



U.S. Department of Transportation
**Federal Highway
Administration**



1

FHWA Task Order - Demonstration of BIM for Bridges

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The Need

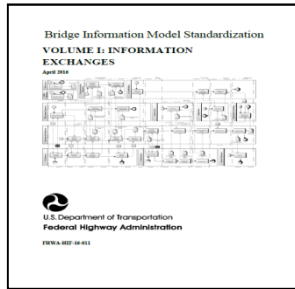
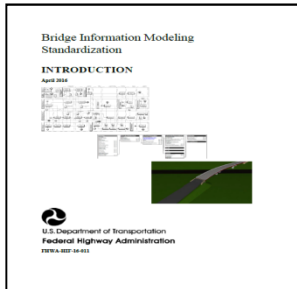
“To advance the standardization of BIM for bridges, the current focus of FHWA is on the execution of a specific data exchange in the bridge life cycle with measurable and well-defined scope.”

- First data exchange to explore is electronic Bridge Design Plans to Bid through Fabrication to Construction
- *IFC Bridge Design to Construction Exchange Requirements U.S.* have already been developed
- Workshop hosted by FHWA for bridge design industry in held in August 2015
- NCHRP workshop was held in May of 2016 to determine next steps with IFC and standardization
- The next phase is implementation of IFC in the bridge community.
 - *Contractual tools*
 - *Familiarity with IFC*
 - *Pooled Fund*

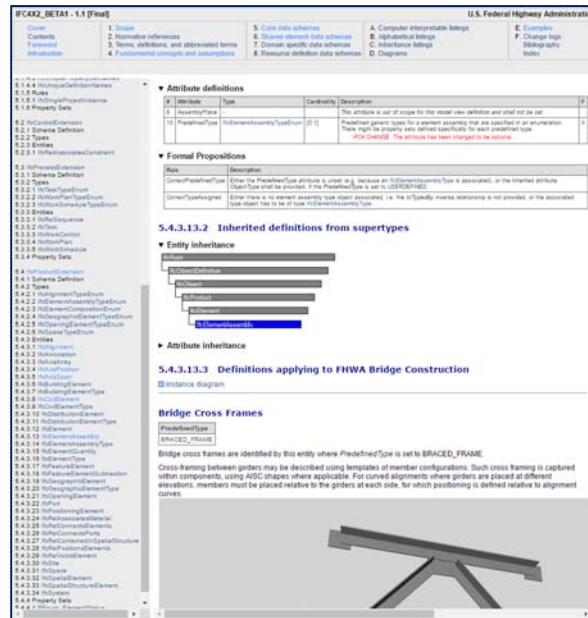
FHWA Bridge Information Model Standardization Project

Focused on **plan-level detail** for bidding and building bridges

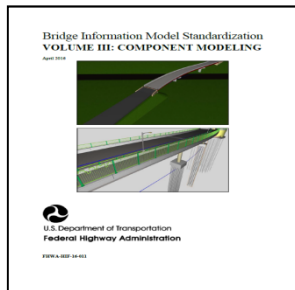
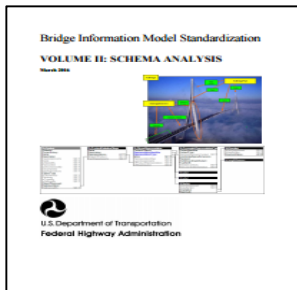
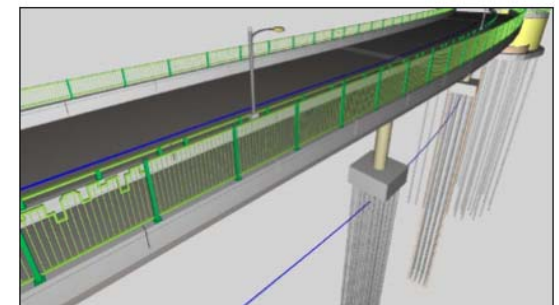
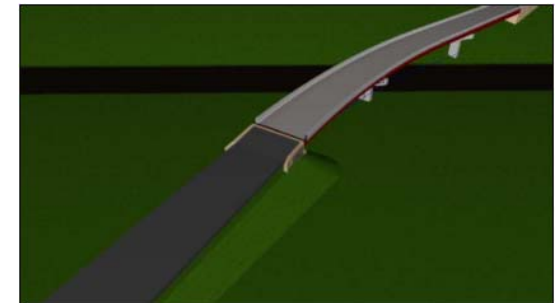
Report: use cases, new integrated process map



Specification for software developers



Example files for steel and concrete bridges



http://www.nibs.org/?page=bsa_bridge
<https://www.fhwa.dot.gov/bridge/pubs/hif16011/>

Bridge Model Standard Development Progress

Per U.S. National BIM Standard Process

Programming

- Bridge process map developed – Bridge IDM
- Additional review and validation required

Design

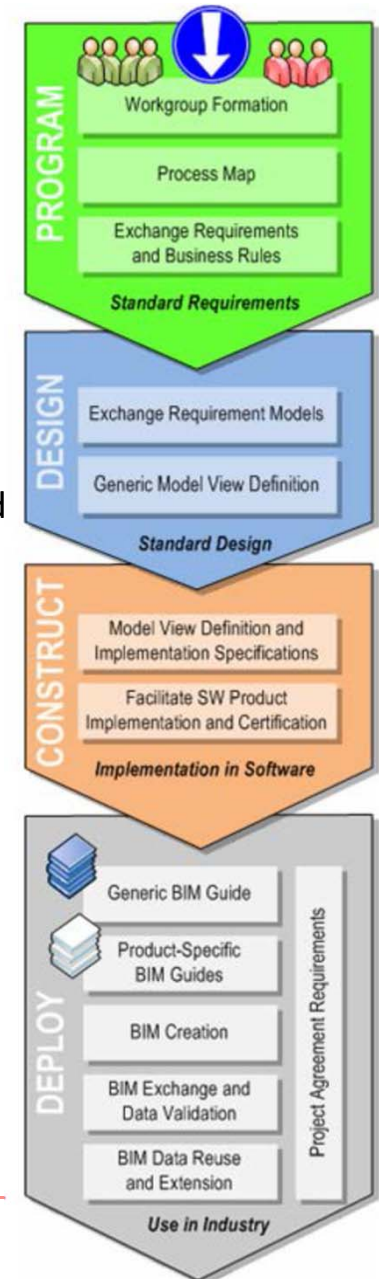
- Exchanges identified
- Design-Construction exchange requirements documented
- Process model and exchanges balloted and maintained as a standard

Construction

- Model view definition based on IFC 4.1 created
- MVD balloted and maintained as a standard
- Initial software deployment testing initiated – more needed

Deployment

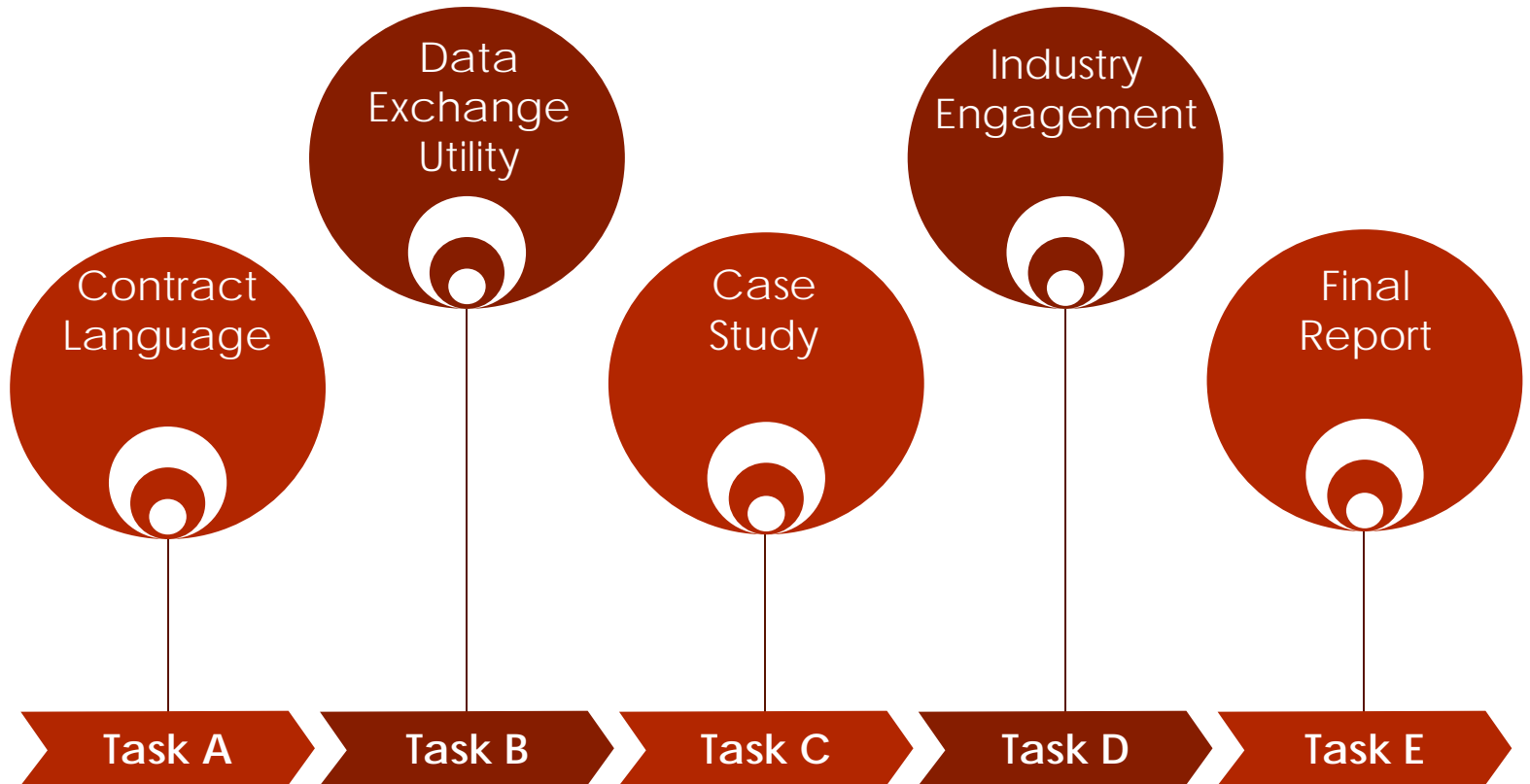
- Engage software vendors to develop implementations
- Validate that implementations meet requirements
- Use in projects



Objective

“The objective of this task order is to implement the use of Building Information Modeling (BIM) for design and fabrication of highway bridge projects using the *IFC Bridge Design to Construction Information Exchange (U.S.)* and to develop recommendations for further refinements and recommendations in the use of the IFC standard for digital delivery of bridge projects in the U.S.”

Current FHWA Task Order



The People

TECHNICAL WORKING GROUP (TWG)

- Scot Becker (WI)
- Carmen Swanwick (UT)
- Brad Wagner (MI)
- Ahmad Abu-Hawash (IA)
- Annette Jeffers (IA)
- Eric Christie (AL/
AASHTOWare)

RESEARCH TEAM (FHWA/WSP)

- Brian Kozy, PM (FHWA)
- Kelley Severns, PM (WSP)
- Josh Sletten (WSP)
- Joe Brenner (WSP)
- Francesca Maier (Fair Cape Consulting)
- Roger Grant (NIBS)
- Tim Chipman (Constructivity)

Task A: Develop Guide Contract Language

BACKGROUND

- Consultants and contractors are using BIM without owner involvement
- Lack of explicit requirements is holding back transfer of the BIM data
- Owners are paying for BIM, but not benefiting from it
- There is a gap in clear, unambiguous contract language both for design deliverables in BIM and using BIM as supplemental or replacement construction contract documents.
- Contract language is needed for design contracts as well as construction specifications

APPROACH

- Collect Documents
- Work with Technical Working Group (TWG) to provide feedback
- Summarize and provide guidance

DELIVERABLES

- ✓ Guide contract language for BIM digital deliverables.

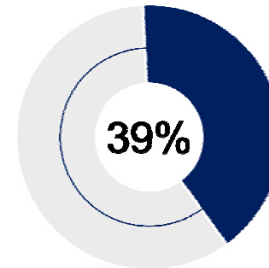
Contract Language

70% complete, soliciting industry feedback

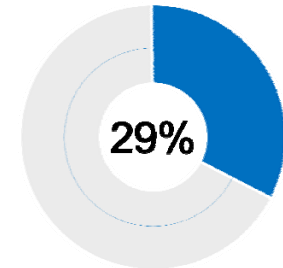
5 sections:

- Introduction
- Professional Services Contracts
- Reference Standards
- Construction Specifications
- Conclusion

Claims where **Communications** was the primary non-technical cause

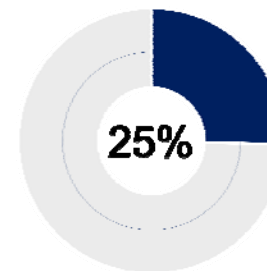


By Number of Claims

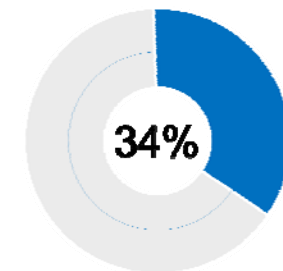


By Value of Claims

Claims where level of **Capability** was the primary cause



By Number of Claims



By Value of Claims

Task B: AASHTOWare to IFC

BACKGROUND

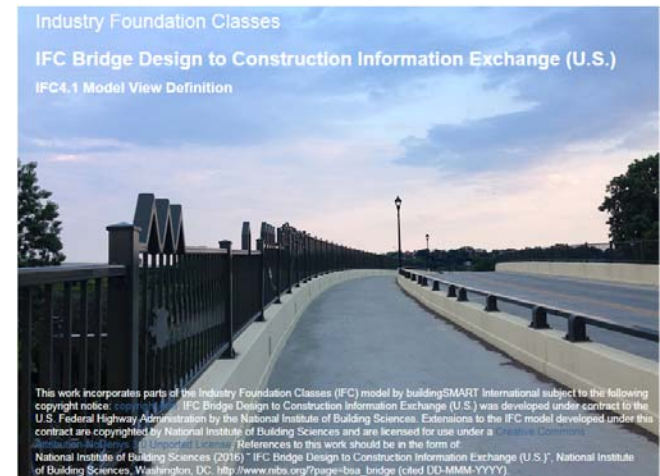
- AASHTOWare Bridge Design software allows bridge designers to define parameters
- This project will provide functionality for a user to export bridges as IFC files.

APPROACH

- Capture bridge design detail using standardized representations within IFC
- Documentation will be created for describing how to map each database table to IFC.
- Utility application will be provided to verify and validate IFC exports
- 30 sample bridges and the case study bridges will be tested automatically against the IFC Bridge Exchange Specification U.S. MVD and manually using software supporting IFC 4.1

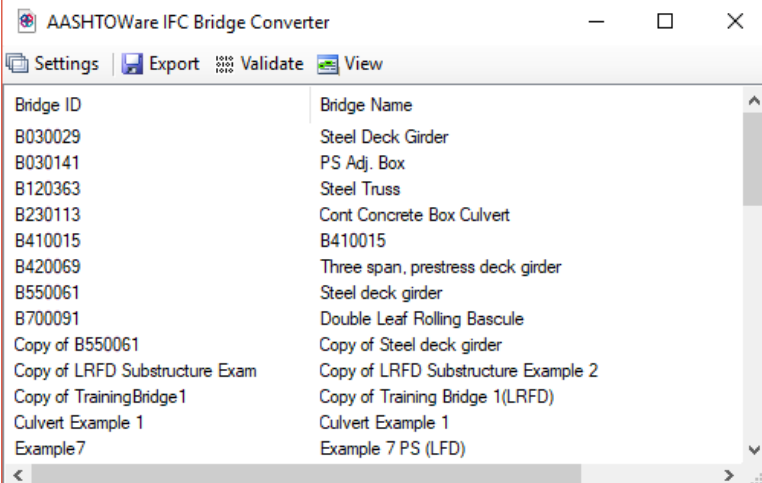
DELIVERABLE

- ✓ Simple Windows application for testing and demonstration purposes that allows a user to select from available bridges, export as an IFC file, and open in an IFC viewer application



AASHTOWare to IFC Task Update

- Exports IFC 4.1 for parameterized geometry and alignment
- Also exports IFC 2.3 for compatibility with more apps – any alignment curvature is reduced to straight line in such case
- AW-specific fields also included in export as custom properties
- Modular code: Utility + Converters + Data Models + Data Formats – all separate components that can be interchanged and re-used

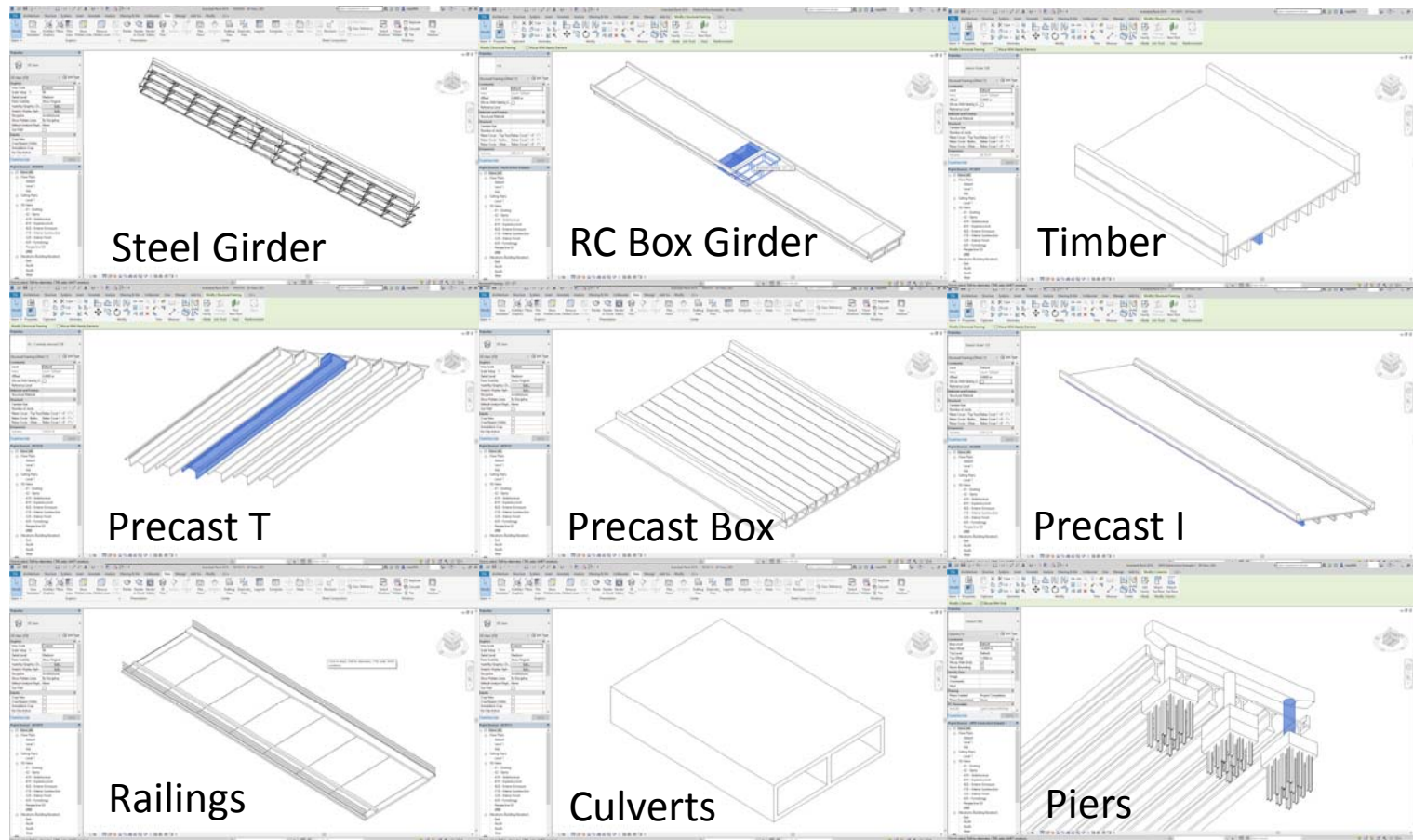


The screenshot shows the 'AASHTOWare IFC Bridge Converter' application window. The window has a title bar with standard minimize, maximize, and close buttons. Below the title bar is a menu bar with 'Settings', 'Export', 'Validate', and 'View' options. The main content area displays a table with two columns: 'Bridge ID' and 'Bridge Name'. The table contains the following data:

Bridge ID	Bridge Name
B030029	Steel Deck Girder
B030141	PS Adj. Box
B120363	Steel Truss
B230113	Cont Concrete Box Culvert
B410015	B410015
B420069	Three span, prestress deck girder
B550061	Steel deck girder
B700091	Double Leaf Rolling Bascule
Copy of B550061	Copy of Steel deck girder
Copy of LRFD Substructure Exam	Copy of LRFD Substructure Example 2
Copy of TrainingBridge1	Copy of Training Bridge 1(LRFD)
Culvert Example 1	Culvert Example 1
Example 7	Example 7 PS (LFD)

AASHTOWare to IFC Task Update

- Exported files tested with Revit, Microstation, Solibri
- Test bridges include AW BrD samples, Wisconsin DOT (shown here)



Task C: Demonstration Project

BACKGROUND

- The demonstration projects provide an opportunity to test IFC, the AASHTOWare BrD data exchange, the guide contract language, and the emerging metadata practices that are important to limiting the risks with digital delivery.

APPROACH

- Partner with Utah DOT
- Provide support to the owner/agency on the application of the developed guide contract language.
- Document the processes during the pilot project and develop a case study report
- Exchange the BIM datasets from AASHTOWare BrD to IFC and then view the IFC files in proprietary BIM formats (e.g. Tekla Structures, ProStructures, and Revit) to evaluate the completeness and reliability of the data exchanges for the Utah models

Task D: Industry Outreach and Consensus

BACKGROUND

Objective: to advance towards bridge data standards through developing a bridge object data template and the guidance for requesting identifying the need for and requesting extensions to the standard, and secondly, building consensus, enthusiasm, and a sense of urgency for the industry to advance the use of digital models based on open standards

APPROACH

- Engage Technical Working Group formed in Task A to help develop material
- Planned Workshops and presentations
 - 2 Webinars
 - 1 Workshop – hosted by Utah



Overall Project Timeline

Deliverable	Delivery Schedule
Kick Off Meeting (complete)	August 31, 2017
Kick Off Meeting Minutes (complete)	September 7, 2017
Revised Workplan to FHWA	September 18, 2017
Task A – Guide Contract Language	February 7, 2018
Task B – AASHTOWare to IFC Model Exchange	March 7, 2018
Task C – Demonstration Projects Draft Report	June 7, 2018
Task C1 – Constructivity Models of Demo Project	June 7, 2018
Task D – Planning Workshop with TWG	January 2018 (in conjunction with TRB)
Task D – 2 Webinars	May/June 2018
Task D – Face to Face Workshops – One 2-day workshop in Utah	September 2018
Task E – Final Report	December 7, 2018

From Task Order to Pooled Fund

Overall Goals



Establish standards, guidelines, or manuals to facilitate the wide use of IFC as an exchange standard



Develop the national standard MVD, data definitions, and data requirements for the model life cycle for all data exchanges



Collaborate with stakeholders to provide timely update of IFC data dictionary for common bridge elements



Collaborate with buildingSMART and software vendors to design and offer suitable training



Establish a forum/expert hub for practitioners in the bridge industry to promote the common modeling formats and share experiences



Develop a template of BIM for Bridges and Structures-specific contractual provisions for managing risks associated with IFC-BIM for bridges and structures.

From Task Order to Pooled Fund

Pooled Fund Objectives		FHWA Task Objectives
Define digital data needs for fabrication and mechanism to deliver to fabricators and what information do owners want to get back from fabricators		Education and Outreach with workshops and webinars
Coordination of cross discipline requirements (design, utilities, etc) – other AASHTO technical committees and joint committees		Testing of IFC exchange and software capabilities
IFC Validation and Acceptance with software industry and bridge industry		Contract Language examples and guidance for digital delivery
Education of bridge offices on IFC, software capabilities and options, liability and contract language before bringing items to SCOBS for ballot		Contribute to data dictionaries / MVD / LOD Discussions
Work with NIBS, buildingSmart to model balloting and consensus methods		Validate IFC through development of exchange tools in AASHTOWare
Establish a “baseline” standard works for at least 80% of state processes		Document Case Studies to provide starting point for state pilot projects
Develop the MVD as a written standard that will be easier for AASHTO to review and ballot		

Other Examples – Michigan DOT Project

Duration

- March 2016 – May 2018

Objectives

- Create the framework to implement BIM for bridges
- Provide recommendations for implementation

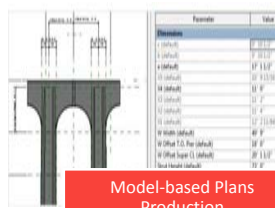
Priority of Tasks

- Identify uses of BIM for bridges
- Create 4 sample models using Bentley OBM
- Develop a framework to describe and manage 3D bridge models
- Create guidance and training for MDOT model development

Uses of BIM for Bridges



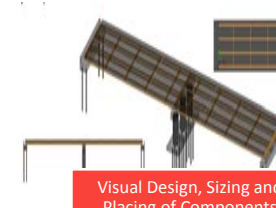
Visualization and Public Outreach



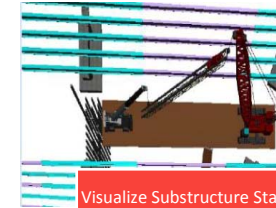
Model-based Plans Production



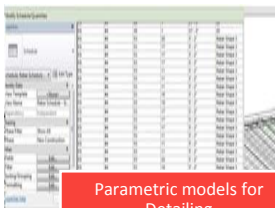
Site Plan and Excavation Design



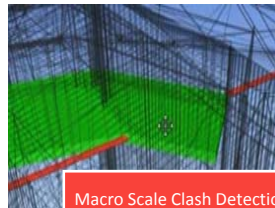
Visual Design, Sizing and Placing of Components



Visualize Substructure Staging



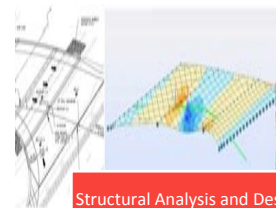
Parametric models for Detailing



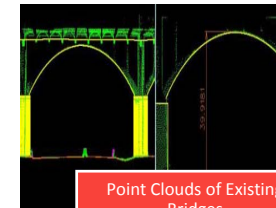
Macro Scale Clash Detection



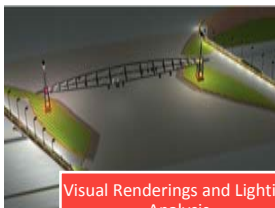
Micro Scale Clash Detection



Structural Analysis and Design



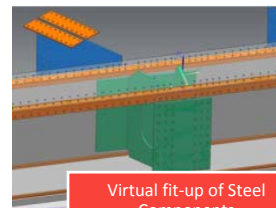
Point Clouds of Existing Bridges



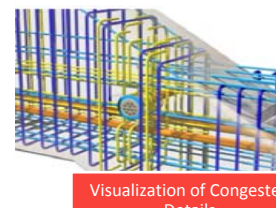
Visual Renderings and Lighting Analysis



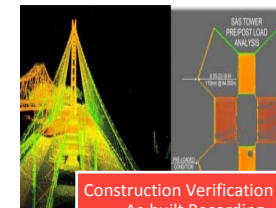
Virtual fit-up of Precast Components



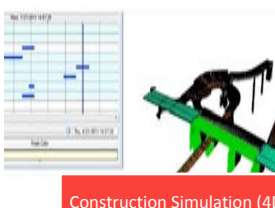
Virtual fit-up of Steel Components



Visualization of Congested Details



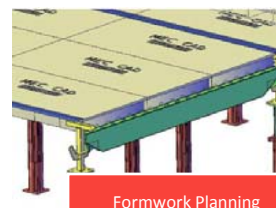
Construction Verification and As-built Recording



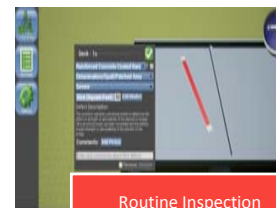
Construction Simulation (4D)



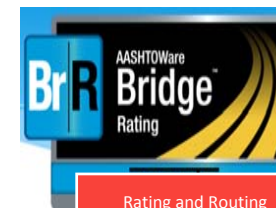
Crane Mobilization and Lift Planning



Formwork Planning

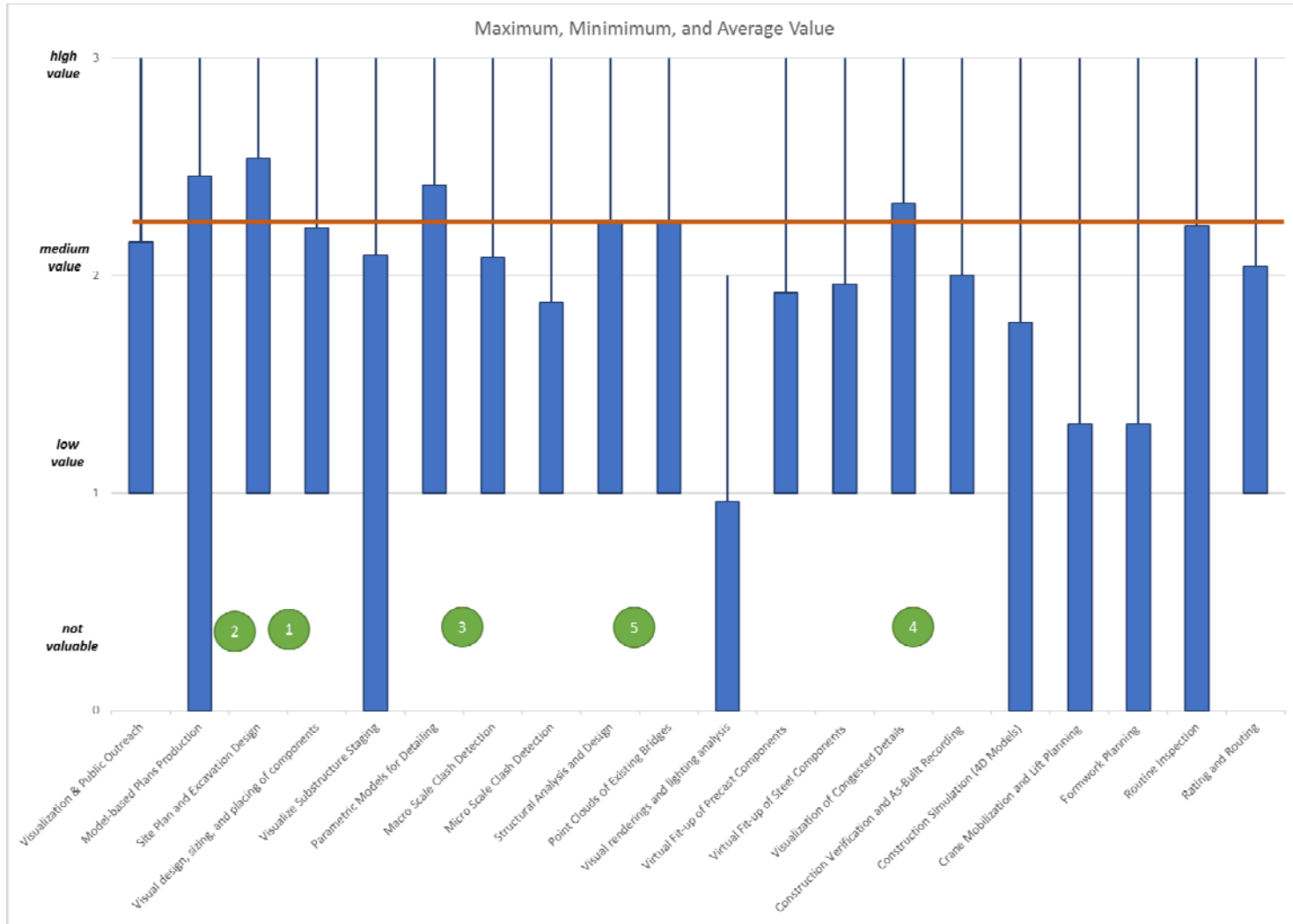


Routine Inspection

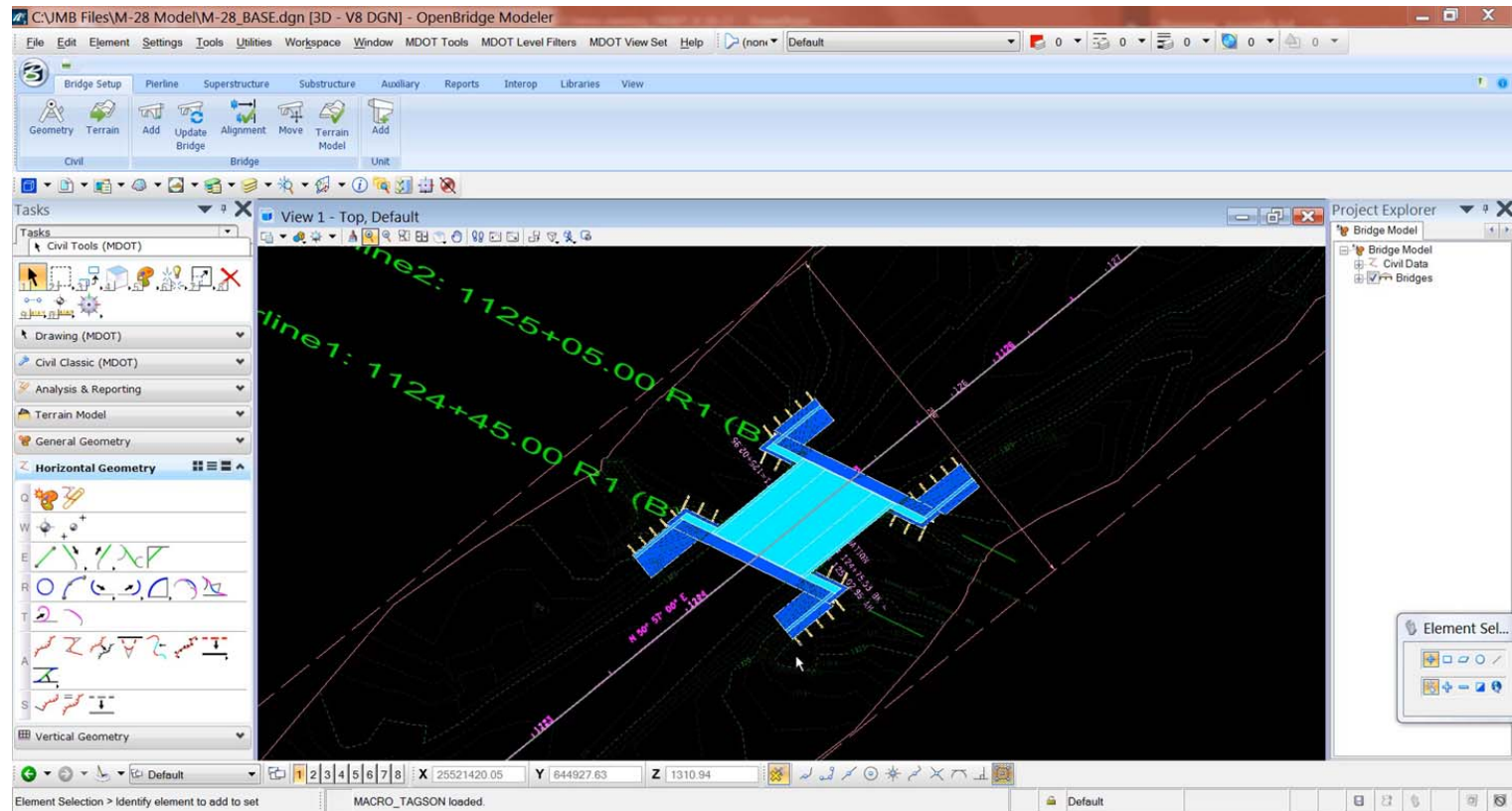


Rating and Routing

Prioritization of Uses



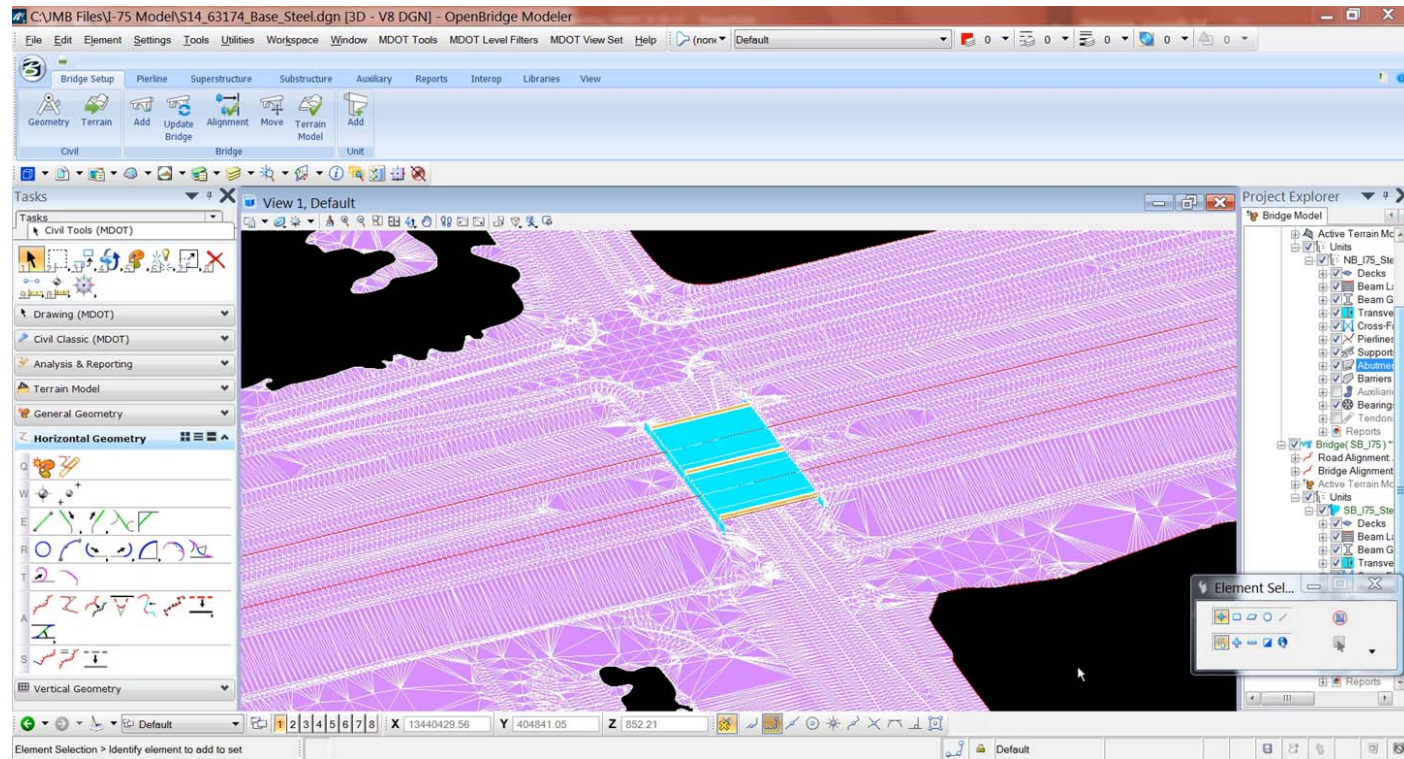
Sample Models



21



Sample Models



22



Sample Models

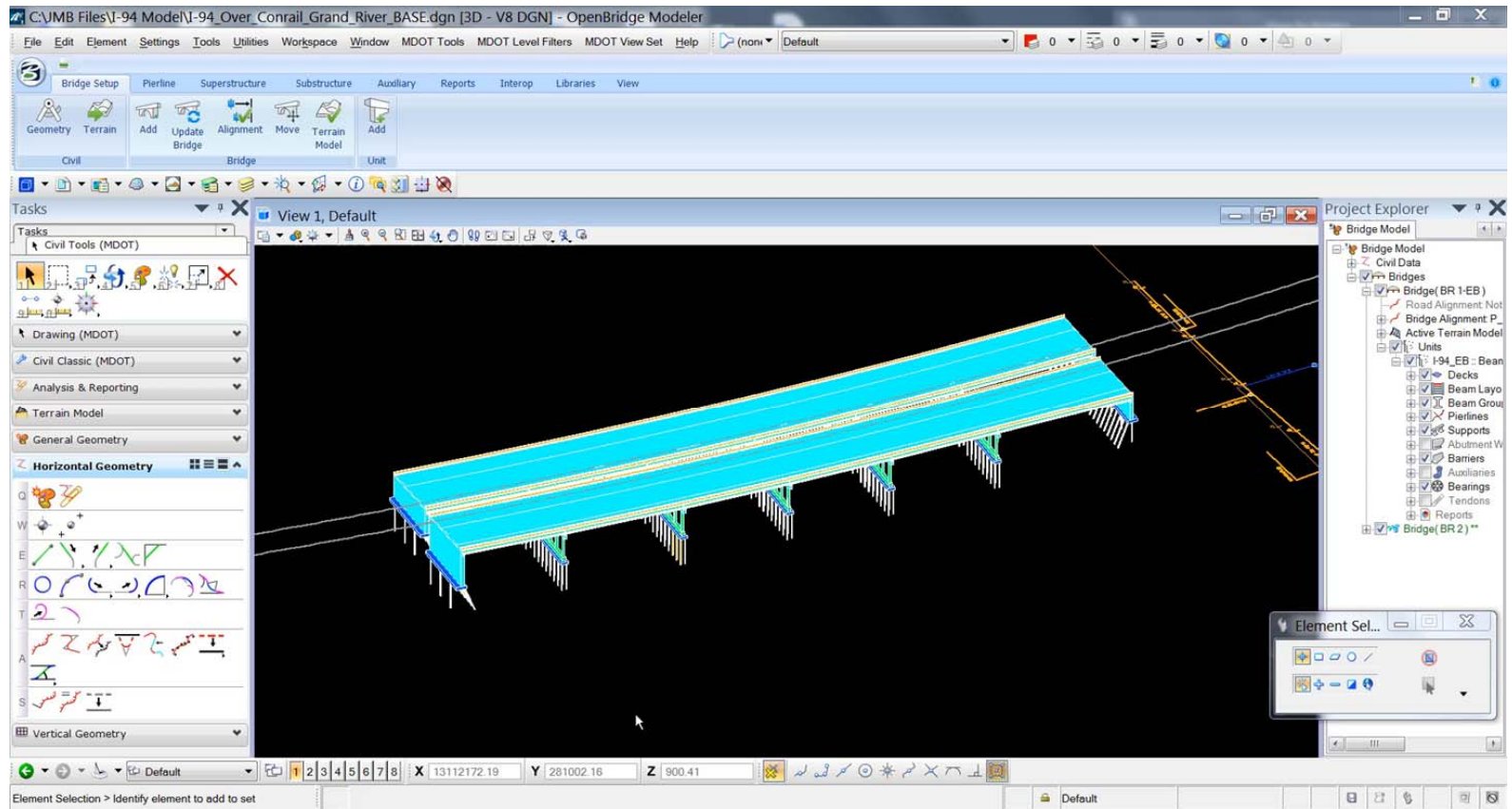
23

The screenshot displays the LEAP Bridge Concrete CONNECT Edition software interface. The main window shows a 3D perspective view of a bridge structure. The left sidebar contains a 'Selection' tree with categories like 'B02 (Open Girder Type)', 'Roadway Elements', 'Superstructure List', 'Foot Path List', 'Wearing Surface List', 'Decks List', 'Spans List', 'Substructure List', 'Abutment A, Slap 1 (Abutment)', and 'Abutment B, Slap 1 (Abutment)'. Below the 3D view, there are two detailed cross-section diagrams. The top one is a plan view showing the bridge deck width and abutment positions. The bottom one is a 'Superstructure Cross Section Sta 602+03' showing the vertical profile of the bridge with various dimensions and component labels. A 'Permanent Load Wizard' dialog box is open in the foreground, showing a cross-section diagram with labels for 'Left Slabwidth', 'Left Girder Spacing', 'Future Beams', 'Stay-in-Place Deck', 'Right Slabwidth', and 'Right Girder Spacing'. The background also shows a table of 'Designs' with columns for 'Span #', 'Design #', 'Location', and 'Load'. The Bentley logo is visible at the bottom center of the software window.



Sample Models

24



Training and Technical Resources



Project
Management
Model Development
and Data
Management

MDOT Research Outcomes

Review the state of the practice

Prioritization of uses

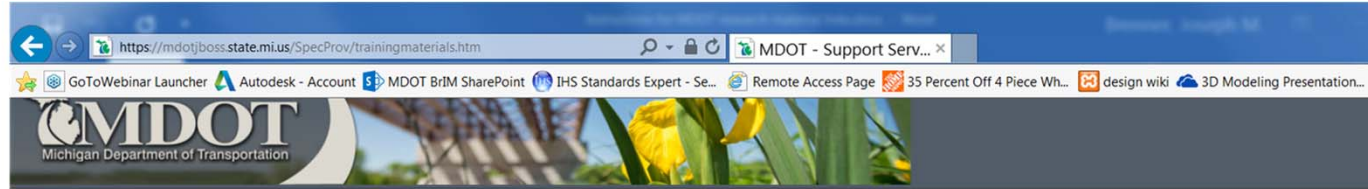
Tools for managing and documenting
bridge models

4 sample models and preliminary OBM
workspace

Training material and technical resources

Key user training

MDOT Research Outcomes



- Roads and Travel
- Rail and Public Transit
- Bridges, Borders and Ferries
- News and Information
- Projects and Programs
- Maps
- Reports, Publications and Specs
- About MDOT
- Doing Business
- Aeronautics
- Title VI Non-Discrimination

Support Services

Help, training and support information is provided below pertaining to the creation of digital design content for bridge, roadway and subsurface utility modeling as well as survey, general workspace and plans production topics. These categories are provided to allow content creators a single location to find additional guidance for the creation of digital data.

If you need assistance or have questions, please see the contact information below:

- Bridge Support e-mail MDOT-BridgeDesignSupport@michigan.gov
- Roadway Modeling e-mail MDOT-RoadwayModelingSupport@michigan.gov
- Subsurface Utilities e-mail MDOT-Drainage-Utility@michigan.gov
- Workspace and Power GEOPAK Installation e-mail MDOT-CADDSupport@michigan.gov
- Survey e-mail MDOT-Survey_Support@michigan.gov
- If you are having issues with the web site working properly contact the Design Automation section at 517-373-0773 or send an e-mail to VerhageH@michigan.gov

Support Services Links:

- [Design Submittal Requirements](#)
- [Survey Standards of Practice](#)

Select a Help and Support category from the drop down menu:

- Core - Plan Set Preparation
- All - Software and Workspaces
- All - Communication
- Core - Maps and Imagery
- Core - Reference Information Documents
- All - Pilots
- Survey - Construction
- Survey - Collection
- Survey - GIS
- All - Research

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<https://mdotjboss.state.mi.us/SpecProv/trainingmaterials.htm>



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Questions?