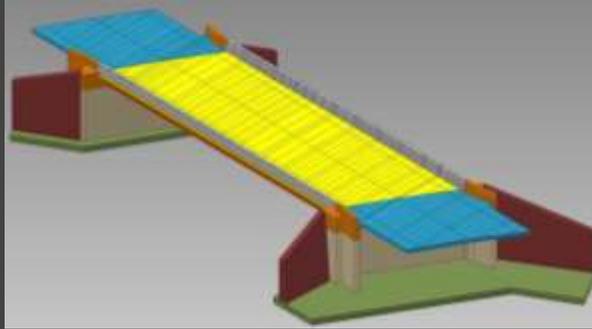


3D MODELS FOR DESIGN & DETAILING



*JOE BRENNER, P.E.
NICK SEMAN, E.I.T.*



3D
MODELING
FOR DESIGN
AND
DETAILING OF
STRUCTURES

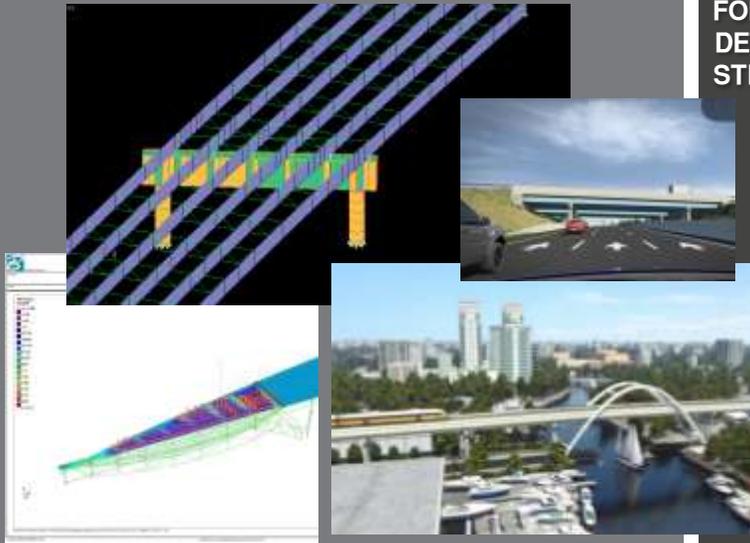
OVERVIEW

- Common uses of 3D models
- What else can a 3D model do?
- Potential future applications
- Steps to further implementation
- Challenges
- Benefits
- Conclusions

COMMON USES OF 3D MODELS

3D

MODELING
FOR DESIGN &
DETAILING OF
STRUCTURES

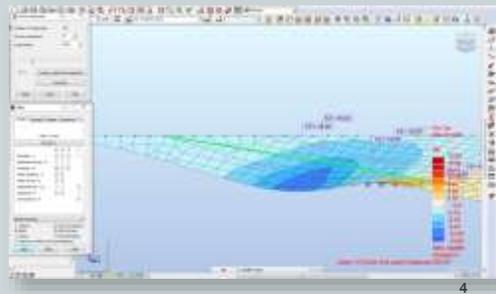
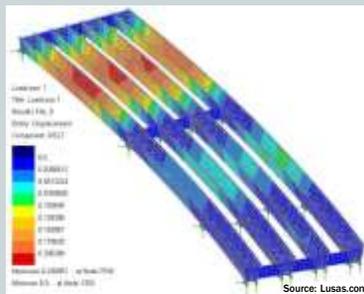


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3D MODELS FOR STRUCTURAL ANALYSIS

■ What are these models?

- Refined method of analysis
- Powerful analysis tool for curved steel girder and other complex bridge
- Typically utilize finite element method approach



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VISUALIZATION AND PUBLIC OUTREACH

■ What are these models?

- Aid in visualizing design intent and project appearance
- Earliest and most widely used type of 3D models
- “Pretty Picture” models vs. design/constr. models

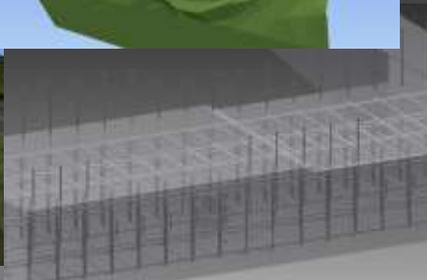
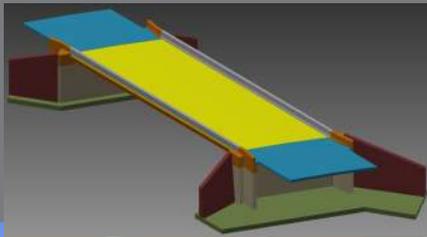


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WHAT ELSE CAN A 3D MODEL DO?

3D

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FOR DESIGN &
DETAILING OF
STRUCTURES



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WHAT ELSE CAN A 3D MODEL DO?

How else could 3D models be used in bridge design process?



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WHAT ELSE CAN A 3D MODEL DO?

Factors driving this question:

- Rapidly improving computing technology
- Other industries models for similar purposes
- Recognition of inherent advantages in 3D technology

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WHAT ELSE CAN A 3D MODEL DO?

How else could 3D models be used in bridge design process?

- Ability to view and interact with the proposed design from any perspective, illustrating any aspect of the proposed structure
- Automatically generate and update 2D drawings of specific components

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WHAT ELSE CAN A 3D MODEL DO?

How else could 3D models be used in bridge design process? (cont'd)

- Improve observation of the interactions between bridge, highway and other disciplines by providing a common platform for the integration of design content
- Provide the ability to perform virtual construction analysis including site preparation and scheduling

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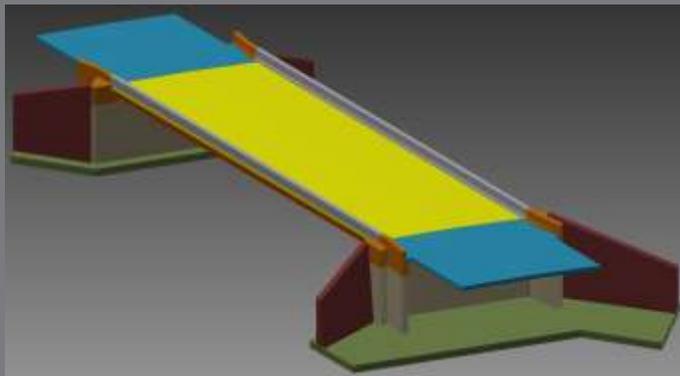
WHAT ELSE CAN A 3D MODEL DO?

How else could 3D models be used in bridge design process? (cont'd)

- Improved interface to study complex/congested reinforcement details
- Ability to analyze individual bridge components with structural analysis applications

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VIEW AND INTERACT WITH DESIGN

**3D****MODELING FOR
STRUCTURES**

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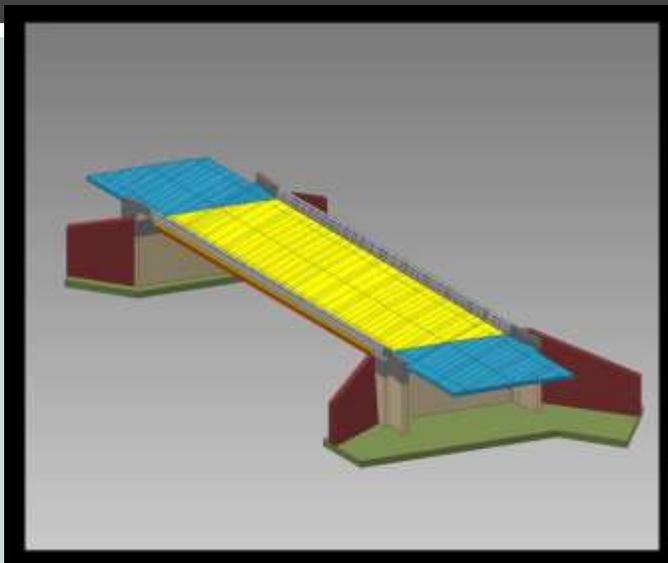
VIEW AND INTERACT WITH DESIGN

Investigation Topics

- 100% accurate visualization from any perspective
- Better convey design – validate concepts
- Allow virtual inspection / review
- Review of aesthetics

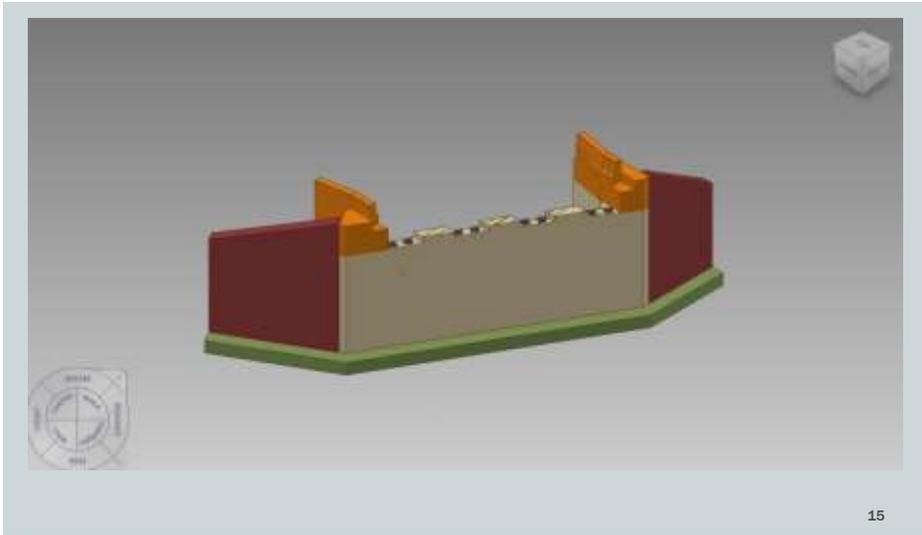
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VIEW AND INTERACT WITH DESIGN

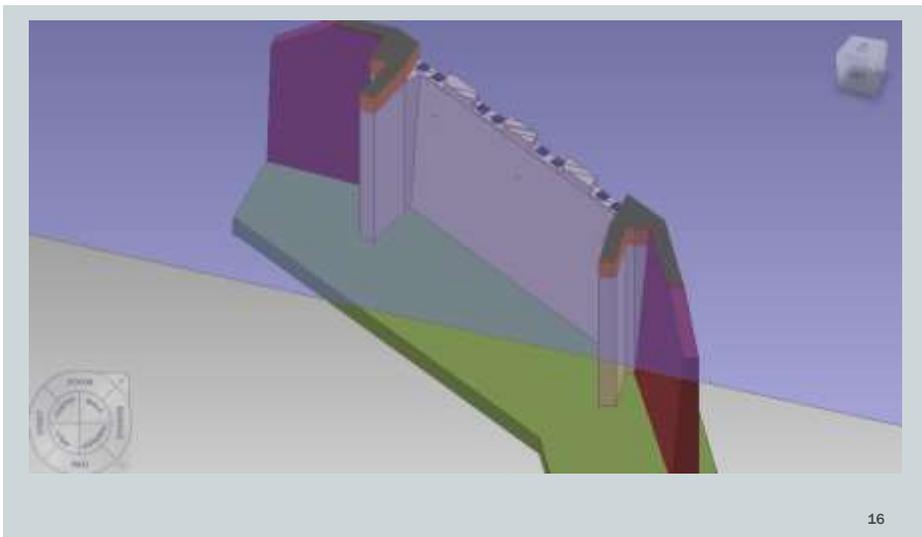


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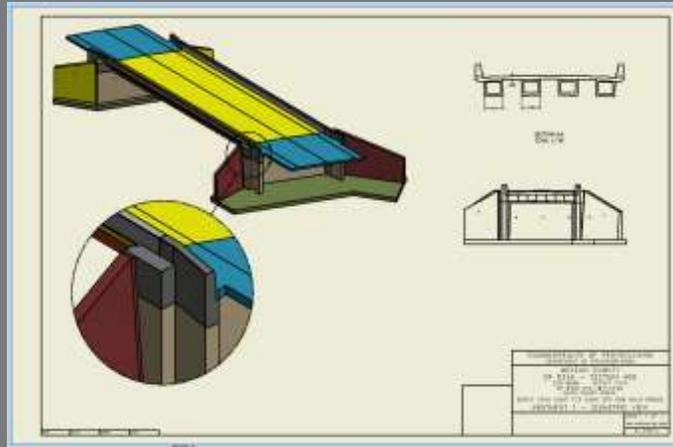
VIEW AND INTERACT WITH DESIGN



VIEW AND INTERACT WITH DESIGN



DRAWING GENERATION



3D

MODELING
FOR
STRUCTURES

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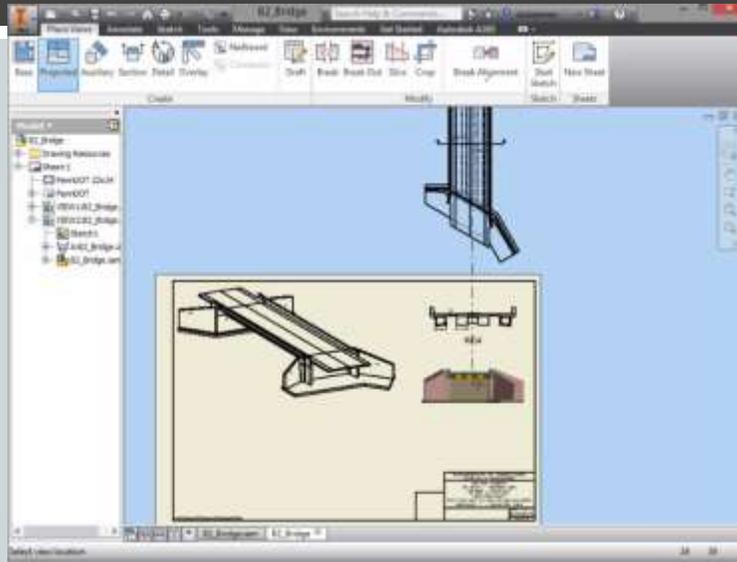
DRAWING GENERATION

Investigation Topics

- Isometric view of bridge and specific components
- Create section views for any component, at any location
- Supplement with additional detail views
- Parametric capabilities with generated drawings

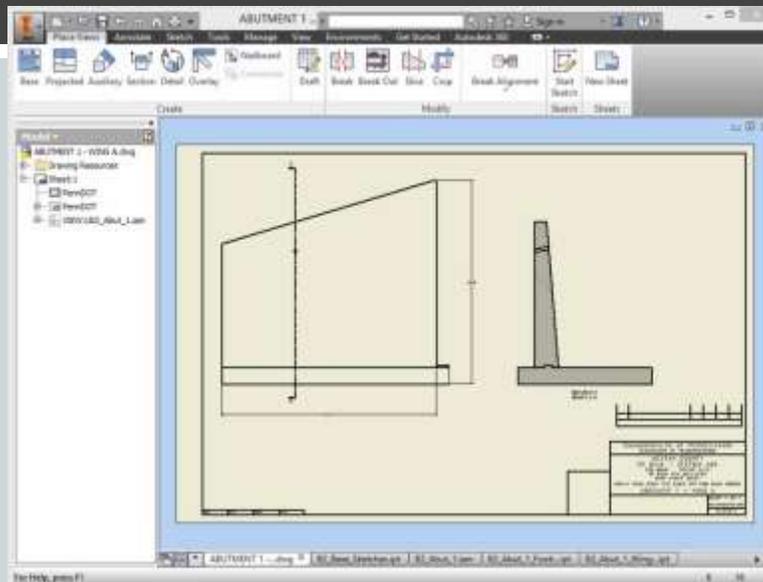
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DRAWING GENERATION



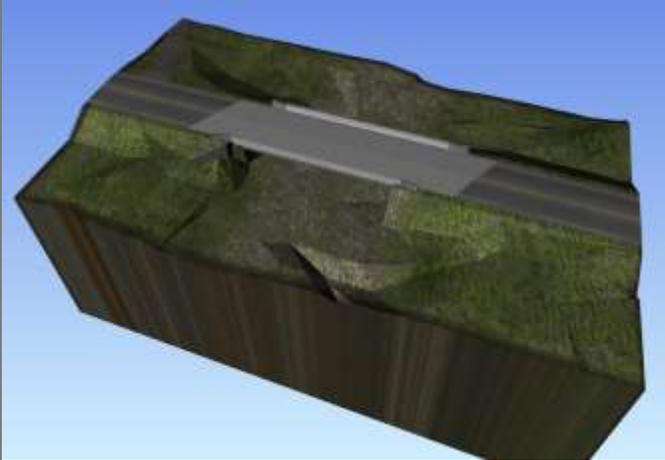
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DRAWING GENERATION



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INTEGRATING DESIGN CONTENT FROM MULTIPLE DISCIPLINES



3D

MODELING FOR
STRUCTURES

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INTEGRATING DESIGN CONTENT FROM MULTIPLE DISCIPLINES

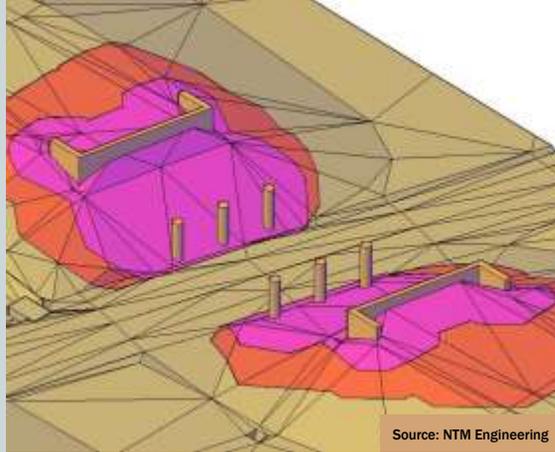
Investigation Topics

- Integration of bridge model with site and roadway models
- Earthwork quantities
- Providing first person POV interface
- Perform Clash analysis between construction features and/or existing features (utilities)

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INTEGRATING DESIGN CONTENT FROM MULTIPLE DISCIPLINES

Earthwork Quantity Example

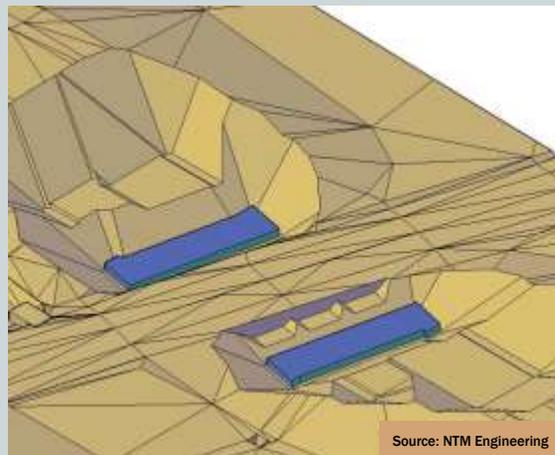


Source: NTM Engineering

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INTEGRATING DESIGN CONTENT FROM MULTIPLE DISCIPLINES

Earthwork Quantity Example



Source: NTM Engineering

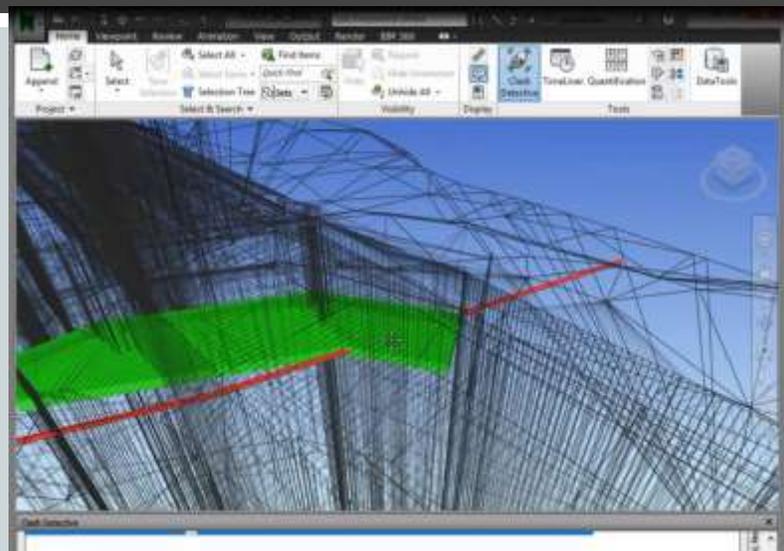
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INTEGRATING DESIGN CONTENT FROM MULTIPLE DISCIPLINES



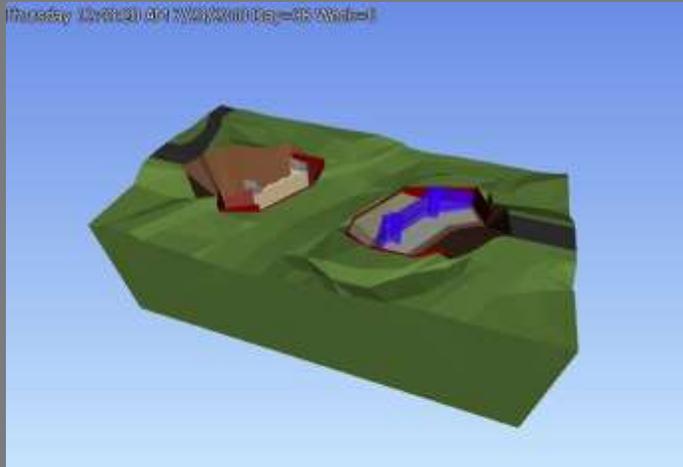
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INTEGRATING DESIGN CONTENT FROM MULTIPLE DISCIPLINES



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CONSTRUCTION SIMULATION AND ANALYSIS



3D

MODELING FOR
STRUCTURES

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CONSTRUCTION SIMULATION AND ANALYSIS

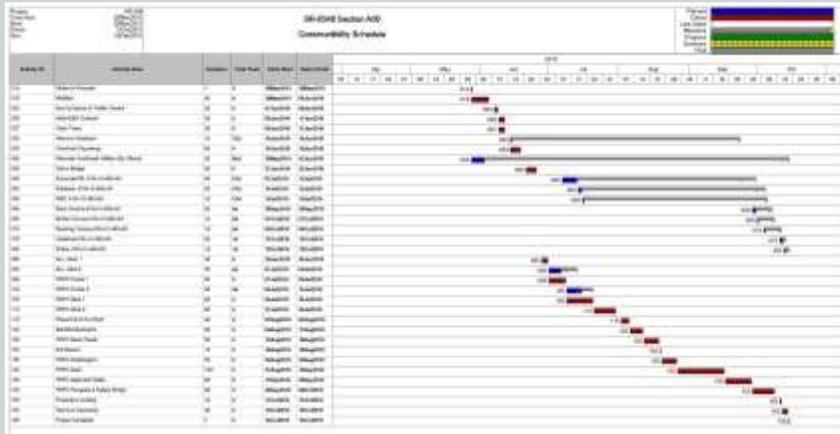
Investigation Topics

- Import project task, scheduling, resource, and cost information and link to 3D model
- Review project activity chronologically
 - Enables the user to view project in its environment at any point in time (4D)
 - Running tally of resource cost (5D)
- Perform project logistical planning
 - Model equipment and resource staging and movement

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CONSTRUCTION SCHEDULE

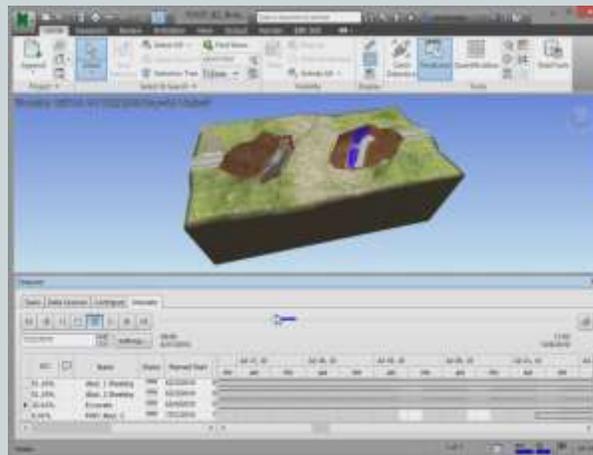
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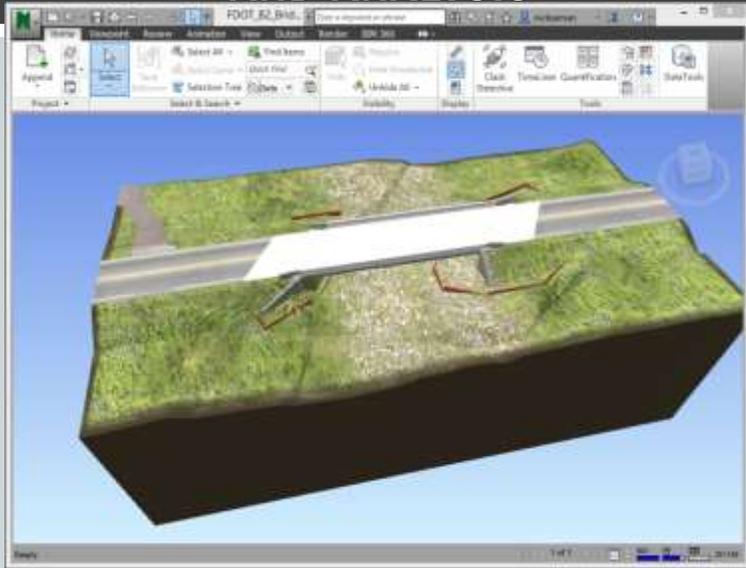
CONSTRUCTION SIMULATION AND ANALYSIS

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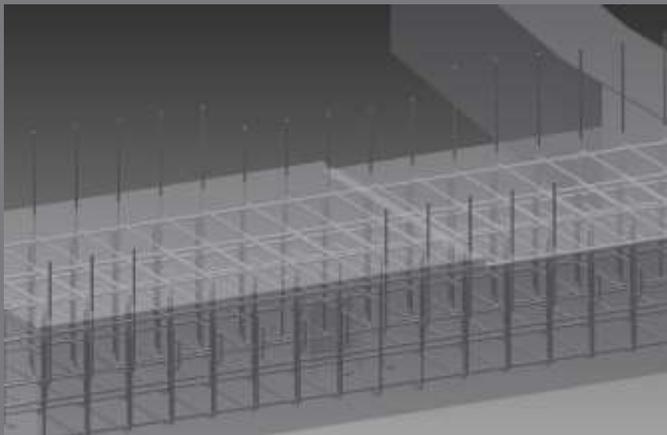
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CONSTRUCTION SIMULATION AND ANALYSIS



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COMPLEX REINFORCEMENT DETAILS



3D
MODELING
FOR
STRUCTURES

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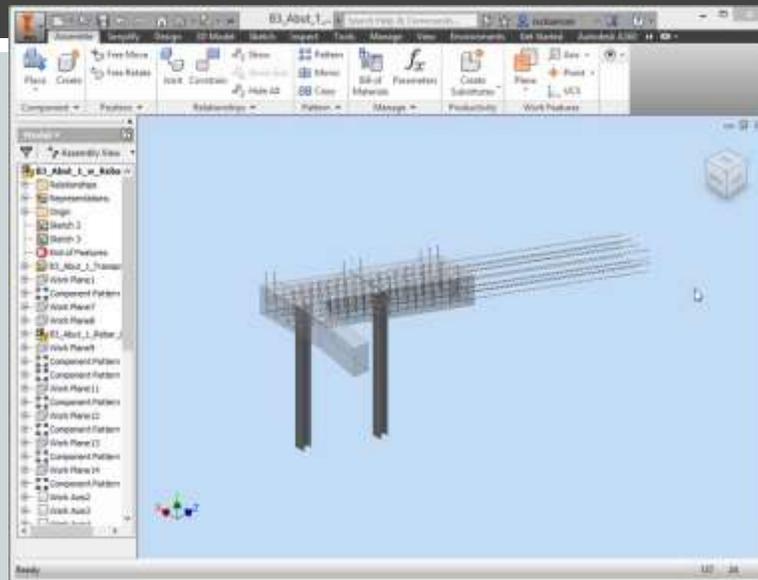
REINFORCEMENT MODELING

Investigation Topics

- Visualization of complex rebar details
- Clash Analysis
- Automation of rebar schedules and quantities

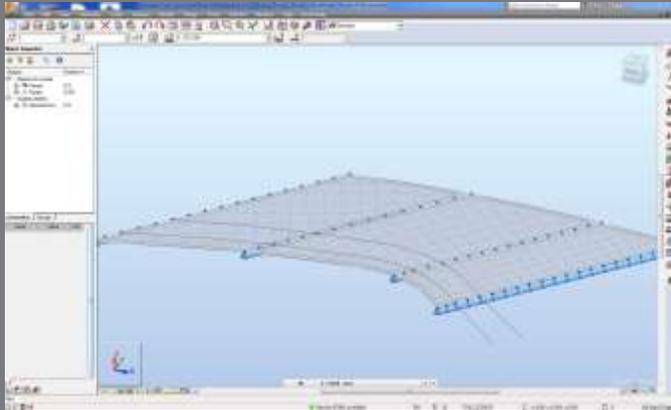
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REINFORCEMENT MODELING



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STRUCTURAL ANALYSIS APPLICATIONS



3D MODELING FOR STRUCTURES

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STRUCTURAL ANALYSIS APPLICATIONS

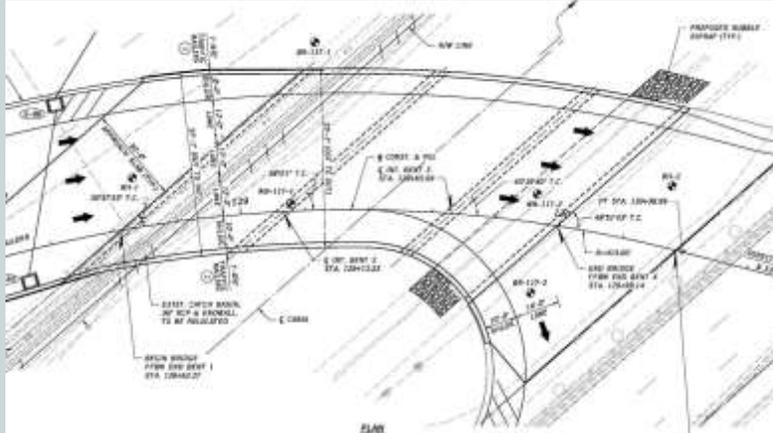
Investigation Topics

- Analysis of model inside 3D parametric software
- Export model geometry to other external structural analysis software
- Use structural analysis model as basis for detailing model

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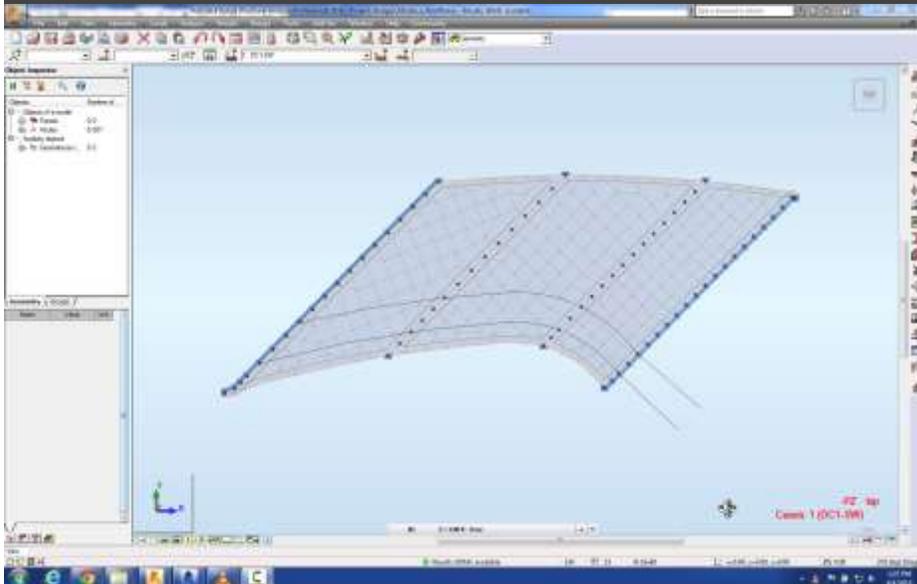
STRUCTURAL ANALYSIS APPLICATIONS

Structural Analysis Example

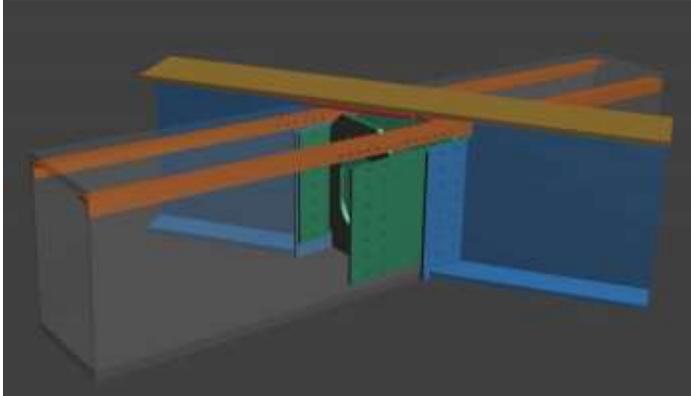


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STRUCTURAL ANALYSIS APPLICATIONS



POTENTIAL FUTURE APPLICATIONS



Source: High Steel Structures

3D

MODELING
FOR DESIGN &
DETAILING OF
STRUCTURES

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POTENTIAL FUTURE APPLICATIONS

- Digital delivery of models/information
- Interoperability between software
- Review of 3D shop drawing models
- Asset management applications

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POTENTIAL FUTURE APPLICATIONS

■ Digital delivery of models

- Digital models with critical bridge information
- Components tied into coordinate system and elevations
- Less paper

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POTENTIAL FUTURE APPLICATIONS

■ Interoperability between software

- Model used in detailing/design/fabrication/construction
- Past practice of “silo-ed” software development is reduced
- Recognition of inherent efficiencies in the process

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POTENTIAL FUTURE APPLICATIONS

■ Review of 3D shop drawing models

- Less time spent on reviewing/creating shop drawings
- Current process: 2D plans to 3D model for fabrication back to 2D shop drawings for review and approval
- Improved communication of design intent

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POTENTIAL FUTURE APPLICATIONS

■ Asset management applications

- Model continually updated from preliminary engineering through construction
- Lifecycle use of model
- Field inspection uses
- Future rehabilitation work

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STEPS TO FURTHER IMPLEMENTATION

- **Collaboration between industry sectors**
- **Determining model content/requirements for each stage of project**
- **Data exchange standards**

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CHALLENGES

- **Resistance to change**
- **Lack of standards/best practices guidelines**
- **Training required**
- **QA/QC of models**
- **Legal implications**

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BENEFITS

- **Increased overall efficiency by linking design/detailing data to downstream applications**
- **Redundant data re-entry reduced**
- **Fewer change orders and field modifications (clash detection)**
- **Conflict resolution early in process**

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BENEFITS

- **Better visualization representation of design intent early in process**
- **Quantity calculations byproduct of model**
- **Use in virtual construction site plan - crane placement, safety equip. locations, coordination of activities (ABC)**
- **And more...**

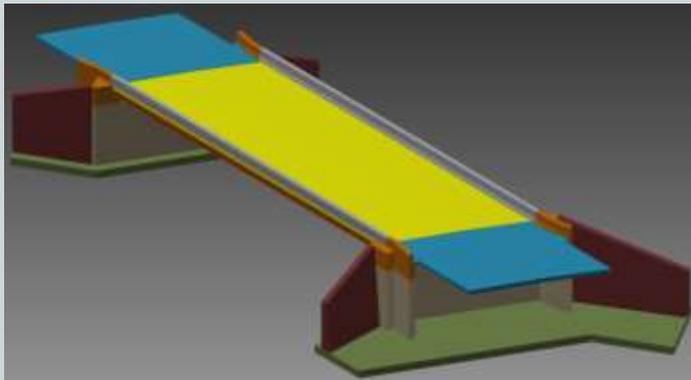
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CONCLUSIONS

- Potential benefits outweigh the challenges
- 3D models have inherent advantages and efficiencies compared to traditional 2D
- It will take time to realize full potential of these models; however, it must start now!

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QUESTIONS?



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