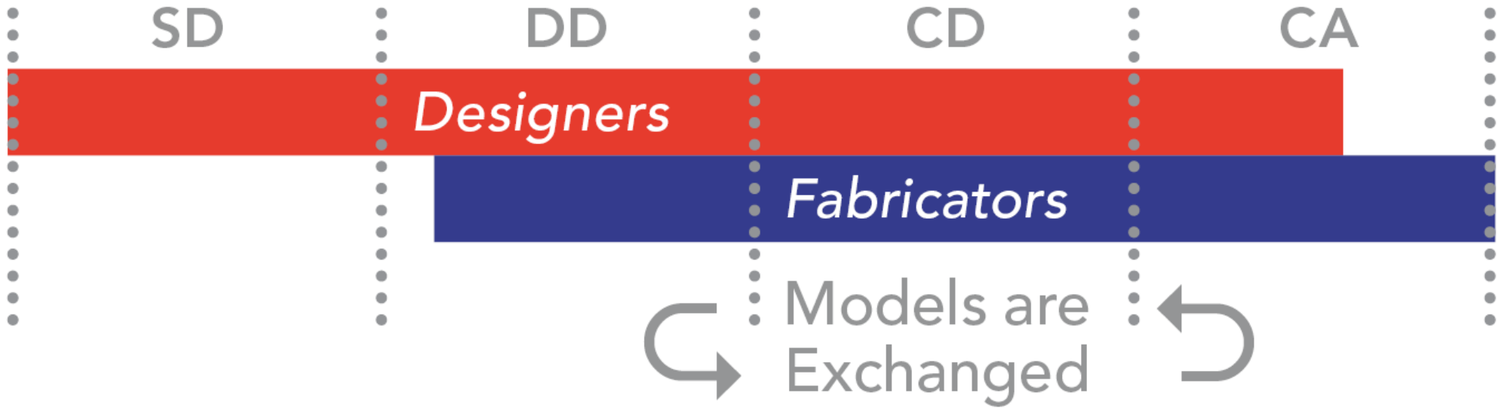
2) Value of BIM to Fabrication
Current Practice

- Designs are duplicated in creation of shop drawings
  - Duplication of efforts is inherently wasteful
  - Time is lost when third parties interpreting construction documents

Lean Principles of Waste

2) Value of BIM to Fabrication
Modeling Rebar in Design

BIM to Fabrication : Benefits



Current State

- Models by designers come with "buyer beware" label
  → *unreliable exchanges*
- Design models only provide drawings
  → *duplication of models*

Future with BIM to Fabrication

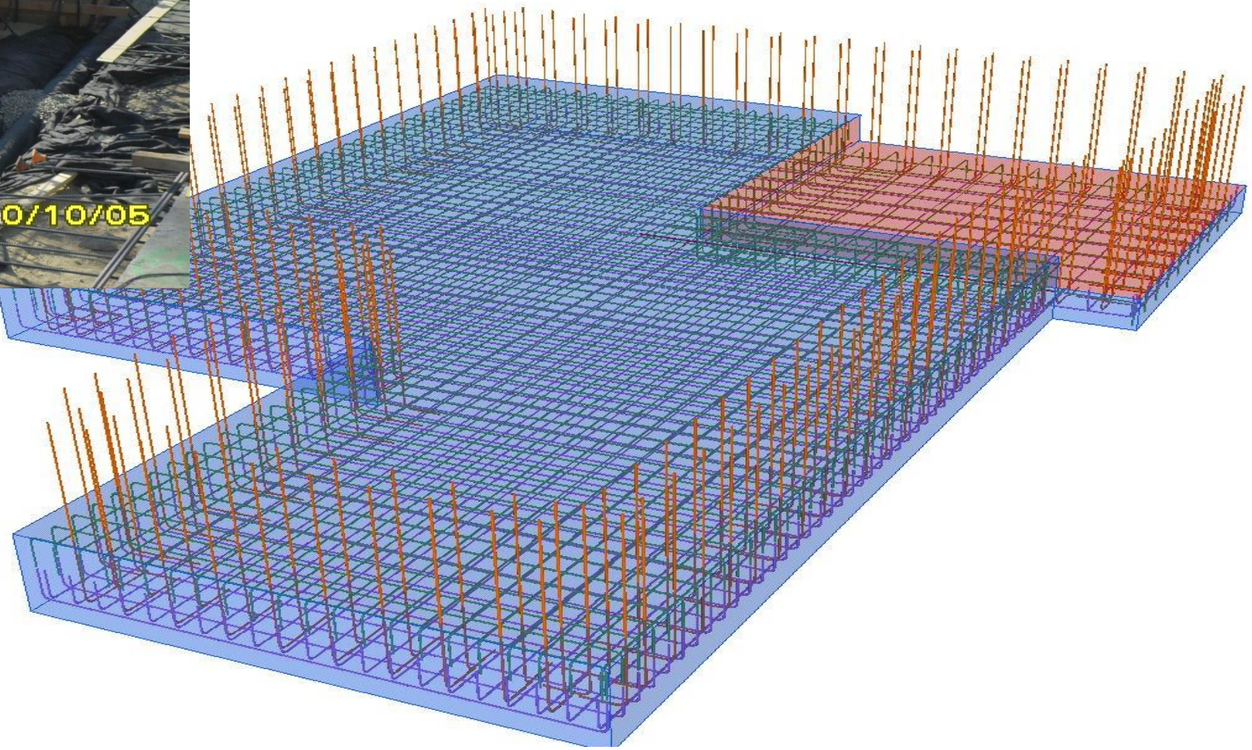
- Models by designers are created to flow directly to fabricator
  → *reliable exchanges*
- Design models provide drawings + fabrication
  → *lean exchanges, reduced waste*

2) Value of BIM to Fabrication
Modeling Rebar in Design

- Estimating is More Accurate
- Able to Explore Design Options Early in Project
- Tighter Bids Reduce Construction Budget
- Construction Goes as Planned

2) Value of BIM to Fabrication

Modeling Rebar in Design: Tighter Bids



REBAR QUANTITY TAKEOFF

Project Number:	PROJ:#				**Date:**	11/19/2012
Project Name:	PROJ:NAME				**Time:**	03:39:24pm

Qty	Name	Size	Grade	Shape	Length	Weight (lbs)
1	REBAR	#4	A615-60	STR	11'-9"	8
1	REBAR	#4	A615-60	STR	10'-2 1/2"	7
2	REBAR	#5	A615-60	2	11'-4 3/16"	24
44	REBAR	#5	A615-60	2	21'-2 13/16	974
42	REBAR	#5	A615-60	2	11'-8 11/16	513
36	REBAR	#5	A615-60	2	22'-5 3/16"	842
3	REBAR	#5	A615-60	2	32'-8 15/16	102
10	REBAR	#5	A615-60	STR	11'-9"	123
21	REBAR	#5	A615-60	TS2_1	21'-9 15/16	478
10	REBAR	#5	A615-60	TS2_1	11'-11 11/1	125
210	REBAR	#5	A615-60	TS2_1	5'-2 3/4"	1145
9	REBAR	#5	A615-60	TS2_1	12'-1 3/4"	114
20	REBAR	#5	A615-60	TS2_1	12'-8 1/16"	264
18	REBAR	#5	A615-60	Unkno	24'-9 7/16"	465
20	REBAR	#5	A615-60	Unkno	14'-11 3/8"	312
447				**Total**	**Weight**	5496.6

2) Value of BIM to Fabrication

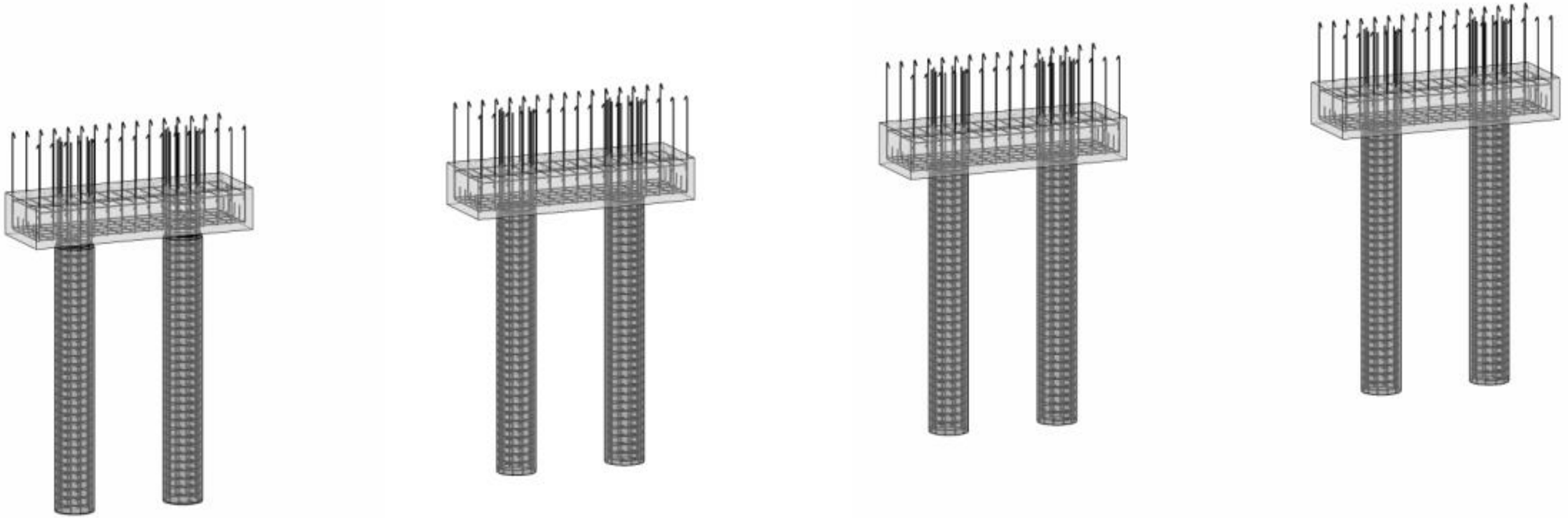
Two Case Studies

Construction Sequencing

Grades of Reinforcement

Case Study

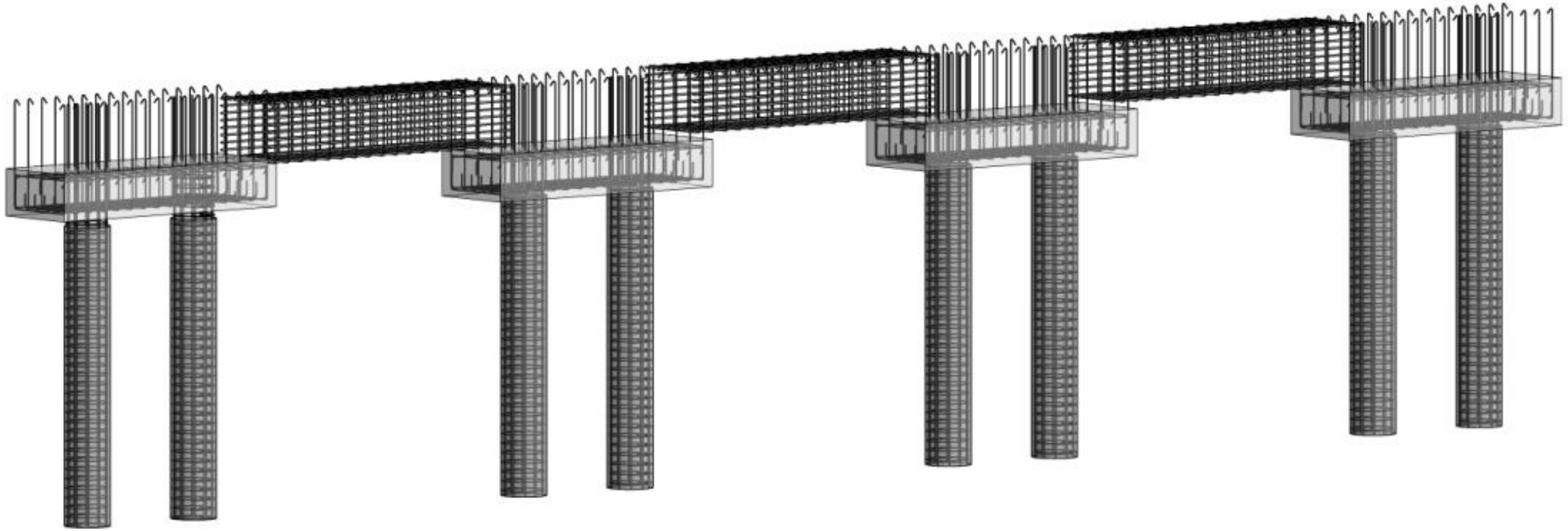
Construction Sequencing – Rebar in Grade Beams



1st Construction Sequence | Install Piles and Pile Caps with Dowels

Case Study

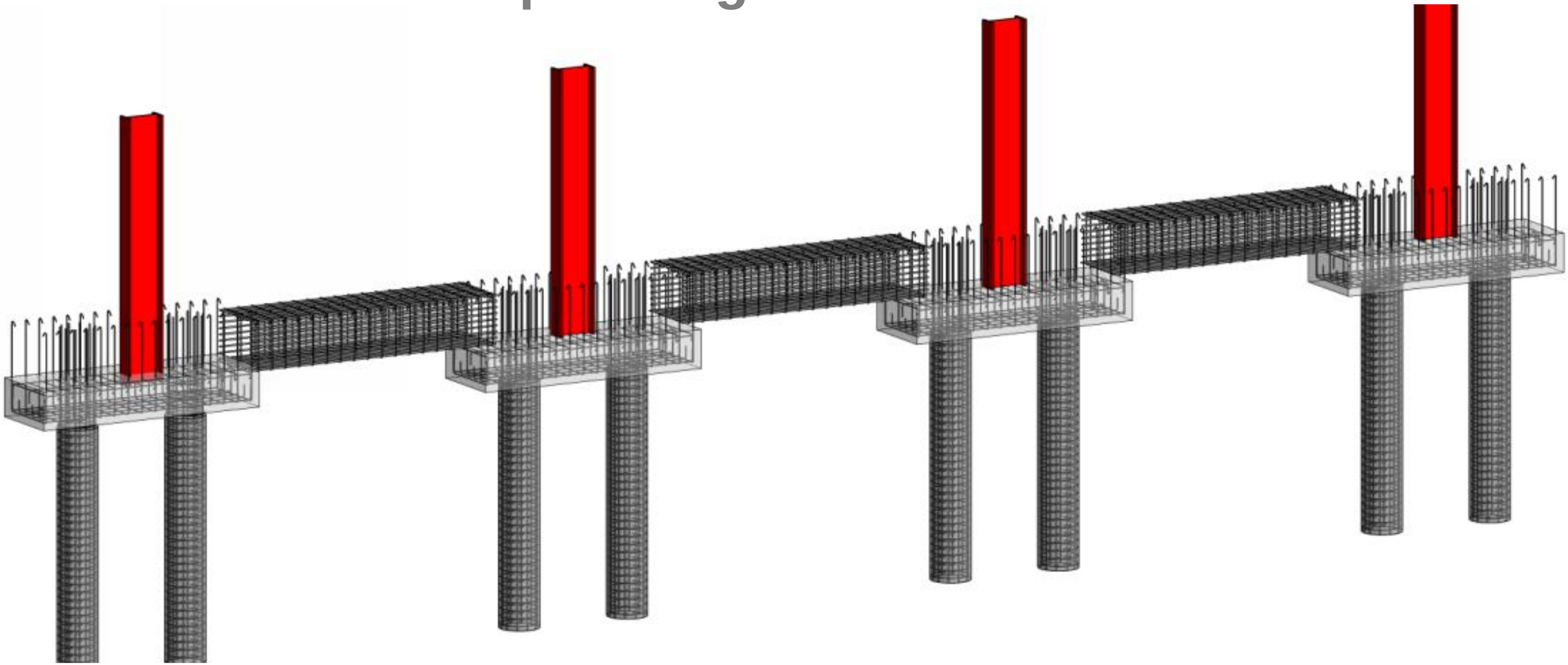
Construction Sequencing – Rebar in Grade Beams



2nd Construction Sequence | Set Infill Grade Beam Rebar

Case Study

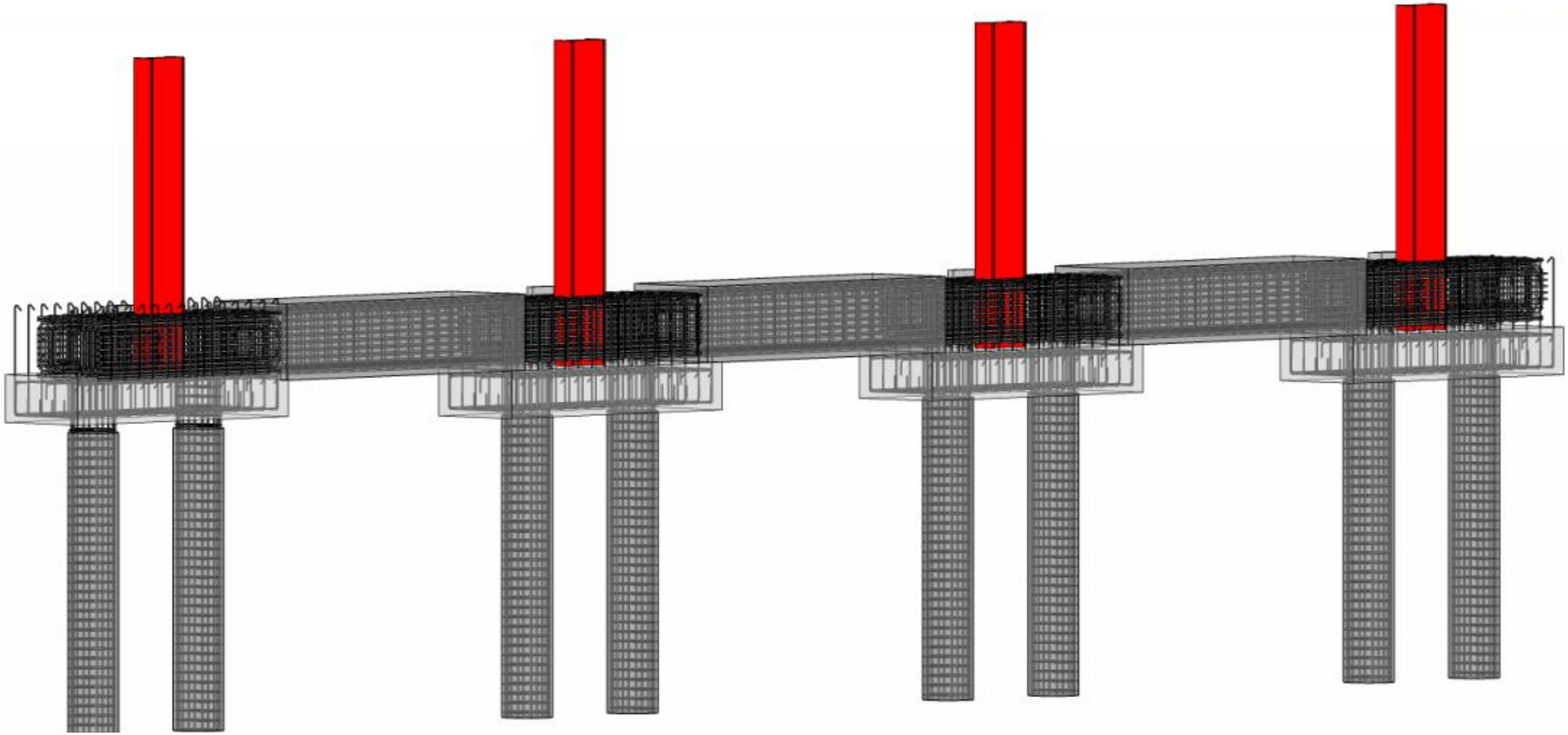
Construction Sequencing – Rebar in Grade Beams



3rd Construction Sequence | Erect Steel Columns

Case Study

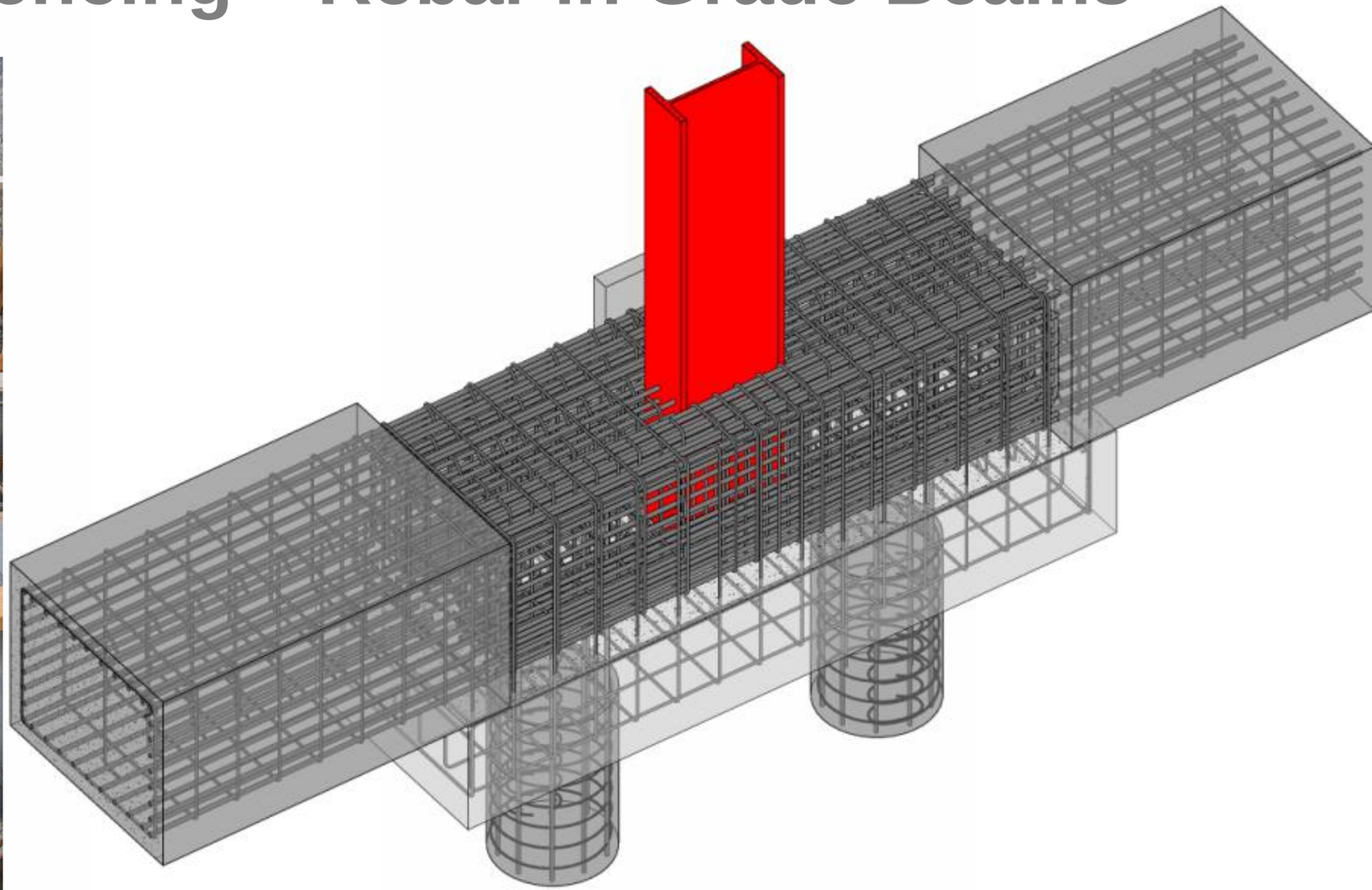
Construction Sequencing – Rebar in Grade Beams



4th Construction Sequence | Install Rebar Above Pile Caps

Case Study

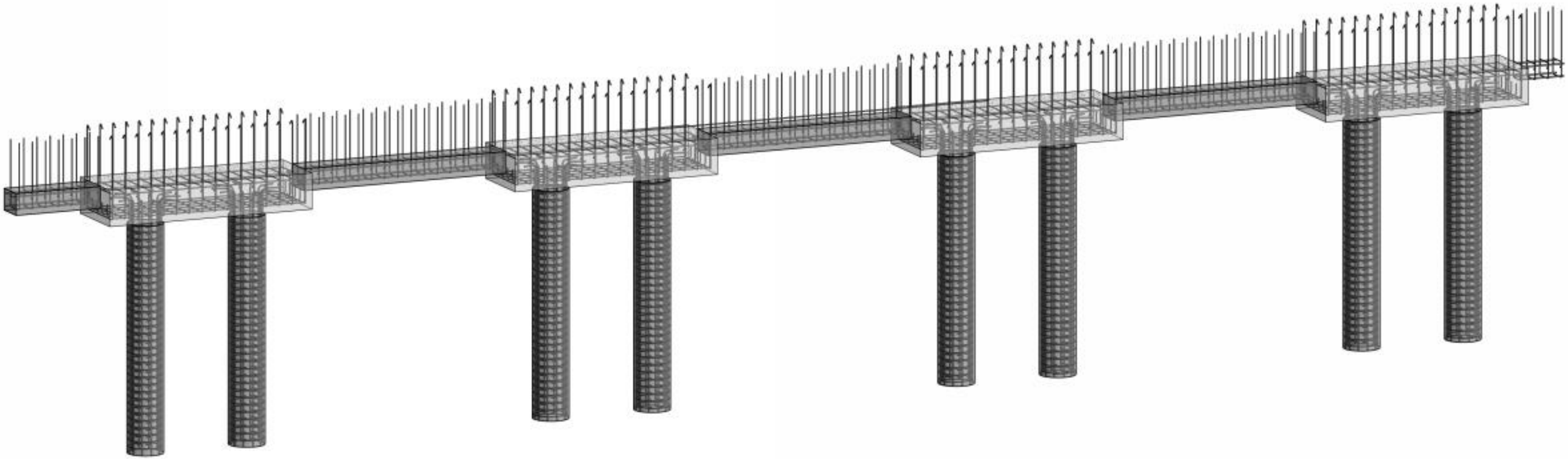
Construction Sequencing – Rebar in Grade Beams



Enlarged View | Column with All Rebar Set

Case Study

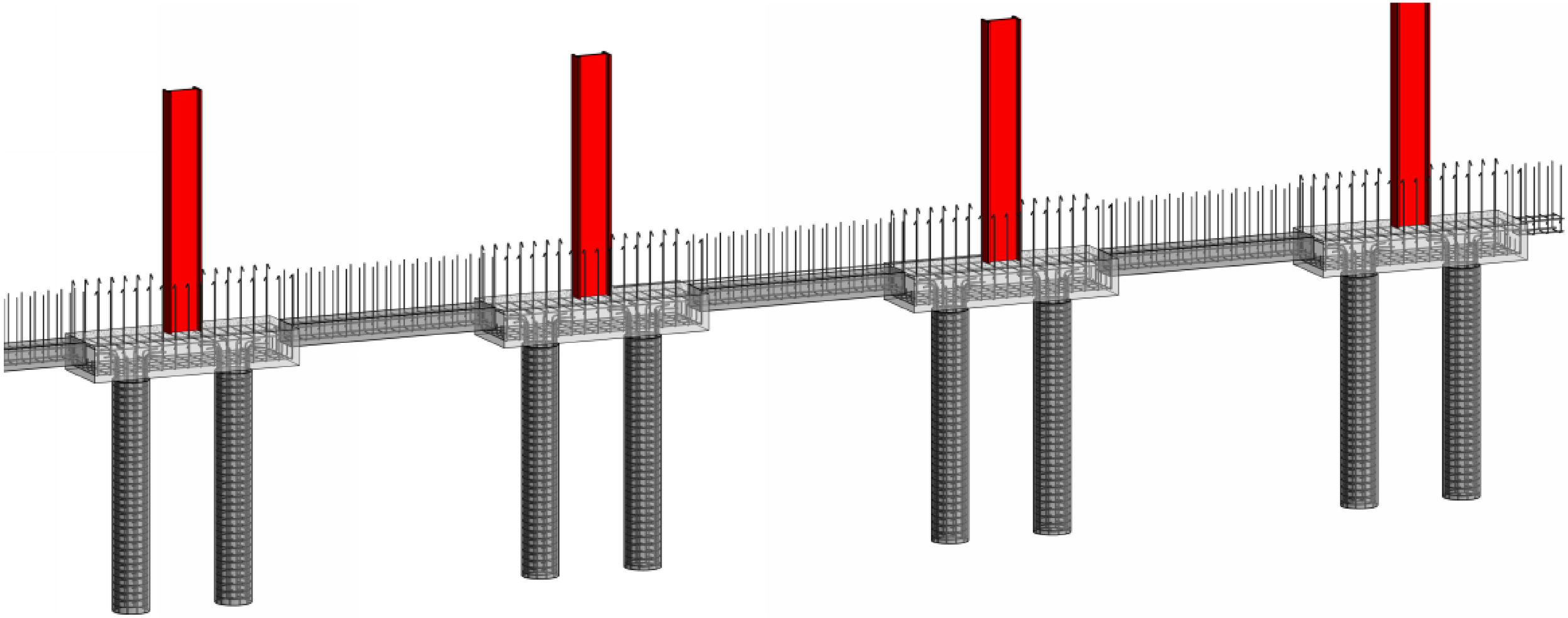
Construction Sequencing – WF in Grade Beams



1st Construction Sequence | Install Pile Caps and Grade Beams

Case Study

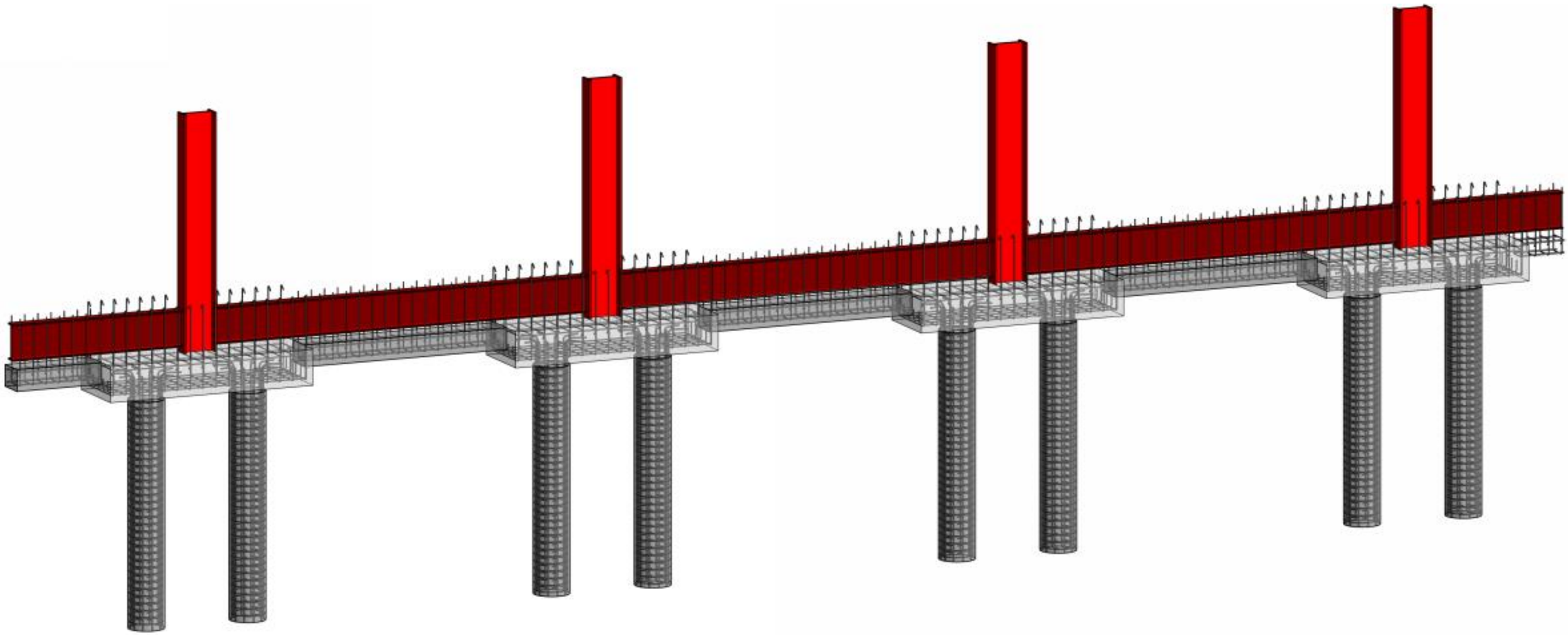
Construction Sequencing – WF in Grade Beams



2nd Construction Sequence | Erect Steel Columns

Case Study

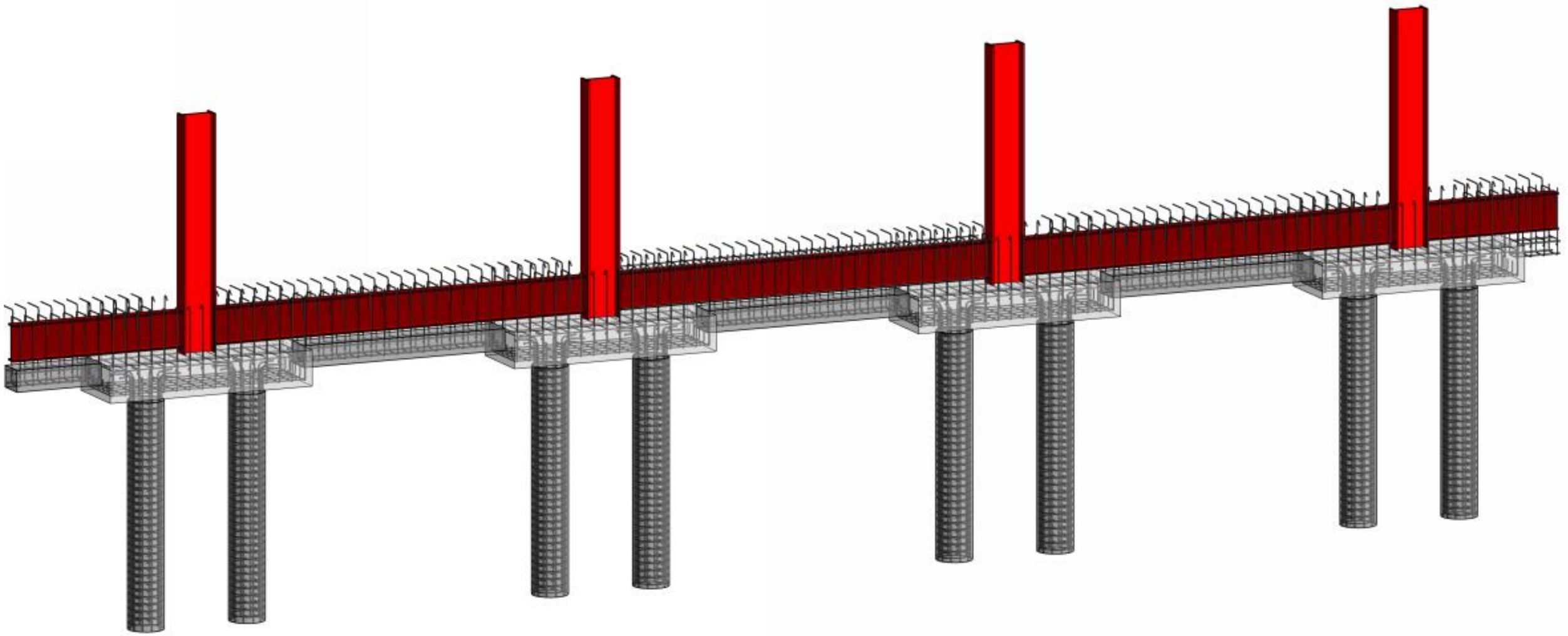
Construction Sequencing – WF in Grade Beams



3rd Construction Sequence | Install Steel Moment Frame Beams Above Pile Caps

Case Study

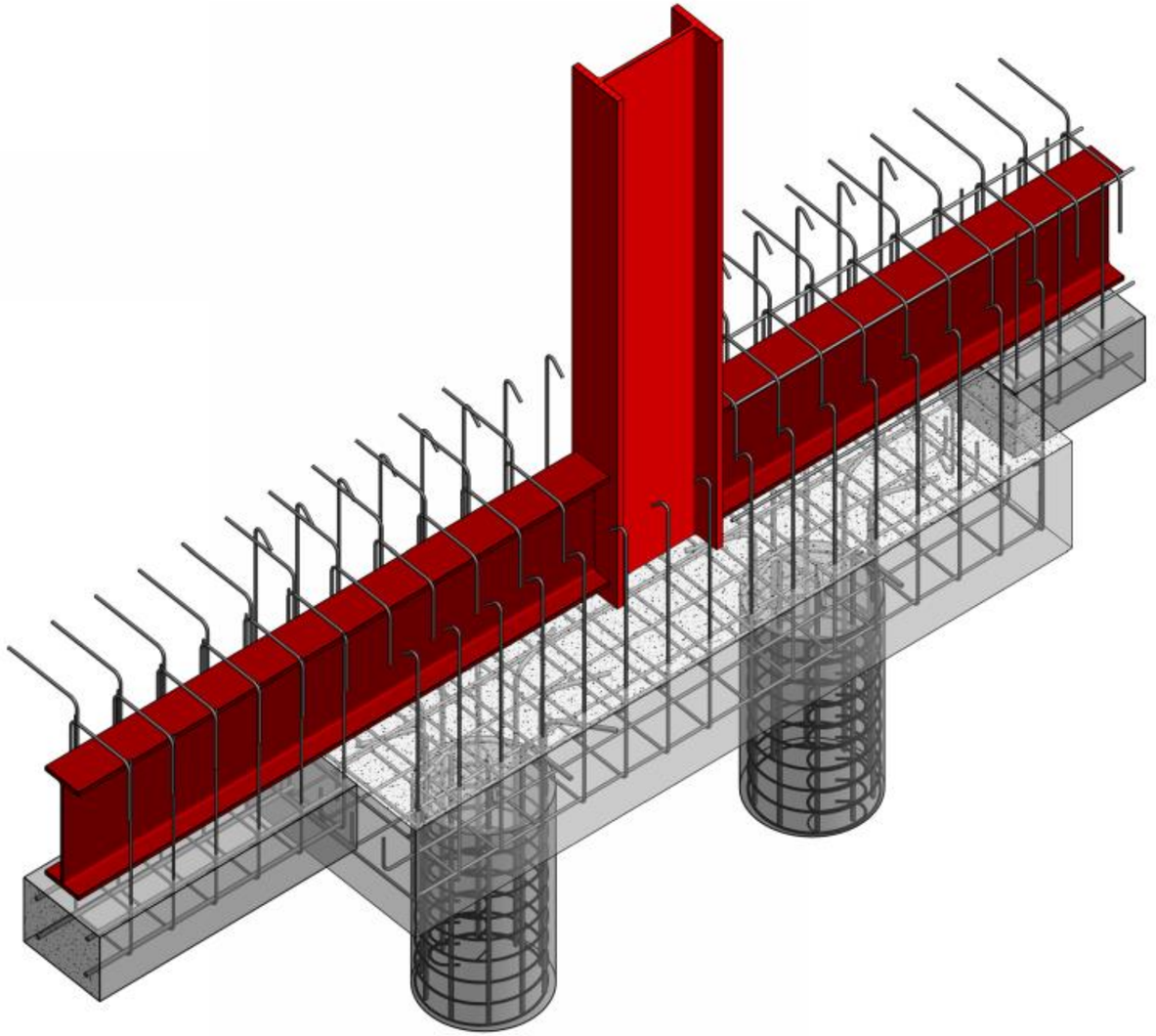
Construction Sequencing – WF in Grade Beams



4th Construction Sequence | Add Minor Rebar Beams for Final Pour

Case Study

Construction Sequencing – WF in Grade Beams



Enlarged View | Beam Column Joint

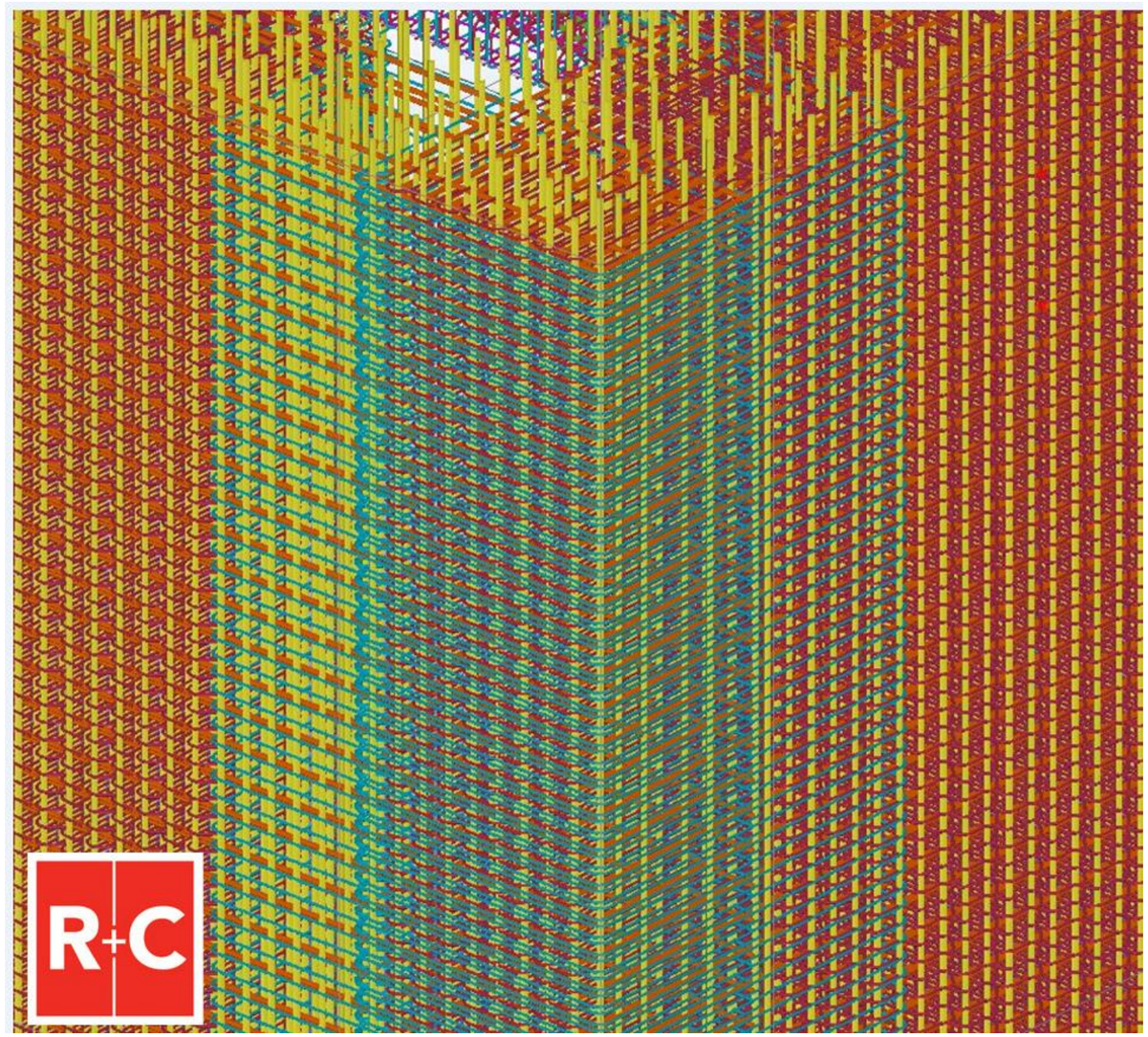
2) Value of BIM to Fabrication

Modeling Rebar in Design

Exploring Economy of Grades of Reinforcement

2) Value of BIM to Fabrication

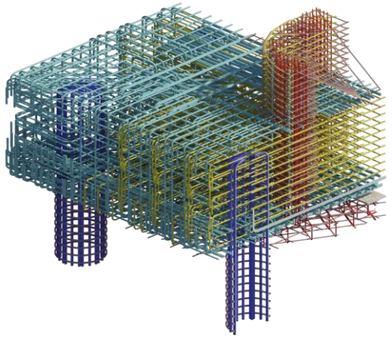
Modeling Rebar – Core Walls in High Seismic Zones

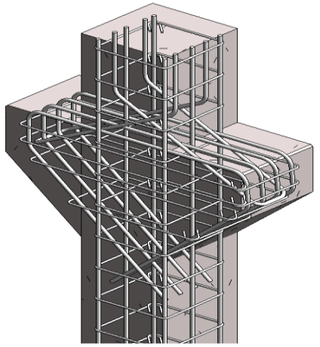


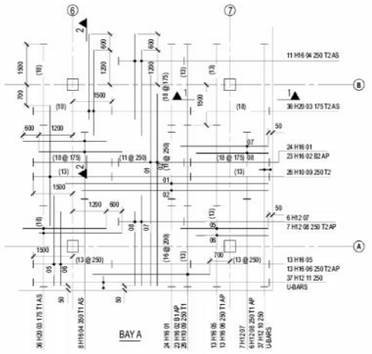
3) Tools for Modeling Rebar

3) Tools for Modeling Rebar

Released in Revit 2015







Rebar for Parts

Individual Fabric Sheets

Multi Rebar Sets Annotation

Documenting Rebar sets

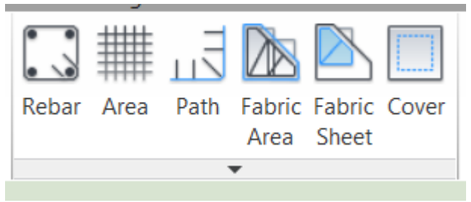
Images in Schedules

Rebar Numbering

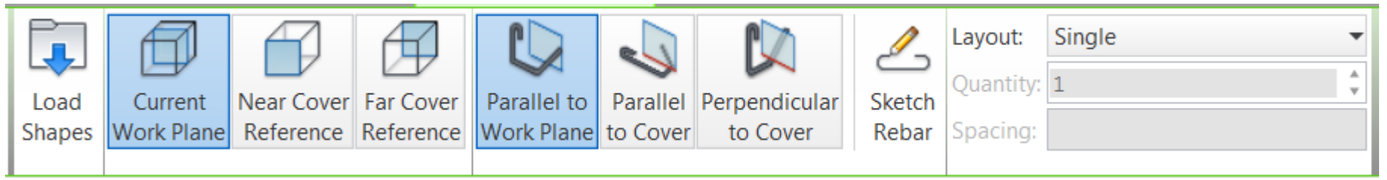
3) Tools for Modeling Rebar

Basic Tools

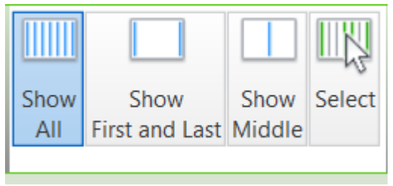
Basic Tools



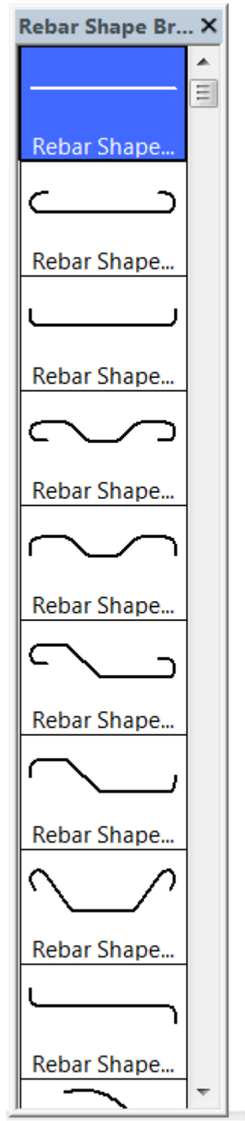
Modeling Tools



Advanced Annotation

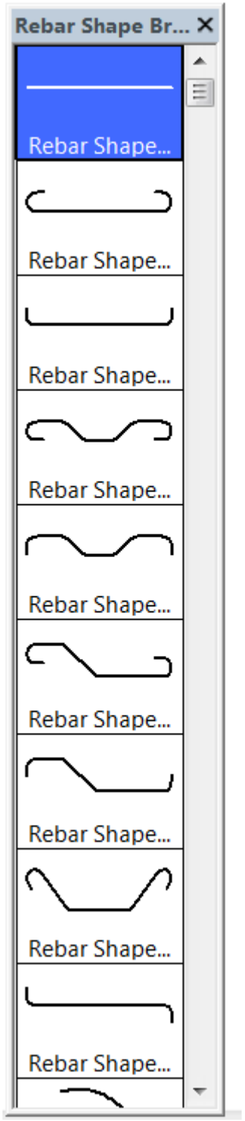


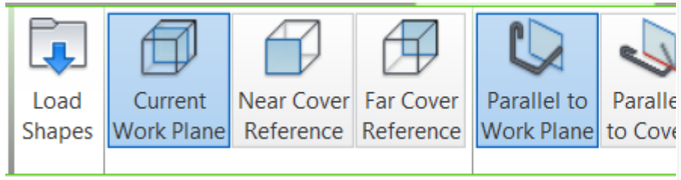
ACI Standard Shapes

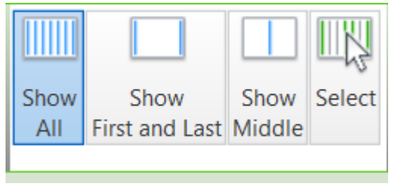


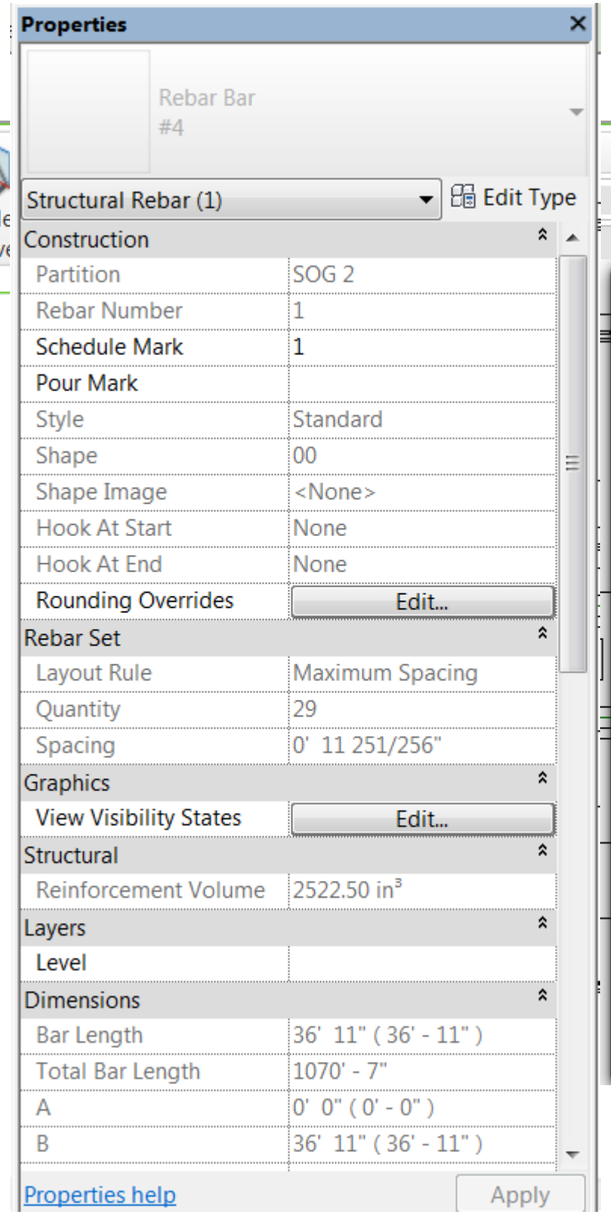
3) Tools for Modeling Rebar

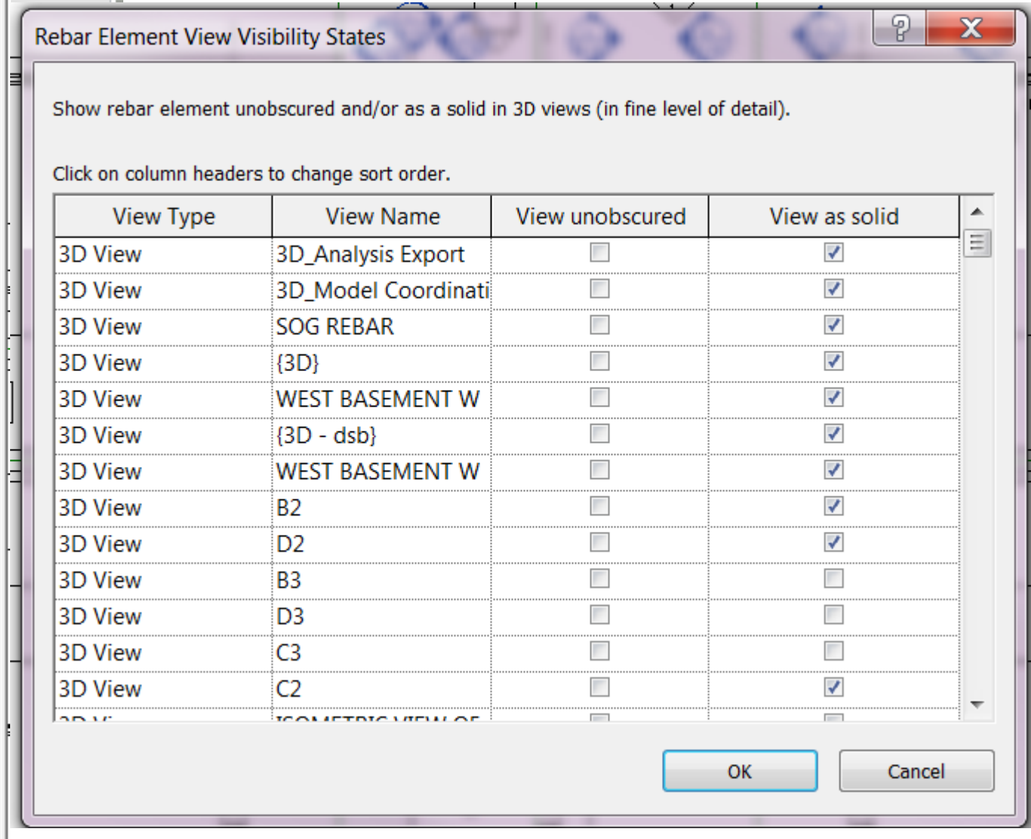
Basic Tools





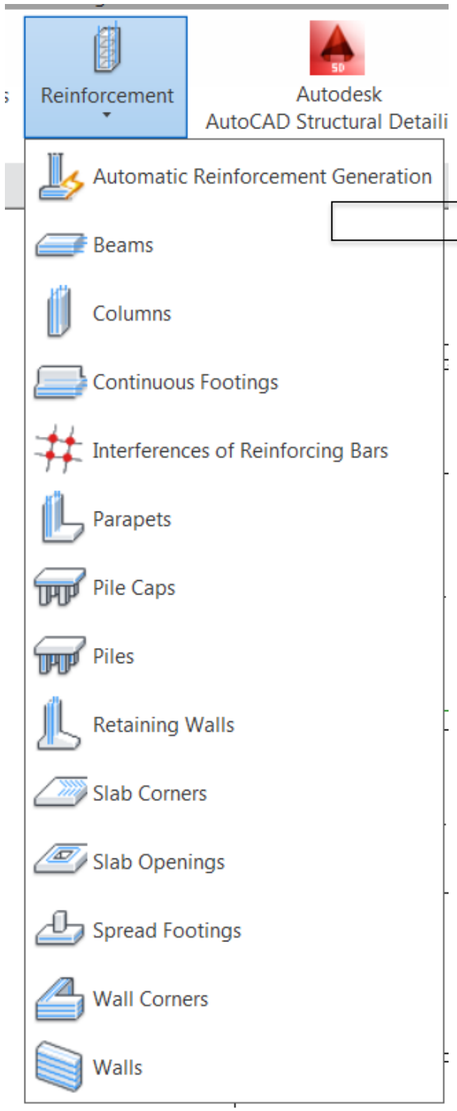


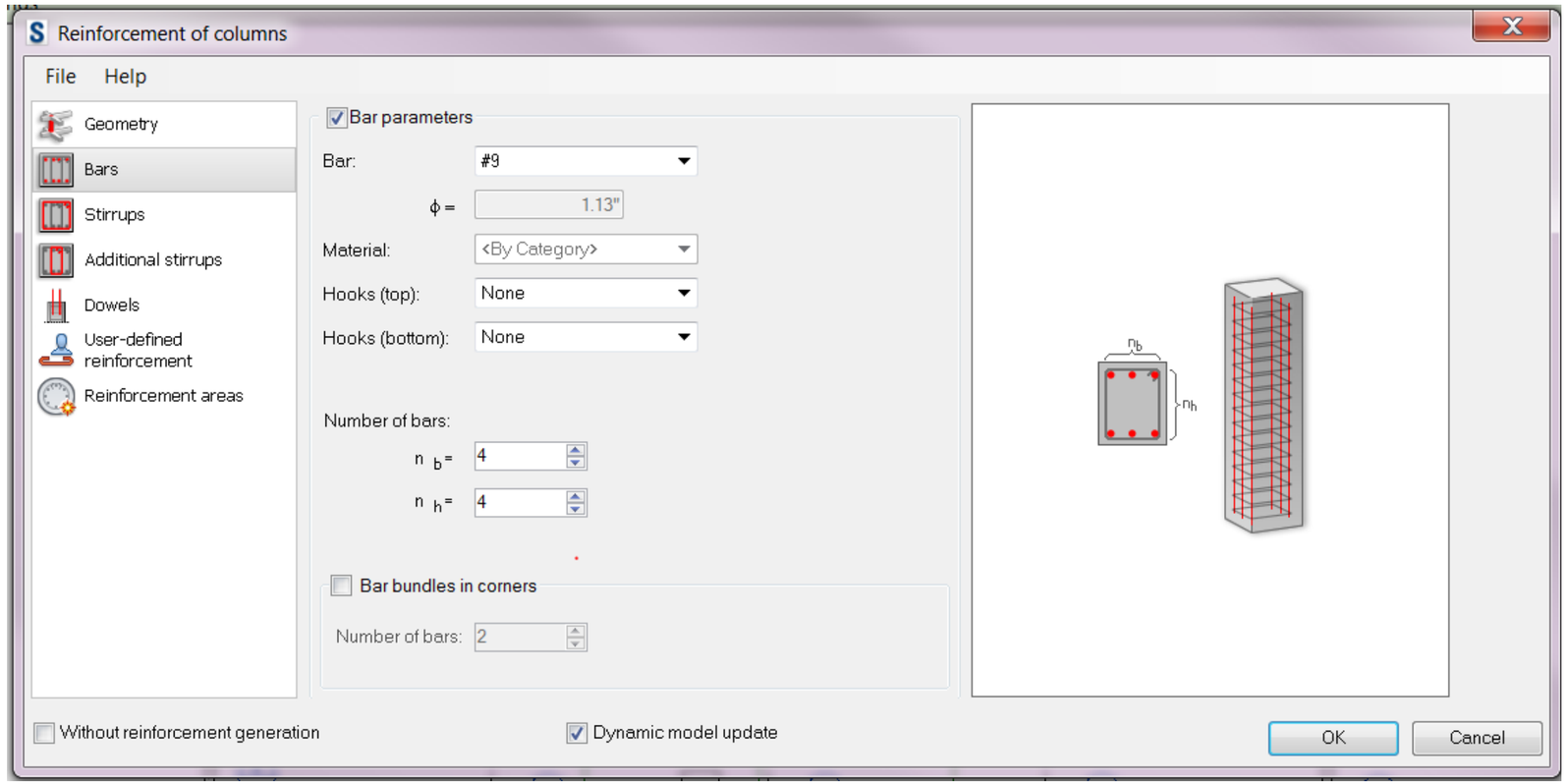




3) Tools for Modeling Rebar

Extension Tools

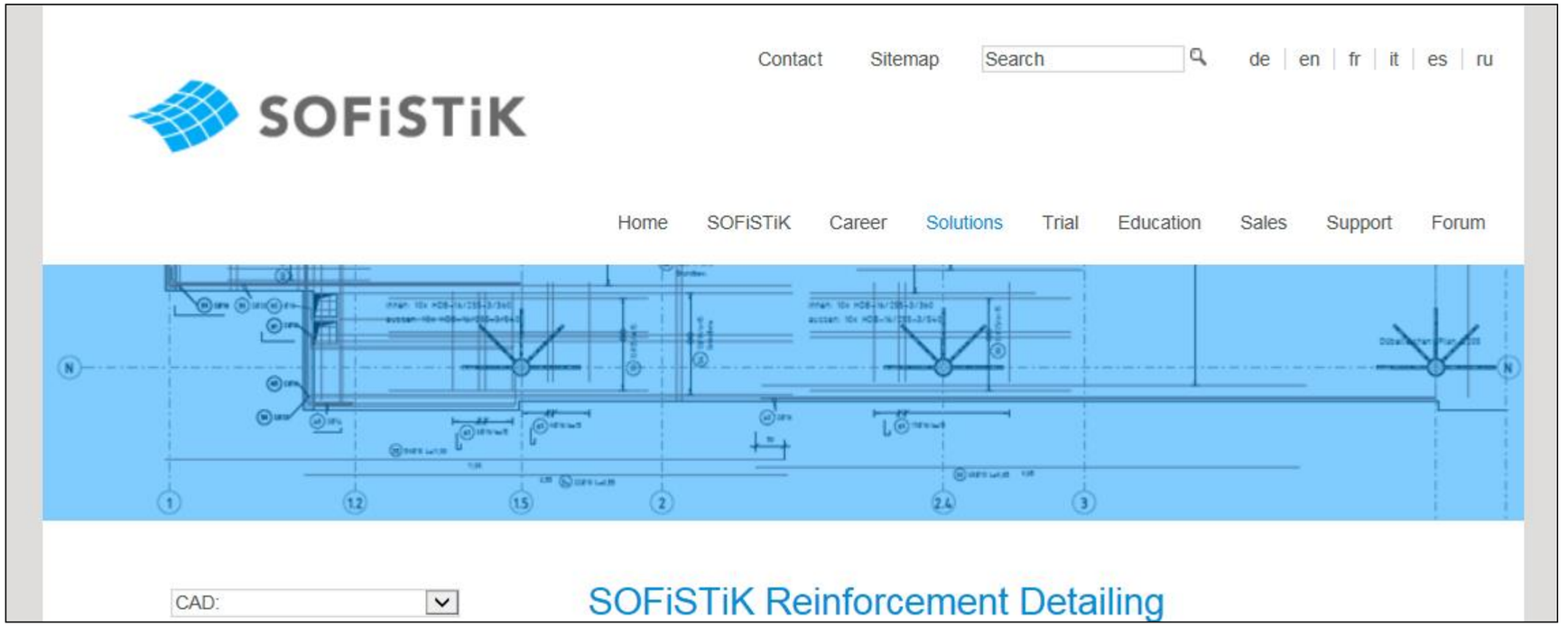




3) Tools for detailing shop drawings - LOD 400

Autodesk Partners

SofiSTiK – Reinforcement Detailing API
(www.sofistik.com)



SE5174 – Producing Shop Drawings Out of 3D Reinforcement Models in Revit Structure

3) Tools for using analysis to drive rebar model

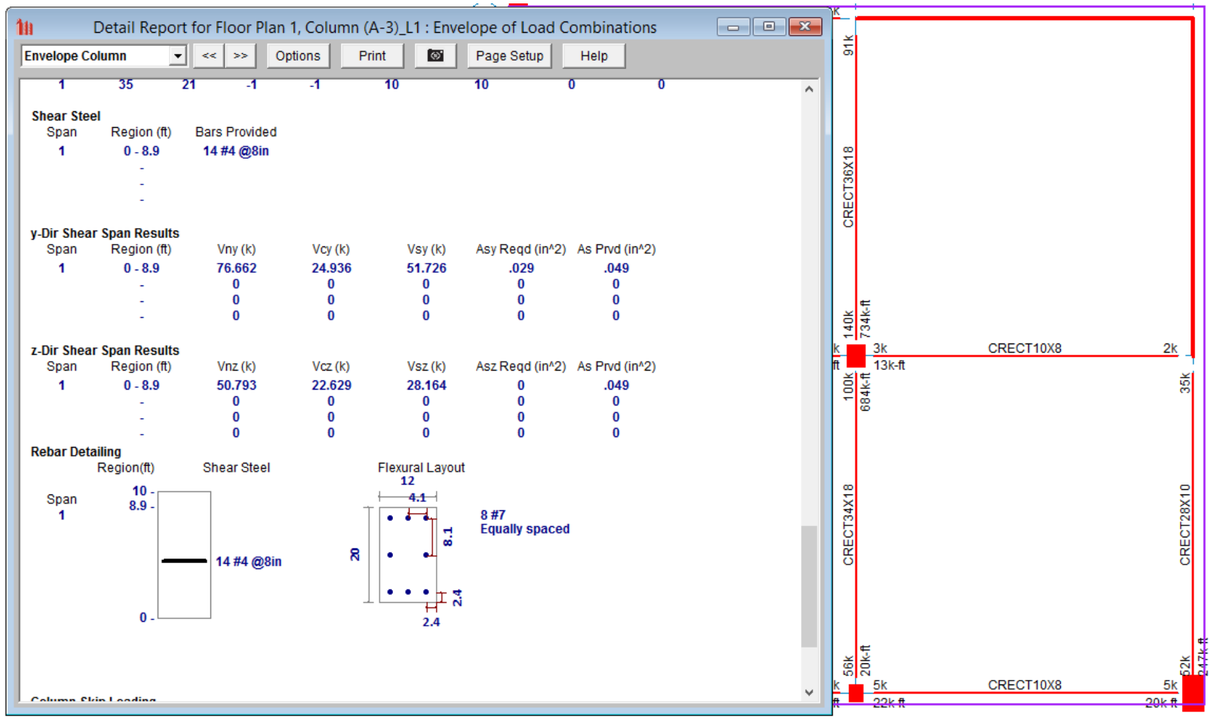
Autodesk Partners

Adapt – Structural Concrete Building Design Software
(www.adaptsoft.com)

3) Tools for using analysis to drive rebar model

Autodesk Partners

Risa Technologies – Structural Concrete Building Design Software (www.risa.com)



SE4609 – Using the RISA-Revit Link for Concrete Buildings and Foundations

3) Tools for using analysis to drive rebar model

Autodesk Partners

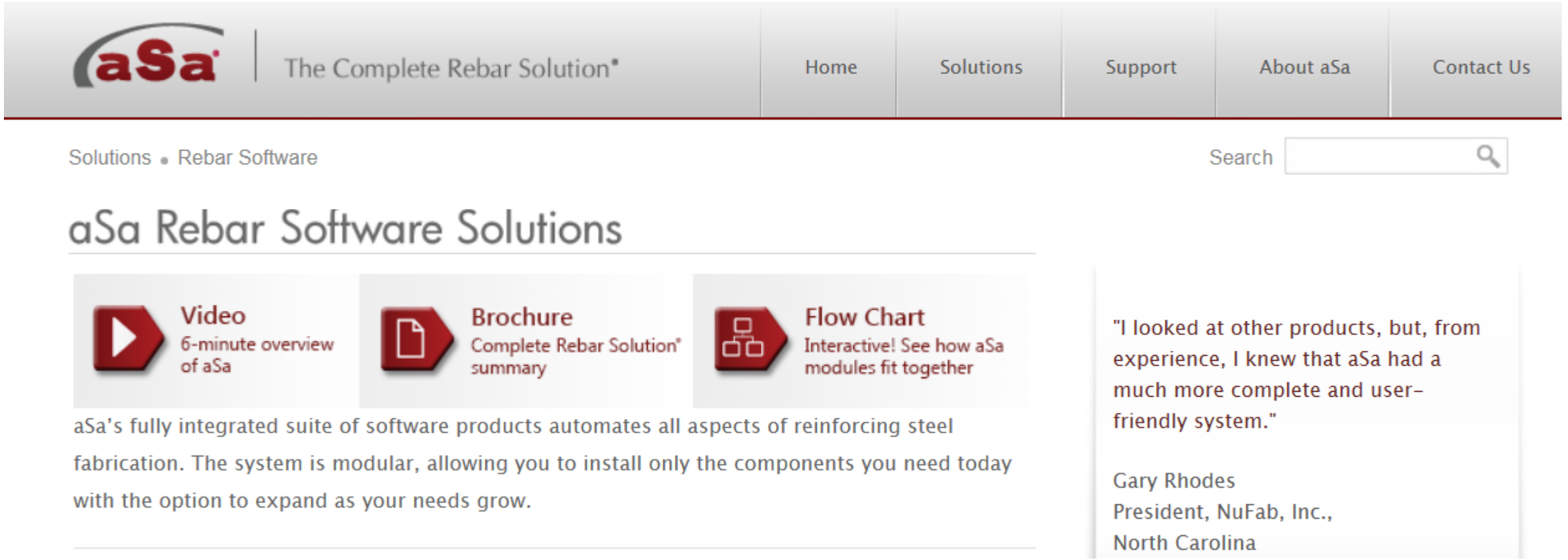
Graitec – Advanced Concrete 2015
(www.graitec.com)

SE6512 – Take Advantage of BIM for Reinforced Concrete Structures

3) Tools for using rebar model for direct fabrication

Autodesk Partners

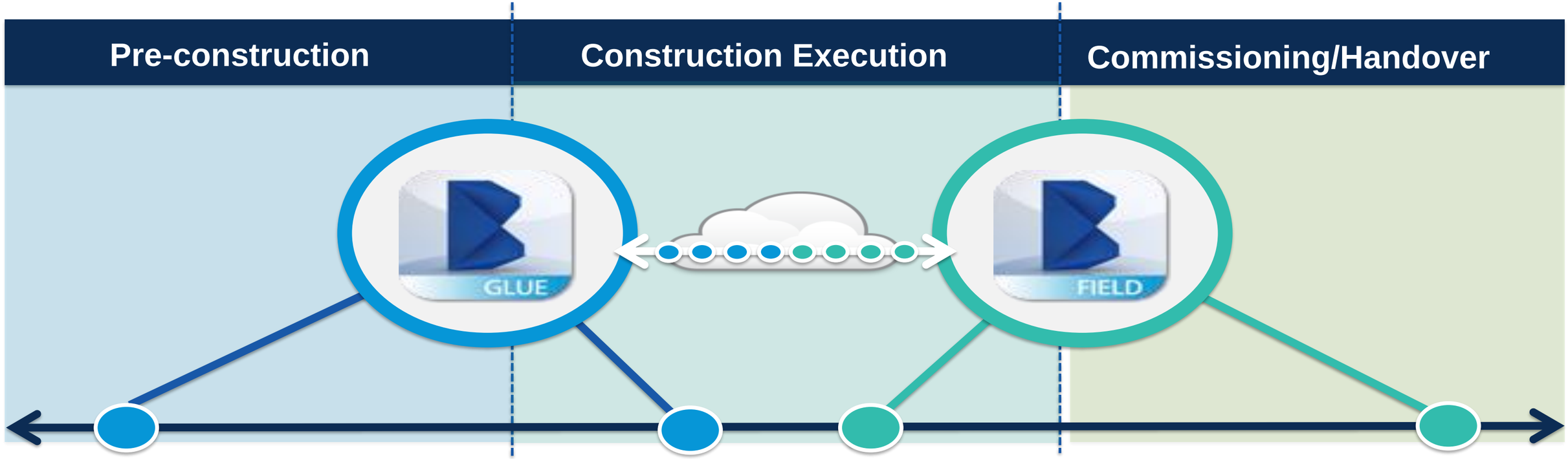
aSA – Rebar Fabrication Enterprise Software
(www.asarebar.com)



FB7276 – Rebar Detailing to Fabrication Workflows Using Building Information Modeling

3) Communication tool for sharing rebar models

BIM 360: Spanning Construction Phases



Connecting Project Teams & Project Data
Via a Common Cloud Database

4) Implementation by Delivery Methods:

Design-Bid-Build

Integrated Teams

4) Implementation by Delivery Methods
Design-Bid-Build Usage

- Rebar modeling is used for:
  - Target Value Design for predicting quantities with high accuracy
  - Improving bids and reducing RFI's/change orders
  - Design tool for exploring multiple options in depth
  - Advanced clash detection and constructability review
  - Model not built for use directly by the subcontractor

4) Implementation by Delivery Methods

Design-Bid-Build Usage: SWOT Analysis

- Strengths:
  - Better coordinated designs with tighter bids made possible by explicit scheduling of quantities
- Weaknesses:
  - Design team takes on additional liability with limited rewards
- Opportunities:
  - Faster, more accurate documentation
- Threats:
  - Low bid environment means that flaws in the model will be exploited by hostile subcontractors to generate change orders

4) Implementation by Delivery Methods
Integrated Teams Usage

- Rebar modeling is used for:
  - Target Value Design for predicting quantities with high accuracy
  - Design tool for exploring multiple options in depth
  - Early procurement of rebar subcontractors
  - Advanced clash detection and constructability review
  - Fabrication data to drive automated rebar fabrication
  - Construction simulations
  - Optimization for Pre-Fabrication

4) Implementation by Delivery Methods
Integrated Teams Usage: SWOT Analysis

- Strengths:
  - Better coordinated designs/tighter bids
  - Reduce number of RFIs to increase team profitability
  - Foster better designs by collaborating with fabricators
  - Increase overall team efficiency
- Weaknesses:
  - Design team takes on more risk
  - Shifts cost of rebar shop drawings
  - Increased cost of design by inclusion of more stakeholders

4) Implementation by Delivery Methods
Integrated Teams Usage: SWOT Analysis

- Opportunities:
  - Improve operational efficiency
  - Reduce team risk with high efficiency design
- Threats:
  - Disruptive technology threatens existing business models

AU Partner Presentations About Rebar

- **SE6880** – Integrated Concrete Design in Revit
- **SE6512** – Take Advantage of BIM for Reinforced Concrete Structures
- **SE4609** – Using the RISA-Revit Link for Concrete Buildings and Foundations
- **SE5174** – Producing Shop Drawings Out of 3D Reinforcement Models in Revit Structure
- **FB7276** – Rebar Detailing to Fabrication Workflows Using Building Information Modeling

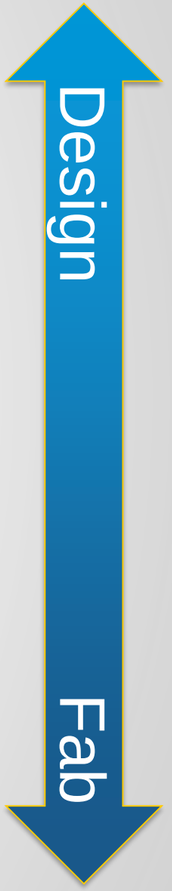
Marsh API

GRAITEC

RISA TECHNOLOGIES

SOFiSTiK

aSa



Session Feedback

- Via the Survey Stations, email or mobile device
- AU 2014 passes given out each day!
- Best to do it right after the session
- Instructors see results in real-time

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