Lance Parve, MSEng, PG, GISP, BIM-CIM Coordinator
Sr Design-Construction Project Engineer
SE Freeways Design-Construction, WisDOT SE Freeways/Region
TRB BIM-CIM Subcommittee Co-Chairperson, ABJ95 & IICTG

Session: **Emerging Technologies & Trends in BIM for Infrastructure / CIM**
Date: **September 20, 2017**
Event: **Intelligent Construction Technologies-IICTG 2017**

Bio:

Lance Parve, MSEng, PG, GISP

Lance works as a Senior Project Design-Construction Engineer /BIM Coordinator for the WisDOT in SE Freeways/SE Region. His work involves planning, design, and construction of mega transportation projects (> $500 million) and also provides BIM-CAD-GIS, 3D technologies, and LiDAR/integrated survey coordination and support. Working for WisDOT since 2007 involving public sector work, with 15 years previous involvement in private sector civil and environmental infrastructure work, he has been involved in numerous successful planning, design, and construction mega-major transportation projects at WisDOT.
He has a MS Engineering degree, MS Certificate Urban Planning GIS degree, and a BS Geological Sciences degree from UW-Milwaukee. He serves as Co-chairperson of the BIM-CIM-VDC Subcommittee of the National Academy of Sciences Transportation Research Board (TRB) ABJ95 Visualization in Transportation Committee. additionally, He also serves on the Steering Committee of IICTG.

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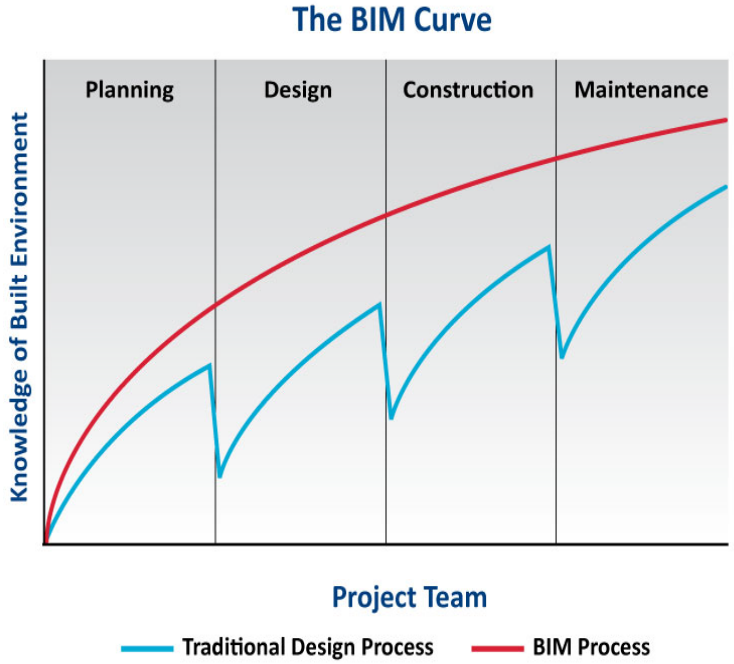
Emerging Technologies & Trends in BIM for Infrastructure

Intelligent Construction Technologies-ICT/IC-CCC

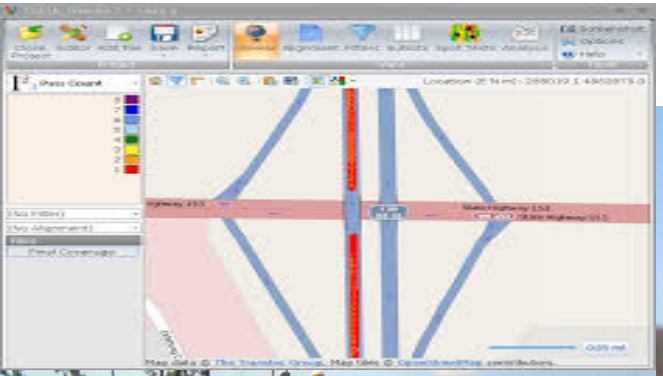
Emerging Technologies & Trends in BIM Infrastructure

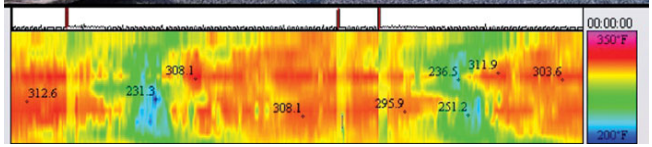
Recent innovations, advances, and developments involving BIM for Infrastructure /model-based technologies are transforming the way Agencies, Consultants, and Contractors plan, design, construct, QA/QC, deliver, maintain, operate, and manage civil infrastructure projects.



Emerging Technologies & Trends in BIM Infrastructure with Intelligent Construction Technologies-Intelligent Compaction-CCC

Compaction test results can be overlaid unto existing/proposed 3D models with roadway alignments, edge of pavement, edge of shoulder, existing surface, proposed top surface, base course surface, and subgrade surface to identify weak areas to improve pavement life, construction uniformity, and analyze pavement data.



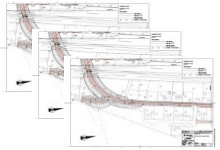


Emerging Technologies & Trends in BIM Infrastructure

WisDOT SE Freeways

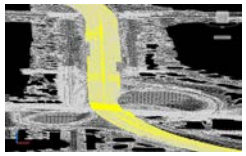
Where we are → Where we are going

2D+ CAD Models



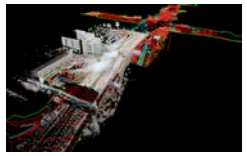
2D Object Features
Objects Not Intelligent
3D DTM Surfaces
Geospatial+Imagery
Multi Disciplinary 2D
Project-based

3D CAD Models



3D Object Features
Objects Not Intelligent
3D DTM Surfaces
Geospatial+Imagery
Multi Disciplinary 3D
Project-based

3D BIM Intelligent Models

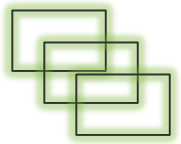


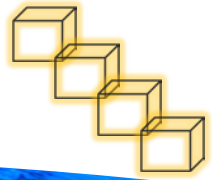
3D+ Intelligent Subassembly Features
3D BIM Databases
3D DTM+ Material Face Surfaces
Geospatial+Imagery
Multi Disciplinary 3D+Clash Detection
Project-based

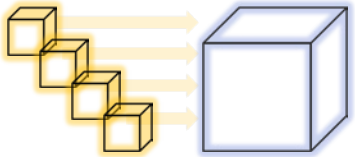
3D BIM Integrated Collaboration Models

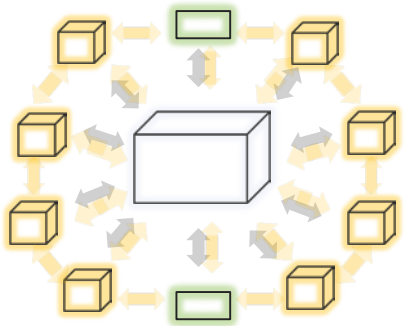
Intelligent Subassembly Features
Integrated 2D-3D-4D-5D-xD BIM DBs+Parametric
3D DTM+ Material Face Surfaces
Geospatial+Wide Area Imagery
Integrated Collaboration Multi Disciplinary 3D+CD
Life-cycle-based

ISOLATED | INTELLIGENT | INTEGRATED







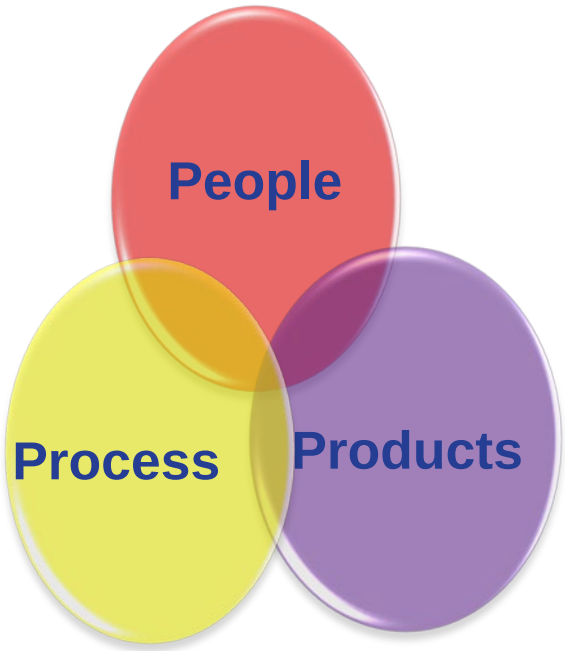


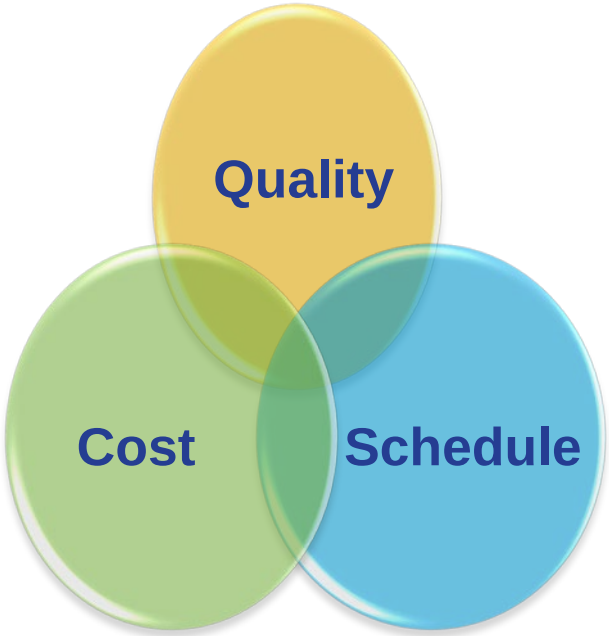
Emerging Technologies & Trends in BIM Infrastructure

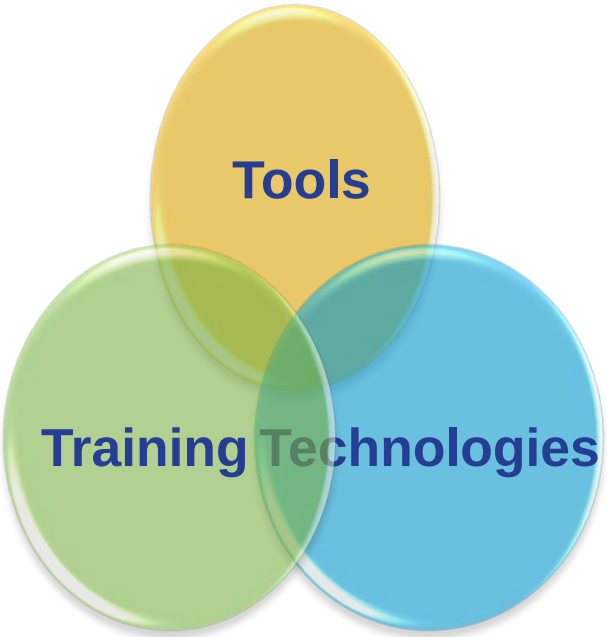
People - Workforce

Process- Organization + Tasks + Workflows

Products-PS&E + Models + Dataflows, DDE, Tools & Technologies







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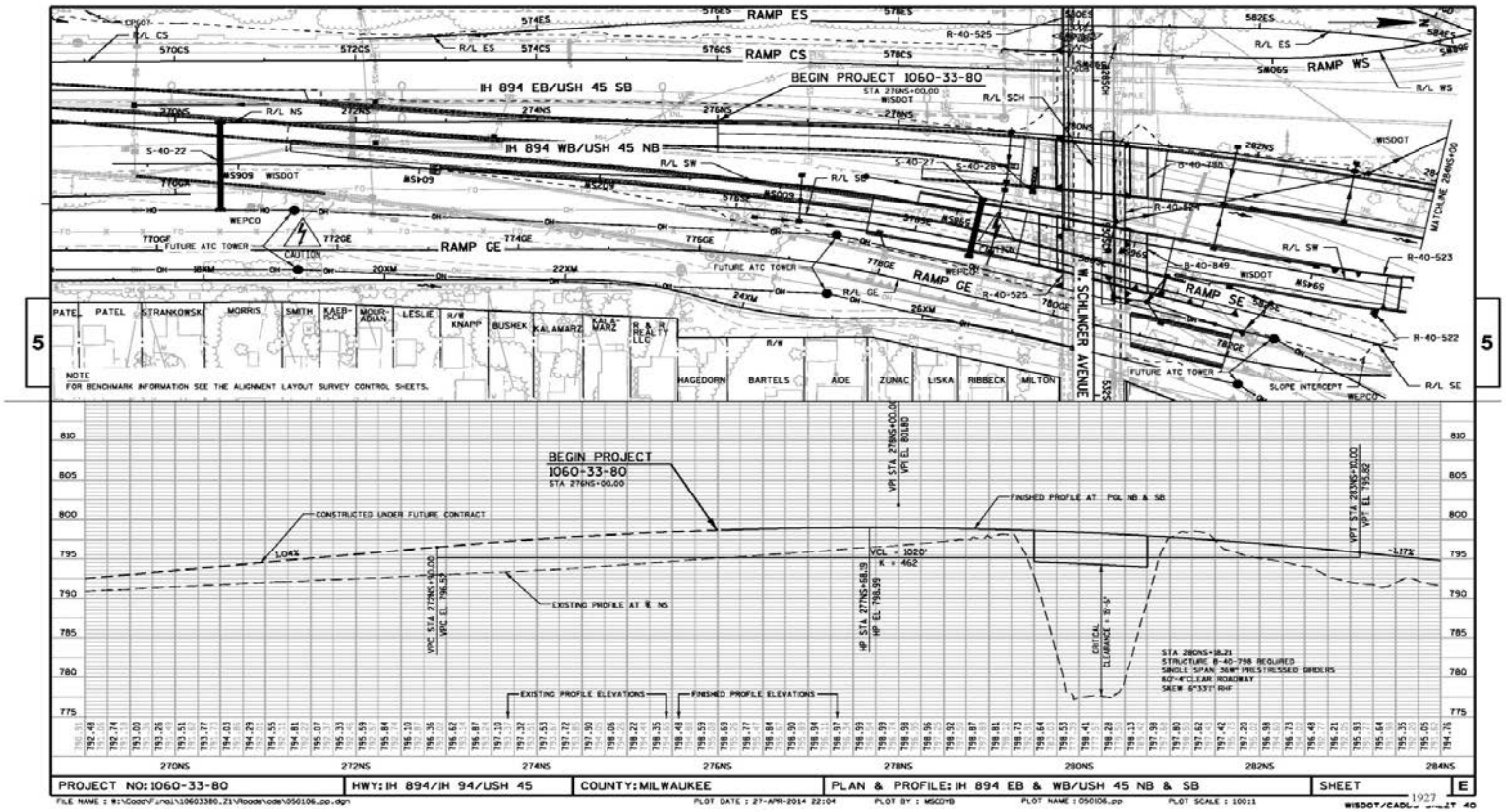
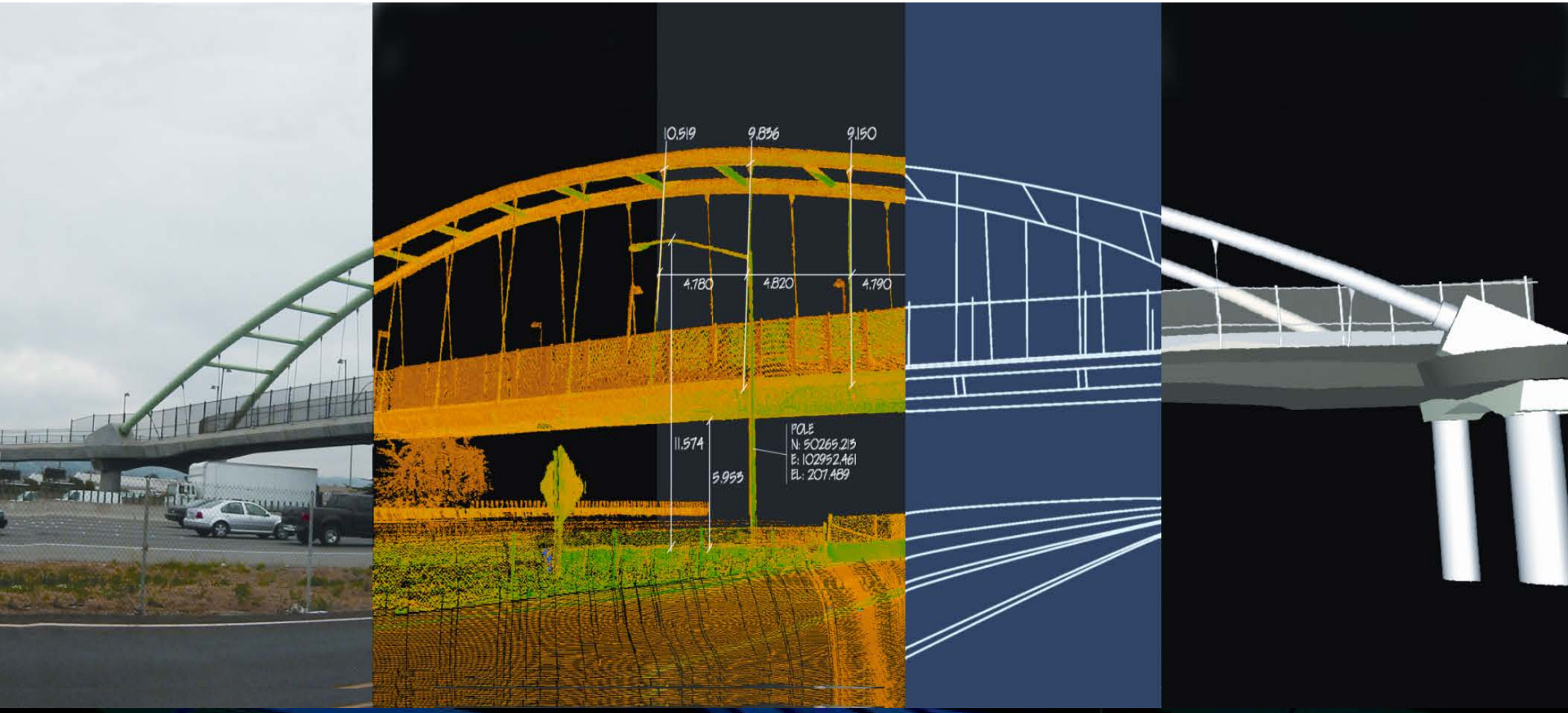
Southeast
Trust.Passion.Champions.

WisDOT Model-based Design & Construction
Moving from Analog to Digital 2D/3D Models

Zoo IC: e.g. Core 1 Rev 9 - 4,869 pages; Core 2 – 6,957 pages



CIM 3D Modeling: Zoo Interchange
Design-grade/Post-construction Surveys



Georeferenced

Hi-resolution

Imagery

3D XYZ

LAS Point

Clouds

3D Feature Lines

3D DTMs

X-Sections

3D

BIM

DSMs

Emerging Technologies in BIM for Infrastructure: Transformative Technology Trends for Transportation

- 2015 → 3D laser scanning becoming more affordable (Reality Capture/Survey)
  - field-accurate LiDAR data with integrated TS/GPS surveys (ex 3D models)
  - importing of point clouds into BIM models (proposed/as-built 3D models)
  - cost savings, real-time verification & field safety improvements for survey
- → Rapid modeling for conceptual designs (Planning/Preliminary Design)
  - alternative infrastructure conceptual designs (2D/3D alternatives)
  - public information visualization (3D models) & stakeholder involvement
- → Computer-aided lean processes and tools (Design/Construction/Review)
  - plans, specs, & estimates (PS&Es) improvements (clash detection, etc.)
  - QA/QC process improvements (GNSS rovers with 3D models field verification)
  - reduced change orders, cost savings, cost avoidance, ROI
- → BIM-CIM processes collaborating with GCs/CMs (Construction)
  - 4D schedule models linked to 3D models
  - fabricators linked to 3D models
- → Data management plays a more vital role (IT)
  - cloud-based collaboration interaction with centralized 2D/3D models
  - internet bandwidth speed & latency improvements for big data/data analytics

Emerging Technologies in BIM/CIM: Transformative Technology Trends for AEC Firms/Projects

- 2016 → Rise of Data-driven Design & E-Project Delivery (Design & Construction)
  - data-centric means databases
  - data management and integrated databases (LAN, cloud) connected via APIs
  - workflows and dataflows to change

  - → Reality Capture & E-Asset Management
    - reality capture of big data and life cycle databases
  - → UAVs, High-Precision GNSS
    - imagery, highway bridge inspection, etc.
  - → CAD & GIS database integration
    - 3D + 4D + GIS for eProject delivery design and construction (BIM-CIM)
    - 2D-3D GIS data linking to CAD-BIM + photo-lidar imagery PCs
  - → BIM-CIM processes & tools
    - increased collaboration with centralized 2D/3D models
    - reduced change orders, cost savings, cost avoidance, ROI

Emerging Technologies in BIM/CIM: Transformative Technology Trends for AEC Firms/Projects

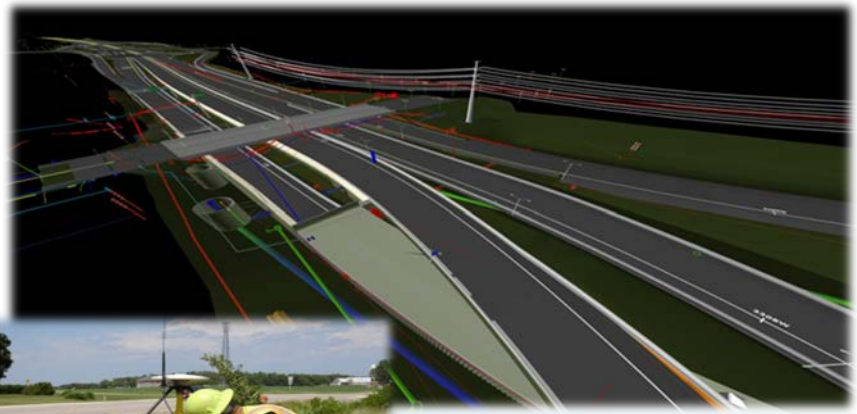
- 2017 → Rise of Data-driven Design & E-Project Delivery for Design & Construction
  - data management and integrated hybrid DBs (LAN, cloud) to legacy apps
  - workflows and dataflows to change
- → Reality Capture & E-Asset Management
  - reality capture with advanced processing software
- → UAVs, GNSS, Sensors, & Robots
  - imagery, surveillance, construction monitoring, traffic
  - increased use of UAVs, need for relaxed FAA strds

- → CAD & GIS database integration
  - 3D + 4D + xD + GIS for eProject delivery design and construction (BIM-CIM)
  - 2D-3D GIS integration with CAD-BIM
  - GIS and IFC eAsset Management linked to 2D/3D
- → BIM-CIM Planning, Design, and Construction processes & tools
  - cloud-based collaboration interaction with centralized 2D/3D models
  - on-ramps to the cloud (IT Internet Cloud Cache Gateway Appliances)
  - internet latency improvements with cache of active files and GFS/GFL
  - increased reduced change orders, cost savings, cost avoidance, ROI

Emerging Technologies in BIM-CIM: Transformative Technology Trends for Transportation

Rise of Data-driven Design & Data-centric Design & Construction

- Advanced iterative and optimized design
- Reuse project data on future work and eliminate rework
- Test design & construction with the real world
- Automate the project planning, delivery & project life cycle process



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Autodesk/Bentley/Other BIM Tools

Vault (Collaboration)	Projectwise (Collaboration)	Falcon (Collaboration)
Infraworks/3DS Max /Navisworks (BIM/Viz/Clash Detection)	Concept Station/Lumen RT /Navigator (BIM/Viz/Clash Detection)	Viasys VDC Clash Detection (for Autodesk)
Structural Bridge Design /Revit/MEP/Pipes/Geotech	HRM-LARS-LEAP-Steel Bridge/SUE/Drainage/gINT	Keynetix Holebase Geotech (for Autodesk)
Autocad/Civil 3D/Map 3D (Intelligent CAD/BIM)	MS/Open Roads Designer /GIS (Intelligent CAD/BIM)	ESRI ArcGIS (GIS)
Recap Pro/Survey (Reality Capture/Survey)	Context Capture/Survey (Reality Capture/Survey)	Pix4D/Many Photogrammetry Tools

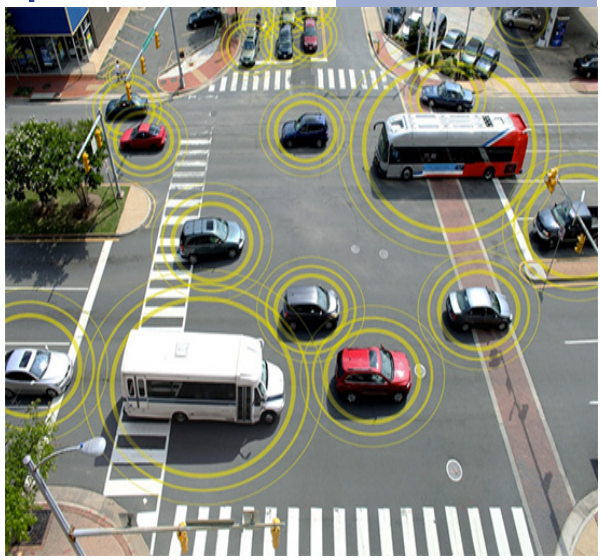
Intelligent Vehicles + Sensor Technologies + Intelligent Roads with Advanced Models

UAV
Accident
Monitoring

Connected Autonomous Vehicles
Machine-Controlled UAV

CAV
V to V, V to I, V to E

Traffic
Operations



Transformative Technology Trends for Transportation

Future Transformative Technologies for Transportation

→ Internet of Things (IoT)-Wireless Connections to Network of Devices/Sensors

→ Big Data, Data Analytics & Data Mining

→ Paper to Digital, E-Government & E-Business

→ Artificial Intelligence (AI), AR, VR

→ Quantum Computing/Super Computing in Cloud Connected to Mobile Devices

→ 3D Printing & Computer Manufacturing

→ Connected & Autonomous/Semi-autonomous Vehicles (CAV)

→ Smart Roads/Transportation Facilities & Smart Infrastructure/Smart 3D Cities

WisDOT SE Freeways

CIM MODEL REQUIREMENTS:
PROJECT NAME/ID

ELEMENT	FORMAT	LOA-CD	LOD-CD	TEMP/STAGING	QA/QC
R/W and Environmental Areas					
R/W-Proposed	DGN/DWG	0.01'	2D	N/A	
Easements-Proposed	DGN/DWG	0.01'	2D	N/A	
Fences-Proposed	DGN/DWG	<0.06'	2D	2D	
Wetlands-Located/Surveyed-Existing	DGN/DWG	<0.06'	2D	N/A	
Non-roadway Surfaces					
Surfaces-Existing	DGN/DWG/XML	<0.06'	3D	N/A	
Grading/Non-roadway Surfaces-Proposed	DGN/DWG/XML	<0.06'	3D	3D	
Cut/Fill Areas-Isopachs-Proposed	DGN/DWG	<0.06'	2D	N/A	
Longitudinal Breaklines /Surface Points	DGN/DWG	<0.06'	3D	N/A	
Slope Intercepts/Surface Limits	DGN/DWG	<0.06'	2D	N/A	
Roadways/Roadway Features Surfaces-Proposed					
Roadway Pavement-Top Surfaces-Proposed	DGN/DWG/XML	<0.02'	3D	3D	
Roadway Pavement-Base Course Surfaces-Proposed	DGN/DWG/XML	<0.06'	3D	3D	
Roadway Pavement-Subgrade Datum Surfaces-Proposed	DGN/DWG/XML	<0.06'	3D	3D	
Roadway Curb and Gutter -Proposed	DGN/DWG/XML	<0.02'	3D	3D	
Roadway Barriers -Proposed	DGN/DWG/XML	<0.06'	3D	3D	
Roadway Pavement Marking -Existing	DGN/DWG	<0.10'	2D	N/A	
Roadway Pavement Marking-Proposed	DGN/DWG	<0.10'	2D	2D	
Roadway Stationing-Proposed	DGN/DWG	0.01'	2D	N/A	
Roadway Alignments /Reference Lines-Proposed	DGN/DWG	0.01'	2D	N/A	
Superelevation Transition Stations-Proposed	CSV	0.01'	N/A	N/A	
Drainage-Storm Sewer – Proposed					
Drainage Inlets/MHs/Outfalls/ Pipes/Culverts/Ponds	DGN/DWG	<0.06'	3D	3D	

WisDOT SE Freeways

Bridges-Proposed					
Stone Base	DGN/DWG/XML	<0.06’	3D	3D	
Piles	DGN/DWG/XML	<0.06’	3D	3D	
Footings	DGN/DWG/XML	<0.06’	3D	3D	
Abutments	DGN/DWG/XML	<0.06’	3D	3D	
Piers	DGN/DWG/XML	<0.02’	3D	3D	
CI Beams	DGN/DWG/XML	<0.02’	3D	3D	
Seats	DGN/DWG/XML	<0.02’	3D	3D	
Deck Including Fillets	DGN/DWG/XML	<0.02’	3D	3D	
Light Blisters	DGN/DWG/XML	<0.06’	3D	3D	
Parapet Walls	DGN/DWG/XML	<0.06’	3D	N/A	
Retaining Walls-Proposed					
MSE-Proposed					
Straps	DGN/DWG/XML	<0.06’	3D	3D	
Footings	DGN/DWG/XML	<0.06’	3D	3D	
Top	DGN/DWG/XML	<0.06’	3D	3D	
Coping	DGN/DWG/XML	<0.06’	3D	3D	
Cast-in-Place-Proposed					
Stone	DGN/DWG/XML	<0.06’	3D	3D	
Piles	DGN/DWG/XML	<0.06’	3D	3D	
Top of Footings	DGN/DWG/XML	<0.06’	3D	3D	
Face of Wall	DGN/DWG/XML	<0.06’	3D	3D	
Coping	DGN/DWG/XML	<0.06’	3D	3D	
Pile and Lagging-Proposed					
CI Piles at Top and Bottom	DGN/DWG/XML	<0.06’	3D	3D	
Face of Wall/Face of Piles	DGN/DWG/XML	<0.06’	3D	3D	
Bottom of Wall	DGN/DWG/XML	<0.06’	3D	3D	
Top of Wall/Coping	DGN/DWG/XML	<0.06’	3D	3D	
Face of Piles	DGN/DWG/XML	<0.06’	3D	3D	
Top and Toe of Sheets	DGN/DWG/XML	<0.06’	3D	3D	
Sign Bridges-Proposed					
Footings	DGN/DWG/XML	<0.06’	3D	N/A	
Piles	DGN/DWG/XML	<0.06’	3D	N/A	
Structure	DGN/DWG/XML	<0.06’	3D	N/A	

WisDOT SE Freeways

Other Structures-Proposed					
Noise Walls	DGN/DWG/XML	<0.06'	3D	N/A	
Screening Fences	DGN/DWG/XML	<0.06'	3D	N/A	
Tunnels-Utility	DGN/DWG/XML	<0.06'	3D	N/A	
Structures-Existing					
Bridges	DWG/XML	<0.06'	3D	N/A	
Walls	DWG/XML	<0.06'	3D	N/A	
Sign Bridges/Tunnels/Other	DWG/XML	<0.06'	3D	N/A	
Special Foundations-Proposed					
Drilled Shafts	DGN/DWG/XML	<0.06'	3D	3D	
Driven Piles	DGN/DWG/XML	<0.06'	3D	3D	
Bored Piles	DGN/DWG/XML	<0.06'	3D	3D	
Caissons	DGN/DWG/XML	<0.06'	3D	3D	
Special Foundation Walls-Proposed					
Foundation Anchors	DGN/DWG/XML	<0.06'	3D	3D	
Underpinning	DGN/DWG/XML	<0.06'	3D	3D	
Pile Caps	DGN/DWG/XML	<0.06'	3D	3D	
Grade Beams	DGN/DWG/XML	<0.06'	3D	3D	
Tiebacks	DGN/DWG/XML	<0.06'	3D	3D	
Lighting-Proposed					
Poles/Masts/Bases	DGN/DWG	<0.06'	3D	3D	
Conduit/Cabinets/Pull Boxes	DGN/DWG	<0.06'	3D	3D	
FTMS-Proposed					
DMS/CMS	DGN/DWG	<0.06'	2D	N/A	
FTMS Fiber Optic lines	DGN/DWG	<0.06'	3D	N/A	
FTMS Huts/Cabinets	DGN/DWG	<0.06'	2D	N/A	
Signs-Proposed					
Signs-Type 1	DGN/DWG	<0.06'	2D	2D	
Signs-Type 2	DGN/DWG	<0.06'	2D	2D	
Traffic Signals-Proposed					
Poles/Heads/Bases	DGN/DWG	<0.06'	3D	3D	
Conduit/Pull Boxes	DGN/DWG	<0.06'	3D	3D	
Water Main Proposed					
Pipes	DGN/DWG	<0.06'	3D	N/A	
Hydrants/Valves/Fittings/ Standpipes	DGN/DWG	<0.06'	3D	N/A	
Sanitary Sewer-Proposed					
Pipes	DGN/DWG	<0.06'	3D	N/A	
Manholes	DGN/DWG	<0.06'	3D	N/A	

WisDOT SE Freeways

Utilities - Existing/Relocated/Abandoned *					
Drainage/Storm Sewer	DGN/DWG	<0.10'	3D	N/A	
Water Main	DGN/DWG	<0.10'	3D	N/A	
Sanitary Sewer	DGN/DWG	<0.10'	3D	N/A	
Lighting	DGN/DWG	<1.5' *	2D	N/A	
FTMS	DGN/DWG	<1.5' *	2D	N/A	
Traffic Control	DGN/DWG	<1.5' *	2D	N/A	

*2D and 3D existing/proposed/abandoned utilities are approximate and other utilities may not be shown. 2D and 3D existing/proposed/abandoned utilities are generated from a variety of sources and formats including: from plans with line and grade, from plans without line and grade, from surveys, from Digger's Hotlining, from as-builts, from municipality records, from pot holing/hydrovac, and from RD/EMI/GPR/SPAR) and are provided in the model, for purposes of information only, requiring confirmation from Digger's Hotline and Utility Providers.

Other Utilities - Existing/Relocated/Abandoned *					
Gas	DGN/DWG	<1.5' *	2D	N/A	
Steam	DGN/DWG	<1.5' *	2D	N/A	
Electrical	DGN/DWG	<1.5' *	2D	N/A	
Communications	DGN/DWG	<1.5' *	2D	N/A	
Fiber Optic	DGN/DWG	<1.5' *	2D	N/A	
Telephone/Data	DGN/DWG	<1.5' *	2D	N/A	
CATV/Data	DGN/DWG	<1.5' *	2D	N/A	

*2D and 3D existing/proposed/abandoned utilities are approximate and other utilities may not be shown. 2D and 3D existing/proposed/abandoned utilities are generated from a variety of sources and formats including: from plans with line and grade, from plans without line and grade, from surveys, from Digger's Hotlining, from as-builts, from municipality records, from pot holing/hydrovac, and from RD/EMI/GPR/SPAR) and are provided in the model, for purposes of information only, requiring confirmation from Digger's Hotline and Utility Providers.

LOA = Level of Accuracy
LOD = Level of Development (2D/3D/4D/5D/xD) – 3D delivery would also include 2D
LOD w/Metadata included

For Checklist:
X = Completed
IP = In-progress
* = Incomplete (not in 3D)

DOT Business Perspective: Life Cycle Approach

Planning & Programming

Project Delivery Planning, Design & Construction

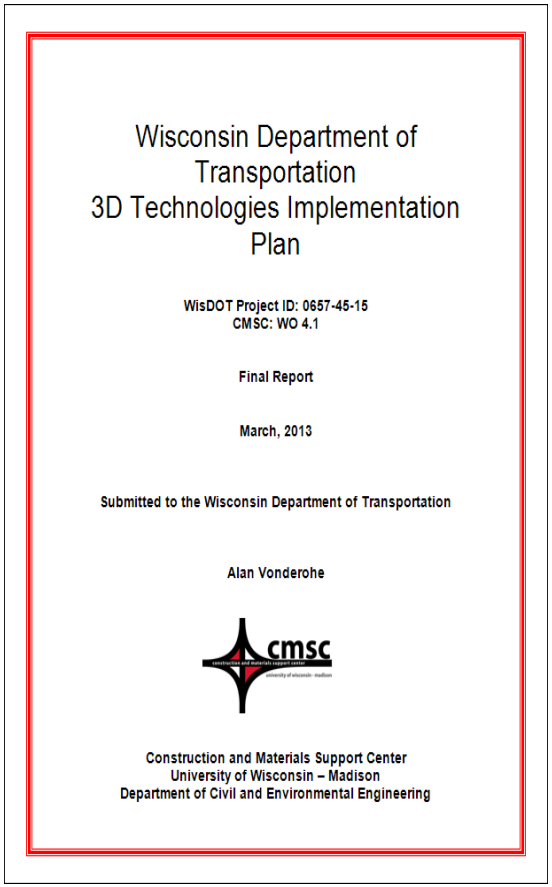
Maintenance Operations

Traffic Operations

WisDOT Design-Construction Initiatives/Best Practices: WisDOT SE Freeways

Technologies Implementation Plan-2017 Roadmap

- PS&E + 3D Models BIM
- Design Review
- Multi-disciplinary Collaboration
- Virtual Clash Detection
- Visualization/AR/VR
- Simulation & Analysis
- Constructability Analysis
- 4D Schedules/Staging
- 5D Costs / Estimates to BIM
- E-Specifications
- Design LiDAR-Integrated Surveys
- 3D CAD-BIM SDDs
- Geotech & Soil Borings to BIM
- Public Information
- Cloud DPD/DDE
- Traffic & Safety
- Integration of CAD-BIM with GIS



Wisconsin Department of Transportation
3D Technologies Implementation Plan

WisDOT Project ID: 0657-45-15
CMSC: WO 4.1

Final Report

March, 2013

Submitted to the Wisconsin Department of Transportation

Alan Vonderohe

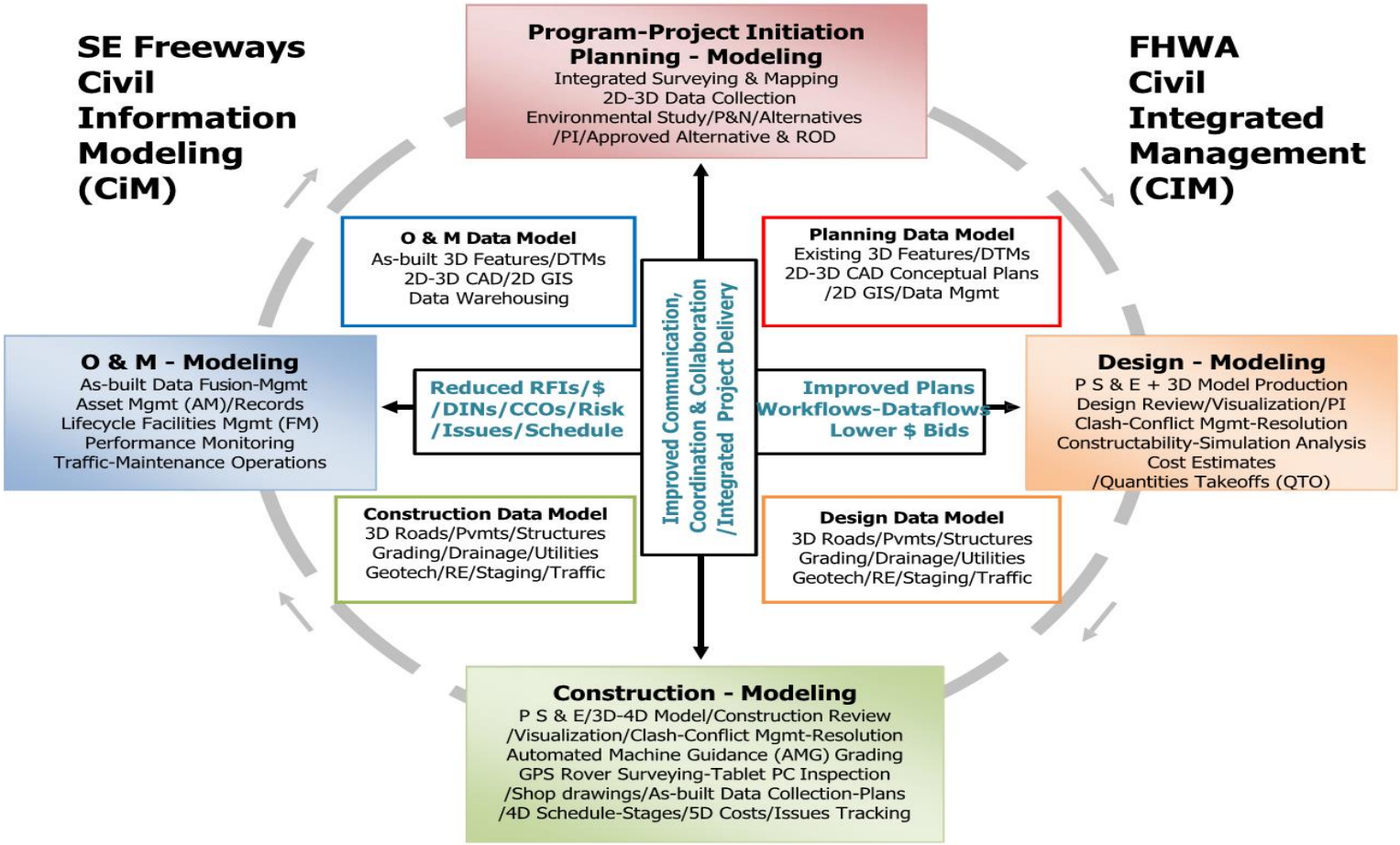
cmsc

Construction and Materials Support Center
University of Wisconsin – Madison
Department of Civil and Environmental Engineering

- 3D Models - AMG/C Earthworks & Stringless Asphalt/Concrete Paving
- Construction Review
- Design-Construction-Contractor Collaboration
- Field Inspection/Acceptance/QA-QC
- Mobile Devices & E-Construction
- Image Capture/Webcams/Mapping
- SPAR/GPR
- Field Clash Detection/Visualization
- Bluebeam/Adobe/BIM 360 Asbuilting
- Construction Stakeout/3D Models
- O & M Lifecycle 3D Model Use
- Asset/Facilities Management-FM
- Cloud DPD/DDE
- Traffic & Safety
- Integration of CAD-BIM with GIS

Wisconsin Case Study:

WisDOT SE Freeways



CIM Exhibit, WisDOT-SE Freeways by Lance Parve, 2012
See N:\SEF\DesignManual\SEF-CIM-Exhibit.PDF.

WisDOT DTSD CIM-BIM Initiatives

eProject Delivery
(CIM-BIM)

PS&E/Models Production
(CIM-BIM)

eConstruction/Inspection
(Mobile Devices)

Life Cycle Asbuilts/Models
(Operations & Maintenance)

Data Warehousing
Content Management System

DTSD Innovation Process

From concept to implementation

Incubate
What is this all about / any value for us?

Go / No – Go?

Evaluate
Show me with my workflows/data

Go / No – Go?

Prototype
Not sure what we need - let's tease it out

Go / No – Go?

Pilot
What will it take to implement?

Go / No – Go?

Implement
Get it into operations – warranty, support, training, phases
No Go can still occur in initial phase.

Essential Components

- Performance
- Policy - Statute
- Business Process
- Partner - Mobile
- Digital Spectrum

Southeast Freeways
Mega Projects - Interchanges

- Marquette Interchange
  (2004 - 2008)
  $810M Elevated IC

- Mitchell Interchange (I-94 NS)
  (2011 - 2012) / (2010 – 2019)
  $295M Interchange
  of Mainline $1.9B

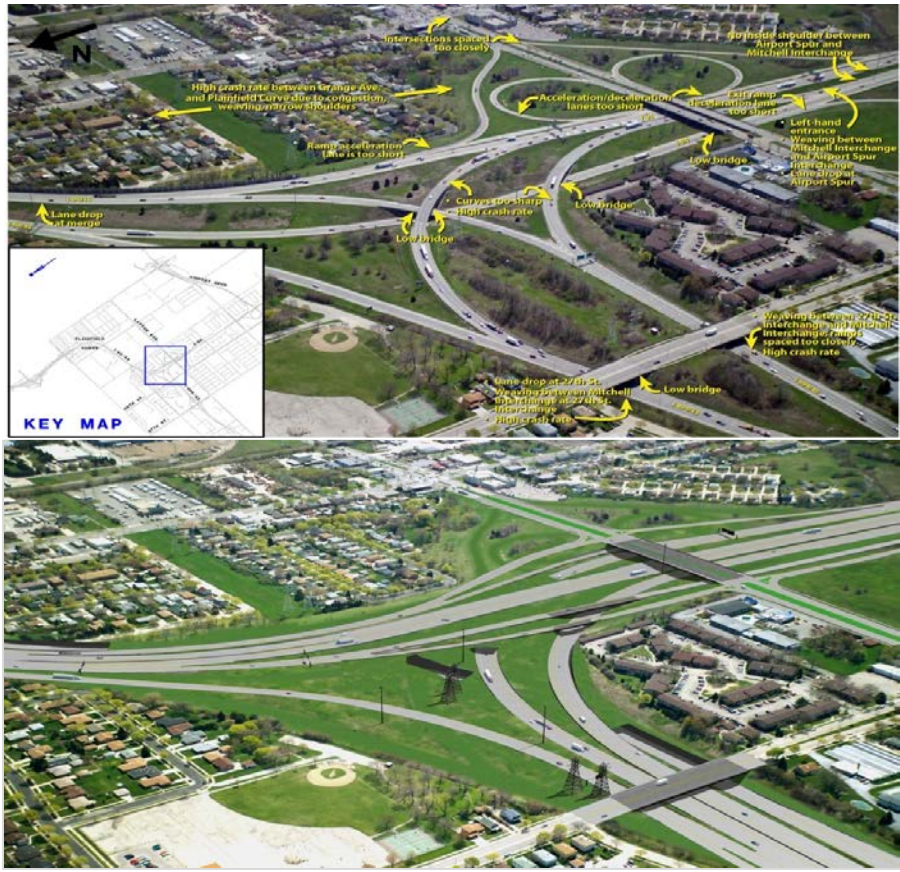
- Zoo Interchange
  (2012 - current)
  $1.7B Mainline Interchange

Marquette Interchange Construction: 2004-2008

- $810m reconstruction of Marquette IC
- 300,000 avg. vehicles per day
- 5-level system interchange
- 52 lane miles of construction
- 56 bridges, 30 ramps, 5 miles of retaining walls
- Links I-94 (W & S), I-43 (N), & I-794 (E)

Mitchell Interchange Construction (Part of I-94 N-S): 2011-2012

- $295M reconstruction of Mitchell IC – part of the 39-mile $1.9b I-94 N-S construction
- 195,000 avg. vehicles per day
- 10 miles of construction
- 3 tunnels, 13 bridges, 1 system/4 service interchanges, 29 retaining walls, 7 noise walls, 4 box culverts, 54 sign structures
- Temporary roads/structures to accommodate 2 lanes of traffic during construction



CIM 2D/3D Modeling: I-94 N-S Construction: 2009-2021

CBA/ROI involving Contract Change Order Issues:

I-94 N-S Construction Project-$1.9 b (construction ~45% complete)

Field Issues - $41.92 m (3,463 Items to date)

- Design Issues (Plan Inadequacies, Quantity Calculations, Premium Costs, etc.):
  37.7% (693 items-$15.8 m)
- Plan Changes (RFIs, Plan Submittals, Plan Omissions, Plan Conflicts, Shop Drawings, Calc Sheets, etc)
  36.3% (1,715 items-$15.2 m)
- Request by Others:
  15.6% (216 items- $6.53 m)
- Safety Enhancement:
  5.3% (206 items- $2.21 m)
- Miscellaneous:
  2.5% (433 items- $1.07 m)
- Cost Reduction Incentive (CRI) Submittals:
  2.0% (41 Items- $0.844 m)
- Change/Credit to Specifications:
  0.6% (159 items- $0.263 m)

CIM 3D Modeling: I-94 Mitchell IC Construction: 2011-2012

CBA/ROI involving Contract Change Order Issues:

I-94 Mitchell IC Construction Project-$294.4 m

Field Issues - $22.2 m or 7.5% (651 of 669 DINs/CCOs)

- Plan Changes (RFIs, Plan Submittals, Plan Omissions, Plan Conflicts, Shop Drawings, Calculation Sheets, etc.):
  42.1% (274 issues)
- Construction Changes (CRI Submittals, Non-conforming Items, Facilitation):
  32.4% (211 issues)
- Design Issues (Plan Inadequacies, Quantity Calculations, Premium Costs, etc.):
  16.1% (105 issues)
- Differing Site Conditions (Soil Conditions, Utility Mislocations, etc.):
  9.4% (61 issues)
- Interdisciplinary Conflicts VDC-BIM-CIM Opportunities:
  6.9% (45 issues)
- Withdrawn:
  2.7% (18 Issues)

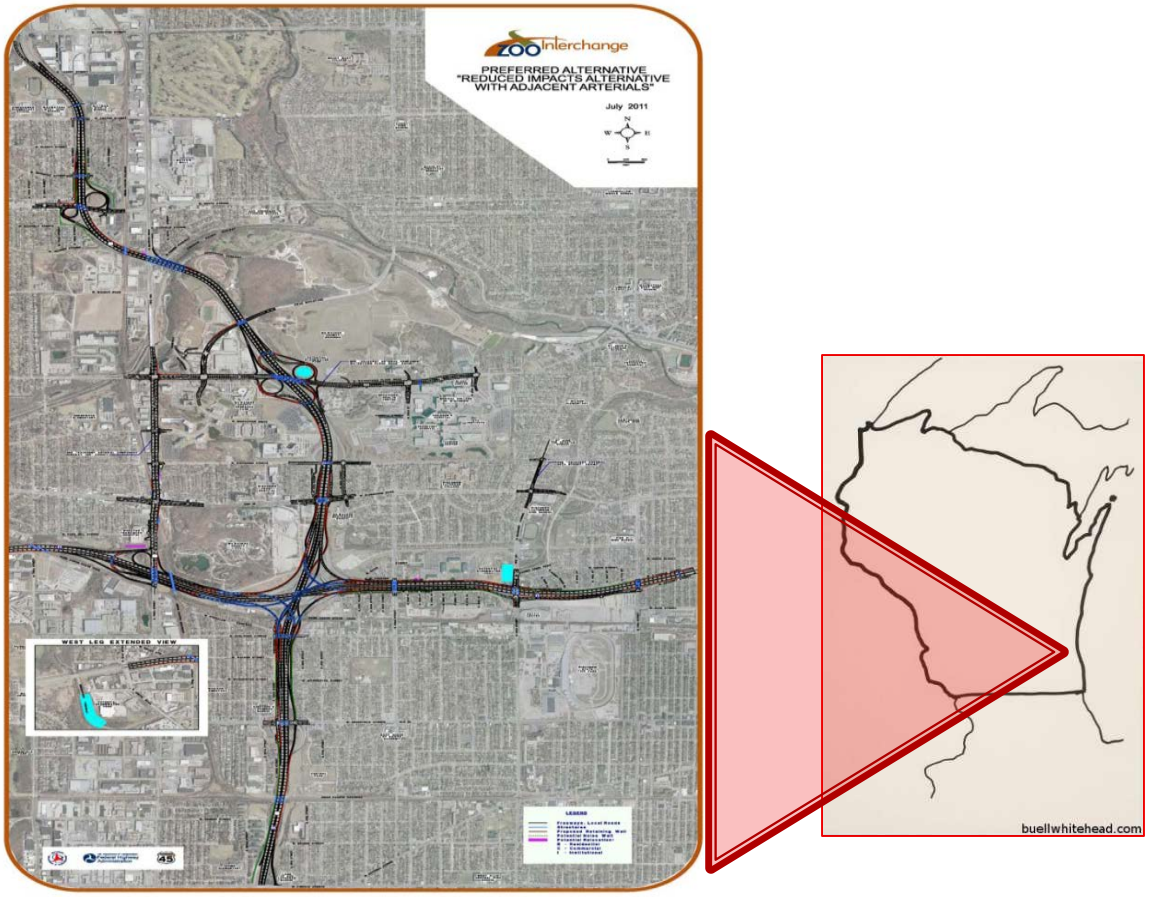
CIM 3D Modeling: I-94 Mitchell IC Construction: 2011-2012

CBA/ROI involving Contract Change Order Issues:

I-94 Mitchell IC Construction Project-$294.4 m Let Amount
(Mitchell IC, CD Road, 27th St, Airport Spur, College-Grange Avenues)
Field Issues:Total - 25.0 m or 8.5% (1221 Issues) (avg - $33,180) for CCOs

• RD-Roadway/Drainage:	25.5%	(186-$8.9 m)	($47,726 avg per issue)
• GN-General:	30.5%	(344-$5.2 m)	($15,091 avg per issue)
• WU-Wet Utilities/Drainage:	11.1%	(193-$2.4 m)	($12,612 avg per issue)
• BR-Bridges:	8.0%	(137-$2.1 m)	($15,218 avg per issue)
• NW-Noise Wall:	8.0%	(20-$1.8 m)	($88,583 avg per issue)
• RW-Retaining Wall:	7.7%	(31-$1.7 m)	($54,913 avg per issue)
• EW-Earthwork:	4.5%	(54-$1.4 m)	($25,535 avg per issue)
• EL-Electrical/ITS/FTMS:	2.6%	(150-$0.90 m)	($5,965 avg per issue)
• TR-Traffic:	2.1%	(87-$0.50 m)	($6,174 avg per issue)
• SS-Sign Structures:	0.1%	(19-$0.10 m)	($4,872 avg per issue)
		1,221 Issues	

CIM 3D Modeling: Zoo Interchange
Construction: 2012-2022



- 9 miles of freeway + RRs
- 6 service interchanges
  - North Avenue
  - Watertown Plank Road
  - Bluemound Road
  - 84th Street
  - Greenfield Avenue
  - STH 100
- Major Arterial Roadways
  - STH 100/Mayfair Road
  - Watertown Plank Road
  - Swan Boulevard
  - Glenview Avenue
  - Greenfield Avenue

CIM 3D Modeling: Zoo Interchange Construction: 2012-2022

- $1.7 b reconstruction of Zoo IC-Corridor
- Handles almost 350,000 avg. vehicles per day in traffic
- Over 15 miles of construction including arterials
- Construction involves 68 bridges including 6 RR structures, 1 system/7 service interchanges, 108 retaining walls, 16 noise walls, 2 box culverts,115 sign structures & numerous utilities
- Temp. roads/structures to accommodate 2 lanes of traffic during construction
- 3D CIM for all disciplines is deployed throughout Zoo IC Design-Construction

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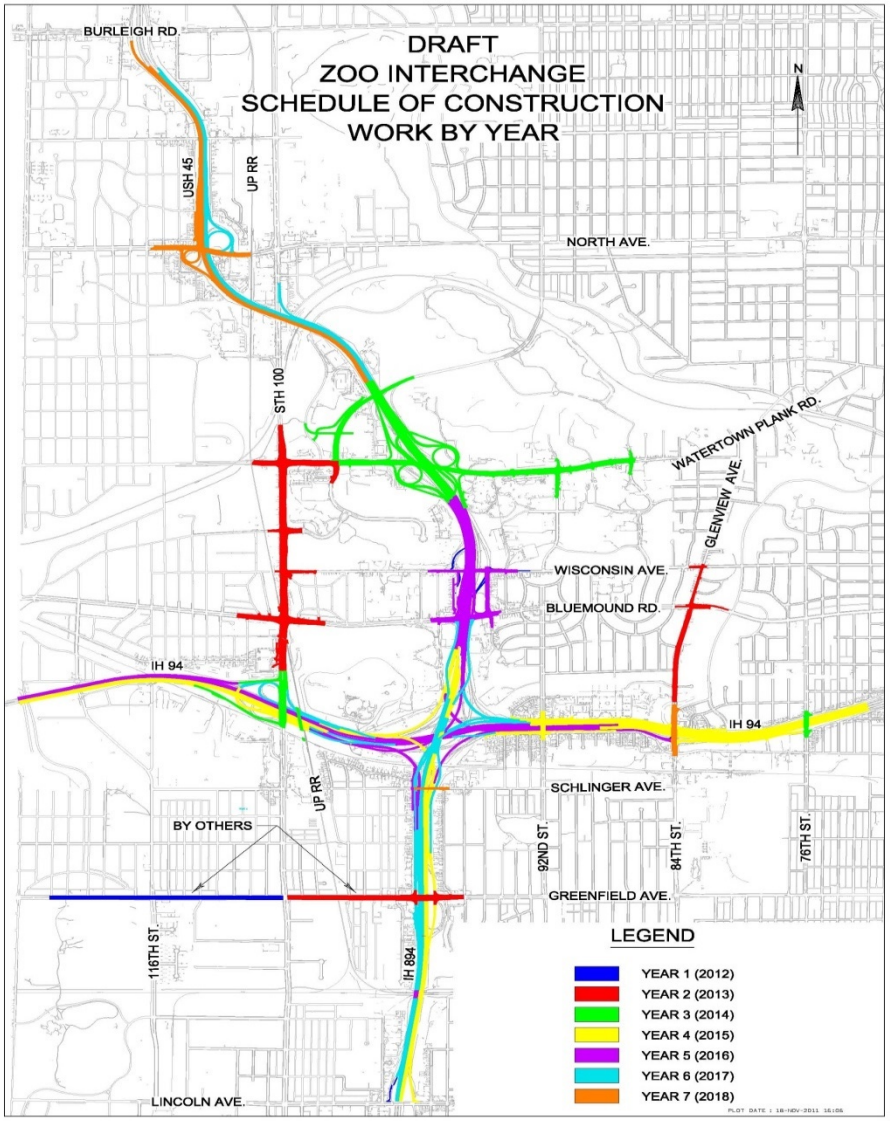
ZOO Interchange



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ZOO Interchange

CIM 3D Modeling: Zoo Interchange Construction: 2012-2022

C3D Technologies/3D Modeling Workflow involving Zoo IC:

Zoo IC Construction Project- $1.7 b total (2007 to Completion in 2022)

- LiDAR/UAV (Pilot) and Integrated Survey - Pre-Design Data Collection:
- CIM Project Execution Plan (PXP):
- 3D Modeling - Roads:
- 3D Modeling - Structures:
- 3D Modeling - Utilities:
- 3D Modeling - Traffic:
- 3D Modeling - PI:
- 3D Modeling - Other:
- 3D Modeling QA/QC:
- 3D Modeling e-Construction/3D Rovers (CEC):
- LiDAR and Integrated Survey – Post-Design Data Collection:
- As-built 3D Modeling:
- 3D Modeling Tools
- O-Other:

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ZOO Interchange

CIM 3D Modeling: Zoo Interchange
Design-grade Survey

3D Survey Integrated Mapping using LiDAR-Static/Mobile/Aerial Scanning with Supplemental RTK GPS/Digital Leveling/TS/UAV for Existing Conditions

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ZOO Interchange

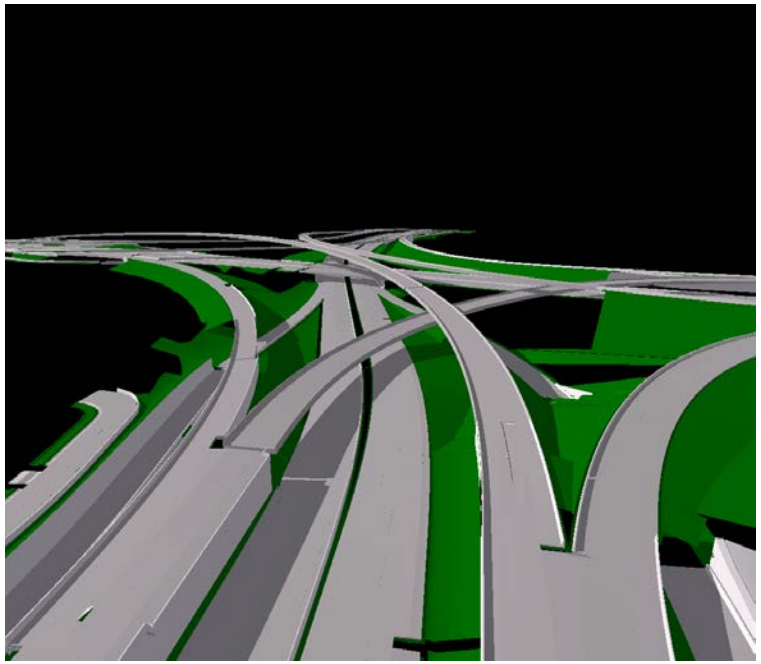
BIM 3D Modeling: Zoo Interchange
Design-grade Survey

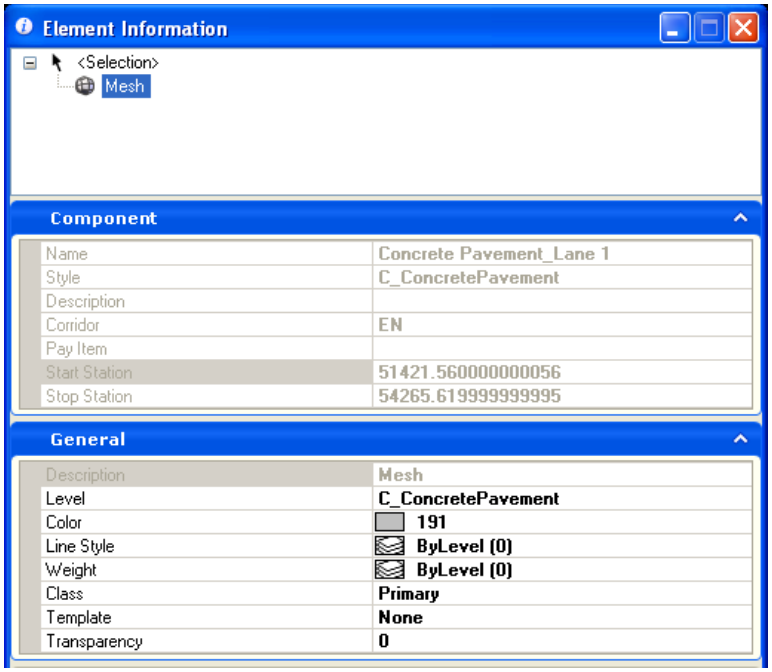
WISCONSIN DEPARTMENT OF TRANSPORTATION

ZOO Interchange

Roadway Model Generation

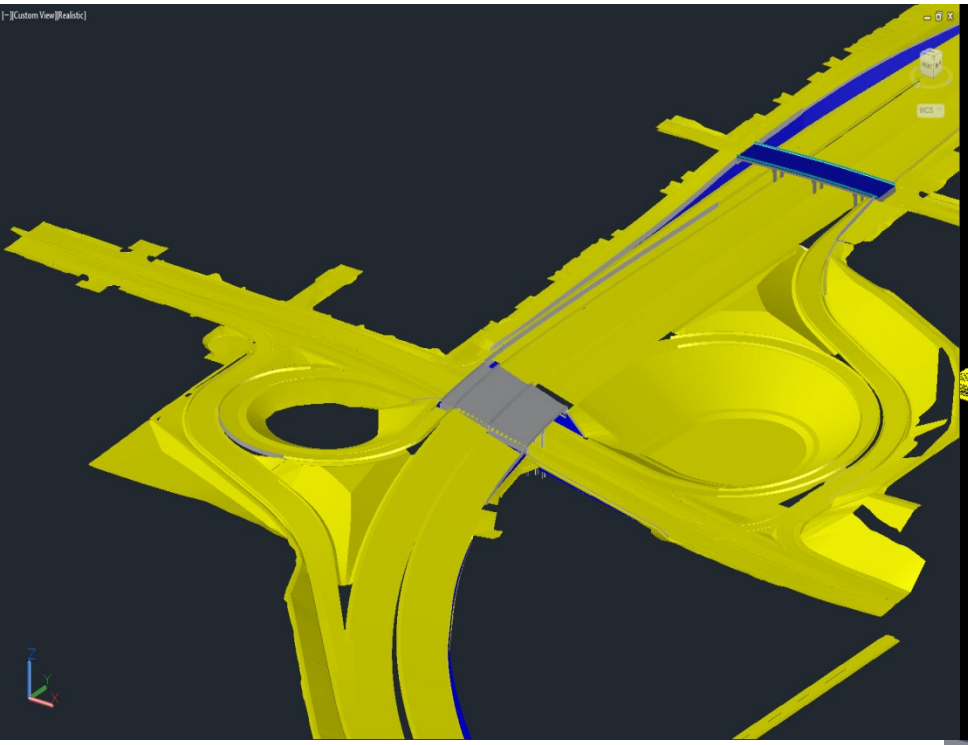
- Native 3D design example: Roadway surfaces

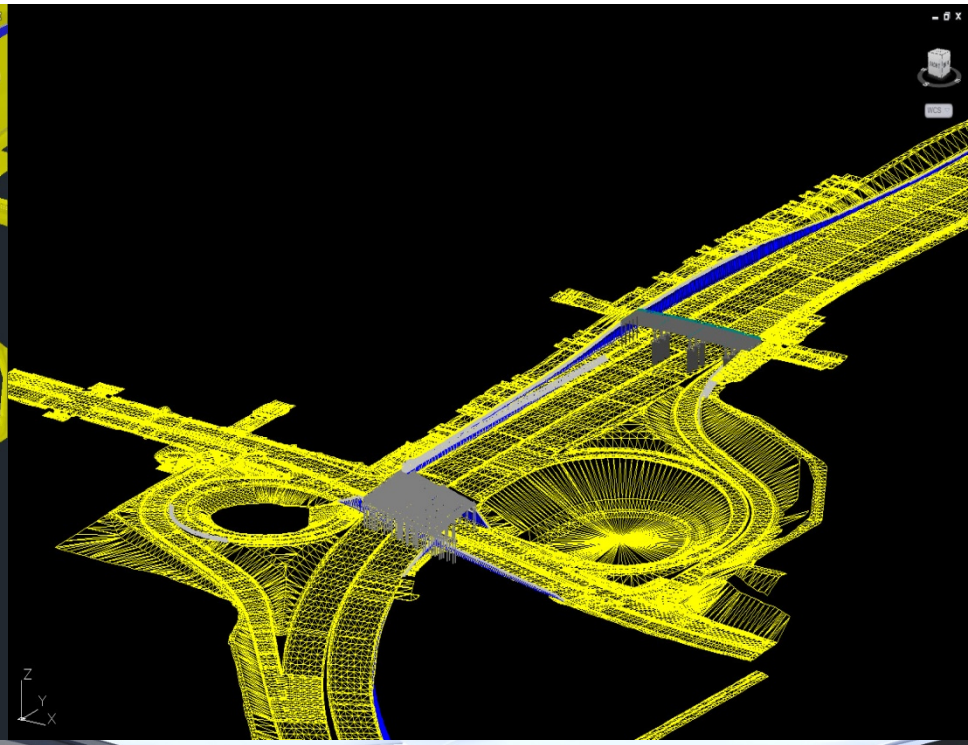


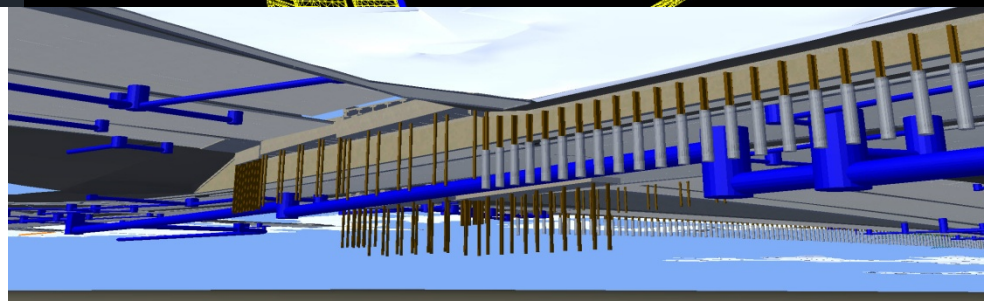


BIM 3D Modeling: Zoo Interchange Design

3D Roads/Drainage/Surfaces







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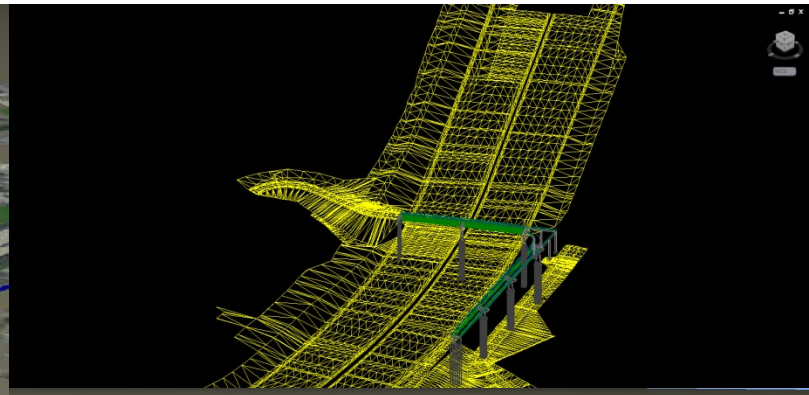
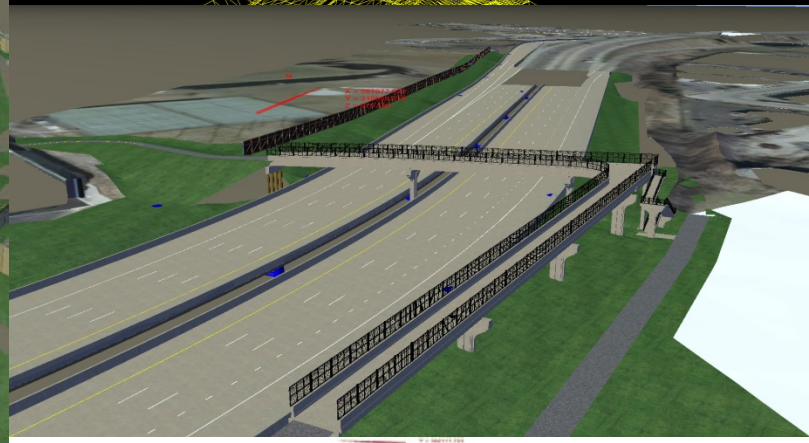
ZOO Interchange

BIM 3D Modeling: Zoo Interchange Design

3D Roads/Drainage/Structures/Surfaces





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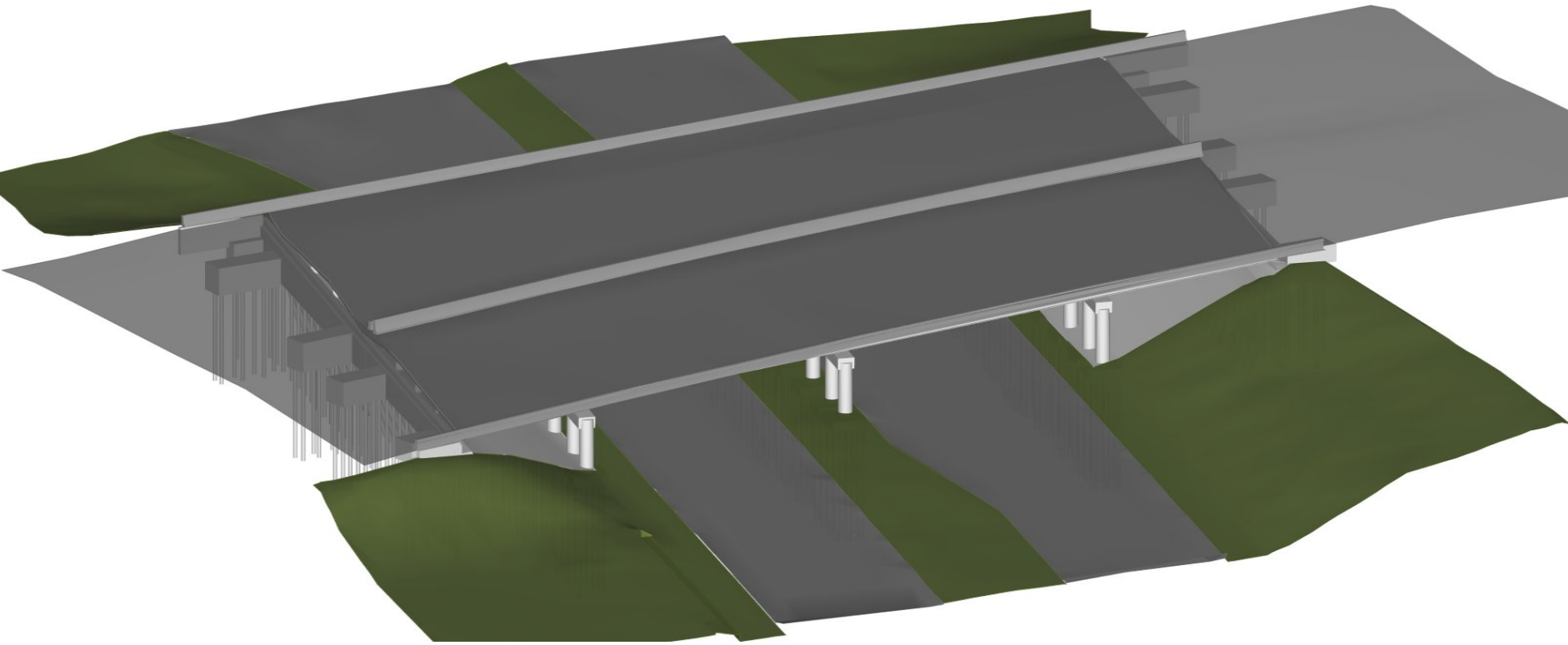
ZOO Interchange

BIM 3D Modeling: Zoo Interchange Design

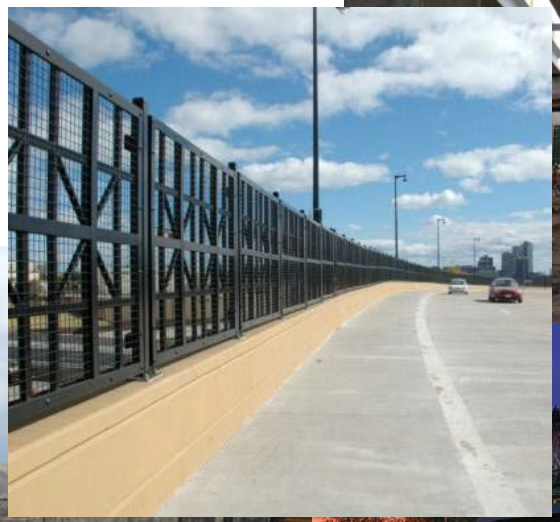
3D Structures: Bridges, Ret Walls, Noise Walls, Tunnels, Sign Bridges, Other



Structures

- 68 Bridges
- 108 Retaining Walls
- Community Sensitive Design



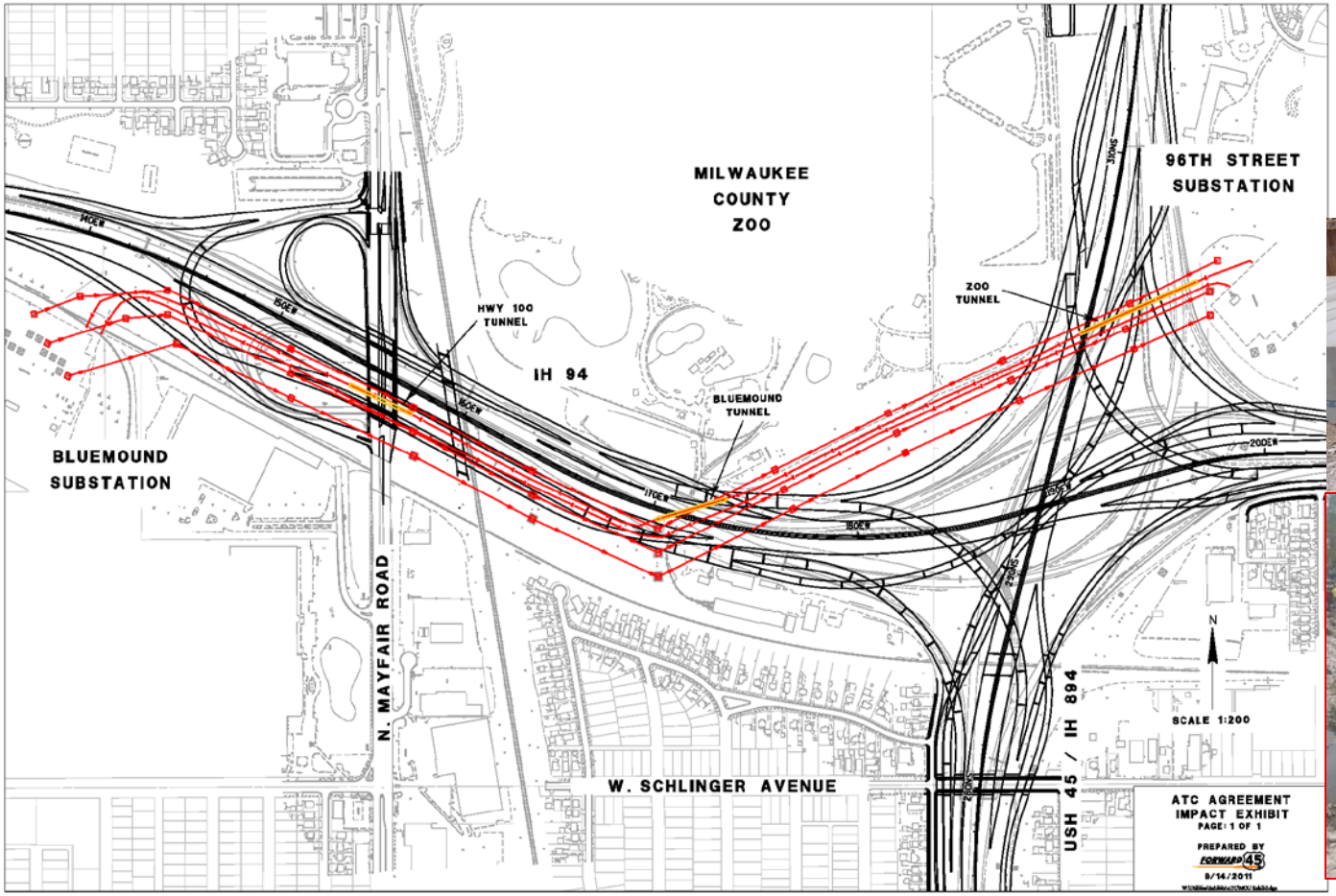







Utilities

IH 94 - West Leg



IH 94 – East Leg
Storm Sewer

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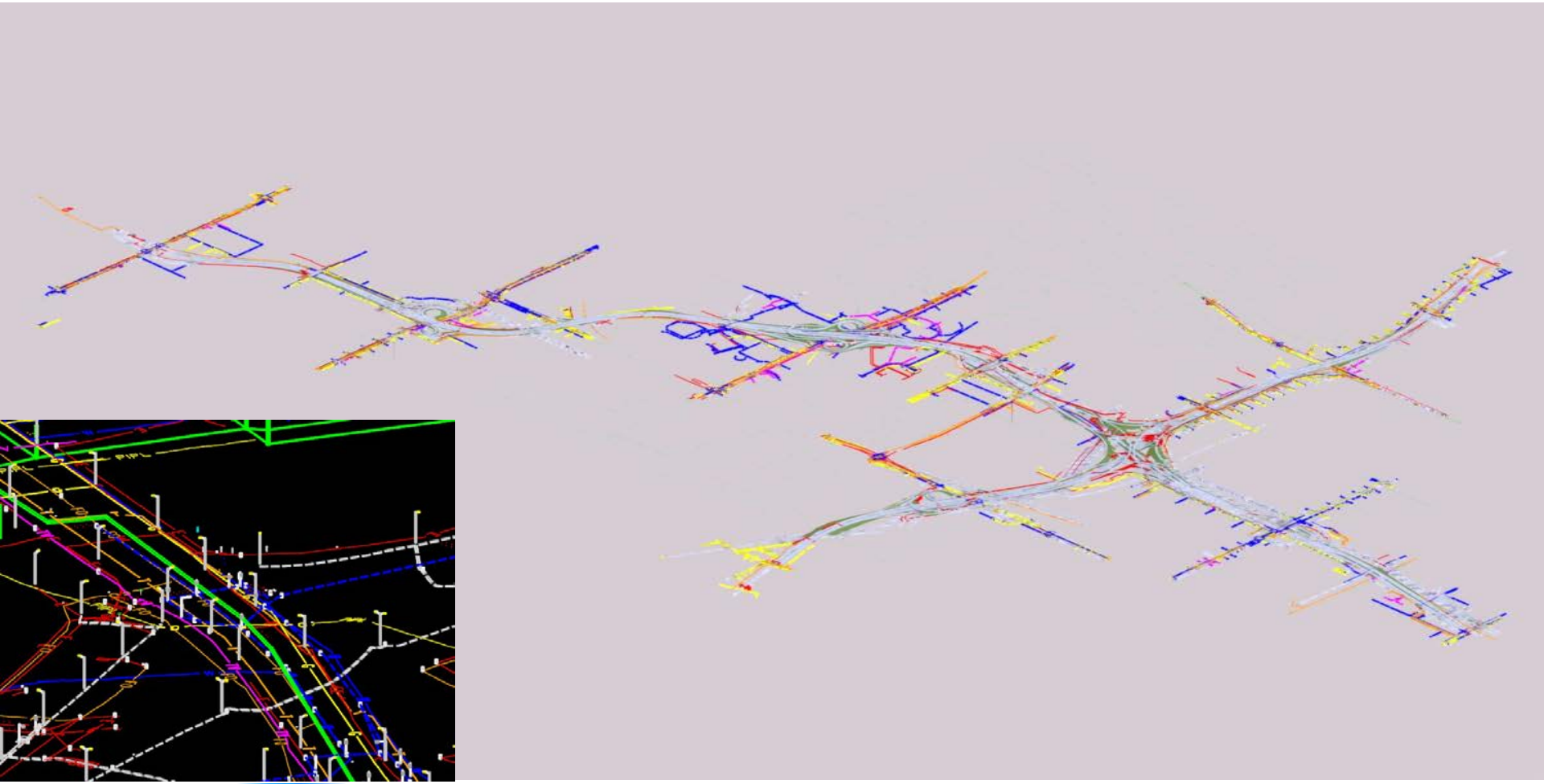
ZOO Interchange

BIM 3D Modeling: Zoo Interchange Design

3D Utilities-Gas, Steam, Electrical, Comm, Fiber Optic, Tel/Data, CATV/Data, Other



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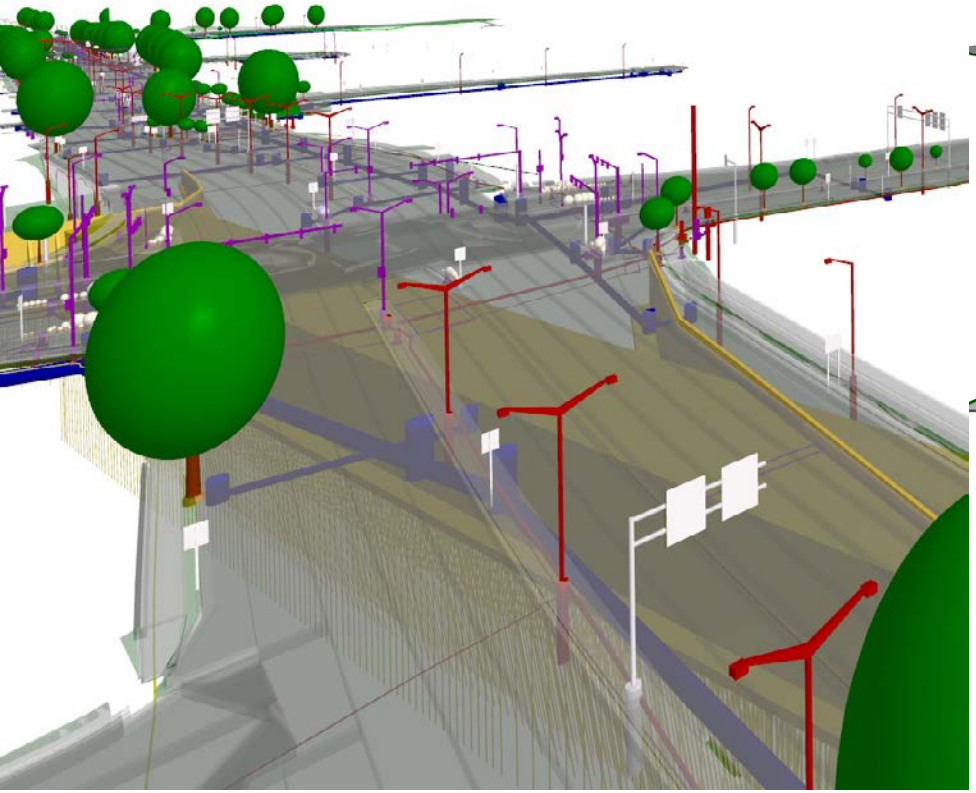
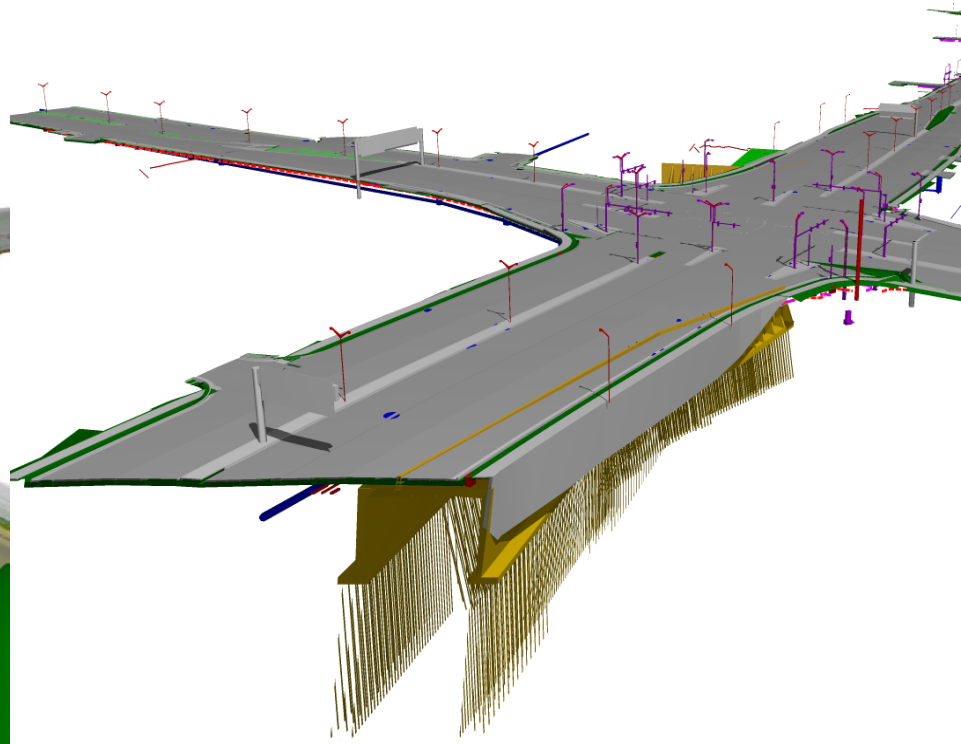
ZOO Interchange

BIM 3D Modeling: Zoo Interchange Design

3D ITS/FTMS, Lighting, Signs, Signals, Landscaping, Water, San Sewer, Other





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ZOO Interchange

Landscape Architecture

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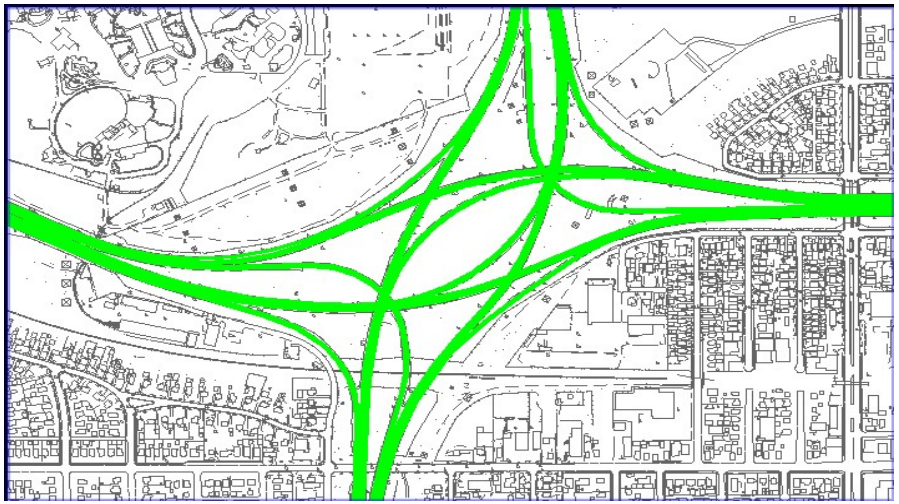
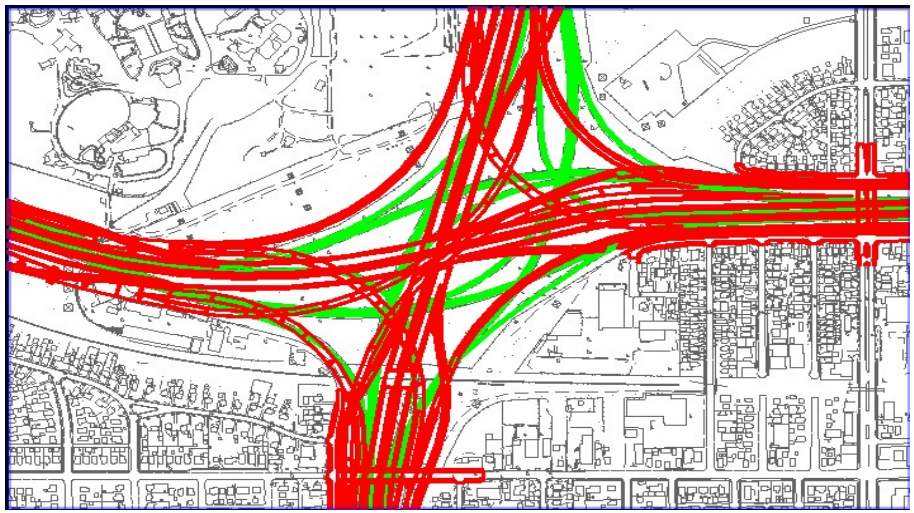
Watertown Plank Road – Drivethrough Simulation

Construction Staging/MOT/Temporary

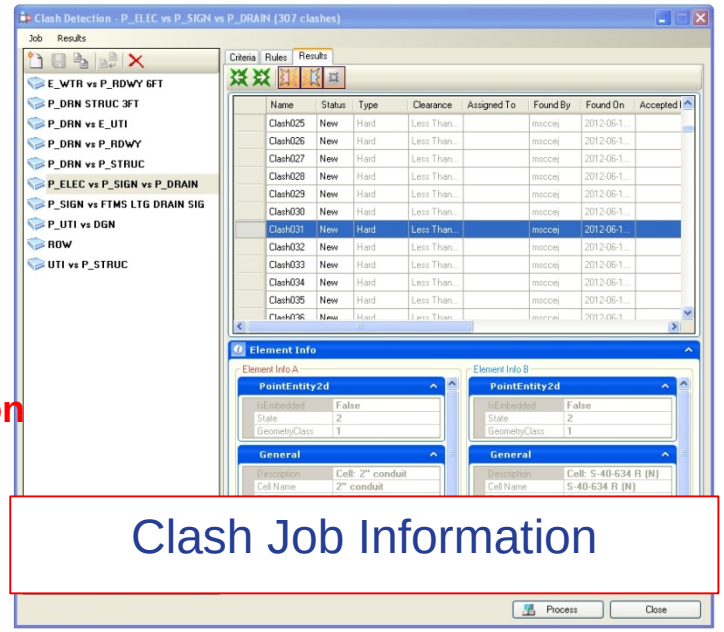
- Minimize traffic impacts
- Maximize contractor operations
- Safety
- Construction packages





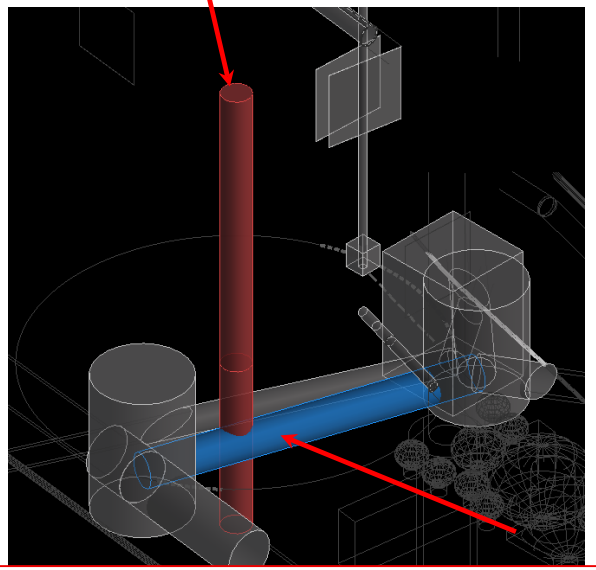
BIM Clash Detection

- Clash Detection Jobs
  - Automated processing of interferences between 3D elements



Clash Job Information

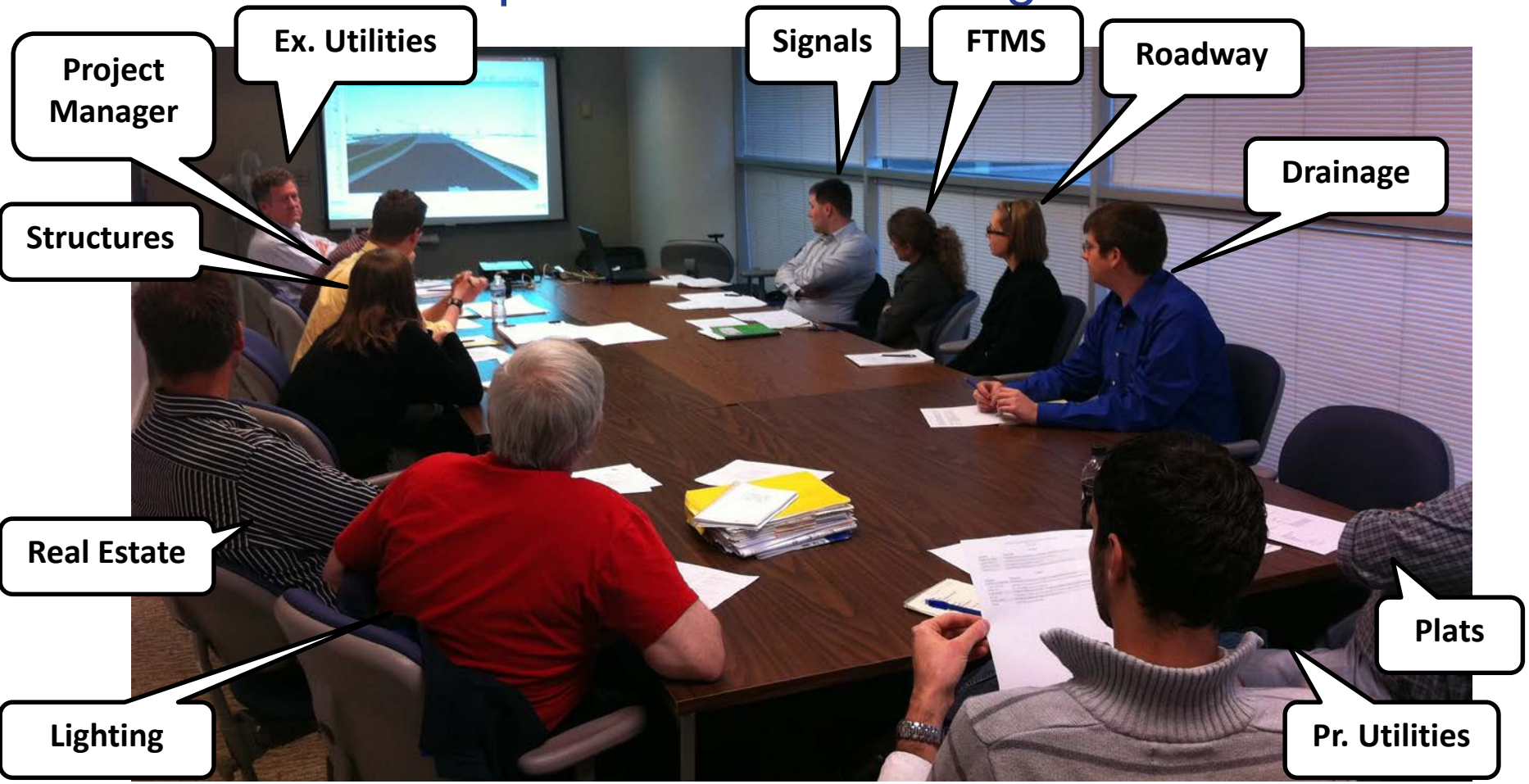
Clash Job Information



View of Element Clash

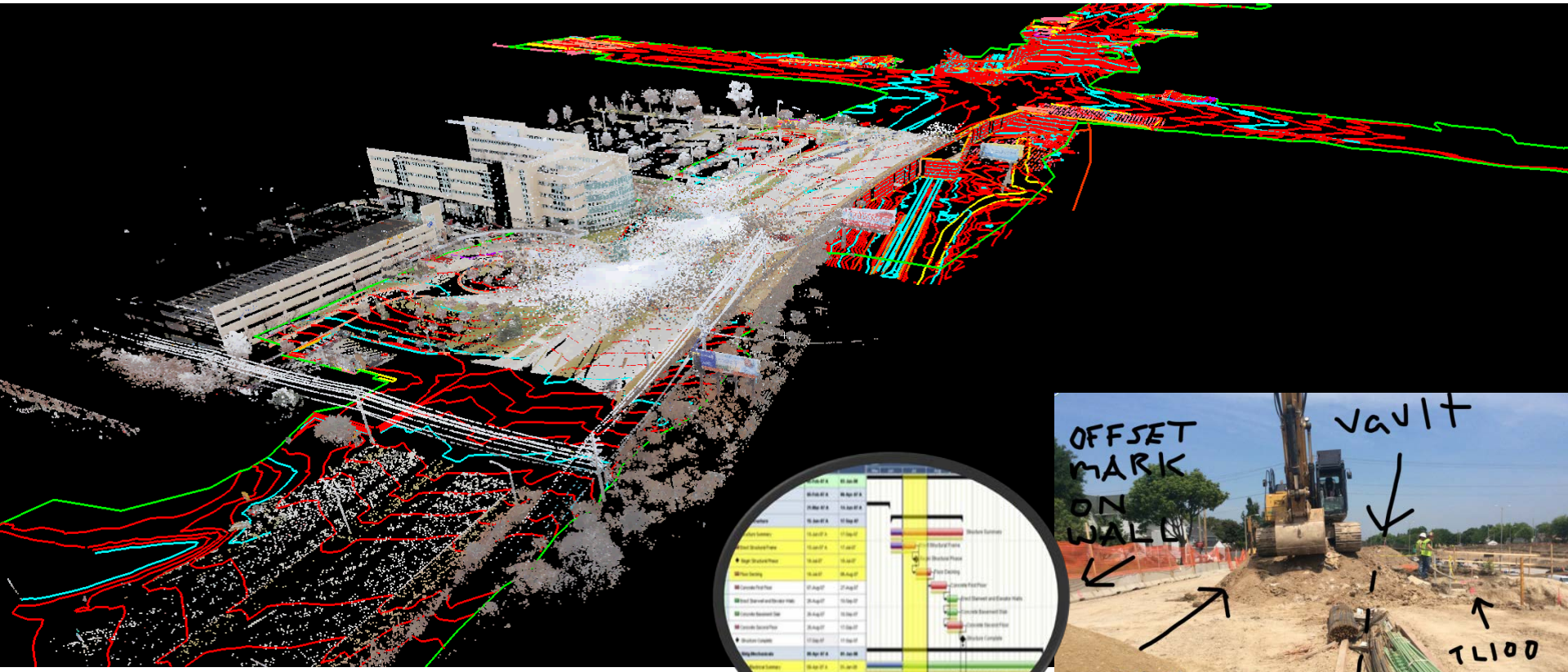
Model Review

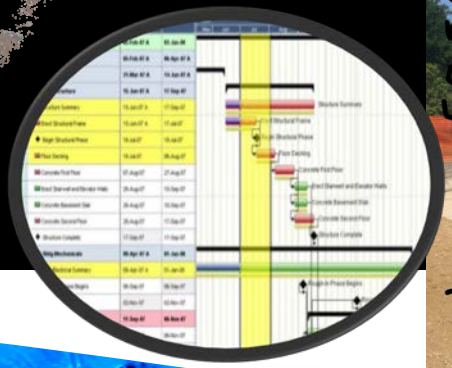
- Task lead representation – Design/Construction

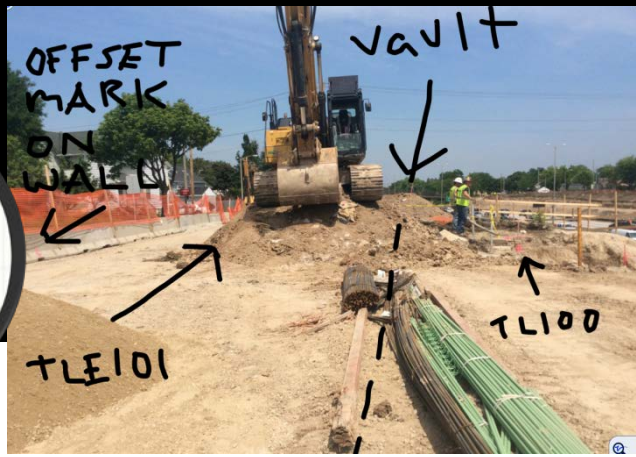


BIM 3D Modeling: Zoo Interchange Design-Construction

3D Model with Temporary Surfaces, Roads, Drainage, Structures, Other







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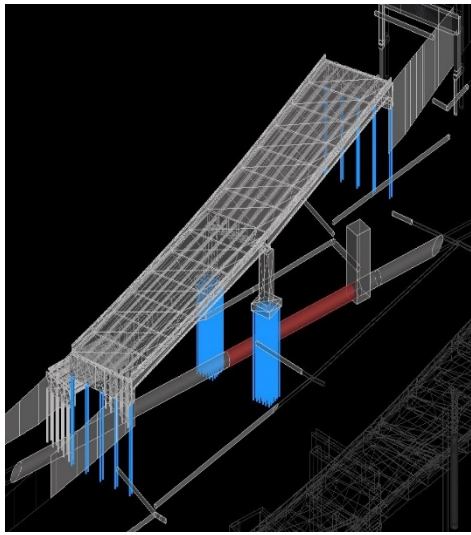
ZOO Interchange

Construction Management

- Public Information
- Traffic Closure Schedules
- Traffic Control & Monitoring
- Stakeholder Coordination
- Adherence to Plans & Specs
- Fabrication
- Inspection
- Schedule
- Budget
- Quality Control
- Change Management
- Dispute/Issue Resolution
- Materials
- Contract Administration
- Safety
- Documentation
- Contractor Submittals
- Environmental Protection

Model-based Construction

Construction Management



Tool(s) Used:

- Autodesk BIM Field 360/Glue 360
- Office & Field Mobile Devices
- AASHTOWare/Infotech Mobile Inspector/Field Manager
- Bluebeam Revu
- Aurigo Masterworks
- Raxar (POC)

Benefits:

- Improved Issues & Risks Tracking & Notification
- Improved Design-Construction (PSE) Reviews, Punch Lists, As-builts
- Improved Constructability (Schedule/Costs) Reviews
- Improved Construction Collaboration & Coordination
- Visualization. Imagery and Geospatial Data Integration
- Content/Document Management System

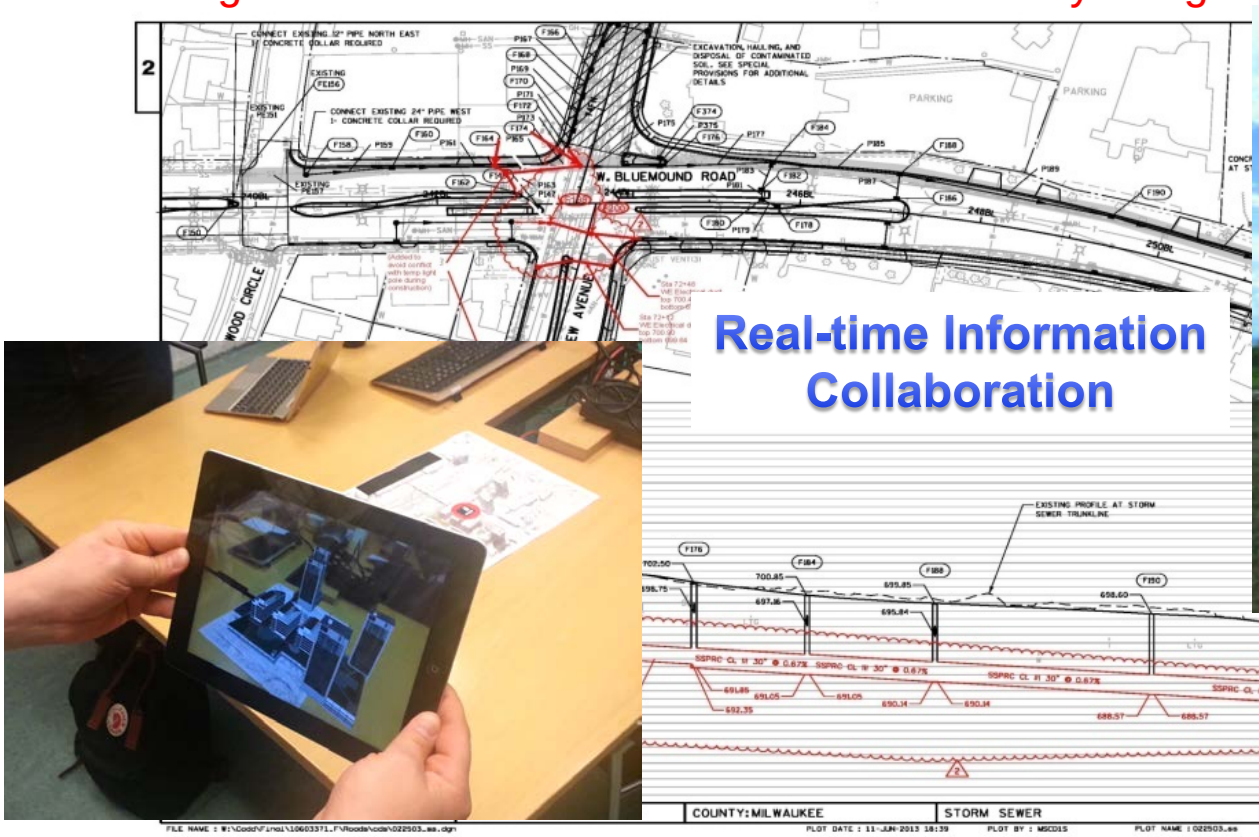
Zoo Interchange Construction Tools

3D Engineered Models in Construction-SE Freeways/Region

BIM/CIM to Field Issues Tracking

Zoo Interchange Construction Tools

3D Engineered Models in Construction-SE Freeways/Region



Real-time Information Collaboration

Zoo IC Construction

- Construction Production Rate (“Burn Rate”)
  - Estimated Work Dollars per Day *(2015)*

    $675,000
  - Estimated Work Dollars per Day (*2016)*

    $978,000

Project Controls

- Provide an efficient and effective method of documenting and tracking all cost, quality, and design **ISSUES** throughout the course of the project.
- Supply reliable cost information to Department management based on input received from the construction team.
- Identify and analyze trends to proactively minimize cost issues and maximize chances for potential savings.
- Assist the construction team with project execution and tracking of non-issue information.
- **Essentially, Project Controls is the information hub of the project.**

ZOO interchange
94 NORTH-SOUTH FREEWAY PROJECT
HOAN I-794 LAKE FREEWAY PROJECT
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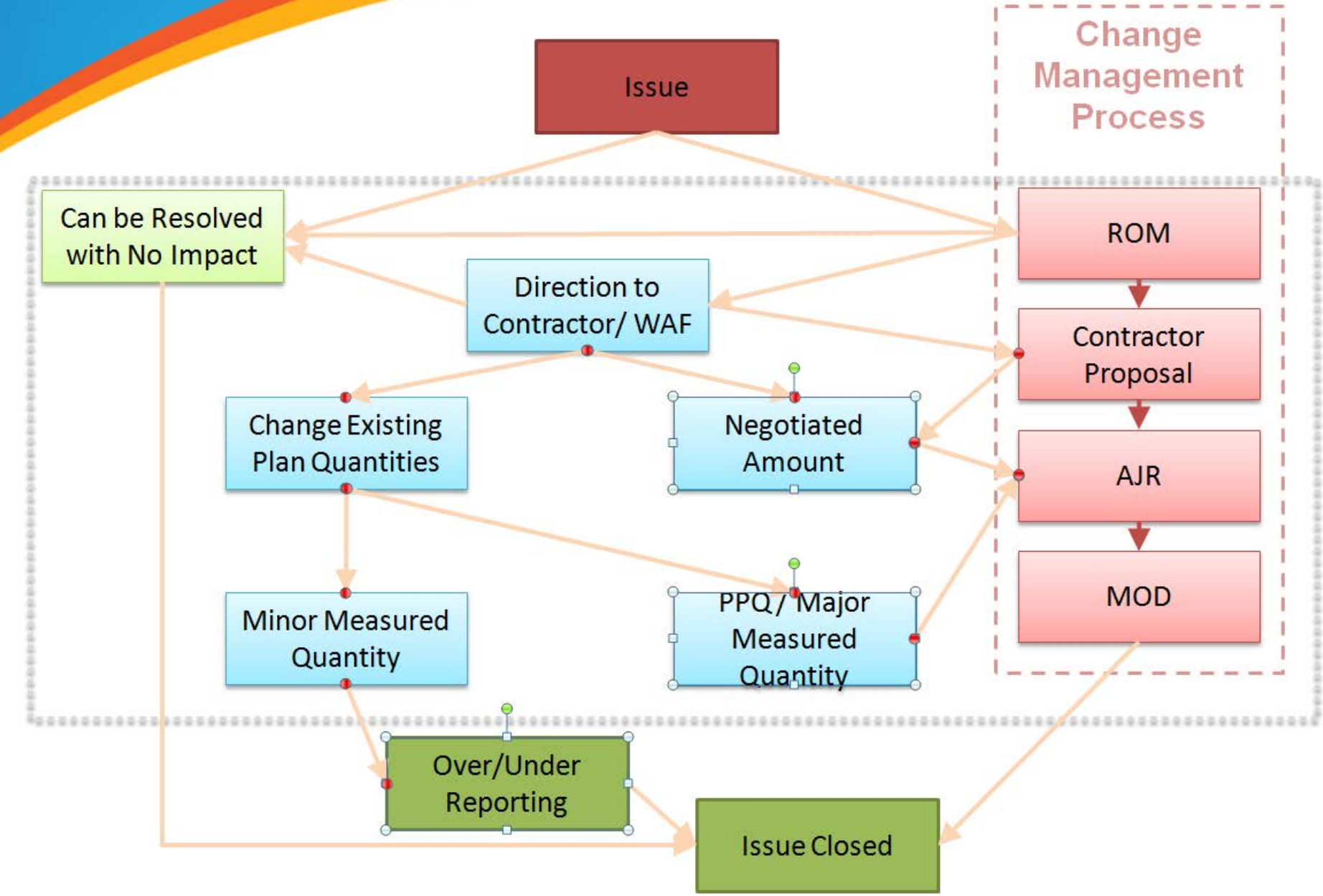
Program Controls

Program Controls are comprised of the five (5) main categories below:

- Finance/Budget
- Schedule
- Change Management
- Risk Management
- Document Control

Program Controls encompasses:

- Construction
- Design
- Real Estate
- Utilities
- Railroad
- Traffic mitigation



zoo interchange

94 NORTH-SOUTH FREEWAY PROJECT

HOAN I-794 LAKE FREEWAY PROJECT

WISCONSIN DEPARTMENT OF TRANSPORTATION

Emerging Technologies & Trends in BIM Infrastructure

Emerging Technologies & Trends in BIM Infrastructure