

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.

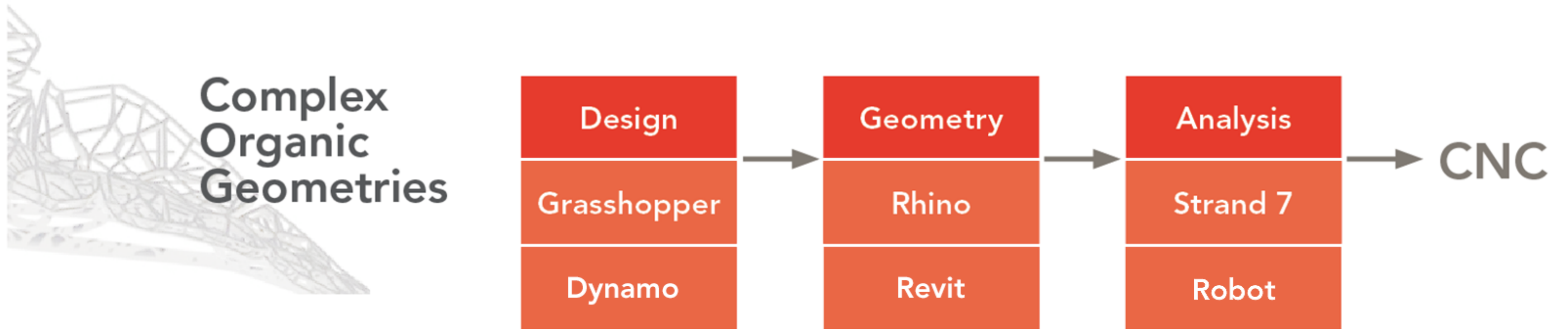
Key learning objectives

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

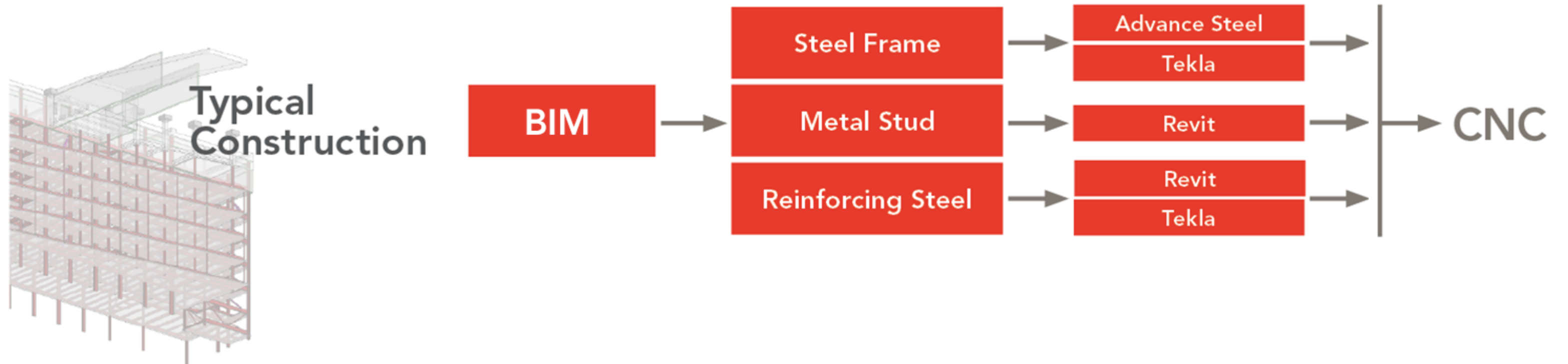
State of the Industry

BIM to Fabrication Workflow Roadmap



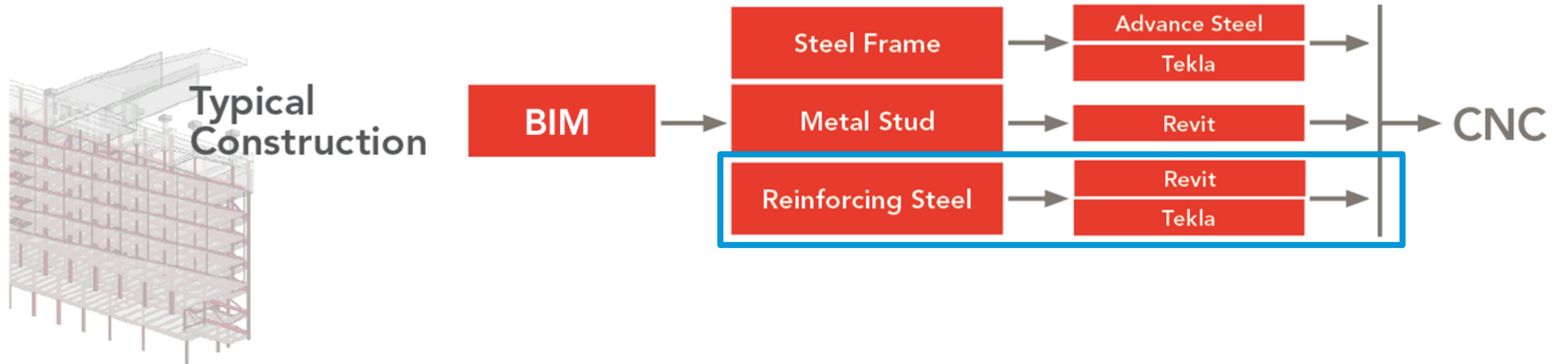
State of the Industry

BIM to Fabrication Workflow Roadmap

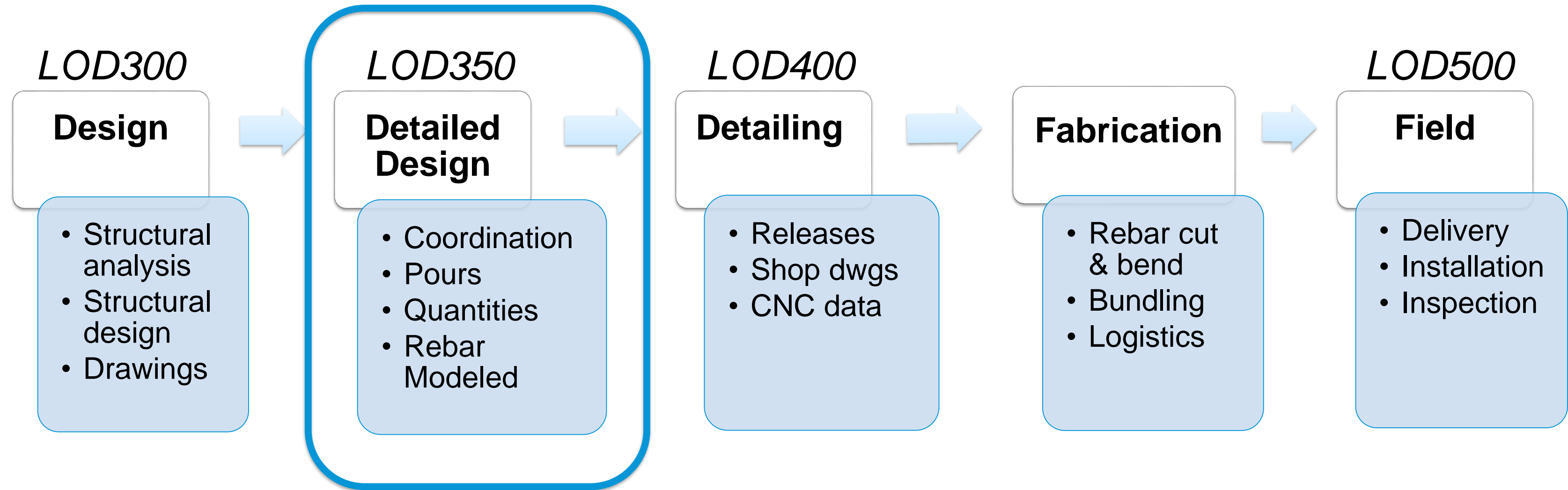


State of the Industry

BIM to Fabrication Workflow Roadmap



Concrete workflows



Agenda for Presentation

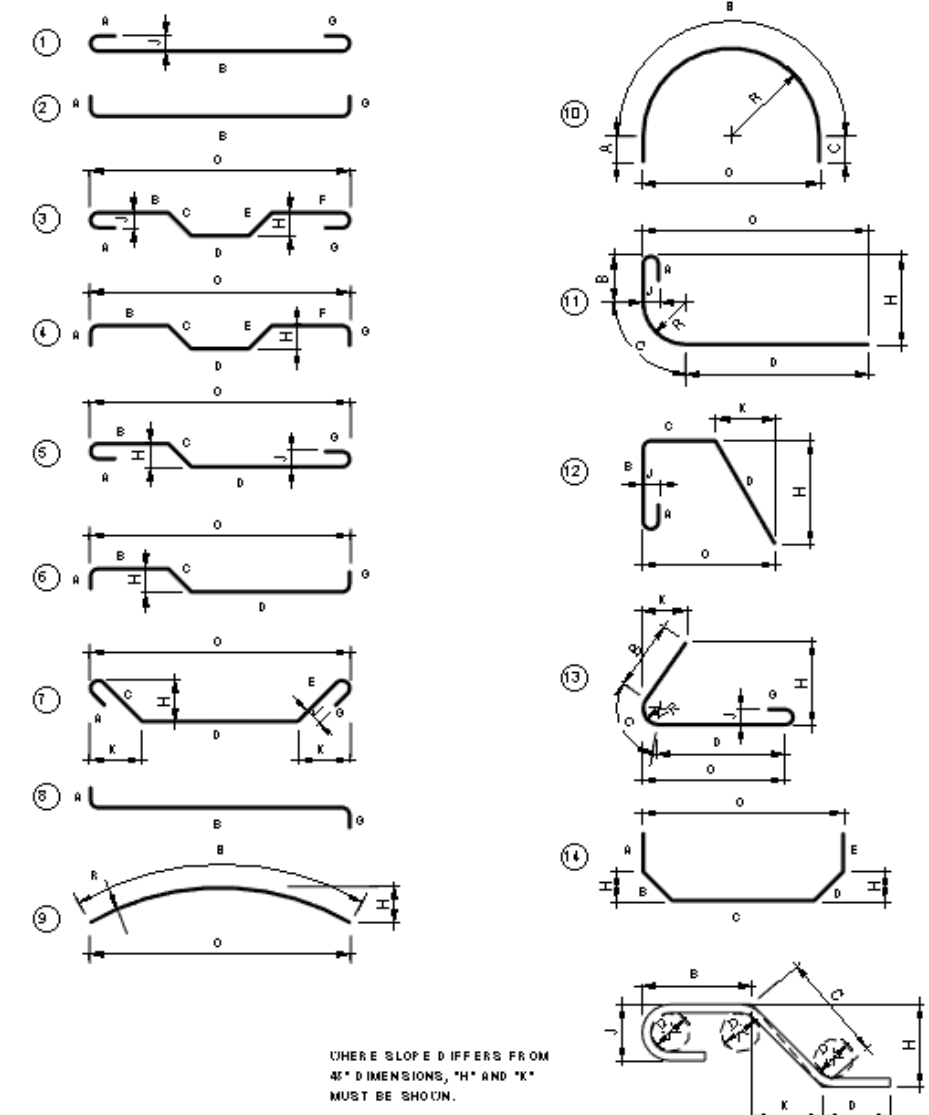
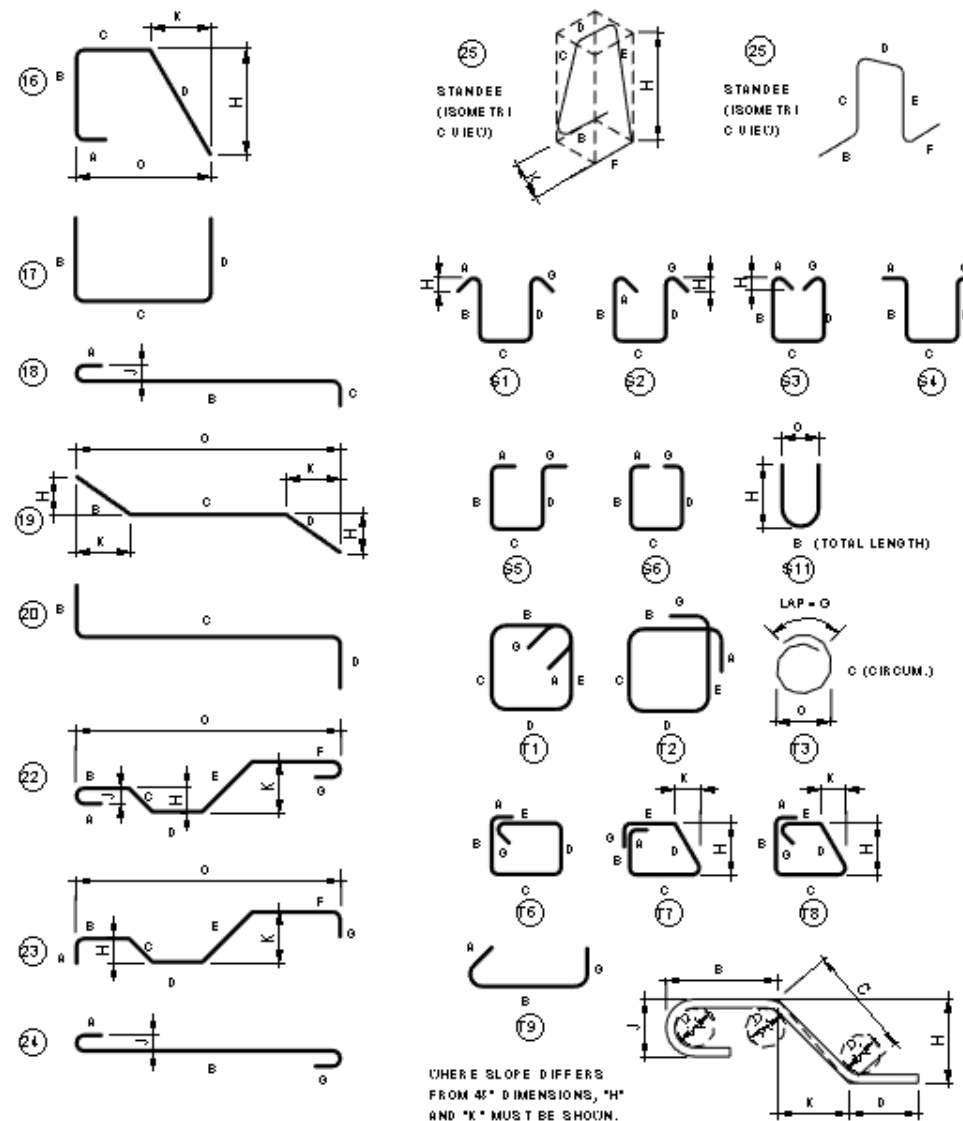
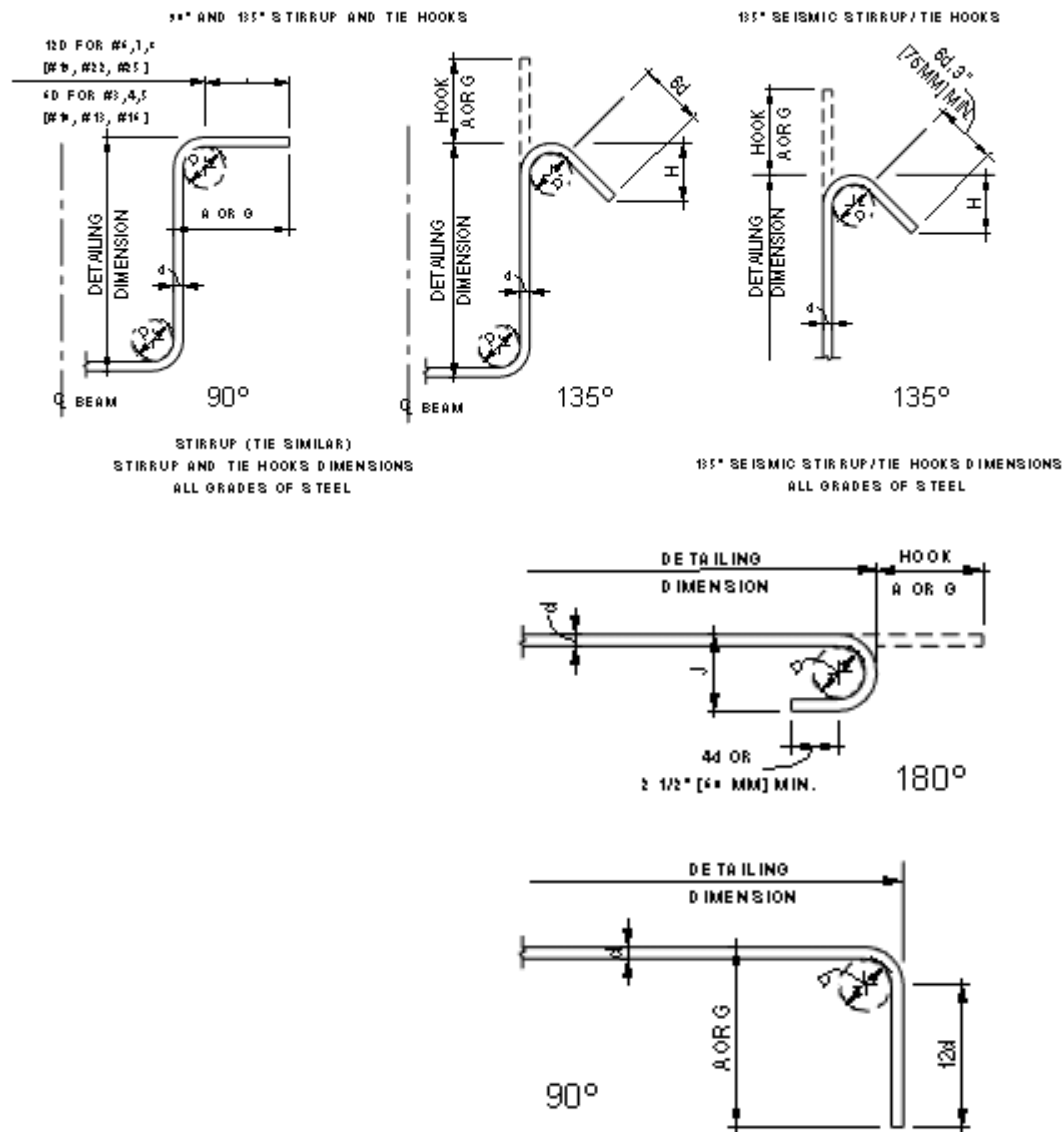
- 1) BIM to Fabrication Defined
- 2) Value of BIM to Fabrication
- 3) Tools for Modeling Rebar
- 4) Implementation by Delivery Methods

1) **BIM to Fabrication Defined**

BIM to Fabrication Defined

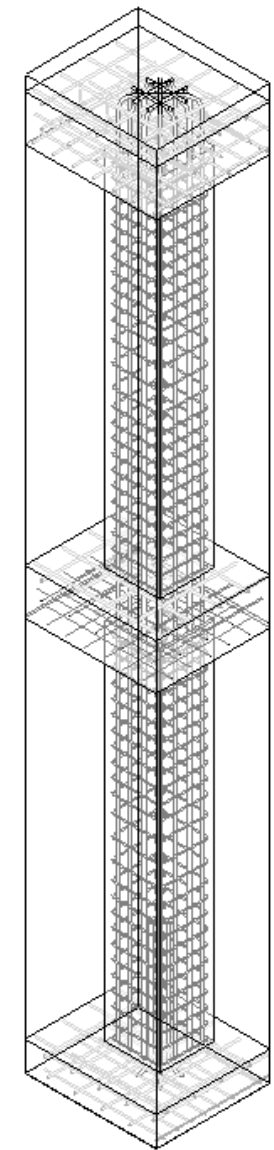
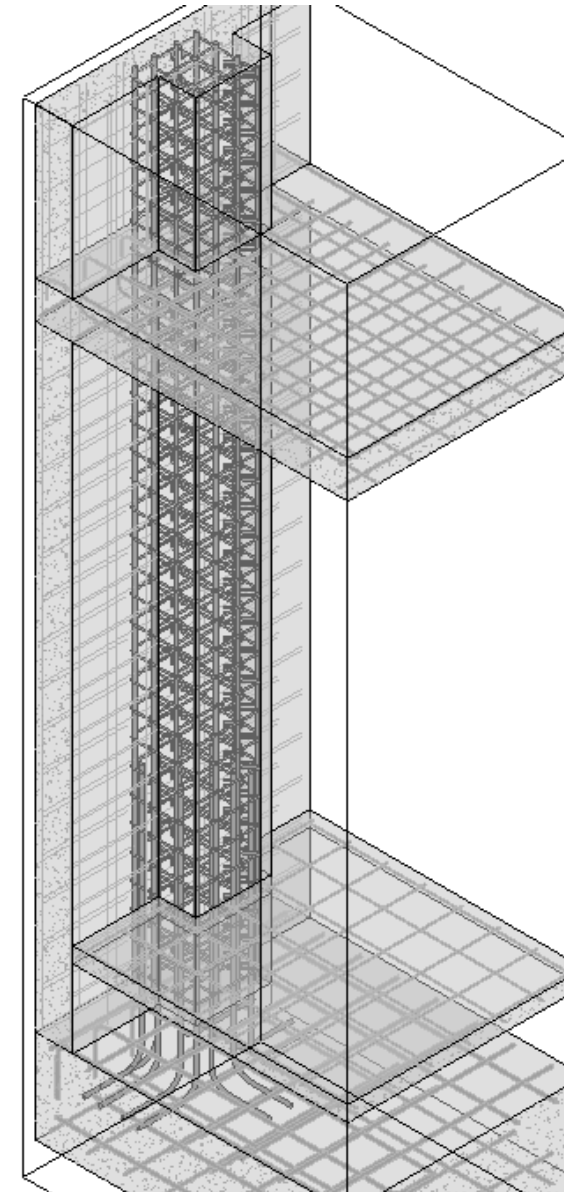
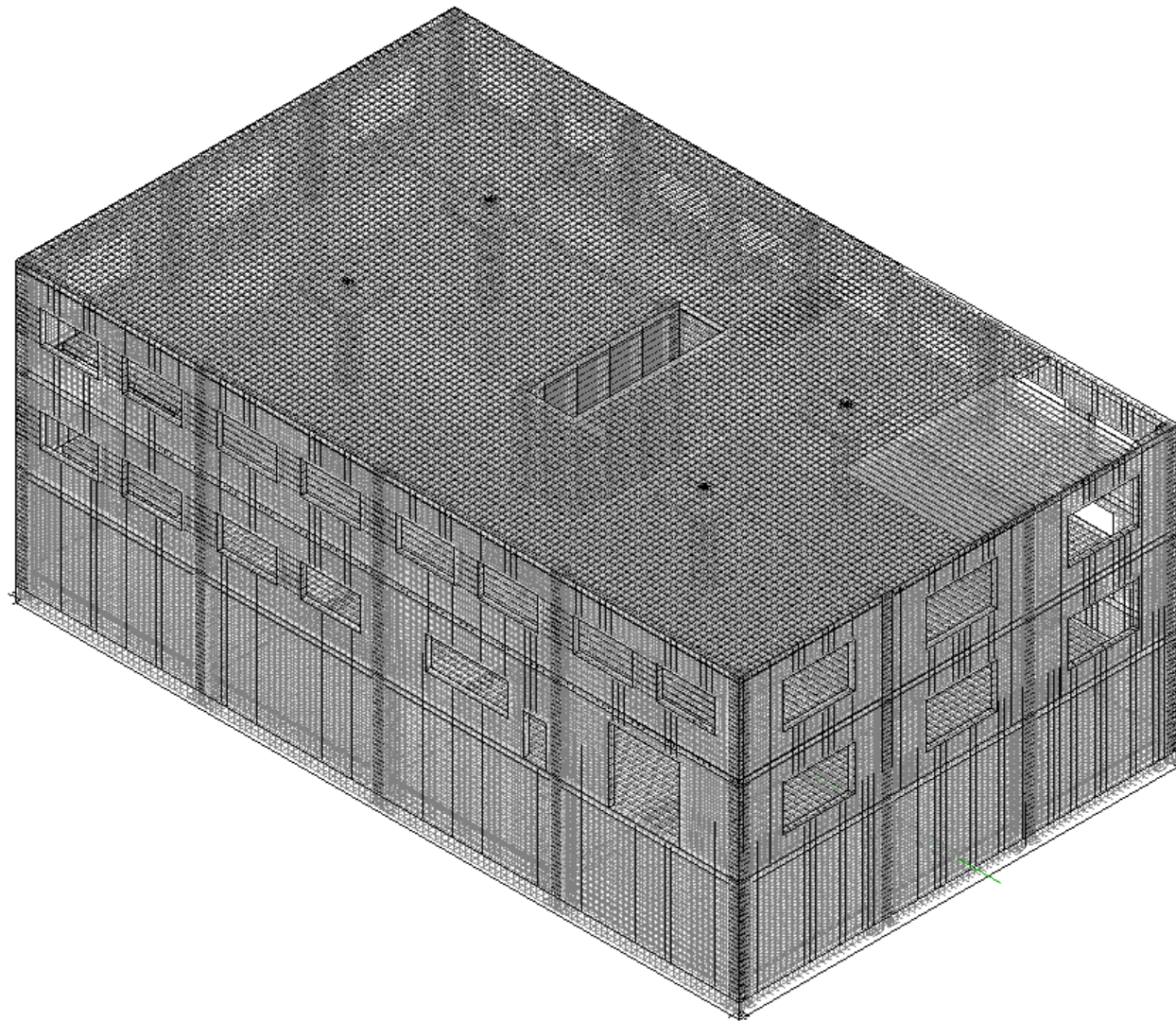
- Rebar is modeled with families that have parameters needed for fabrication:

ACI STANDARD BAR DEFINITIONS



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



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

2) Value of BIM to Fabrication

2) Value of BIM to Fabrication

Current Practice

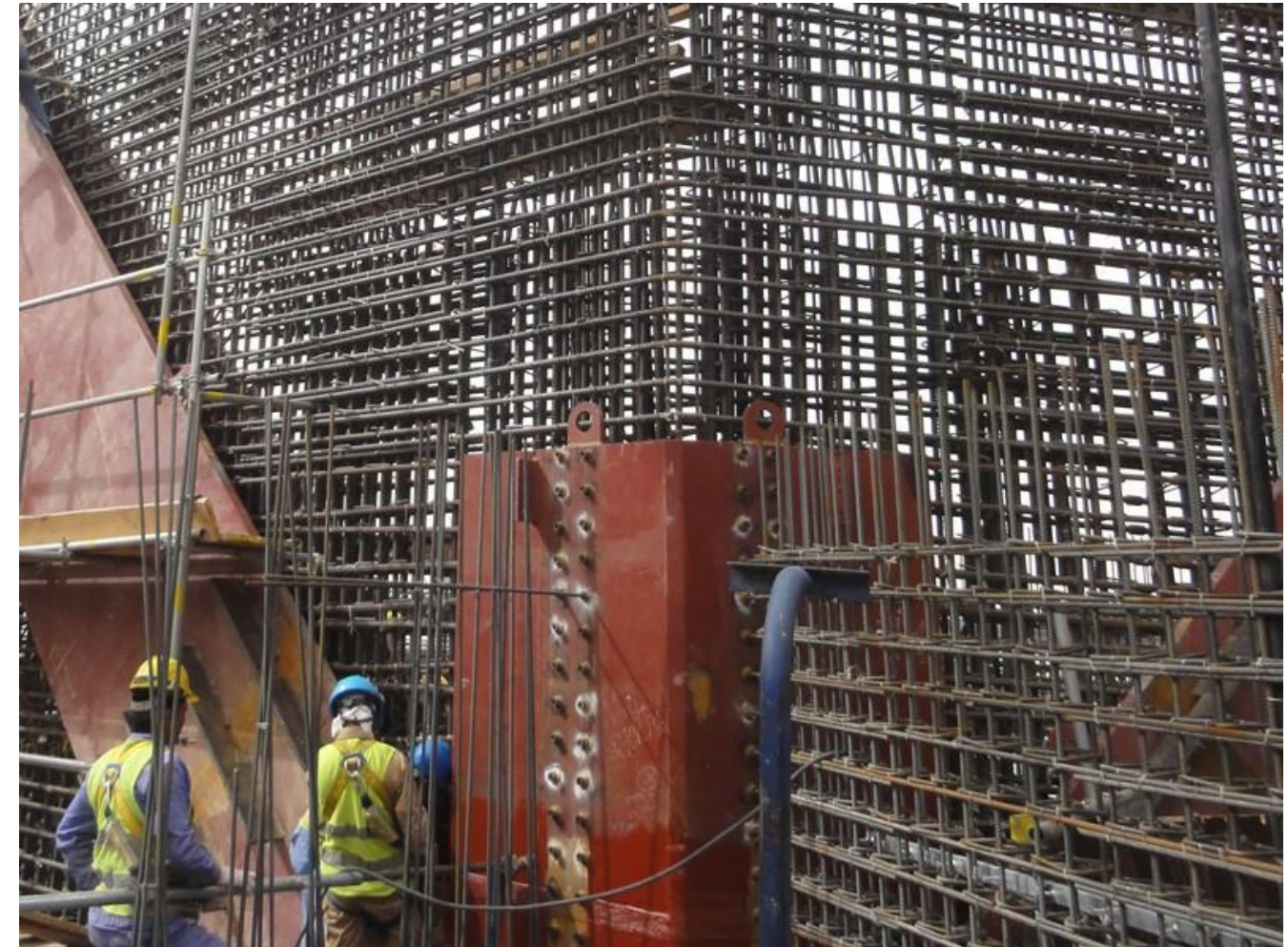
- Challenges in Construction Documents
 - Uncertainty quantities
 - Missing details
 - Change Orders



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

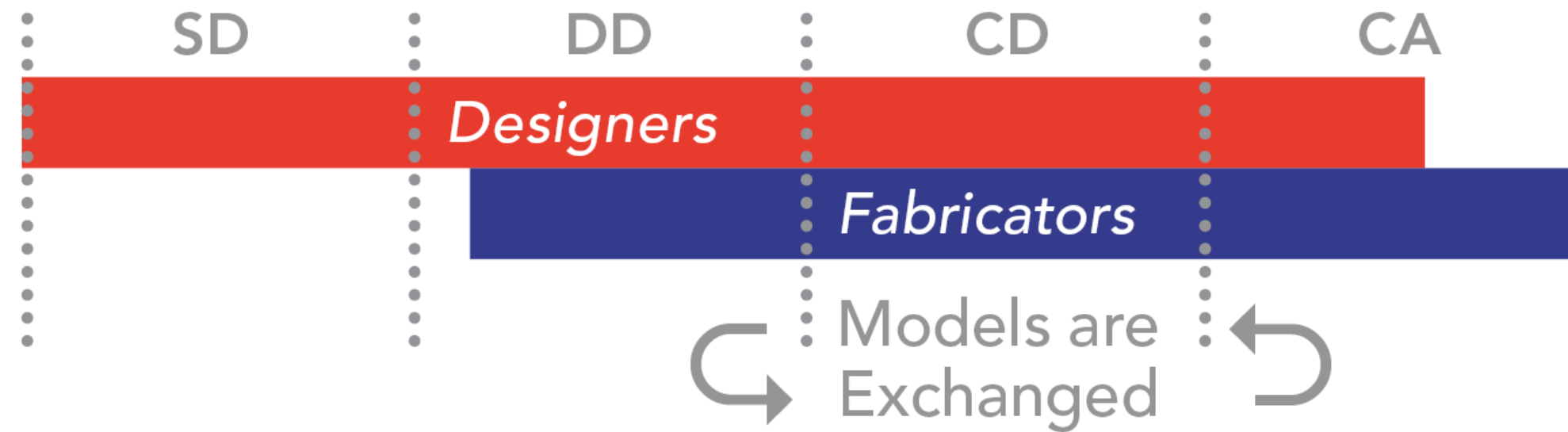
Lean Principles of Waste



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

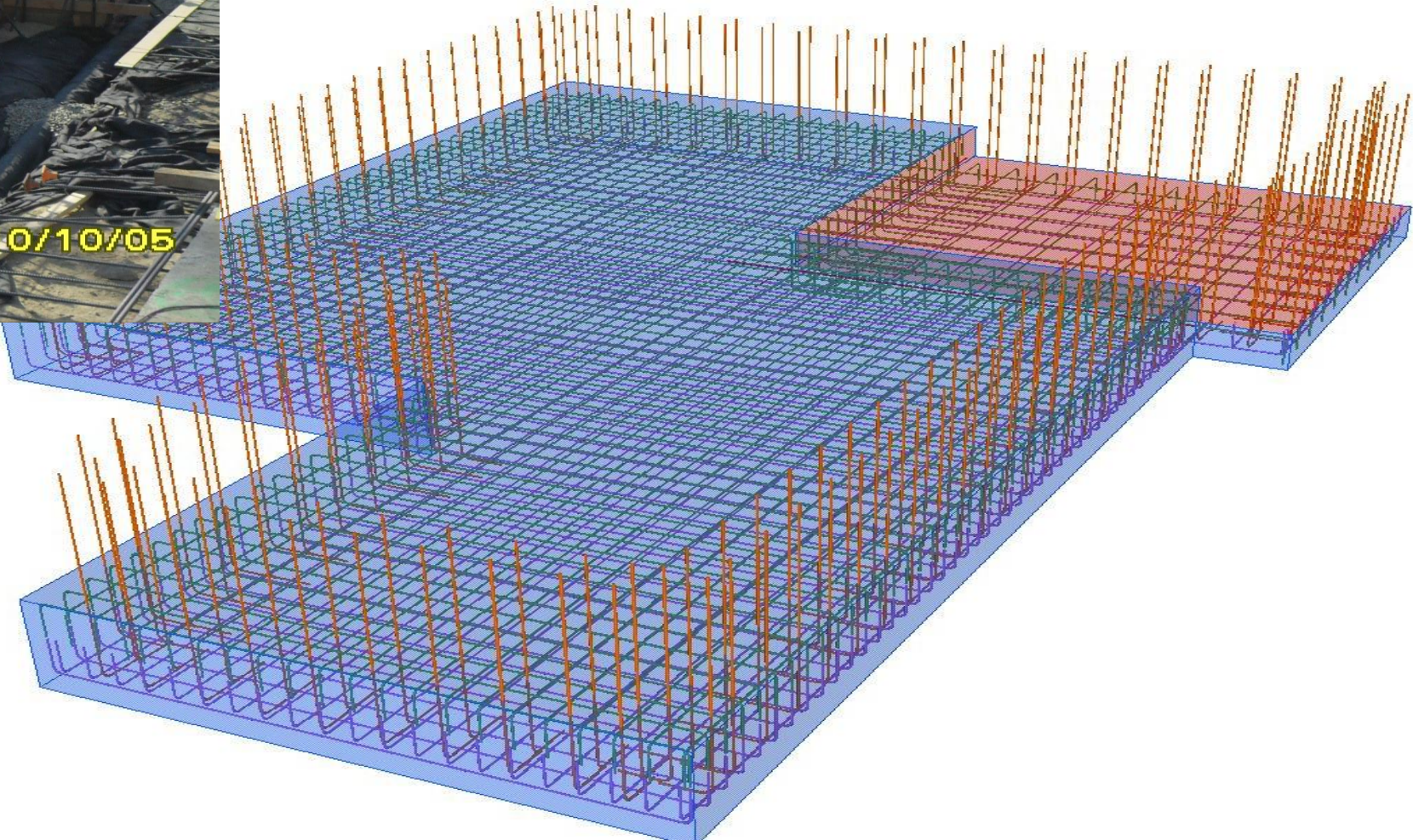
Modeling Rebar in Design

- 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 11/16"	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

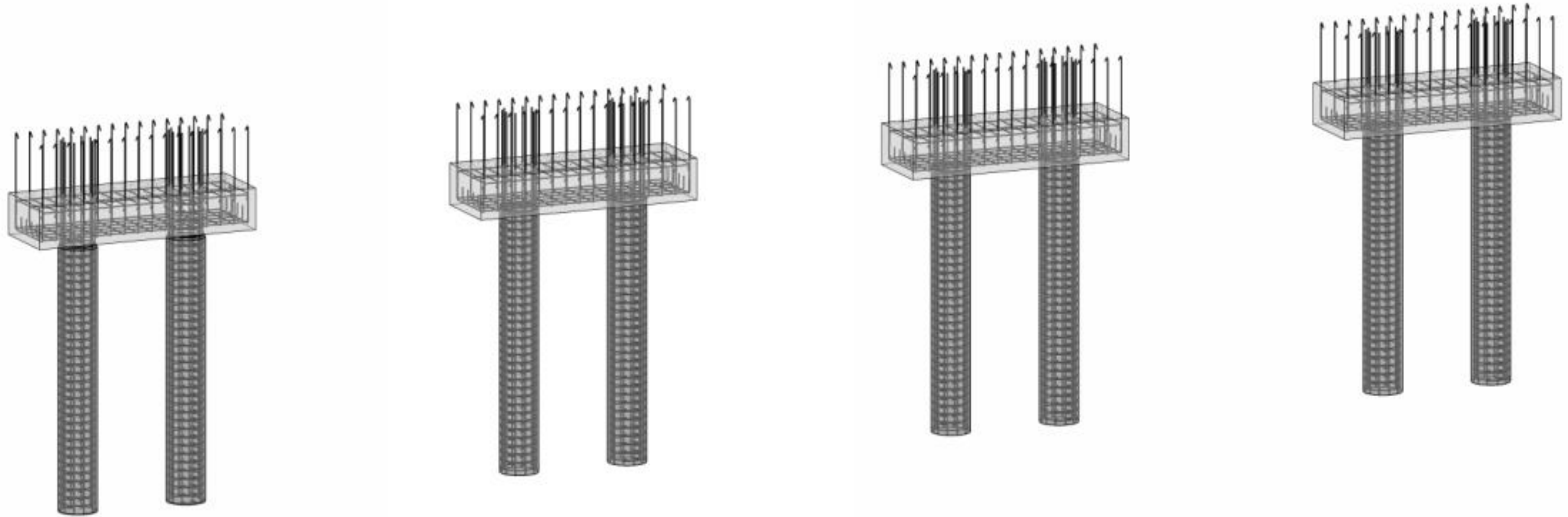
Two Case Studies

Construction Sequencing

Grades of Reinforcement

Case Study

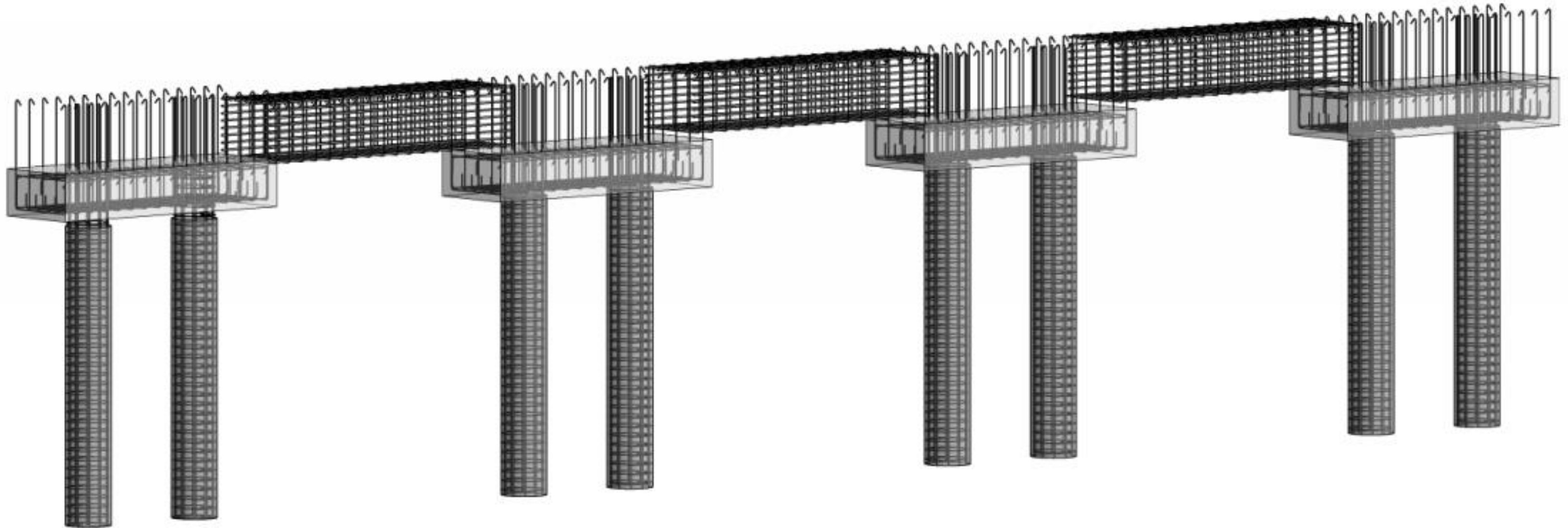
Construction Sequencing – Rebar in Grade Beams



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

Case Study

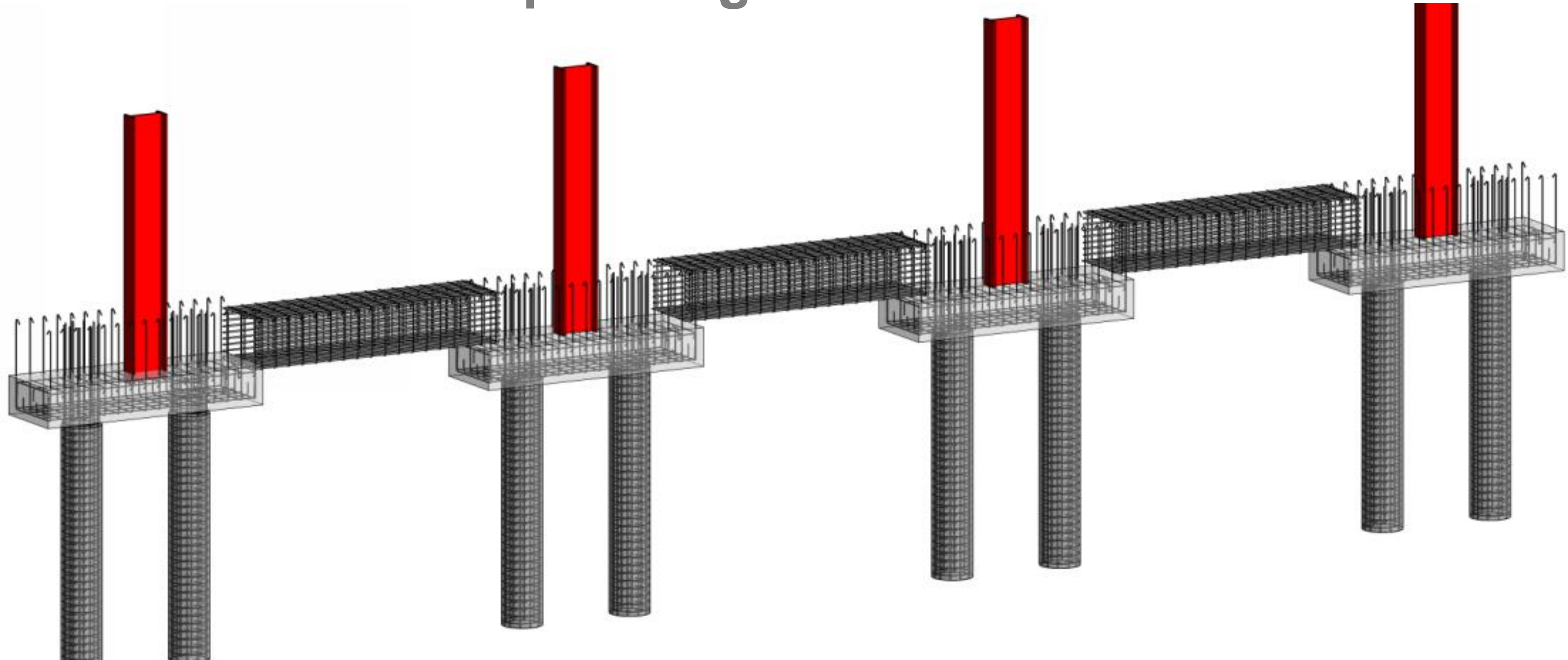
Construction Sequencing – Rebar in Grade Beams



2nd Construction Sequence | Set Infill Grade Beam Rebar

Case Study

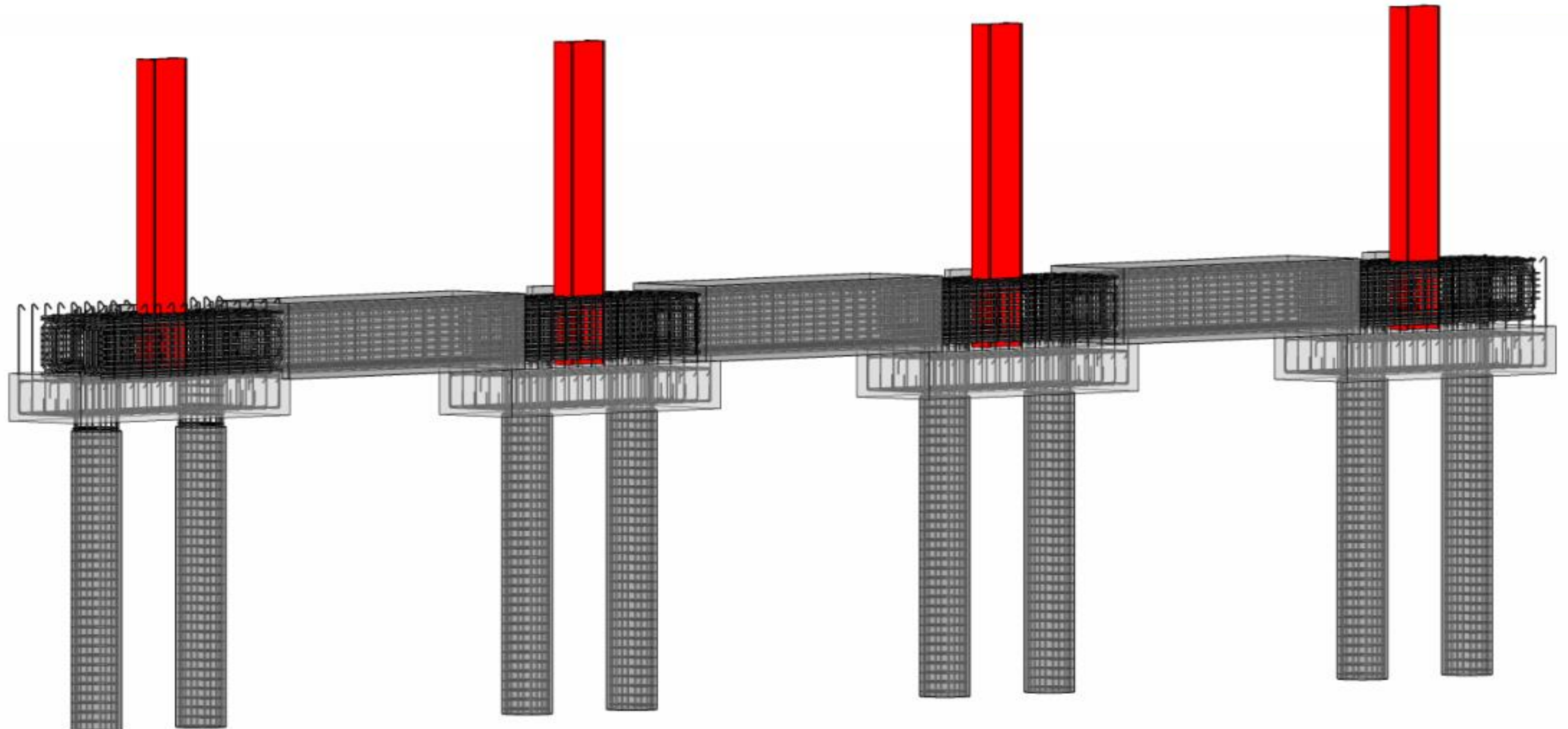
Construction Sequencing – Rebar in Grade Beams



3rd Construction Sequence | Erect Steel Columns

Case Study

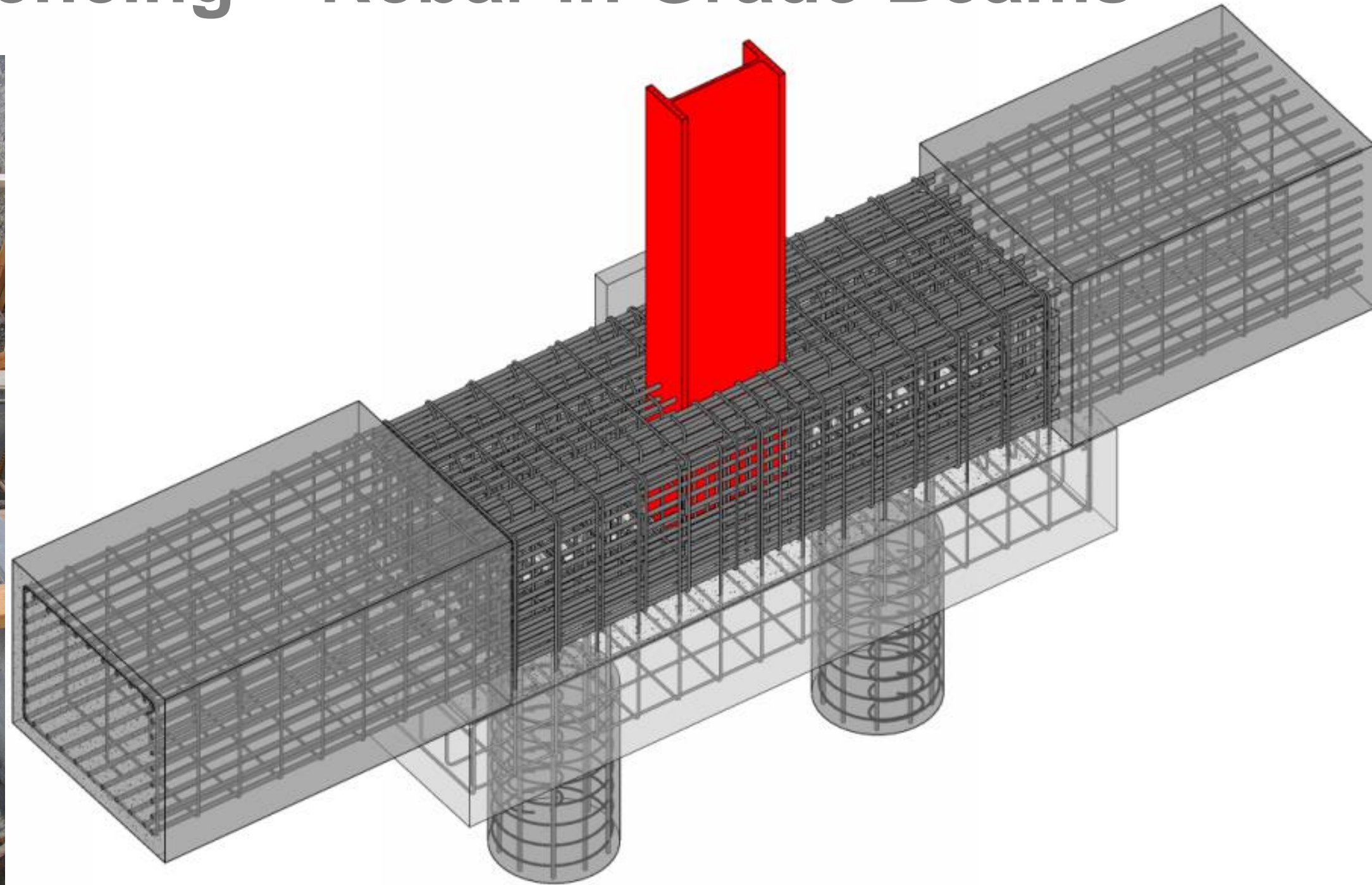
Construction Sequencing – Rebar in Grade Beams



4th Construction Sequence | Install Rebar Above Pile Caps

Case Study

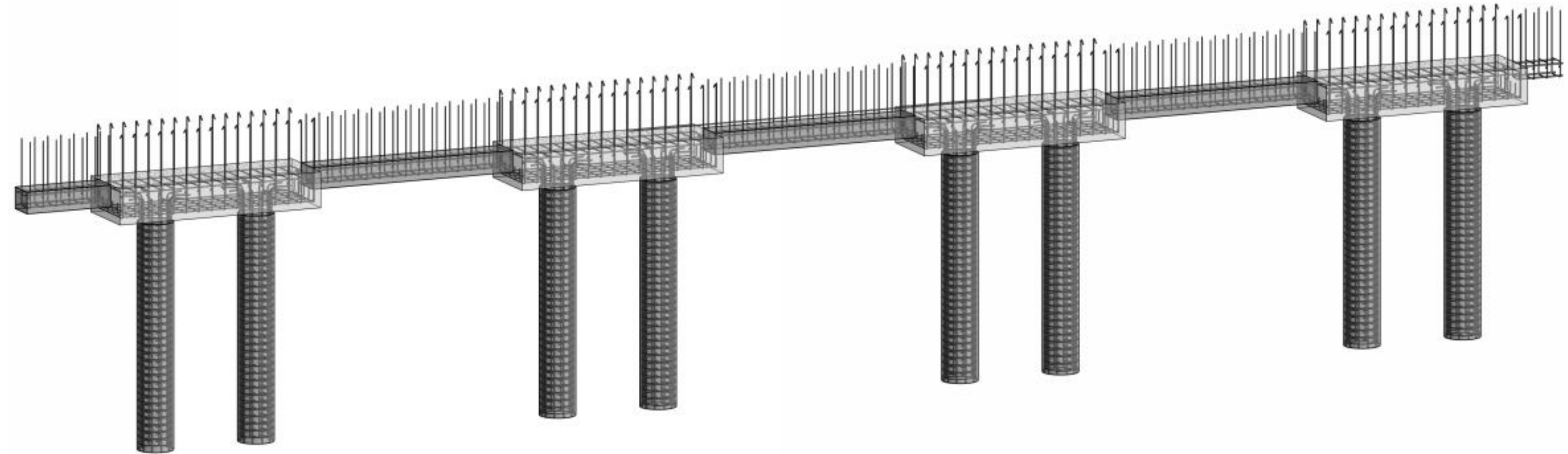
Construction Sequencing – Rebar in Grade Beams



Enlarged View | Column with All Rebar Set

Case Study

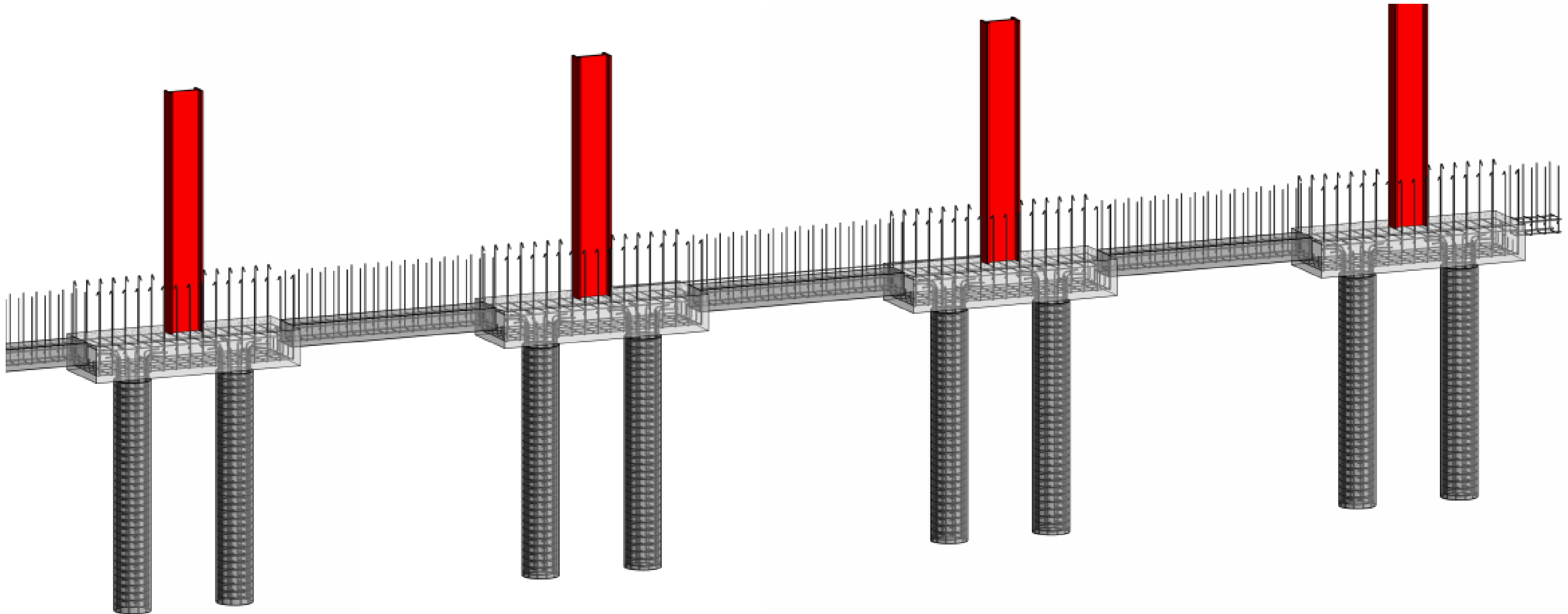
Construction Sequencing – WF in Grade Beams



1st Construction Sequence | Install Pile Caps and Grade Beams

Case Study

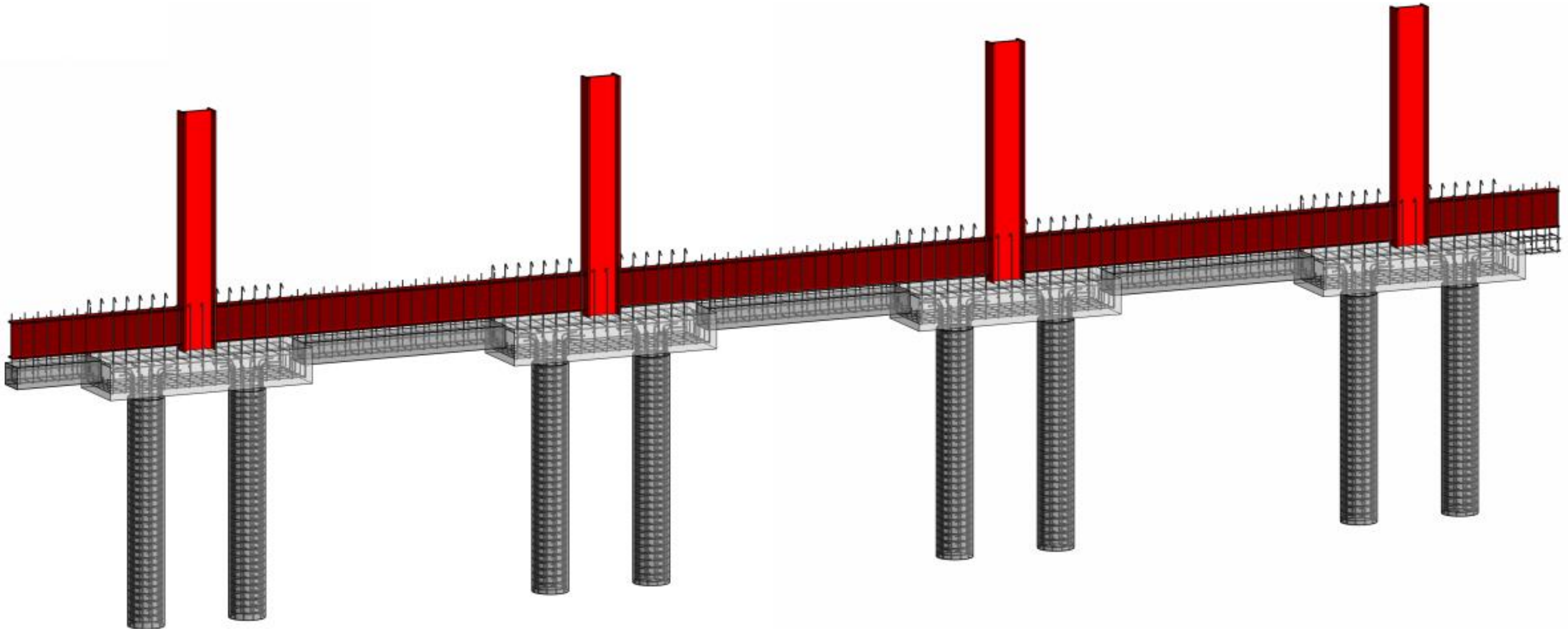
Construction Sequencing – WF in Grade Beams



2nd Construction Sequence | Erect Steel Columns

Case Study

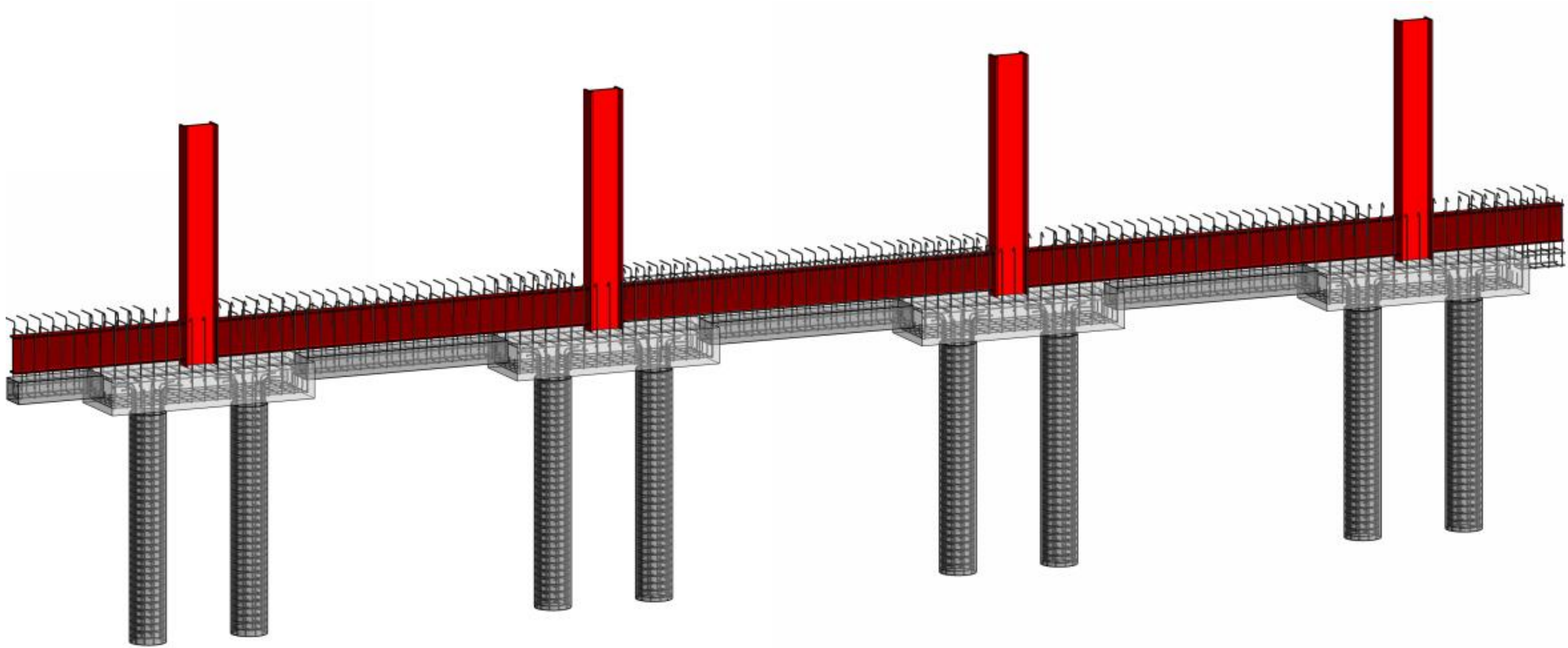
Construction Sequencing – WF in Grade Beams



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

Case Study

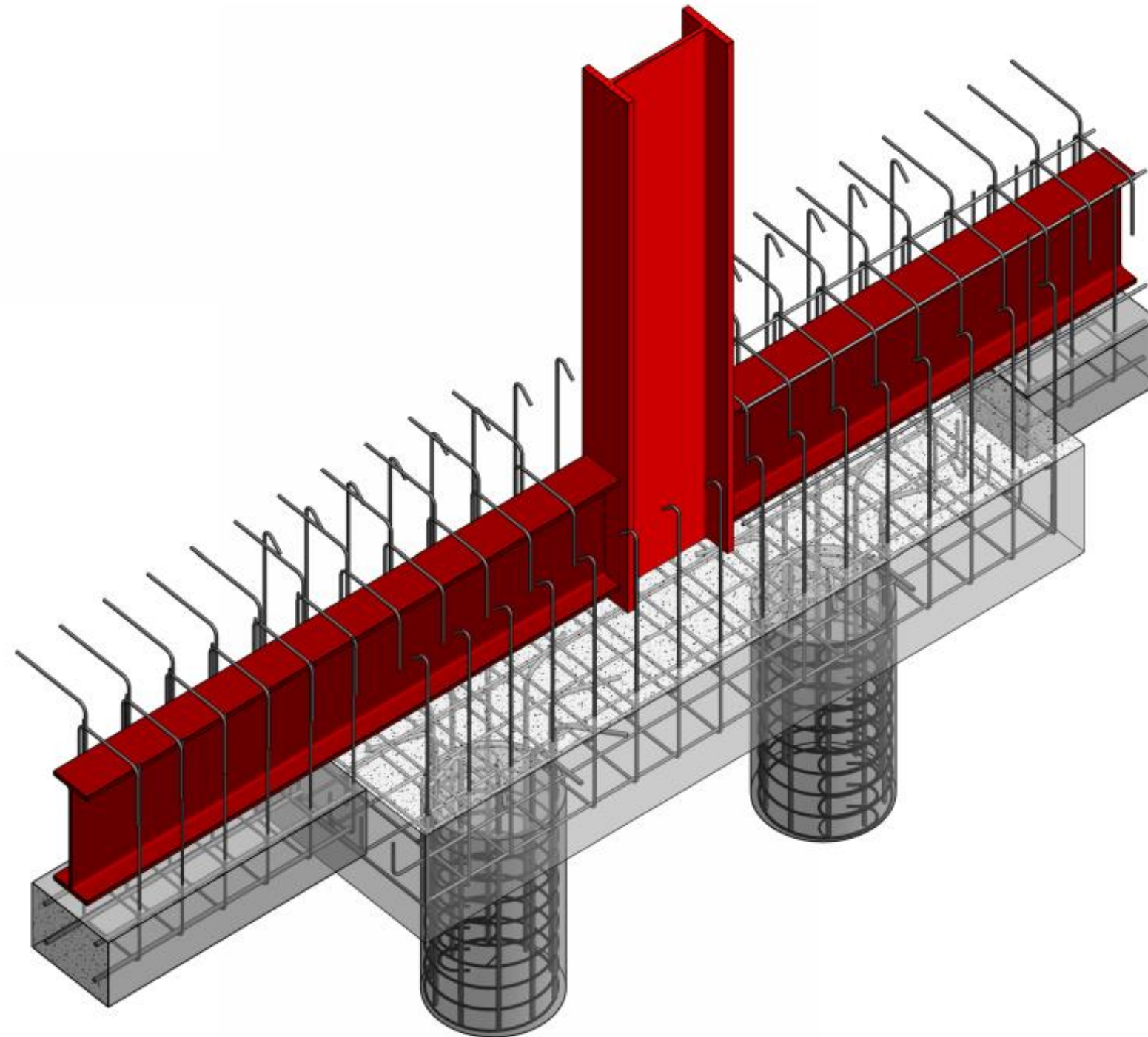
Construction Sequencing – WF in Grade Beams



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

Case Study

Construction Sequencing – WF in Grade Beams



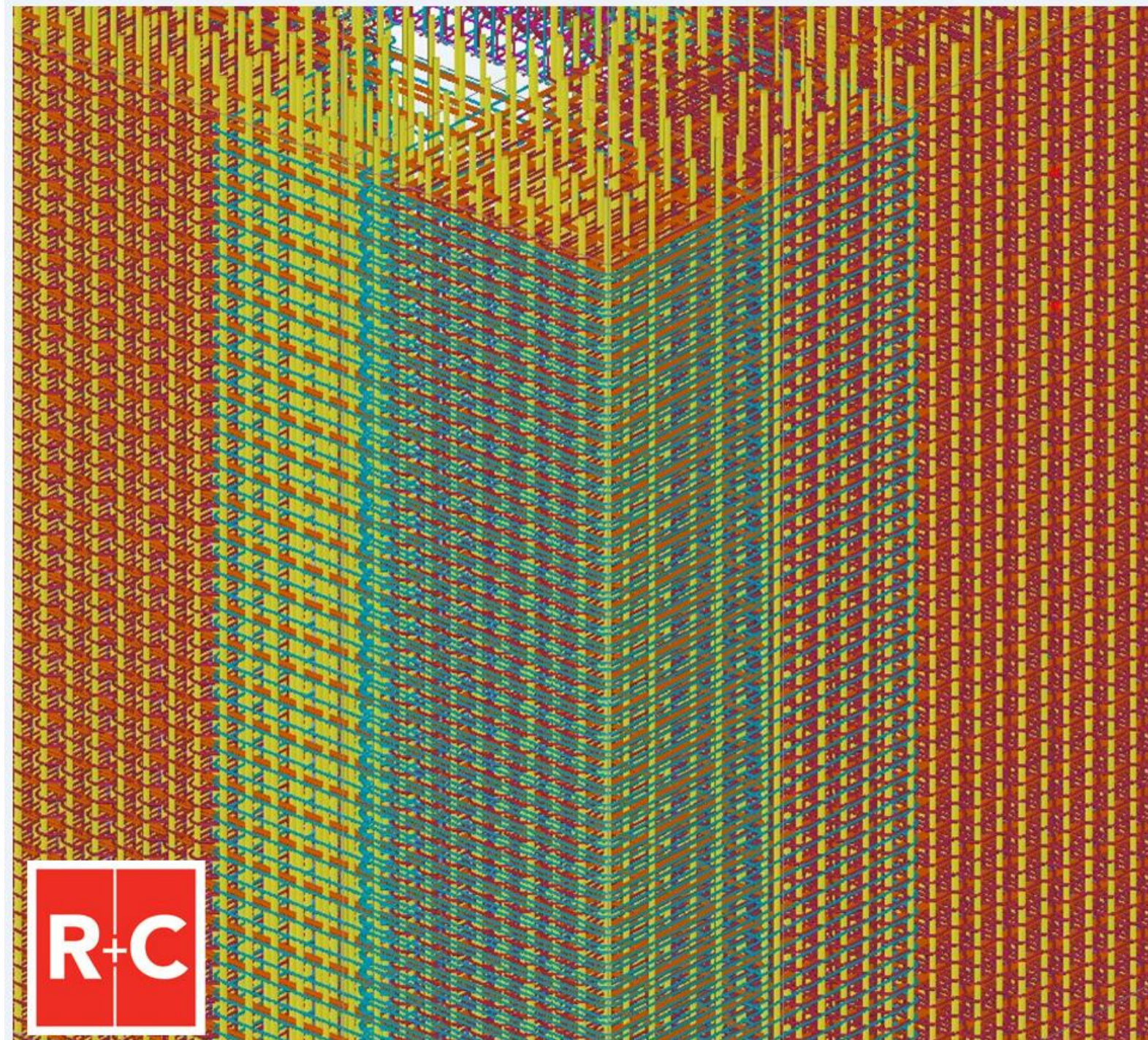
Enlarged View | Beam Column Joint

2) **Value of BIM to Fabrication** **Modeling Rebar in Design**

Exploring Economy of Grades of Reinforcement

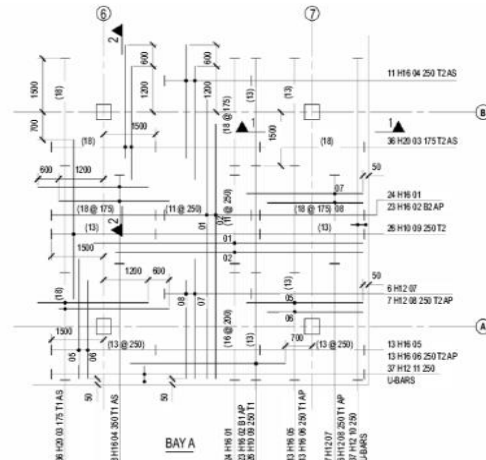
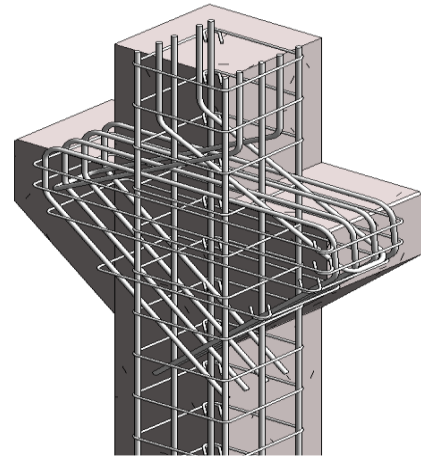
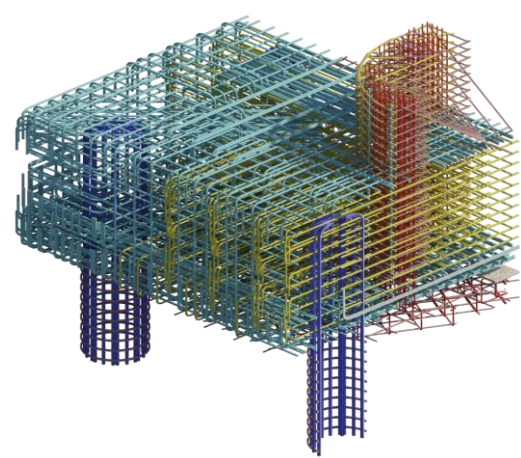
2) Value of BIM to Fabrication

Modeling Rebar – Core Walls in High Seismic Zones



3) Tools for Modeling Rebar

3) Tools for Modeling Rebar Released in Revit 2015
















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DR MARGERY STREET, LONDON

STATUS	DATE
APPROVED	14/05/2019
Drawn By	BJF
Checked By	
Revised	
Date	
Last Revised	14/05/2019

Excavation	Star Reinforcing schedule	Project No	2205	Revision	14/05/2019				
Level	Ground Floor	Drawn By	BJF	Last Revised					
LOCATION	Bar DETAIL PARTICULAR	TYPE AND SIZE	NUMBER OF SETS	NUMBER BAR SET	TOTAL NUMBER	LENGTH m±	BAR SHAPE	BAR CROSS SECTION	WGT KGS
Detail A		W32	1	5	5	4000	5 STRAIGHT	1	16.97
		W32	1	10	10	350		2	5.32
		W32	1	4	4	1070		200 - 200 - 150	12.48
		W32	1	14	14	1500		600 - 600	51.76
		W32	1	2	2	1470		500 - 500	2.61
		W32	1	6	6	1620		1000 - 1000	9.72
Detail B		W32	1	7	7	350		1000 - 1000	3.88
		W32	1	12	12	1070		400 - 400 - 450	19.78
		W32	1	80	80	2000		500 - 500	146.20
		W32	1	45	45	2020		500 - 500	224.74
		W32	1	20	20	1070		100 - 100	49.77
		W32	1	20	20	1070		100 - 100	49.77

This schedule conforms to BS 9852: 1999

Reference: Total weight bar reinforcement

Total weight on this page (kg) =

535.66



Rebar for Parts

Individual Fabric Sheets

Multi Rebar Sets Annotation

- Rebar Numbering

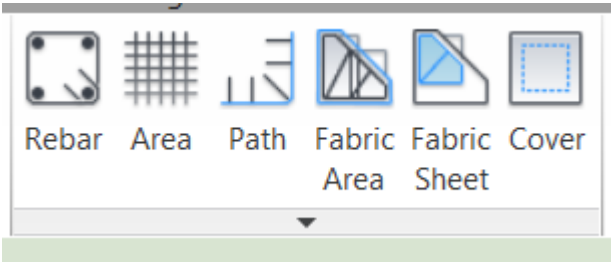
- Images in Schedules

- Documenting Rebar sets

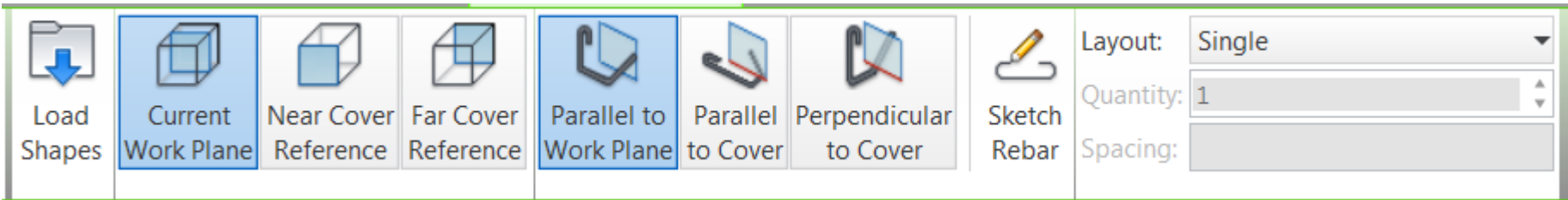
3) Tools for Modeling Rebar

Basic Tools

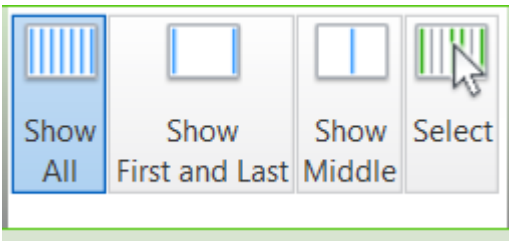
Basic Tools



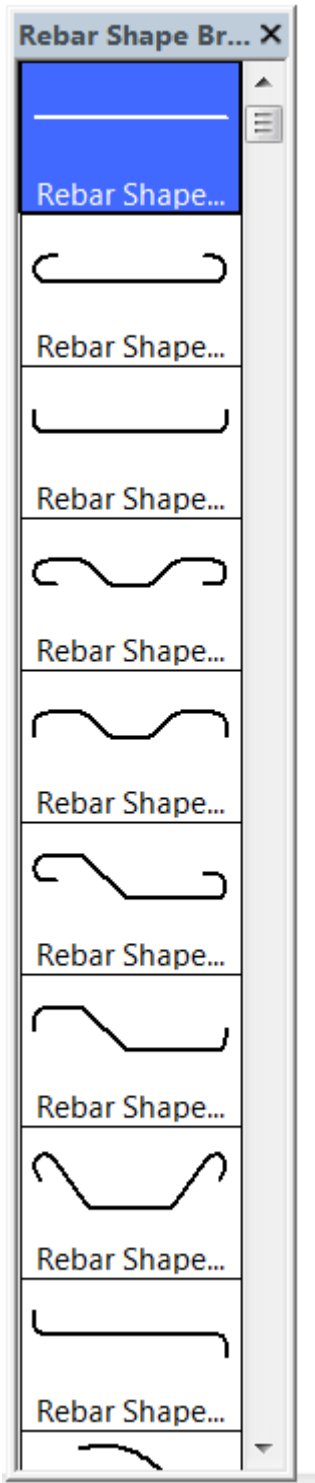
Modeling Tools



Advanced Annotation

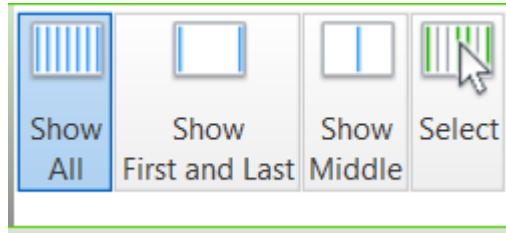
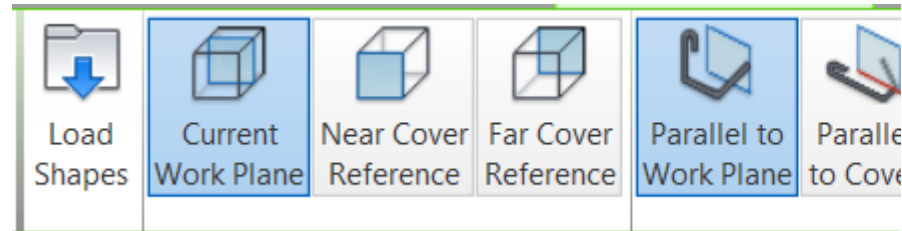
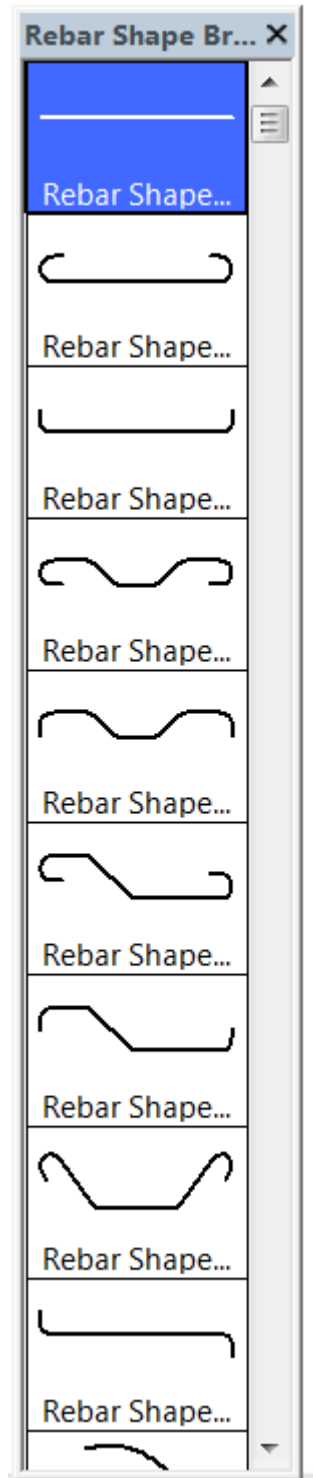


ACI Standard Shapes



3) Tools for Modeling Rebar

Basic Tools



Properties

Rebar Bar #4

Structural Rebar (1) Edit Type

Construction

Partition	SOG 2
Rebar Number	1
Schedule Mark	1
Pour Mark	
Style	Standard
Shape	00
Shape Image	<None>
Hook At Start	None
Hook At End	None
Rounding Overrides	Edit...

Rebar Set

Layout Rule	Maximum Spacing
Quantity	29
Spacing	0' 11 251/256"

Graphics

View Visibility States Edit...

Structural

Reinforcement Volume	2522.50 in ³
----------------------	-------------------------

Layers

Level	
-------	--

Dimensions

Bar Length	36' 11" (36' - 11")
Total Bar Length	1070' - 7"
A	0' 0" (0' - 0")
B	36' 11" (36' - 11")

[Properties help](#) Apply

Rebar Element View Visibility States

Show rebar element unobscured and/or as a solid in 3D views (in fine level of detail).

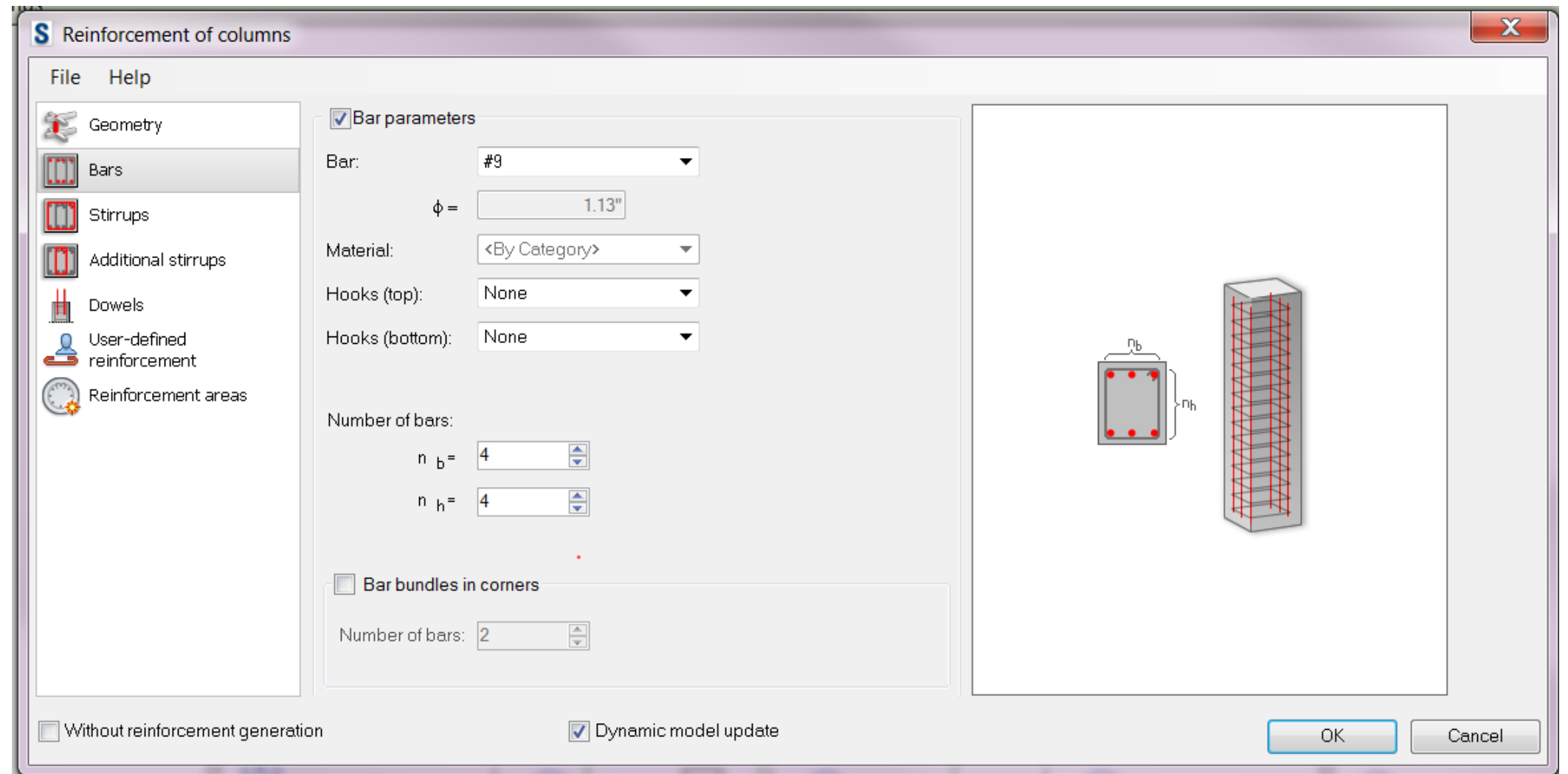
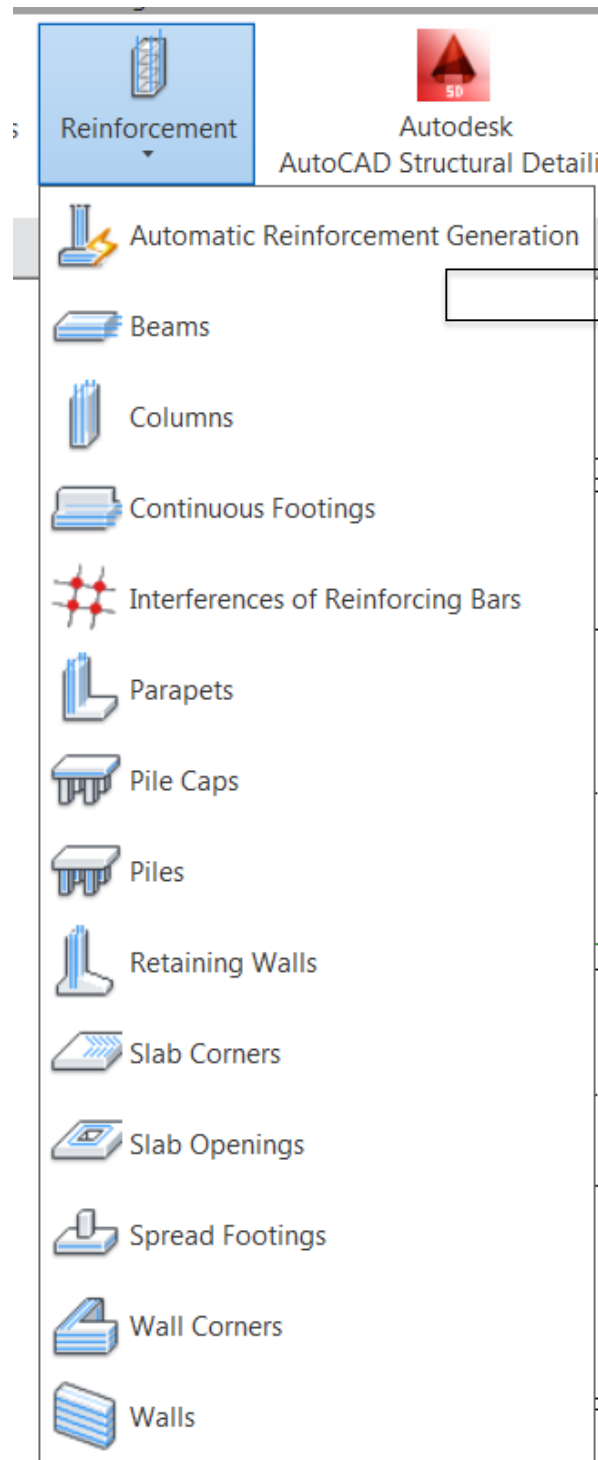
Click on column headers to change sort order.

View Type	View Name	View unobscured	View as solid
3D View	3D_Analysis Export	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3D View	3D_Model Coordinati	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3D View	SOG REBAR	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3D View	{3D}	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3D View	WEST BASEMENT W	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3D View	{3D - dsb}	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3D View	WEST BASEMENT W	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3D View	B2	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3D View	D2	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3D View	B3	<input type="checkbox"/>	<input type="checkbox"/>
3D View	D3	<input type="checkbox"/>	<input type="checkbox"/>
3D View	C3	<input type="checkbox"/>	<input type="checkbox"/>
3D View	C2	<input type="checkbox"/>	<input checked="" type="checkbox"/>

OK Cancel

3) Tools for Modeling Rebar

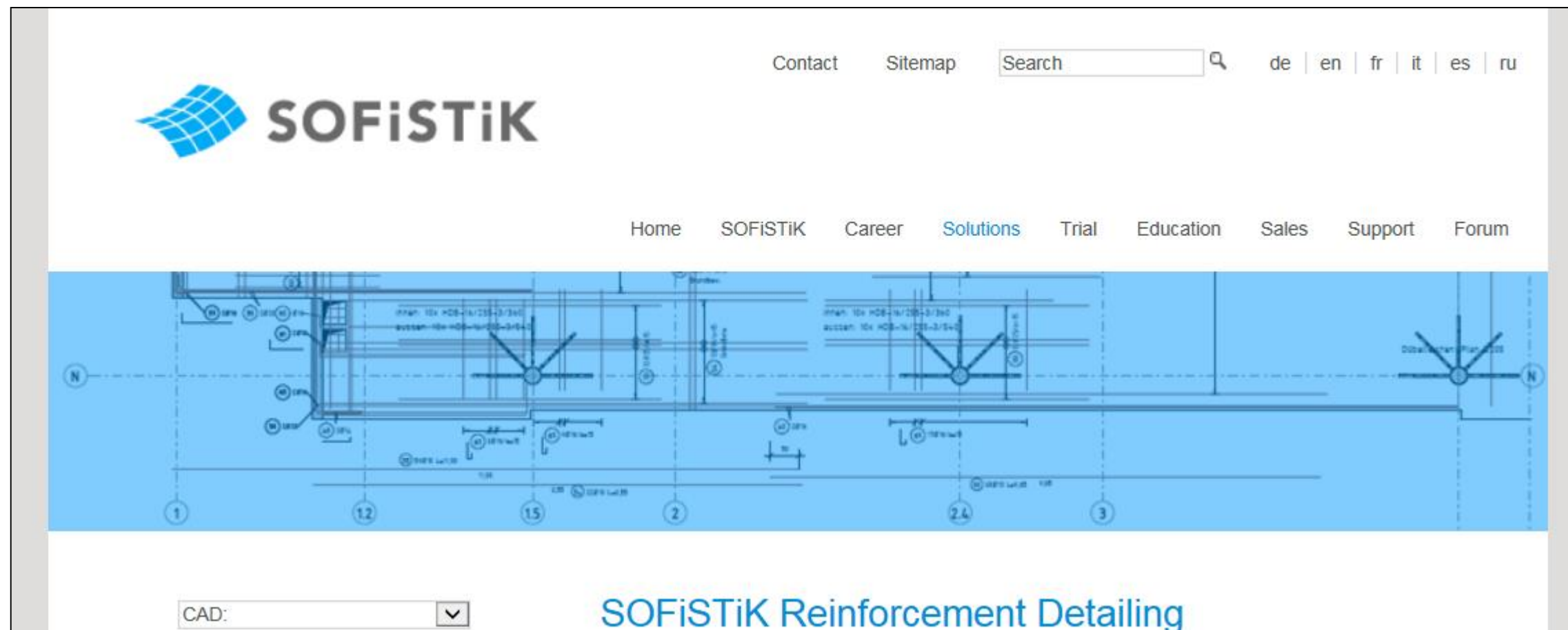
Extension Tools



3) Tools for detailing shop drawings - LOD 400

Autodesk Partners

SofiTik – 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)

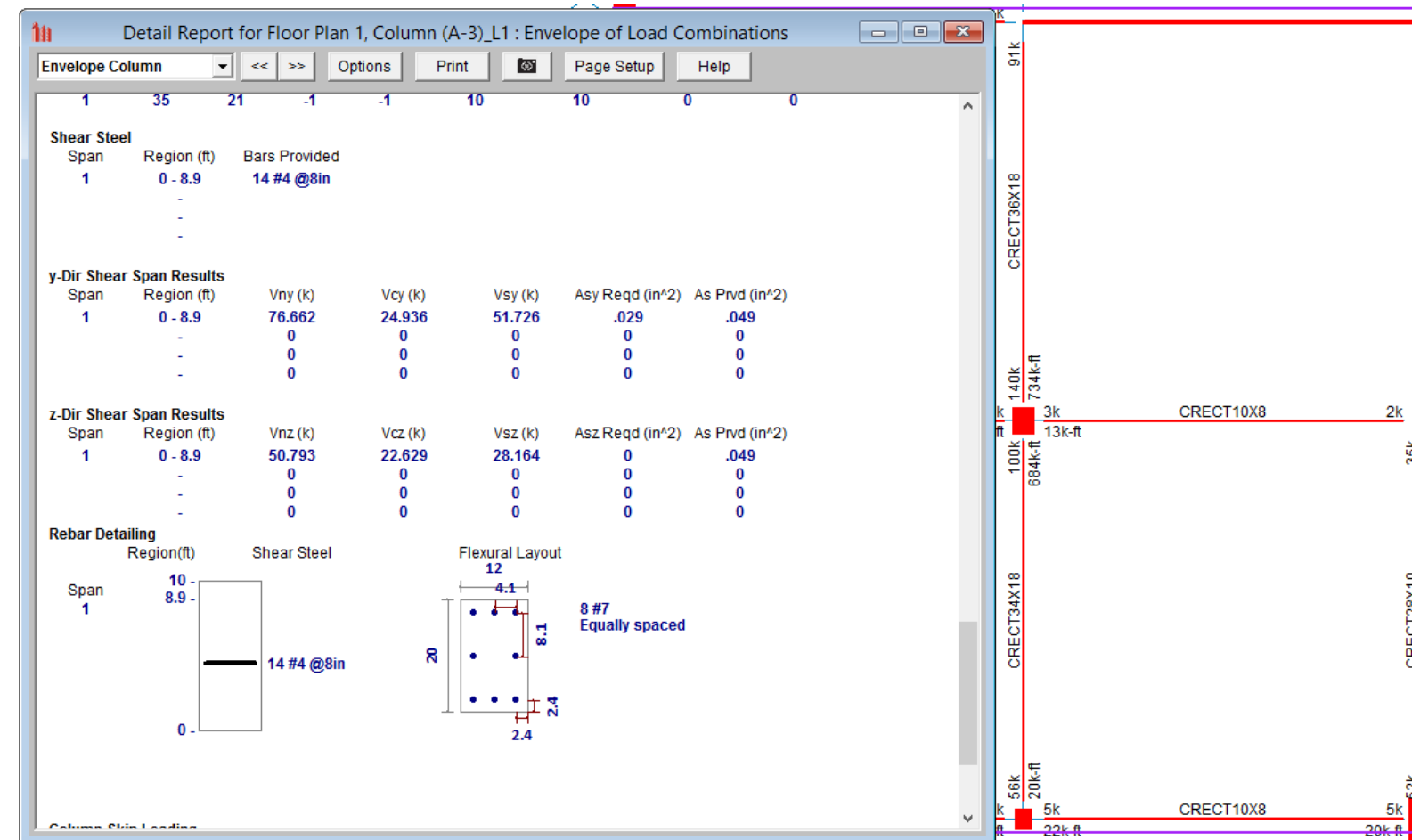
The screenshot displays the ADAPT website interface. At the top is the ADAPT logo. Below it is a navigation bar with links for BUILDING, BRIDGE, CONSULTING, PURCHASE, and SUPPORT. The main heading reads "Integrated Reinforced & Post-Tensioned Concrete Building Design Software". A paragraph below states: "For over 30 years, engineers worldwide have relied on ADAPT's industry leading software solutions to achieve productivity and accuracy in their projects. Since 1981, ADAPT has been the most popular and recognized software for the design of reinforced and post-tensioned concrete. Now, ADAPT is as widely used for the design of conventionally reinforced concrete structures as it is for post-tensioned concrete." Below this, a central graphic illustrates the software's capabilities with five key features:

- ADAPT-Edge Analyzes Full Building Model for Lateral and Gravity Loads**: Accompanied by a 3D model of a building frame.
- ADAPT-Floor Pro® - Designs Individual Levels and Automatically Combines Lateral and Gravity Analysis Results from the Building and Individual Slab Solutions**: Accompanied by a 3D model of a floor slab.
- ADAPT-MAT® - Designs Mat Foundations Using Automatically Generated Load Take-down**: Accompanied by a 3D model of a foundation mat.
- ADAPT-Builder with Edge offers a Fully Integrated Modeling Approach for your RC/PT Building Projects**: Accompanied by a 3D model of a building frame.
- Easily Extract all Column and Shear Wall Design Loads**: Accompanied by a screenshot of a software output table.

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

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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)


aSa | The Complete Rebar Solution*


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aSa Rebar Software Solutions

**Video**
6-minute overview of aSa

**Brochure**
Complete Rebar Solution* summary

**Flow Chart**
Interactive! See how aSa modules fit together

aSa's fully integrated suite of software products automates all aspects of reinforcing steel fabrication. The system is modular, allowing you to install only the components you need today with the option to expand as your needs grow.

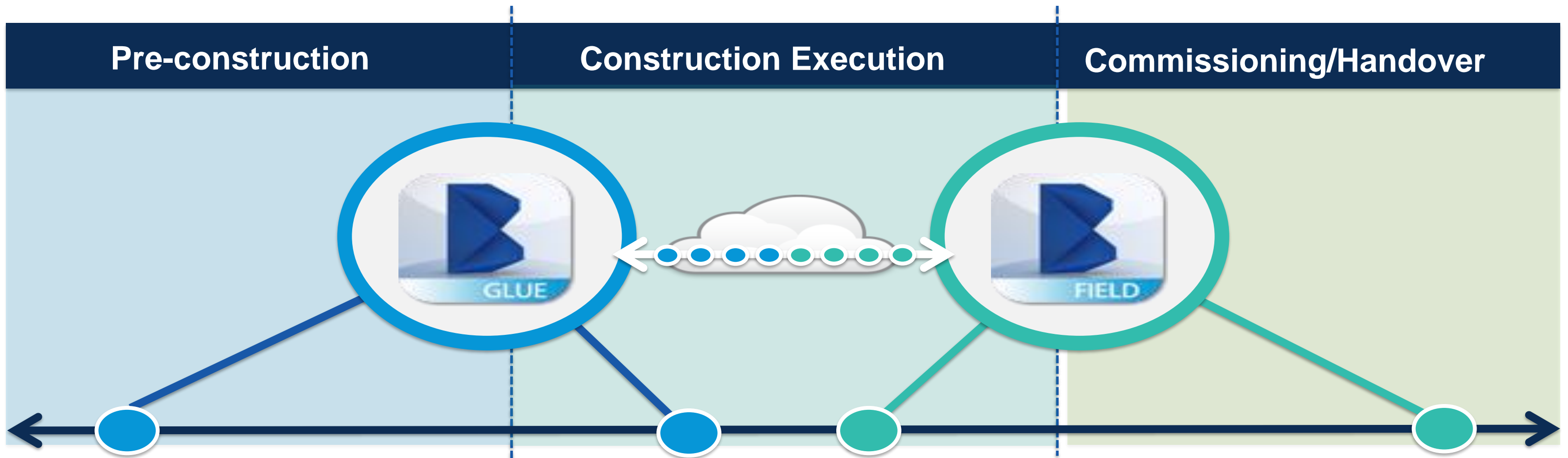
"I looked at other products, but, from experience, I knew that aSa had a much more complete and user-friendly system."

Gary Rhodes
President, NuFab, Inc.,
North Carolina

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

Design

Fab

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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