CIM-Civil Integrated Management: Best Practices and Lessons Learned

WisDOT SE Freeways - Focus on Construction

Ryan Luck, PE & Jason Roselle, PE
Chief, SEF Construction; Supervisor, SEF Construction

Kurt Flierl, PE
PM, SEF Construction

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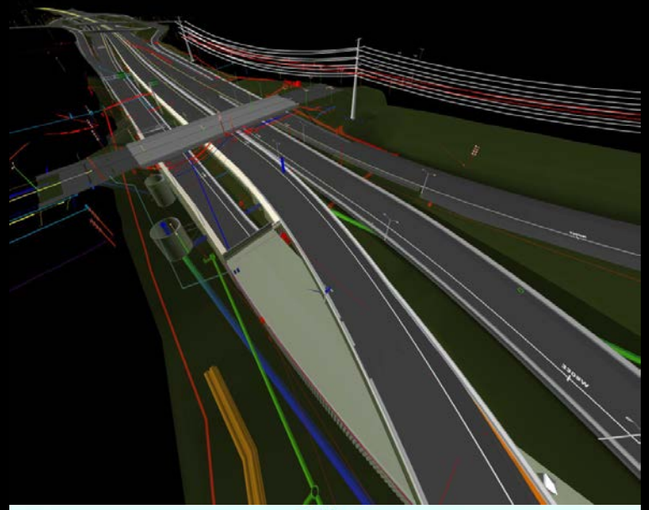
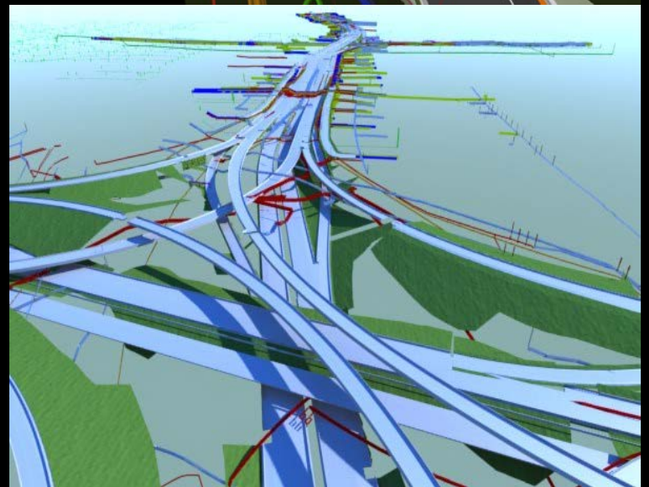
Sr. Project Engineer/CAD-BIM-GIS Coordinator, SEF Design;
Integrated Construction Coordinator, Mortenson Construction

Dan Kucza, PS & Shane Zodrow, PE, PS
Survey Group Leader, Project Eng-Surveyor, Kapur & Associates

Brady Frederick, PE & Jeremy Craven, PE
VP-Operations; VP-Technologies, Edgerton Contractors





http://tktimelapse.com/code/LA-0014.html

CIM-Civil Integrated Management: Best Practices and Lessons Learned

WisDOT SE Freeways - Focus on Construction

Meeting Agenda: 9:00-10:30 a.m. 08-22-12 @ Zoo IC Bldg

- Intro – WisDOT SE Freeways Projects Overview: Luck & Roselle
- 1. CIM – Concepts, Processes, Benefits, & ROI: Parve
- 2. CIM – Technologies, Tools & Data Management: Parve
- Q & A – Interactive
- 3. CIM – Planning-Integrated Survey & LiDAR Data Collection Applications: Parve
- 4. CIM – Design Applications: Parve
- Q & A – Interactive
- 5. CIM – Construction Applications & 3D-4D Pilot: Mortenson Construction & Parve
- 6. CIM – Maintenance & Operations - Lifecycle Applications: Parve
- Q & A – Interactive

CIM-Civil Integrated Management: Best Practices and Lessons Learned

WisDOT SE Freeways - Focus on Construction

Meeting Agenda: 10:30-12:00 p.m. 08-22-12 @ Zoo IC Bldg

- Break
- 7. CIM – Construction Mitchell IC Case Study (2011-12): Flierl
  Kapur & Associates
- Q &A – Interactive
  Edgerton Contractors
- Q &A – Interactive
  Mortenson Construction
- 8. CIM – Construction Best Practices & Lessons Learned Summary: Flierl
- Q &A – Interactive

CIM-Civil Integrated Management: Best Practices and Lessons Learned

WisDOT SE Freeways - Focus on Construction

Meeting Agenda: 1:00-4:00 p.m. 08-22-12 after Lunch

- **Construction Site Visit - Zoo IC (on-route)**
- **Construction Site Visit - Mitchell IC - CD Roads - Airport Spur**
- **Q &A – Interactive**

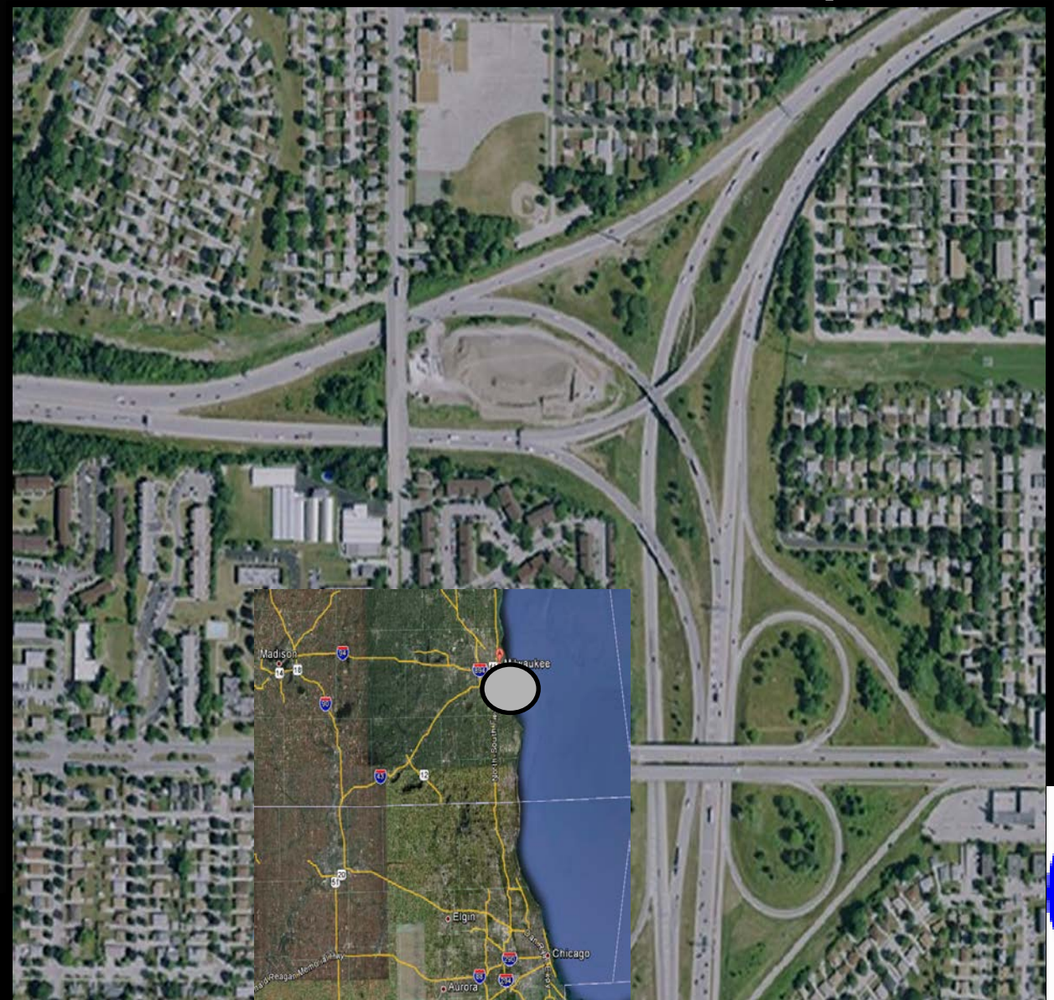
CIM-Civil Integrated Management: Best Practices and Lessons Learned

WisDOT SE Freeways - Focus on Construction

Introduction – Mitchell IC Construction $162.5 m 2011-12 Project

- $162.5 m reconstruction of Mitchell IC – part of the $1.9 b I-94 N-S construction
- Handles over 195,000 avg. vehicles per day
- Construction involves 3 tunnels, 13 bridges,

  1 system/4 service interchanges (including Airport Spur), 29 retaining walls, 7 noise walls, 4 box culverts, 54 sign structures & numerous utilities
- Temp. roads/structures to accommodate 2 lanes of traffic during construction
- CIM-VDC Pilot Study for Mitchell IC Construction Project



CIM-Civil Integrated Management: Best Practices and Lessons Learned

WisDOT SE Freeways - Focus on Construction

Mitchell IC Construction Project – I-94 N-S Corridor

CIM-Civil Integrated Management: Best Practices and Lessons Learned

WisDOT SE Freeways - Focus on Design

Introduction - Zoo IC Design Project (Construction $1.7 b 2012-18)

- **Planning, Surveying & Data Collection (2007-12)**
  (LIDAR Mobile-Static/APS/GPS/TS)
- **Environmental Study (02/2012 ROD)**
  (EIS & Preferred Alternative)
- **Design (2012-15)**
  (Preliminary/Final Design - P, S & E's)
- **Construction (2012-18)**
  (Arterials & Freeways)
- **Operations/Maintenance**
  (Infrastructure Lifecycle)

CIM-Civil Integrated Management: Best Practices and Lessons Learned

WisDOT SE Freeways - Focus on Design

Zoo IC Design Project

- $1.7 b reconstruction of Zoo IC-Corridor
- Handles almost 350,000 avg. vehicles per day
- Construction involves 68 bridges including 6 RR structures, 1 system/7 service interchanges, 108 retaining walls, 15 noise walls, 2 box culverts,115 sign structures & numerous utilities
- Temp. roads/structures to accommodate 2 lanes of traffic during construction
- CIM-VDC is being used throughout Zoo IC Design Project

WISCONSIN DEPARTMENT OF TRANSPORTATION

FORWARD 45

CH2MHILL

HNTB

KAPUR & ASSOCIATES, INC. CONSULTING ENGINEERS

WOOLPERT

Mortenson construction

CIM-VDC in Transportation

Discussion Topics

- Where are potential savings & cost avoidance being achieved if at all using CIM-VDC?
- How can construction schedules be streamlined & shortened using model-based tools?
- How do the quality of megaproject PS&E plans improve with model-based delivery?
- What about integrated project delivery (IPD) & WisDOT design-bid-build (DBB) projects as compared to design-build (DB) projects?
- What changes to WisDOT-Consultant workflows are involved including design-reviews construction reviews using model-based delivery for mega-major WisDOT projects?
- What potential investment will be required in workforce training and I.T. infrastructure?
- How can data be collected more accurately & efficiently involving 3D plans production?
- How are these initiatives funded & supported by FHWA & DOT management?
- How will legal issues be handled involving model delivery if provided pre-bid on delivery of P, S & E construction documents?

CIM-VDC

Concepts, Definitions & Processes

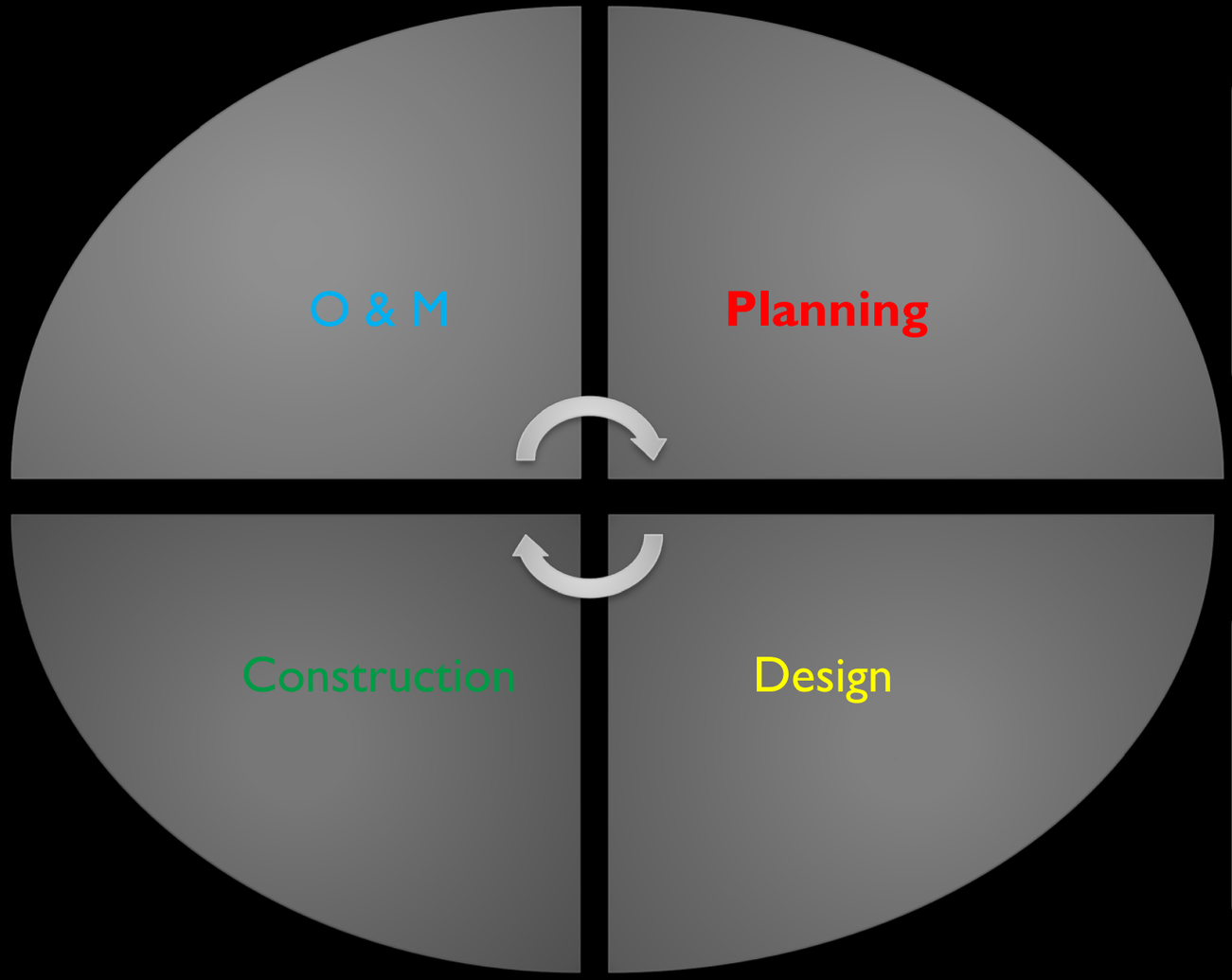
- CIM or Civil Integrated Management is “the collection, organization and managed accessibility to accurate data and information related to a highway facility including planning, environmental, surveying, design, construction, maintenance, asset management and risk assessment.”
- *- FHWA, AASHTO, ARTBA & AGC*

- VDC or Virtual Design & Construction is “the use of integrated multi-disciplinary performance models of design-construction projects to support explicit and public business objectives.”
- *- Stanford Center for Integrated Facility Engineering (CIFE)*

CIM-VDC

Transportation Facilities – Lifecycle Management

Operations & Maintenance
- Facilities Maintenance
- Asset Management
- Statewide TOC
- Monitoring
- Renovation



Planning
- Program-Project Initiation
- Finance/Budget
- Environmental Study/Doc/PI
- Survey, Mapping, & D.C.
- Design Alternatives

Construction
- Construction Bid/GC
- DBB/DB/IPD
- Construction /CEC
- RFIs, DINs, CCOs
- As-built Plans

Design
- 30% Preliminary Design
- 60% Design
- Utilities/Geotech/RE/Traffic
- P, S & E Final Design + Model
- Construction/Bid Docs

CIM-VDC

Concepts, Definitions & Processes

- CIM or Civil Integrated Management is “the collection, organization and managed accessibility to accurate data and information related to a highway facility including planning, environmental, surveying, design, construction, maintenance, asset management and risk assessment.”

  - FHWA, AASHTO, ARTBA & AGC

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  - Stanford Center for Integrated Facility Engineering (CIFE)

CIM-VDC

Concepts, Definitions & Processes

Databases, Processes & Tools

- CiM or Civil Information Model is the digital database for a civil facility from inception to life cycle, suite of software tools & associated set of processes to produce, communicate and analyze design and construction.

- BiM or Building Information Model is a digital database for a architectural facility from inception to life cycle, suite of software tools & associated set of processes to produce, communicate and analyze design and construction.

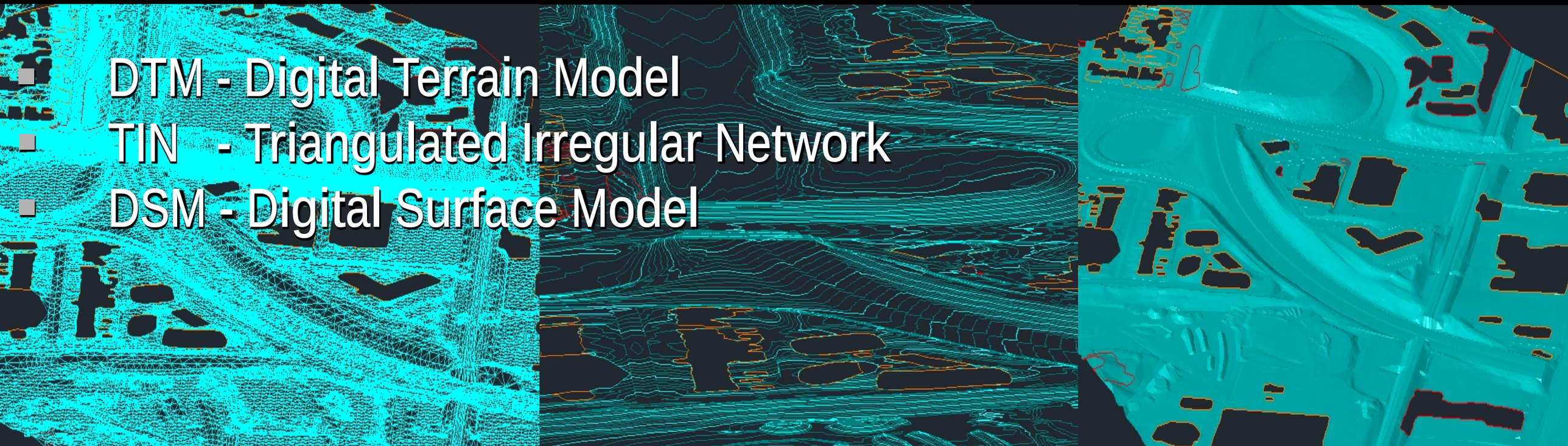
- The databases, tools & processes use multidisciplinary performance models of design & construction input such as Building or Civil Information Models (3D), CPM Schedules (4D), Cost Estimates (5D) and Specifications (6D) to simulate & validate project objectives.
  - Michael Lingerfelt, AIA

CIM-VDC

Concepts & Definitions & Processes

Digital Modeling Databases

- CAD - 2D-3D Graphical Vector DB + Raster Aerial Orthophoto
- GIS - Geospatial Features Mapping DB
- CiM - Parametric Objects DB (3D + 4D + 5D +6D)

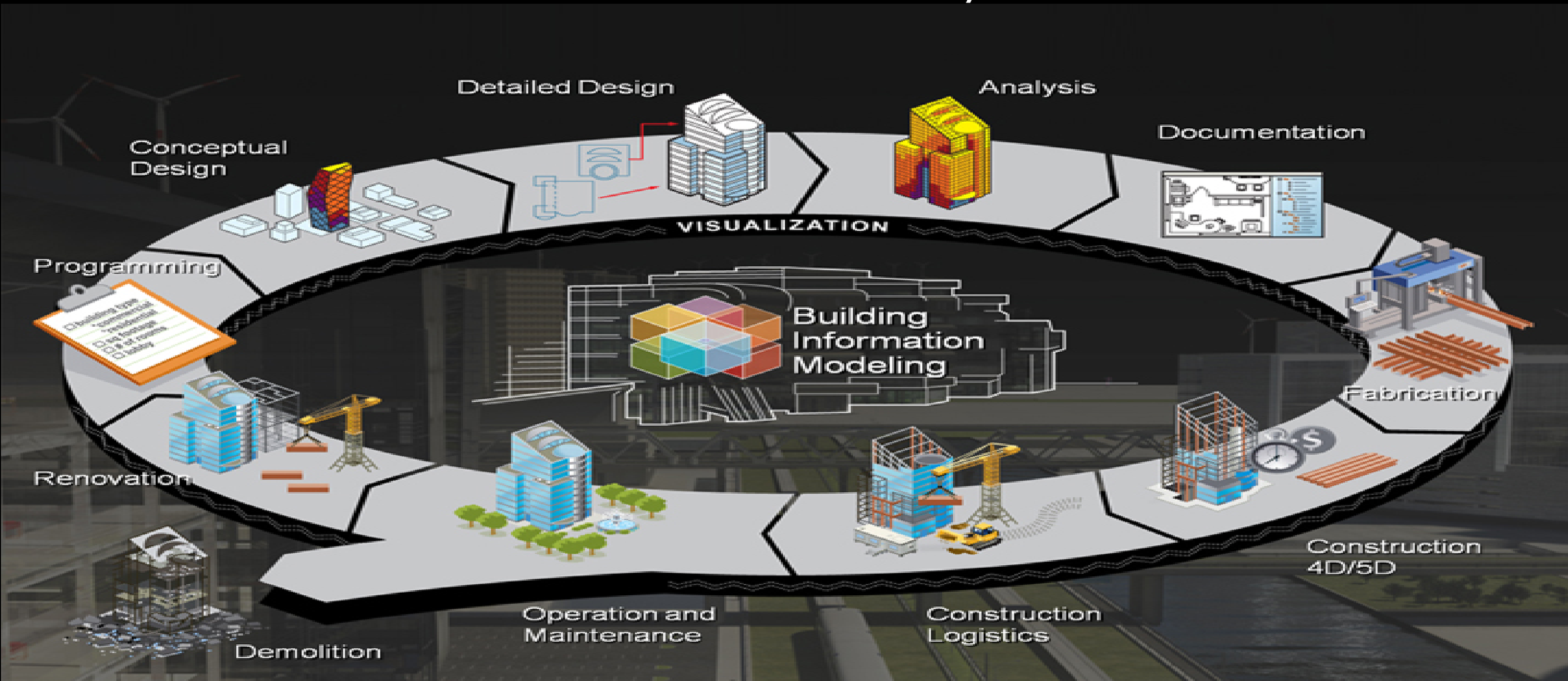


- DTM - Digital Terrain Model
- TIN - Triangulated Irregular Network
- DSM - Digital Surface Model

CIM-VDC

Benefits & ROI

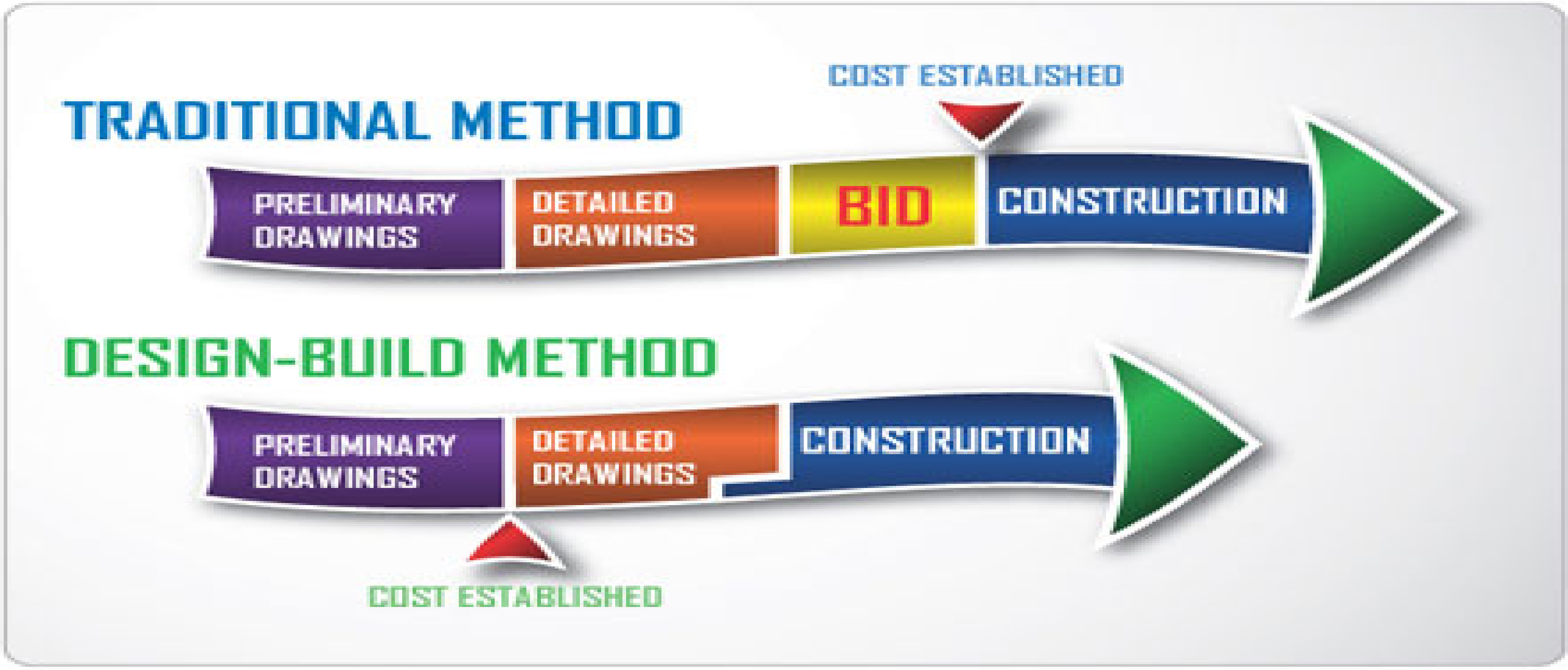
CIM-VDC Information Cycle



CIM-VDC

Benefits & ROI

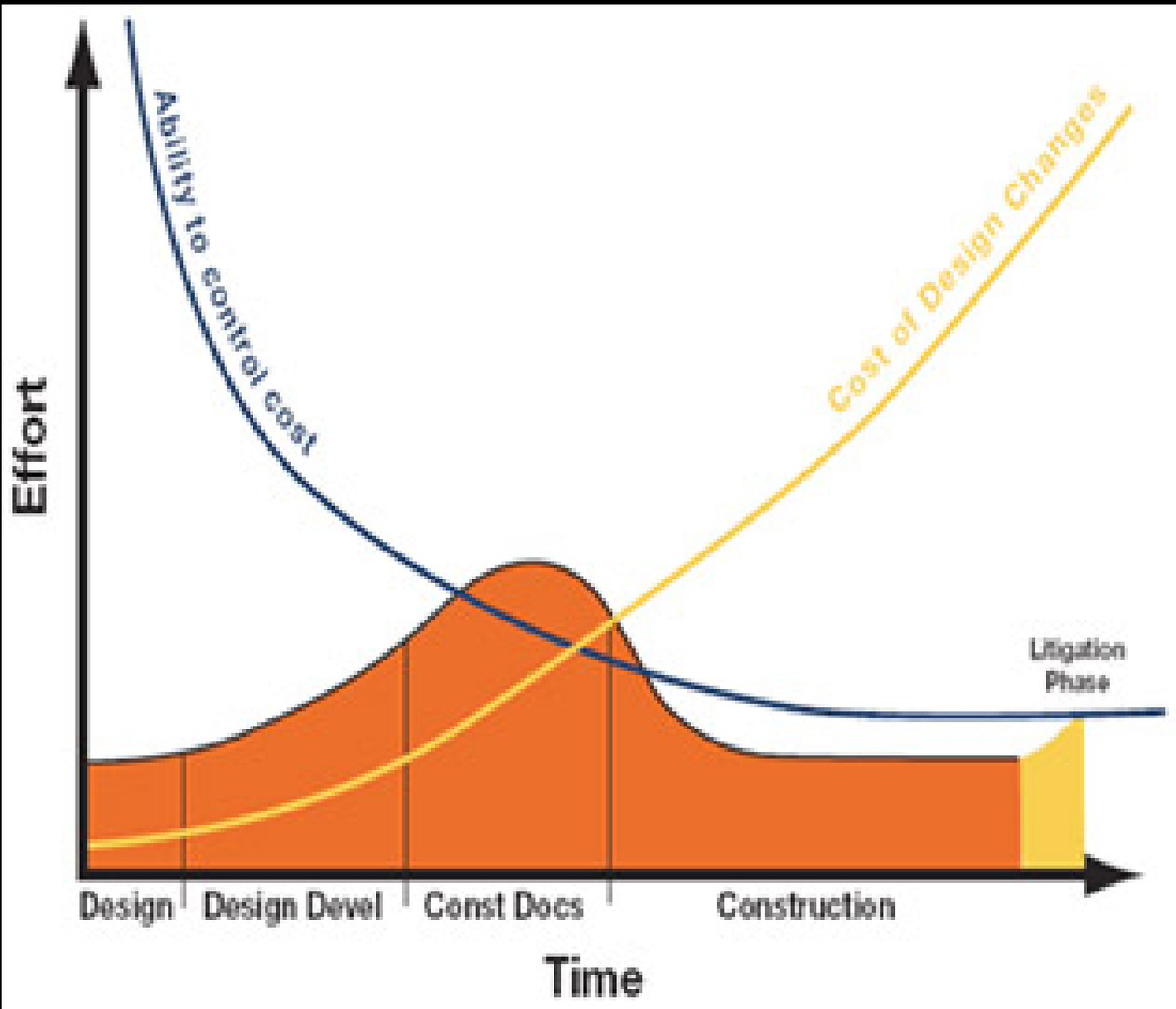
Integrated Project Delivery-IPD

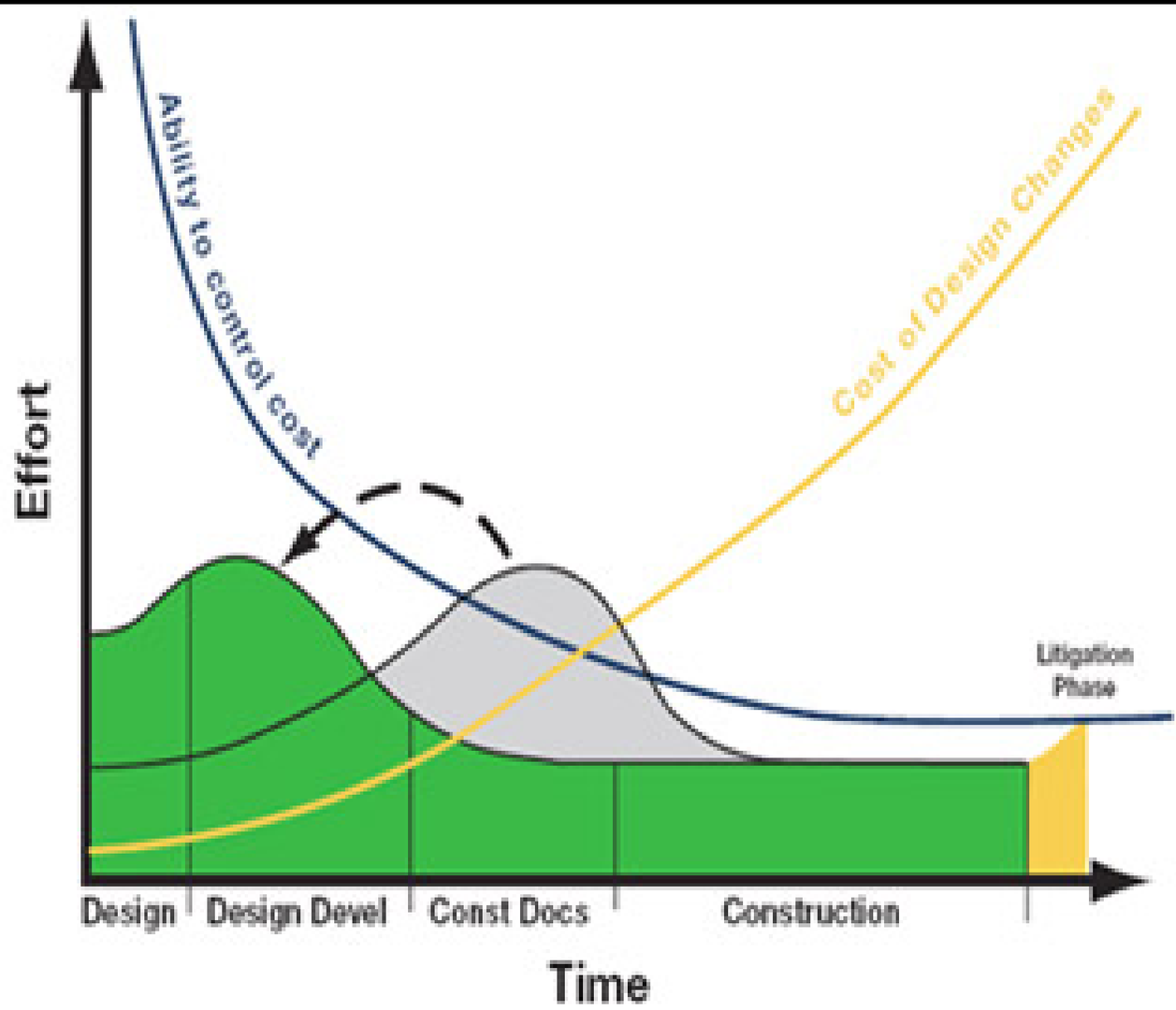


CIM-VDC

Benefits & ROI

Integrated Project Delivery-IPD

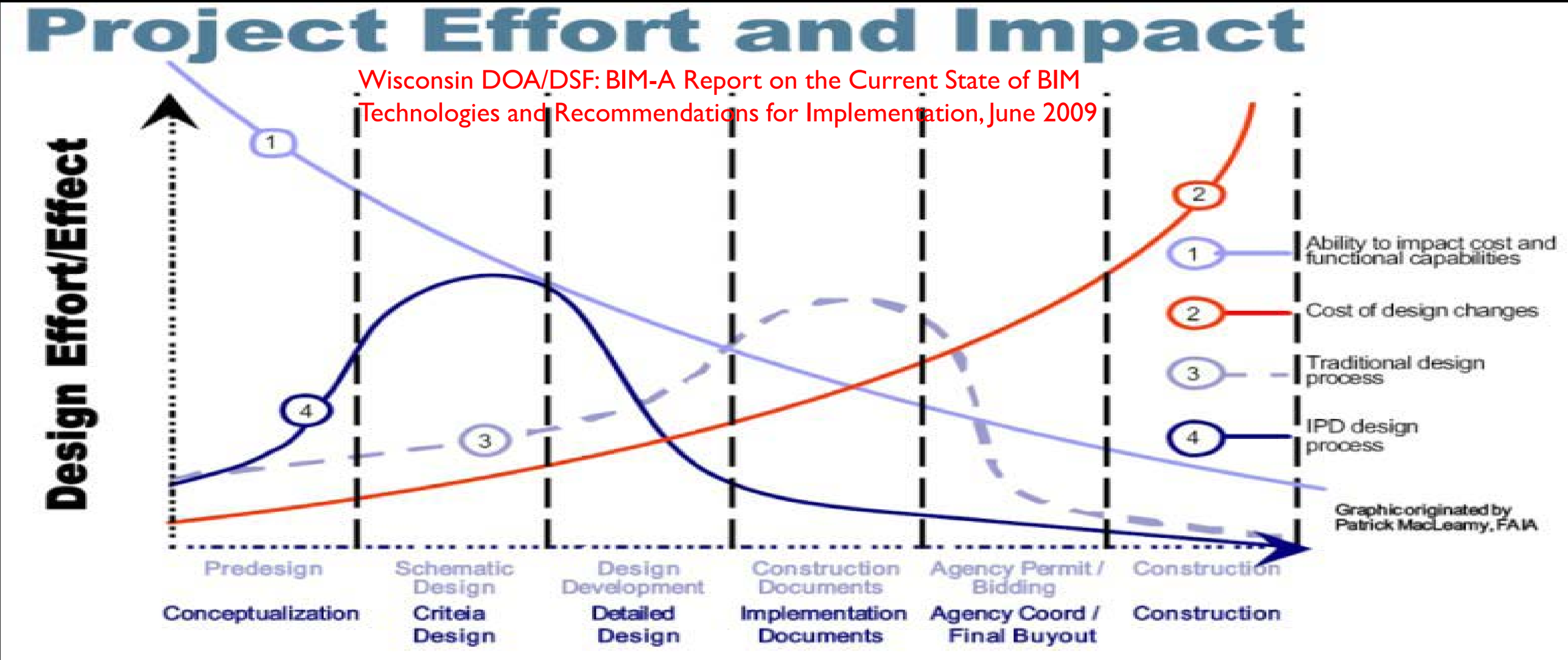




CIM-VDC

Benefits, & ROI

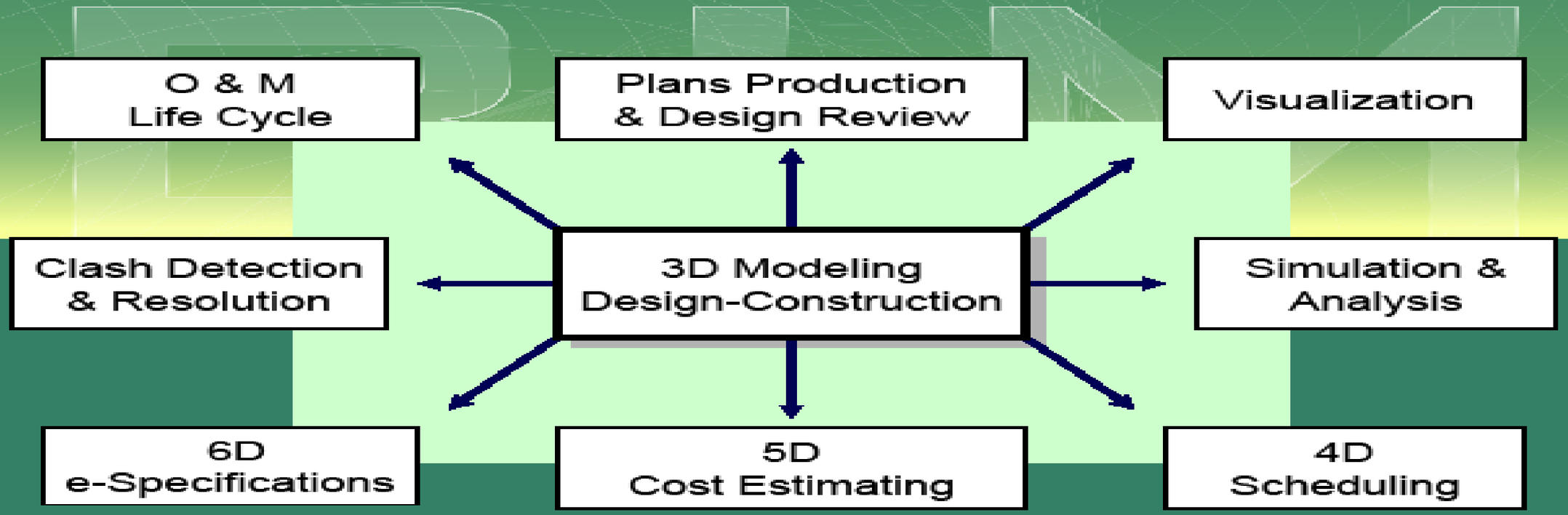
Integrated Project Delivery-IPD



CIM-VDC

Benefits, & ROI

Benefits of CIM-VDC



CIM-VDC

Benefits & ROI

Key Best Practices for CIM-VDC

- Design, visualize, analyze and simulate projects "virtually" digitally n a PC first, before constructing in the field
- Integrate and aggregate multidisciplinary 3D accurate data
- Consider reshaping current processes and workflows to CIM-VDC as "the way we do it" may be less efficient and not leverage emerging cutting–edge technologies
- Find and fix clashes or conflicts earlier in the process (Clash Detection & Resolution)
- Reduce project re-work, risk, cost and schedule
- Increase communication, coordination and collaboration between all project design, ad hoc and construction staffs
- Move to data-centric decisions vs. document-centric defense
- Integrate CAD, GIS, CiM-BiM, Survey, Utility, Geotech, Real Estate & Traffic Databases for Analysis, Visualization, Simulation, Model-based Plans Production and Reporting

CIM-VDC

Benefits, ROI & Workflows

"To CIM or not to CIM"

- Cost Savings & Cost Avoidance are achieved primarily during the Construction Phase
- Integrated project delivery, 3D D.C. & model-based P, S & E construction document delivery are disruptive to the transportation planning, design & construction process
- Collaboration between DOT planning-design-construction & oversight staffs, consultant designers, GC & subcontractors is required to achieve maximum gains
- Workflow changes require FHWA & DOT management support
- Workflow changes require a significant investment in workforce training
- Workflow & dataflow changes require a significant investment in I.T. & technologies
- Model-based P, S & E construction-bid document delivery requires additional legal front-end & back-end document language (contracts & model disclaimers)

CIM-VDC

Benefits, & ROI

Opportunities for ROI - CBA of CIM-VDC

RFIs for I-94 Layton CD Project-
Field Issues - $? for $81 m project

- RW-Retaining Wall: 19%
- BR-Bridges: 16%
- RD-Roadway: 16%
- NW-Noise Wall: 9%
- WU-Wet Utility: 8%
- SS-Safety/Standards/Specs/Cost Red: 5%
- DU-Dry Utility & EL-Electrical: 4%
- TR-Traffic: 3%
- DM-Demolition: 0%
- EW-Earthwork: 0%
- GN-General: 22%

DINs for I-94 Layton CD Project-
Field Issues - $? for $81 m project

- RW-Retaining Wall: 16%
- WU-Wet Utility: 14%
- RD-Roadway: 13%
- DU-Dry Utility & EL-Electrical: 13%
- BR-Bridges: 10%
- SS-Safety/Standards/Specs/Cost Red: 6%
- NW-Noise Wall: 3%
- TR-Traffic: 3%
- EW-Earthwork: 2%
- DM-Demolition: 0%
- GN-General: 21%

CIM-VDC

Benefits, & ROI

Opportunities for ROI - CBA of CIM-VDC

RFIs for I-94 Mitchell IC Project-
Field Issues - $? for $162.5 m project

- BR-Bridges: 23%
- RW-Retaining Wall: 19%
- DU-Dry Utility & EL-Electrical: 16%
- WU-Wet Utility: 13%
- RD-Roadway: 8%
- SS-Safety/Standards/Specs/Cost Red: 4%
- NW-Noise Wall: 2%
- TR-Traffic: 2%
- EW-Earthwork: 2%
- DM-Demolition: 0%
- GN-General: 12%

DINs for I-94 Mitchell IC Project-
Field Issues - $? for $162.5 m project

- BR-Bridges: 23%
- RW-Retaining Wall: 12%
- WU-Wet Utility: 11%
- DU-Dry Utility & EL-Electrical: 8%
- RD-Roadway: 5%
- TR-Traffic: 5%
- SS-Safety/Standards/Specs/Cost Red: 3%
- EW-Earthwork: 2%
- NW-Noise Wall: 1%
- DM-Demolition: 0%
- GN-General: 29%

CIM-Civil Integrated Management: Best Practices and Lessons Learned

WisDOT SE Freeways - Focus on Construction

Introduction – Mitchell IC Construction $162.5 m 2011-12 Project

- $162.5 m / $81 m reconstruction of Mitchell IC / CD Roads–$1.9 b I-94 N-S construction
- Handles over 195,000 avg. vehicles per day
- Construction involves 3 tunnels, 13/12 bridges, 1 system/4 service interchanges (including Airport Spur), 29/21 retaining walls, 7/1 noise walls, 4/2 box culverts, 54/22 sign structures & numerous utilities
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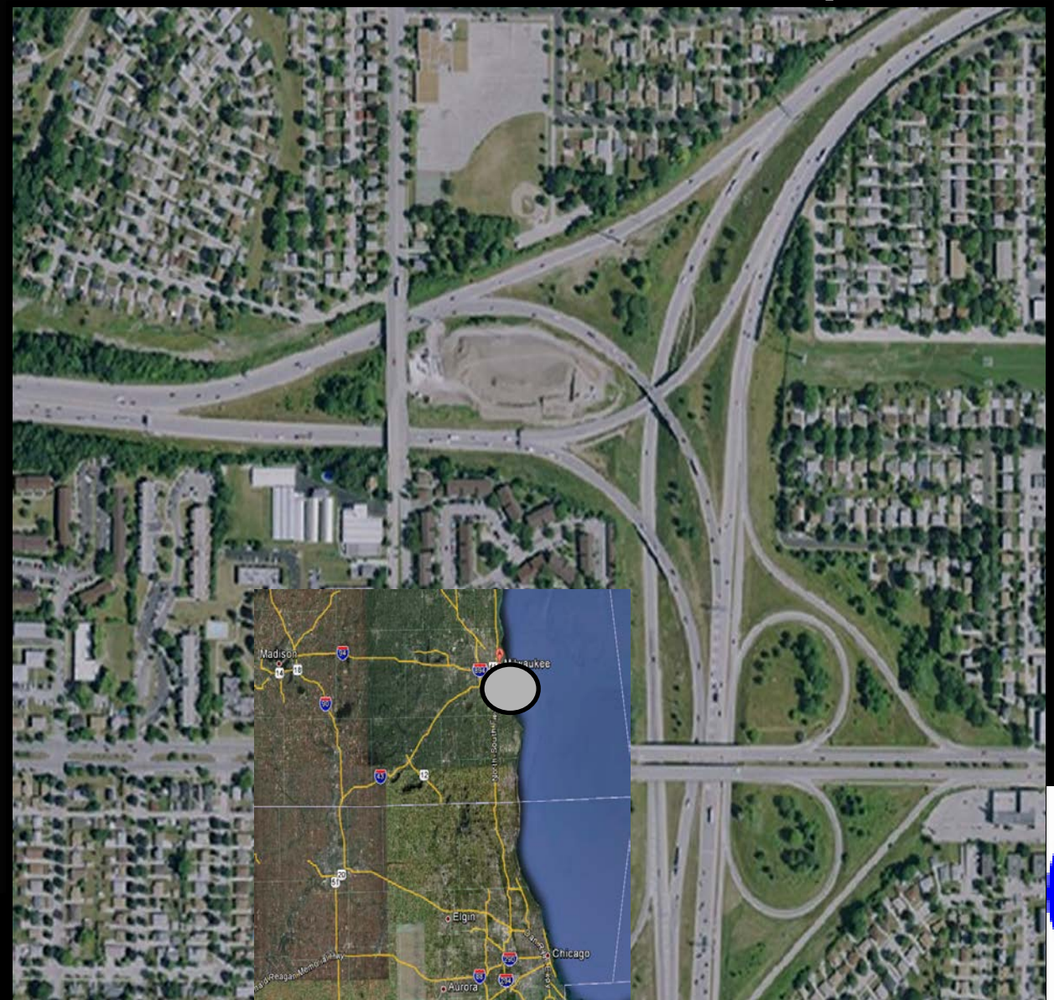


CIM-VDC

Technologies & Tools

CiM-BiM Tools vs. Visualization Tools

- Hand Rendering
- 2-D CAD (vector graphics) + Images (raster orthophotos)
- 3-D CAD (features/DTM-TIN surfaces/3-D faces) + Images
- Digital Realistic Rendering to 3-D Model (by adding color, texture, lighting, shadow, reflectivity, etc.)
- Photo-Simulation to 3-D Model (by adding photo-editing)
- Digital Animation (moving the 3-D model & images)
- Real-time Simulation (real-time simulation & virtual reality)
- Web, Multi-media & Video

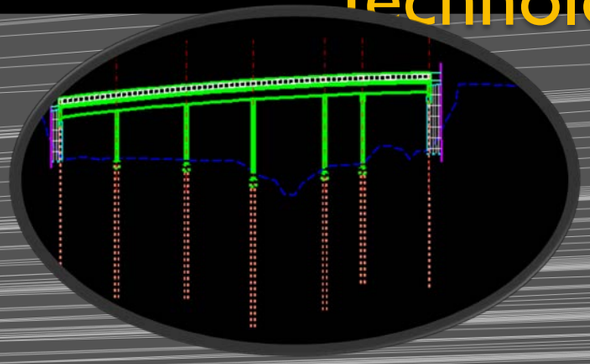
"If I can visualize it, I can understand it."
Albert Einstein

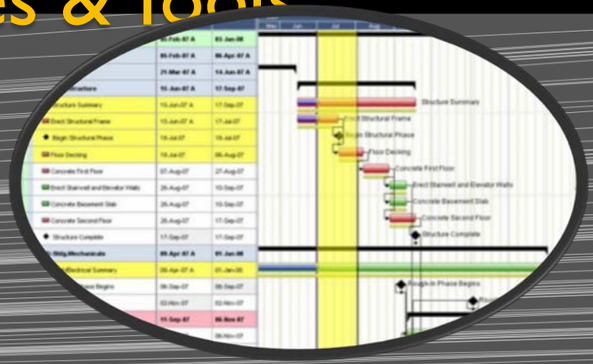
CIM-VDC

Technologies & Tools

Design Drawings

Microstation/Inroads



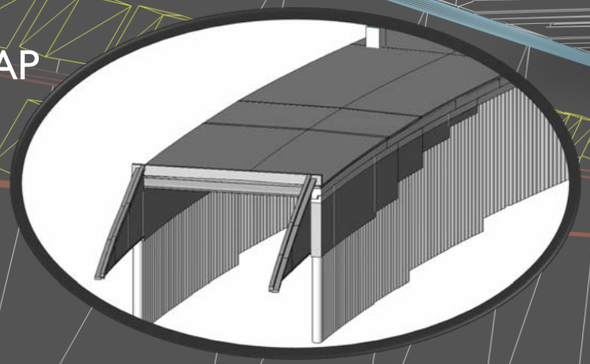


Primavera

Schedule Design

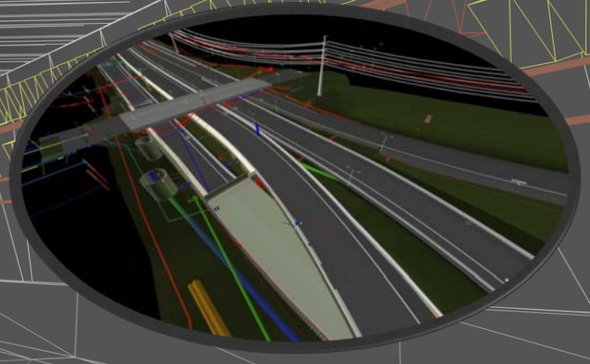
Structures

Autodesk® Revit®
Structure
Bentley LEAP



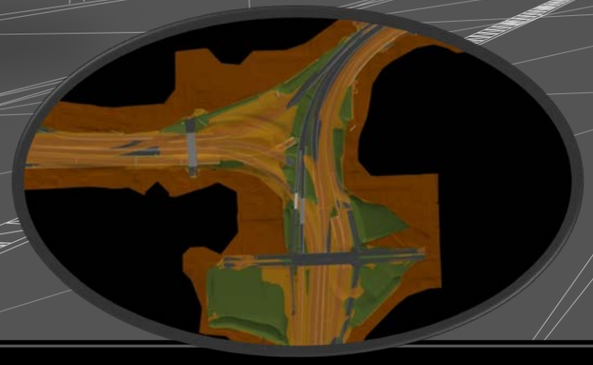
Geometrics

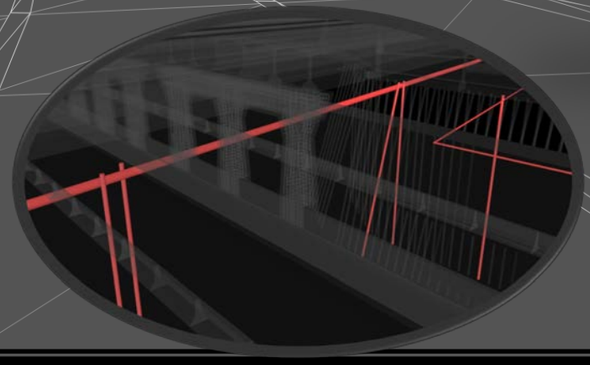
AutoCAD® Civil® 3D/
Microstation



Surfaces

Inroads and
AutoCAD®
Civil® 3D





4D/Constructability

Navisworks® Manage
Bentley Navigator
Clash Detection

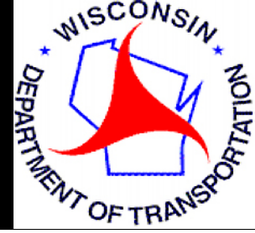
CIM-VDC

Technologies & Tools

CiM-BiM Tools

CIM-VDC

Technologies & Tools



Barriers & Opportunities for CIM-VDC SW

- Open vs Proprietory DBes
  - Bentley Inroads, & Autodesk Civil 3D
  - Analysis & Data Management vs. Graphics & Features
- Interoperability Export & Import
  - LandXML
  - GIS (ESRI ArcView)
  - Traffic (VISSIM vs Paramics)
  - Bentley Inroads, & Autodesk C3D
- Standards & Protocols

Visual Solutions INCORPORATED

VisSim Modeling the Future

US Army Corps of Engineers

GSA

Trimble

AIA

ESRI

CIM-VDC

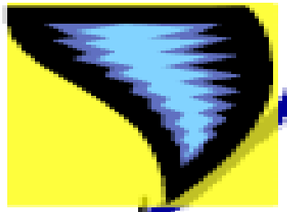
Benefits & ROI

To CIM or not to CIM?

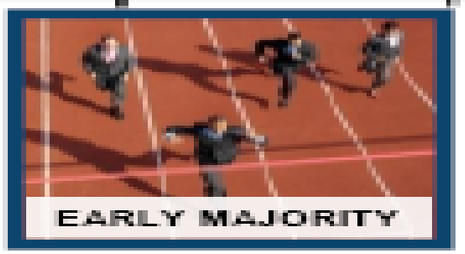
LOCATION ON THE CURVE FOR VDC

-Typ. Young
-Many Ideas
-INVESTMENT

-Tech. Kill Joys
-Love Tech. Failures
-COST



-Revolutionary
-First To Implement Win
-INVESTMENT



-Evolutionary
-Focus on Biz. Efficiency
-INVESTMENT

-New only after 50%
-Only When I Must
-COST

YOU MUST KNOW WHERE:

-YOU?

-COMPANY OWNERS?

-MIDDLE MANAGEMENT?

-STAFF?

-CLIENTS?

-TORNADO?

Raymond L. Goodson, Jr., Inc.
STRUCTURAL CIVIL SURVEY
INTEGRATED PROJECT DELIVERY (IPD)
Presenter: WILL IKERD | wikerd@rlginc.com

Sponsored By: Bentley McGraw Hill Construction ENR

CIM-VDC

Benefits & ROI

Use CIM-VDC multi-disciplinary performance models to:

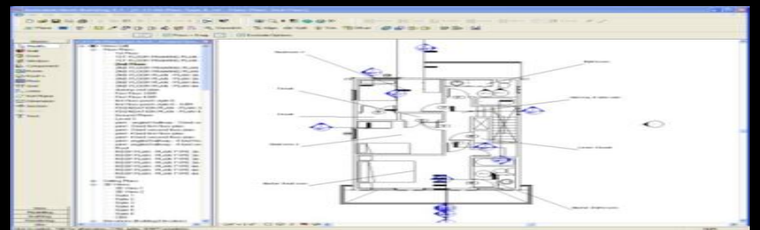
…support business objectives…

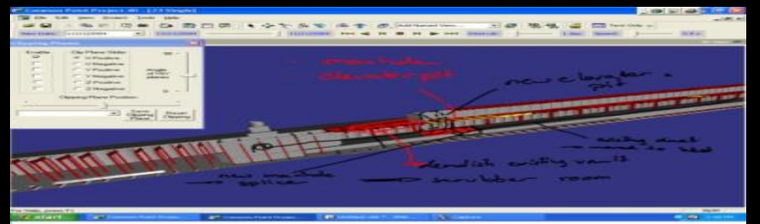
…simulate and validate objectives…

…add value to project…

<u>Factors to Determine What CiM-BiM Tools are Used</u>

- **Project Objectives, Goals & Scope**
- **Project Schedule**
- **Project Budget**
- **In-house Knowledge & Experience**
- **Costs-Benefits-ROI**

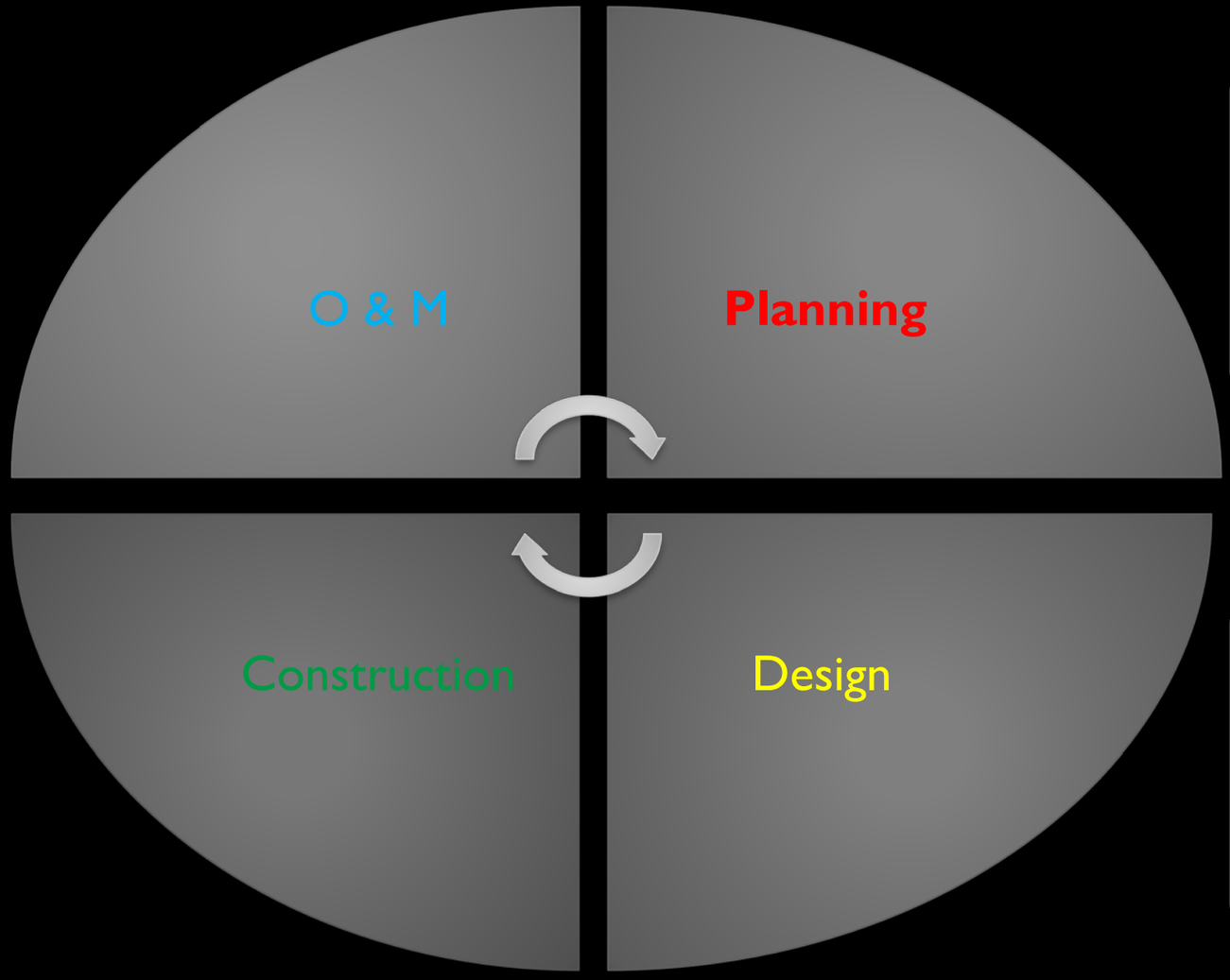




CIM-VDC

Transportation Facilities – Planning Applications

Operations & Maintenance
- Facilities Maintenance
- Asset Management
- Statewide TOC
- Monitoring
- Renovation



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Design
- 30% Preliminary Design
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- Utilities/Geotech/RE/Traffic
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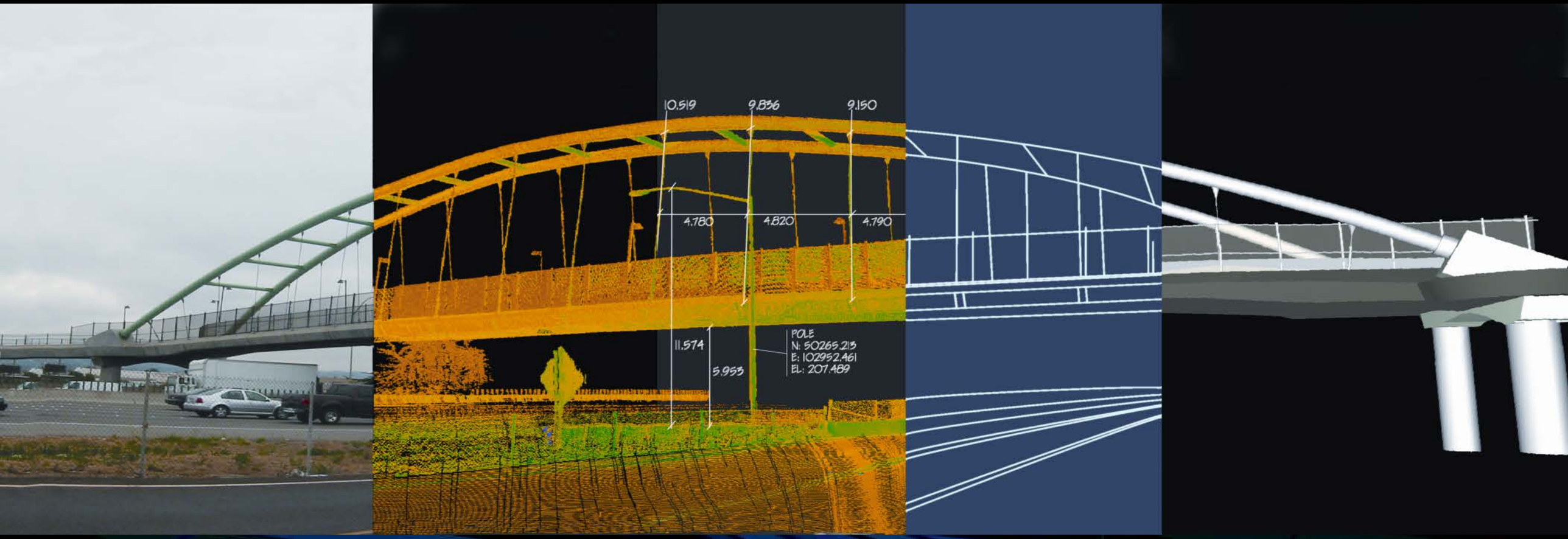
CIM-VDC

Integrated Survey with LiDAR Data Collection - Planning



Georeferenced

Hi-res Digital

Images

3D

XYZ Return

LAS Point Clouds

2D -3D Feature Lines

3D DTMs-TINs

X-Sections

3D

CIM-BIM

DSMs

CIM-VDC

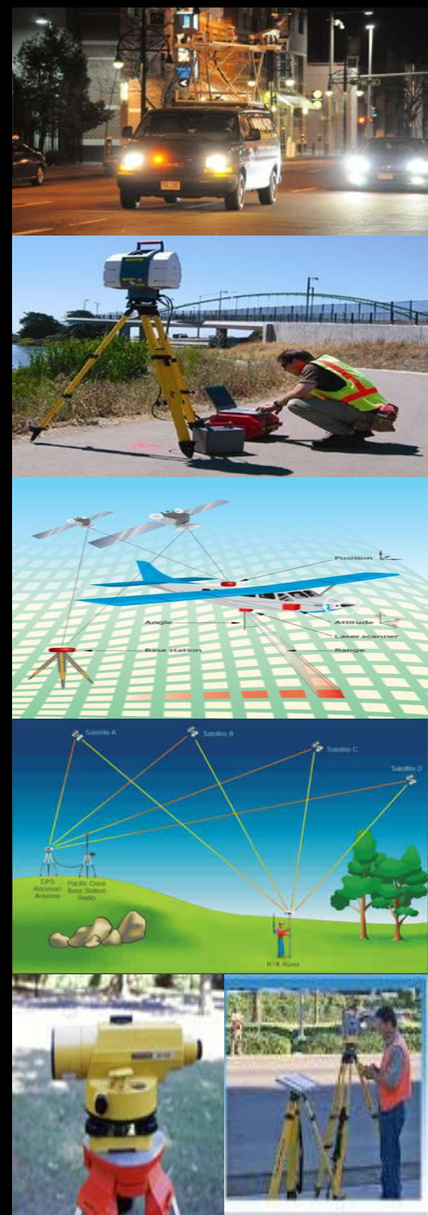
Integrated Survey with LiDAR Data Collection - Planning

LiDAR Point Cloud courtesy of WisDOT, CH2MHill, HNTB, Kapur & Associates and Woolpert

CIM-VDC

Integrated Survey - Mobile/Static/Aerial LiDAR/APS/RTK GPS/TS/DL

- **LiDAR (Light Detection And Ranging) Laser** – an optical remote sensing technology measuring scattered light and time delay to determine distance to an object or surface using reflected laser pulses
- **Mobile Laser Survey (MLS)** – Terrestrial LiDAR
- **Static Laser Survey (SLS)** – Terrestrial LiDAR
- **Aerial Laser Survey (ALS)** – Fixed Wing, Helicopter, UAV
- **Aerial Photogrammetric Survey (APS)** – Fixed Wing
- **Real-Time Kinematic Global Positioning System (RTK GPS)** – WisCORS (Continuing Operating Ref. Station) & Base Station(s)
- **Conventional Survey TS & DL** – Servo or Robotic Total Station (TS) & Differential Leveling (DL)



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Integrated Survey - Mobile/Static/Aerial LiDAR/APS/RTK GPS/TS/DL

Comparison of Typical Survey Accuracies

- Fixed Wing Aerial Photogrammetry
  - ± 6" Vertical Accuracy (Low and Slow) (0.3'-0.5')
- Low Altitude Helicopter Photogrammetry
  - ± 1"-2" Vertical Accuracy (Lower and Slower) (0.1'-0.2')
- Mobile LiDAR Laser Scanning (with Differential Leveled HATs)
  - ± ½"-1" Vertical Accuracy (0.06'-0.08')
- RTK GPS (WisCORS) (Supplemental GPS)
  - ± ½" – 1" Vertical Accuracy (0.06'-0.08')
- Static LiDAR Laser Scanning
  - ± ¼" - ½" Vertical Accuracy (0.02'-0.05')
- Total Station & Differential Leveling
  - ≤ ± ¼" - ½" Vertical Accuracy (0.02'-0.05')

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Integrated Survey with LiDAR Data Collection - Planning

- Planning/Mapping Level Data
  - Done without benefit of ground control (≅0.2'±) with good satellite visibility
  - Done without benefit of ground control (≅1.0'±) with poor satellite visibility
- Design Level Data
  - Done with benefit of ground control
    - ≅0.06'-0.10'± using Mobile Mapping System (2σ)
    - <0.06' using Tripod Mounted Scanners (2σ)

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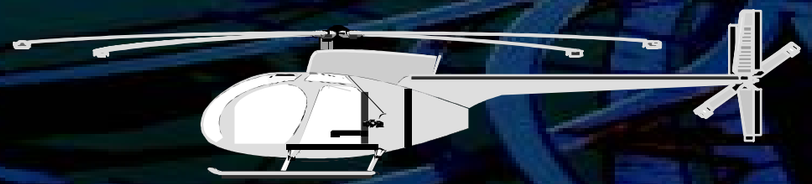
Integrated Survey – Photogrammetry (APS)

Every 100’ of altitude for aircraft = 0.01’+/- vertical accuracy



500’

1,000’-2,500’
FAA “Floor”=
1,000’

1” = 83’ photo scale
0.05’ vertical accuracy

1” = 166’ photo scale
0.12-0.30’ vertical accuracy

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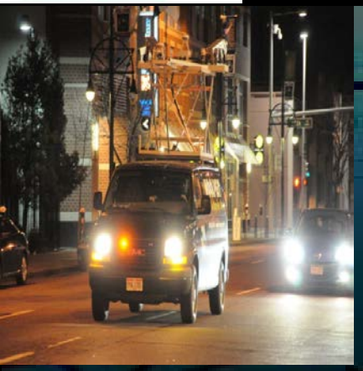
Integrated Survey - Mobile/Static/Aerial LiDAR/APS/RTK GPS/TS/DL



- Collect data at design-level accuracies rapidly for corridor planning, design, in-progress construction, as-builts, assets mgmt/operations/maintenance
- Increase safety/reduce work zone accidents
- Shorten projects lifecycle
- Just-in-time features/surfaces extraction
- Deliver higher quality products/2D to 3D
- Improve multi-disciplinary coordination/collaboration
- Provide higher quality service
- Deliver 3D data tied to 3D-4D-5D intelligent BIM models/schedules, costs and specs
- Save $ for WisDOT/FHWA/Taxpayer

CIM-VDC

Integrated Survey with LiDAR Data Collection - Planning

CIM-VDC

Integrated Survey with LiDAR Data Collection in Planning

- LiDAR, and similarly, RADAR, both have ability to image an object only as small, or detailed, as the wavelength itself.
- A small object detectable by RADAR is the size of a quarter.
- A small object detectable by LiDAR is at nano technology size.
- Both technologies actively transmit pulses of waves (ultraviolet, visible or near infrared for LiDAR or radio, TV, or microwave for RADAR).
- Transmitted pulses of waves bounce off objects in their paths and portions of these waves return to the instrument.
- Portions of pulses returned by various LiDAR scanners range from one, through multiple, to practically unlimited.
- Single pulse LiDAR is good for hard surfaces and multiple pulse penetrates vegetation.

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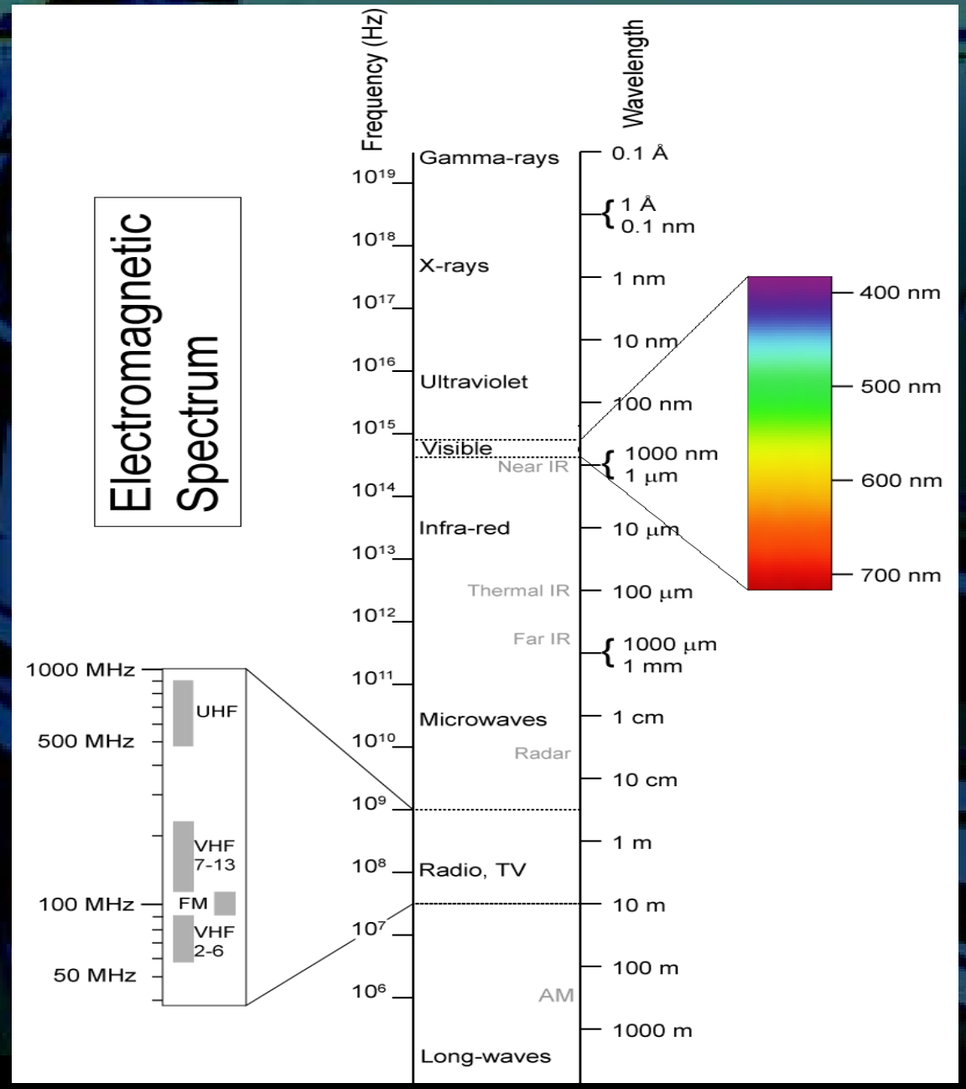
Integrated Survey with LiDAR Data Collection in Planning

+LiDAR (Light Detection and Ranging) wavelengths encompass the ultraviolet, visible and near infrared range of the electromagnetic spectrum at range from 10^{-6} m (μm) to 10^{-9} m (nm).

+RADAR (Radio Detection and Ranging) wavelengths range from cm's to 100 m.



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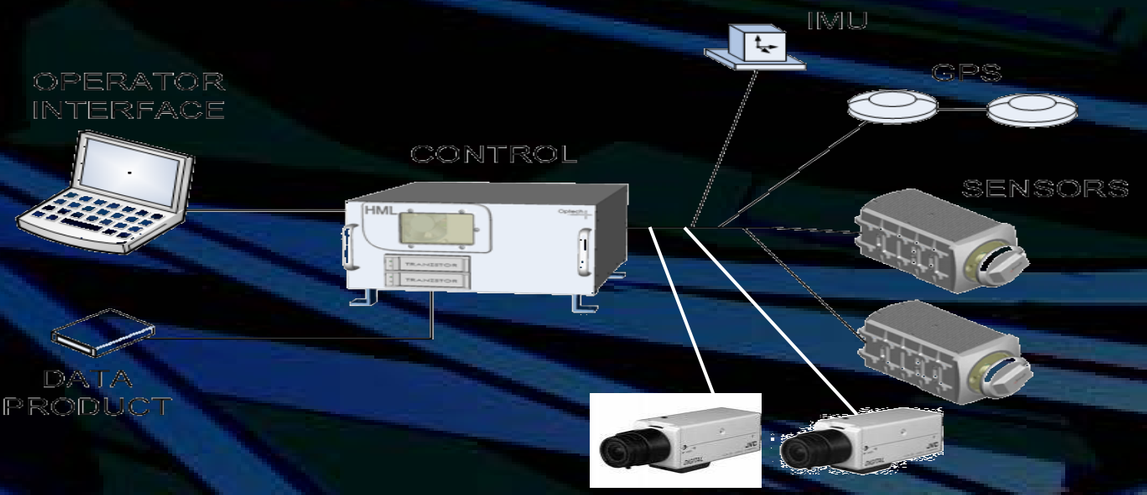
Integrated Survey with LiDAR Data Collection in Planning

- LASER- Light Amplification by Stimulated Emission of Radiation – a continuous beam of highly focused light



- LiDAR systems consist of lasers, mirrors, scanners, photodetectors, receivers, and a position and orientation system (GNSS, IMU)

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Integrated Survey - Mobile/Static/Aerial LiDAR/APS/RTK GPS/TS/DL

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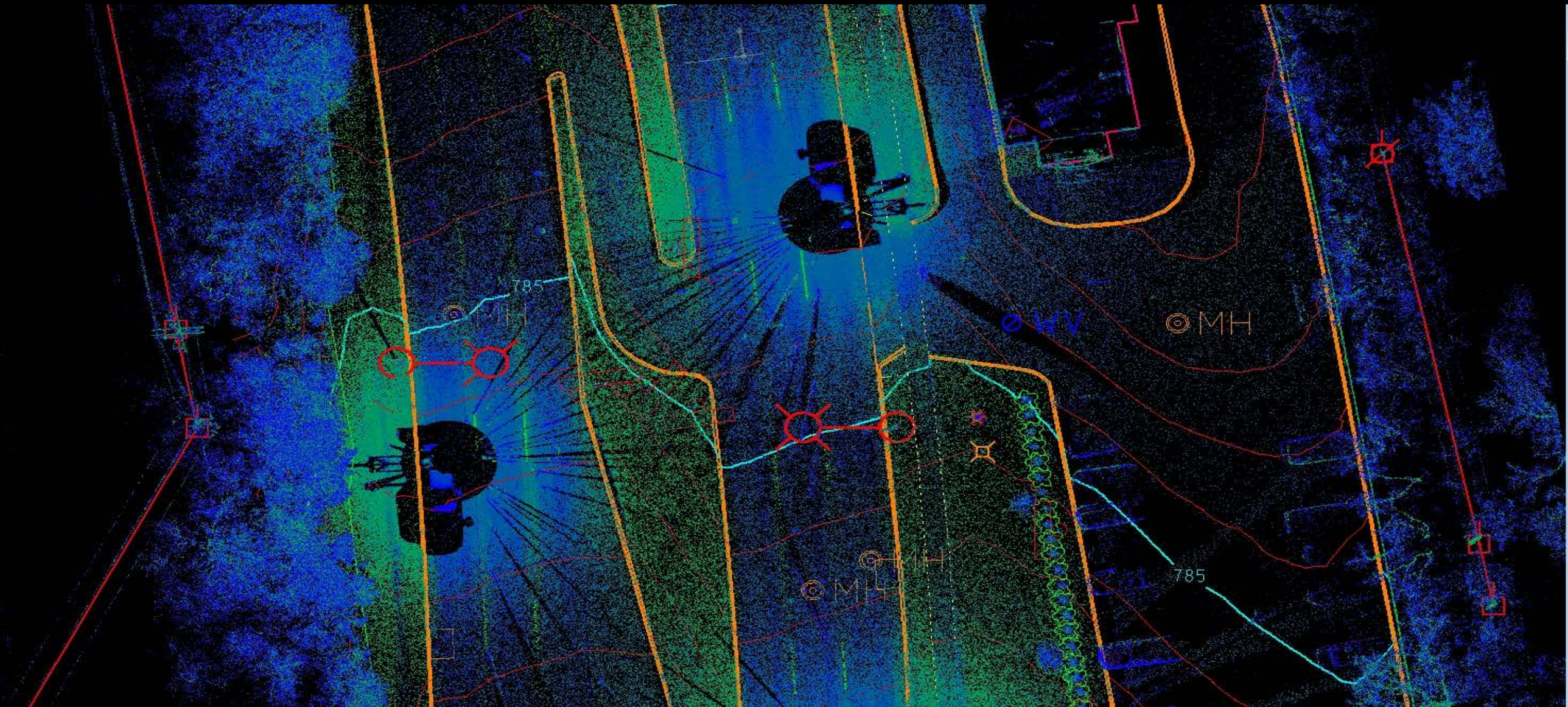
Integrated Survey with LiDAR Data Collection - Planning



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Integrated Survey with LiDAR Data Collection - Planning

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Integrated Survey - Mobile/Static/Aerial LiDAR/APS/RTK GPS/TS/DL

Integrated Survey + LiDAR Data Collection - Typical Workflow

- Project Planning/Scheduling – LiDAR Mobile/Static/Airborne, Season, Weather and Trajectories-Mobile/Airborne or Setups-Static
- Control Survey – RTK GPS (X,Y,Z) and Differentially Leveled (Z) Survey High Accuracy Targets (HATs) or Vertical Targets
- Data Acquistion – Using LiDAR Hardware-specific Collection SW
- Data Adjustment – Using LiDAR SW
  - Calculate Smoothed, Best Estimated Trajectory (SBET)-Mobile
  - Create Initial LAS File
  - Edge Match Data
  - Geometrically Constrain Point Cloud (PC) Data to Ground Control
  - Colorize Point Cloud
  - Transform Point Cloud to Project Coordinate System
- Data Classification – PC including Bare Earth Ground Points Using LiDAR SW
- Mapping – Point and Line Feature Extraction including Break Lines with QA/QC X-sections Using Mapping SW with Calibrated Digital Images
- Mapping – DTM Surface Model from Bare Earth Ground Points and Break Lines Using LiDAR SW
- Viewing – Viewing, Measuring & QA/QC

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Integrated Survey - Mobile/Static/Aerial LiDAR/APS/RTK GPS/TS/DL

- Two-mile Test Section of Urban Arterial (STH100)
- Pairs of Targets every 1,000 ft (500 ft when needed)
- Check Sections every 4,000 ft
- Targets controlled horizontally via RTK GPS and vertically via Conventional Surveying Methodologies
- Results on surfaces:

	Hard	Soft
◦ Uncontrolled check sections:	0.82’ (1σ) v	0.75’ (1σ) v
◦ Check sections tied to ground:	0.09’ (1σ) v	0.11’ (1σ) v
◦ Check sections tied & matched:	0.025’ (1σ) v	0.10’ (1σ) v

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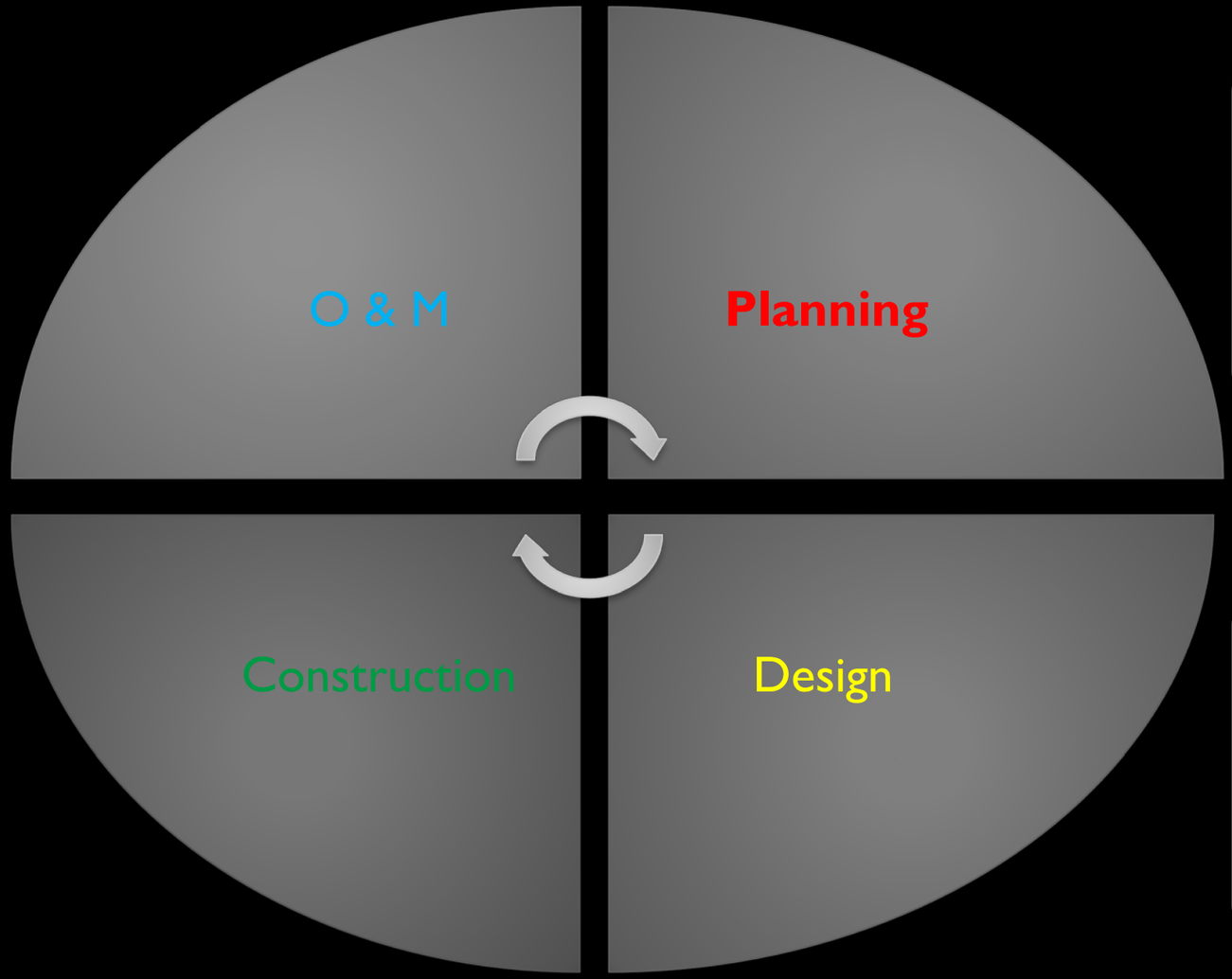
Transportation Facilities – Design Applications



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- RFIs, DINs, CCOs
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Design
- 30% Preliminary Design
- 60% Design
- Utilities/Geotech/RE/Traffic
- P, S & E Final Design + Model
- Construction/Bid Docs

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Design Applications - Workflows

CIM-VDC Deployment on the Zoo IC Project
Level of Detail (LOD) is value-added for BxP

BIM Execution Plan: Zoo IC Project 1060-33-01
Design Task Assignment Matrix: 2012-2017 Construction

	% 0	Study / Existing / D.C. 10	30% P.D. 30	60% P.D. 60	90% P.S.&E. 90	P.S.&E. 100	Schedule / Costs / Pre-Contract	Construction
Roadways / Temp. Roads / Pavement		E	P	P	P	P	P	P
Structures / Temp. Structures		E	P	P	P	P	P	P
DTMs / Grading		E	P	P	P	P	P	P
Drainage / Ponds		E	P	P	P	P	P	P
FTMS		E			P	P	P	P
Lighting		E			P	P	P	P
Utilities / RRs (By Others)		E				P	P	P
Signals		E			P	P	P	P
Pavement Marking / Signing						P	P	P
Traffic Control / TMP / MOT								
Erosion Control / Fencing								
Subsurface Geotech / HazMat		E	P		P	P	P	P
ROW/Parcels		E		P	P	P	P	P
Schedule					S	S	S	S
Costs						C	C	C

3D E
3D P
4D S
5D C

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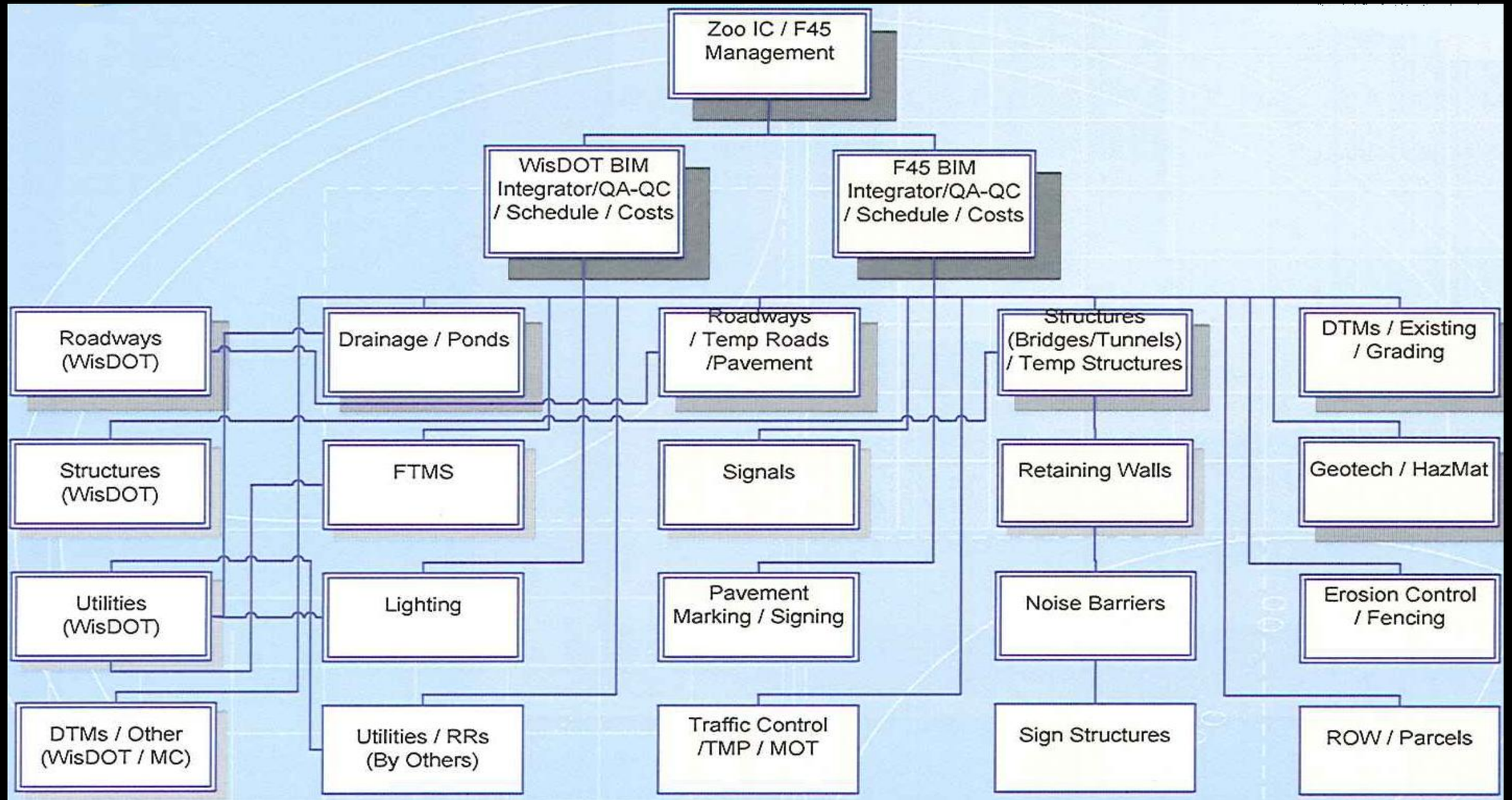
Design Applications - Workflows

CIM-VDC Deployment on the Zoo IC Project



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Design Applications - Workflows

Design-Construction Oversight/Coordination
Multi-disciplinary Integration/Collaboration

Clash Detection, Analysis, Simulation & Visualization (Navisworks / Navigator)

Clash Analysis /Resolution (Navisworks / Navigator / CAD) (RFIs/DINs/CCOs)

Existing & Proposed 3-D Models (C3D or MS In-roads/Geopak/LandXML to CAD & Revit) +
4-D Construction Scheduling Tasks (Primavera/Microsoft Project Schedules to Navisworks/Navigator)

Roadways/Structures/Misc.
(Roads, Bridges, Tunnels, Retaining/Noise Walls, RRs, PM, Storm, Sign Structures, FTMS, Signals, Lighting, Traffic, etc.)

Utilities-UG/AG/OH (Other)
(Sanitary, Water, Electric, Gas, FO, CATV, Telephone, Communication, Fire Protection, Steam, etc.)

Surfaces/Subsurfaces-DTMs
(LiDAR Mobile/Static/Aerial/RTK GPS/Total Station/Diffeential Leveling Survey, Geotech HazMat), Landscaping, etc.)

STH 100.jpg

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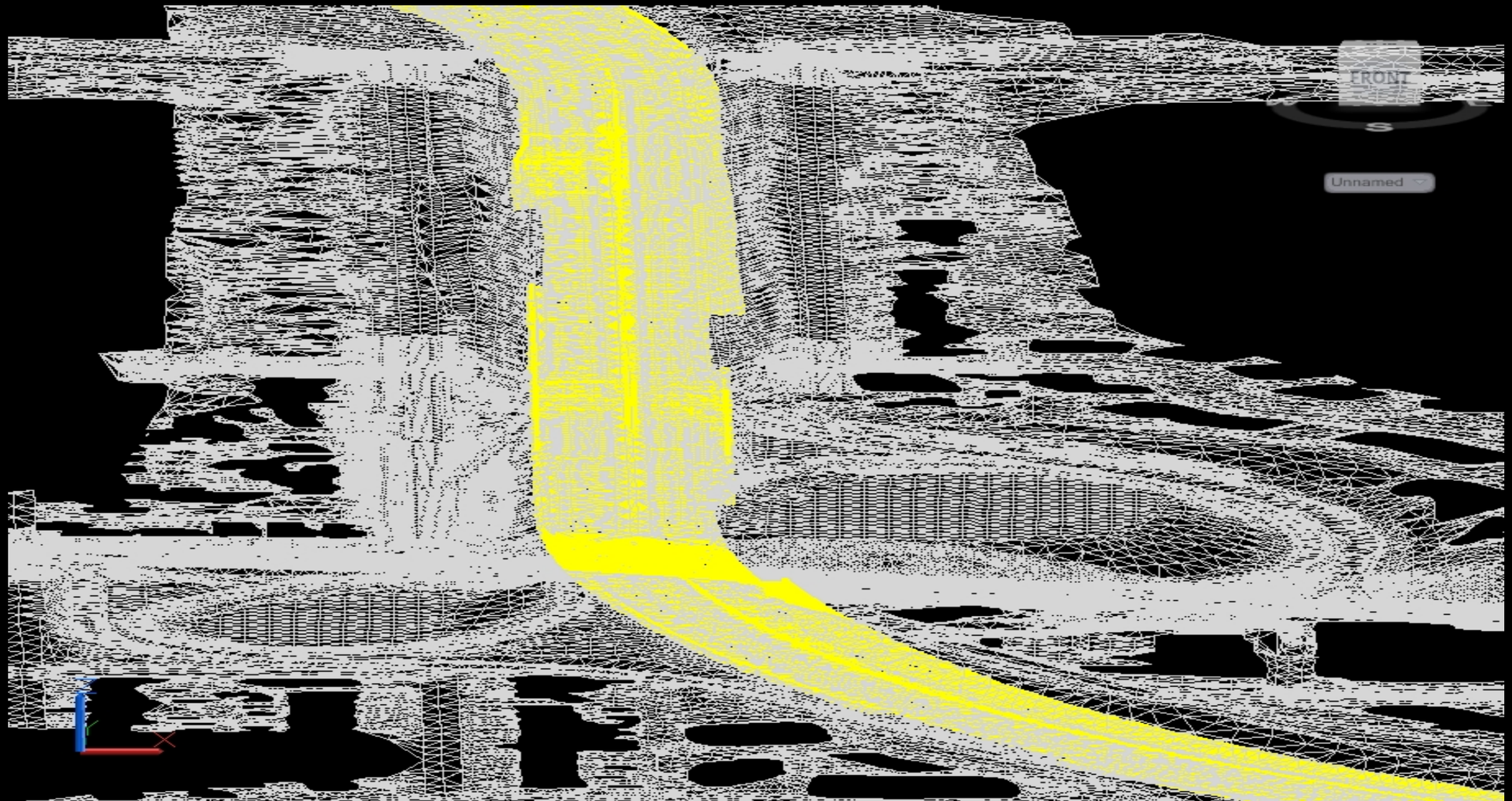
Design Applications

CIM-VDC Deployment on the Zoo IC Project



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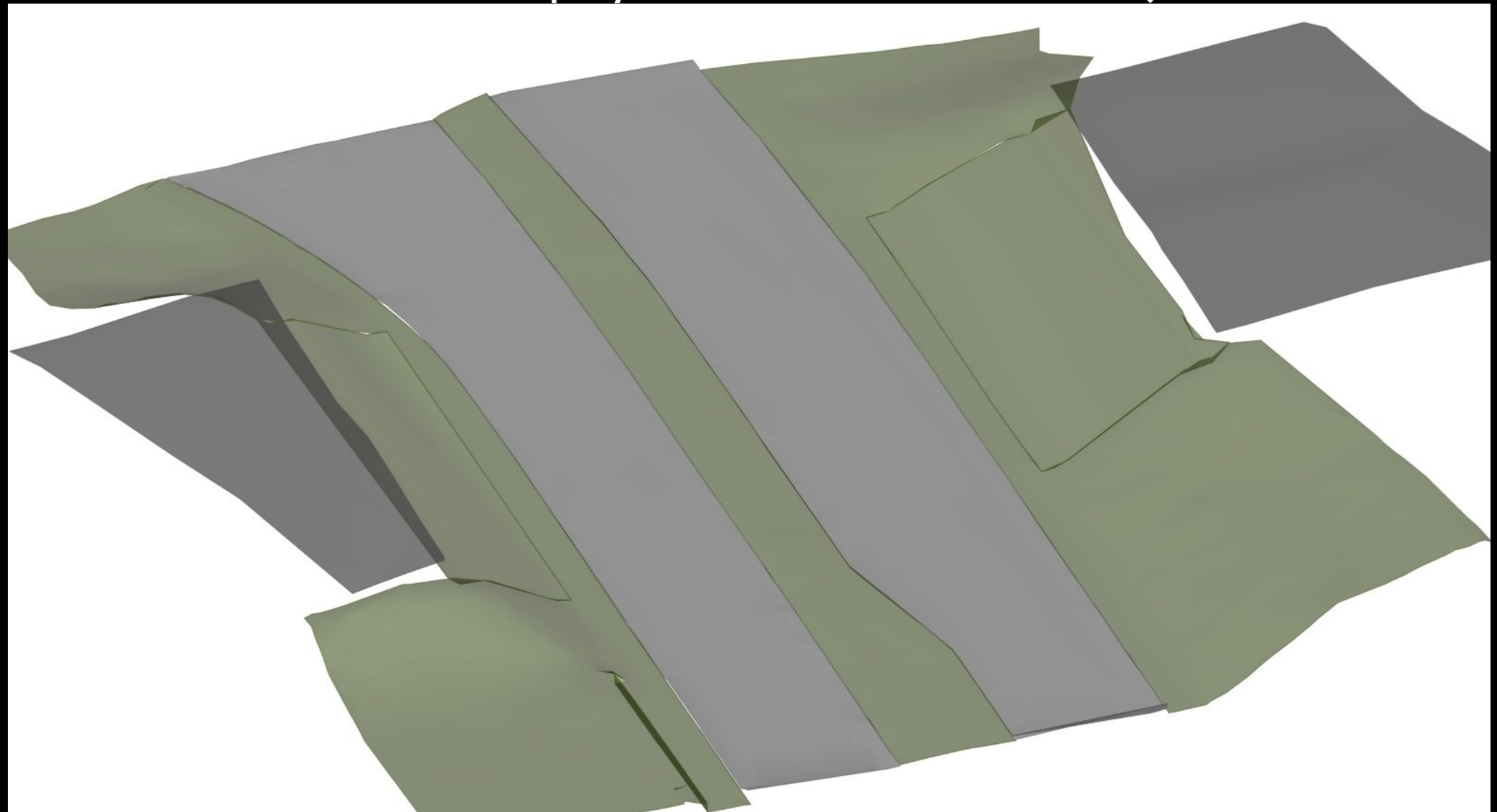

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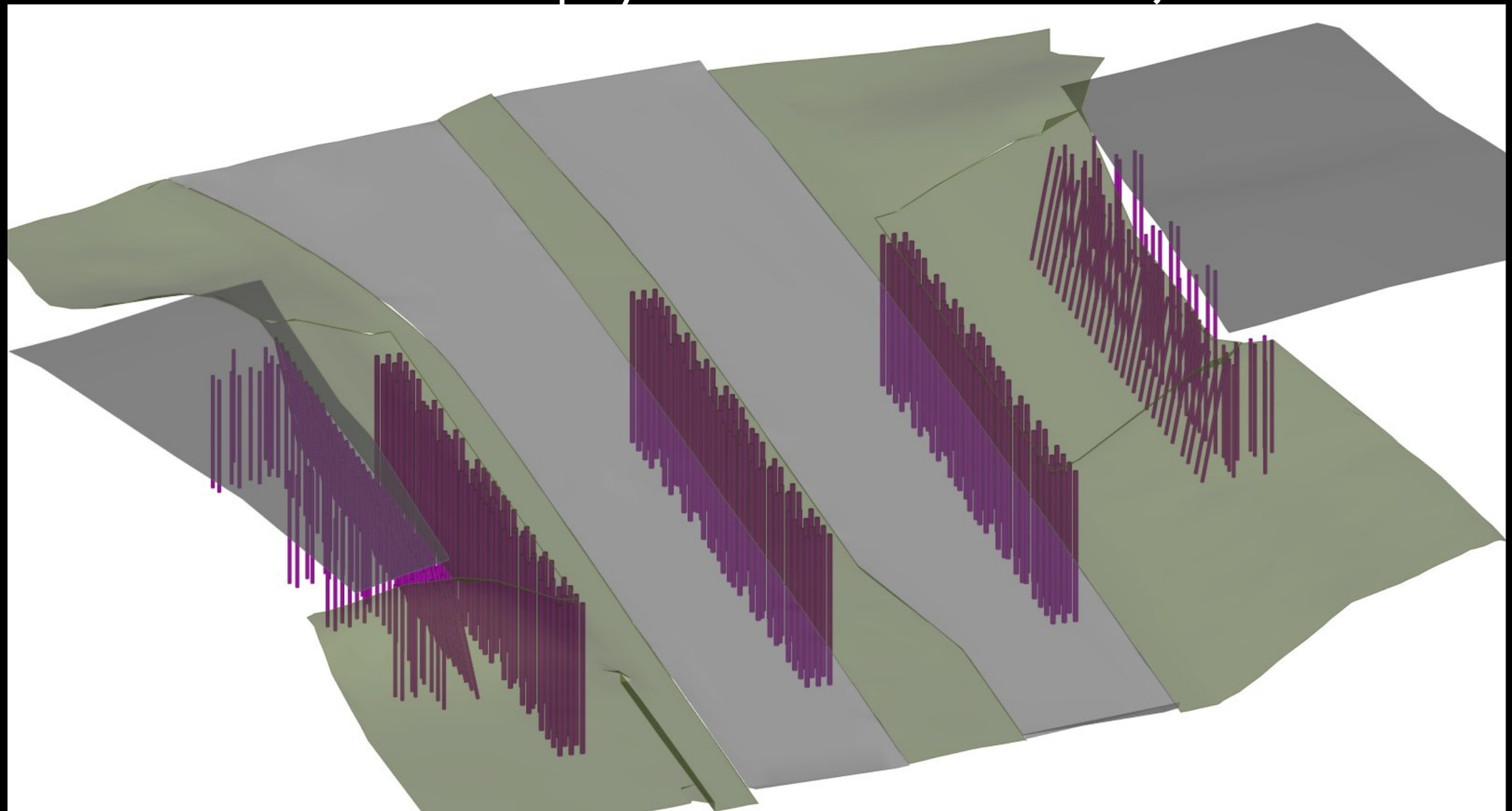

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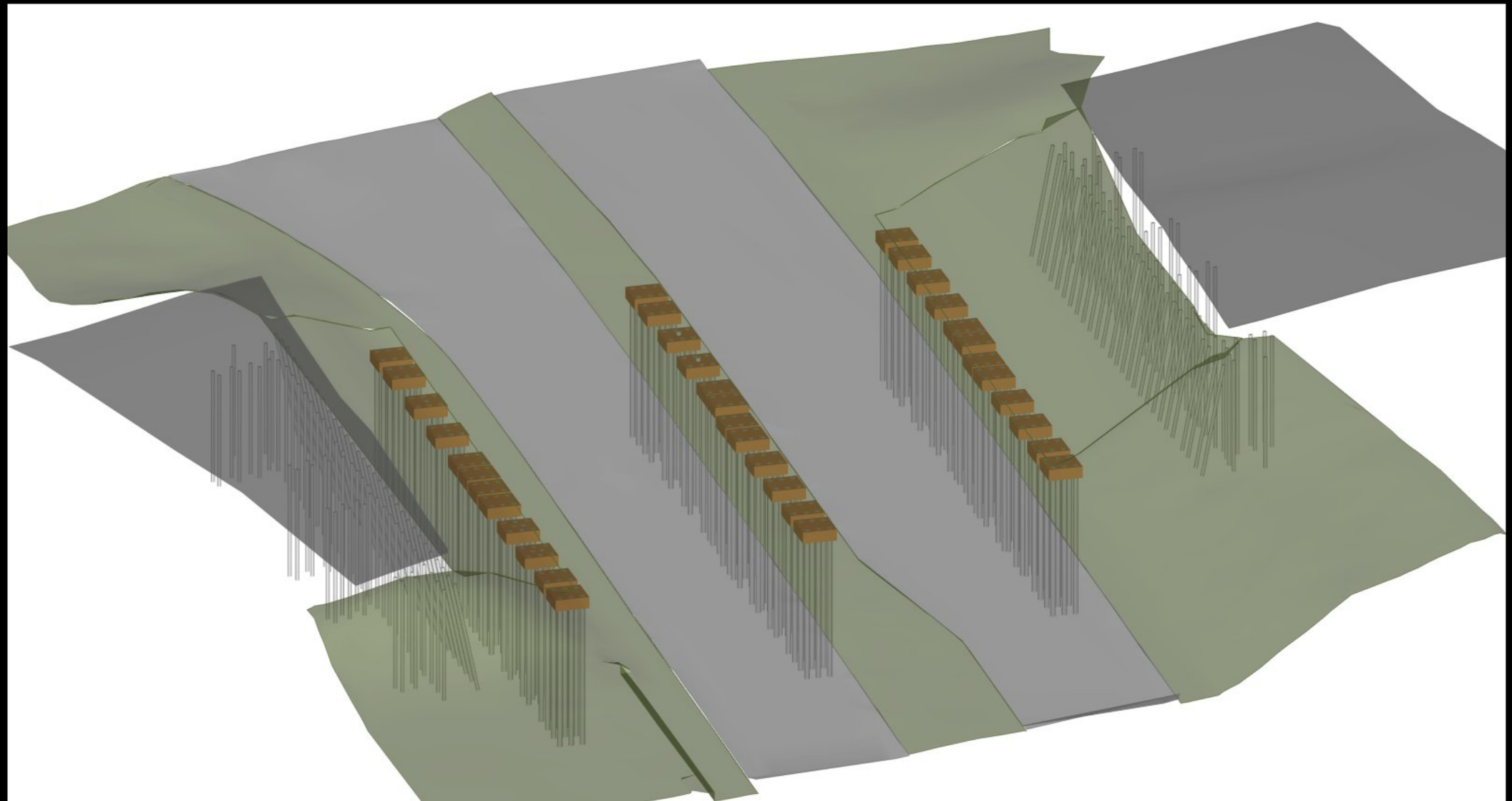

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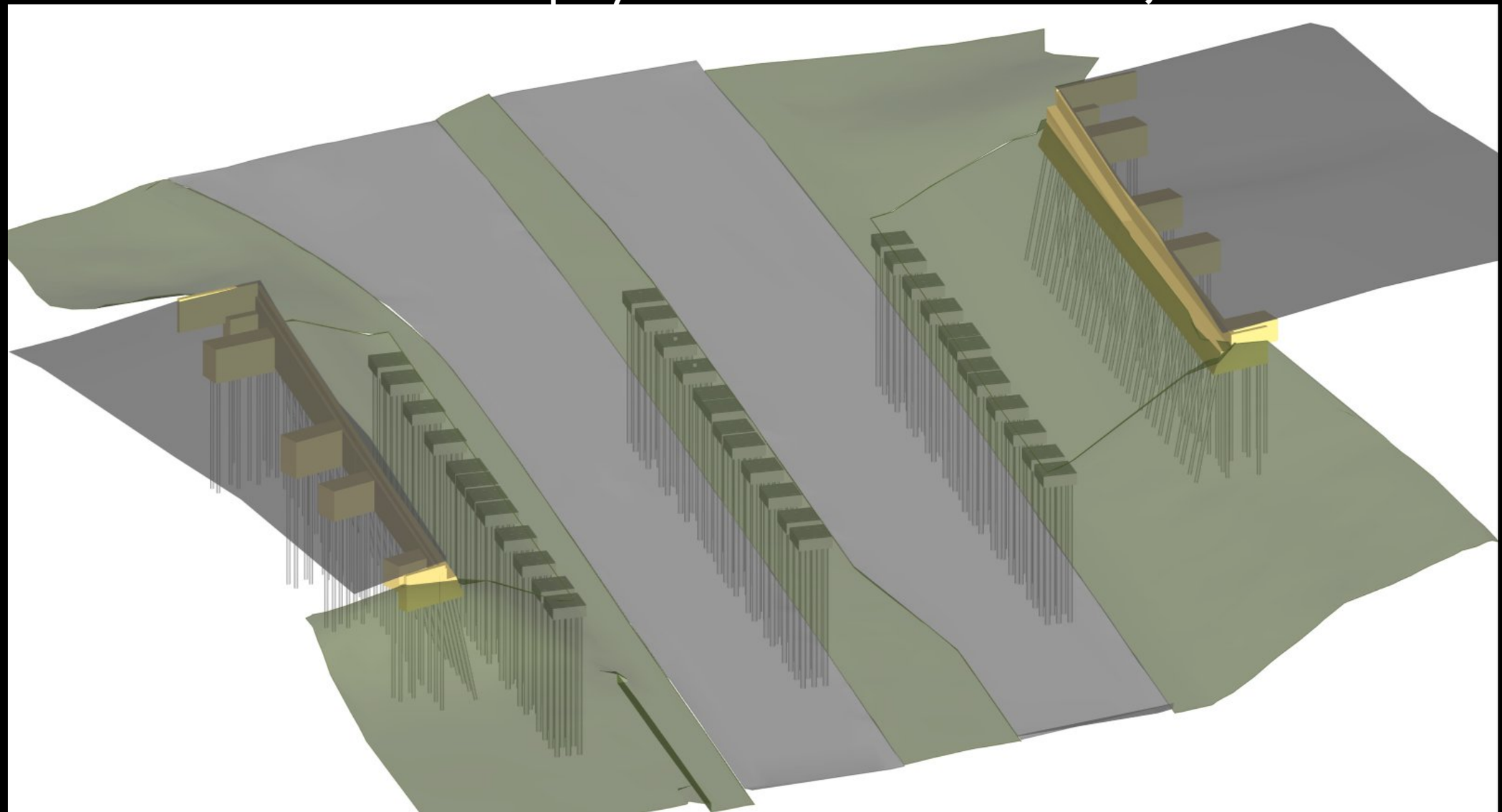

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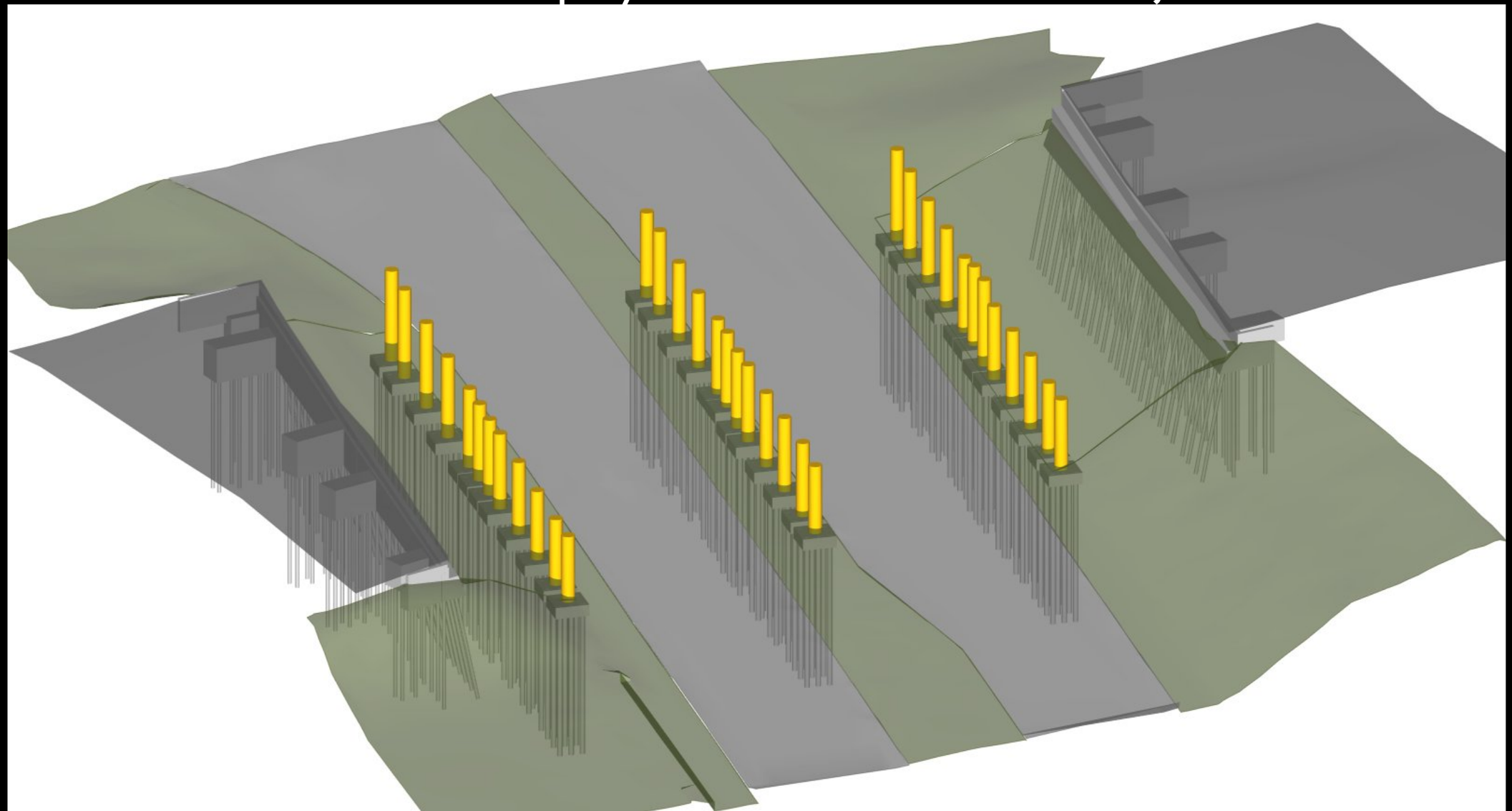

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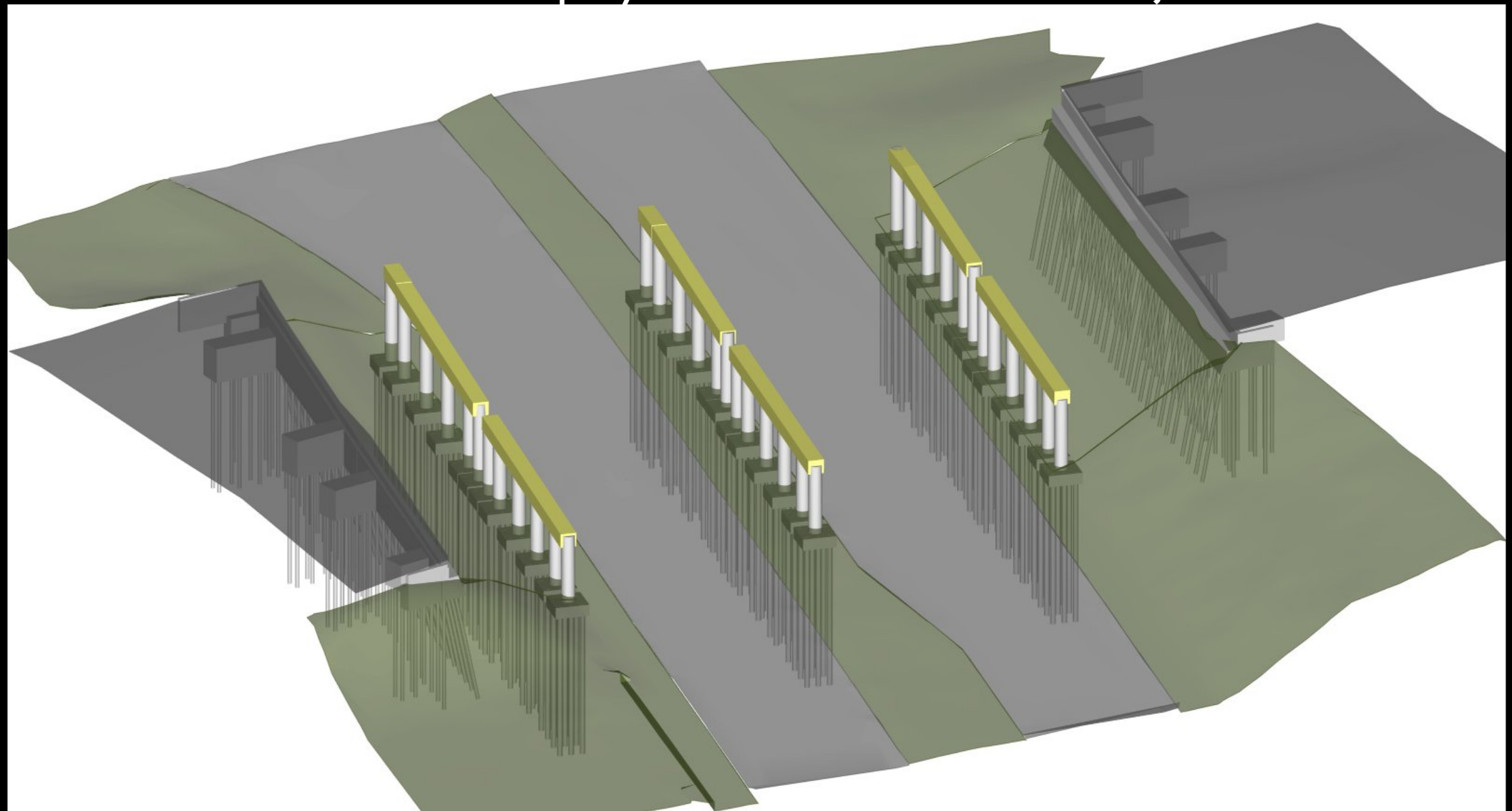

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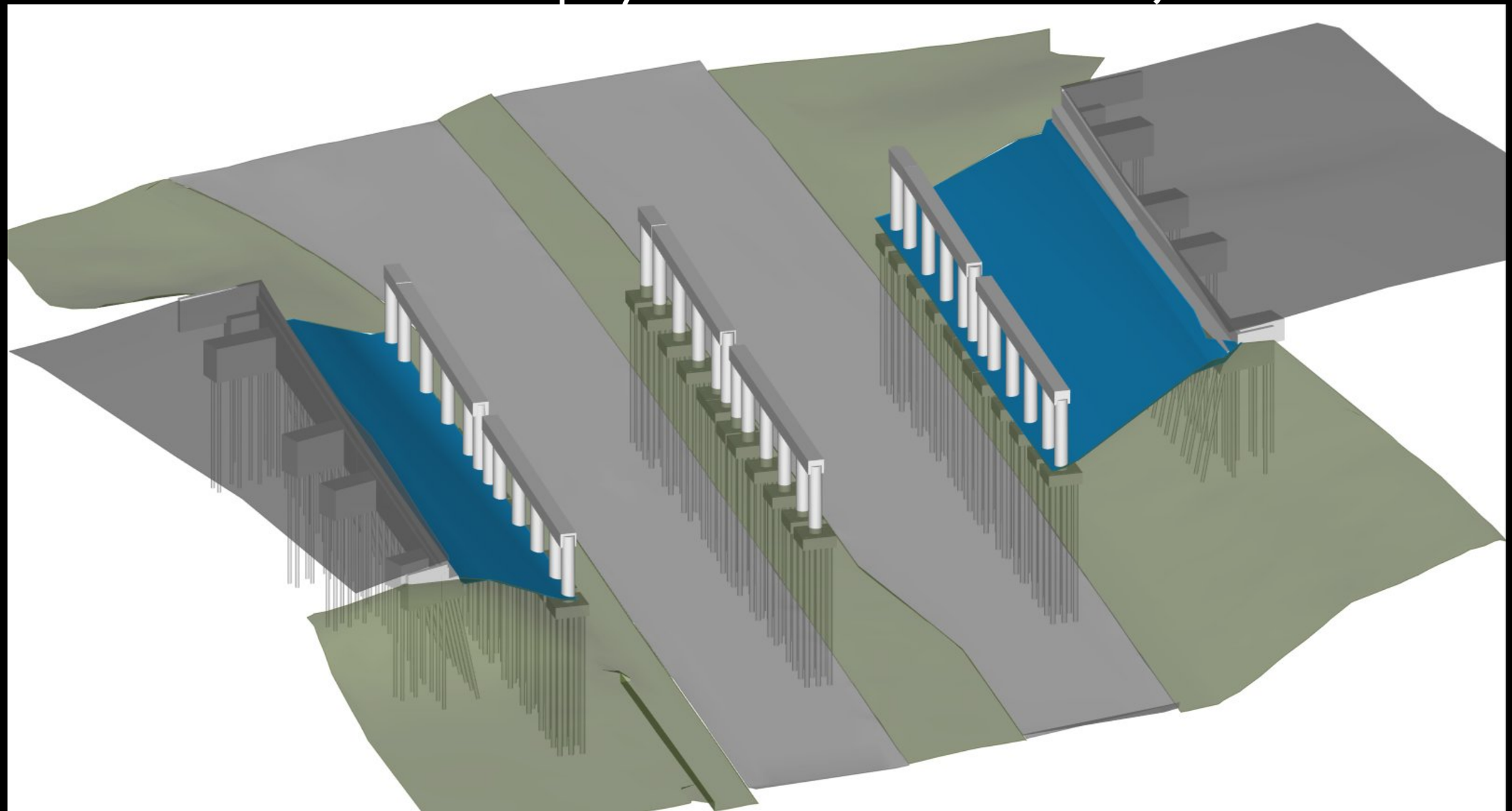

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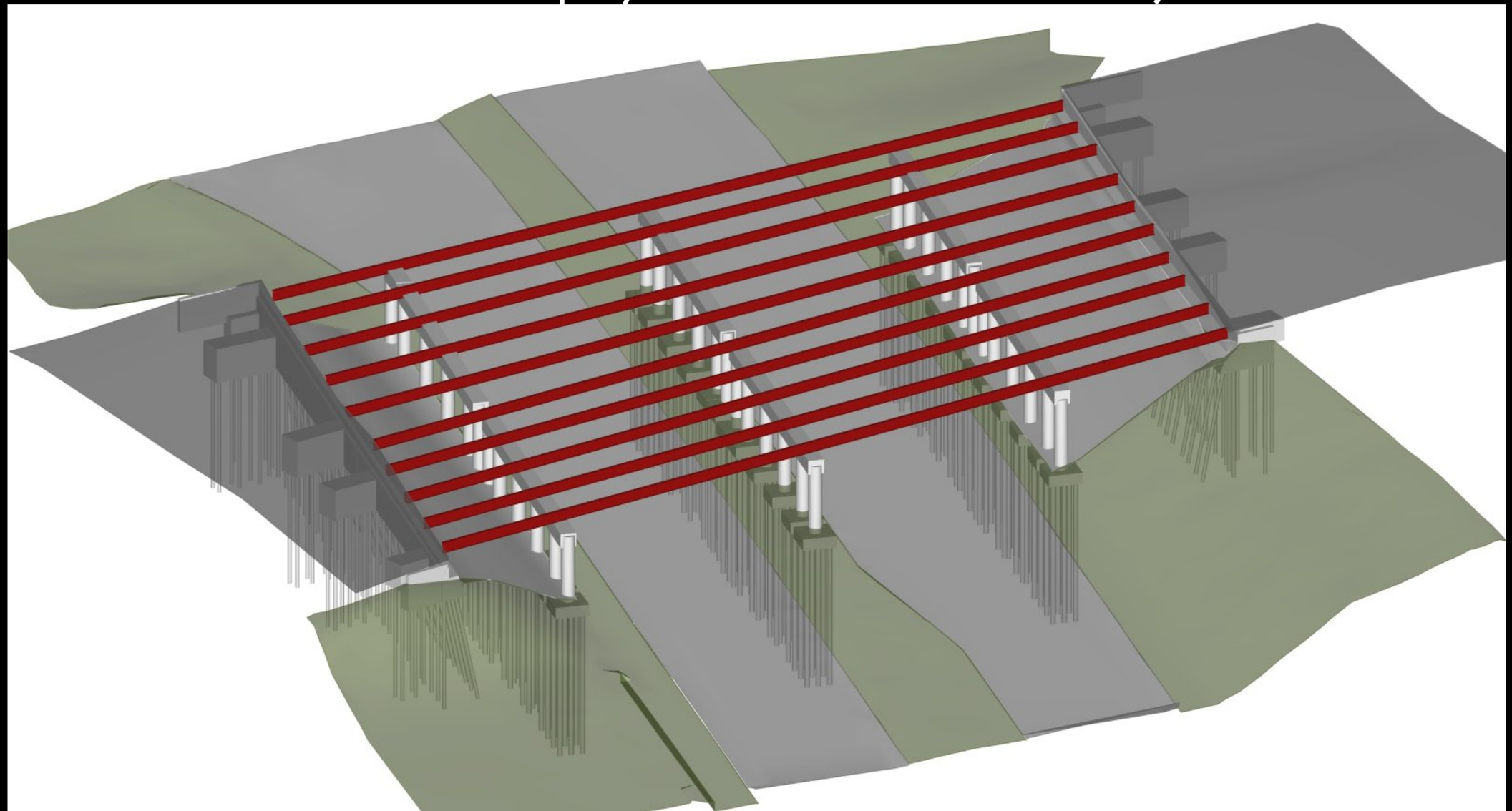

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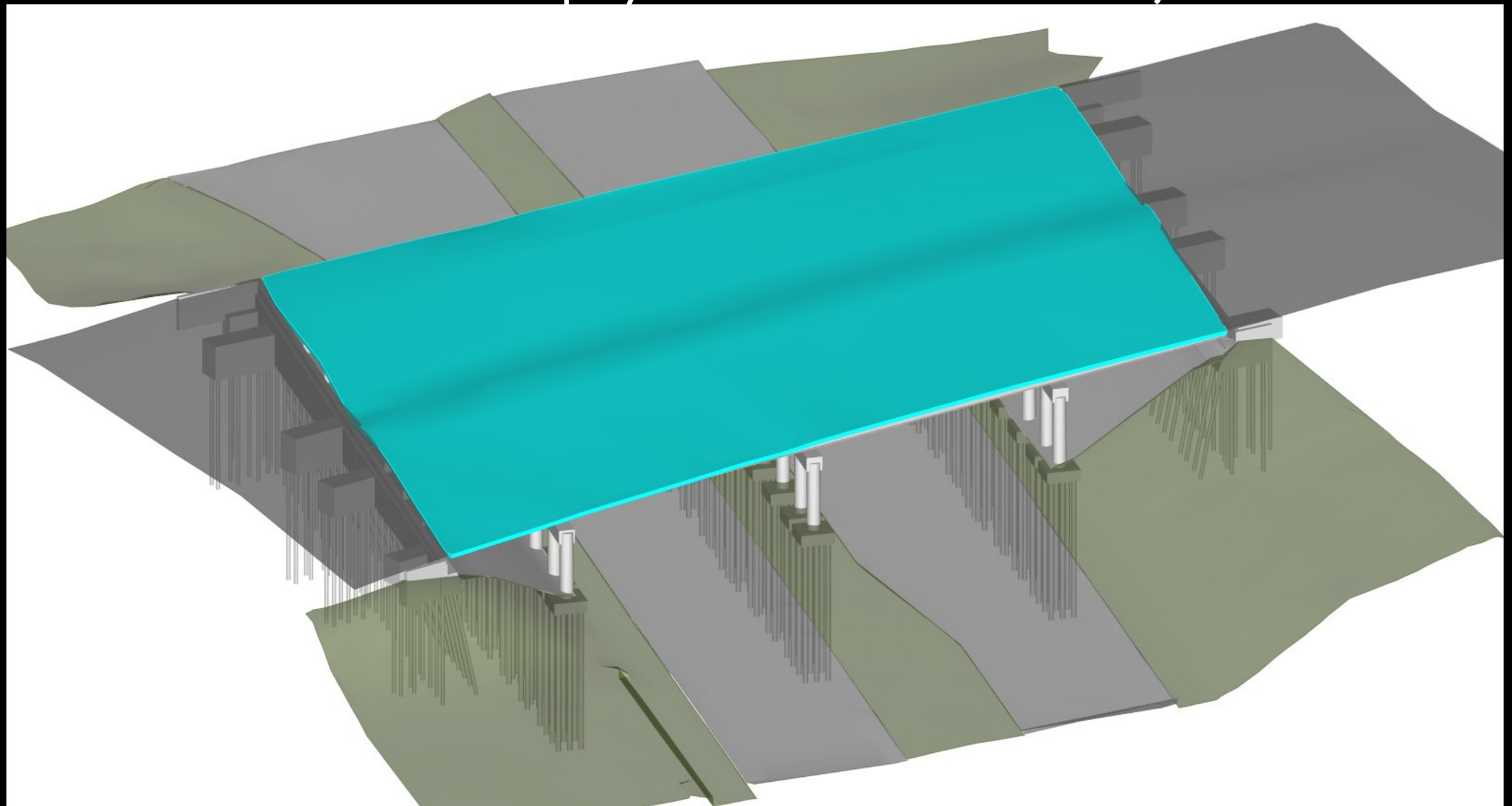

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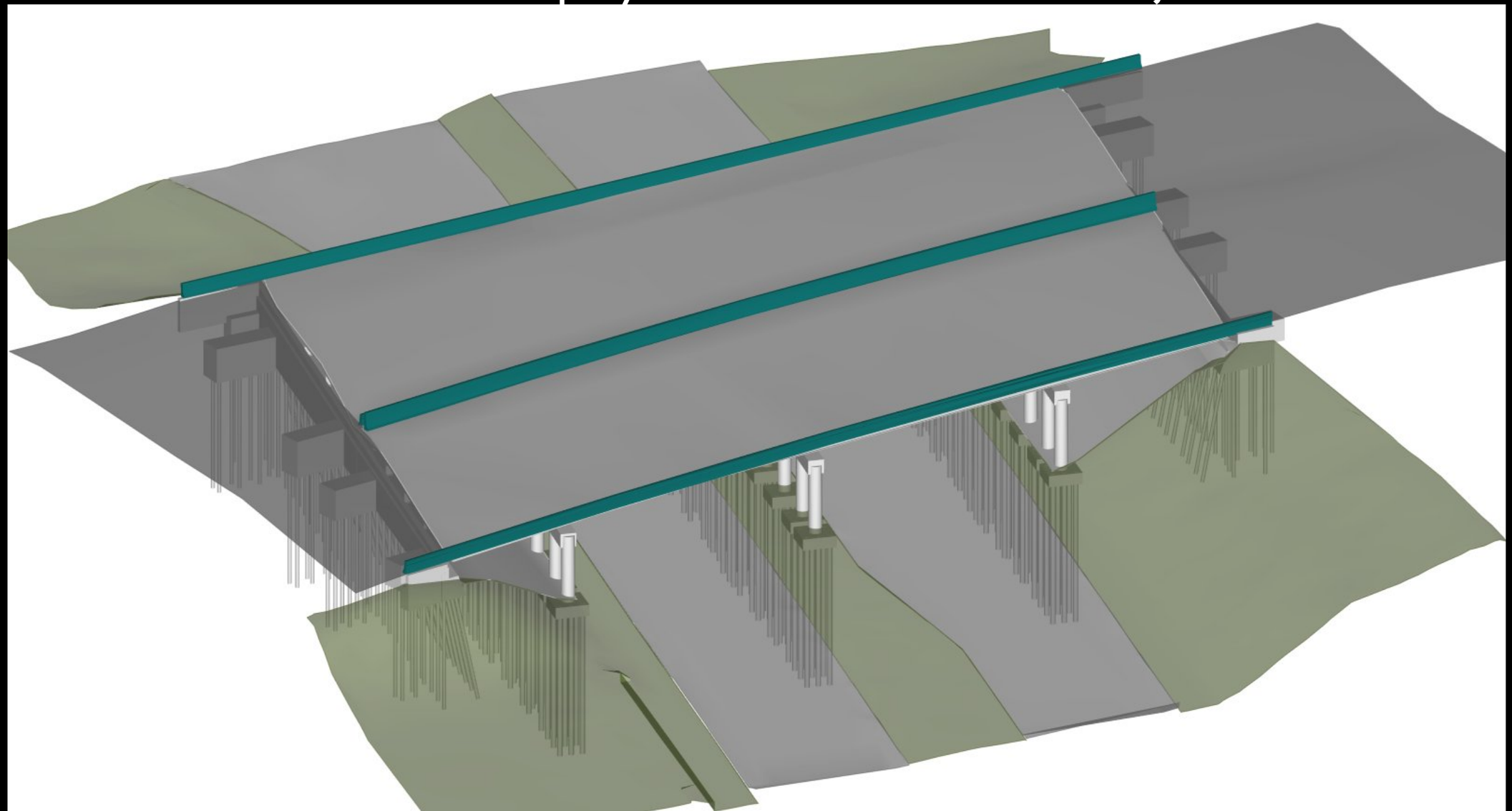

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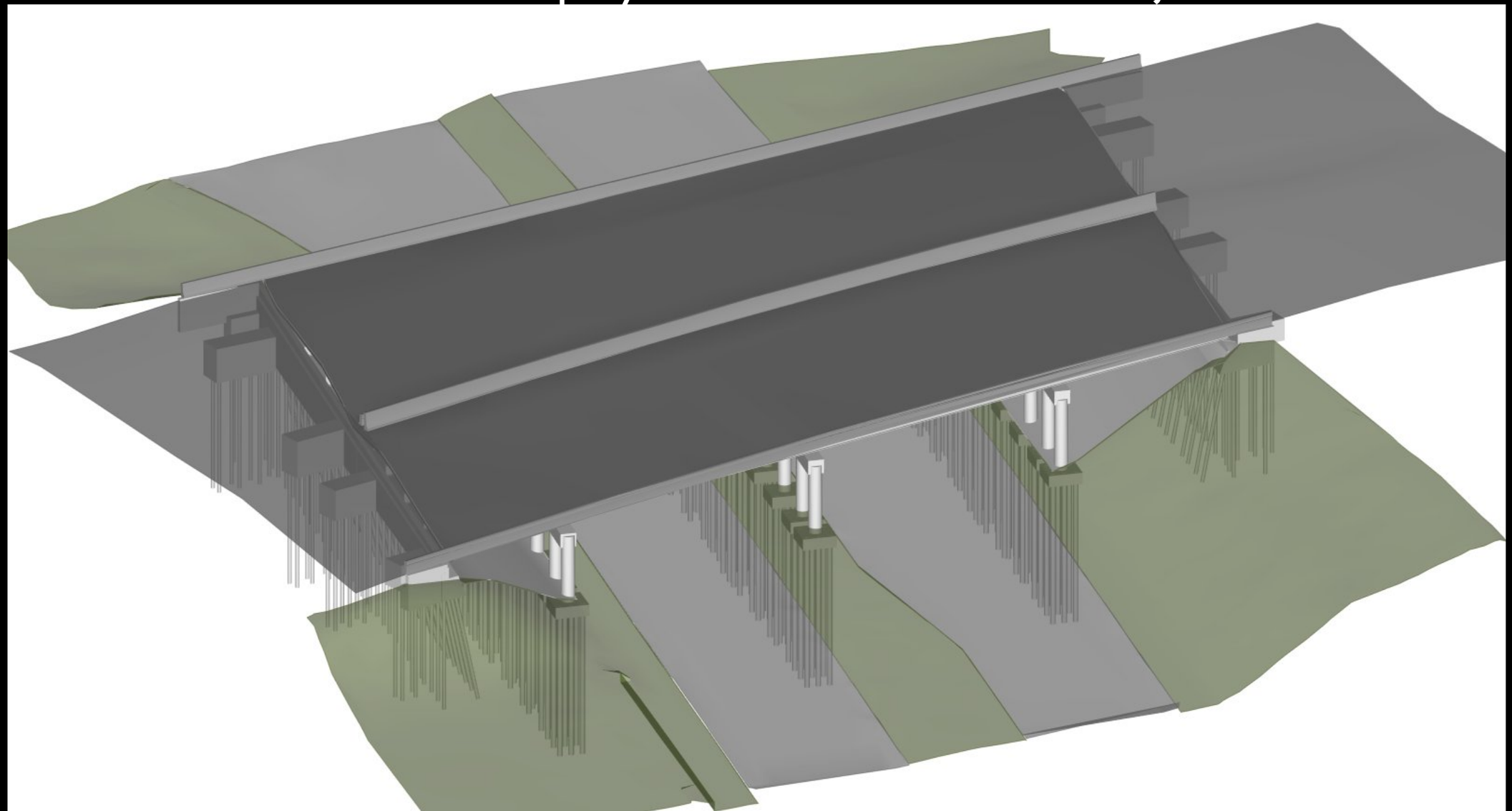

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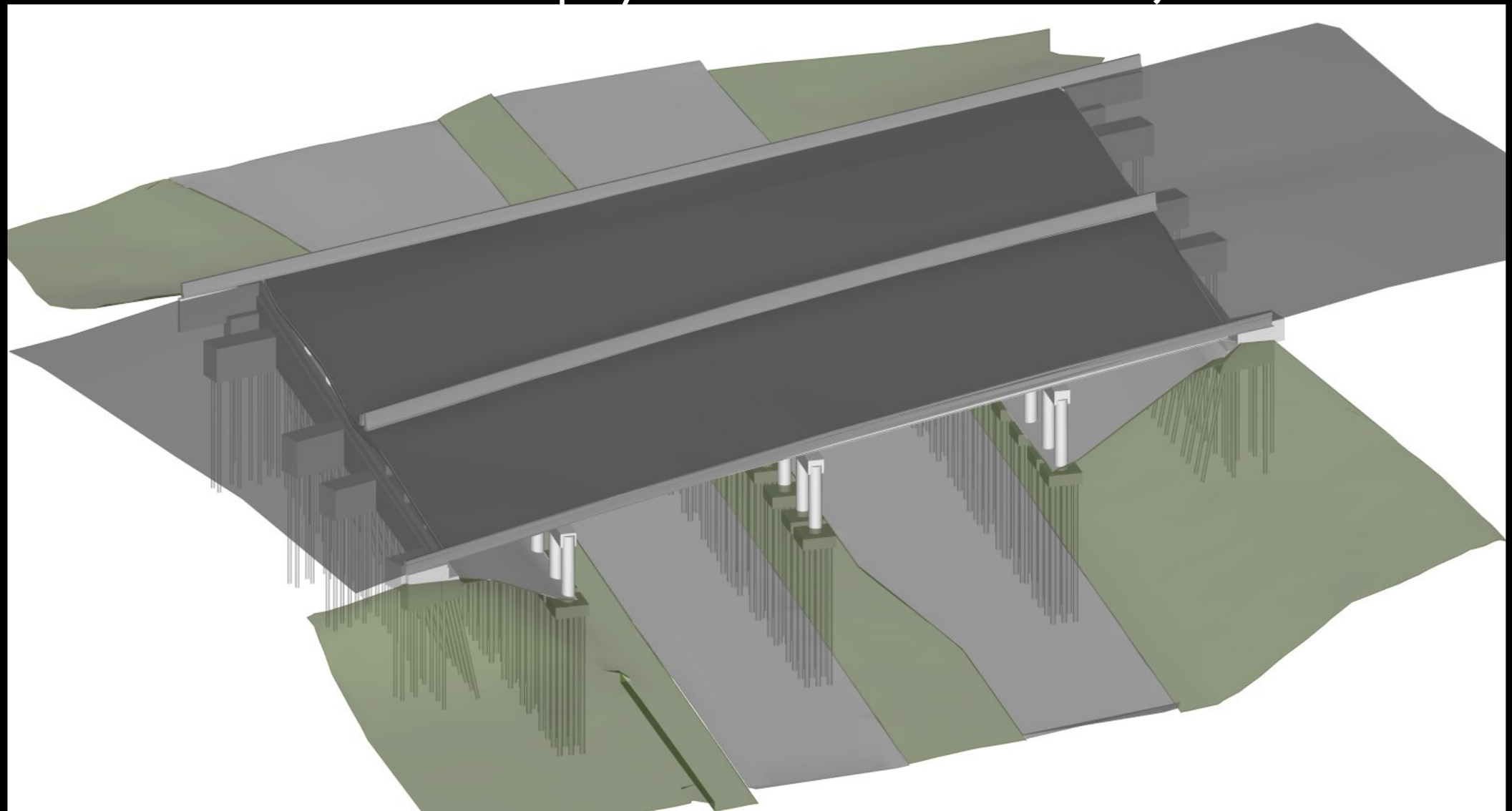

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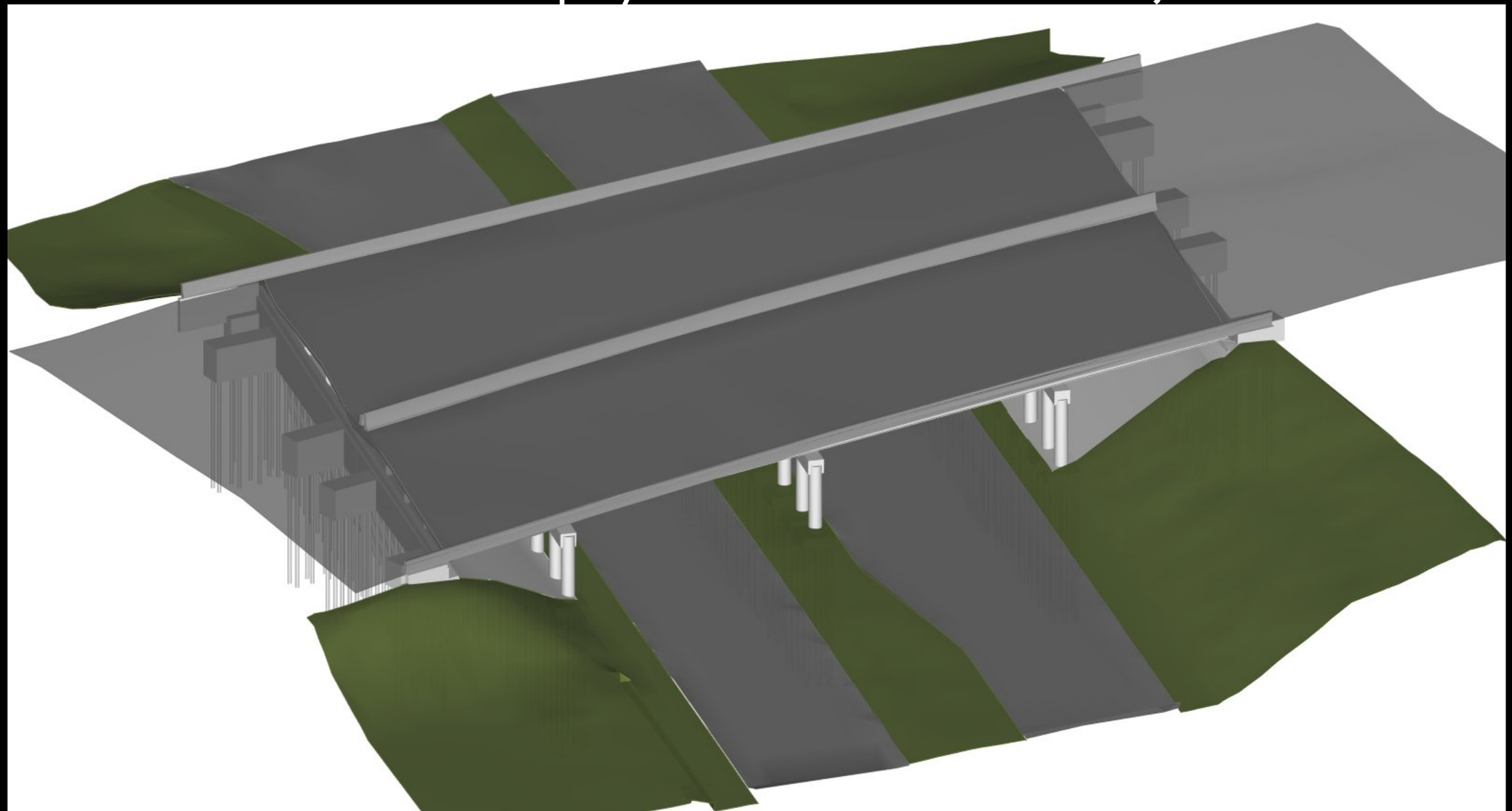

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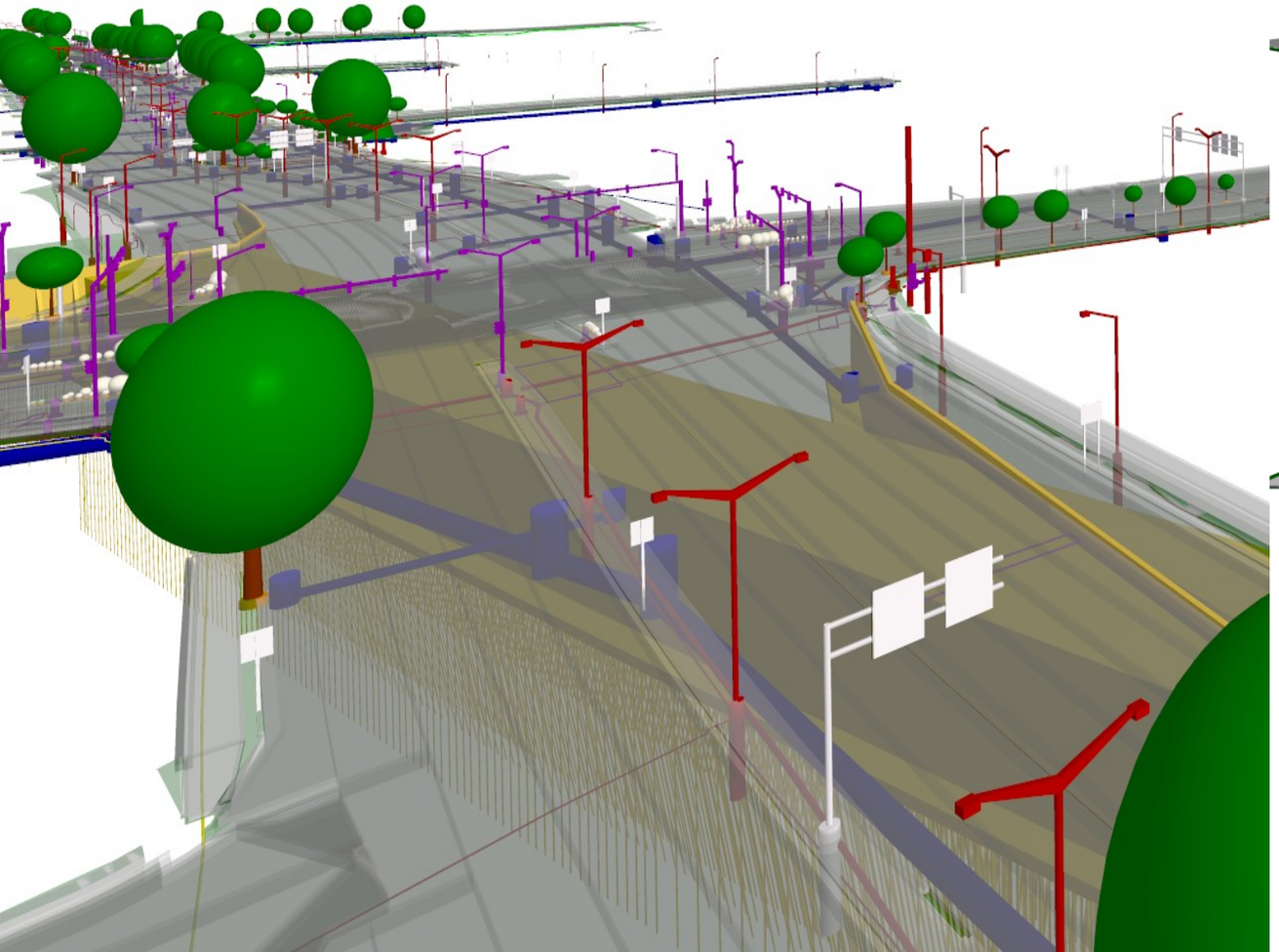

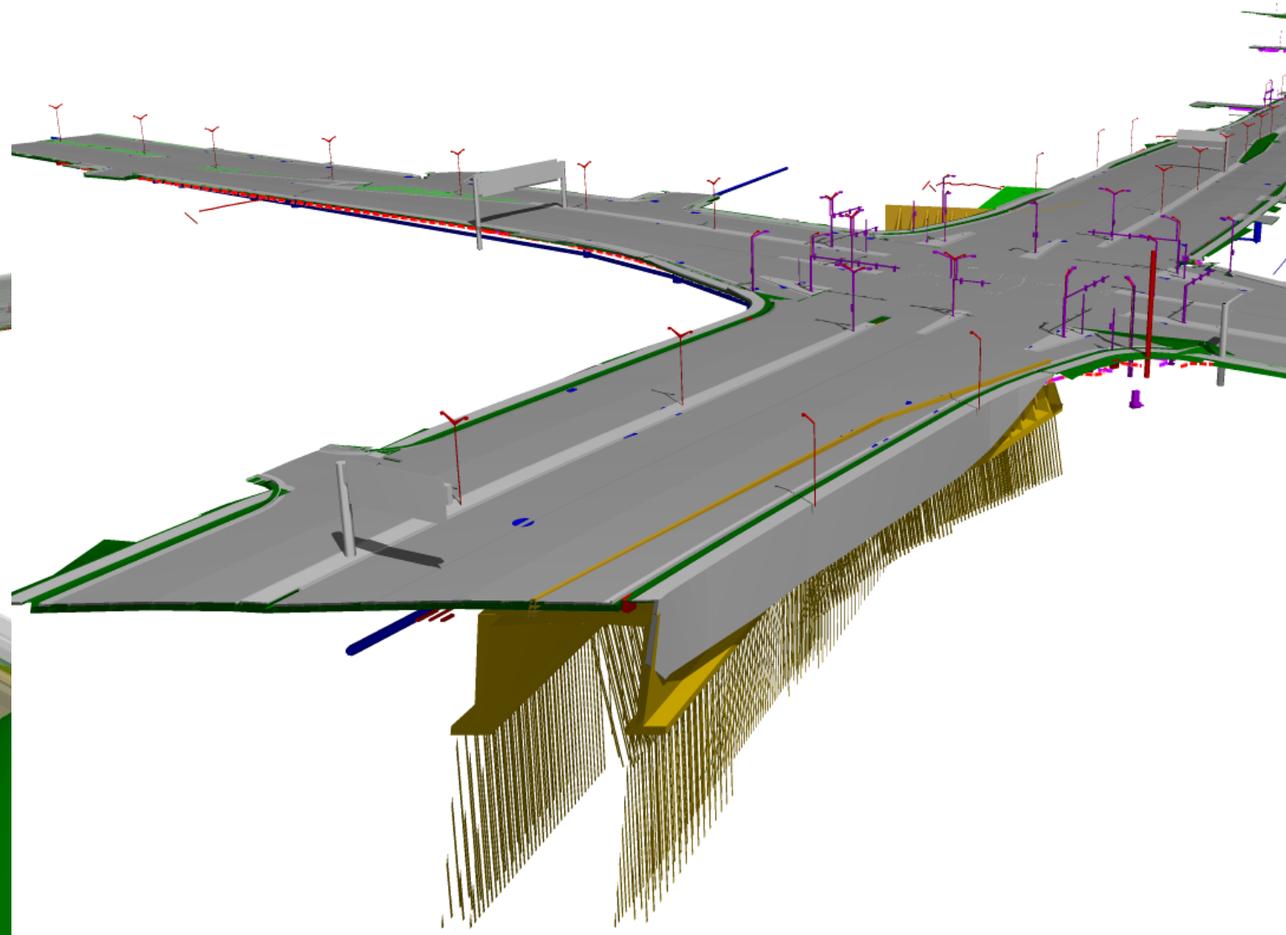

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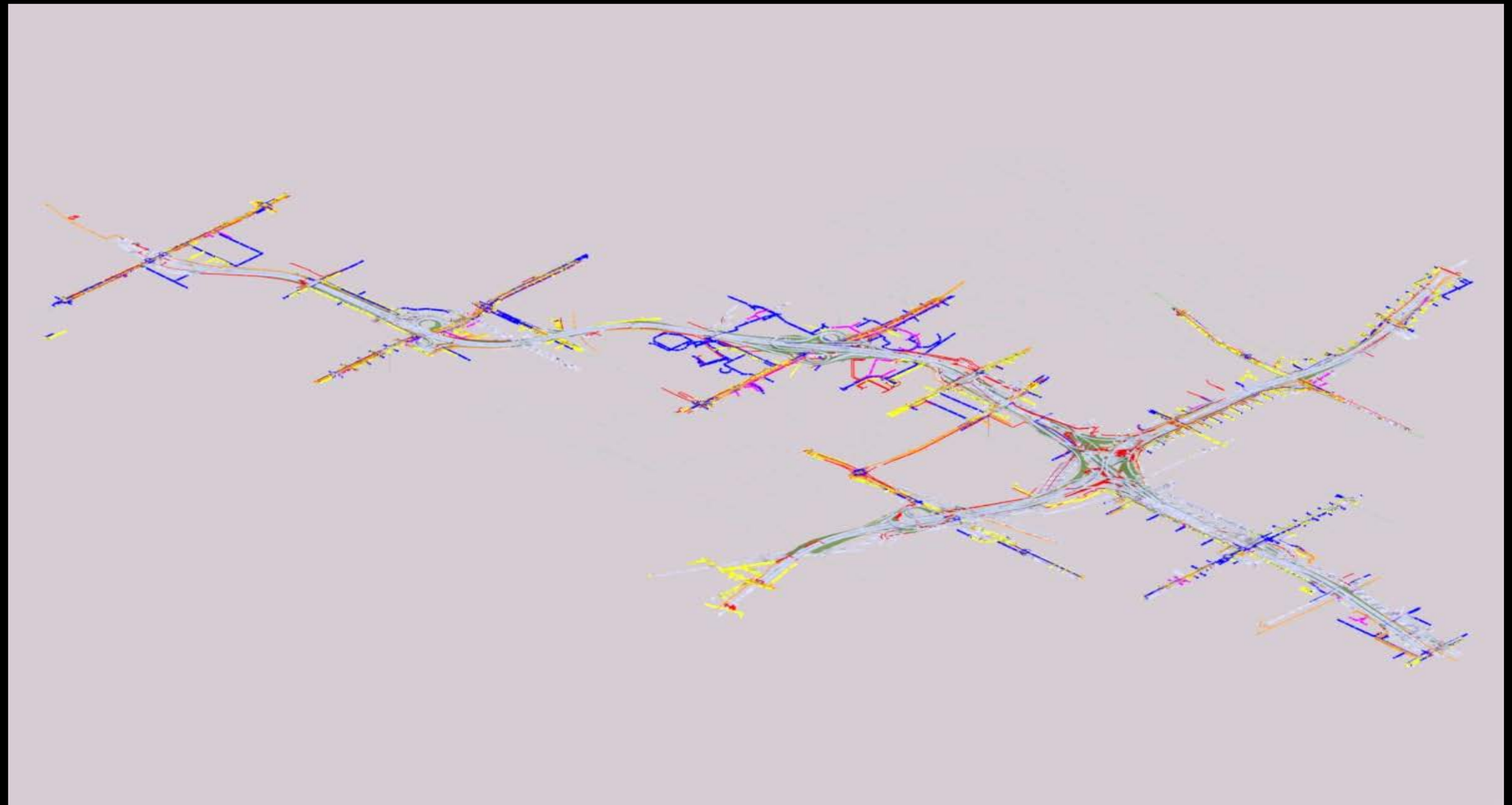

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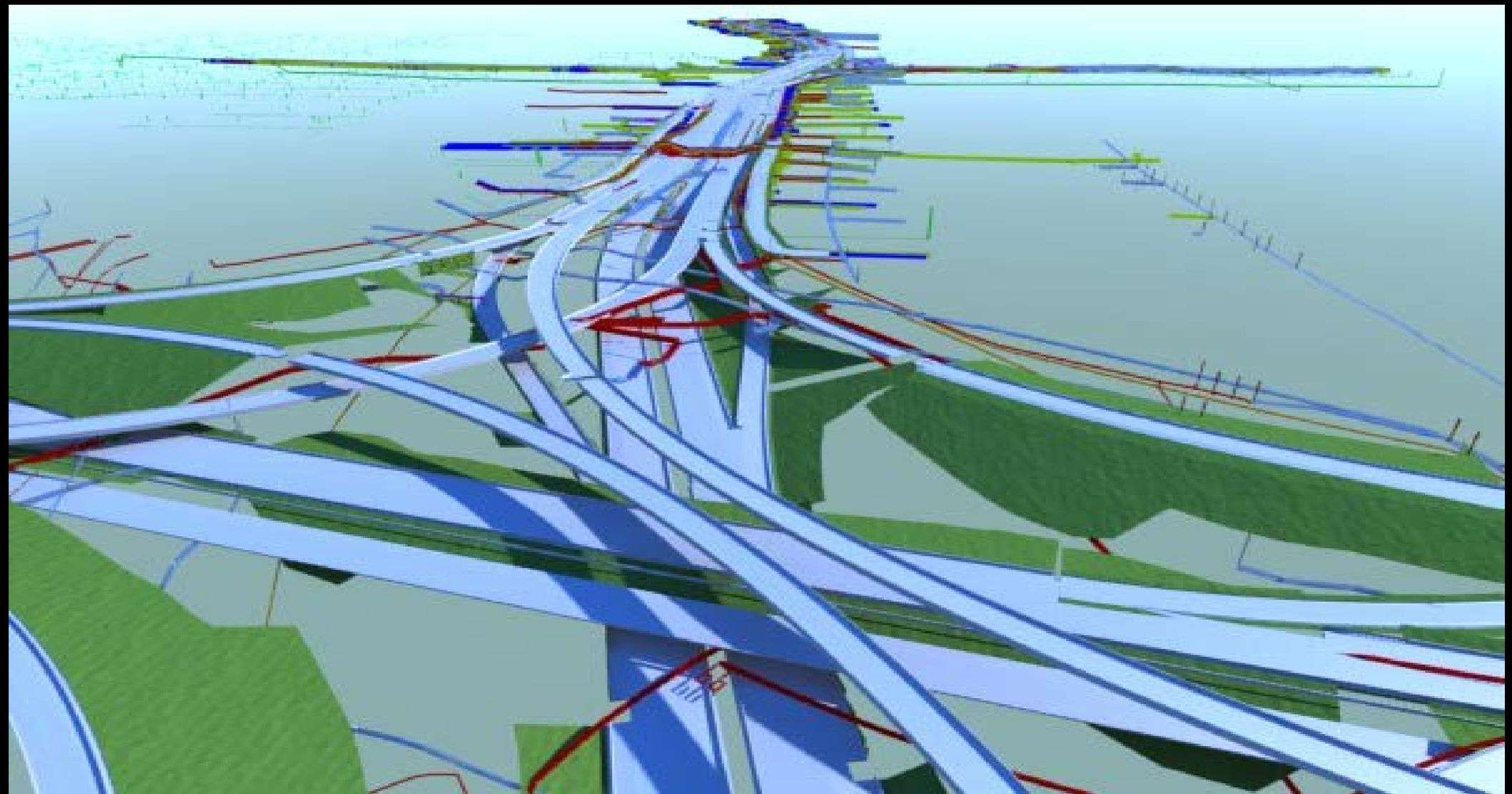

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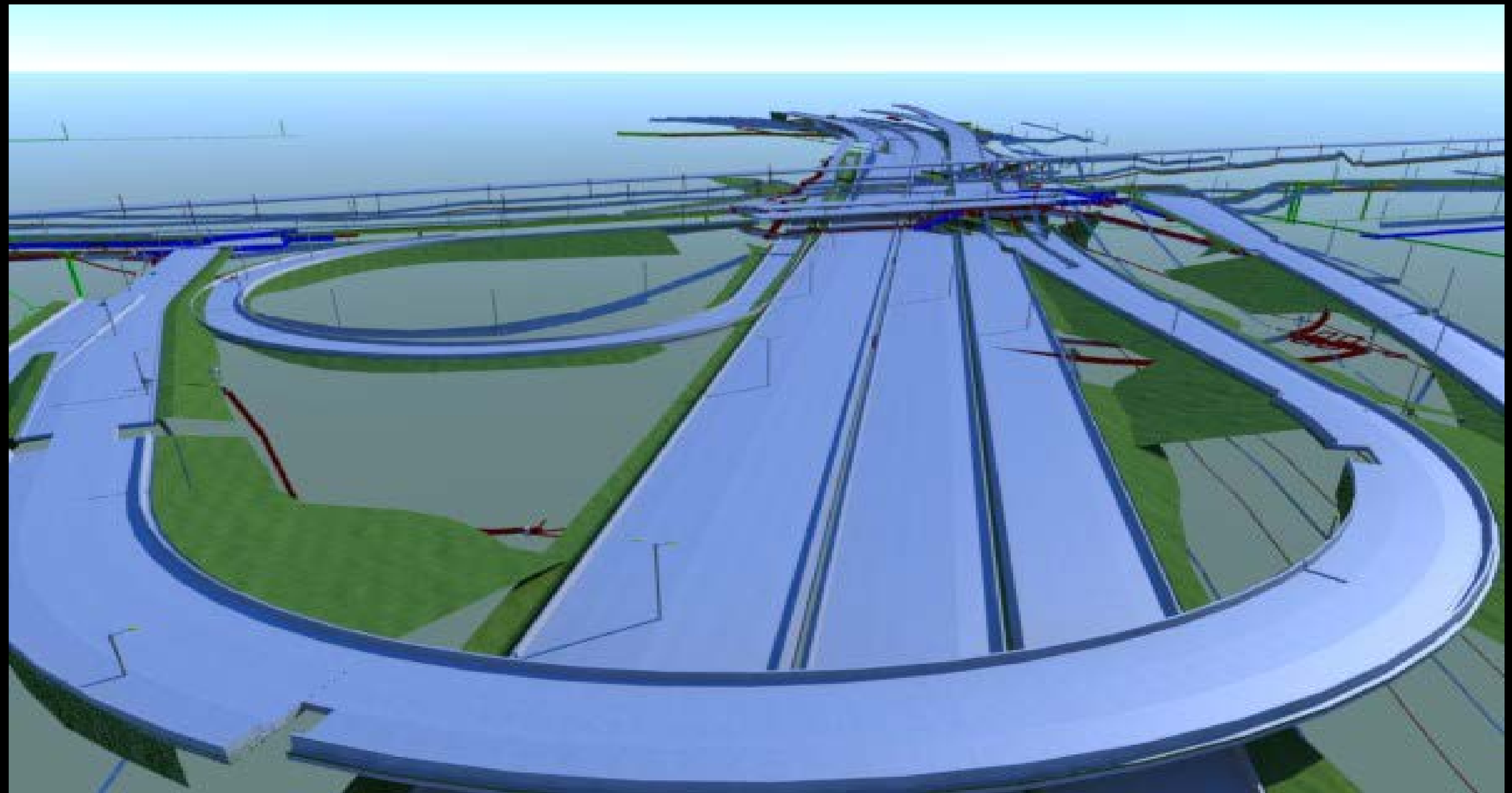

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Design Applications

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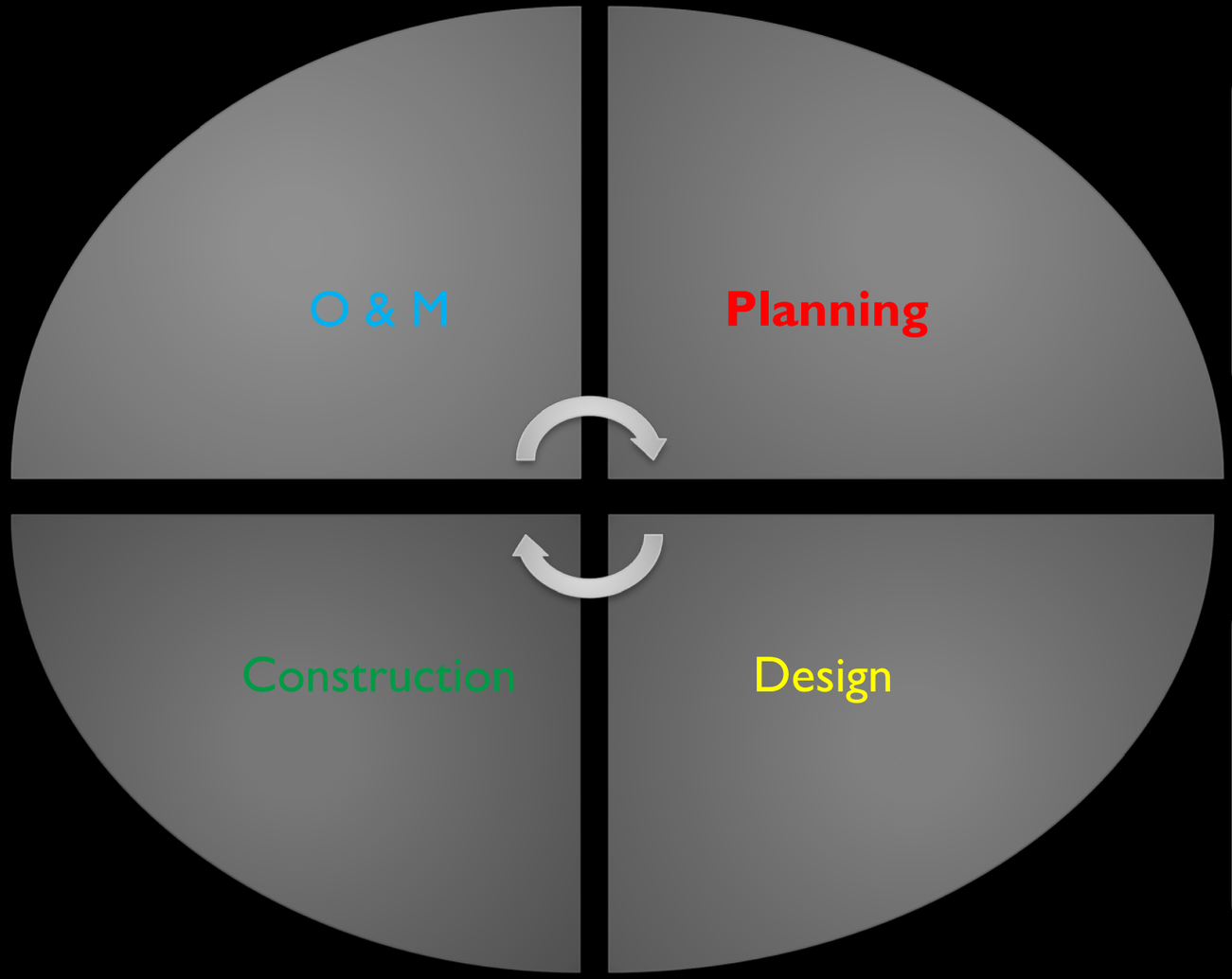
Design Applications

CIM-VDC Deployment on the Zoo IC Project

CIM-VDC

Transportation Facilities – Construction Applications



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- Utilities/Geotech/RE/Traffic
- P, S & E Final Design + Model
- Construction/Bid Docs

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Construction Applications

CIM-VDC Pilot Deployment on the Mitchell IC Project

How is a **4,572** P, S & E construction bid document converted and transformed it into a 3D Model?…

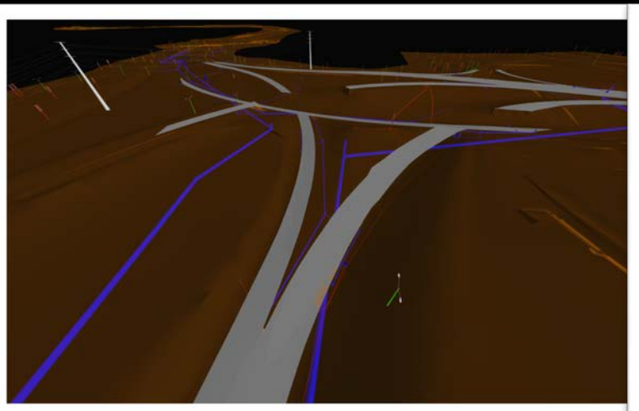
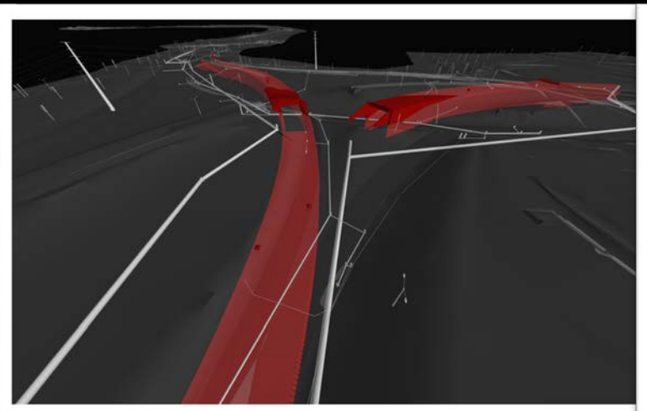
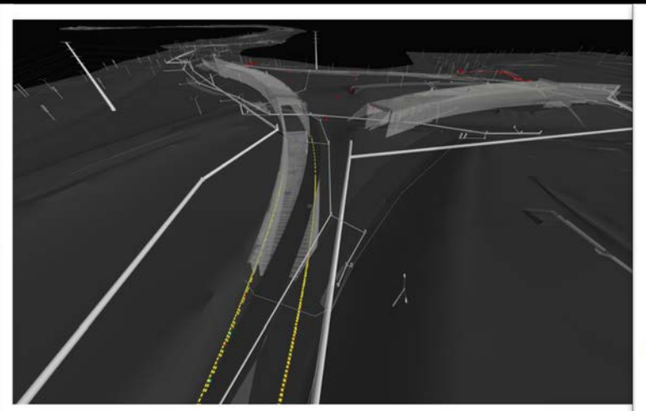
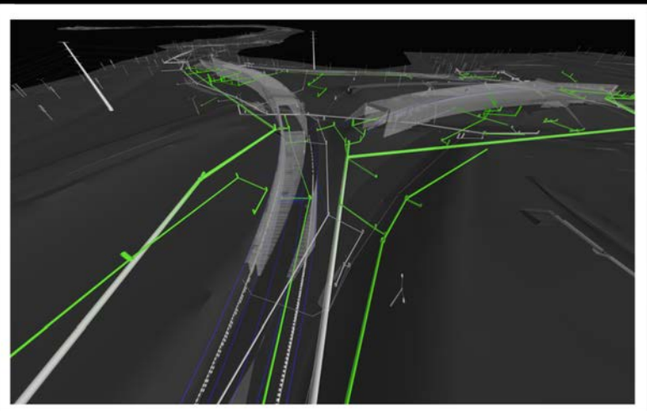
…and **2,677** schedule tasks added?

CIM-VDC

Construction Applications

CIM-VDC Pilot Deployment on the Mitchell IC Project

- 3D Modeling was deployed "brute force" after design was completed
- P, S & E construction documents - 4,572 plan sheets
- 4D Schedule involved design sequencing of construction phases
- 2,677 tasks in CPM Schedule

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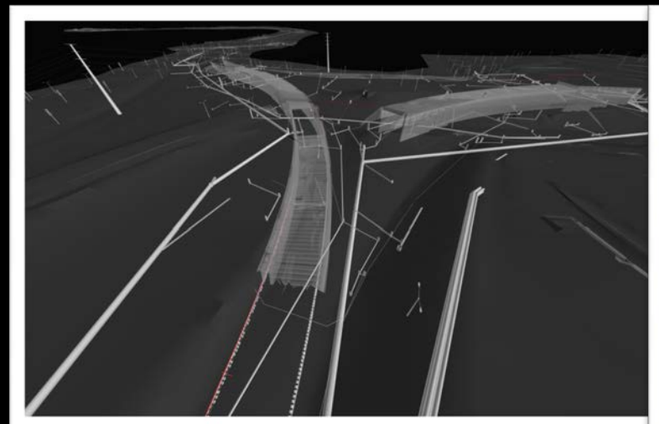
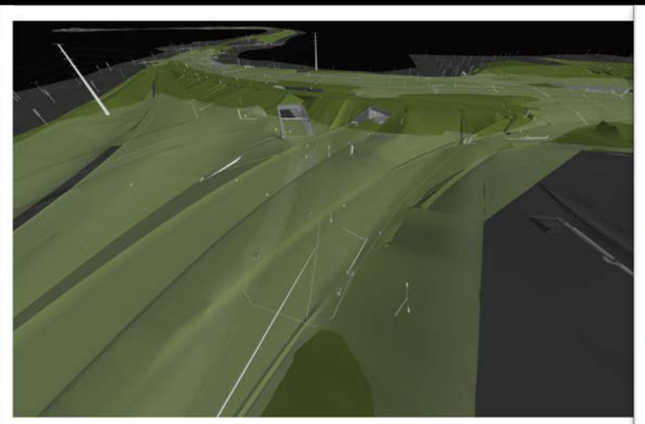
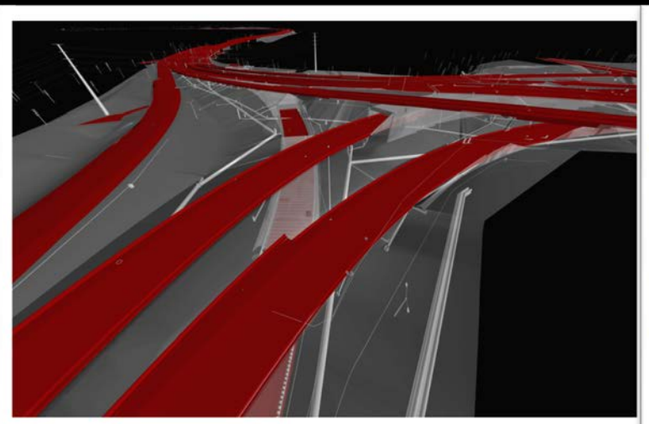
Construction Applications

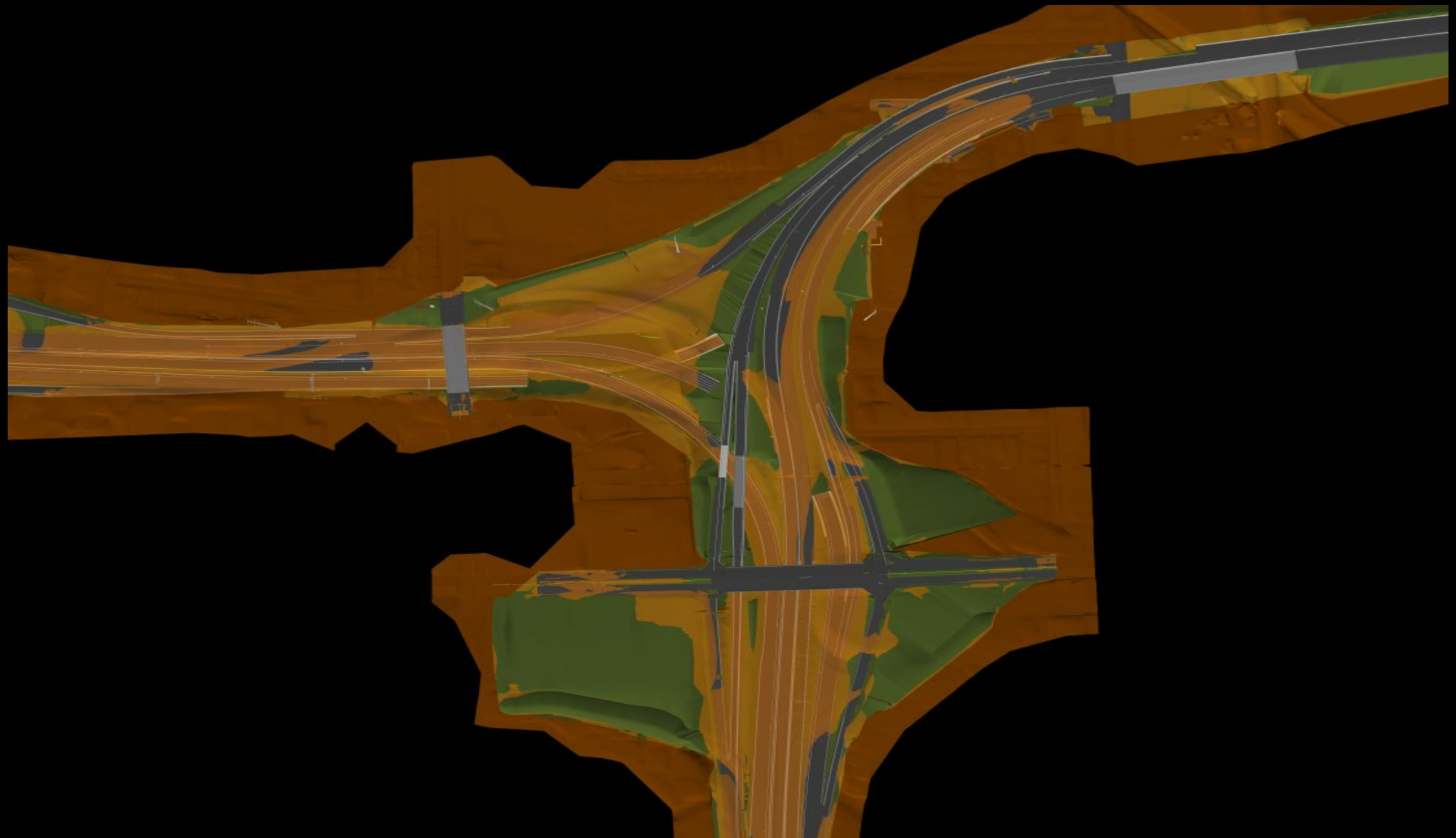
CIM-VDC Pilot Deployment on the Mitchell IC Project

- Tunnel Structures (3) modeled in Revit
- Utilities modeled in C3D
- 3D model compiled in Navisworks
- Clash detection generated in Navisworks
- Visualization of 3D model in Navisworks
- 4D design constructability schedule simulated in Navisworks

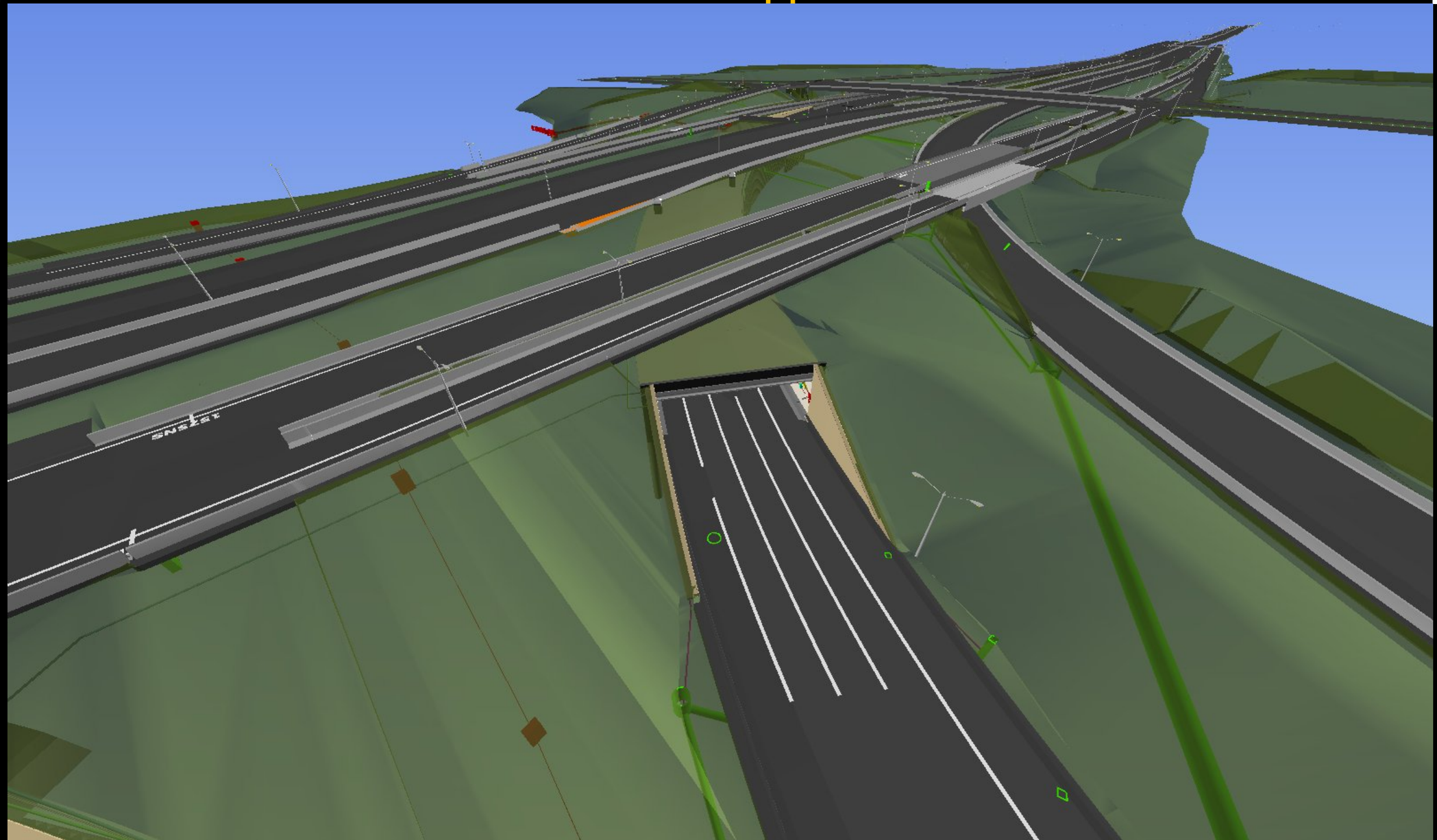

CIM-VDC

Construction Applications



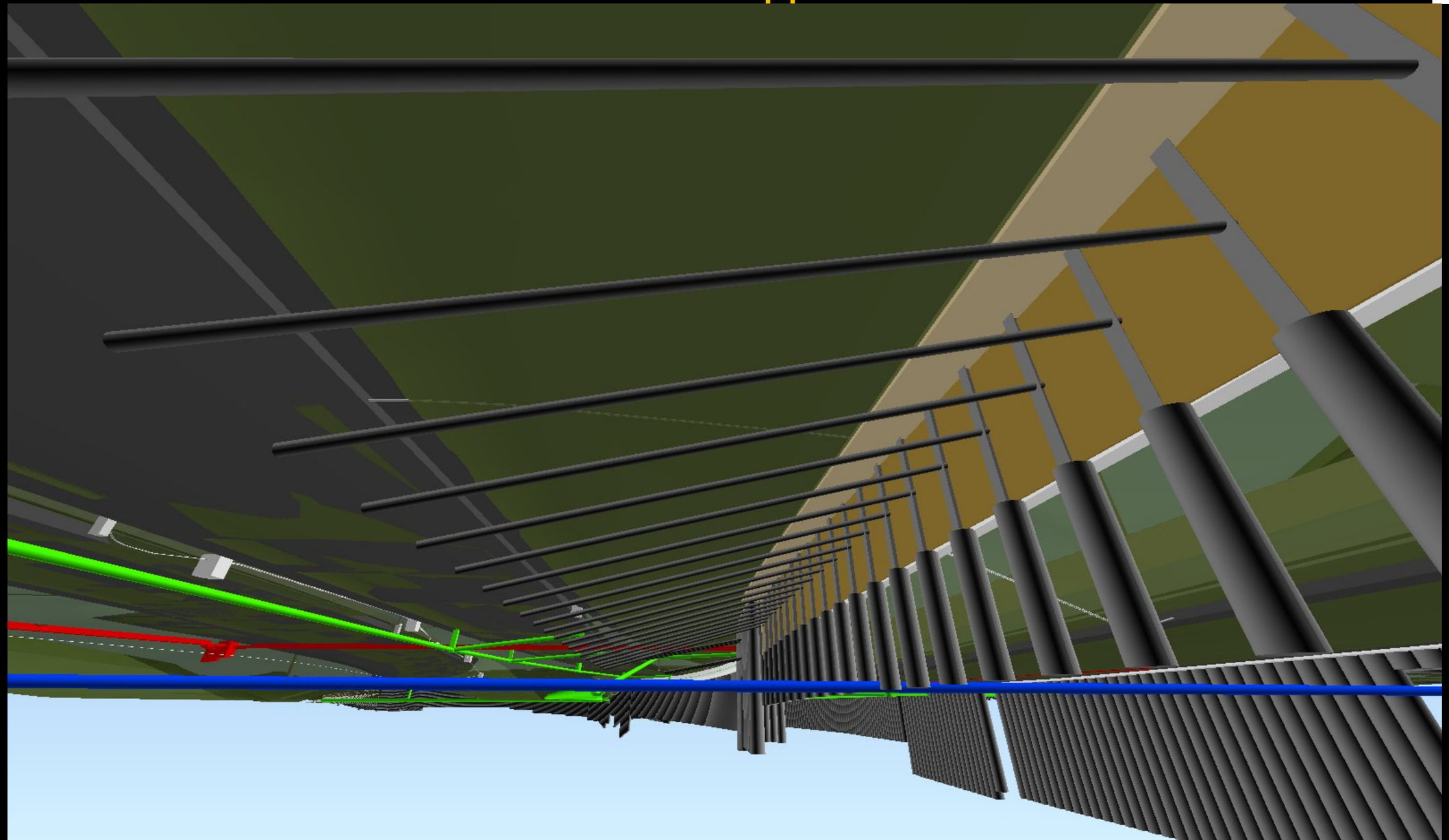
CIM-VDC

Construction Applications



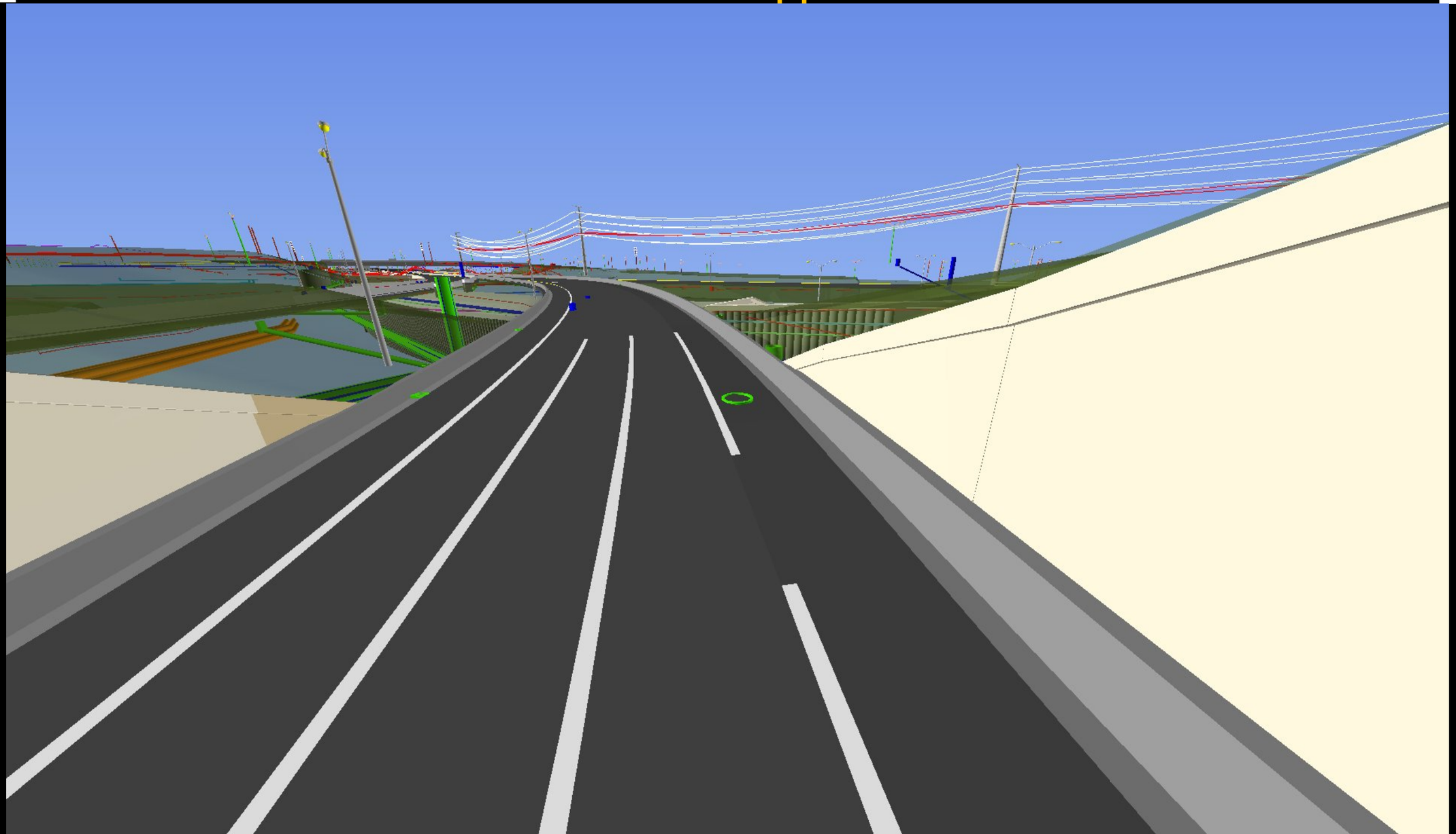
CIM-VDC

Construction Applications



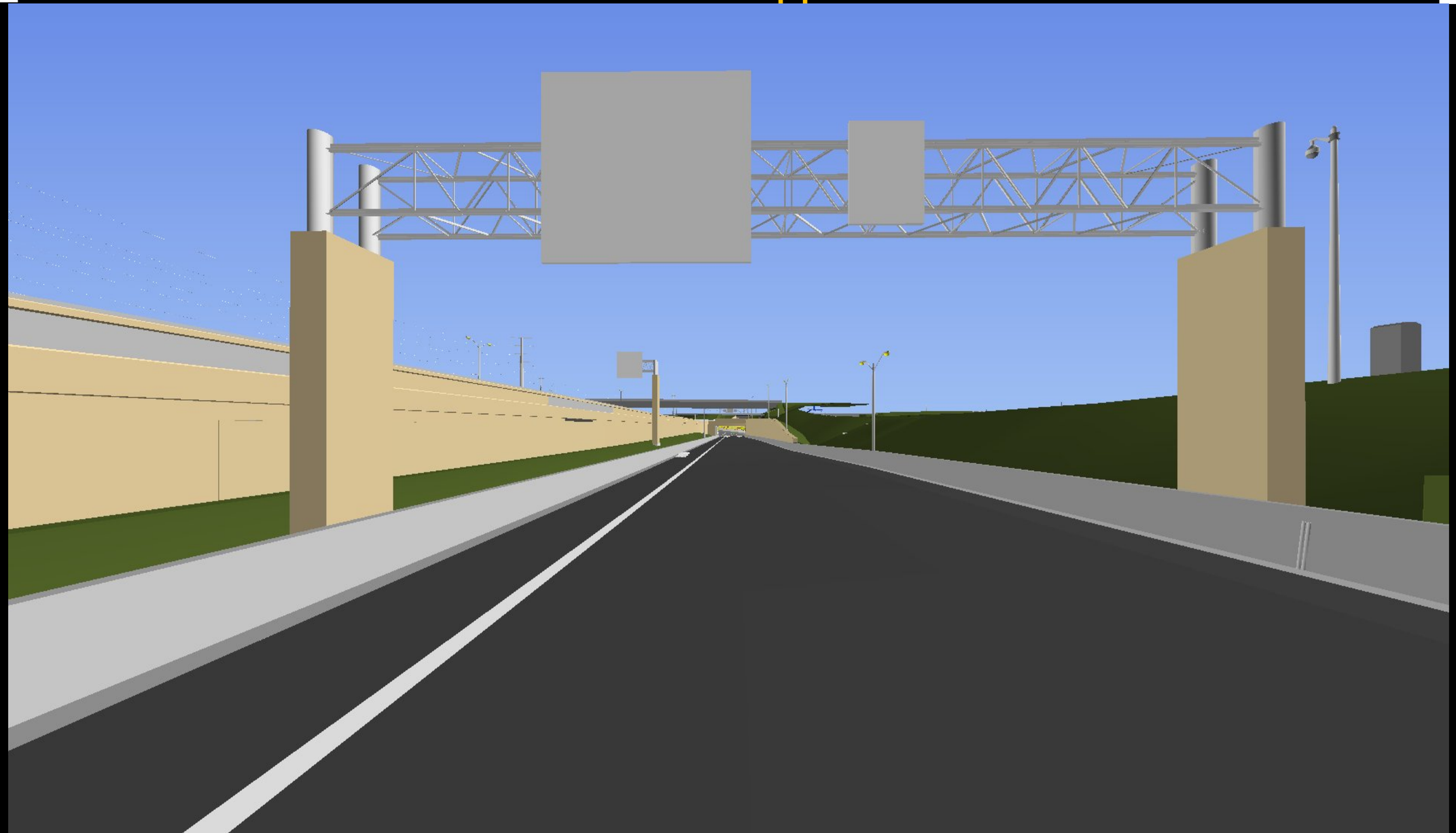
CIM-VDC

Construction Applications



CIM-VDC

Construction Applications



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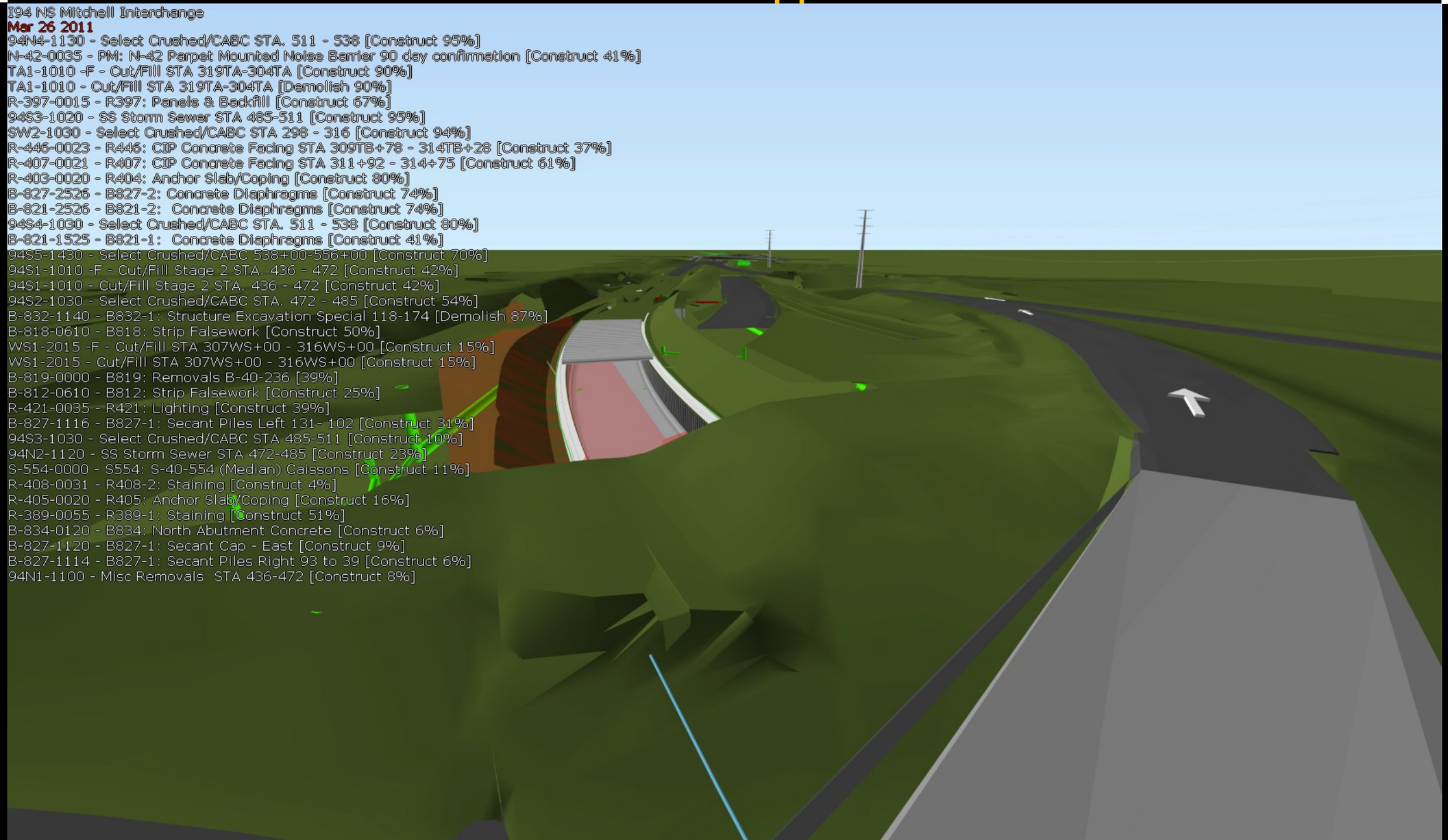
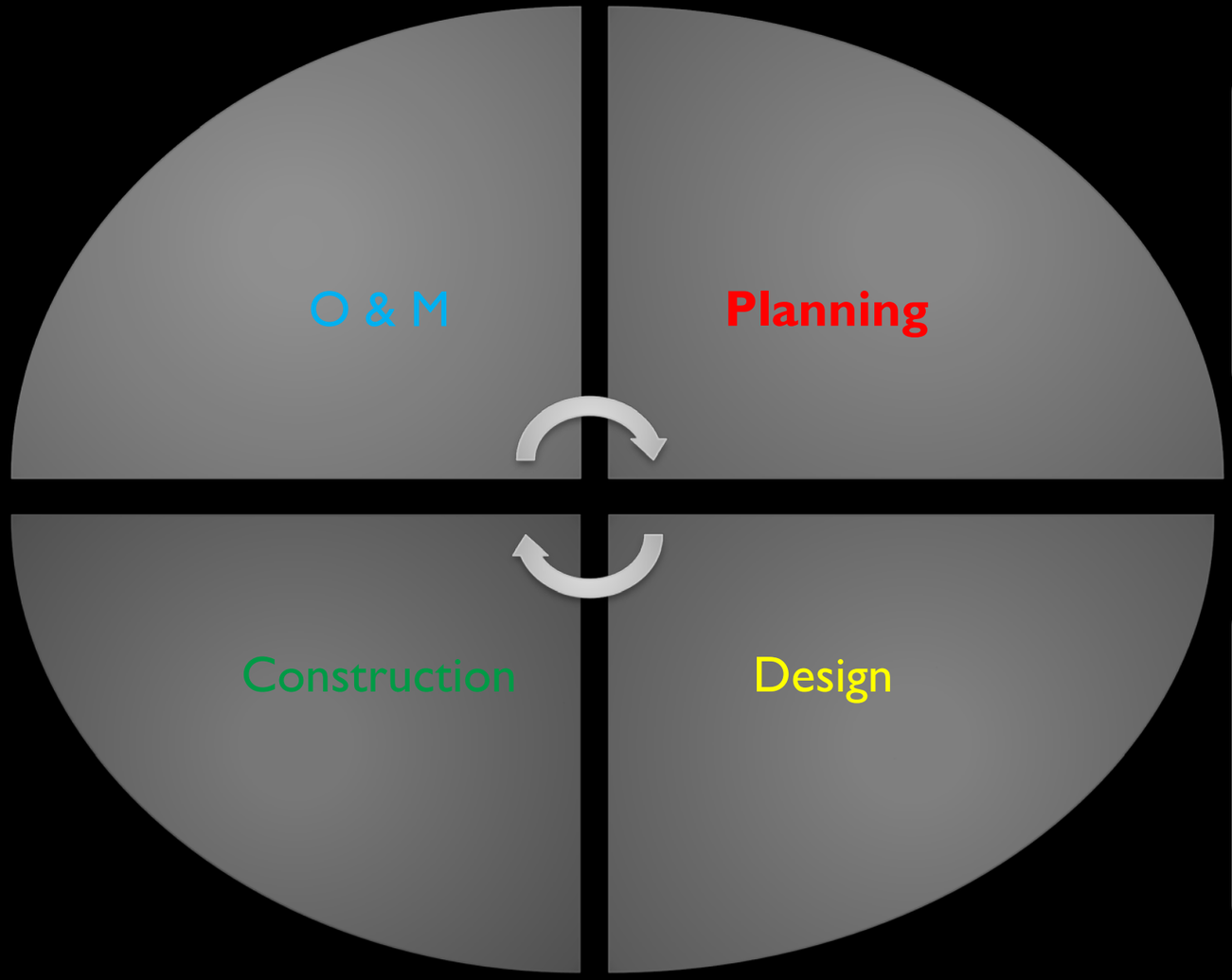


CIM-VDC

Transportation Facilities – O & M Applications

Operations & Maintenance
- Facilities Maintenance
- Asset Management
- Statewide TOC
- Monitoring
- Renovation



Planning
- Program-Project Initiation
- Finance/Budget
- Environmental Study/Doc/PI
- Survey, Mapping, & D.C.
- Design Alternatives

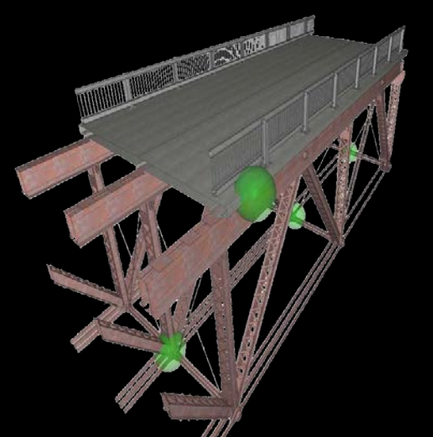
Construction
- Construction Bid/GC
- DBB/DB/IPD
- Construction /CEC
- RFIs, DINs, CCOs
- As-built Plans

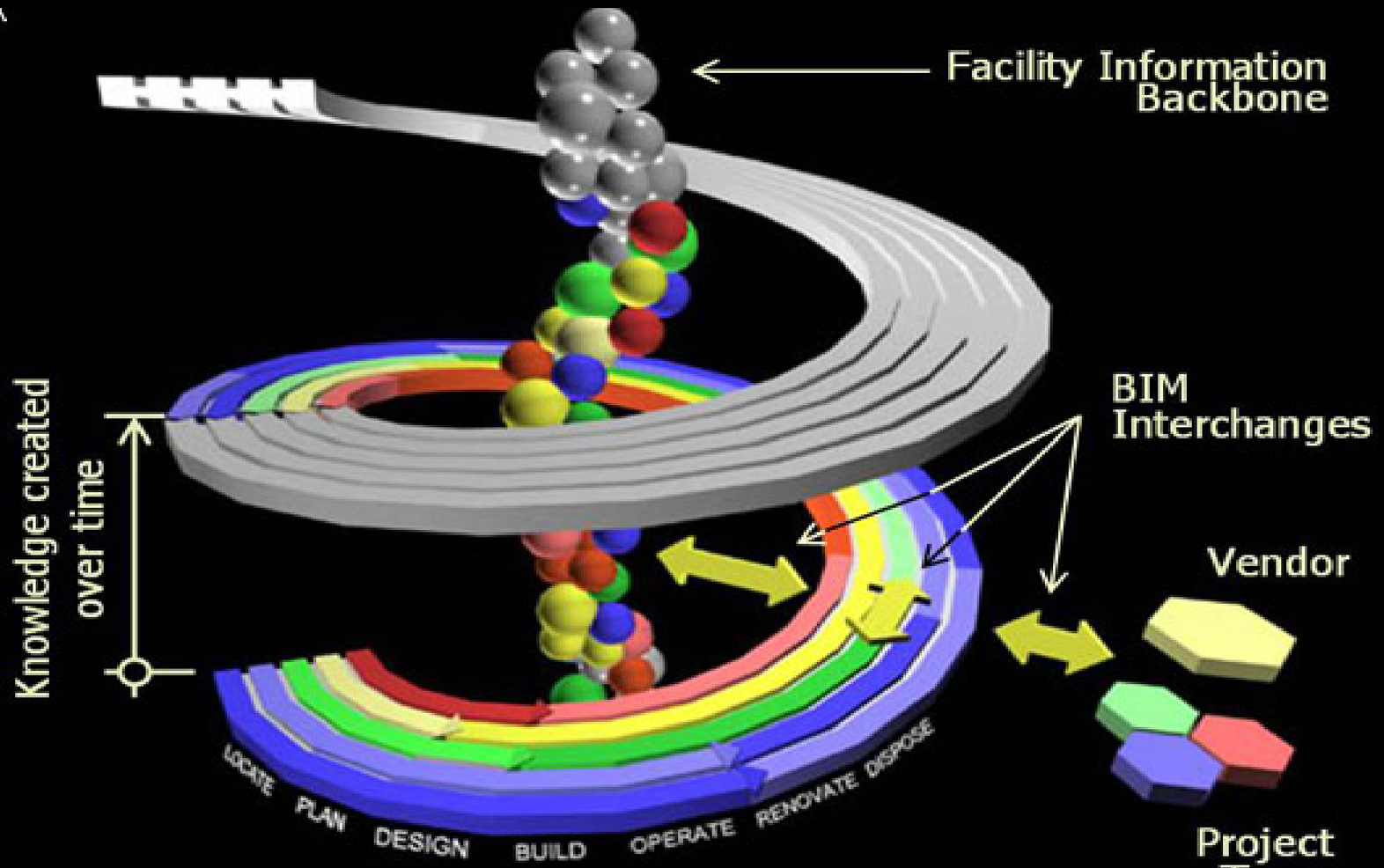
Design
- 30% Preliminary Design
- 60% Design
- Utilities/Geotech/RE/Traffic
- P, S & E Final Design + Model
- Construction/Bid Docs

CIM-VDC

Maintenance & Operations – Lifecycle Applications

Lifecycle FM Information





CIM-VDC

Transportation Facilities – Lifecycle Management

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- Monitoring
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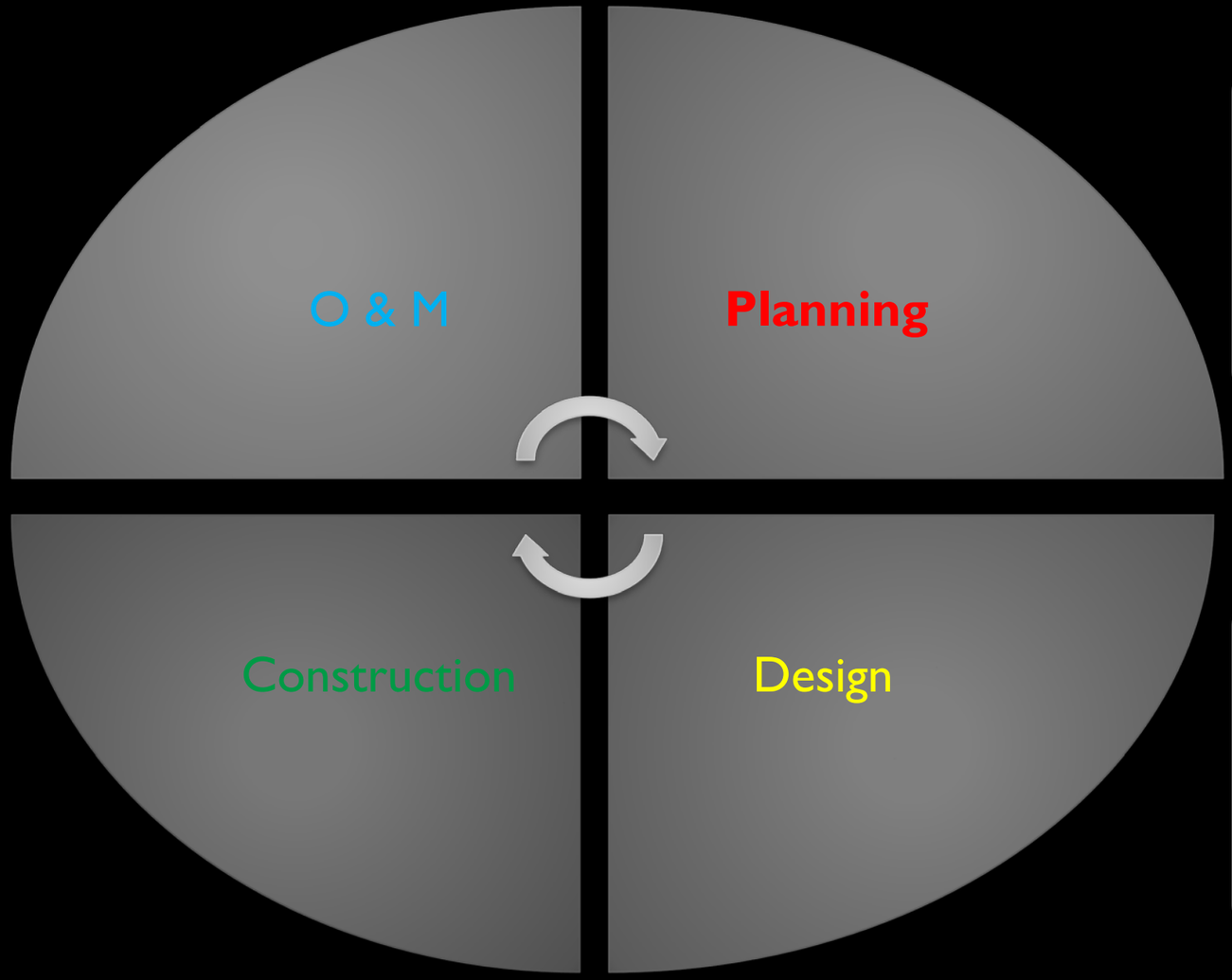

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CIM-Civil Integrated Management: Best Practices and Lessons Learned

WisDOT SE Freeways - Focus on Construction

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