CABES

CALIFORNIA BRIDGE ENGINEERS SEMINAR

ADVANCING BRIDGE ENGINEERING THROUGH INNOVATION

Presentation 5 - Accelerated Bridge Construction (ABC) Integrated with Building Information Modeling for Infrastructure (BIM4I) Technology

Caltrans

CABES 2026

DES
DIVISION OF ENGINEERING SERVICES

Accelerated Bridge Construction (ABC) Integrated with Building Information Modeling for Infrastructure (BIM4I) Technology

2026 CALIFORNIA BRIDGE ENGINEERS SEMINAR (CABES)
Secretary of State Building Auditorium, Sacramento, CA
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Specialization in Construction Engineering

Agenda

- Motivation and Background
- Accelerated Bridge Construction (ABC)
- Project Overview - Ward Creek
- BIM4I
- Use Cases and Benefits of Integrating BIM4I with ABC

VALUES

Collaboration — We inspire and motivate one another through effective communication, teamwork, transparency, and partnership.

Equity — We strive to eliminate disparities while improving outcomes for all.

Innovation — We are empowered to seek creative solutions and take informed risks.

Integrity — We promote trust and accountability through our consistent and ethical actions.

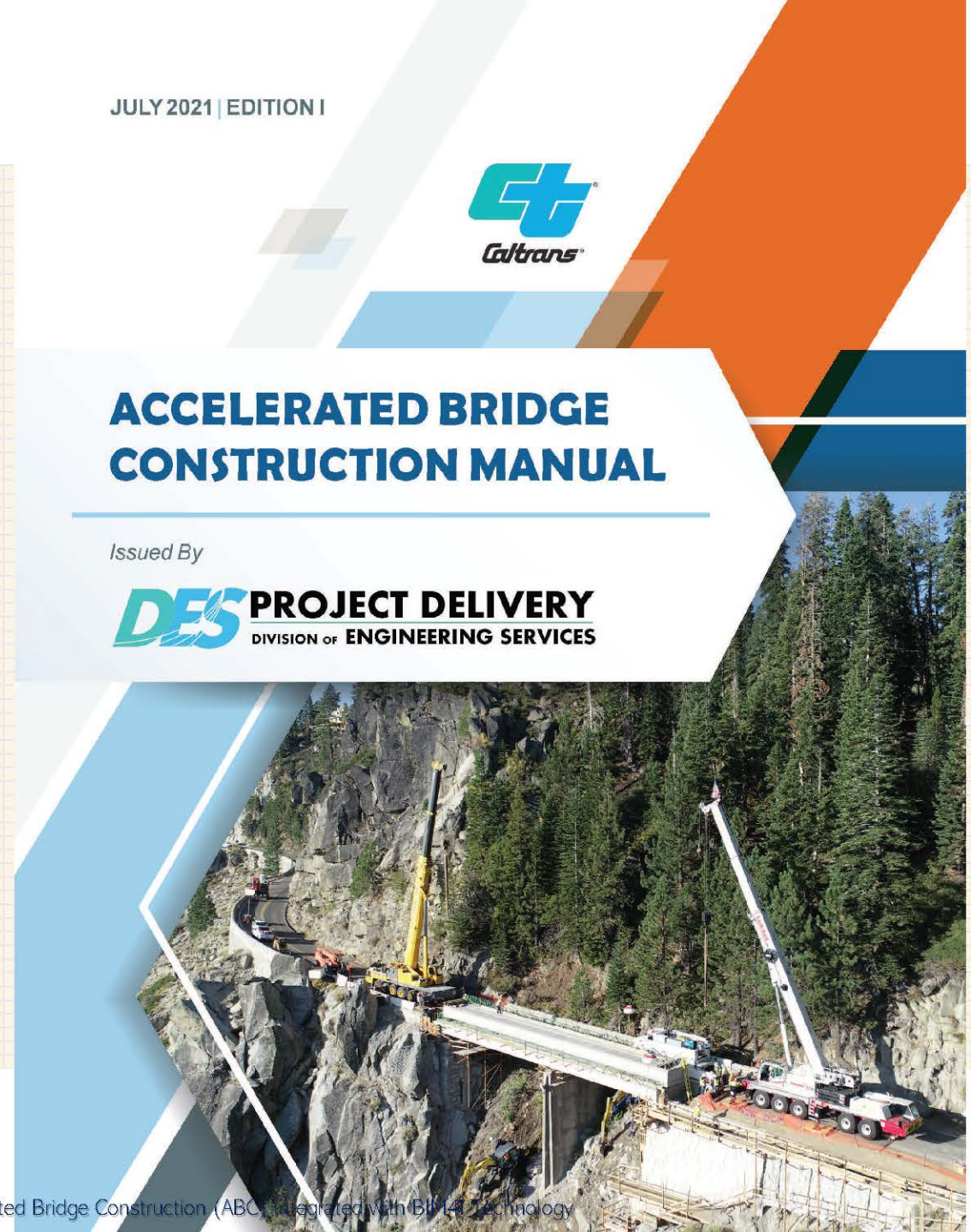
People First — We consider how our work impacts people within the organization, within our communities, and throughout California.

Pride — As one Caltrans family, we are proud of our work and strive for excellence in public service.

Stewardship — We efficiently, effectively, and equitably deliver projects, services, and asset management.

Motivation and Background

- Aging Infrastructure- Need to minimize on-site construction duration
- Traffic congestion
- Safety for motorists and construction workers
- Environmental constraints
- Complex ABC methods and advanced materials
- Need for Data Continuity




Source: MUSEO DEI BAMBINI

Accelerated Bridge Construction

- Bridge construction methods that use the most efficient combination of ***innovative planning, design, materials***, and ***construction techniques*** to significantly reduce construction related impacts by reducing the number of onsite construction days and/or minimizing traffic disruption.

ABC Methods

Examples

Prefabricated Bridge Elements & Systems (PBES)

Self Propelled Motorized Transporters (SPMT)

Lateral Slide (LS)

Incremental Launch (IL)

Temporary Bridge (TB)

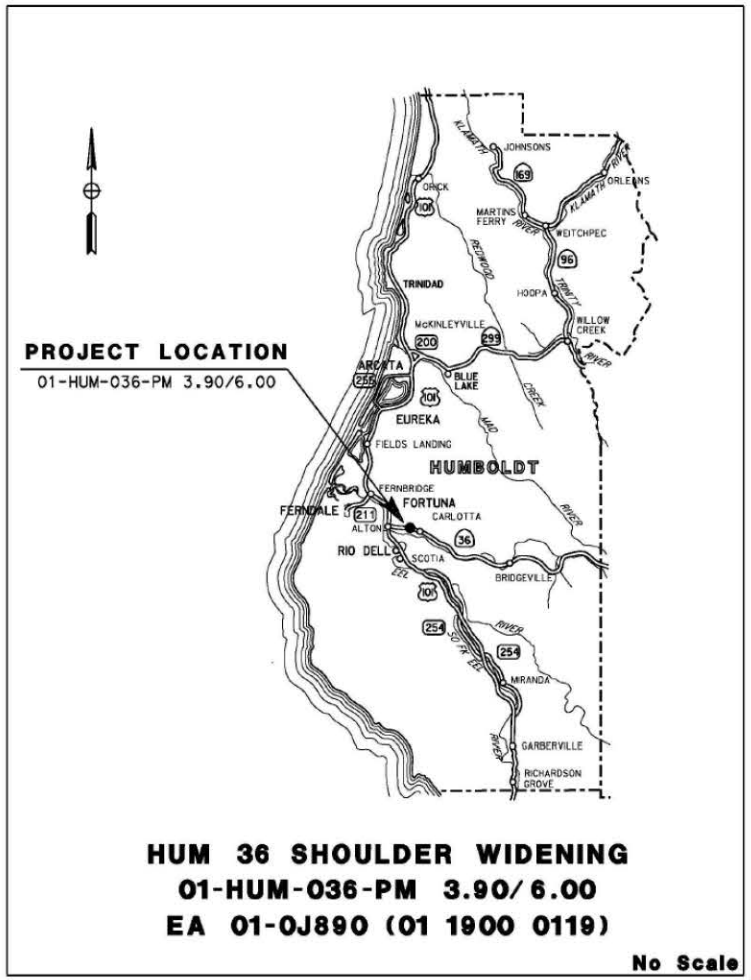
ABC reduces on-site construction time, improve safety, and enhance quality

Source: Caltrans

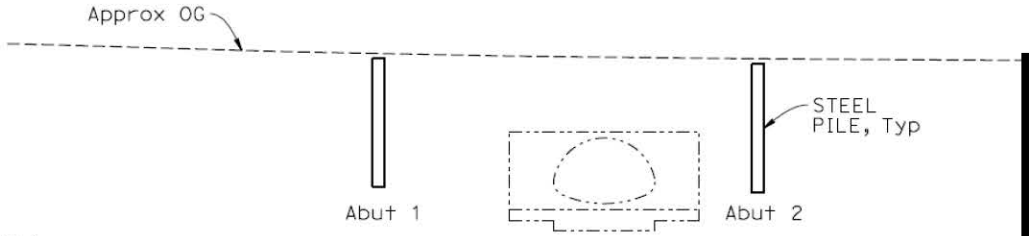
Project Overview: 01-0J8904 Ward Creek Bridge

District 1

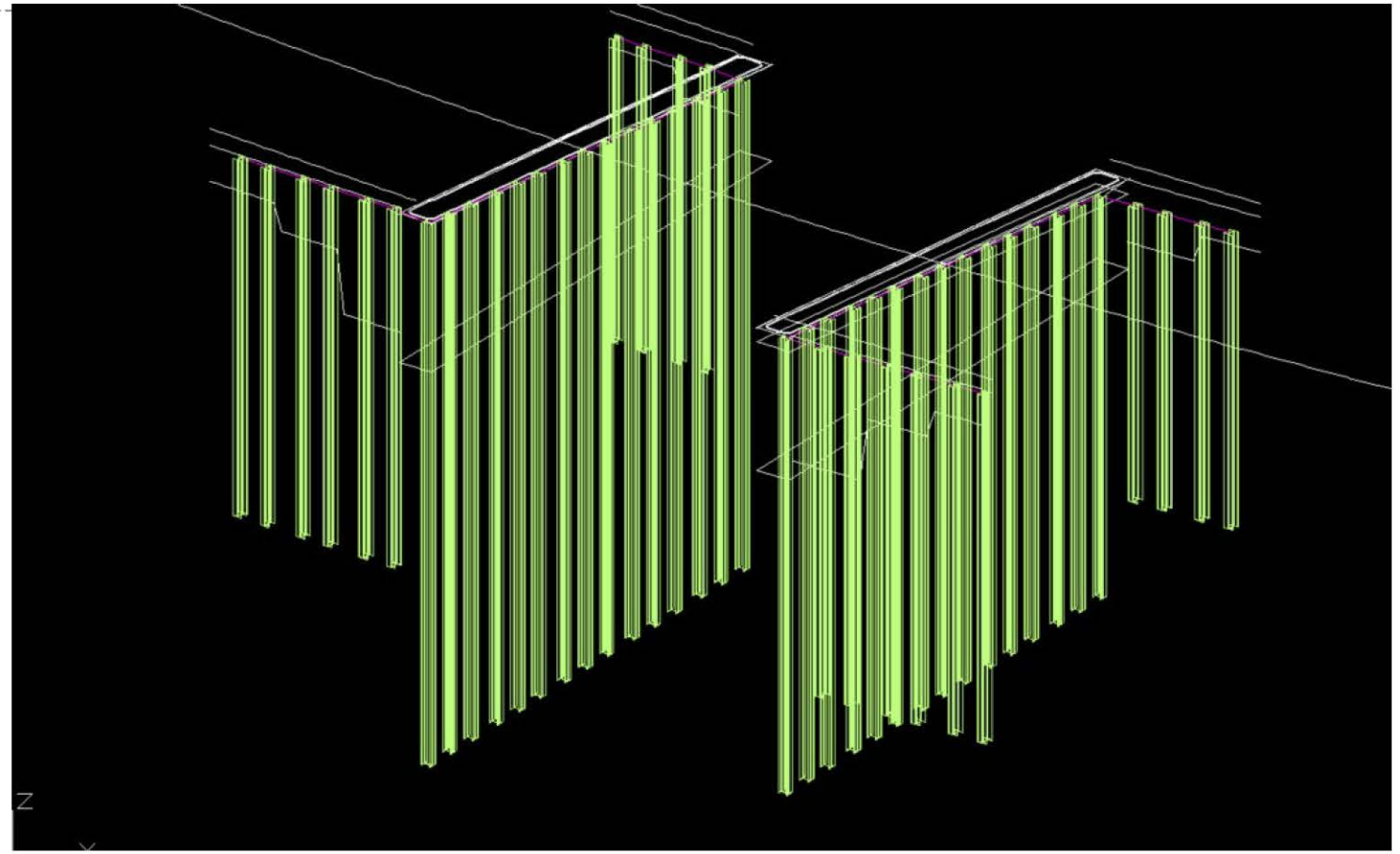
Need: Addressing Fish Passage



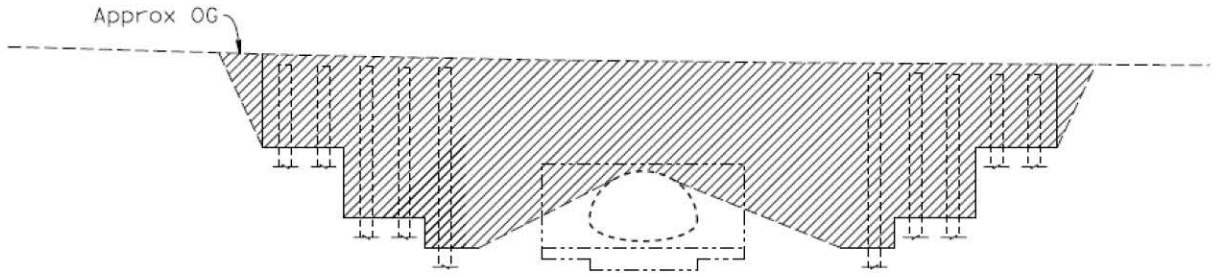
Step 1- Drive Piles



STEP 1
a. Drive piles during permitted lane closure.
b. Cut piles 1' below OG.
c. Temporarily pave over the piles before opening to traffic.

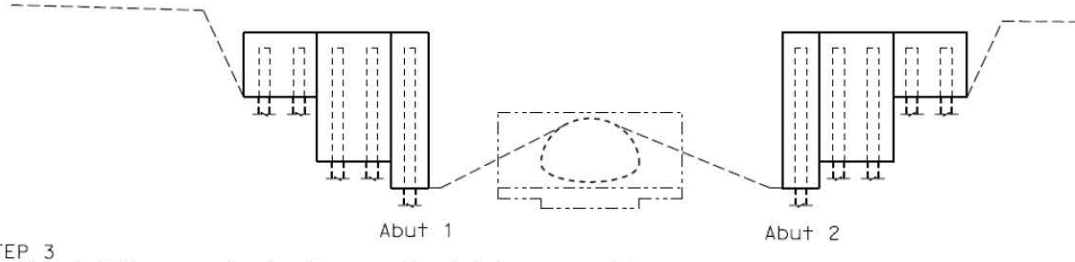


Step 2- Excavation

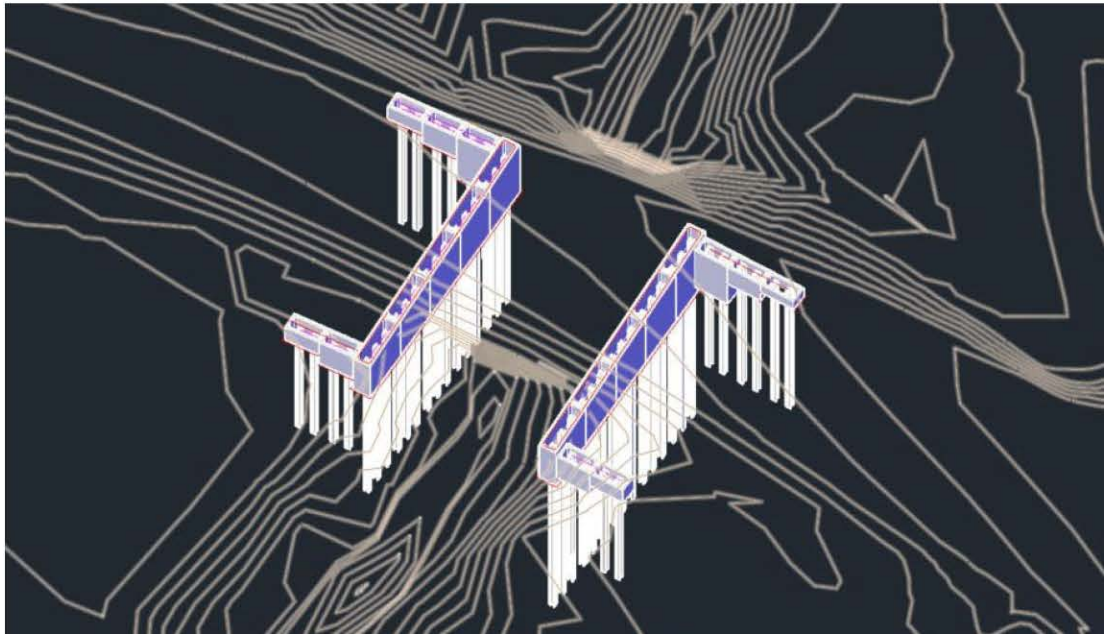


STEP 2
a. Excavate for Abutments, retaining wall and superstructure.
b. Cut piles to appropriate elevation.
c. Piles shall be clean and free of debris.
d. Construct lower pile anchors.

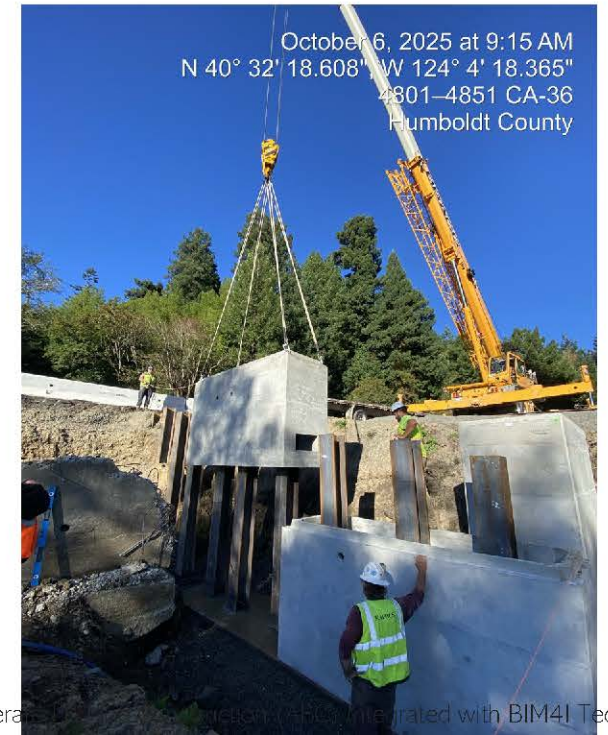
Step 3- Erecting Reinforced Concrete Box (RCB) Segments

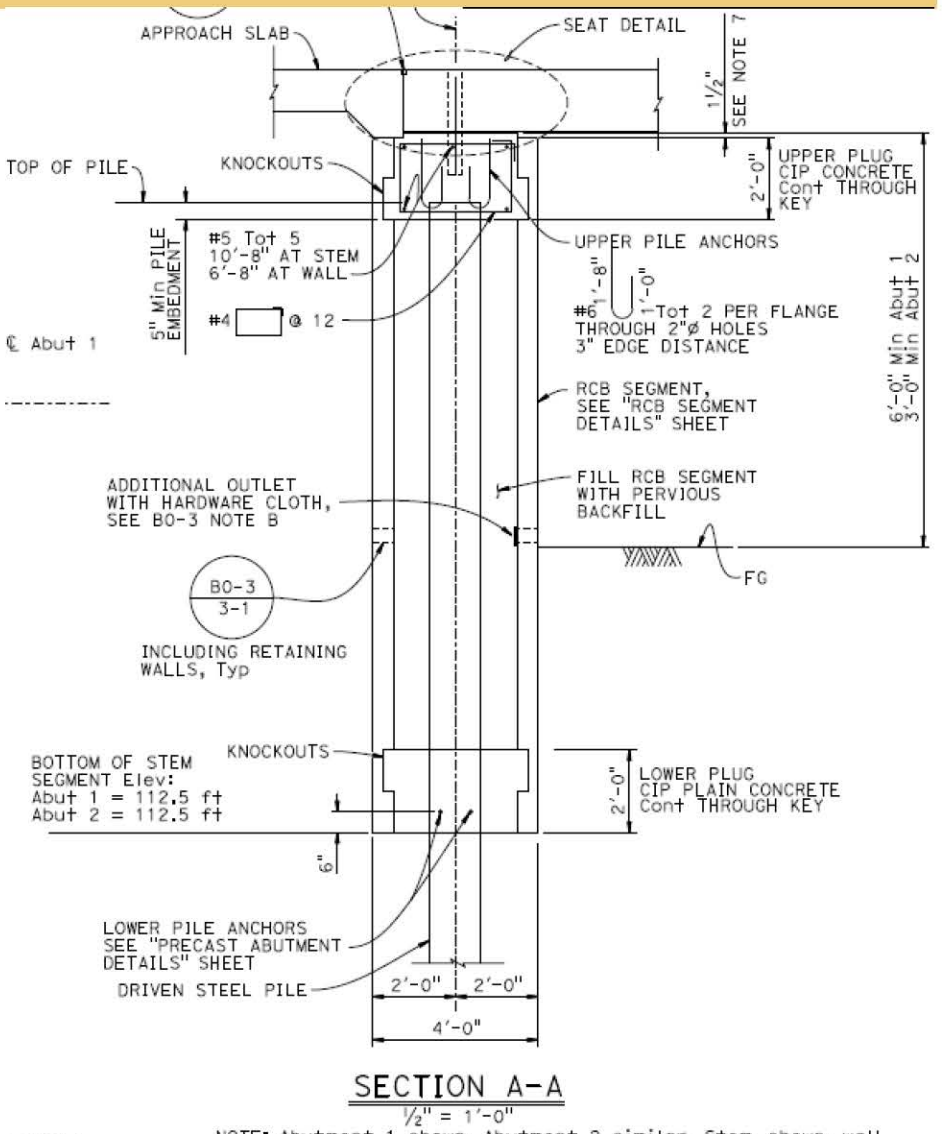


STEP 3
a. Erect RCB segments to the required tolerances. If horizontal joints are used, placing the upper sub-segments maybe delayed until step 3d.
b. Cast the lower plug and CIP keys.
c. Proceed when lower plug concrete achieves 1,500 psi compressive strength.
d. Place pervious backfill.
e. Cast upper plug and CIP keys.
f. Proceed when upper plug concrete achieves 1,500 psi compressive strength.

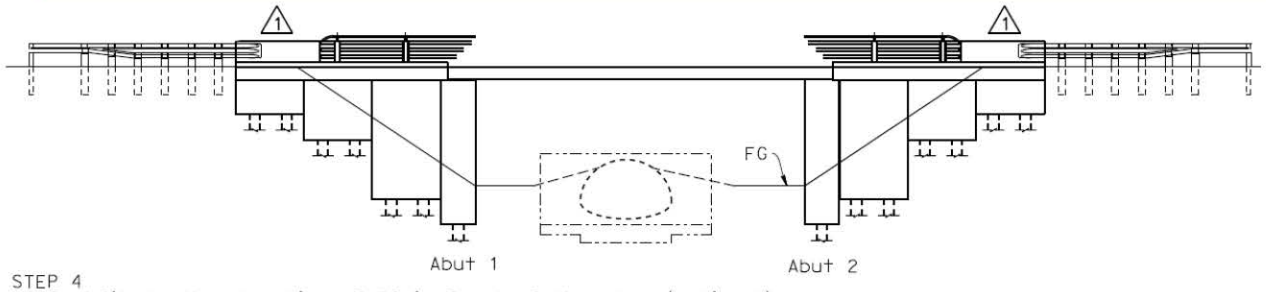


Innovation- Box Culvert used for RCB Segment

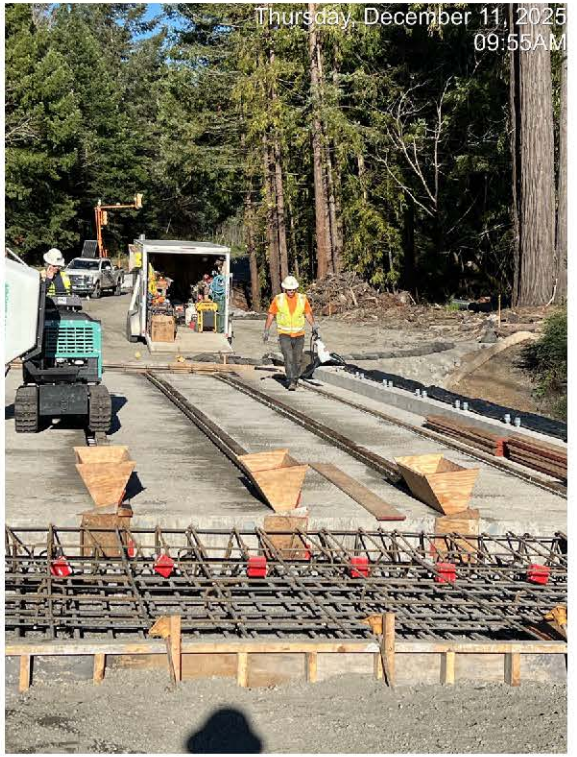


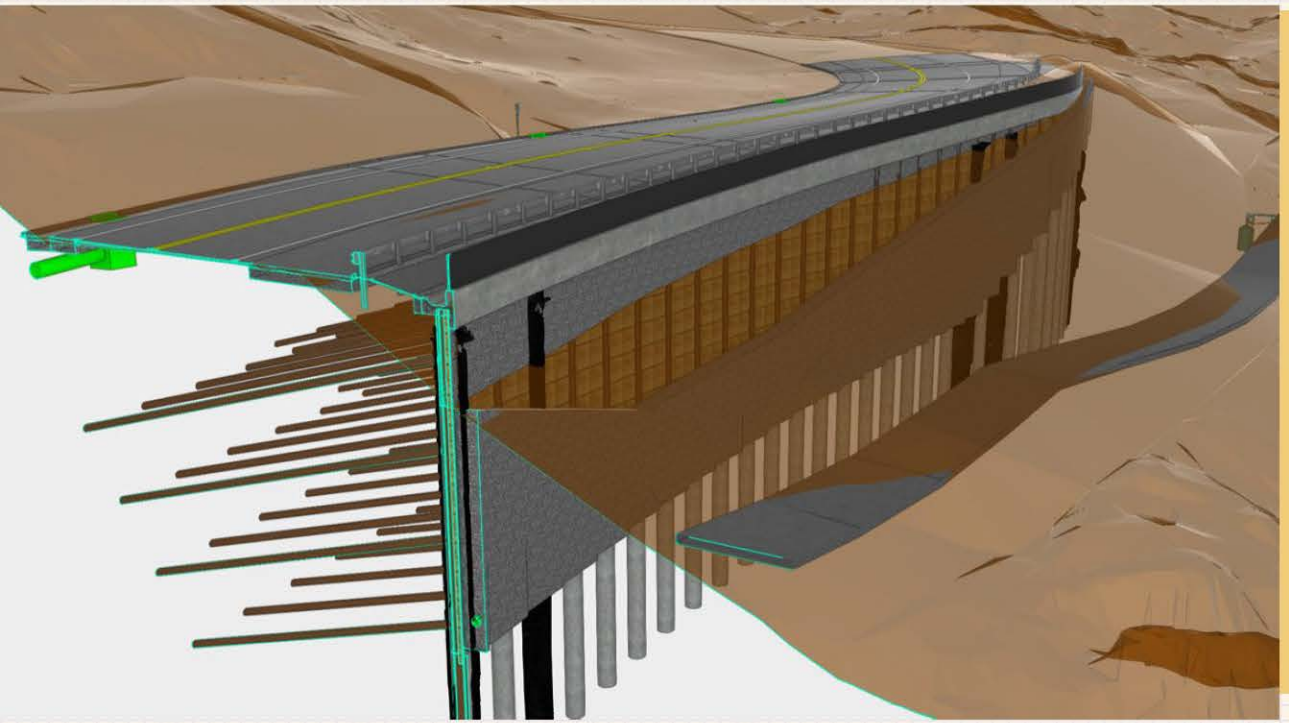


Step 4- Erecting PreCast (PC) Slabs and Connecting with Ultra-High Performance Concrete (UHPC)



STEP 4
a. Backfill to the elevation of FG in front of the stem (optional).
b. Erect PC slabs.
c. Place drill and bond dowels at Abutment seats.
d. Construct UHPC joints.
e. Proceed when non-shrink grout achieves 5,000 psi.
f. Place backfill simultaneously at Abut 1 and Abut 2, equalizing the horizontal earth pressure.
g. Construct remaining items for this stage, including approach slab, bridge railing, and polyester concrete overlay.





BUILDING INFORMATION MODELLING FOR INFRASTRUCTURE

(BIM4I)

Source: Caltrans BIM4I strategic plan

What is BIM?

Building Information Modeling (BIM) is an ***intelligent 3D model-based*** approach that gives engineering and ***construction professionals*** the insight and tools to more efficiently ***plan***, ***design***, and ***build*** highways and bridges

- 3D design & visualization
- Embedded details for improved information
- Cloud platform for collaboration

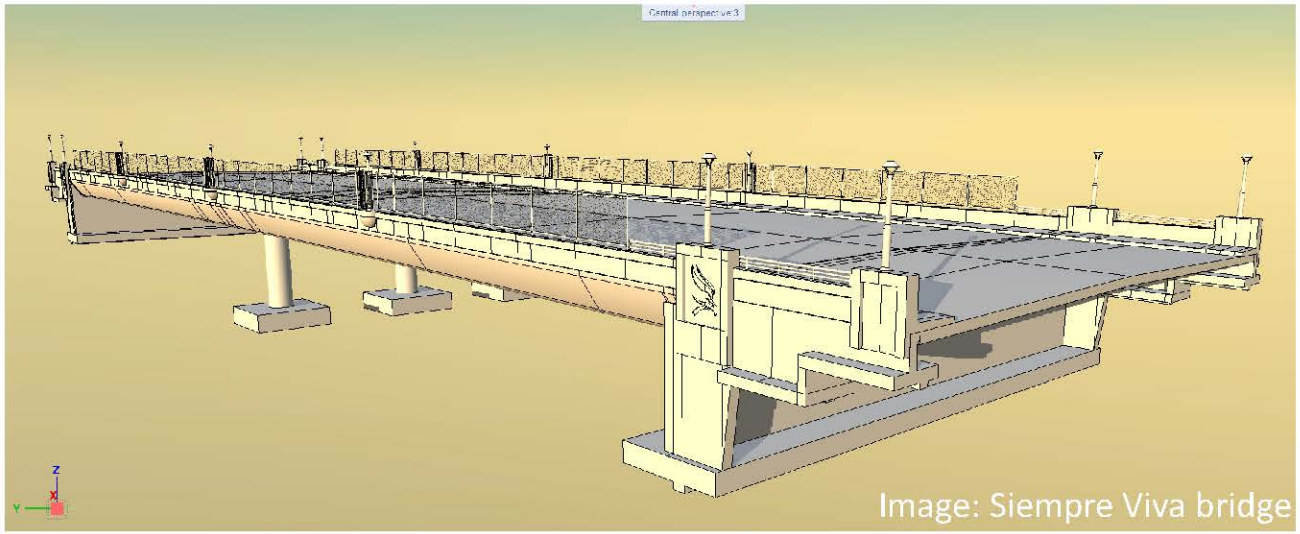


Image: Siempre Viva bridge

What is BIM4I?

Building Information Modeling for Infrastructure (BIM4I) is a ***collaborative work method*** for ***structuring, managing***, and using ***data*** and ***information*** about transportation ***assets*** throughout their ***lifecycle***. This process is supported by technologies that create a ***digital representation*** of a project's physical and functional characteristics. These digital models integrate ***geometry***, ***structured data***, and ***documentation*** from multiple sources to support decision making and information exchange throughout the asset lifecycle from planning and design through construction, operations, and maintenance.

Source: Caltrans Project Delivery Directive

Why Integrate BIM4I with ABC?

BIM4I + ABC

01 THE CHALLENGE

ABC Requires High Geometric Precision

- Off-site prefabrication must meet exact design specifications
- Components installed with pinpoint accuracy on-site
- Minor tolerance deviations cause significant delays & cost overruns
- Precision execution is important to success

Minor deviations → major delays & cost overruns

02 BIM4I SOLUTIONS

A Powerful Synergy

Conflict Detection
Early resolution of design conflicts before fabrication — eliminates rework

4D Simulation
Advanced scheduling & sequencing of prefab delivery and installation

LiDAR + Point Cloud
Real-time progress tracking and highly accurate as-built data collection

Quality Control
Automated, precise workflows throughout construction.

BIM4I + ABC = Precision at Scale

03 APPLIED IN PRACTICE

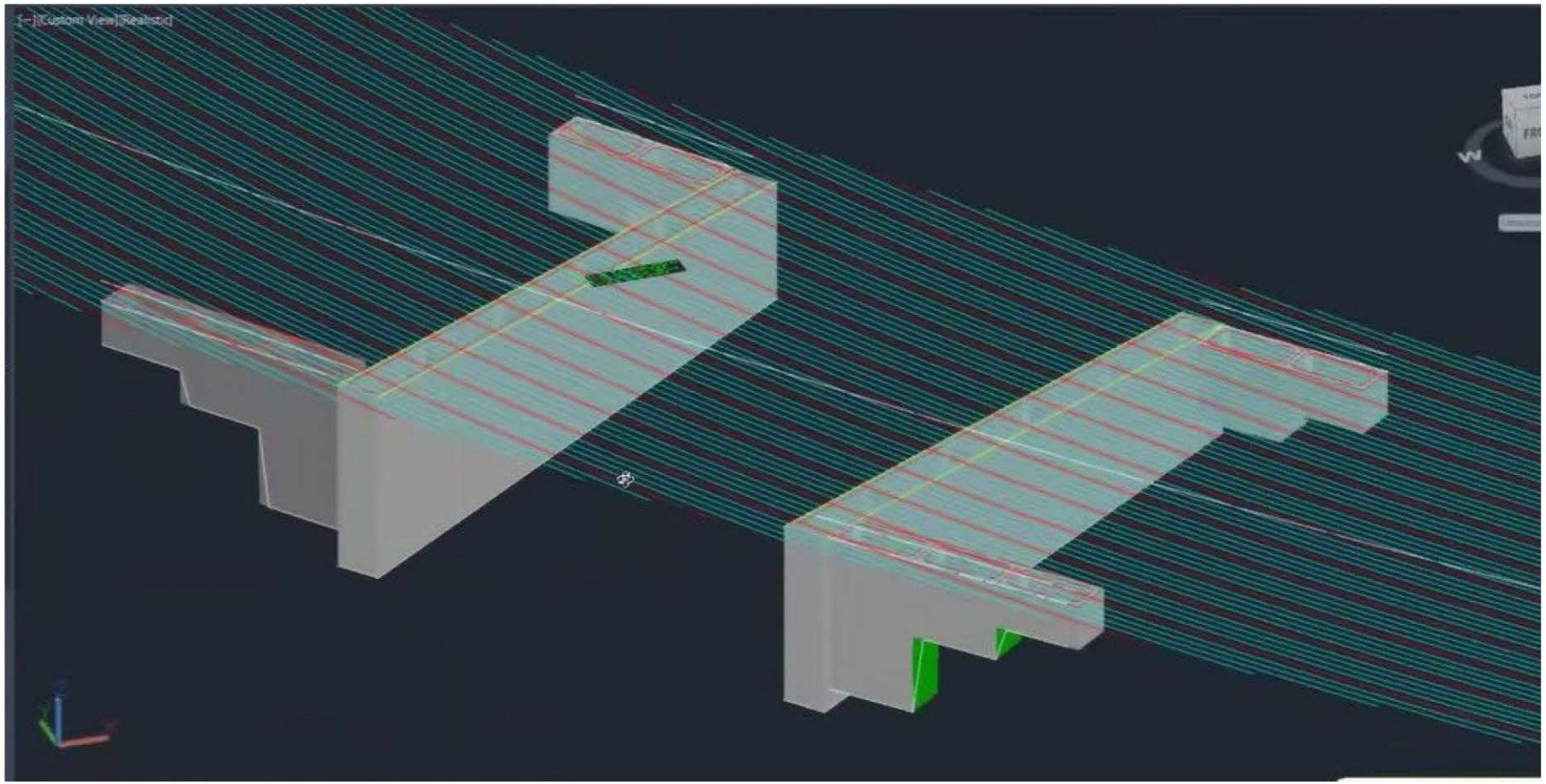
Project Case Study

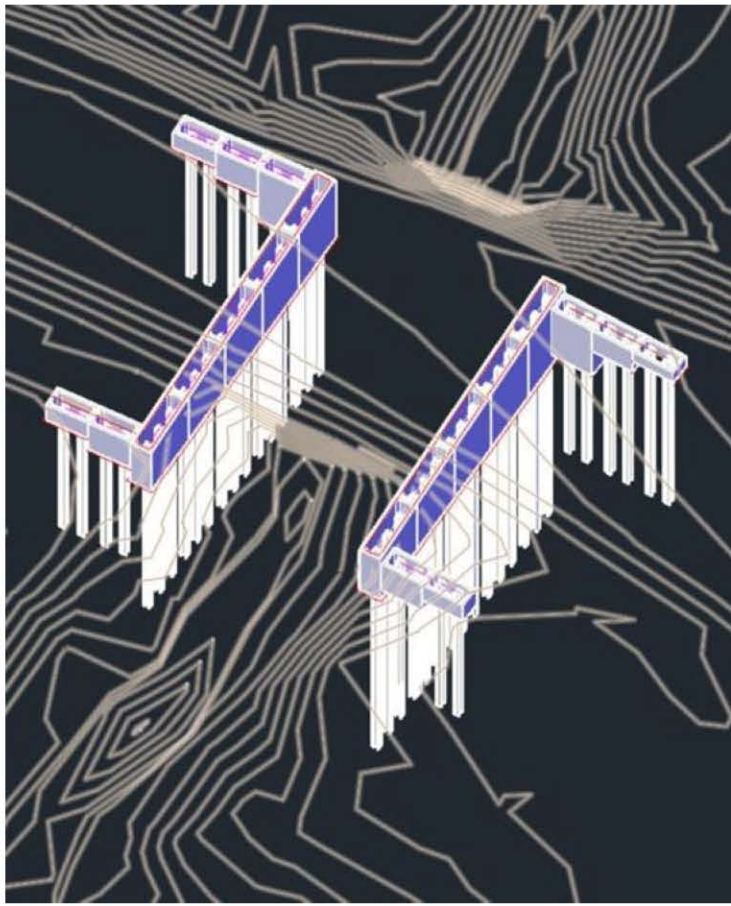
1. **Import As-Built Data**
   Survey-derived top-of-deck surface imported into the digital model
2. **Geometric Validation**
   Evaluated cross slopes, elevations & compliance against design standards
3. **Model-Based Analysis**
   Detailed analysis reconciled field conditions with design requirements
4. **Refined Overlay Surface**
   Polyester overlay developed maintaining constructability &

Outcome: Enhanced accuracy, reduced rework, optimized rehabilitation

Data-driven modeling · LiDAR integration · 4D simulation · Precision ABC delivery

Digital Engineering- Visualization



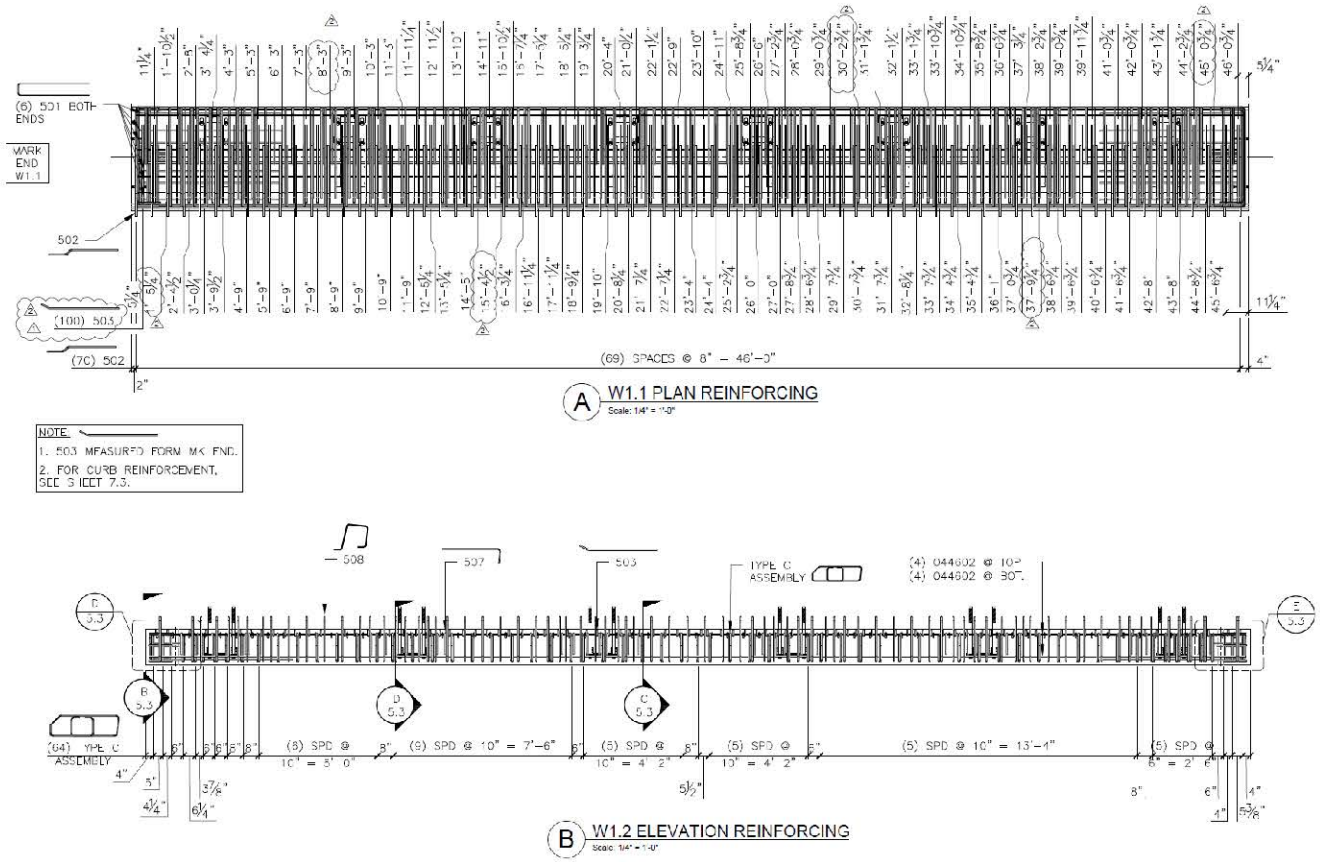


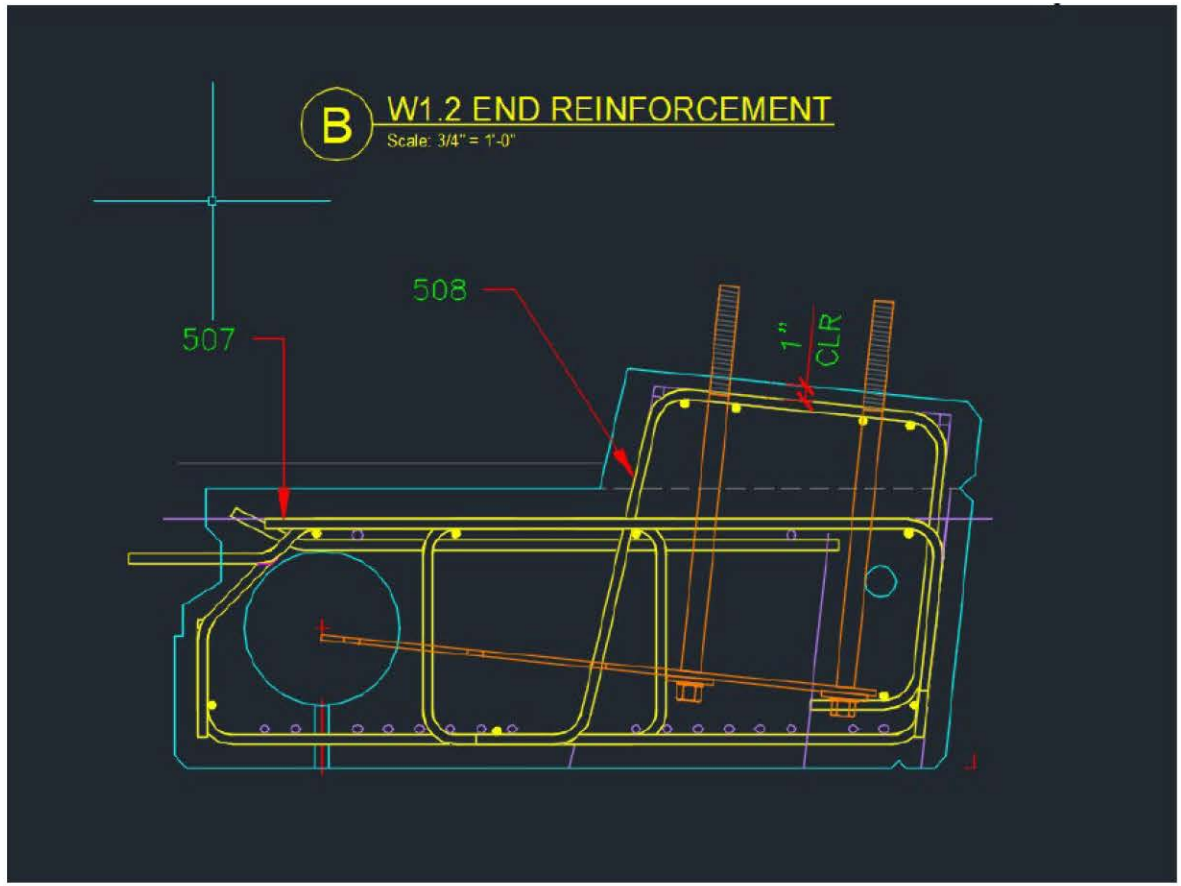
Source: Ward Creek bridge

Point Cloud Overlay

Source: Ward Creek bridge

Digital Engineering- Conflict Detection



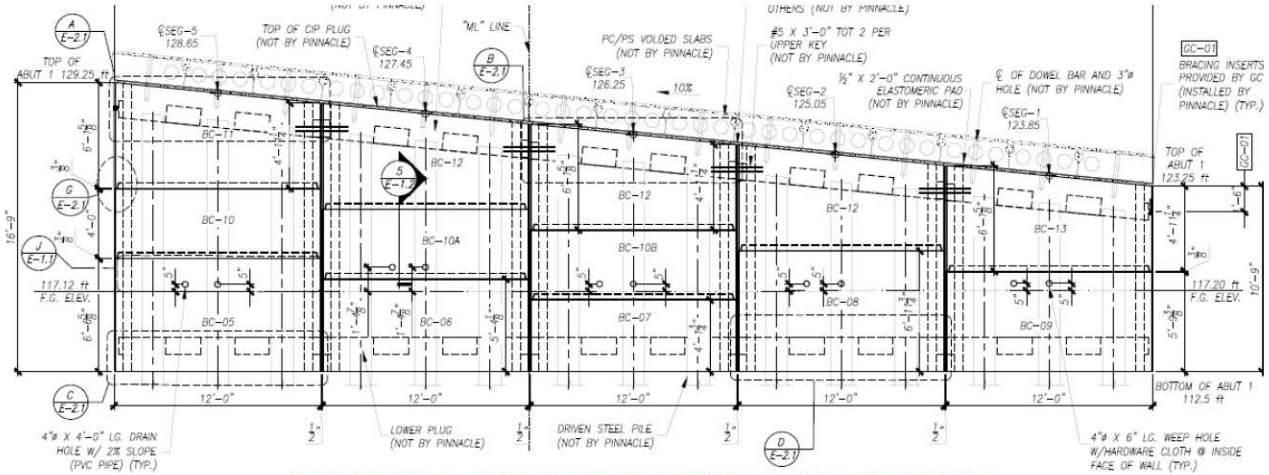


Source: Ward Creek bridge

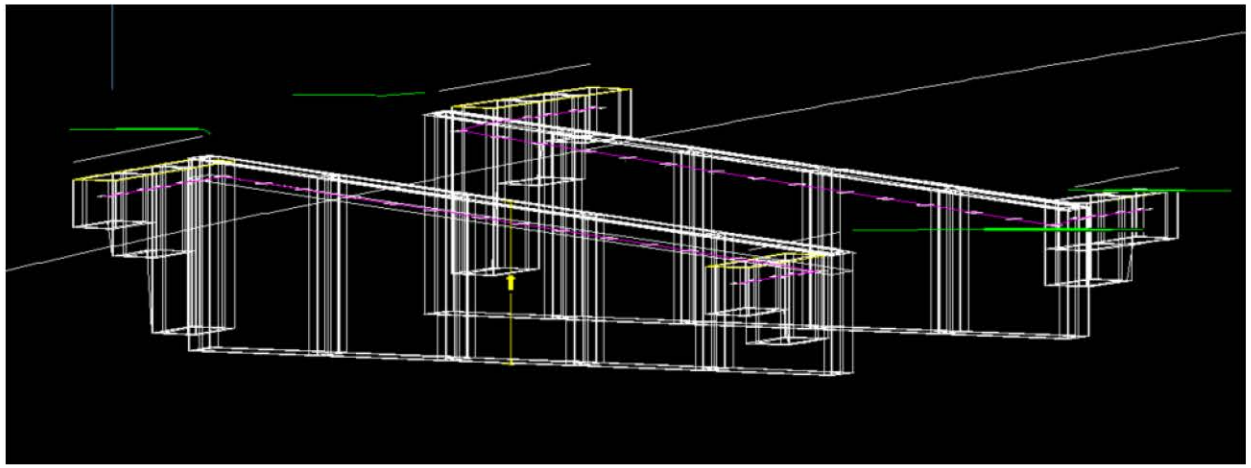
Digital Engineering- Checking Dimensions and Elevations

PILE DATA TABLE							
Location	Pile Type	Nominal Resistance (kips)		Cut-Off Elevation (ft)	Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Required Nominal Driving Resistance (kips)
		Compression	Tension				
Abut 1	HP 12x84	190	N/A	121.80-127.80	67(a) 94(b)	67	310
Abut 2	HP 12x84	190	N/A	121.00-127.00	76(a) 94(b)	76	260
Retaining Wall Abut 1-Left	HP 12x84	50	N/A	121.80 and Var	88(a) 88(b)	88	160
Retaining Wall Abut 1-Right	HP 12x84	50	N/A	127.80 and Var	88(a) 88(b)	88	180
Retaining Wall Abut 2-Left	HP 12x84	50	N/A	121.00 and Var	88(a) 88(b)	88	170
Retaining Wall Abut 1-Right	HP 12x84	50	N/A	127.00 and Var	88(a) 88(b)	88	150

Ward Creek Bridge							
Abutment 1						Slope	
Pile No.	Pile Spacing, ft.	Cumulative Distance, ft.	Top of Pile	Pile length		Delta Y, ft.	-6
7	0.00		127.80	60.80		Delta X, ft.	55.5
8	3.75	3.75	127.39	60.39		slope	-0.108
9	3.75	7.50	126.99	59.99			
10	4.50	12.00	126.50	59.50			
11	3.75	15.75	126.10	59.10			
12	3.75	19.50	125.69	58.69			
13	4.50	24.00	125.21	58.21			
14	3.75	27.75	124.80	57.80			
15	3.75	31.50	124.39	57.39			
16	4.50	36.00	123.91	56.91			
17	3.75	39.75	123.50	56.50			
18	3.75	43.50	123.10	56.10			
19	4.50	48.00	122.61	55.61			
20	3.75	51.75	122.21	55.21			
21	3.75	55.50	121.80	54.80			

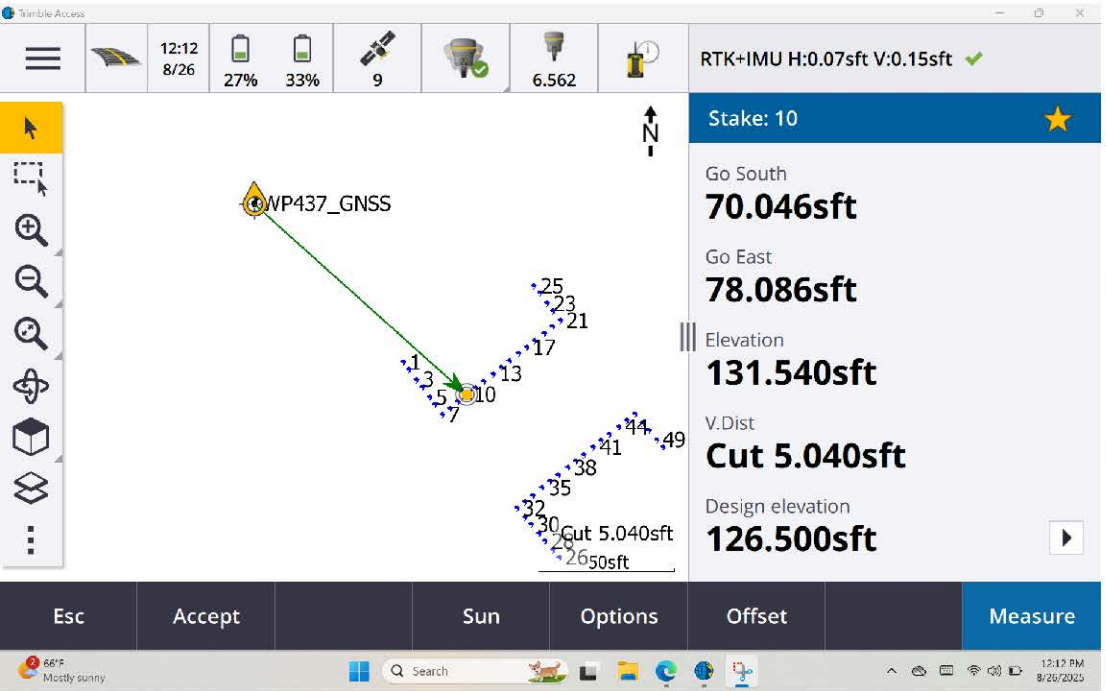


ABUTMENT 1 - RCB STEM SEGMENT CROSS SECTION-A



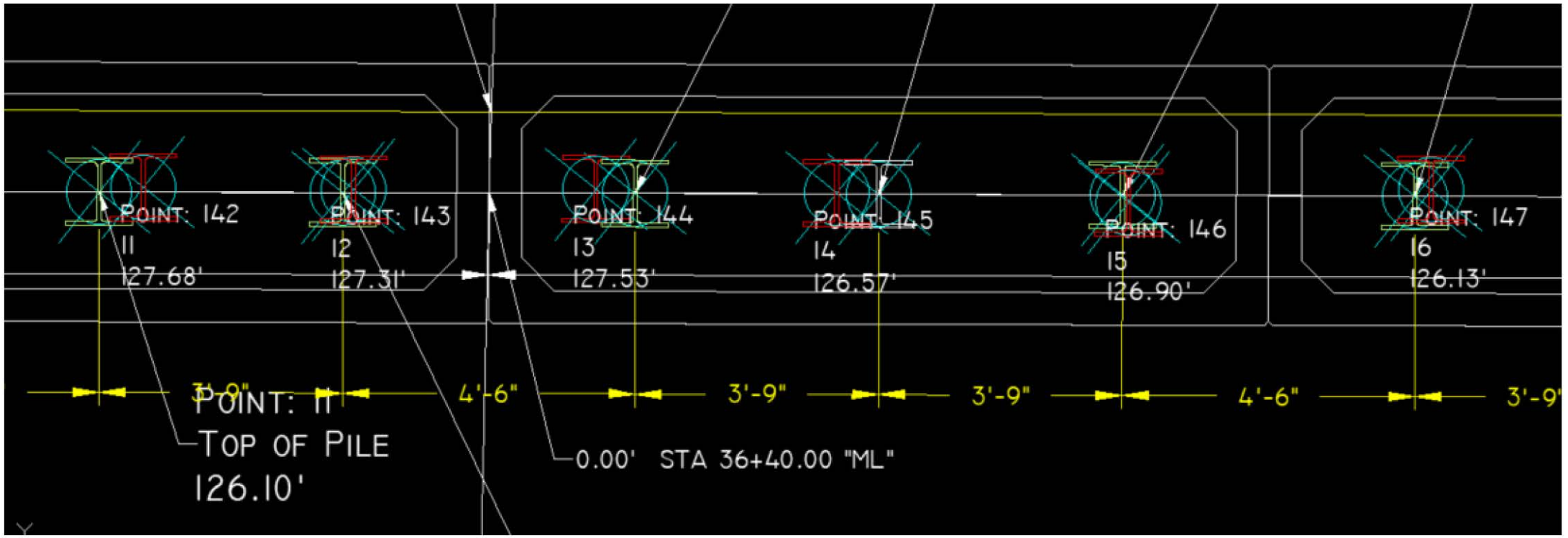
Source: Ward Creek bridge

Digital Engineering- Field Layout & Verification



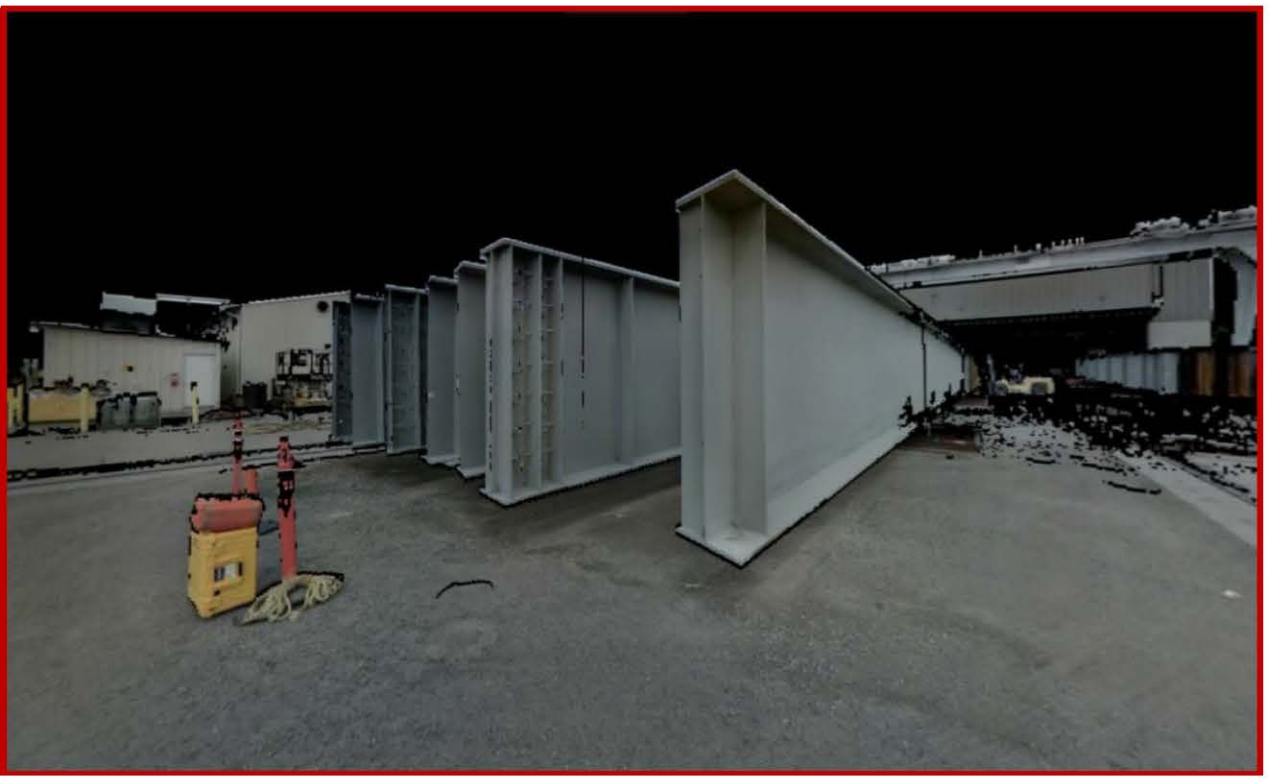
Source: Ward Creek bridge

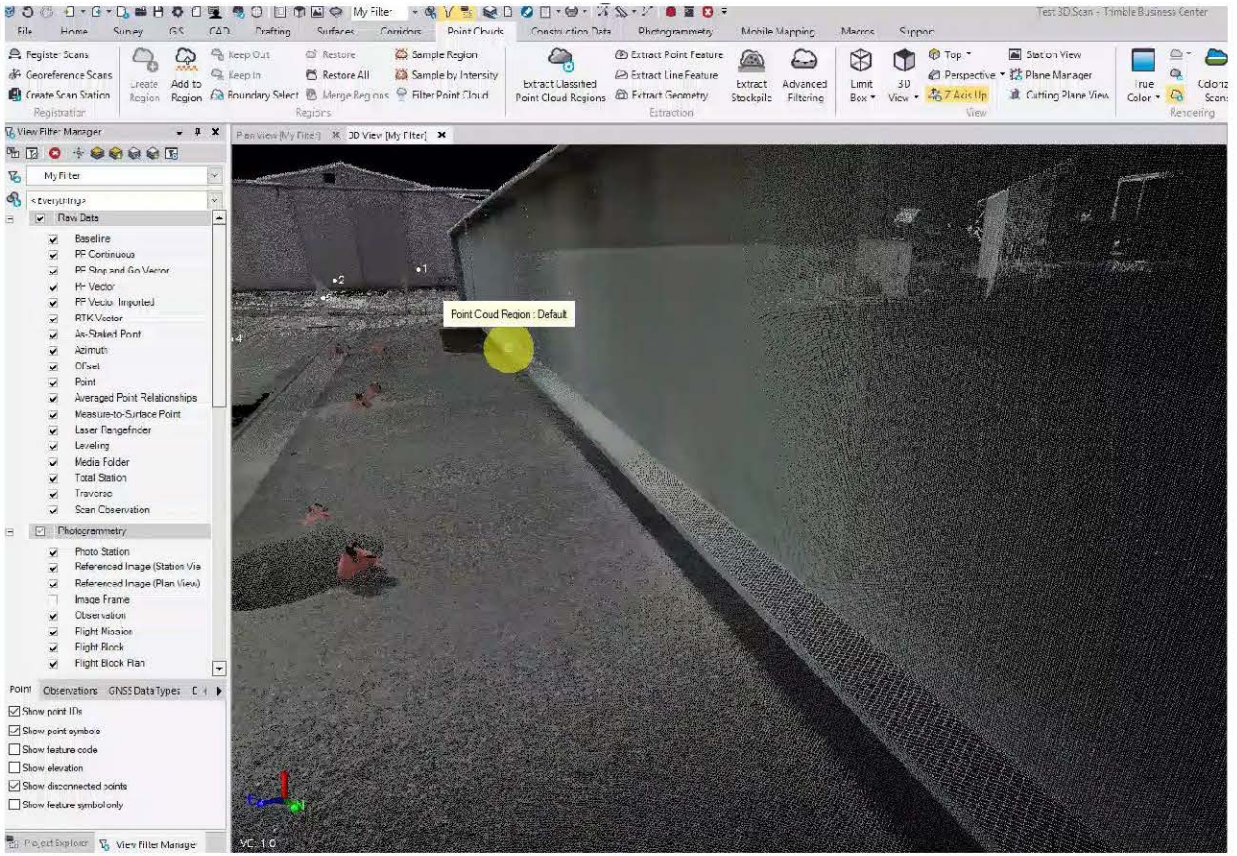
Constructability Check



Source: Ward Creek bridge

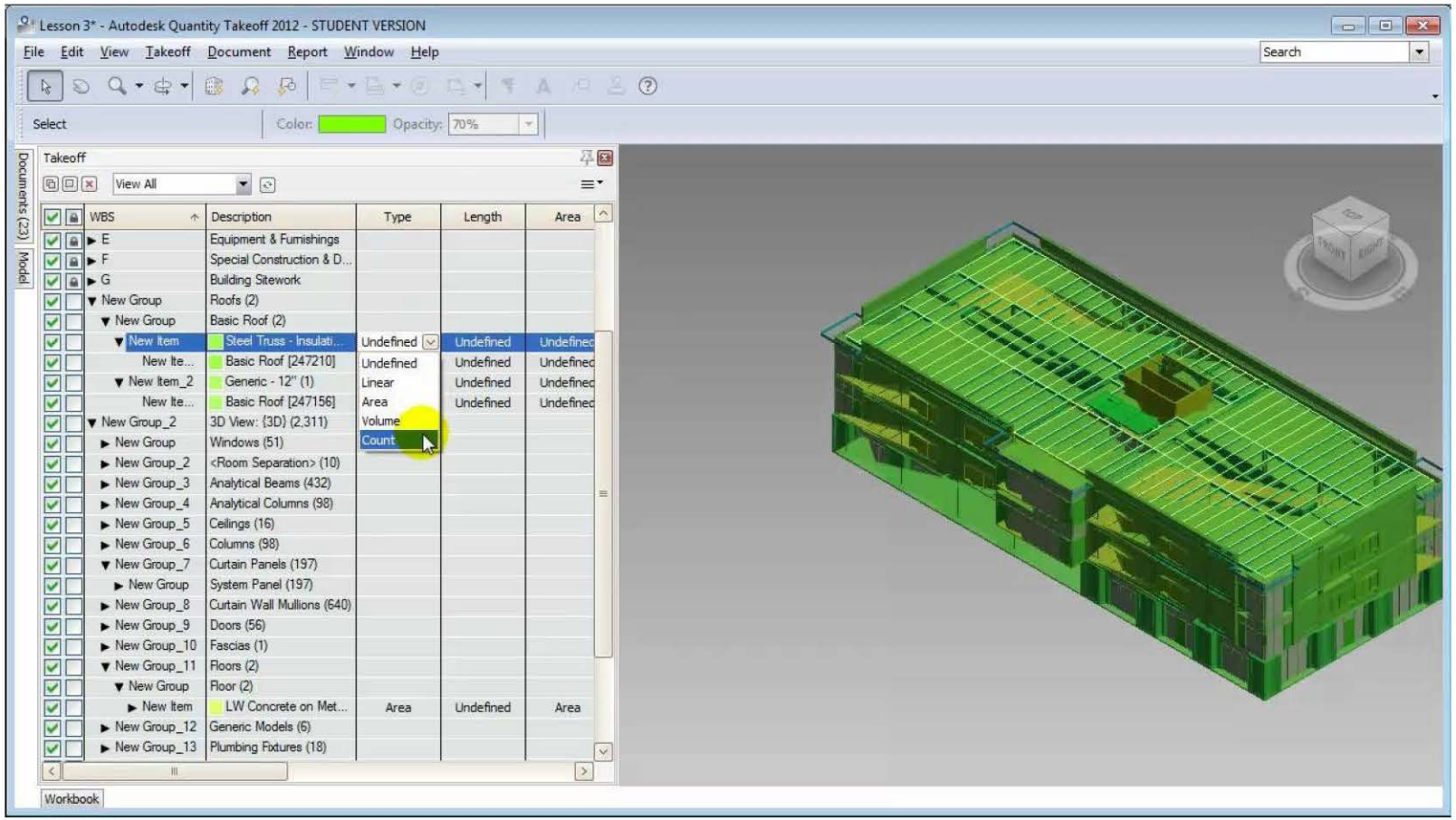
Enhanced Construction Accuracy through Laser Scanned Data/ LiDAR-based Point Cloud Verification





Source: American River Bridge (ARB)

Quantity Take-Off



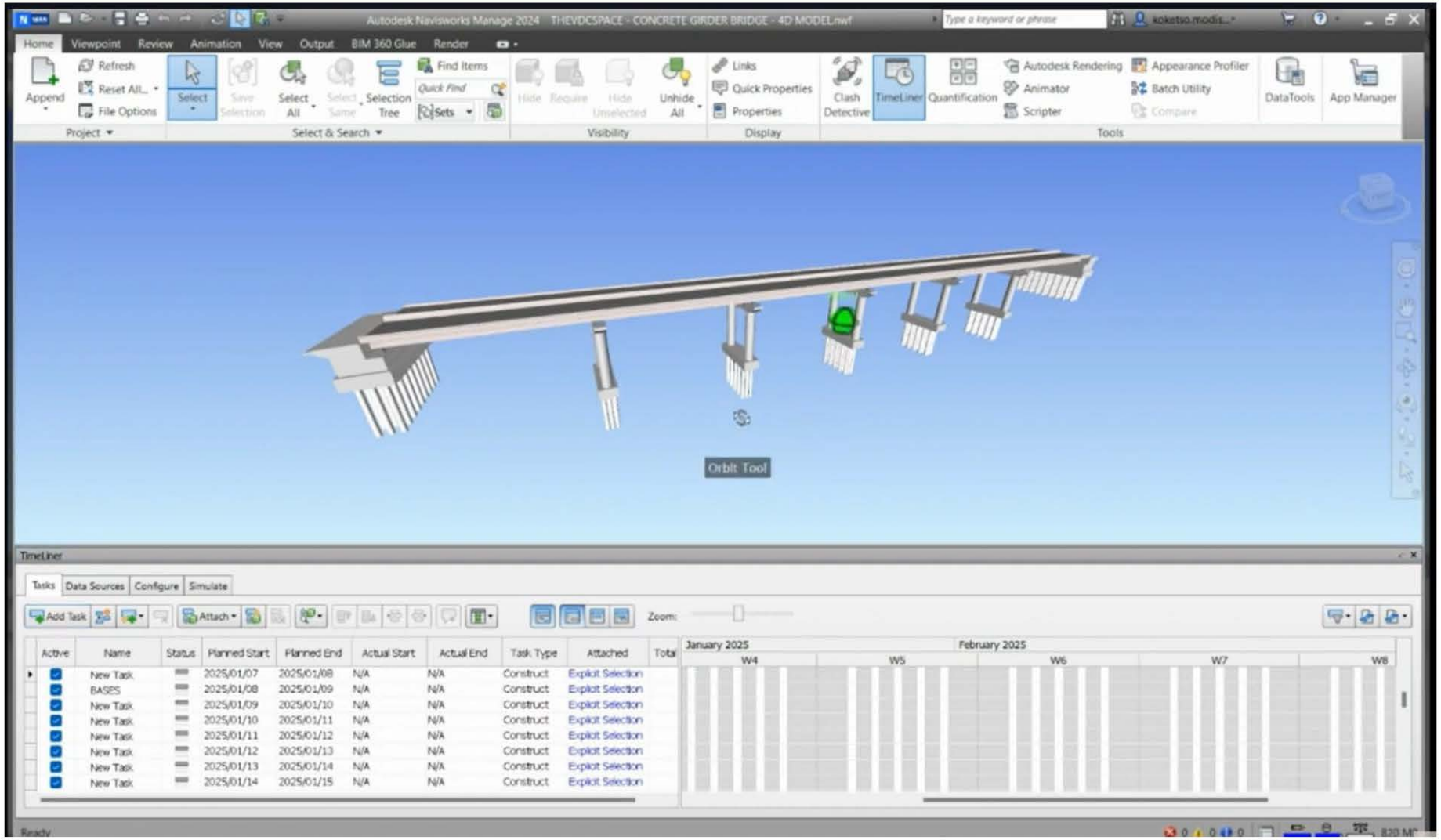
P.O.Box 1, Street address 1, 12345 City 1
Tel. 555 1234567, Fax 555 7654321
Email: first.last@company.com

Project name: | Project number:
Project address: | Item #2 | List date:

QTY	Mark	Prelim Mar	Profile	Material	Length / ft-in	Weight / lb	Top Level / ft-in
1	B34		W12X40	Steel_Und	7'	278.7	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B107		W12X40	Steel_Und	6'11"1/2	276.9	
1	B107		W12X40	Steel_Und	6'11"1/2	276.9	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B107		W12X40	Steel_Und	6'11"1/2	276.9	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B91		W12X40	Steel_Und	6'11"1/2	276.9	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B94		W12X40	Steel_Und	6'11"1/2	276.9	
1	B94		W12X40	Steel_Und	6'11"1/2	276.9	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B97		W12X40	Steel_Und	6'11"1/2	276.9	
1	B97		W12X40	Steel_Und	6'11"1/2	276.9	
1	B97		W12X40	Steel_Und	6'11"1/2	276.9	
1	B34		W12X40	Steel_Und	7'	278.7	
1	B34		W12X40	Steel_Und	7'	278.7	
Total							
28					195'7"	7,787.70	8.52
28					Canteliver Beems have not been modeled		

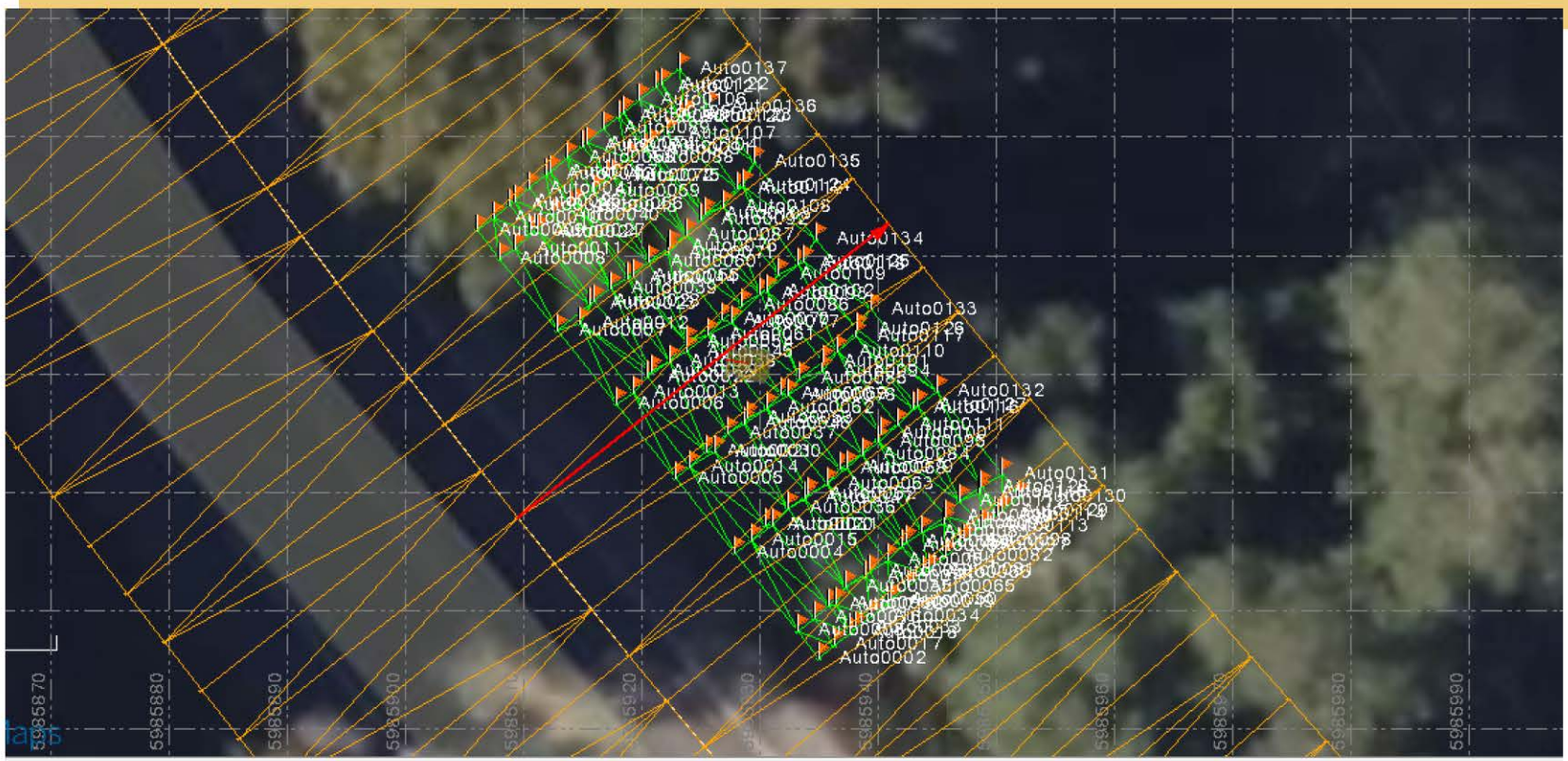
Source: Youtube BIMTopia and Caltrans VTB

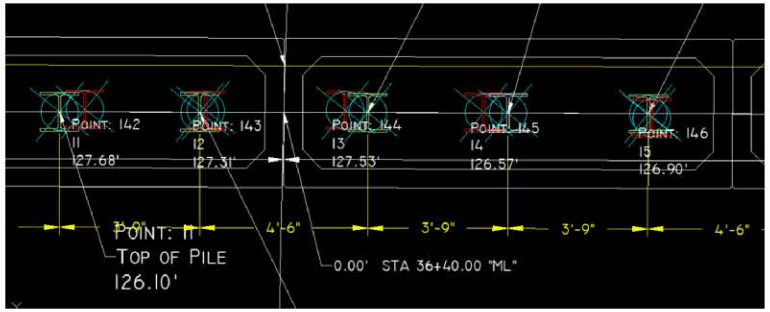
4D Simulation/Scheduling

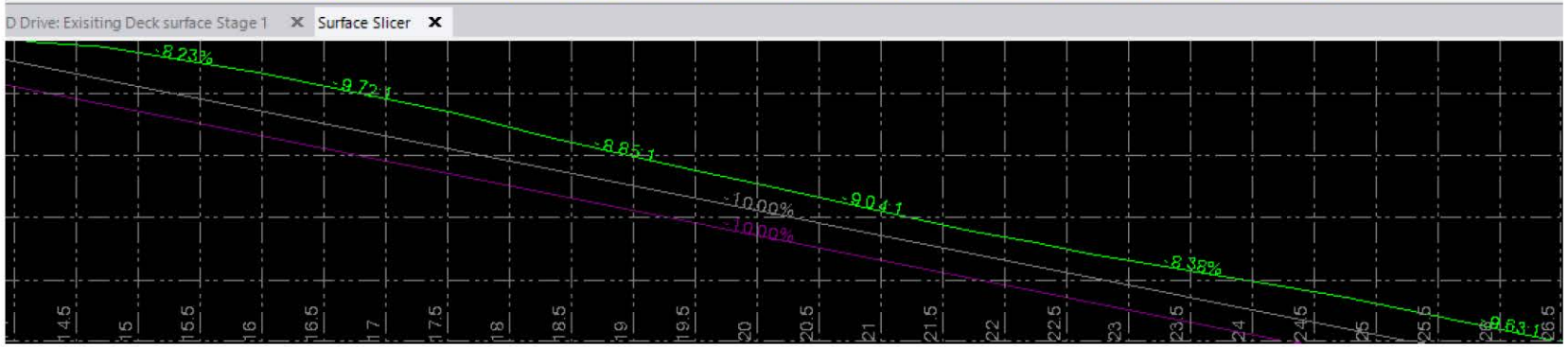


Source: Youtube THE VDC Space

As-builts

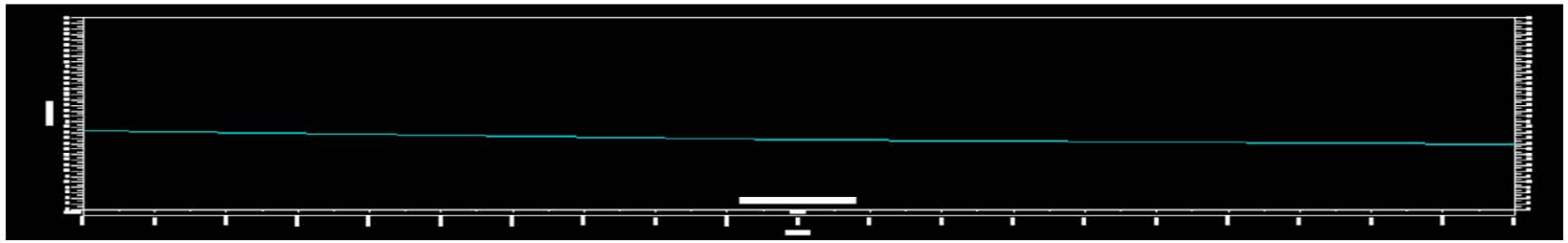






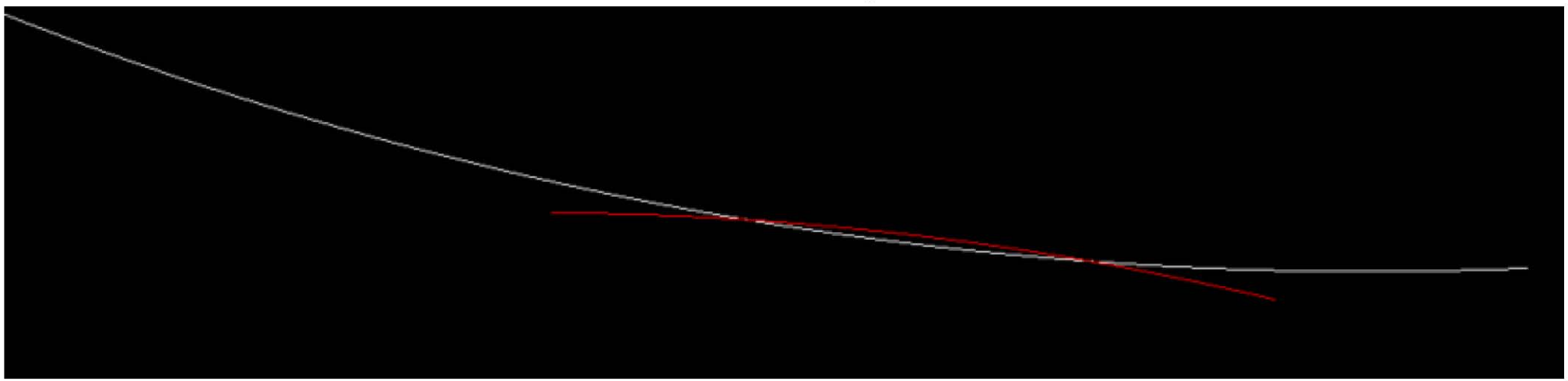
Source: Ward Creek bridge

Profile Comparison



Roadway profile: Sag Curve

PC slab camber profile



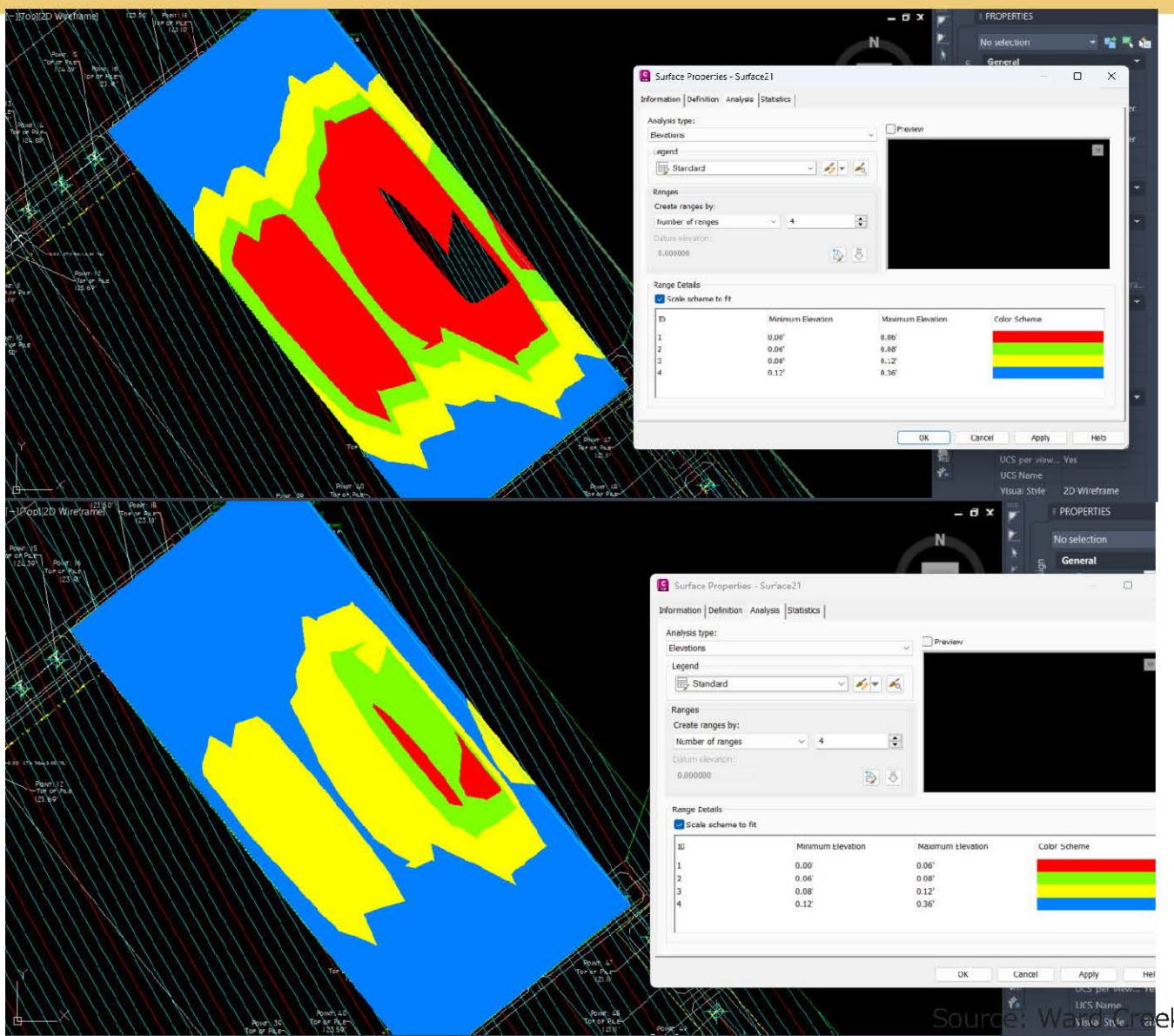
Deck surface profile overlayed over the Roadway profile (polyester surface)

Source: Ward Creek bridge

Polyester Overlay Surface Modeling

Constraints:

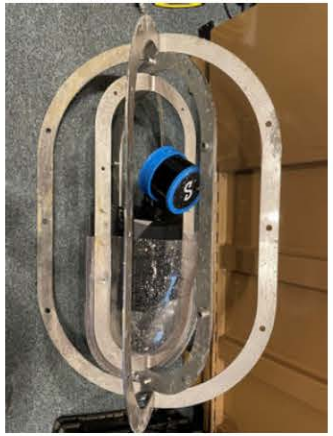
- Camber Variability between slopes
- High Camber
- Need to preserve cross slope
- Precast curb- couldn't go thicker than 1.5" at curb
- Smoother transition of the polyester Overlay longitudinally to connect it to the roadway profile
- Not exceed 125% of Polyester quantity



Source: Wa[illegible]ek bridge

Field Tools

- ❑ GNSS Rover
- ❑ GNSS Base Station
- ❑ Robotic Total Station
- ❑ LiDAR
- ❑ sUAS
- ❑ Laser scanner



KEY TAKEAWAYS

ABC + BIM4I in Practice

1. ABC dramatically reduces on-site construction time through prefabrication and smarter sequencing
2. BIM4I integration enables precision coordination between design, fabrication, and field operations
3. Ward Creek demonstrates LiDAR, GNSS, and 3D modeling working together in real conditions
4. Polyester overlay surface modeling resolved camber variability while satisfying quantity constraints
5. Digital data continuity extends beyond construction into asset management and lifecycle value

Thank You

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Structure Construction · Caltrans

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California Department of Transportation
Structure Construction
Division of Engineering Services
CABES Conference

https://dot.ca.gov/programs/bim4i

https://dot.ca.gov/-/media/dot-media/programs/engineering/documents/abc/ctabc-2021-06-30_a11y.pdf

Data-driven modeling · LiDAR integration · 4D simulation · Precision ABC delivery