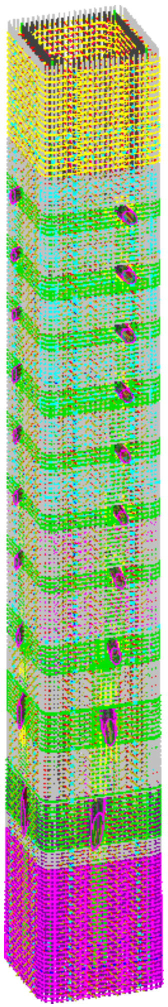
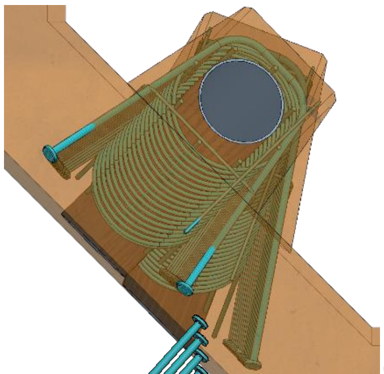
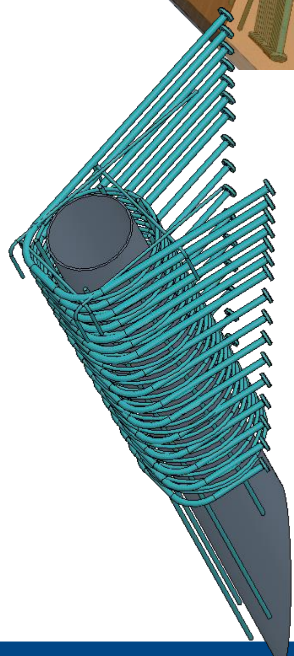
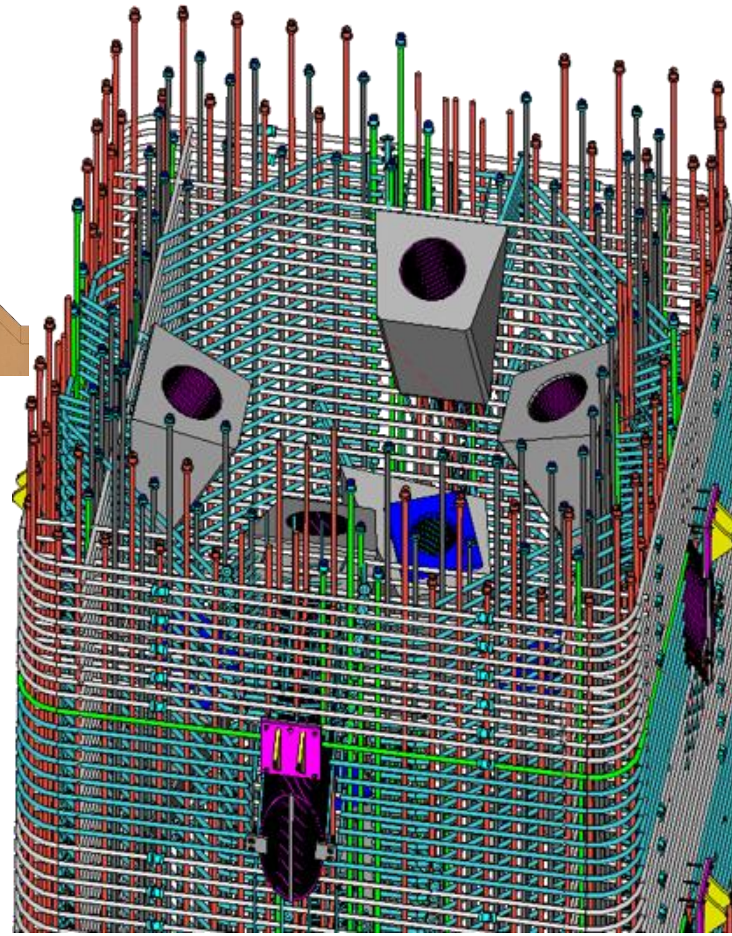
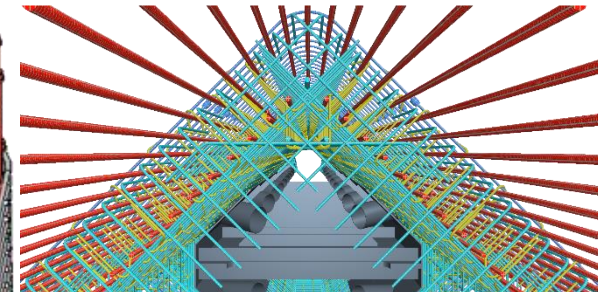
Latest Developments in VDC from Rebar Detailing and Fabrication Perspective

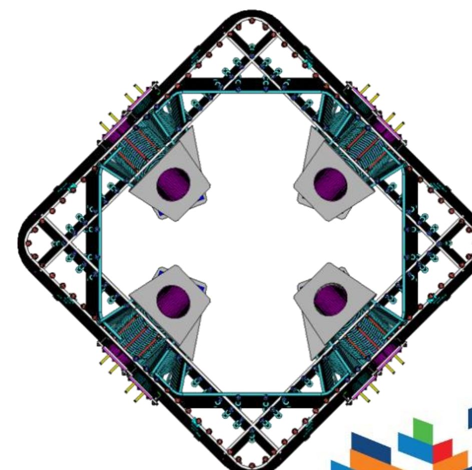










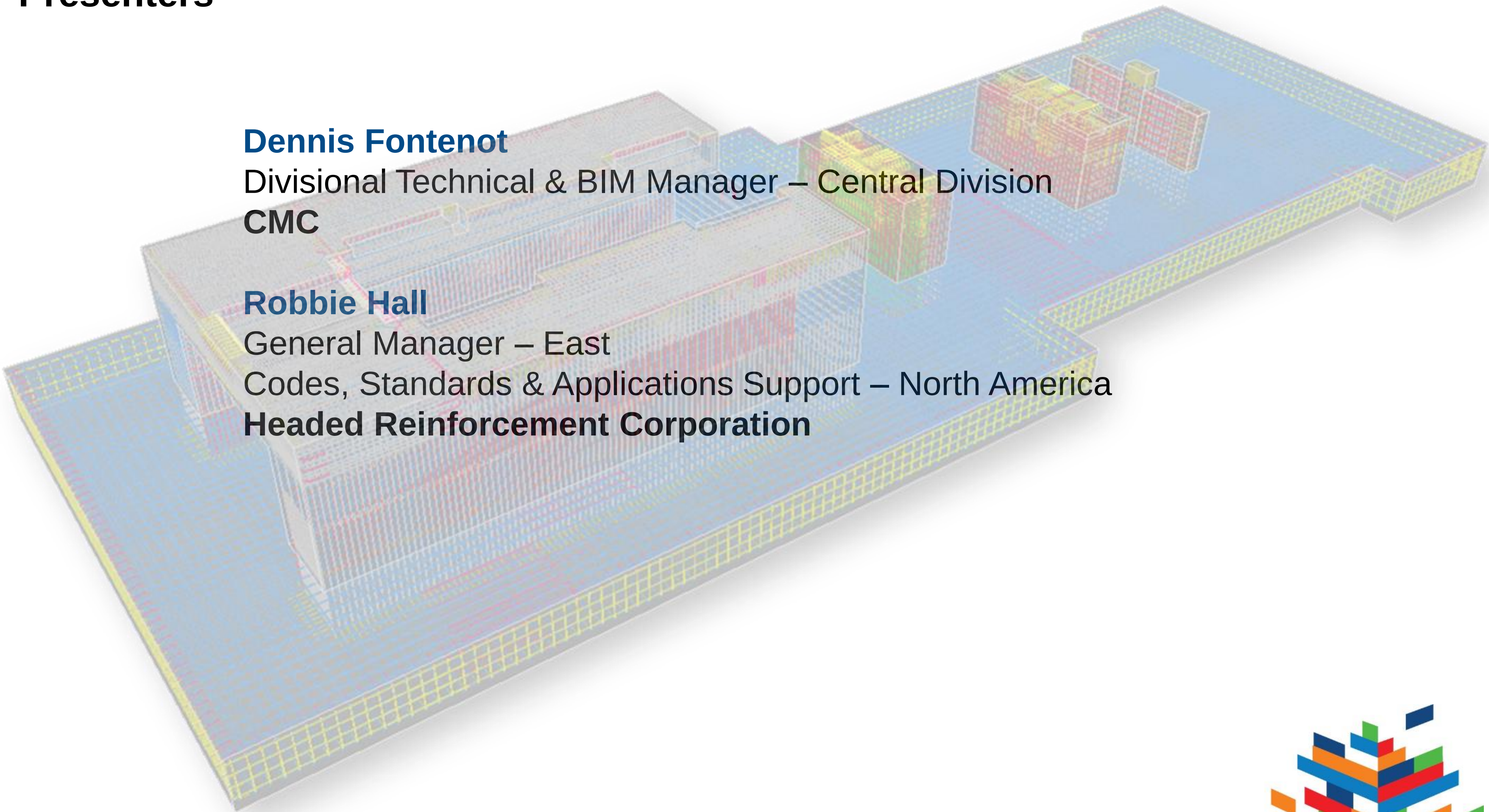


THE WORLD’S GATHERING PLACE FOR ADVANCING CONCRETE

aci CONCRETE CONVENTION

Presenter Introductions

Presenters



Dennis Fontenot
Divisional Technical & BIM Manager – Central Division
CMC

Robbie Hall
General Manager – East
Codes, Standards & Applications Support – North America
Headed Reinforcement Corporation

Presenter Introductions

Dennis Fontenot

Divisional Technical & BIM Manager – Central Division

CMC

- *38 years CMC*
- *Detailing, Area Detailing Manager, Project Management, Estimating, Training, Business Analytics and Process Improvements.*
- *Technology, Software Development and Implementation.*
- ***CRSI Committees:** Reinforcing Bar Detailing, BIM Task Group, Standards, Placing Reinforcing Bars, Durability, Manual of Standard Practice, and Engineering Practice*
- ***ACI Committees:** 117 Tolerances,131 Building Information Modeling, 315 Details of Concrete Reinforcement, and 315B Constructability.*

Presenter Introductions

Robbie Hall

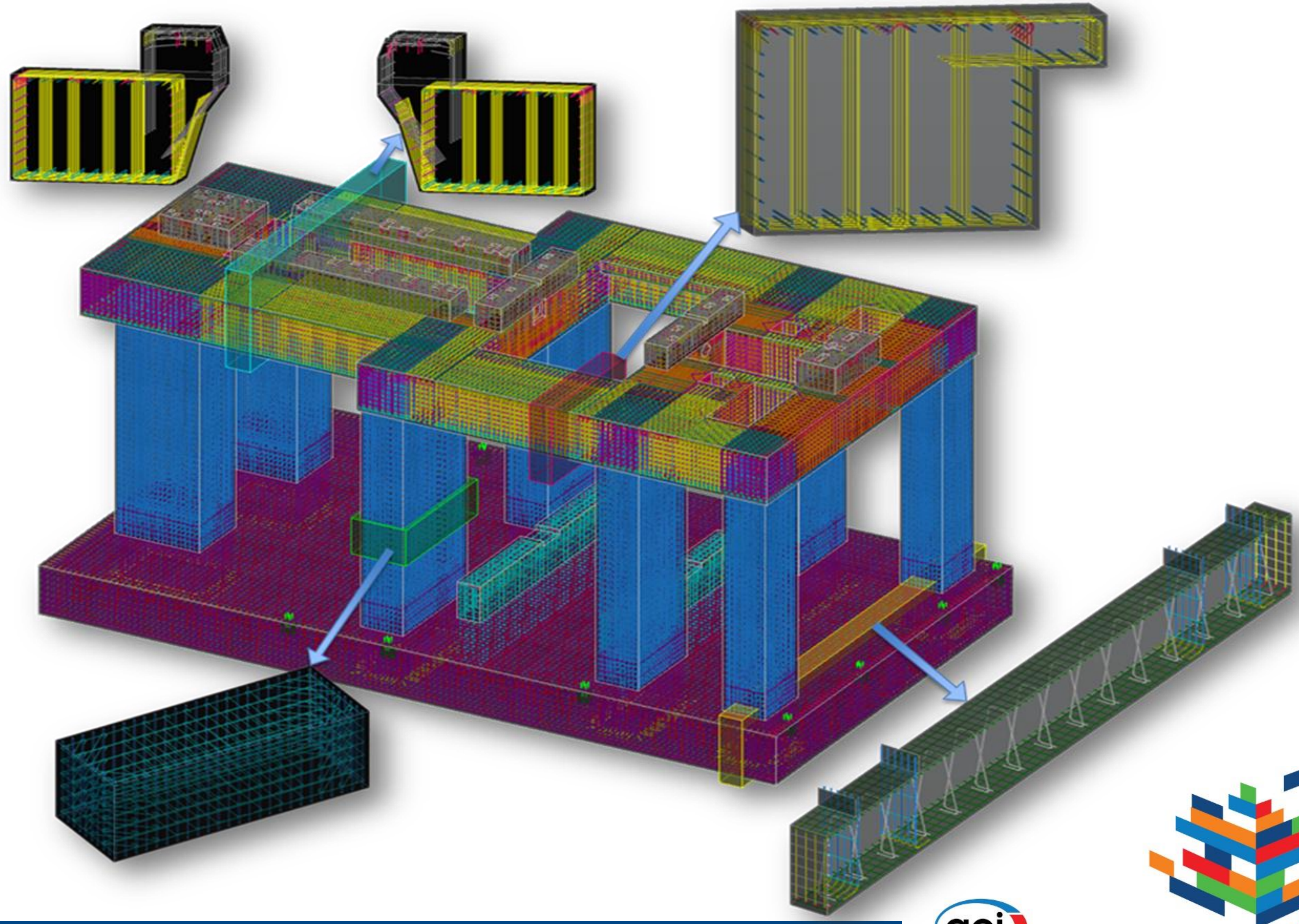
General Manager – East

Codes, Standards & Applications Support – North America

Headed Reinforcement Corporation

- *22 years in the reinforced concrete industry. Prior to joining HRC, spent 17 years with multiple Rebar Fabricators focused on Detailing, Project Management, Detailer Training and Management of Detailers.*
- ***ACI Committees** : 117 Tolerances, 131 Building Information Modeling, 315 Details of Concrete Reinforcement, 408 Bond and Development of Steel Reinforcement, 408A Mechanical Reinforcing Bar Anchorages and Splices*
- ***ASCE** Construction Institute Sub-Committee on Rebar Cages*
- ***ASTM** Committee A01.05.01 on Reinforcing Bars*
- ***CRSI Committees** : Engineering Practice (Vice Chair), Manual of Standard Practice (Vice Chair), Placing Reinforcing Bars, Reinforcement Anchorages and Splices (Vice Chair), Reinforcing Bar Detailing (Chair) Reinforcing Bar Fabrication, Research and Development*
- ***RSIC** : Technical Committee*

CRSI Reinforcing Bar Detailing Committee



CRSI Reinforcing Bar Detailing Committee

Detailing Committee Overview

- *Responsible for keeping current in the practice of estimating and detailing of reinforcing bars.*
- *Develops and maintains the publication Reinforcing Bar Detailing and the Reinforcing Bar Detailer Training Program, as well as Chapters 5, 6, and Appendix C of the CRSI Manual of Standard Practice.*
- *Responsible for serving as a liaison with ACI 131 Building Information Modeling of Concrete Structures and ACI 315 Details of Concrete Reinforcement.*

BIM Task Group Overview

- *Formed in 2015*
- *Currently made up of 18 CRSI member companies representing software vendors, rebar detailing, fabrication & placing companies, concrete contractors and rebar accessory manufacturers*
- *Membership overlaps with ACI 131*
- *Published first Tech Note, Intro to BIM for Steel Reinforced Concrete, in 2021*

CRSI Reinforcing Bar Detailing Committee

Forward looking plans for Detailing Committee

- *While the committee scope includes maintaining publications that cover rebar detailing standards & standard practices as well as rebar detailer training, there will continue to be a heavy focus on BIM*

Forward looking plans for BIM TG

- *Complete the educational brochures discussed today*
- *Produce additional resources*

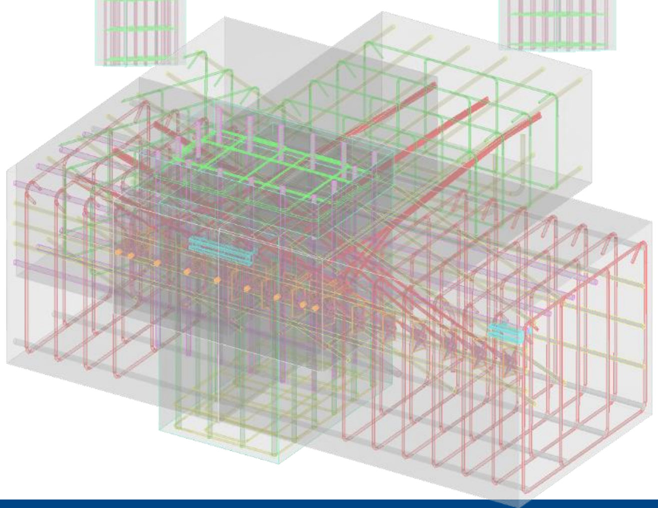
Relationship between CRSI BIM TG and ACI 131 Committee

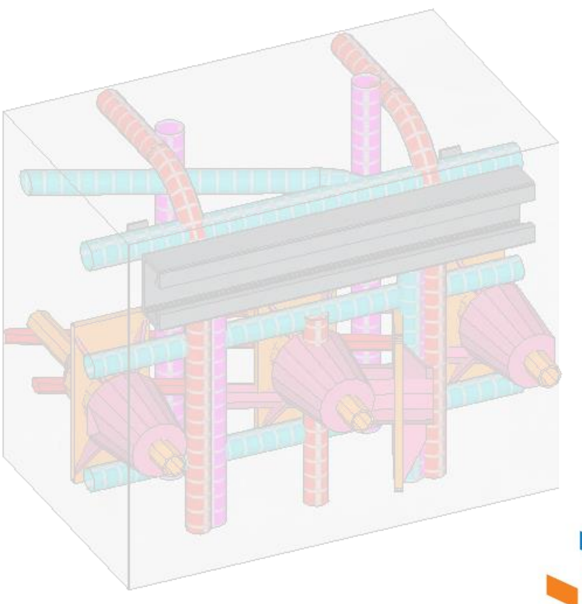
- *CRSI Detailing Committee members actively involved in ACI 131*
- *Coordination on existing Tech Notes (both CRSI and ACI)*
- *Continued coordination with future resources*

CRSI Constructability & Productivity Initiatives

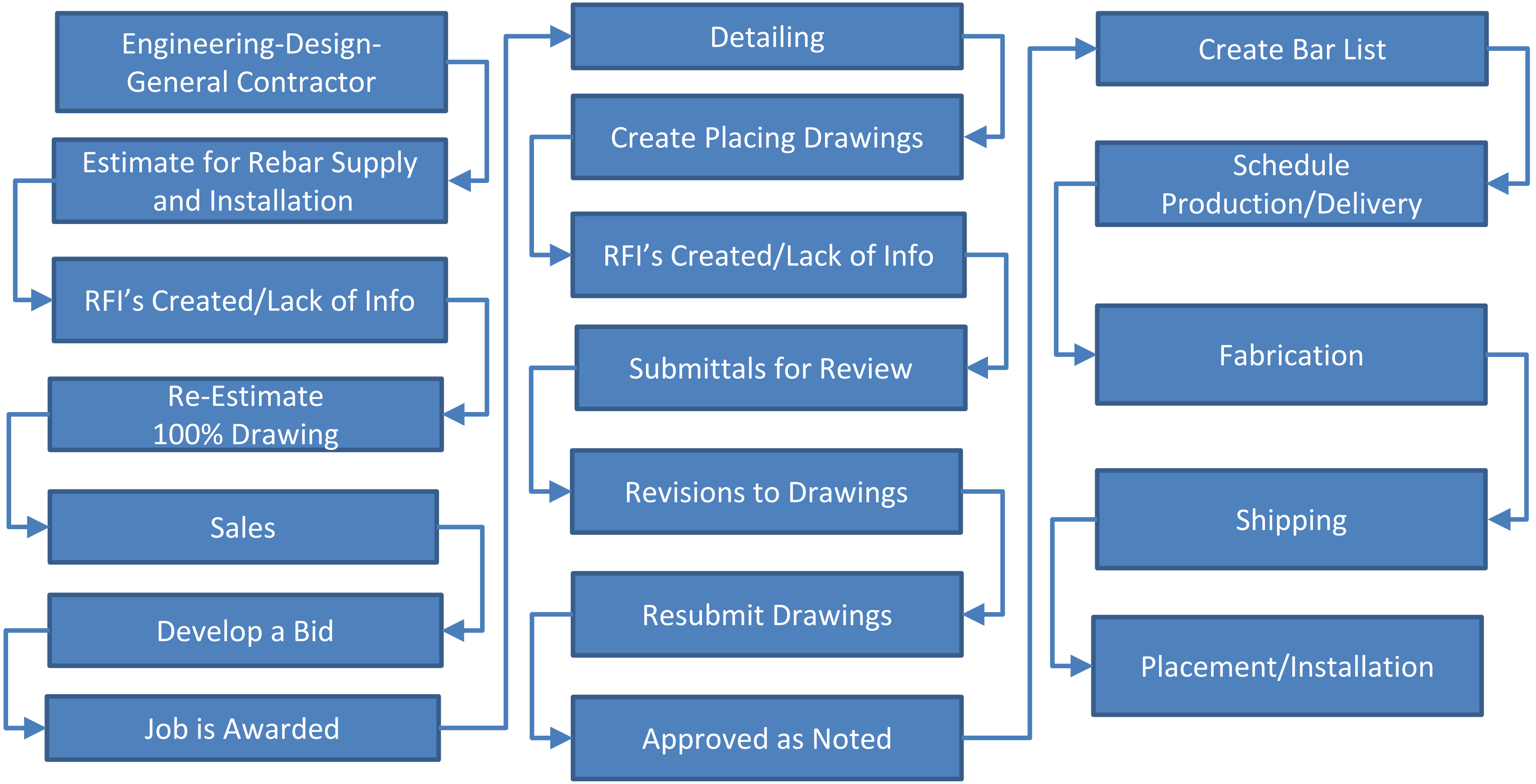
Related Constructability/Productivity initiatives at CRSI & ACI

- **CRSI Constructability + Communication Task Group: Mission Statement**
  - *Address construction-stakeholder identified issues via focus group and its participant expertise through the internal and external interactions (communications and physical) throughout project development and construction full life cycle.*



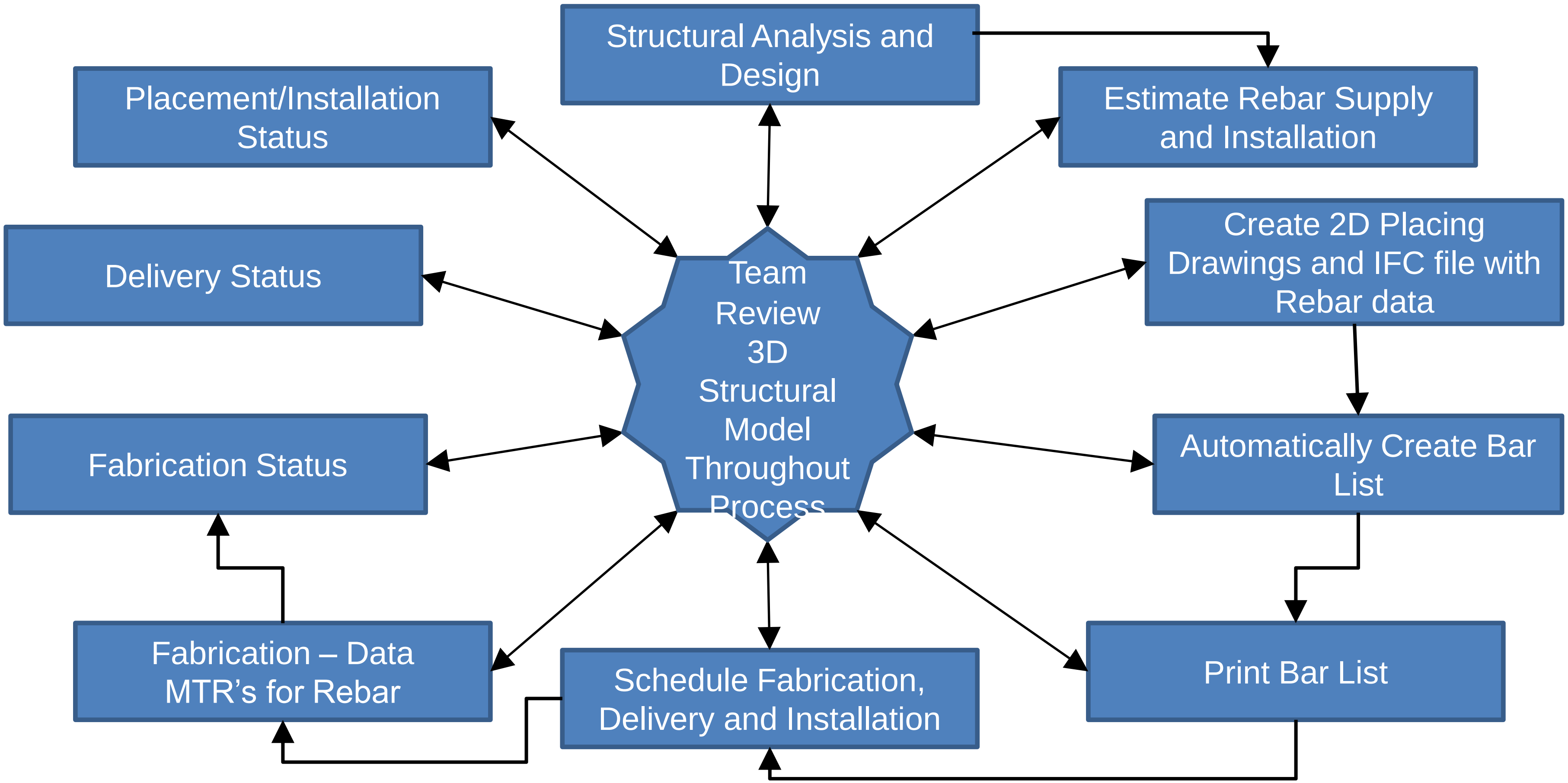


Enabling Collaborative Workflows



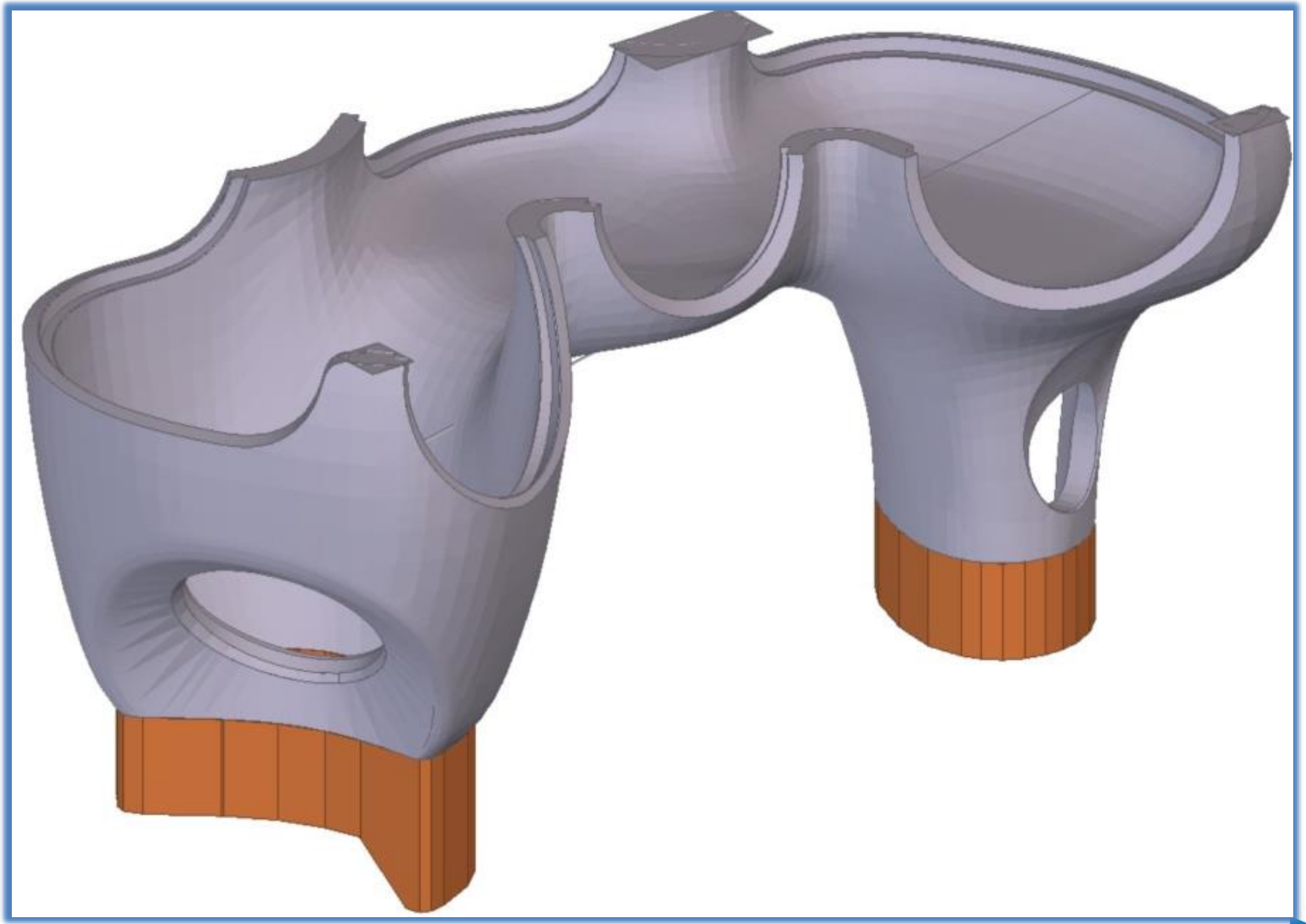
Need to go from a fragmented, linear process (engineering to construction) to…

Enabling Collaborative Workflows

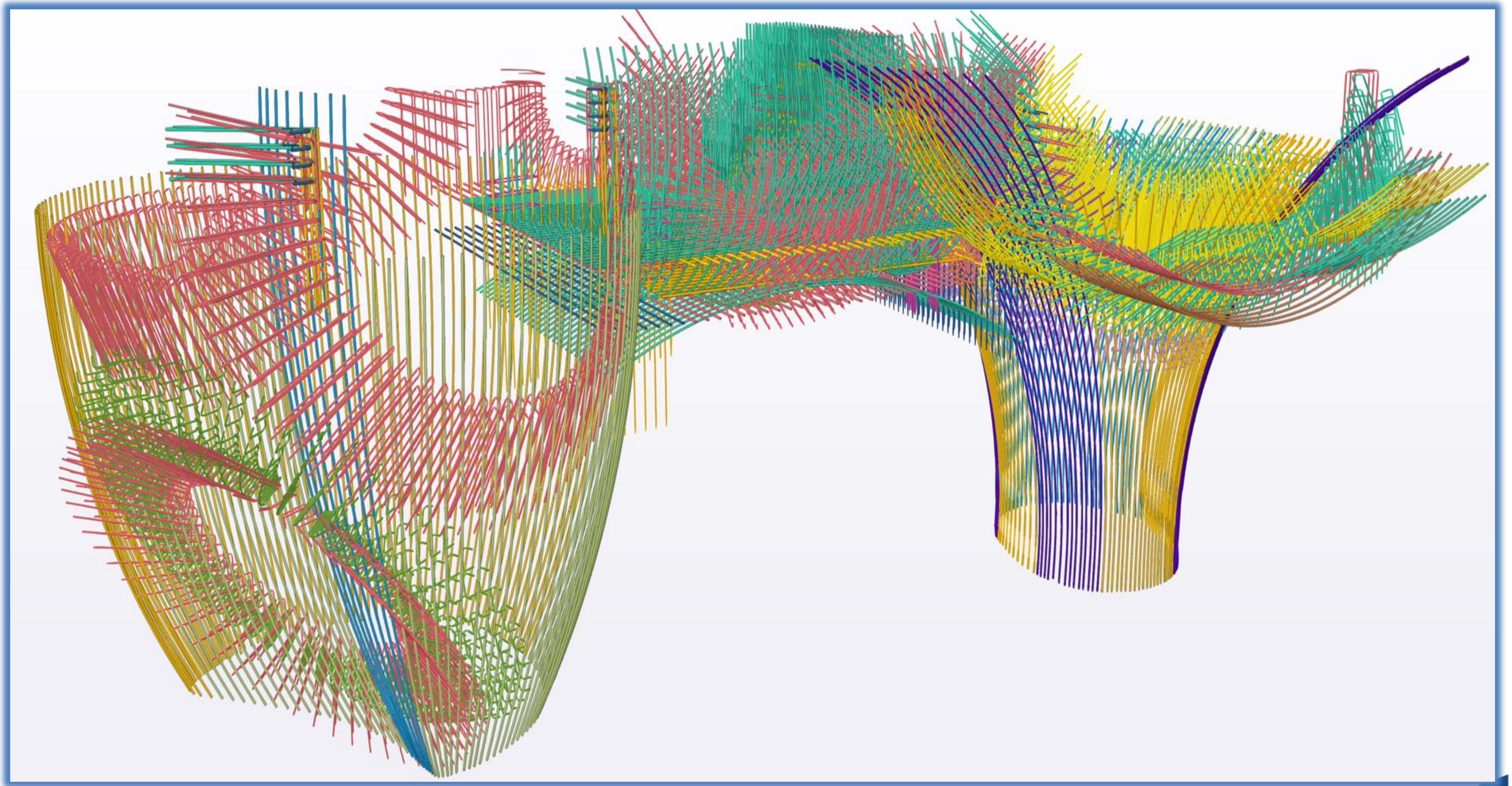


…A truly collaborative rebar workflow utilizing 3D structural model

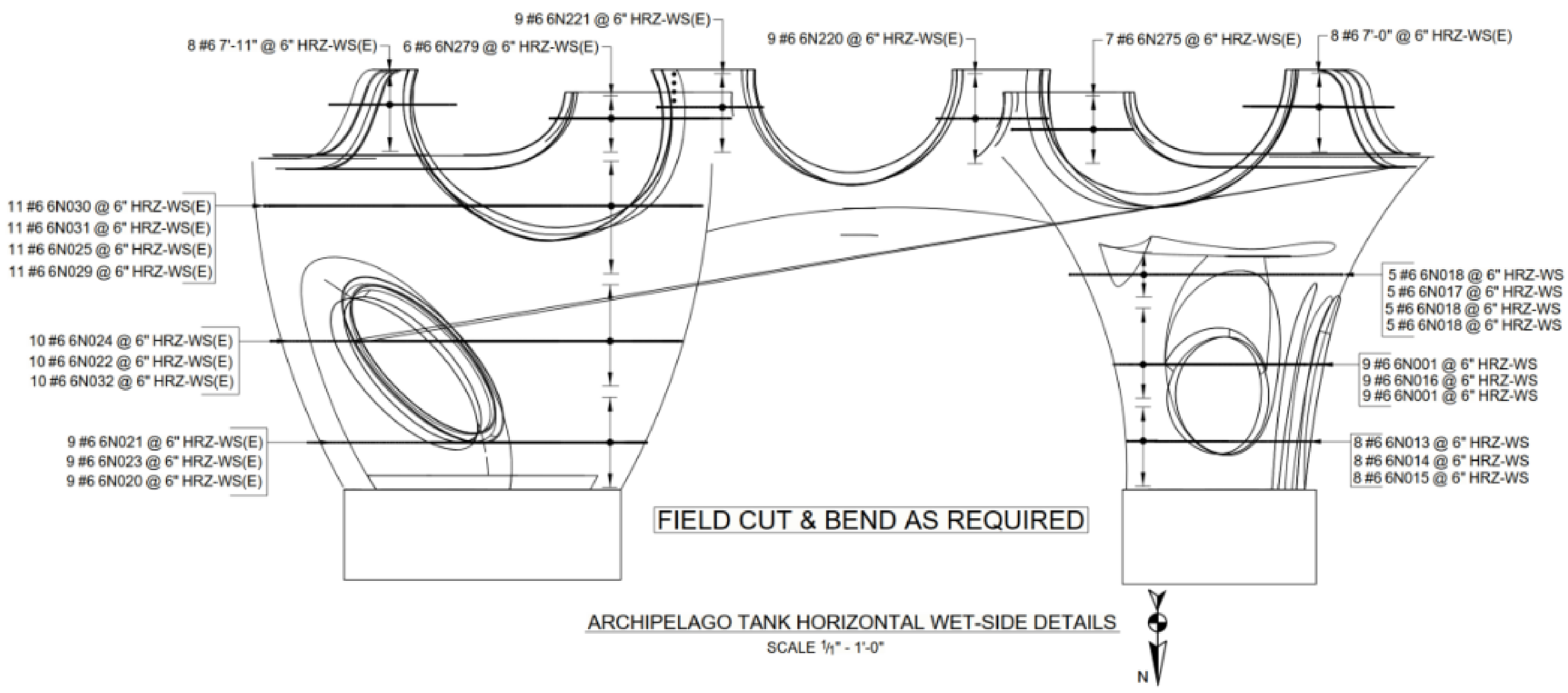
Collaborative Workflows With BIM



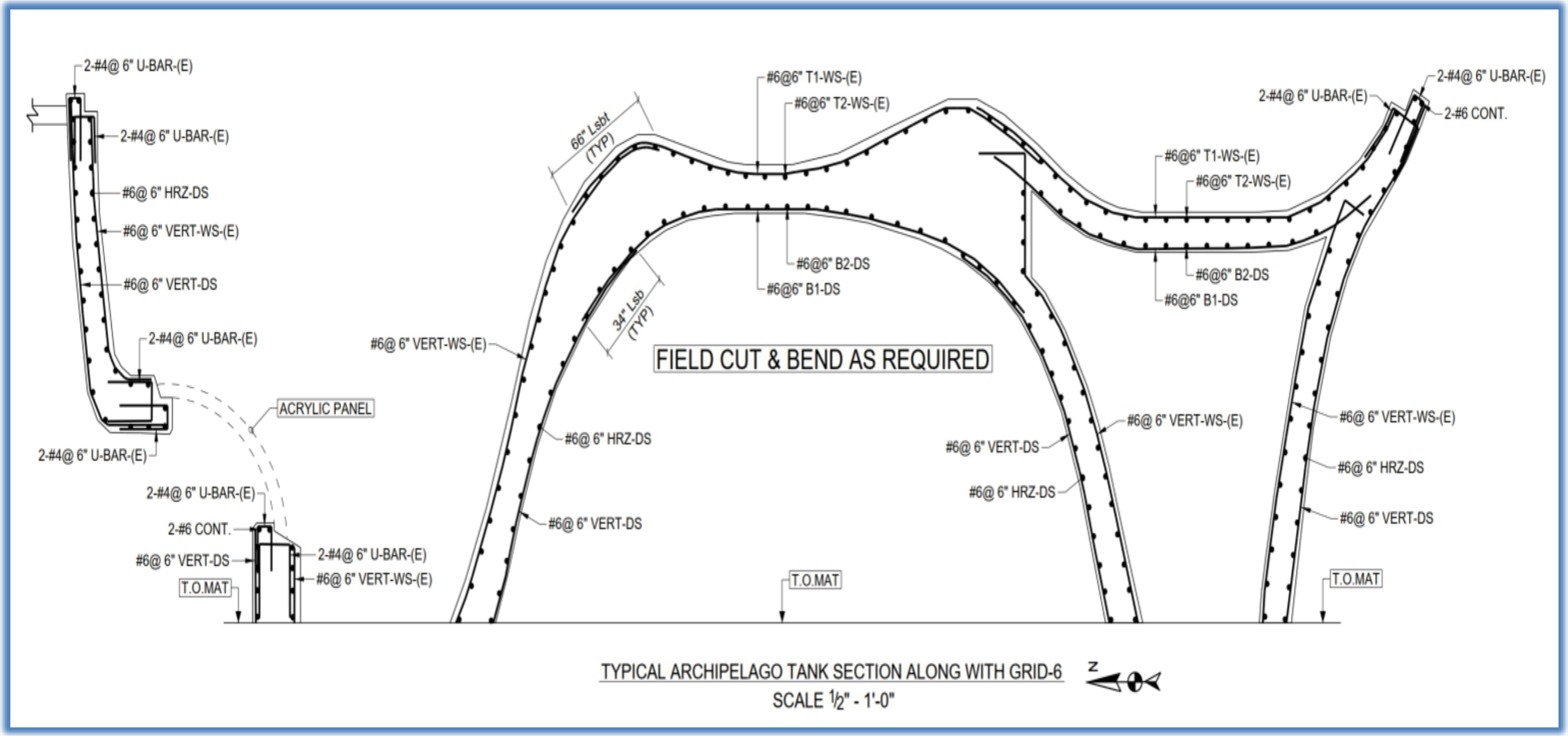
Collaborative Workflows With BIM



Collaborative Workflows With BIM

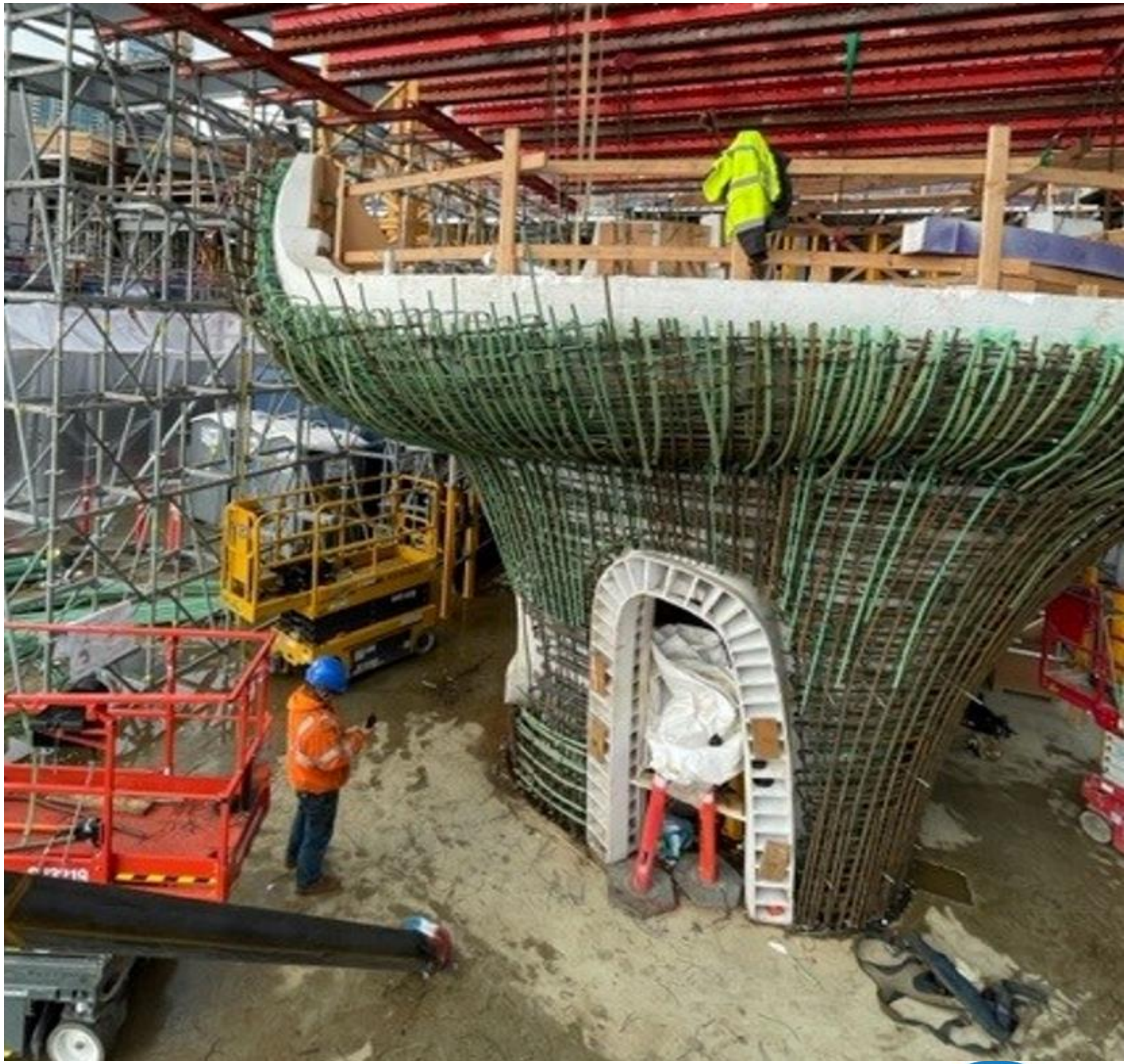


Collaborative Workflows With BIM

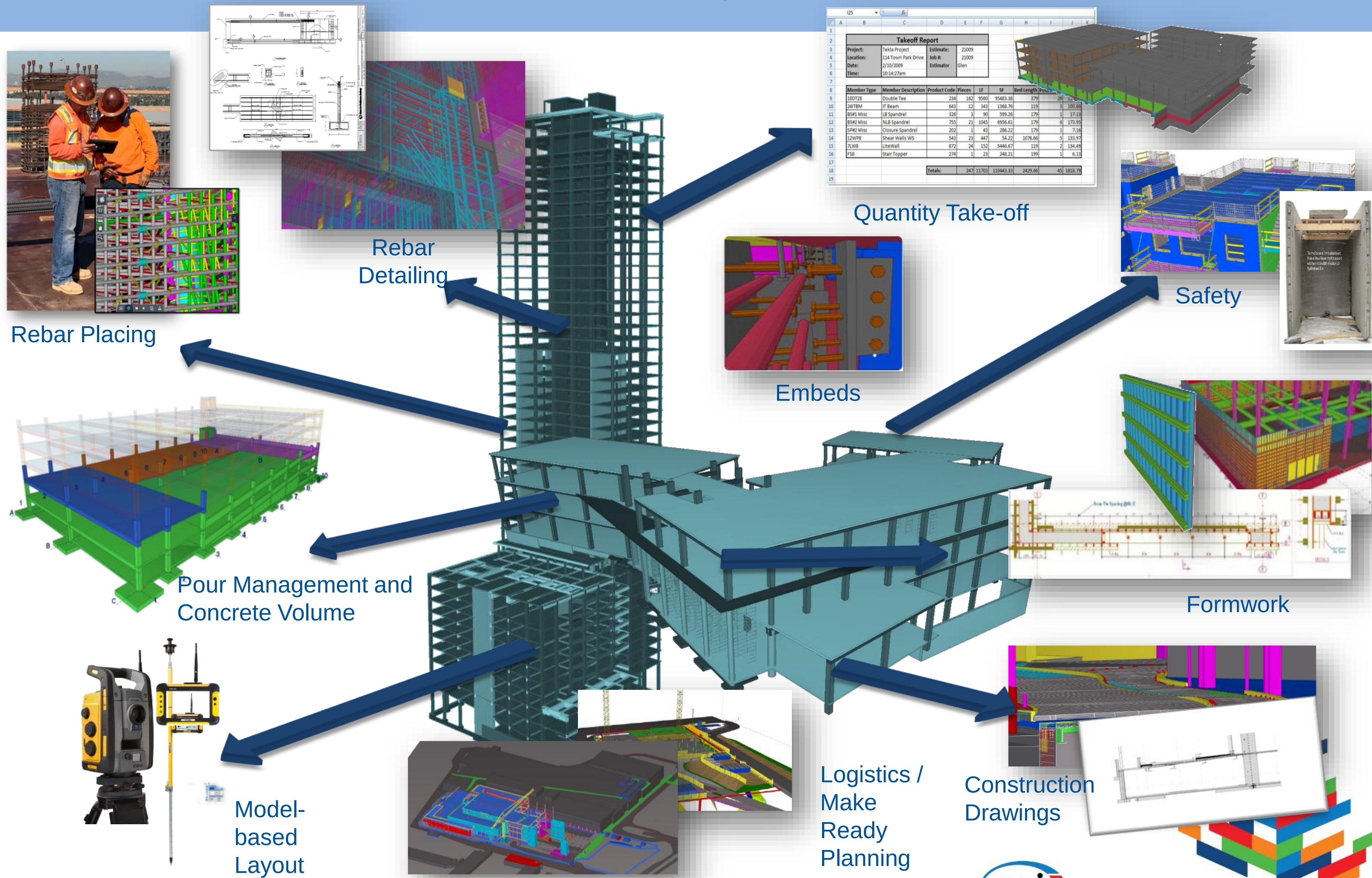


Collaborative Workflows With BIM

Collaborative Workflows With BIM



What are some of the benefits of using BIM in concrete construction?



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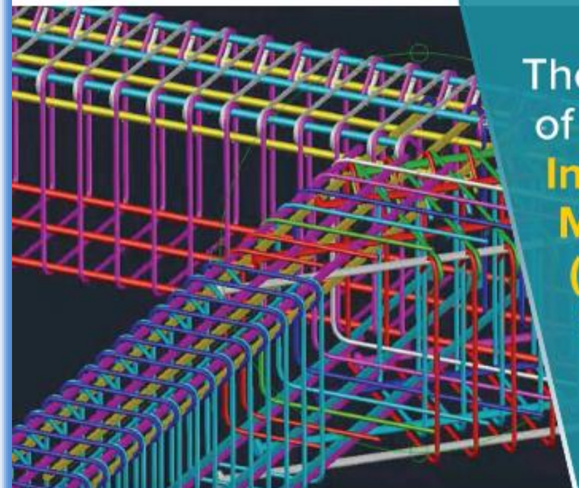
CRSI BIM Task Group Educational Brochures

CRSI Concrete Reinforcing Steel Institute

"Rebar modeling, in my opinion, is the next evolution of the BIM process as we continually migrate to a more manufacturing mindset."
– Don Josephson; Howard S. Wright, a Balfour Beatty Co.



The Benefits of Building Information Modeling (BIM) for Steel Reinforced Concrete

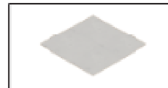
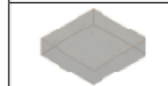
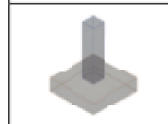
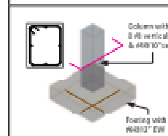
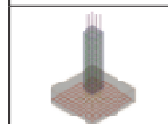
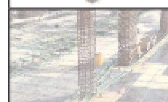
What is Building Information Modeling?

Building Information Modeling (BIM) is a 3D process used to generate and manage digital models of buildings and infrastructure. This process is used by those who plan, design, construct and manage facilities. The process involves creating and maintaining intelligent models that represent physical characteristics of a facility, as well as contain parametric data about the elements within the model. Numerous software packages exist that fall within the definition of BIM, each having distinct advantages to different parts of the life cycle of a facility, from design to construction through operation. While the current state of BIM is very dependent on the region and market sector, its adoption and use continue to expand and evolve.

Although the focus of most BIM discussions centers on the 3D model itself, the information contained within is of equal importance. The National Building Information Model Standard1 (NBIMS) defines Building Information Modeling (BIM) as "the DIGITAL REPRESENTATION of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its life cycle from inception onwards."

In general, BIM encompasses more than a 3D computer-rendered virtual mock-up of a structure, it includes a database of information. In addition to physical architectural attributes, the complete BIM contains all the building component information, from wall systems, structural systems (including reinforcing steel), electrical systems, HVAC equipment, plumbing fixtures, door and window schedules and finishes. Often supplemental information is included such as the manufacturer, supplier, and square footage of every material specified on the project. In other words, **BIM is an "Intelligent 3D Model"**. Commonly, BIM will be comprised of a collection of Models, likely created by different discipline specific applications, and then combined using a common exchange format. Ultimately, following its use from design through construction, BIM is intended to be used as a tool for facility owners and operators to better manage their facility throughout its entire existence.

For cast-in-place reinforced concrete structures, LOD definitions for elements such as foundations, beams, columns, etc. could be interpreted as follows:

	**LOD 100** – Concrete members may or may not be graphically shown in the model and any data or geometry should not be relied upon for any specific purpose. If shown, members are represented in approximate locations and member thicknesses and cross sections are approximate.
	**LOD 200** – Concrete members exist graphically in the model; however, they should be considered generic and any data or geometry should not be relied upon for any specific purpose. Members are represented in approximate locations and member thicknesses and cross sections are approximate.
	**LOD 300** – Structurally significant concrete members are to be accurately positioned and dimensioned in the model with proper respect to the model origin. Non-graphic data (i.e. material strength) may also be represented through notes attached to a member.
	**LOD 350** – Concrete members should be represented in actual locations with correct thicknesses and cross sections. Members should be complete and include penetrations, openings, joints, etc. *This model should clearly communicate design intent, but may not take into account construction sequencing & scheduling, doweling, splices of reinforcing bars, etc. However, it should provide enough information for the reinforcing bar detailer to coordinate with industry standards, project typical details, and construction sequencing/scheduling in order to create placing drawings.*
	**LOD 400** – Concrete members should be represented in actual locations with correct thicknesses and cross sections. Members are modeled completely and are "fabrication ready" to include specific quantities, sizes, shapes and orientation of the element, as well as all required reinforcing data to be supplied by the rebar fabricator.
	**LOD 500** – Element is a field verified representation of the completed element and all components installed prior to concrete pour. Per the BIMForum interpretation, "Since LOD 500 relates to field verification and is not an indication of progression to a higher level of model element geometry or non-graphic information, this Specification does not define or illustrate it."

As BIM continues to evolve and become more commonplace as a method of communication, collaboration, and information exchange, it is becoming ever more critical to have a clear method of defining the reliability of each piece of information found in a model at any given moment in the lifecycle of a project. The intent of the LOD Specification is to provide such a reference to the AEC community.

Organizations such as the American Concrete Institute (ACI) with help from CRSI and its members are continuously refining the IFC specifications to assure that all necessary information is properly defined and inconsistencies between platforms continue to diminish.

Concrete Reinforcing Steel Institute (CRSI) is the authoritative resource for steel reinforced concrete information. CRSI authors many industry-trusted technical publications and standards documents; and whose members include rebar producers, fabricators, placers, accessory manufacturers and suppliers, and design/construction professionals.

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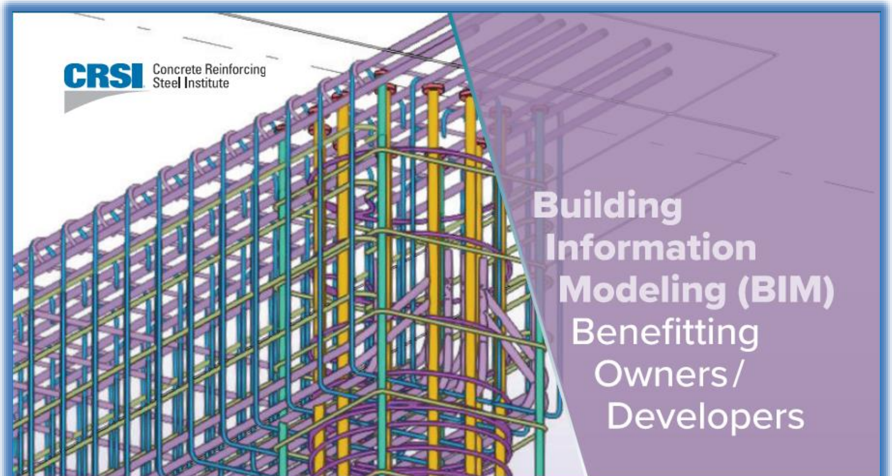
BIM Benefiting Owners & Developers



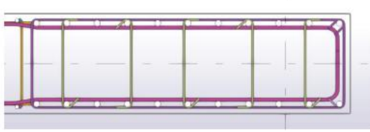
Benefits of BIM

Visualization of finished structures has multiple key advantages for owners & developers. Visualizations can be used to show how aesthetically pleasing the envisioned project will be and how it will function with the surrounding community for early financing/investment presentations. If the project is a pre-sell type of project such as multi-story unit's, the visualization can provide a completed project view for potential residents. Trade's providing cost estimates can use the visualization to understand and locate the areas within the structure allowing for better cost estimates and more competitive pricing on supplies and services. Scheduling impacts may also be lessened or improved.

Modeled 3D Structures

Modeled 3D structures provide clarity, not as easily achievable in 2D, thus reducing or minimizing costs from change orders during construction.

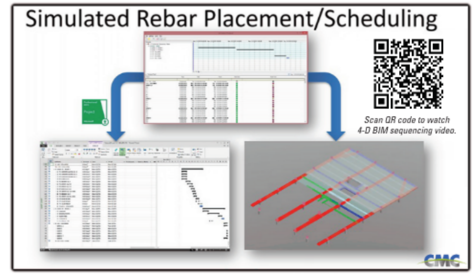
As an Owner, using BIM on your project helps reduce the risk of costly change orders and delays during the construction process. With BIM Owners can visually see the design in 3D prior to the construction process beginning. Having this ability allows the Owner time to ensure that the design intent matches their vision of the structure. If adjustments need to be made at this point in the process, it can be done with very little impact to the project. Whereas in the past, Owner changes would occur more often while the work was being performed which creates a negative impact to the overall cost of the project and construction schedule.



There's a 4D BIM?

While many are aware of BIM's 3D capabilities, "4D BIM", which adds Scheduling and Sequencing capabilities to the Model, is often overlooked or underutilized. By combining the graphics power of the model with a project scheduling tool, 4D BIM provides an advanced virtual, and very visual look into how construction will occur at various moments in time. This allows all project stakeholders to see how the project will progress, allowing for advance planning and coordination of material deliveries and staging, equipment needs, and the forecasting of labor requirements for optimal efficiencies and safety.

When utilized effectively, opportunities are often found to reduce the project timeline, discover, and address potential site hazards, and even uncover potential cost savings. As construction progresses, the schedule is frequently updated, providing a past, present, and future look at the state of the project. If for any reason the project scope changes or a target is missed, all involved can see the effects and adjust accordingly to avoid future surprises and setbacks.



A four dimensional BIM model contains additional dimensional information, known as a scheduling data or the time element. Therefore, 4D BIM is essentially 3D BIM + scheduling/sequencing.

5D BIM

5D BIM complements its previous dimension, 4D, by adding the cost component to the time model heavily used in the construction industry.

The fifth BIM dimension, 5D, integrates the information further with cost data by bringing in detailed cost information into the project. This cost data may include schedules, prices, and quantities. Utilizing 5D BIM in project management is an effective tool to minimize costs and future budgetary risks. The method continues to promote collaboration and efficiency across construction teams to produce self-sustainable and efficient structures while minimizing unnecessary project costs and overruns.

6D BIM

6D BIM is referred to as the sustainability phase that focuses on facilities management. Sustainability drives information that supports facilities management and operations. 6D BIM focuses on the success of making a building or other structure a self-sustainable, safe, and energy-efficient entity.

7D BIM

7D BIM involves operations and facility management, which is particularly utilized by owners and building management. 7D BIM is the dimension that tracks an entity's status, technical specifications, maintenance logistics, warranties, operation manuals, and more. 7D BIM is critical in the later and execution stages of a project, and its primary goal is to regulate the project health and efficiency from its first day in operation until it is decommissioned.

Improving Facility Management and Maintenance

BIM has the potential to improve facility management and maintenance as it relates to reinforcing steel in concrete structures, in many ways.

- Information about the reinforcing steel present in existing concrete foundations for a buildings mechanical equipment may be available in the model thus making it much easier to determine if the foundations are acceptable if/when new mechanical systems need to be replaced and installed.
- Models may allow organizations a useful starting point for space and occupancy management. Being able to see where most of the reinforcing steel exists and in what walls, may provide valuable information when doing remodels to improve space and occupancy management.
- BIM can provide data about materials used in the construction of the building, such as the reinforcing steel used in the building's concrete members. Knowing that concrete and rebar are the main structural components in their building's construction provides a level of comfort as well as valuable information about the durability, energy efficiency and life expectancy for their building. Reinforced concrete construction also provides an owner with piece of mind knowing that environmentally responsible, recyclable materials were used as opposed to non-renewable materials such as timber.

In this day and age of "Zero Carbon" goals for the construction of buildings, the use of reinforced concrete materials, as per the point above is especially pertinent and worthy of noting.

Management and access to accurate drawings may be better provided in a BIM model, such as as-builts of the reinforcing for the existing structure. Although traditional 2D CAD software has always offered some ability to provide accurate as-built records, BIM has some advantages over 2D CAD such as an easier means of representing three-dimensional aspects of the building and can carry extensive data about the reinforcing in the structure. ■

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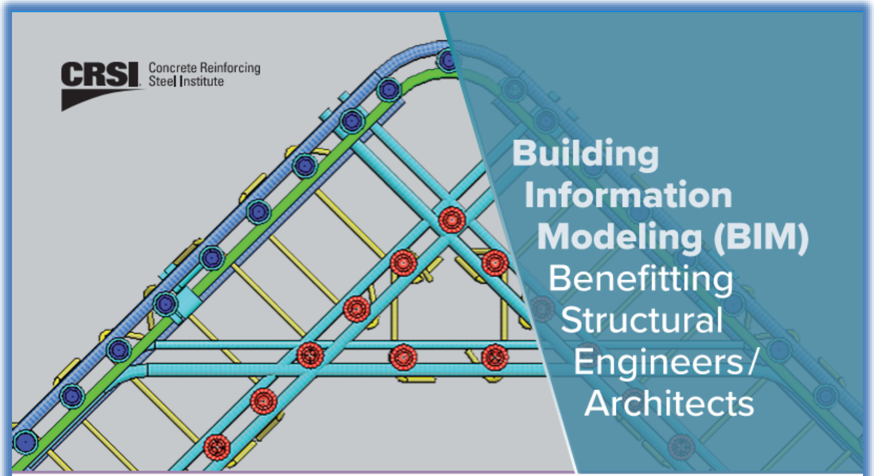
BIM Benefiting Structural Engineers & Architects

CRSI Concrete Reinforcing Steel Institute

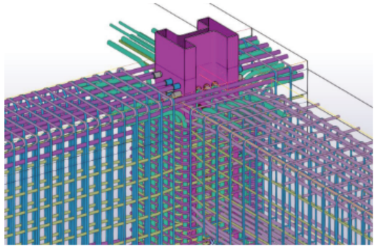


Building Information Modeling (BIM) Benefitting Structural Engineers/ Architects

Benefits of BIM

As the Structural Engineer or Architect, using BIM on your project helps reduce the risk of costly change orders and delays during the construction process.

With BIM through the coordination meetings, Engineers and Architects can visually see clashes prior to the construction process beginning. Having this ability allows the Engineer and Architect time to adjust the design as required so clashes can be resolved prior to the start of construction. If adjustments need to be made at this point in the process, it can be done with very little impact to the overall project. Whereas in the past, the clashes would occur while the work was being performed which creates a negative impact to the overall cost of the project and construction schedule.



Once the reinforcing steel is modeled in 3D, clashes or interference from structural steel members become very obvious.

Changes often occur, either during the design phase or during construction. When the Engineer can actually "see" what has changed in the model, they may be able respond with a more appropriate solution if they can see how the changes will potentially affect other members. The model may even provide ideas on how to solve an issue in a simpler, less labor intensive or costly manner.

In some cases, this improved insight provided by the model may even dictate whether the change can even be implemented, and whether the proposed changes are even worth the time and expense to solve the issue at hand. Very often, for example, changes that decrease the size of a concrete member, can greatly increase costs due to additional rebar being needed to reinforce the member, thus negating any real advantage to making the change.

Coordination between the Architects design and the EOR/LDP's structural design is improved by working on the same model. Information on member sizes, for example, can become available for incorporation into the Architects drawings/model, almost immediately.

- May be able to see the need for redesign due to clashes of congested reinforcement (bar size/ spacing), embeds, structural steel, couplers, and other trades such as MEP. With direct access to the model, RFI's from various trades can be minimized with real-time intent and extents, assuming completely accurate. Resolution proposals can be given from better perspective given.
- Materials can be more accurately estimated. Information can also be added to material elements such as bar size, ASTM, grade and bid items/cost codes/elements. Other things can be defined manually such as pour/sequencing, heat info (including PT) and other endless options. All of this info can also be filtered by.

Design Analysis

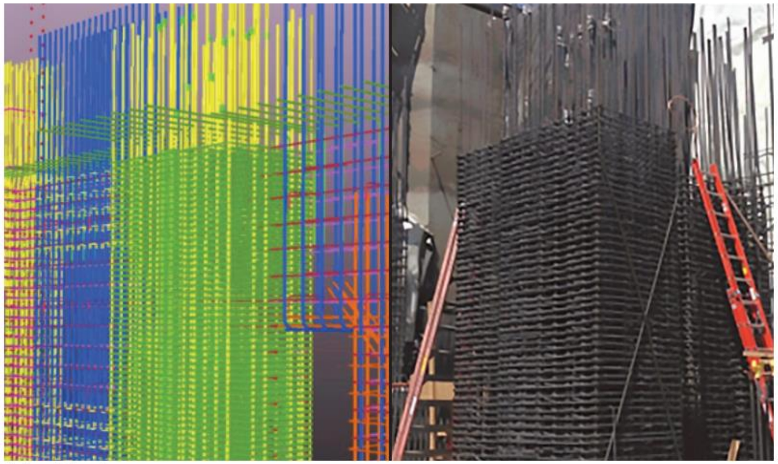
- Structural design analysis is vital as it ensures the safety, optimizes performance, meets functionality requirements, complies with codes, assesses risks, and fosters innovation in structural engineering.
- Utilizing BIM for design analysis brings benefits such as improved collaboration, accurate data, parametric modeling, simulations, clash detection, and data-driven decision-making. These advantages contribute to more efficient, coordinated, and optimized structural design analysis processes.
- Data-driven decision-making: BIM allows engineers to extract and analyze data from the model, enabling informed decision-making throughout the design analysis process. By analyzing the data, engineers can identify trends, evaluate different design options, and make evidence-based decisions. This data-driven approach helps optimize the design, enhance performance, and mitigate risks.

Scan QR code to watch 4-D BIM sequencing video.

5D BIM

5D BIM complements its previous dimension, 4D, by adding the cost component to the time model heavily used in the construction industry.

The fifth BIM dimension, 5D, integrates the information further with cost data by bringing in detailed cost information into the project. This cost data may include schedules, prices, and quantities. Utilizing 5D BIM in project management is an effective tool to minimize costs and future budgetary risks. The method continues to promote collaboration and efficiency across construction teams to produce self-sustainable and efficient structures while minimizing unnecessary project costs and overruns. ■



Design, model, execute.

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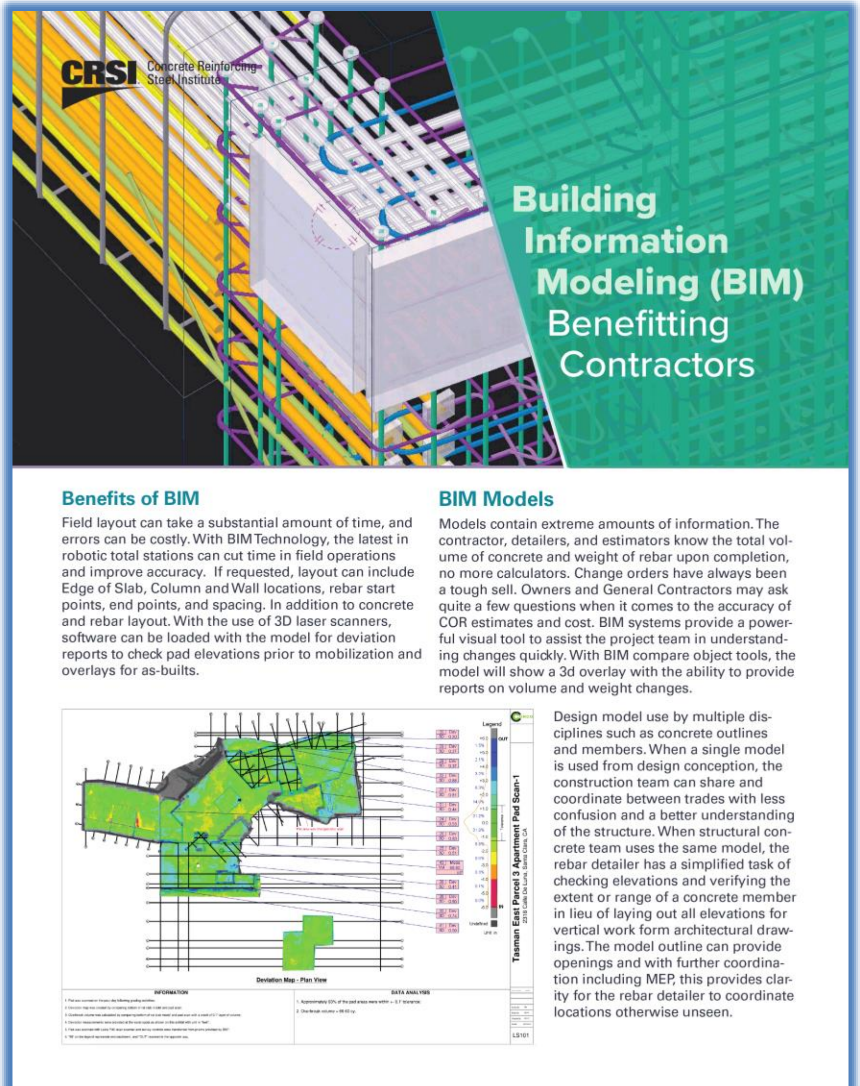
BIM Benefiting Contractors



CRSI Concrete Reinforcing Steel Institute

Building Information Modeling (BIM) Benefitting Contractors

Benefits of BIM

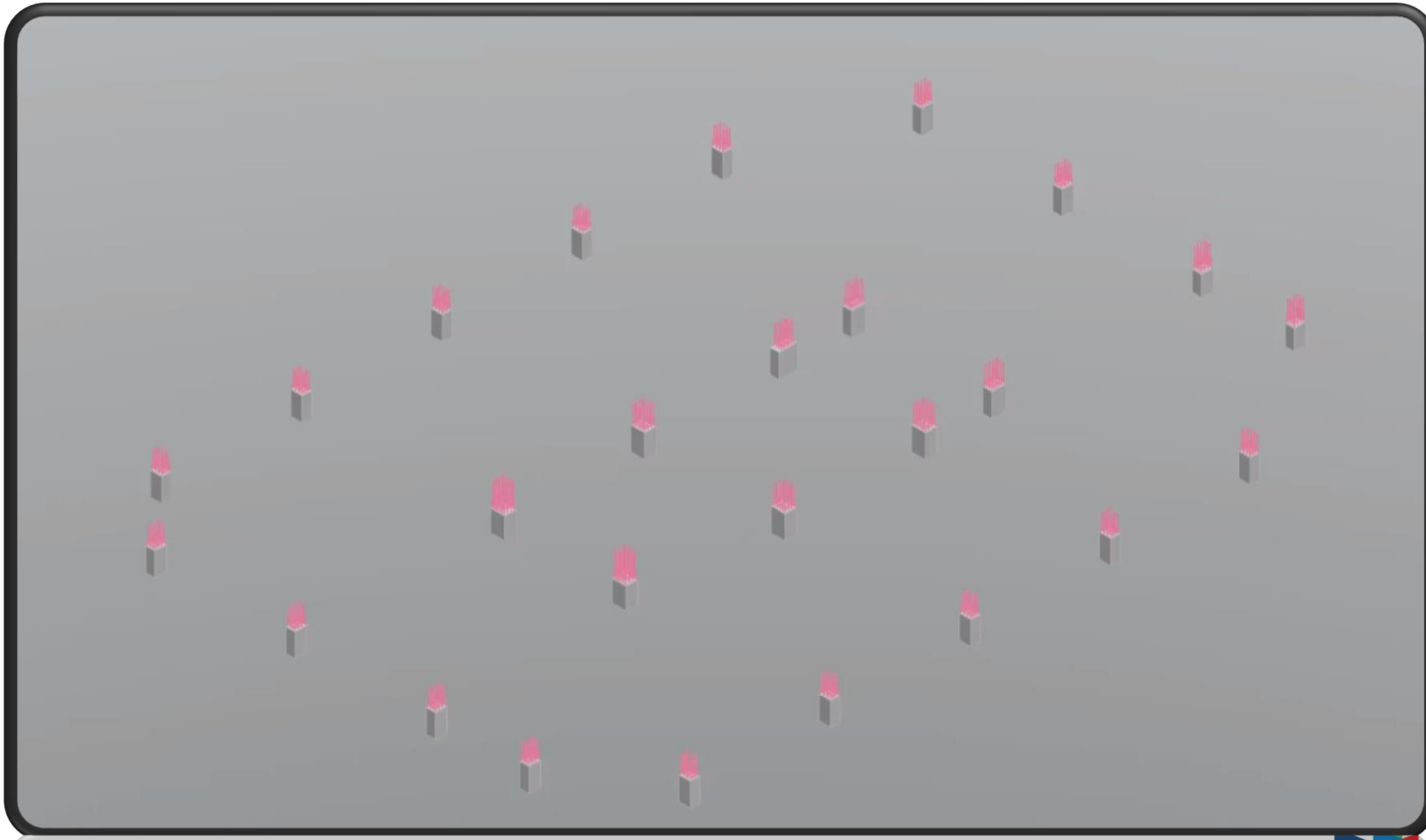
Field layout can take a substantial amount of time, and errors can be costly. With BIM Technology, the latest in robotic total stations can cut time in field operations and improve accuracy. If requested, layout can include Edge of Slab, Column and Wall locations, rebar start points, end points, and spacing. In addition to concrete and rebar layout. With the use of 3D laser scanners, software can be loaded with the model for deviation reports to check pad elevations prior to mobilization and overlays for as-builts.

BIM Models

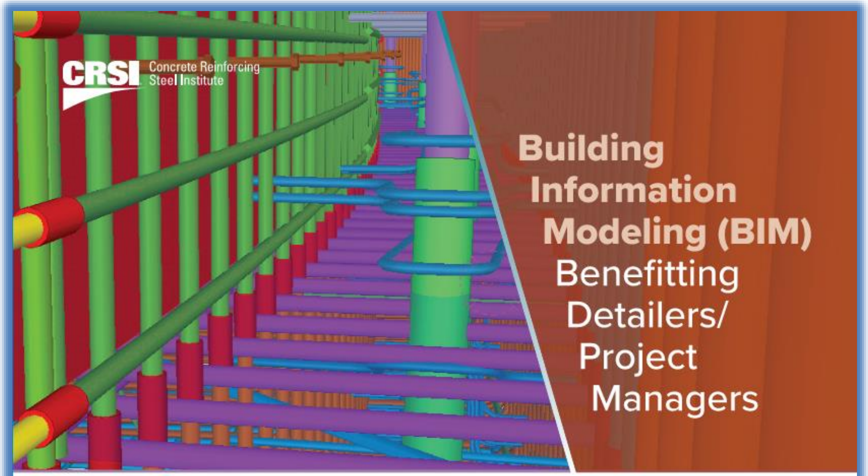
Models contain extreme amounts of information. The contractor, detailers, and estimators know the total volume of concrete and weight of rebar upon completion, no more calculators. Change orders have always been a tough sell. Owners and General Contractors may ask quite a few questions when it comes to the accuracy of COR estimates and cost. BIM systems provide a powerful visual tool to assist the project team in understanding changes quickly. With BIM compare object tools, the model will show a 3d overlay with the ability to provide reports on volume and weight changes.

Design model use by multiple disciplines such as concrete outlines and members. When a single model is used from design conception, the construction team can share and coordinate between trades with less confusion and a better understanding of the structure. When structural concrete team uses the same model, the rebar detailer has a simplified task of checking elevations and verifying the extent or range of a concrete member in lieu of laying out all elevations for vertical work form architectural drawings. The model outline can provide openings and with further coordination including MEP, this provides clarity for the rebar detailer to coordinate locations otherwise unseen.

BIM Benefiting Contractors



BIM Benefiting Rebar Detailers & Project Managers



Benefits of BIM

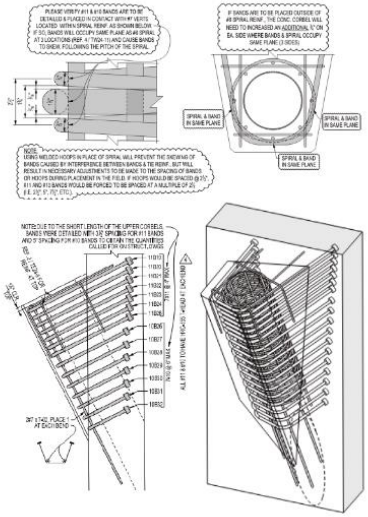
The BIM model makes it easier to show or overlay other trade materials such as pipes, conduit, embedded steel items, post-tensioning components, precast connections, HVAC/Mechanical openings, structural steel connections, etc.

BIM Models allow detailers to build projects in a virtual platform. Detailing within a model typically displays bar diameter, spacing, and any other structural requirements like hooks and bend radius, allowing the detailer to quickly address anything that may cause issues in the field. BIM software has the ability to produce reports for weights, bar size, marks, and other important information upon request.

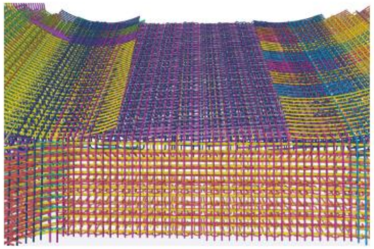
Congested areas are easier to see in 3-D, easier to resolve issues in advance or write RFI's to clarify, or request EOR/LDP input. Clearer communication of structural geometry and design intent from the EOR may be possible. Far too often RFIs lack information or a clear response to provide direction. Today's industry leans heavily on open communication between contractors, subcontractors, and the design team. During collaboration meetings or a simple screen share, models can be shown to address recognized issues and be corrected without having to process additional paperwork.

Detailer Training Improvements

Reinforcing details can be shown in 3-D which may aid to increase improved training, accuracy in detailing, as well as, identifying congestion or problem areas.



Samples of requests for information (RFI) on typical drawings.



Modeled area (before).

Constructed area (after).

- Training of new detailers is made much easier in 3-D because its easier for new persons in the industry to comprehend what rebar detailing is, and what some potential issues are that they will need to learn how to face and solve these types of problems. Trainees have to understand what they are drawing before they can ever become a good quality, accurate rebar detailer.
- A model may also make it easier to share with outside or contract detailers in other locations.
- Congestion areas or problems can be much easier identified in 3-D than in 2-D. This is probably one of the biggest advantages to detailing in a 3-D model, and for the field installers, can be a huge advantage to them being able to see these areas in advance of them actually constructing the area of concern.
- A comprehensive BIM model contains virtual representations of the actual building parts and components used to construct a structure, allowing a structure to be "virtually constructed" even before it is physically materialized.
- Further to identifying congestion or problems, detailing in a 3-D model showing these problematic areas when the drwgs are submitted for approval to the GC or A/EOR gives them a chance to aid in solving the problem or at least responding to the issue early-on.

The detailing documents could be incorporated into the model, thus improving access to them by anyone at any time which would improve the process of distribution, especially for the fabrication shop and the field.

Level of Development 350

In Level of Developement (LOD) 350, concrete members should be represented in actual locations with correct thicknesses and cross sections. Members should be complete and include penetrations, openings, joints, etc. Primary reinforcement is represented either graphically and/or as non-graphical information in notes associated with or attached to the reinforced elements. Rebar may be graphically shown at congested areas and for general representation. Graphic and non-graphic data as required to convey design intent should also be attached in its entirety. Items like expansion/contraction joints, pour stops and closure strips are represented in correct locations.

Design specific lap locations should be identified graphically or through notes. The model at LOD 350 should clearly communicate design intent, but may not take into account construction sequencing & scheduling, doweling, splices of reinforcing bars, etc. However, it should provide enough information for the reinforcing bar detailer to coordinate with industry standards, project typical details, and construction sequencing/scheduling in order to create placing drawings.

Level of Development 400

Concrete members should be represented in actual locations with correct thicknesses and cross sections. Members are modeled completely and are "fabrication ready" to include specific quantities, sizes, shapes and orientation of the element, as well as all required reinforcing data to be supplied by the rebar fabricator.

A model at LOD 400 will be the result of the reinforcing bar detailer's work and is the minimum LOD that a reinforcing bar detailer should provide to another party. The model considers construction sequencing and scheduling, doweling, splices of reinforcing bars, etc. and all reinforcing is fully detailed (quantity, size, length, callouts, etc.) and ready to present on placing drawings and bar lists for fabrication and installation. ■

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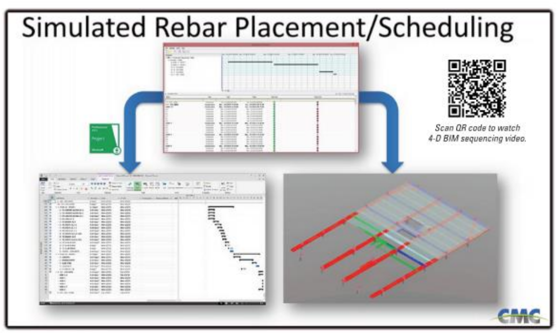
BIM Benefiting Rebar Fabricators & Suppliers

Benefits of BIM

Estimating, sales and detailing departments may all benefit from whatever Level of Developement (LOD) is provided on the plans/model.

A BIM model could be used by a fabrication shop's shipping dept to show delivery location and/or jobsite access.

Further, the shop could view scheduled delivery dates and/or fabrication dates proposed by the Project Managers or Detailers, according to the jobsite construction schedule.



Models showing where the material will be installed and in which elements they are part of could be of benefit to the shop as the shop managers may be able to apply their construction knowledge to the bending of the rebar. (ie: an example might be over-bending top 90° hooks in a slab to 91° or 92° instead which allows the hook to "hang" more easily when installing).

A model may contain information for miscellaneous hardware such as formsavers, couplers, terminators and even placing accessories such as bolster or chairs. Being able to see these special items ahead of time could potentially aid the fabricator in ensuring that they have enough inventory levels to meet the project needs, or even just alerting them to future needs.

Scheduling of other concrete reinforcing scopes such as post-tensioning and studrail deliveries into a BIM model could be beneficial to a fabrication shop's scheduling department. Coordination of deliveries with these other scopes is critical for efficient shipping times and dates, and having the right material arrive on the jobsite at the right time, for the installers.

Templates modeled and printed out to scale can aid the shop in fabrication, especially for complex and/or special shapes. Also, if the shop is bending a special shape it may need to be compared to modeled bar drawn to scale to ensure it can be fabbed to fit in the field correctly.

Modeled bars for complex structures can be shown to the shop and the field so all parties can agree on the best dimensions and/or shapes to be used for efficient fabrication as well as efficient placing in the field. It may be easier to spot the grouping of varying length bars if they have been modeled first before fabrication, especially with field input as well.

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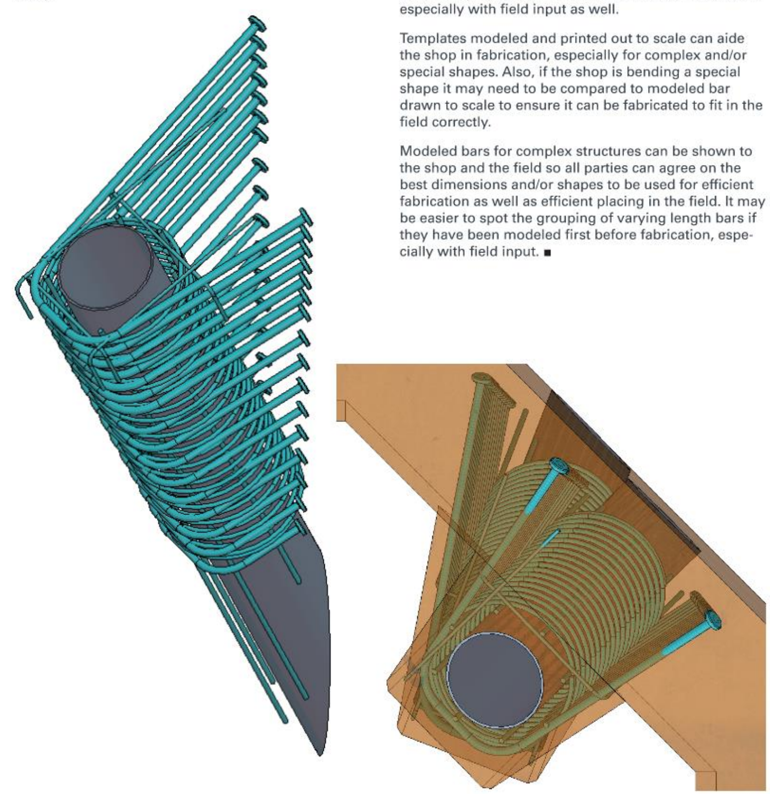

3D Modeled bars for complex shapes as shown above, make it easier for the fabricator to visualize what they bending.

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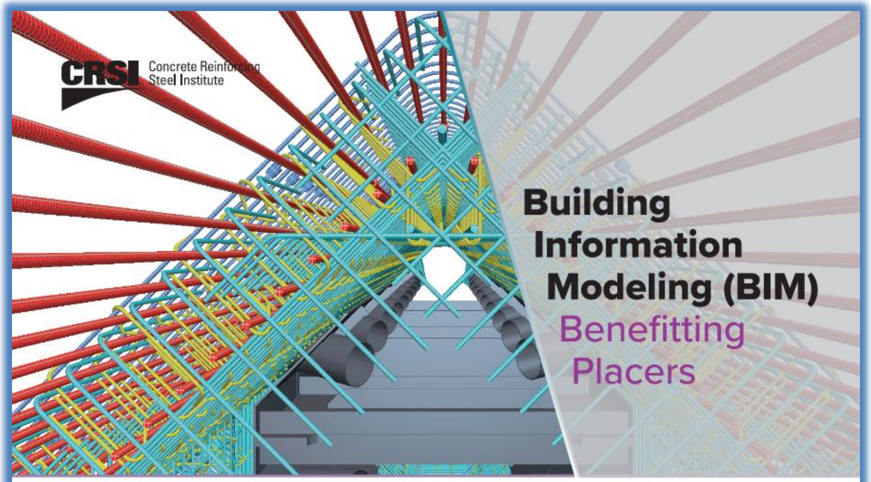
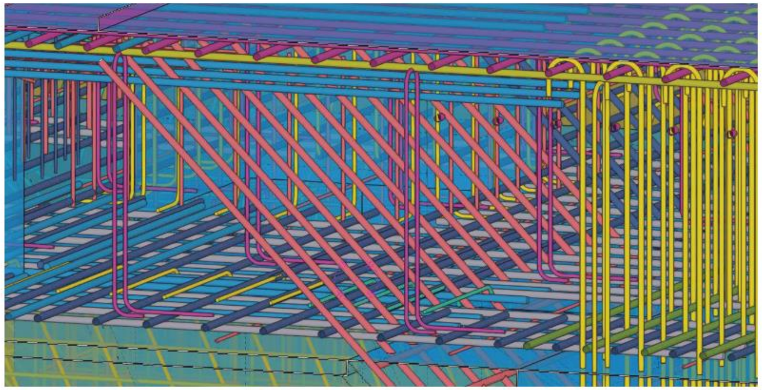
BIM Benefiting Rebar Placers

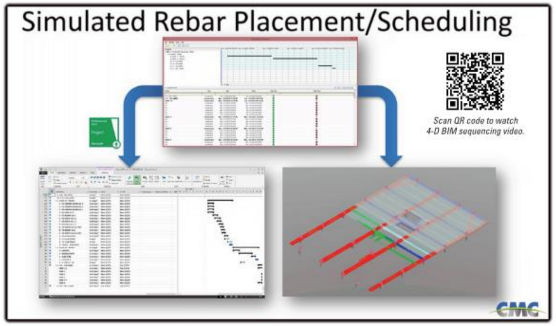


Benefits of BIM

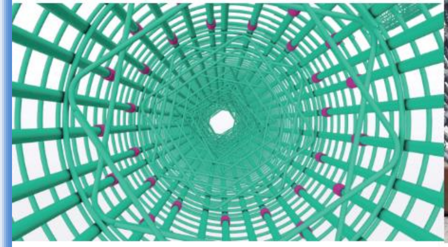
- A 3-D model can provide the installer with valuable insight as to the jobsites layout, access and staging areas, similar to a 2-D plan but different or additional views that are more realistic are more easily shown in 3-D. Crane location(s) for hoisting and truck access and unloading is quite often shown on a model which can be a great advantage for the placer to have an idea of, in advance.
- BIM could be invaluable to the installer as to where there are congested areas on-site. The detailer can produce details in 3-D on their drwgs so the installers can easily see how an area has to go together; being aware and able to see these congestion areas in advance can be a huge advantage to their production on-site, plus they may be able to place bars earlier on to make the problem area easier to install later.



- Scheduling information can be added to the BIM model by the contractor and other trades. This insight can be obtained early on by the placer to not only coordinate their daily/weekly labor requirements but also help them identify when major pours may be happening requiring spikes in the manpower.



- Further to scheduling, the rebar fabricator can input all of their individual delivery dates and times to the jobsite as well. Not only can full load weight information be input into the model but so can the placing drwgs indicating "where" each bar for each particular load will be installed. This detailed information can be applied to small "hot-shots" or "rushes" to the jobsite carrying shortages or repair materials.
- Enough information should be shown on the model such that it can be used by the placer for the coordination of their labor (as noted above), location of their equipment and laydown or staging and unloading of the material.
- Pour breaks, construction joints and pour strips can be shown and dimensioned accurately on the model in addition to pour sequence's and/or load breakdowns which can all be shown more clearly on the placing drawings by colors or labels, or graphically on a model, to indicate what exactly is on each load.



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CRSI Technical Note

ENGINEERING
ETN-D-9-21

Technical Note

Introduction to Building Information Modeling (BIM) for Steel Reinforced Concrete

What is Building Information Modeling (BIM)?

Building Information Modeling (BIM) is a 3D process used to generate and manage digital models of buildings and infrastructure. This process is used by those who plan, design, construct and manage facilities. The process involves creating and maintaining intelligent models that represent physical characteristics of a facility, as well as contain parametric data about the elements within the model. Numerous software packages exist that fall within the definition of BIM, each having distinct advantages to different parts of the life cycle of a facility, from the design to construction through operation.

Although the focus of most BIM discussions centers on the 3D model itself, the information contained within is of equal importance. The National Building Information Model Standard[1] (NBIMS) defines Building Information Modeling (BIM) as "the DIGITAL REPRESENTATION of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its life cycle from inception onwards."

In general, BIM encompasses more than a 3D computer-rendered virtual mock-up of a structure, it includes a database of information. In addition to physical architectural attributes, the complete BIM contains all the building component information, from wall systems, structural systems, electrical systems, HVAC equipment, plumbing fixtures, door and window schedules and finishes. Often supplemental information is included such as the manufacturer, supplier, and square footage of every material specified on the project. In other words, BIM is an "Intelligent 3D Model". BIM is intended to be used as a tool for facility owners and operators to better manage their facility throughout its entire existence.

BIM is applied to the details of concrete reinforcement in both the design and construction phase of a facility. In the design phase, BIM is often used by the design team to define the physical characteristics of the reinforced concrete elements by defining concrete shapes and edges in physical space. The reinforcement information is input as either data within the concrete elements, or physical representations of the reinforcement. This definition of concrete and reinforcement information is often to a 'design intent' level of modeling. In the construction phase, the concrete geometry is often defined to a construction level of detail, and the reinforcement is defined to a level from which it can be fabricated and installed.

How is Building Information Modeling (BIM) Utilized on a Steel Reinforced Concrete Project?

BIM can be utilized on a project in different ways and is highly dependent on the makeup of the project team, BIM capacity (software, experience, etc.) and the desired outcomes and deliverables. In some cases, simple 3D models of specific areas are all that is desired. In others, the full BIM process is used.

At the start of a project, it is important that the expectations between the Contractor and the Fabricator related to BIM are discussed in detail, so all parties involved understand the project requirements. These discussions need to include:

- What is the contractual scope between Fabricator and Contractor?
- Is the 3D modeling being used solely by the contractor for visualizing and troubleshooting areas of high congestion or other concerns?
- Will the model itself be a deliverable to the Engineer and/or Contractor?
- Will the Contractor be supplying the Fabricator with a model to work from?
- Additional information, as needed.

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