Structural Design in the Plant Industry

Getting it Right from the Start

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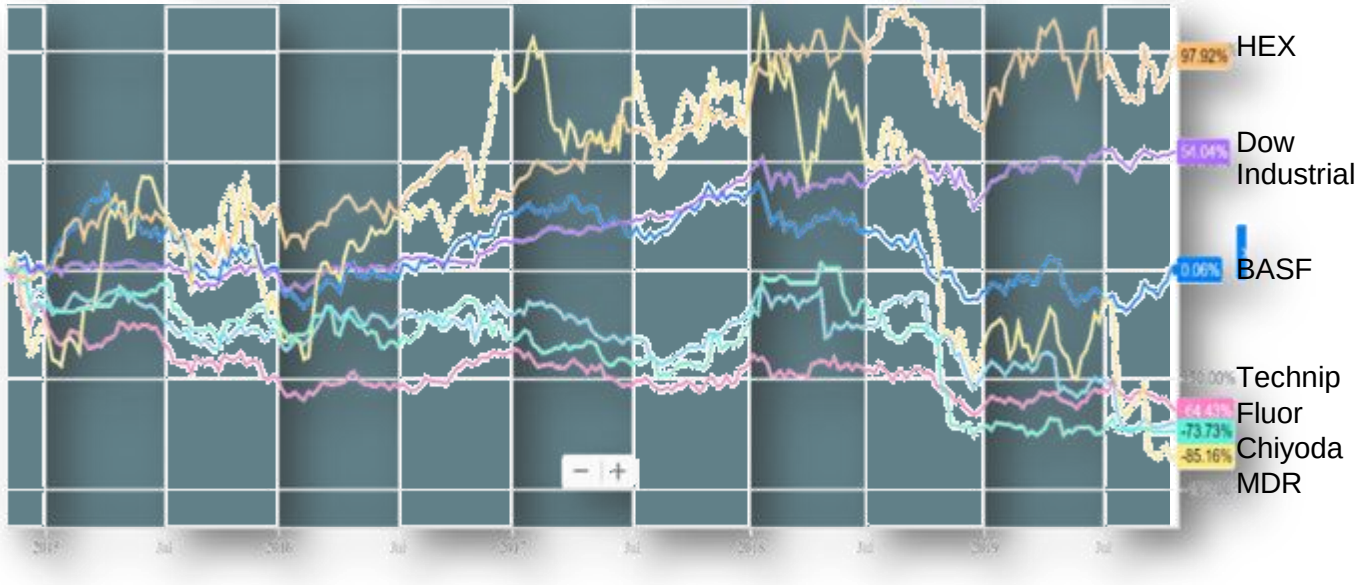
Getting it Right from the Start

February 6th, 2020

EPC’s are struggling



Low profits
(Below 5% unstable)

Projects late / over budget

$500B
Completion cost miss

Major engineering firm Chiyoda announces ¥180 billion bailout from Mitsubishi

Oil services firm TechnipFMC to split into two publicly traded companies

McDermott names new CFO, reports $1.9B net loss, skips interest payment

BUSINESS

Fluor Corp. to close regional offices, sell off businesses as namesake director Peter Fluor retires

The new structure emerging from the company's strategic and operational review intends to create a 'leaner organization.'

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The Cost of Designing

Doing the same thing faster is **not** helping

Need to increase Net Design time
Reduce time to find/check/compare/document and update

Focus on Growing Your Business, Not Your IT
You need solutions that support your growth, not hinder it
Minimize tools and interfaces

Integration is free
Empower engineers within the same environment

Customer Outcome
Repeat business
Higher margins

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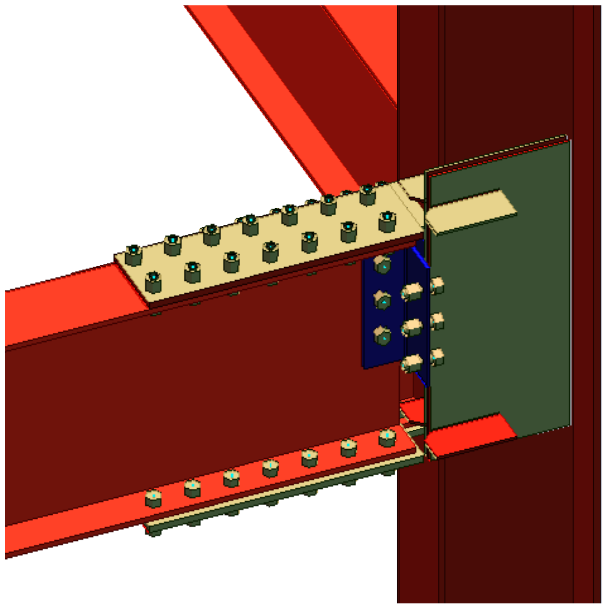
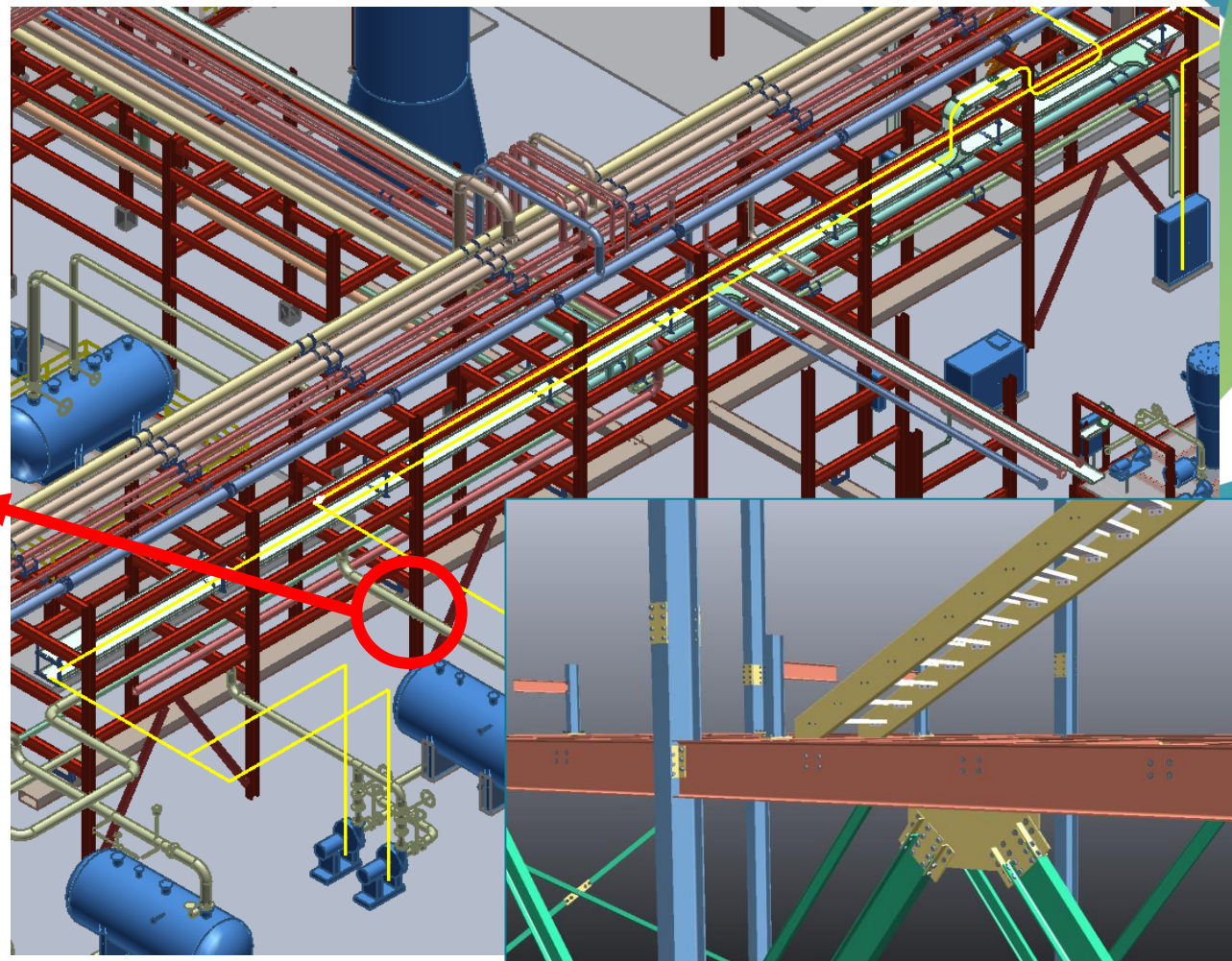
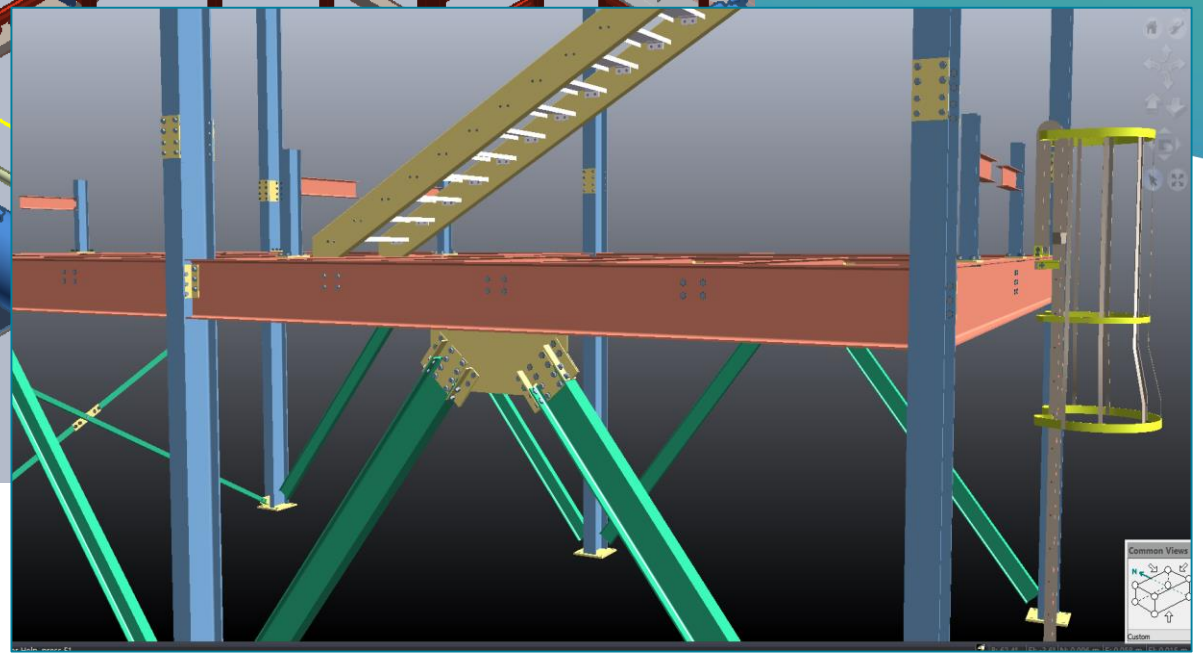
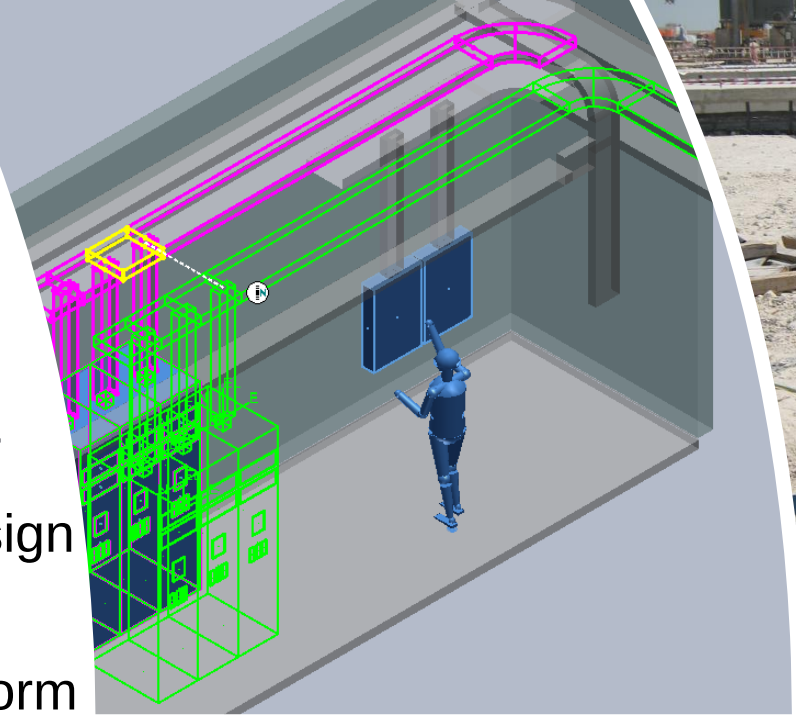
More than Structural







Empower Engineers for more Net Design Time



Smart 3D is more than Piping/Equipment Design

Leverage the common Smart 3D design platform

- **Structural Detailing (fully integrated add-on to S3D)**
- Civil Design
- Cable Management

The Outcome

Preferred Contractor Status

- Delivery on-time on budget
- Flexibility to adapt to scope changes

Enhanced Design Quality

- Less design changes
- Validating the design
- Making the connection with fabricators
- Automatic creation of the project deliverables

Efficient Utilization of Resources

- Productivity
- Flexibility
- Use junior engineers to make senior decisions

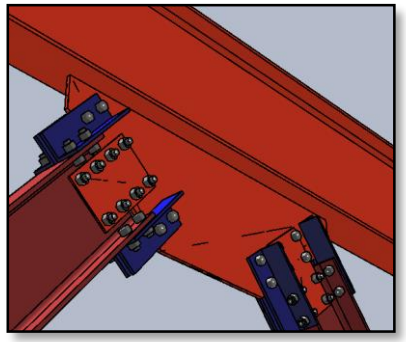
Smart 3D & SDS/2 Connect Workflow

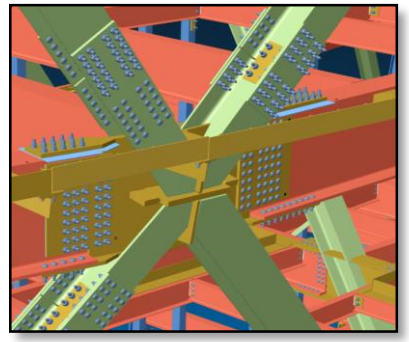
EPC | Fabricator | EPC

Smart 3D

SDS/2

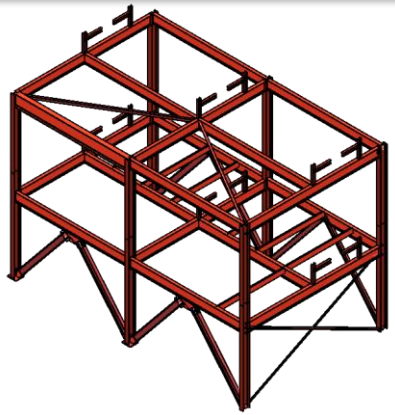
Analysis software



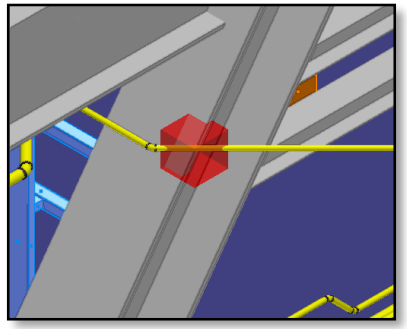


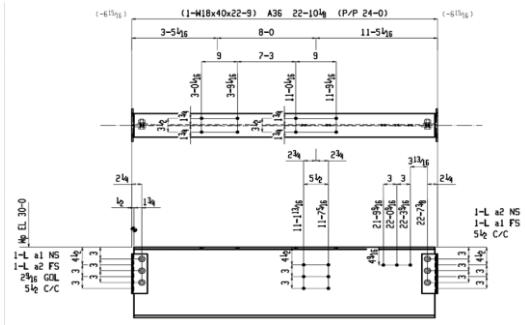
Steel Fabrication and Erection

Plant & Piping layout → Structural Layout → Structural Analysis → Traffic Items → Connection design → Clash Detection → Construction Documents → Steel Detailing → Shop Drawings → Shop Drawing Review → SPR – Review and Construction Planning



Structural Analysis





Bolted Structural Connections

using Intergraph Smart 3D with SDS/2 Connect

Kari Wrampe

Associate Applications Engineer

BURNS McDONNELL


ABOUT BURNS & McDONNELL

WHY SDS/2 CONNECT?

Integration

Schedule Savings

Construction

The Evaluation

INTEGRATION

Smart 3D with SDS/2 Connect

Last to be designed, first to be installed

Build more Intelligent models

More objects are modeled

Designers know Smart 3D

Share model with fabricator

Smart 3D

Design Consistency

Interferences

To Do List

Imperial or Metric


SCHEDULE SAVINGS

Schedule Savings

Engineered connection design

Fabricator does not need to redesign steel

Shop drawing review can start earlier

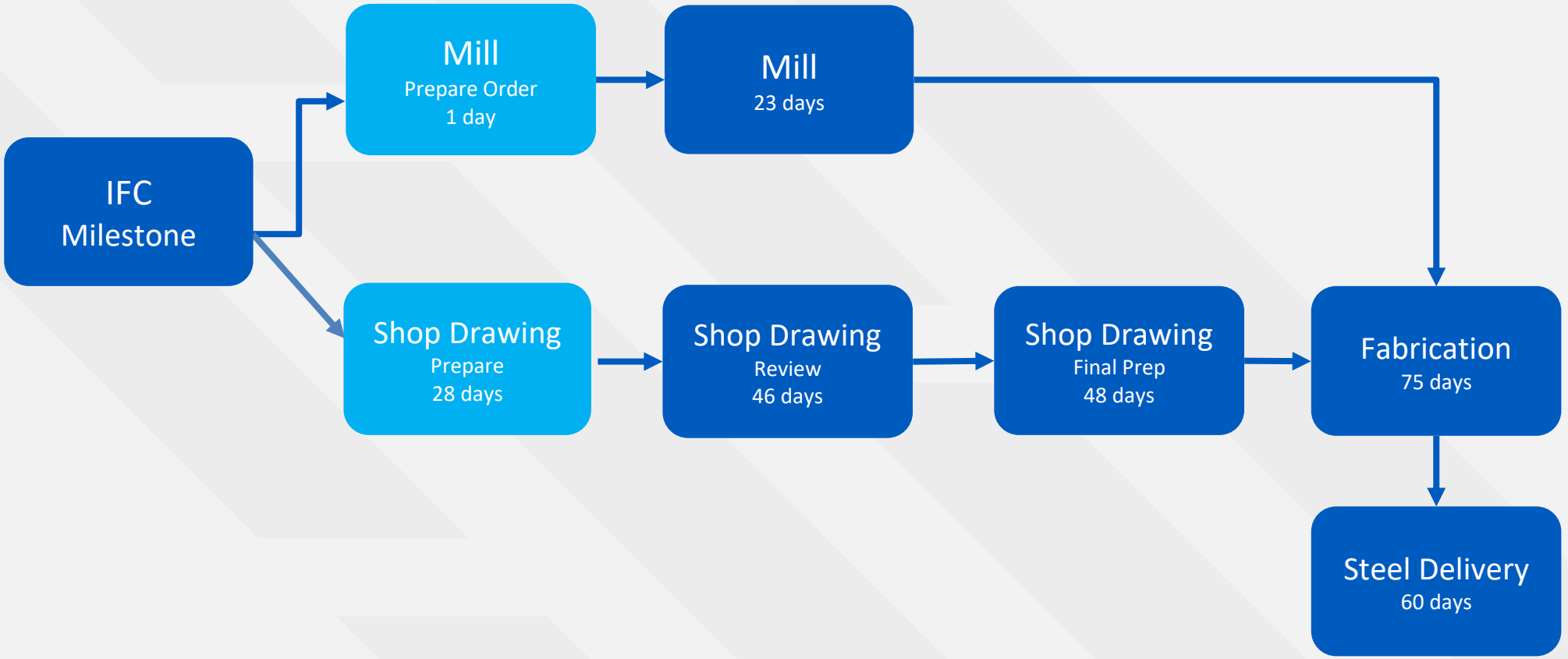
Construction work packages created sooner

Schedule Savings

- Better modeling
- No other product support
- No import from 3rd party software
- Real time information
- Connection design in Smart 3D before IFC
- Fabricators use SDS/2 Detailing model
- Engineering review
  - Reports show calculations for designed connections
  - Reports reference sections in the code

Fabrication Process - Current

Fabrication Process with SDS/2 Connect




CONSTRUCTION

Construction

- Steel procurement
- Erection processes
- Get assembly marks from SDS/2 Detailing
- Use in downstream applications like Smart Construction
- Create construction work packages sooner
- SDS/2 optimizes bolts and reduces plate work
- SDS/2 Detailing used for sequencing

THE EVALUATION

Evaluation

SDS/2 Connect and SDS/2 Detailing

Configured SDS/2 Connect with standards

Engineers and Smart 3D designers used applications

Models

- Existing
- Fabricator

Workflow for Evaluation

Model Structure in Smart 3D

Design connections in Smart 3D with SDS/2 Connect

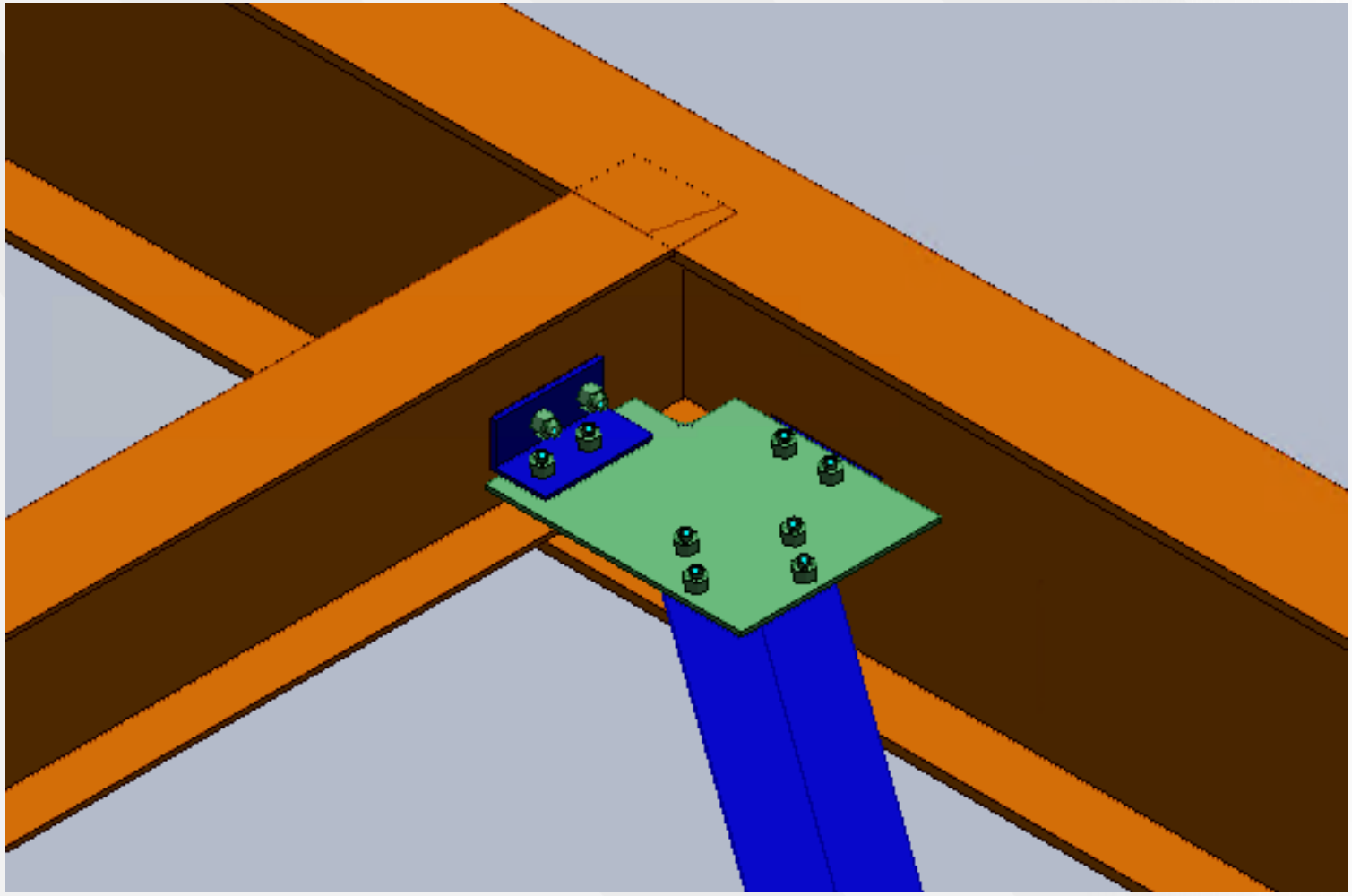
Transfer model to SDS/2 Detailing for final detailing and fabrication work

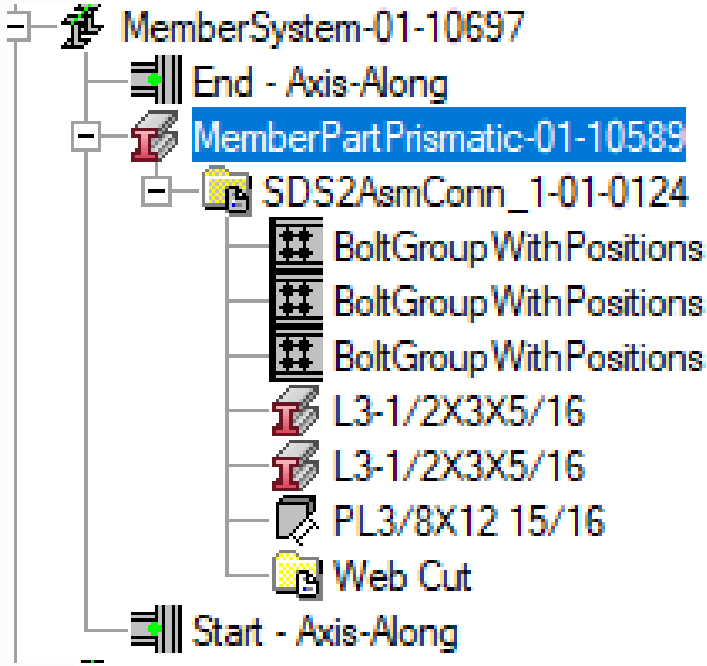
Import assembly marks to Smart 3D for use in work packages

Evaluation

- Smart 3D performance not affected
- Configurations can be saved per project
- Workflow changes for structural framing
- Engineers in Smart 3D
- Attributes can be locked on individual connections
- Standard connections can be added as codelist values
- Edit connection shows 3D preview and design calculations

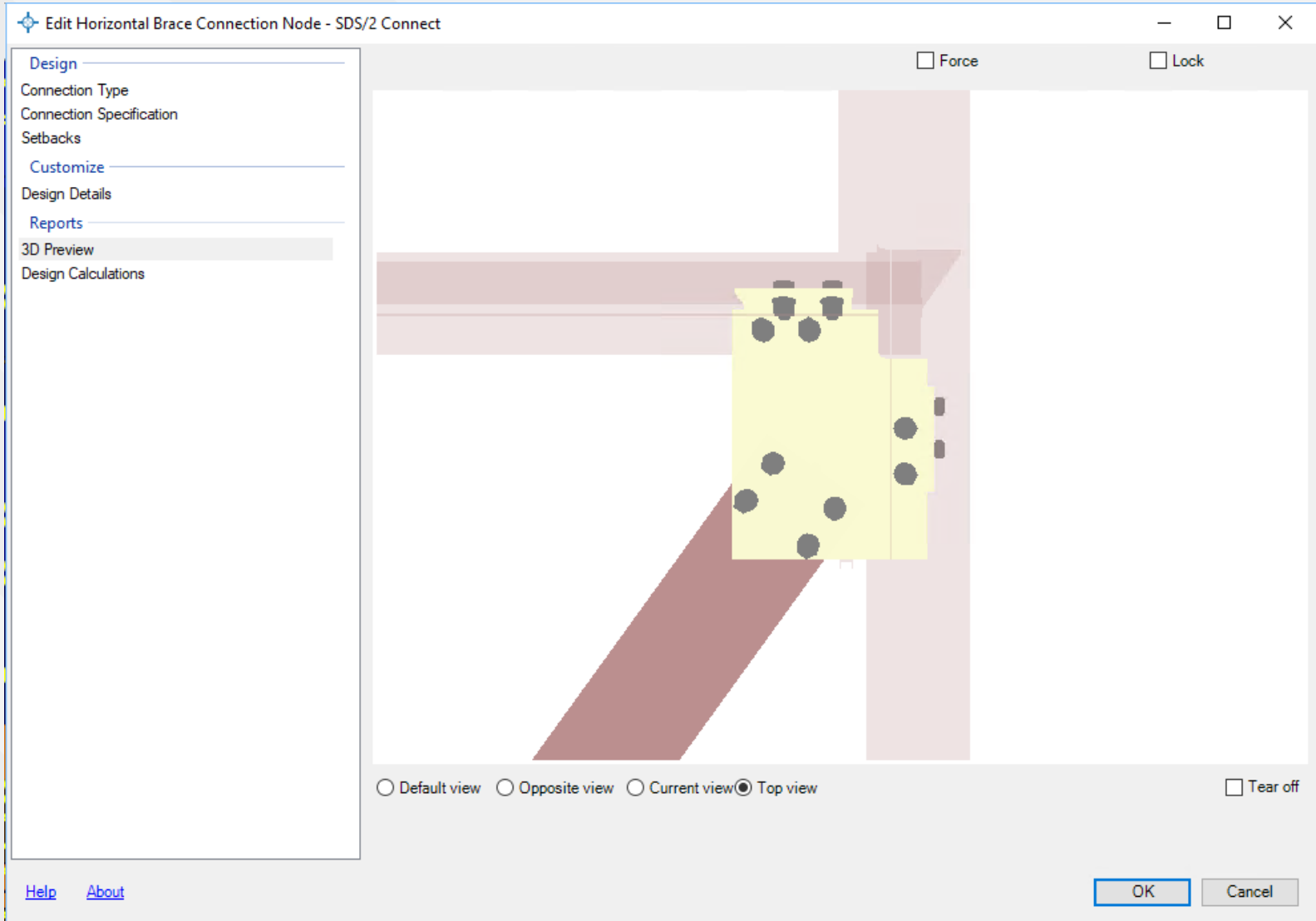
Graphic View vs. Workspace Explorer





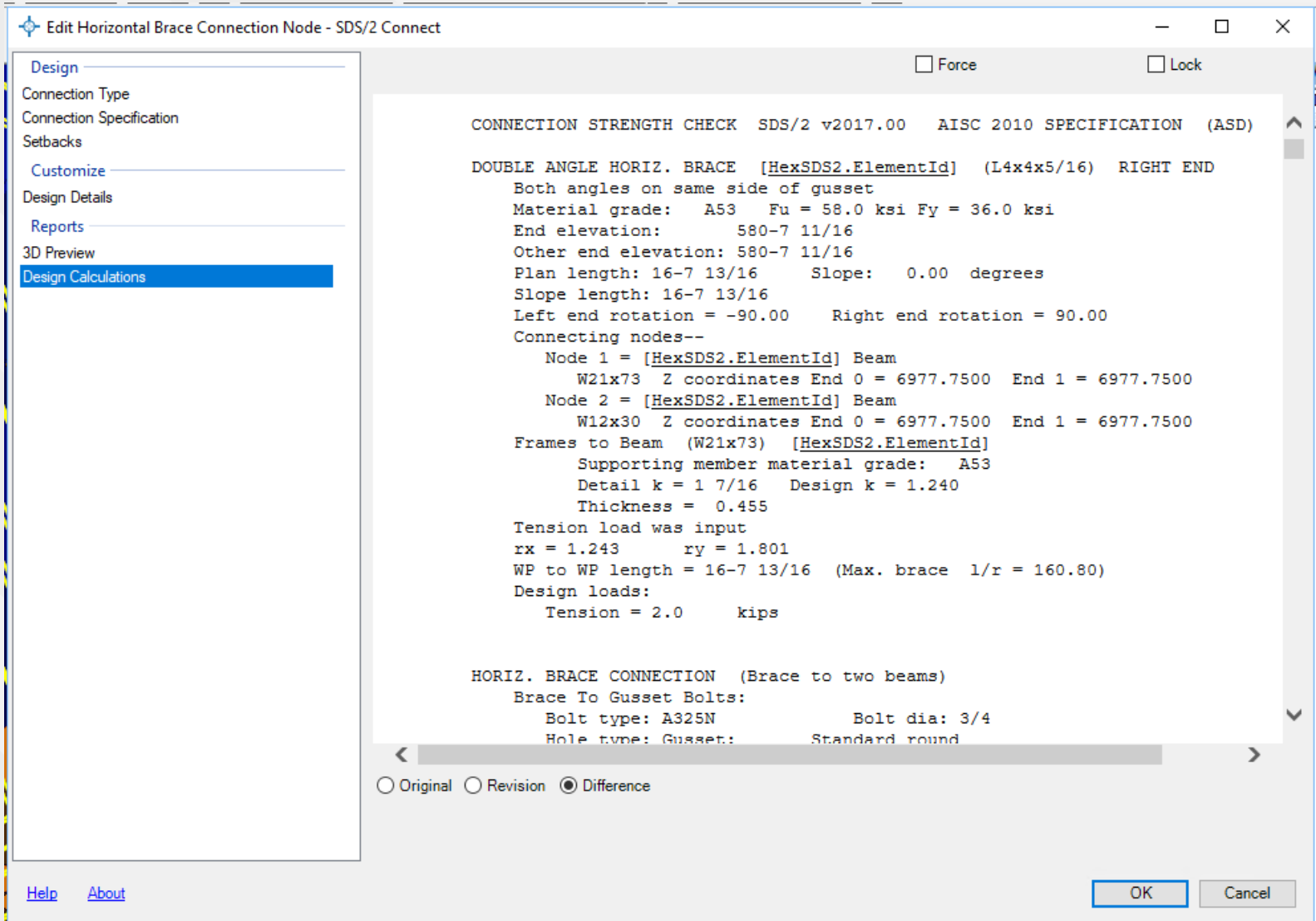
Edit Connection

- View 3D preview
- Modify connection type
  - Brace plate
  - Plain end
- Modify loads
  - Tension
  - Compression



Edit Connection

- Review design calculations



SDS/2 Connect with Smart 3D

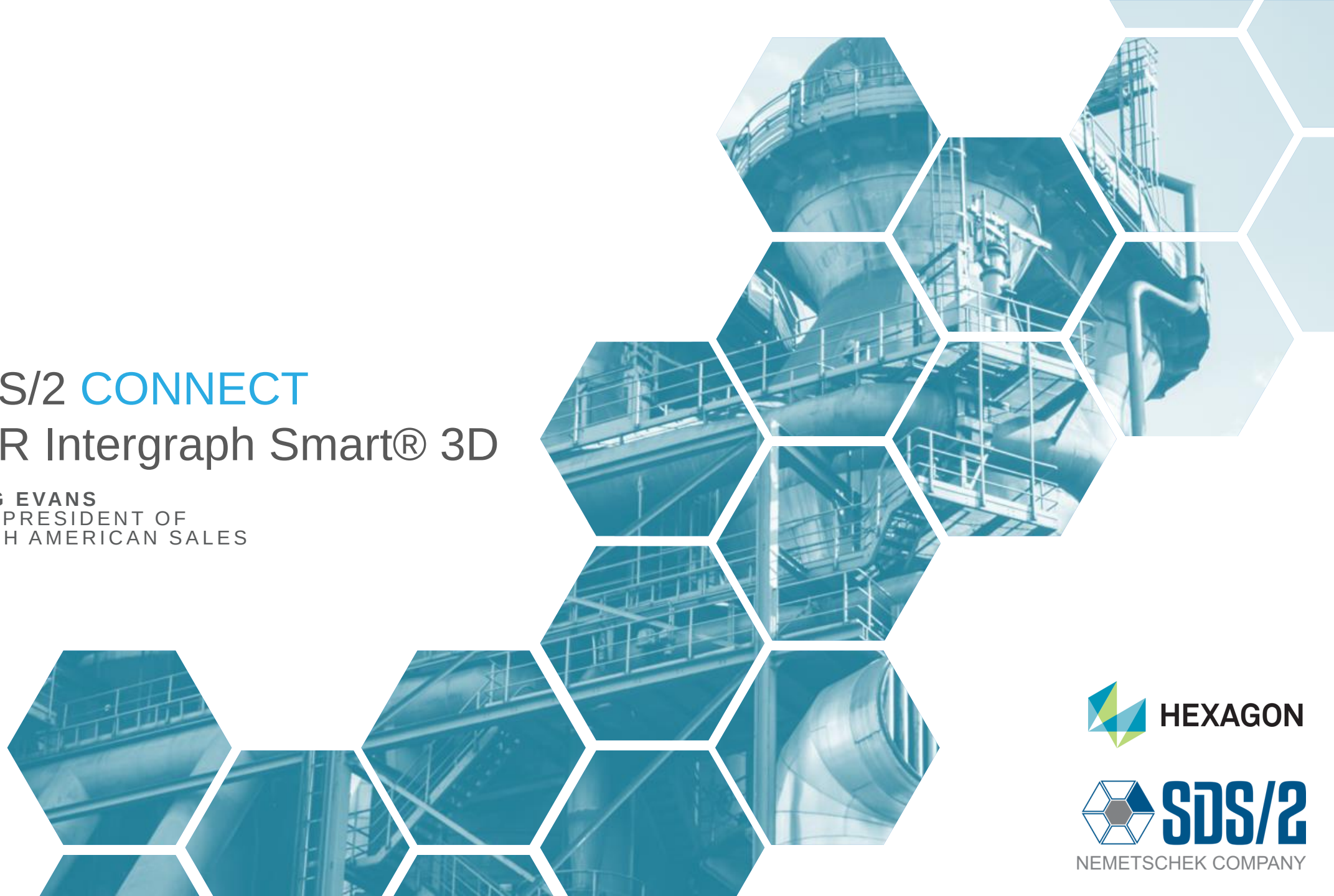
SCHEDULE

COST

QUALITY

SDS/2 CONNECT
FOR Intergraph Smart® 3D

DOUG EVANS
VICE PRESIDENT OF
NORTH AMERICAN SALES



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SDS/2
NEMETSCHEK COMPANY

SDS/2 CONNECT FOR SMART 3D

1 THE STEEL CONNECTION DESIGN IS PART OF SDS/2

- Intelligent automation of steel connection design

2 WORKS WITHIN S3D

- Adds further level of detail to S3D

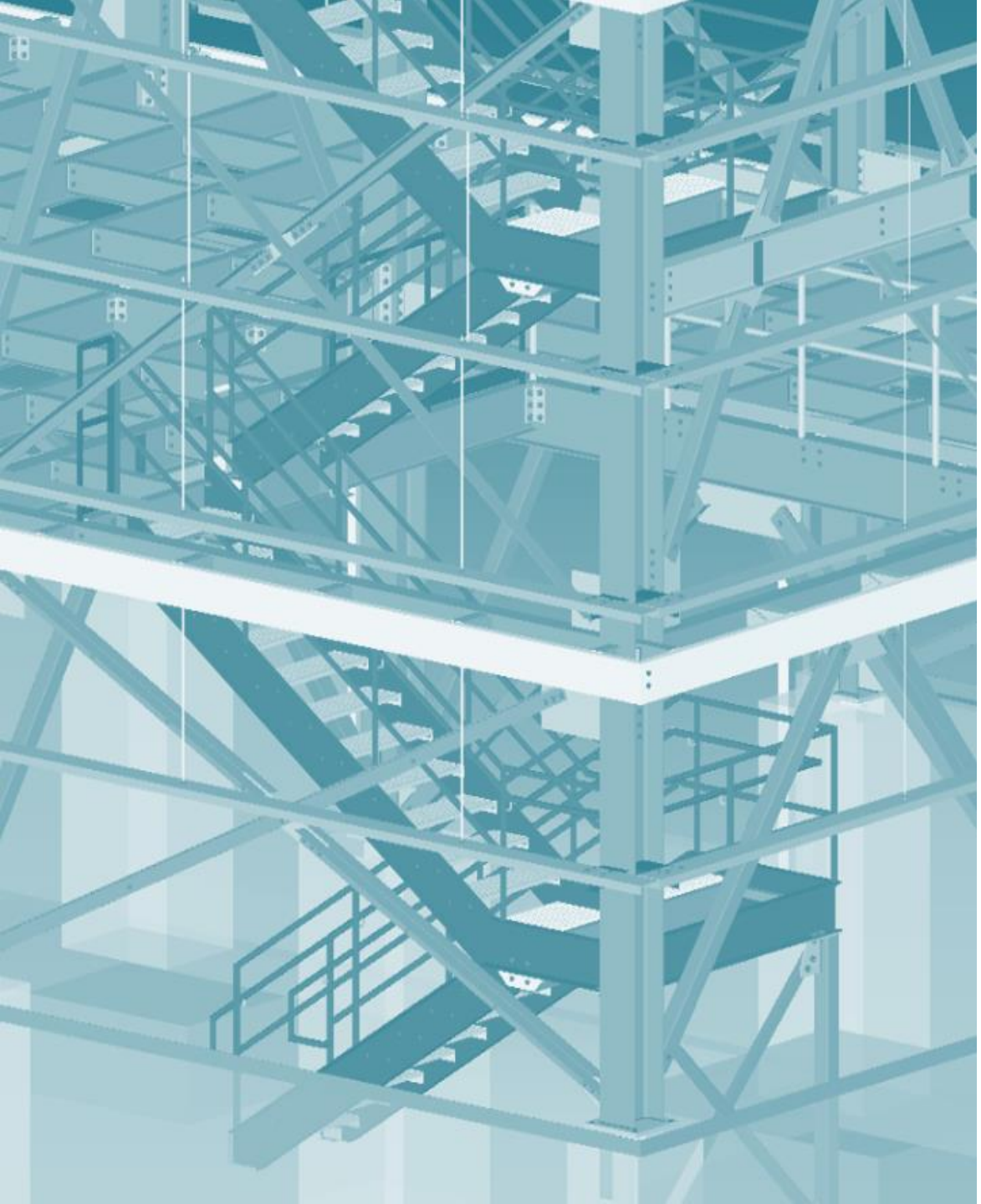
3 LICENSES PROVIDED BY HEXAGON

4 DOWNSTREAM COMPATIBLE

- For streamlined fabrication

WHY WAS SDS/2 CONNECT DEVELOPED?

- Steel connection design is time consuming and costly
- Steel connections can have serious implications in plant related structures
- Engineers have different software needs than Plant/Piping Teams
- Using different software causes issues



SDS/2 DETAILING SOFTWARE

To satisfy today's construction requirements 3D steel detailing tools are essential. There are a few choices out there, but the automated tools provided by SDS/2 enable you to do more.

- Steel (and concrete) detailing
- Structural 'BIM'
- Deliver a constructable and erectable model
- Shop drawing production

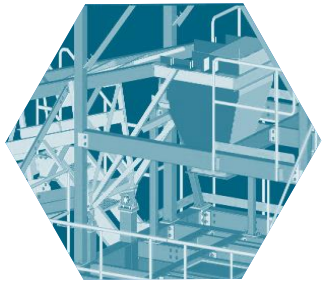
But also…

- **Intelligent automation of steel connection design**

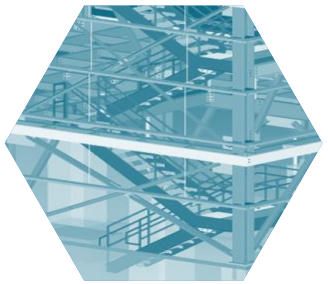
WHAT'S SO SPECIAL ABOUT SDS/2 CONNECT?

A lot of tools on the market can apply connections to a model, so what makes SDS/2's connection design different from the rest?

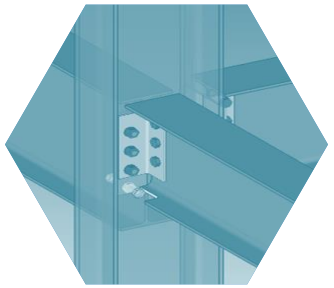
STRUCTURAL INTEGRITY



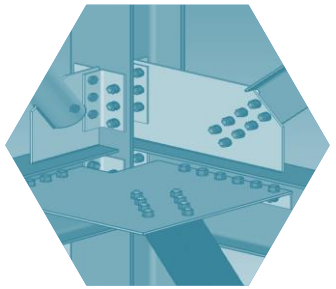
CONSTRUCTABILITY



ERECTABILITY

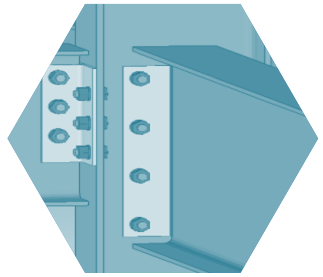


COMPLETE NODE

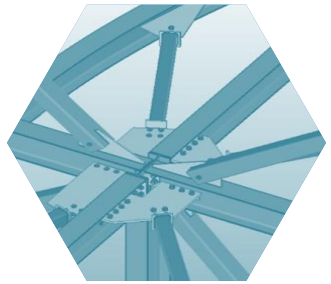


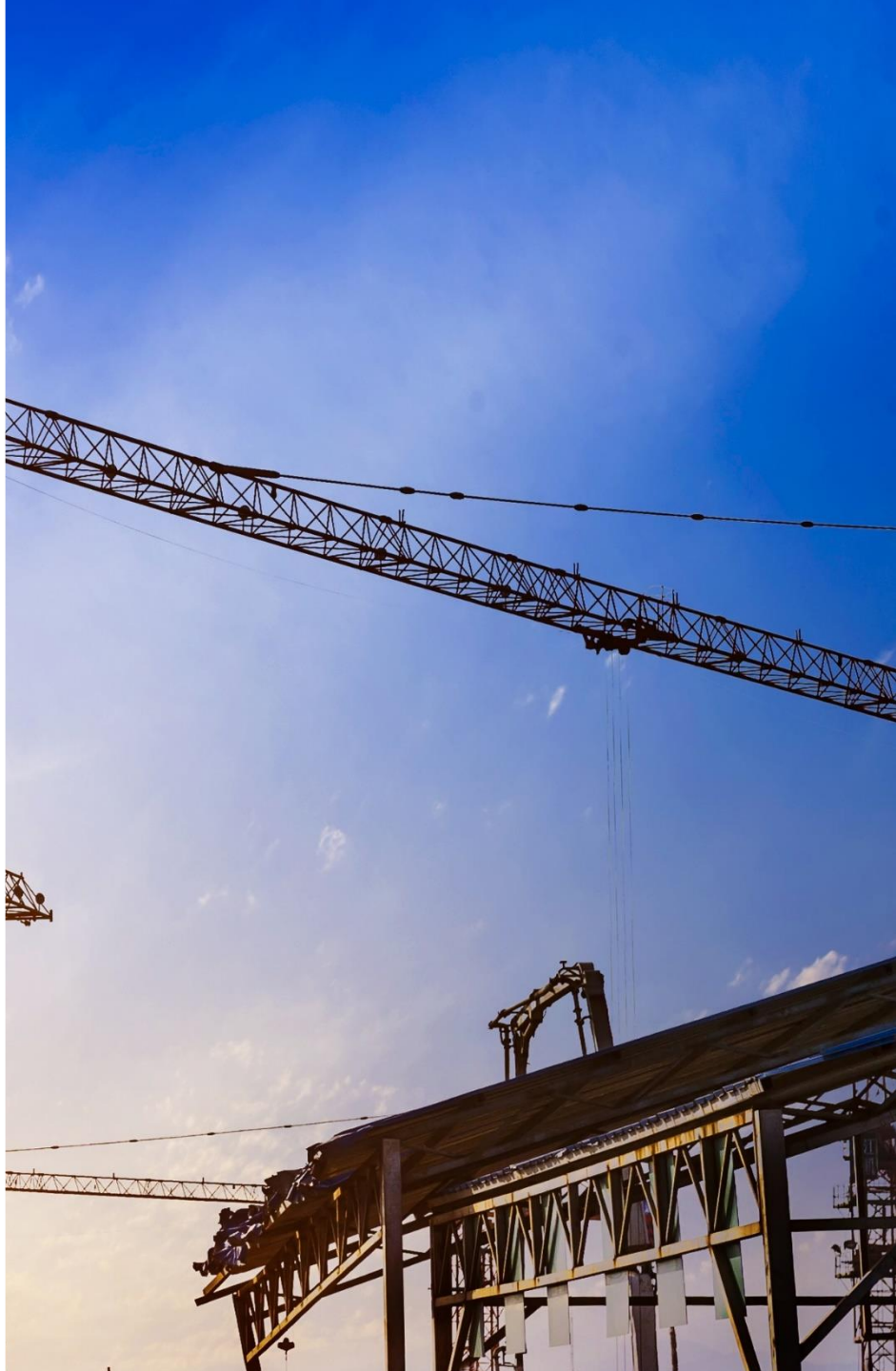
COMPLETE STRUCTURE

COMPLETE OPTIMIZATION

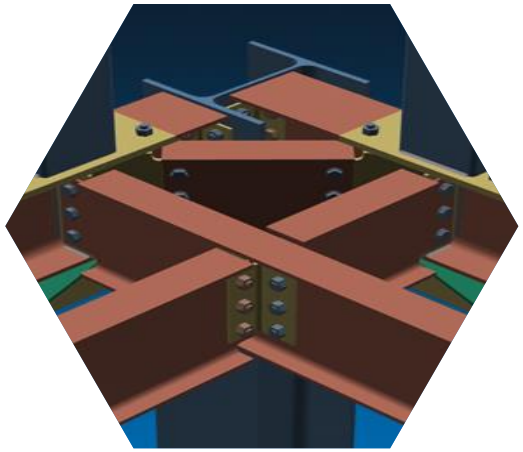


COMPLETE CONTROL



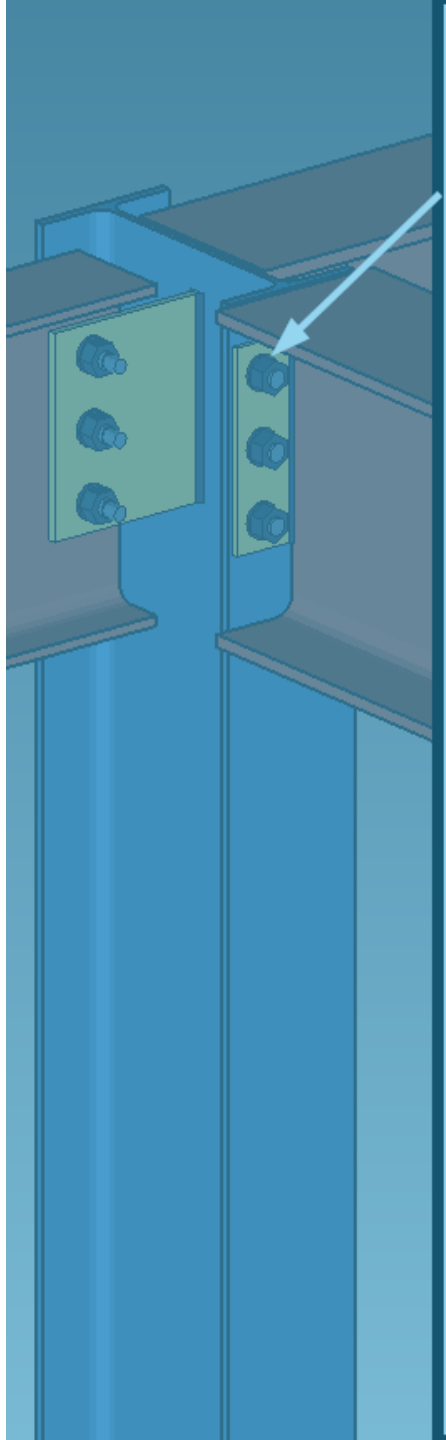


COMPLETE INTELLIGENTLY AUTOMATED STEEL CONNECTION DESIGN WITHIN SMART 3D



STRUCTURAL INTEGRITY

- True auto-design
- Fully code compliant
- Preferences
- 28 limit states checked
- 25 pages of calculations



Allowable bolt shear load

ss	11.9 kips
ds	23.9 kips
Fnv/OMEGA	27.00 ksi

Allowable bolt tensio

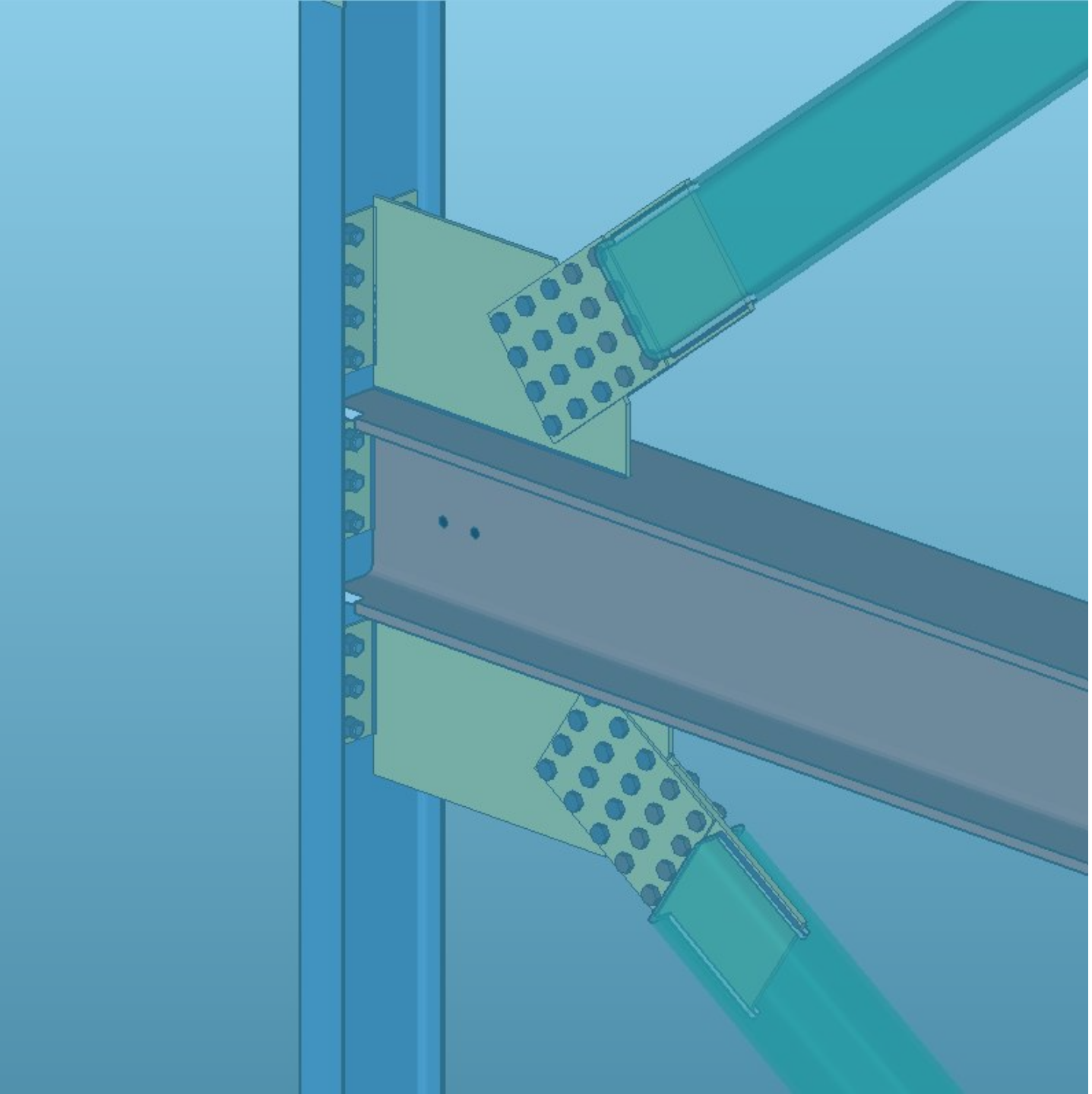
Fnt	90.00 ksi
Fnt/OMEGA	45.00 ksi
Bolt area	0.4418

Allowable strength summary for Member [332

	Calc. Num.	Rn/OMEGA
Beam web shear	2	60.2 kips
Beam net web shear	8	43.1 kips
Conn. block shear	252	49.6 kips
Conn. gross shear	15	61.2 kips
Conn. net shear	21	51.1 kips
Weld to supported mbr.	24	43.1 kips
Supporting mbr. bolt shear	1	71.6 kips
Conn. brg.: supporting mbr.	110	66.9 kips
Brg. on supporting mbr.	110	137.8 kips

Connection ductility check

Min. OSL bolt diameter to preclude bolt fracture: 0.29

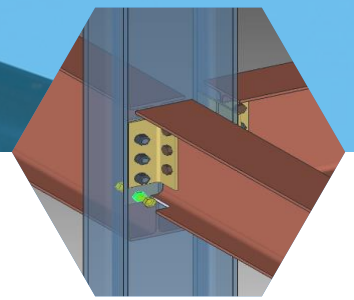


CONSTRUCTABILITY

- High level of detail
- Beams cut back
- Bolt clashes
- Accurate gusset plates

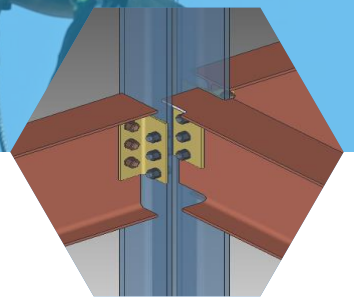
ERECTABILITY

Reduce Field Issues



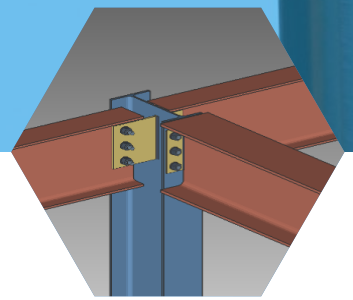
BOTTOM FLANGE THINNED

avoid material clashes with bolts



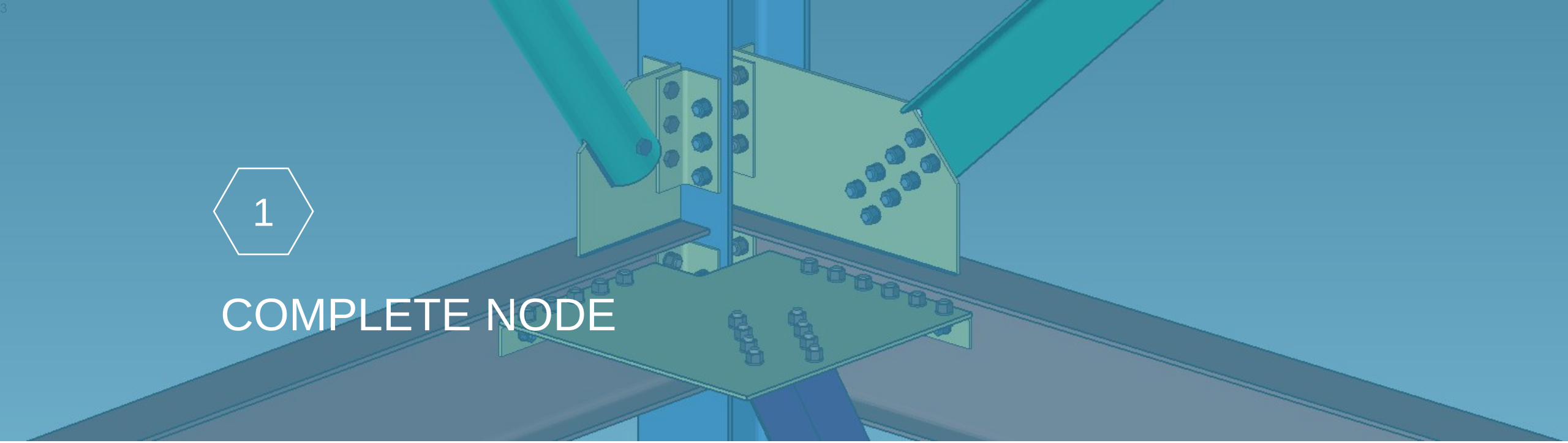
COPED FLANGE

avoid hitting the shear plate during erection



EXTENDED SHEAR PLATE

to allow torque wrench access and bolt path clearance



1

COMPLETE NODE

EVEN MORE IMPORTANT FOR ERECTABILITY

Incorporating erectability checks into design eliminates costly field fixes and produces a better model.

ESSENTIAL FOR ACCURATE CLASH DETECTION

SDS/2 Detailing automatically checks for clashes, eliminating extra steps required by more manual detailing packages.

2

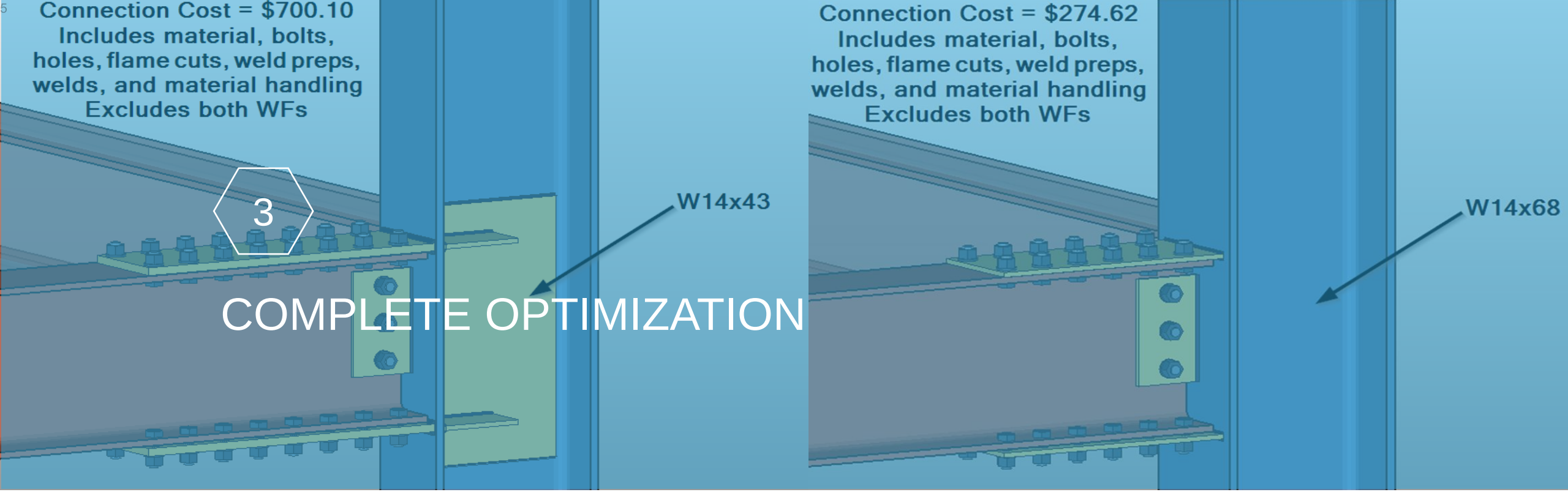
COMPLETE STRUCTURE

SIGNFICANT TIME SAVINGS

With the flexibility for auto design or batch design, an entire structure can be connected in seconds.

BASED ON YOUR PREFERENCES

Using your preferences for fabrication, you can quickly design and apply cost-effective connections.



3

COMPLETE OPTIMIZATION

MATERIAL SAVINGS

Over-designed connections add materials and bolts to project costs.

TIME SAVINGS

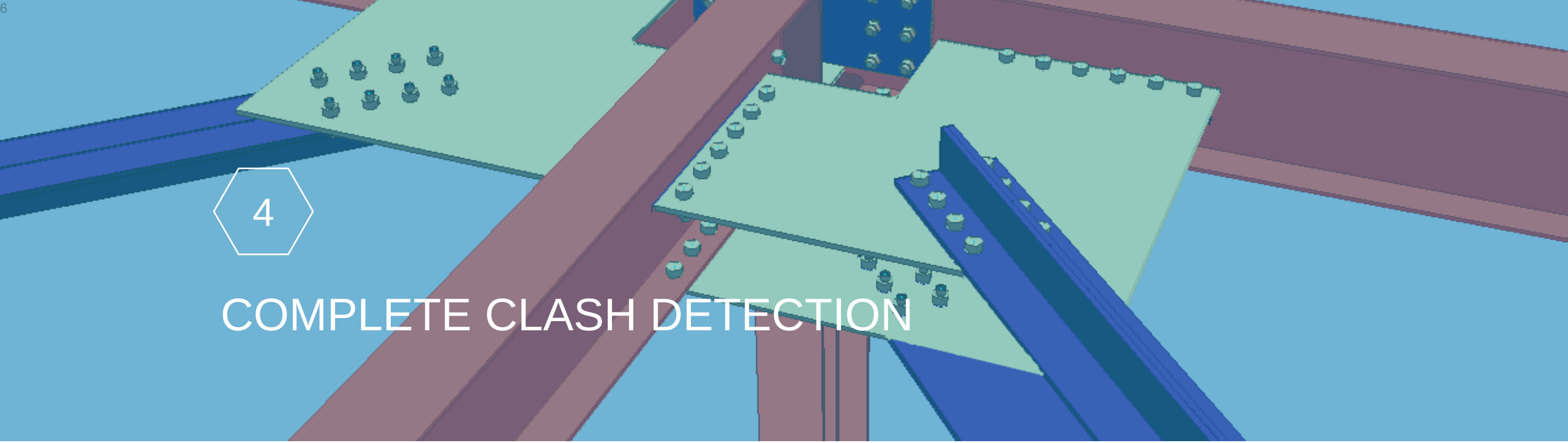
Optimizing bolts and holes on a connection reduces fabrication and erection time and labor.

PATENTED CONNECTION DESIGN LOCKS

Lock in the overvalues that you require for ultimate control connections designed by SDS/2.

USER DRIVEN

User design and fabrication preferences make the connection design automation even faster.



4

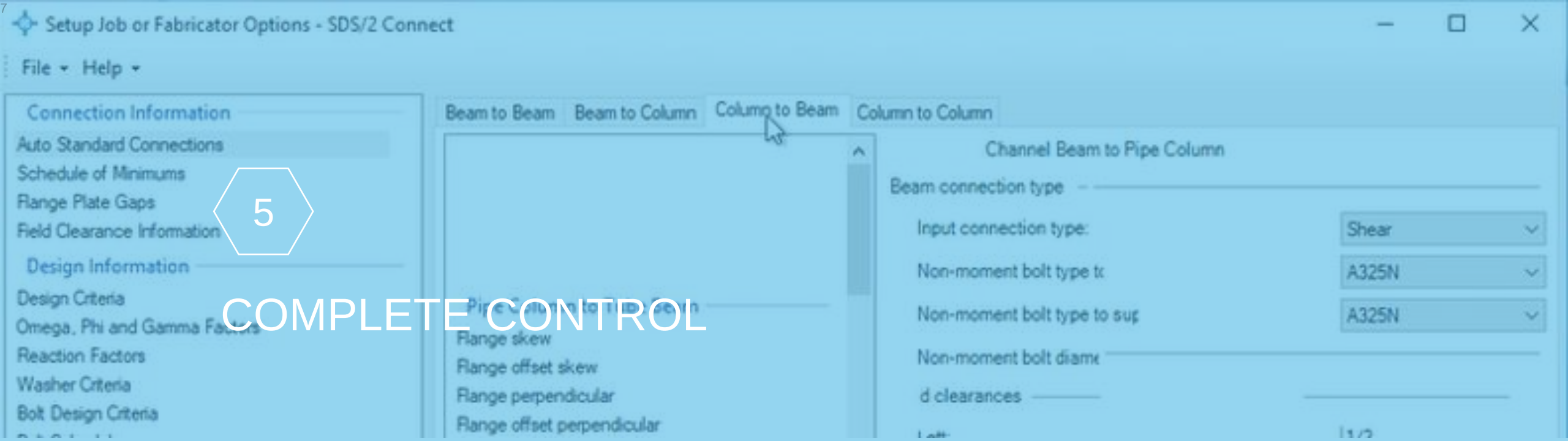
COMPLETE CLASH DETECTION

ACCURACY

Gusset plates will be accurate in the S3D model

OPTIMIZE FOR CLASH PREVENTION

You can quickly optimize connection design workflows to help avoid clashes entirely.



ROBUST DESIGN AND MANUFACTURING SETTINGS

Pre-selecting connection configurations, bolt sizes and more give you full control of connection design automation.

FABRICATION CENTERED OPTIONS

Optimizing items like piecemarking and plate thicknesses for connection design to fit your shop preferences is a key advantage.

WHAT'S THE SCOPE?

Design Codes:

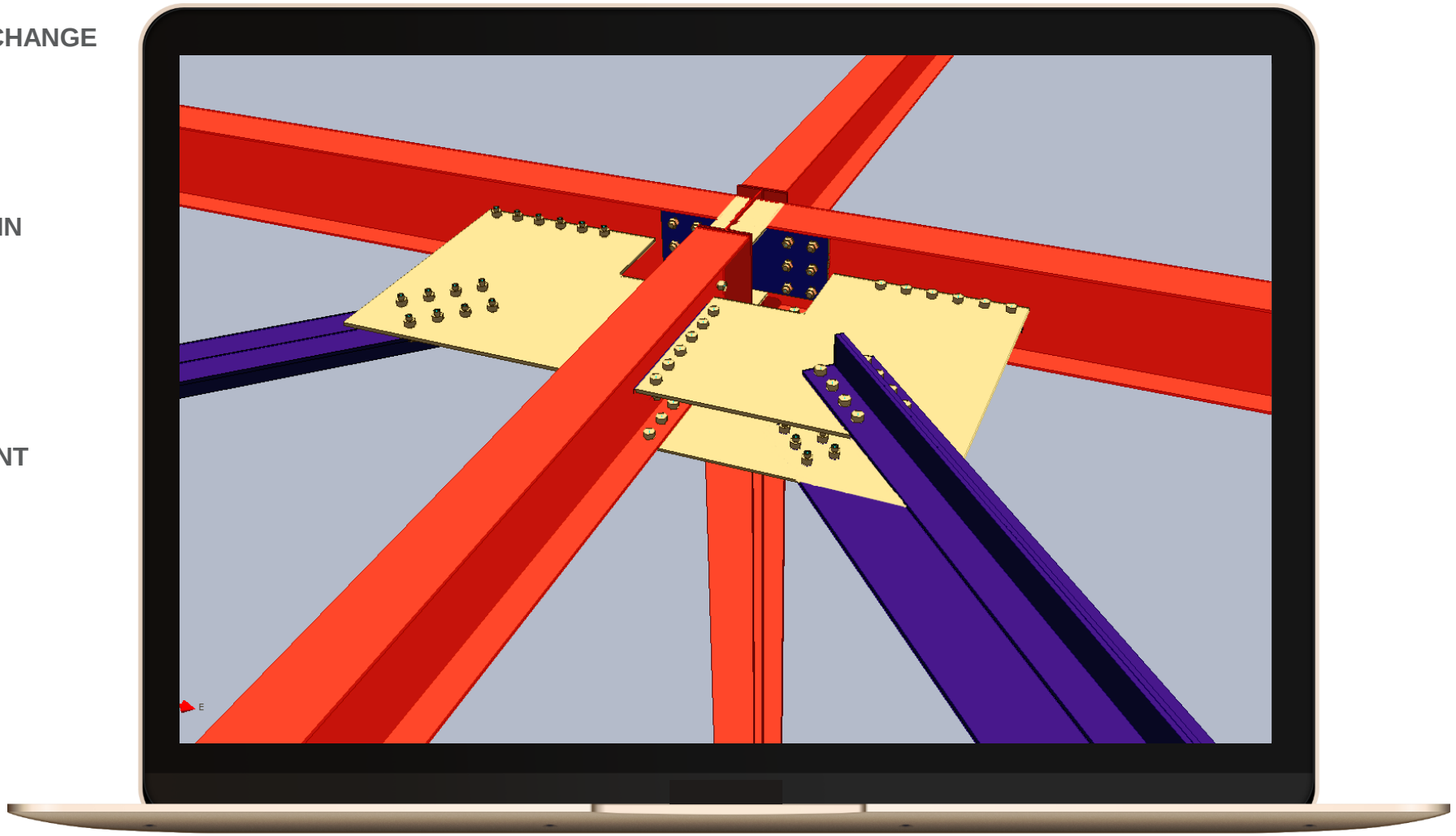
- All US Codes
- Canadian Codes
- European
- Australian (limited)

Geometry:

- Usually directed by code limitations

HOW WILL THIS FIT INTO MY WORKFLOW?

- NO INTERFACE/SOFTWARE CHANGE
- NEW FUNCTIONALITY BUILT IN
- AUTOMATE A LARGE PERCENT OF PROJECT



WHAT ARE THE BENEFITS TO ME?

1 PIPING TEAM

- Accurate gusset plates for pipe interference
- Real-time information
- Helps create a ‘connected’ model

2 ENGINEERING TEAM

- Quick, easy and accurate connection design
- Reduce number of drawings
- No lengthy approval process for new software supplier

3 PROJECT BENEFITS

- Reduced RFIs & field corrections
- Compressed construction schedules
- Increased profit

4 COMPANY BENEFITS

- Quality projects
- On-time and on-budget projects
- Increased profit

WORKING TOGETHER TO IMPROVE THE INDUSTRY

HEXAGON

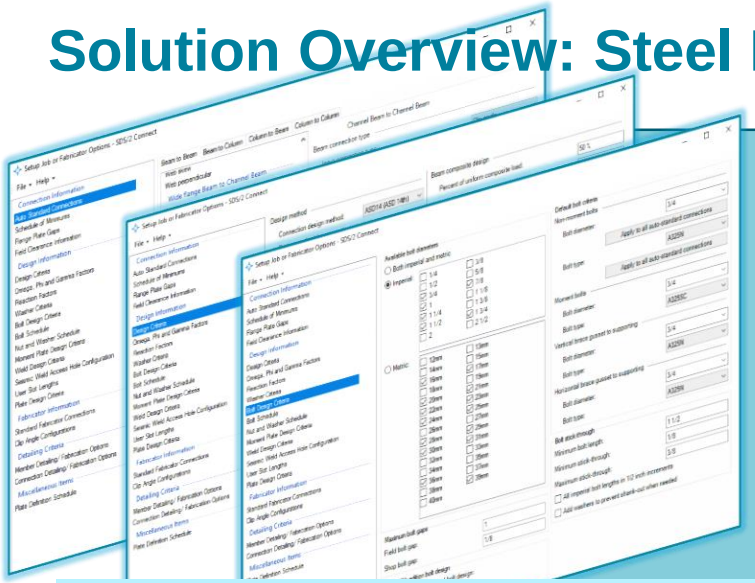
SDS/2
NEMETSCHEK COMPANY

Joe Harrison

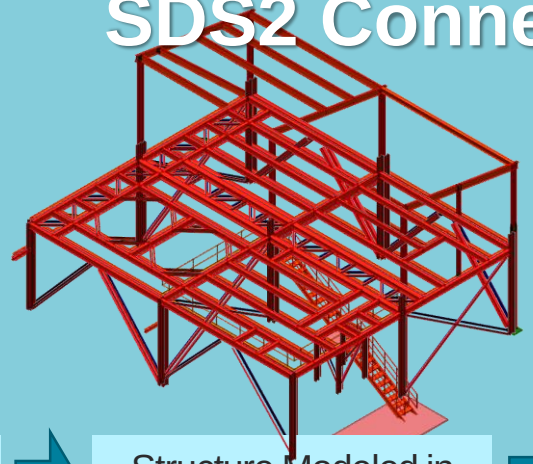
Executive Product Manager

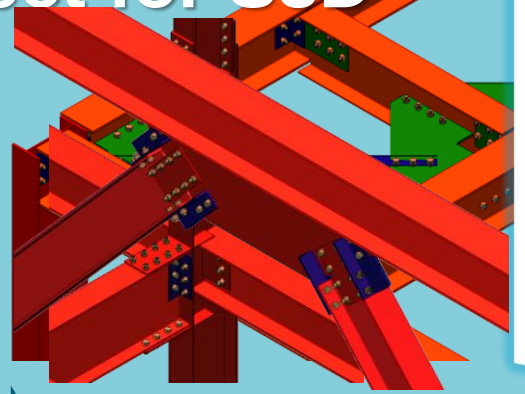
Hexagon PPM

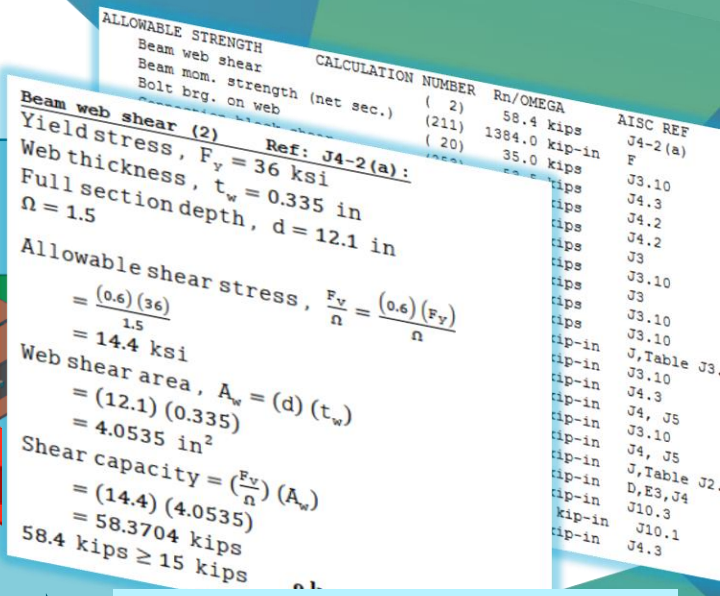
Solution Overview: Steel Detailing in Smart 3D



SDS2 Connect for S3D







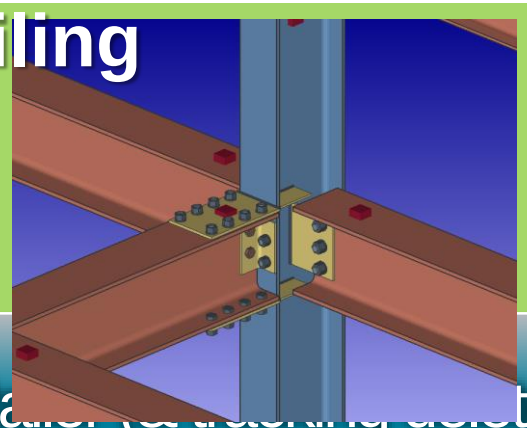
Updates S3D Catalog, Set Preferences (Standards, Design Criteria, Bolt Settings, …)

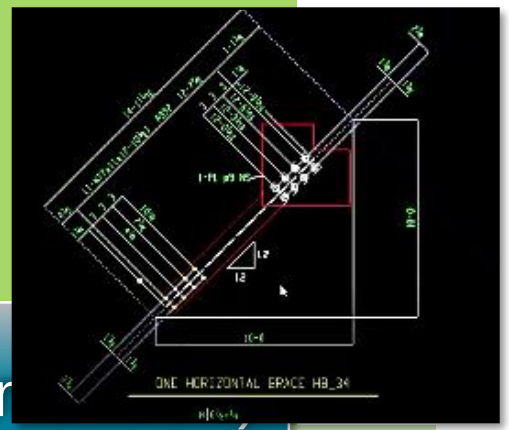
Structure Modeled in Smart 3D

Assembly Connections Placed with SDS/2 Connect

Connections are Designed, Calculations Reviewed

SDS2 Detailing





Detailing/Fabrication can begin

Piecemarks added

begin

ings can be generated

Summary

- Clear value prop – no need for external CAD solution
- Integrated with the other disciplines
- Validated and documented connections
- Supporting the standards
- Less interface to be created/maintained
- Link to fabrication
- Automatic creation of deliverables

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Q&A

Thank You

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