Western Bridge Engineers' Seminar

Overcoming Oregon Design-Build Challenges

Rapid Bridge Replacement at Hancock Mountain

Presentation

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T.Y. LIN INTERNATIONAL
engineers | planners | scientists

Owner

Oregon Department of Transportation

Contractor

Slayden

History of Rapid Reconstruction in Oregon

I-5 Columbia River (Interstate) Bridge Trunnion Replacement (1997)

Portland, Oregon

TYLI offered services in analysis of construction options and assistance during construction.

Project Outcome

- "The traffic nightmare that state transportation officials had predicted when the freeway traffic was narrowed from six lanes to three never materialized as commuters used buses or trains, detoured to Interstate 205 or simply stayed home. "

  - The Oregonian

- "I expected gridlock. I was never so glad to be wrong. I am so proud of our citizens -- all of our citizens."

  - Royce Pollard, Mayor, City of Vancouver

- Christie Constructors realized $1.5 million in bonus payments ($100,000 per day) on top of $2.87 million for the project.

Design–Build Procurement

Oregon Design-Build

- OTIA III – Oregon Transportation Investment Act
  - Examined Repair and Replacement of over 300 Bridges Statewide
  - Bond Funding
  - Differing Delivery Methods
    - Traditional Design-Bid-Build
    - Design-Build
    - CMGC – “Contractor at Risk” – One project, the I-5 Willamette River (Eugene)
- Utilizes a Program Manager – Oregon Bridge Delivery Partners (OBDP)
- Project is “Elk Creek to Hardscrabble Creek, Bundle 401”
- Partners Construction Contractor: Slayden Construction Group with the Engineer, T.Y. Lin International

Elk Creek to Hardscrabble Creek

Oregon State Highway 38

- Elkton to Drain, Oregon
- 5 Bridge Replacements
  - Elk Creek Crossings 1, 2, 3 and 4
  - Hardscrabble Creek
- Cost - $52 Million, Design, Construction and Program Management
- Unique Features
  - Schools Program – **Student designed Bridge Pylons**
  - Rapid Replacement
  - Aesthetic components (Bridge rail and Features at Bridge #1)
- http://www.obdp.org/files/dashboard/projects/bundles/401.pdf

Elk Creek Crossing #1
Before and After

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Elk Creek Crossing #1

Student Designed Pylons

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Elk Creek Crossing #2
Before and After

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Hardscrabble Creek Before and After

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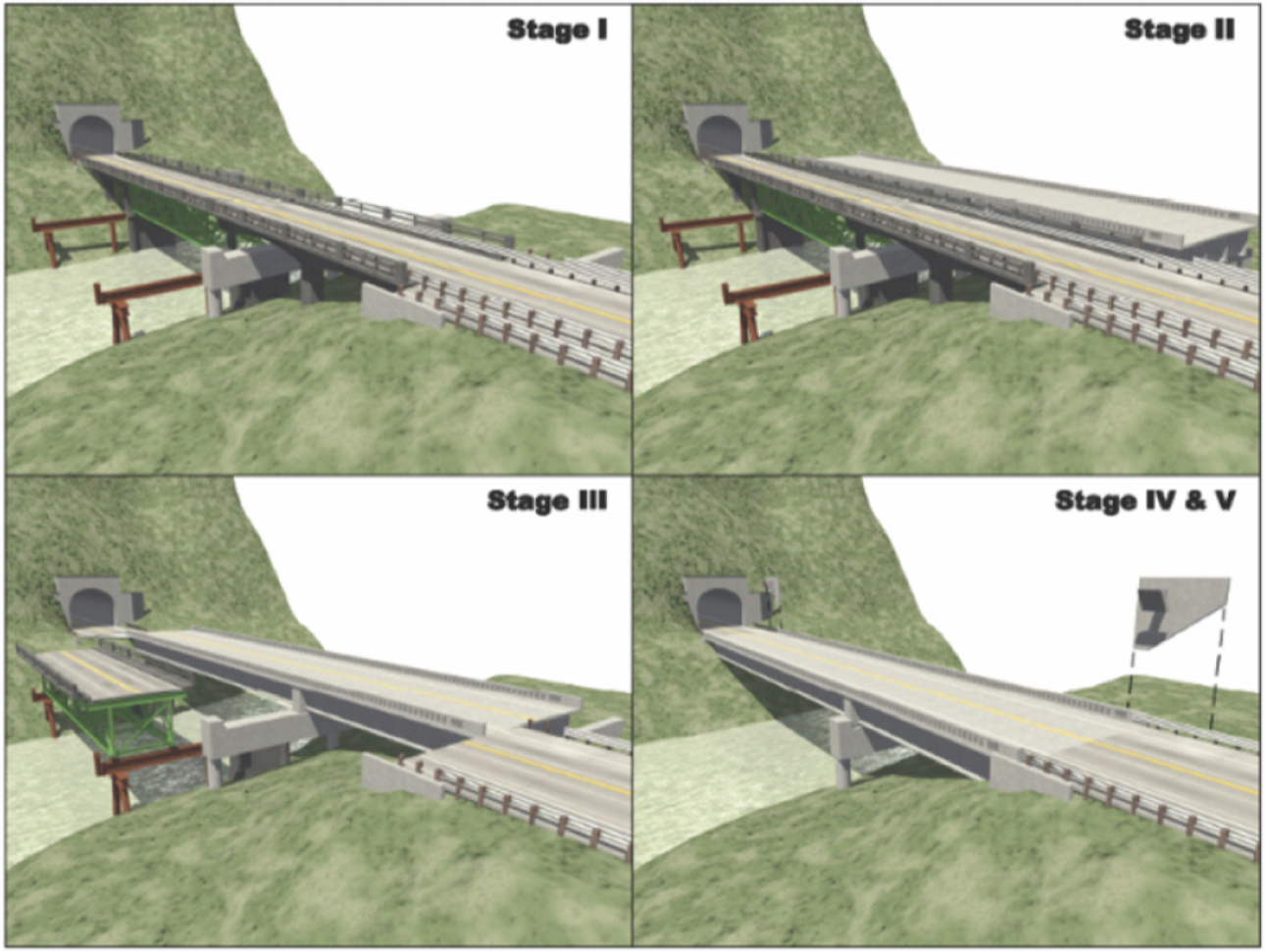
Elk Creek Crossing #3 and #4

Location of Bridges in Proximity to the Elk Creek Tunnel

Bridge #3 approximately 100 ft from tunnel portal
Bridge #4 approximately 50 ft from tunnel portal

Rapid Replacement in 2 - Weekend closure periods

Schematic



Design Build Proposal

Stage I:

Construct temporary and permanent substructures beside and around existing bridge.

Stage II:

Construct complete new superstructure on temporary supports to the side of the existing Structure.

Stage III:

Demolish approach spans with conventional methods.

Translate existing truss main span to side.

Translate completed new bridge into final position.

Stage IV & Stage V:

Install precast wingwalls.

Backfill to bridge abutment.

Install Precast End Panels and Guard Rail connections.

Demolish truss span.

Remove temporary substructure supports.

Finish paving and other punch list items.

Oregon Department of Transportation

Slayden

TYLININTERNATIONAL

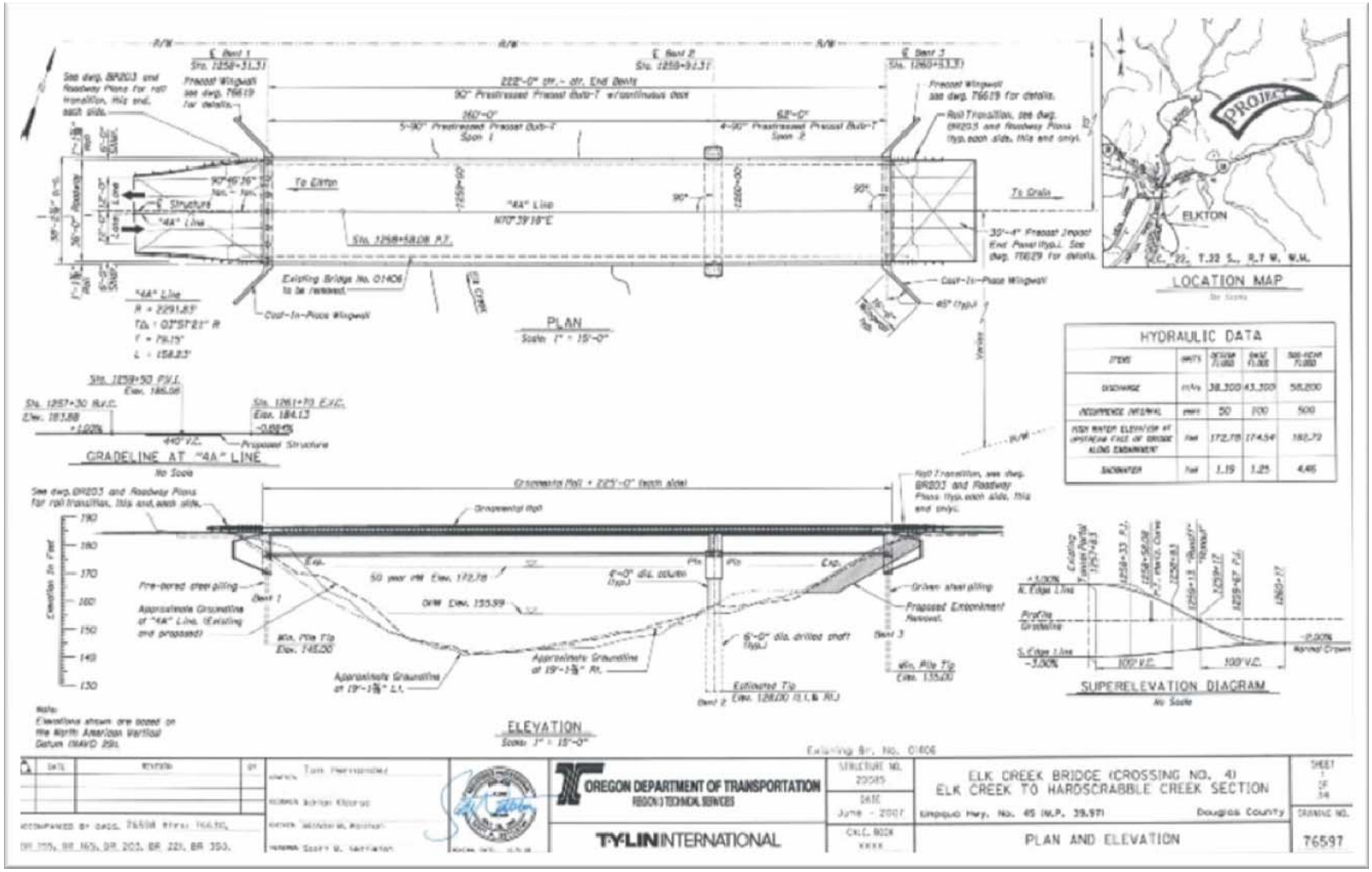
RAPID REPLACEMENT STAGING ILLUSTRATION

430

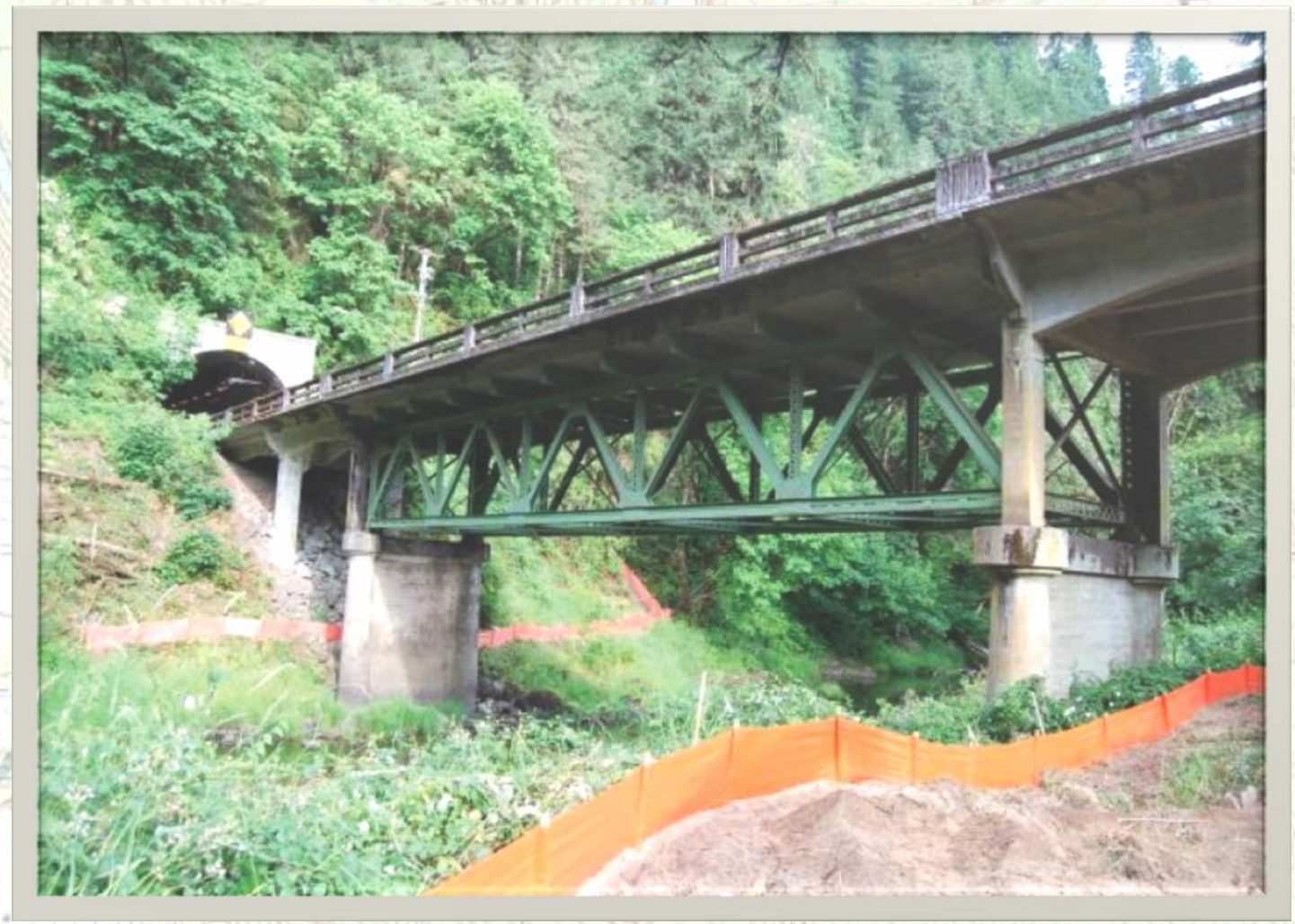
Crossing #4

- **Relatively Simple**
  - Straight Alignment (Superelevation transition)
  - 2 Span w/ 90 degree bents
  - Prestressed concrete simple spans
- **Environmental Challenges**
  - Fluvial Criteria – Oregon interpretation of requirements for re-establishing lost habitat
- **Geotechnical Challenges**
  - Tailings from the tunnel construction in the area
  - Pre-bored piling required at West abutment

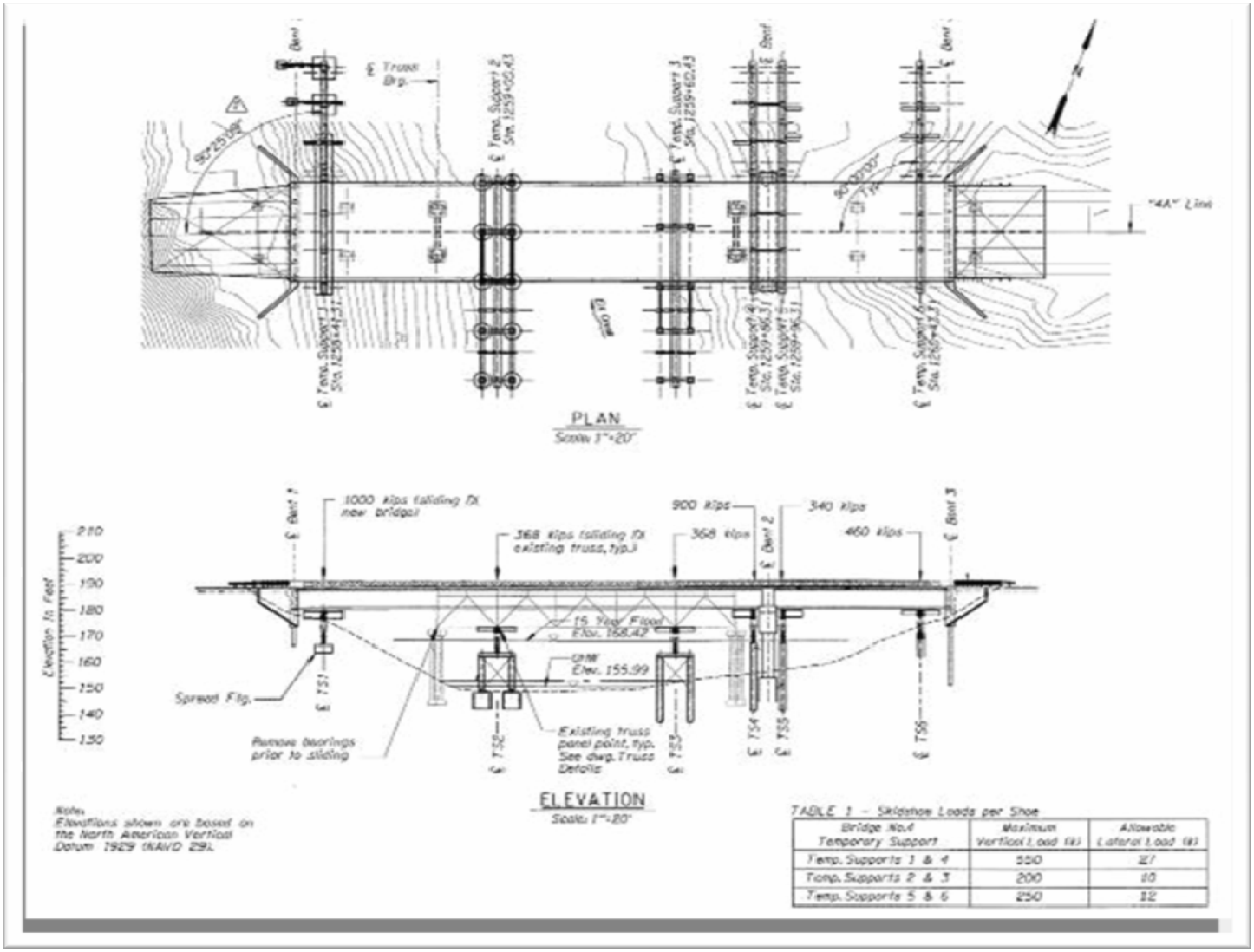
Crossing #4


PLAN
Scale 1" = 15'-0"
LOCATION MAP
ELKTON
PROJECT
HYDRAULIC DATA
GRADELINE AT "4A" LINE
ELEVATION
SUPERELEVATION DIAGRAM
OREGON DEPARTMENT OF TRANSPORTATION
TY·LIN INTERNATIONAL
ELK CREEK BRIDGE (CROSSING NO. 4)
ELK CREEK TO HARDSCRABBLE CREEK SECTION
PLAN AND ELEVATION
76597

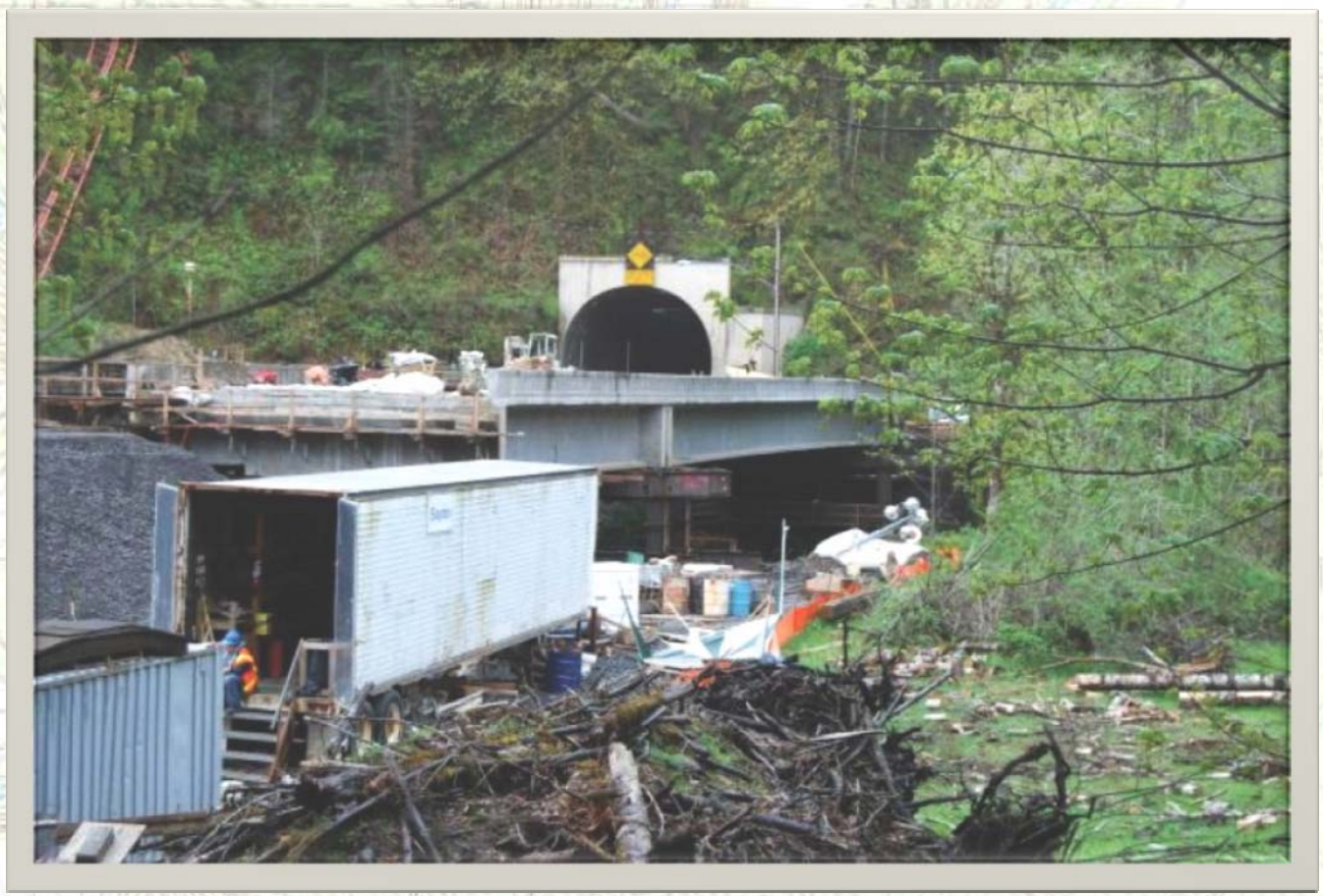
Existing Structure, Before



Perpendicular Temporary Supports



Just Prior to Move, April 29th

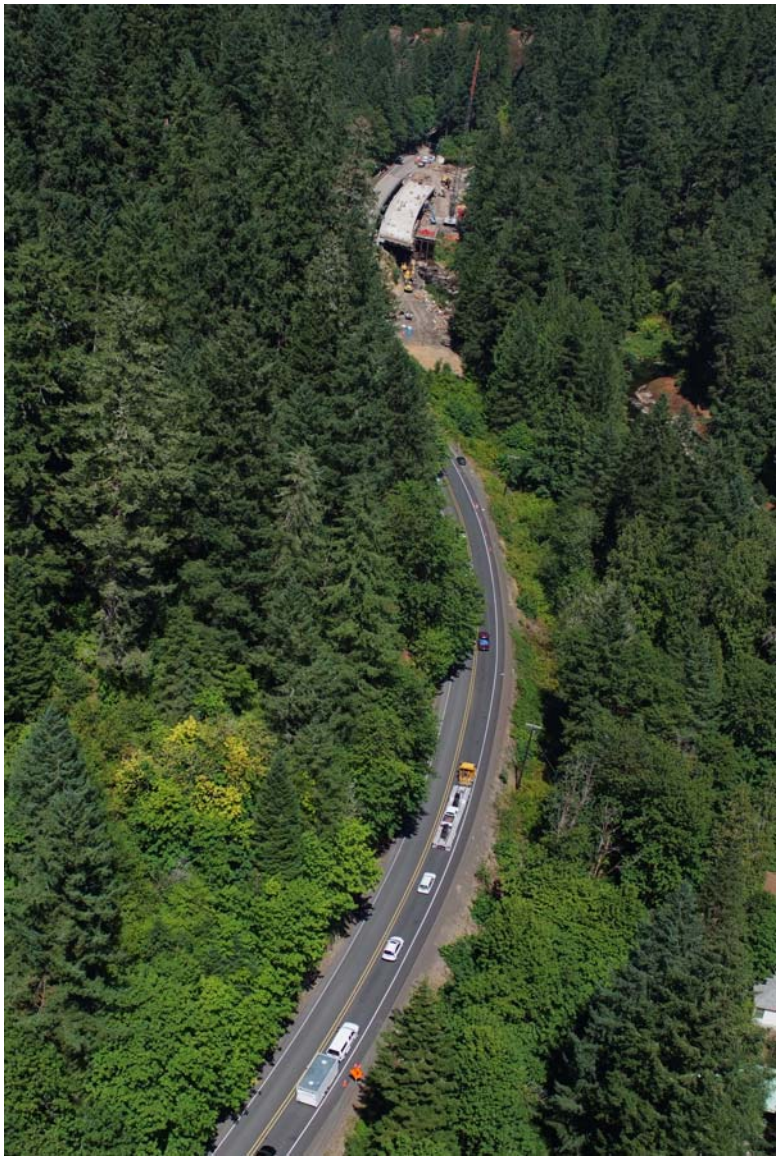


Crossing #4, Precast Wingwall

Crossing #4, Current

Crossing #3

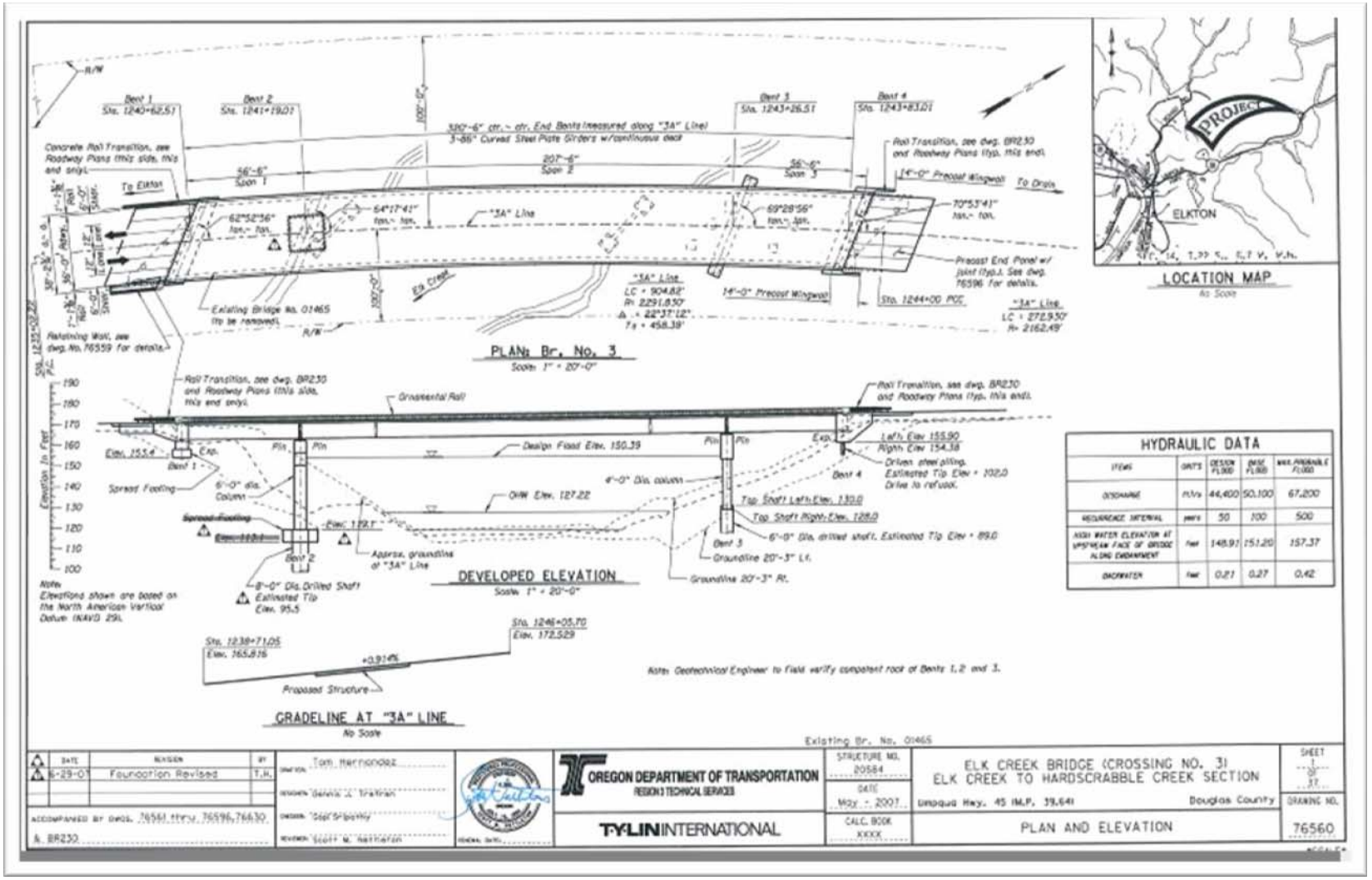
- **More Difficult Site**
  - Longer span
  - Curved alignment
  - Super - elevated
  - High skew angle
  - Steel plate girder bridge with short end spans
  - Extreme topography



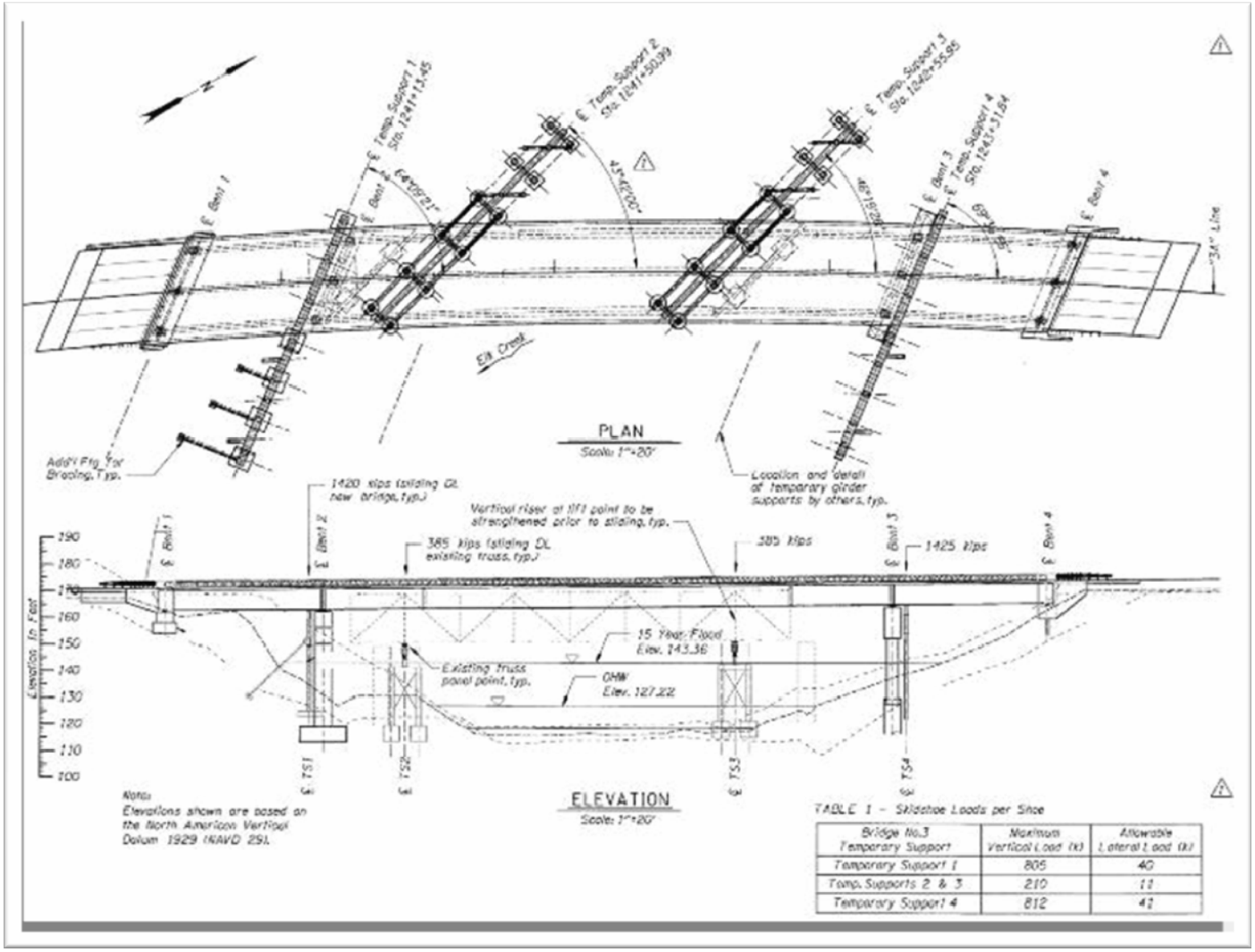
Design Challenges

- **Short End Span Configuration**
  - Produces uplift
  - Code requires restraint
    - Difficult to install complex restraint system in short time period
  - Solution
    - Construct bridge with “low” ends to *elastically* deform upon placement and “pre-stress” a downward force onto the abutments
    - Not sufficient to offset all code required loads, but it will cover the Service loading.
    - Originally based no the concept of Alternate Load Factor Design. Plastic deformation to establish an “Auto-moment”. Abandoned because criteria do not support bottom flange plastic deformation, contract also disallows untried techniques.

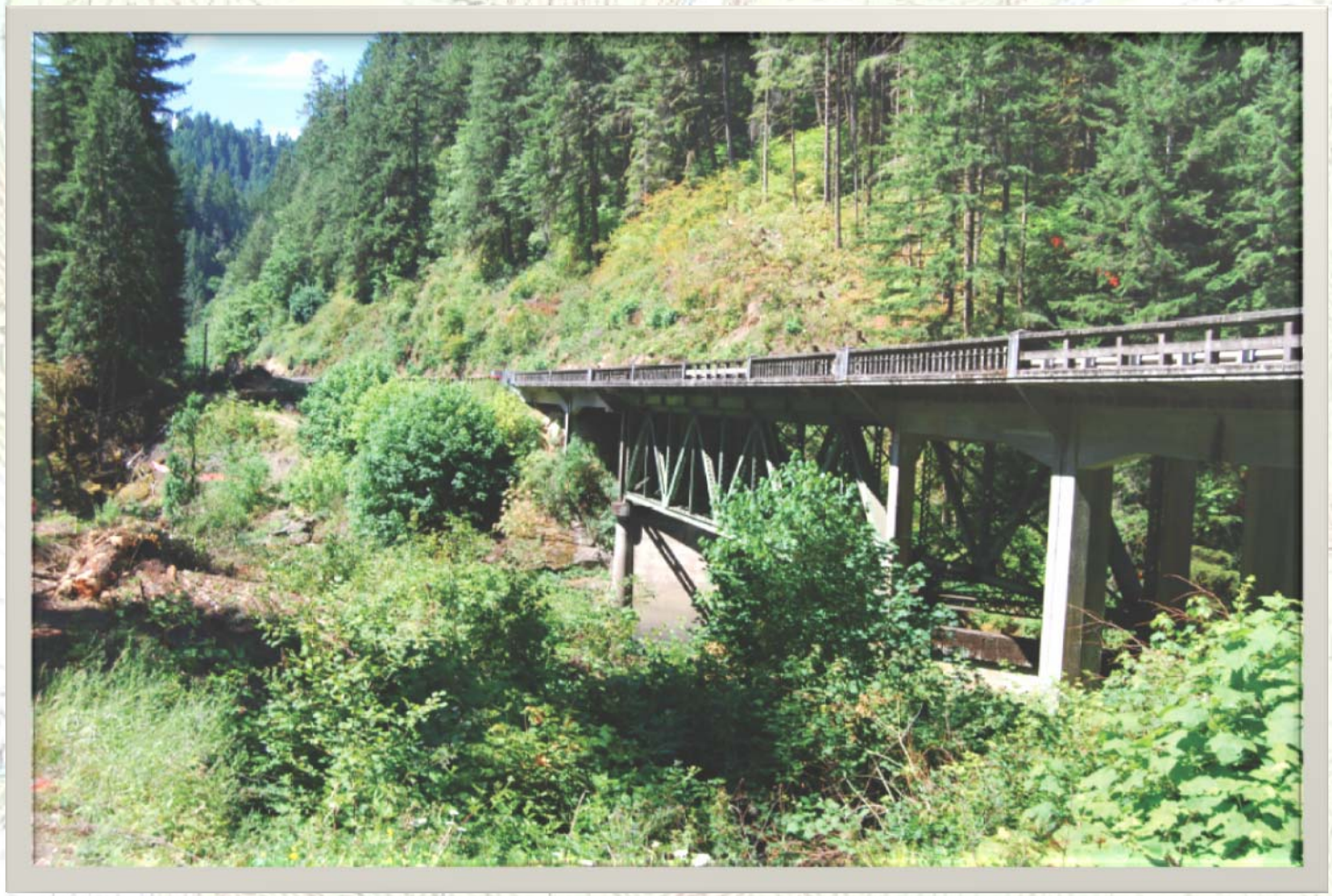
Crossing #3 Plans



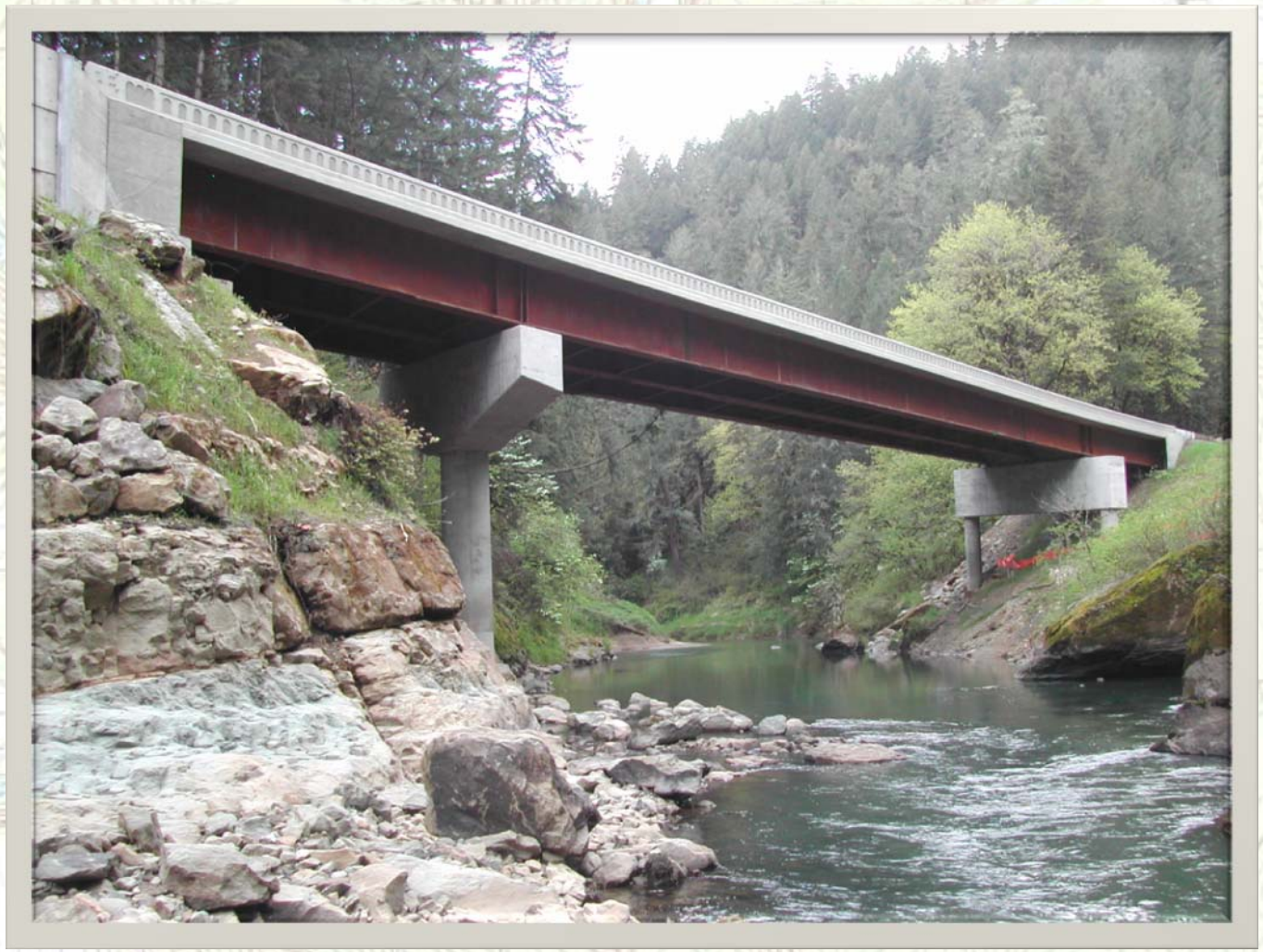
Differing Skew Angles



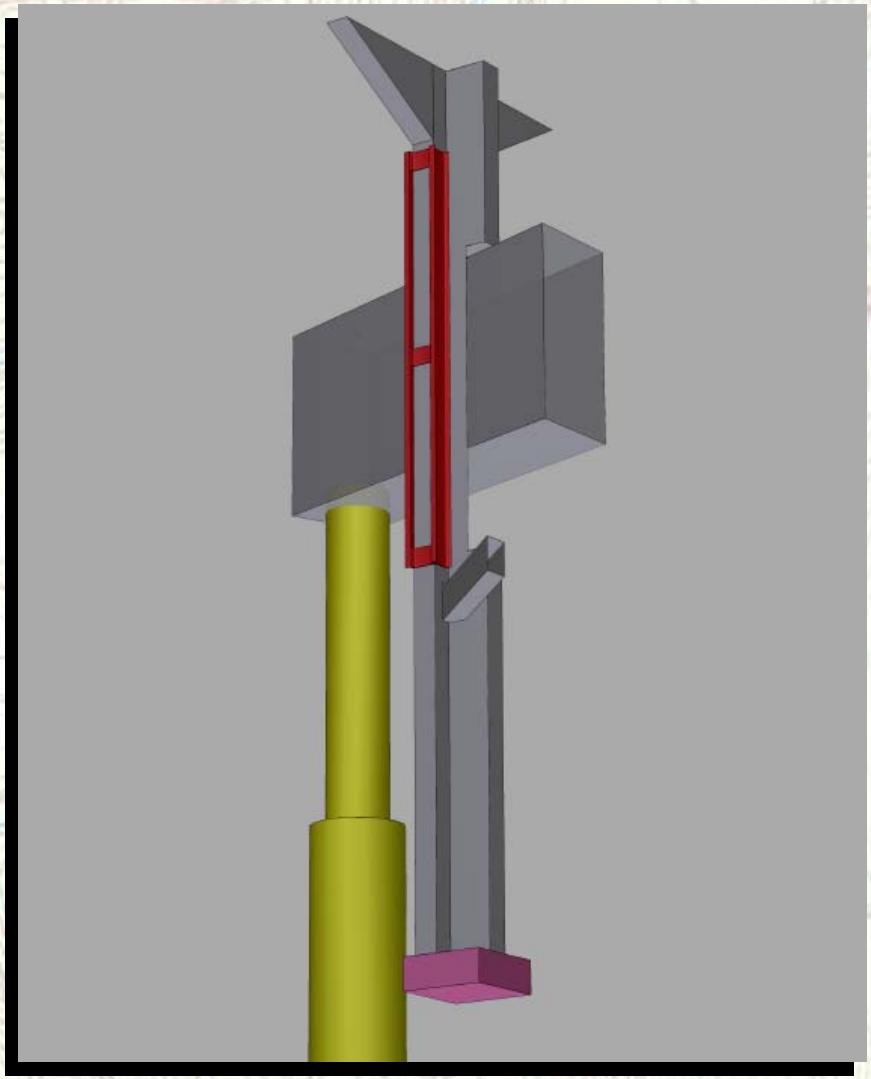
Existing Structure, Before



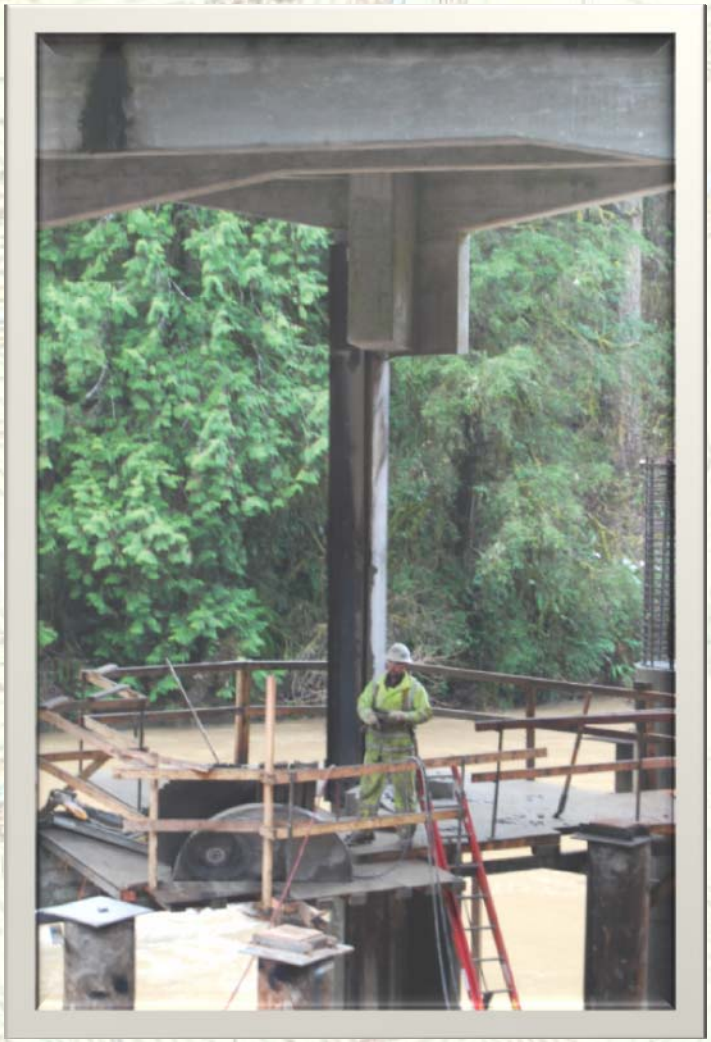
Existing Structure, Current



Shoring at Bent 3

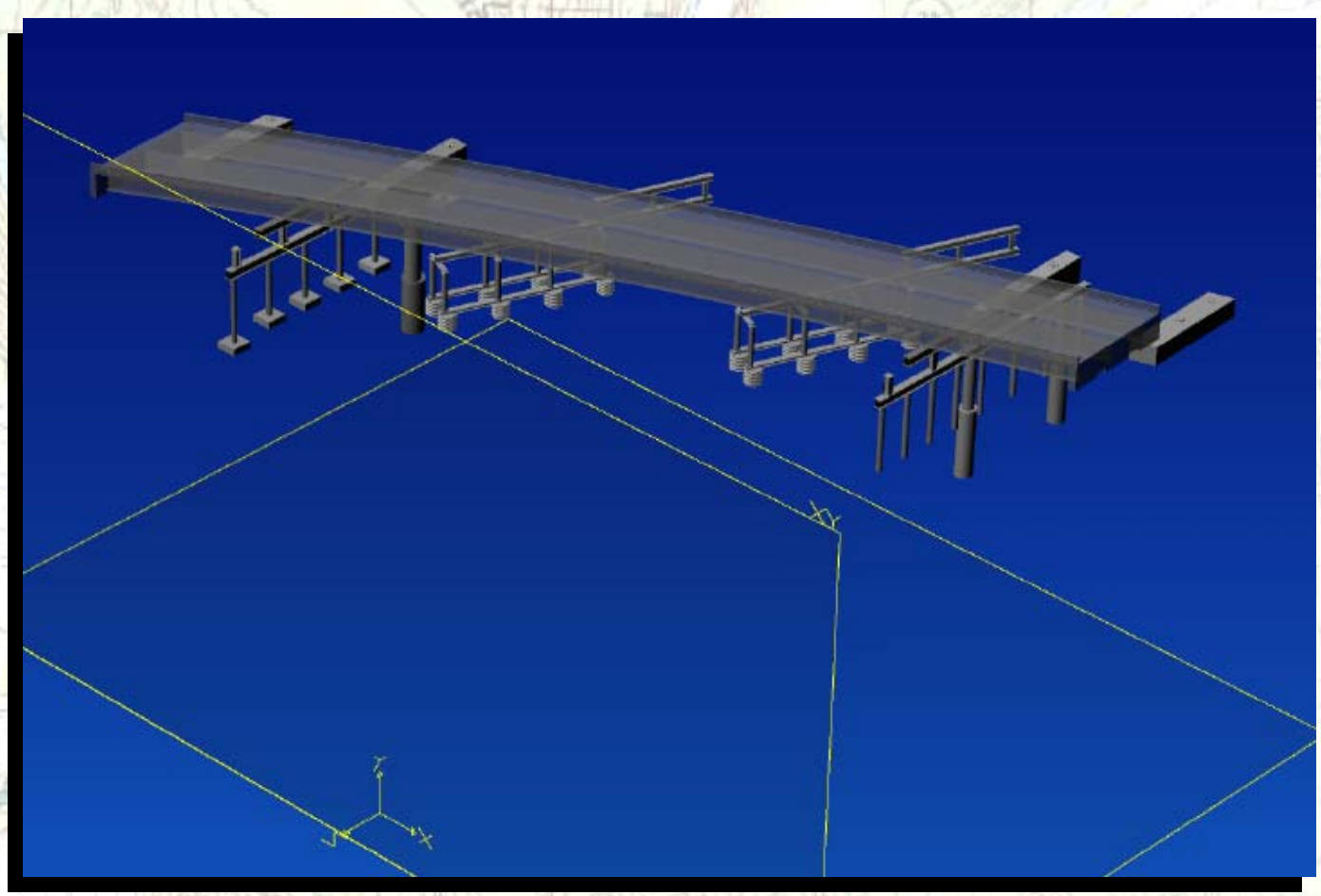


Shoring at Bent 3



Precasting End Panels

Crossing #3, Three Dimensional Modeling



Summary and Conclusions

- **Useful Technique in Various Environments**
  - Dense Urban (I-5 trunnion replacement)
  - Small Urban (Depot Street)
  - Rural with long detour (Elk Creek to Hardscrabble)
- **Perception is Often the Biggest Hurdle**
  - Several Projects have had this technique proposed in Oregon, Generally they have not gone forward because it is felt that the impact will be too extreme.
    - Note: Proposed on McKay Cr to Silvies Slough project, Proposal evaluators indicated that the technique was inappropriate at that site, despite relatively simple detour.
  - Design Build is the contracting format that make this happen.

Summary and Conclusions - continued

- **Technical Challenges**
  - Connecting the super structure appropriately to the substructure after the move
    - Satisfactory performance under Service
    - Seismic Loads – connections to transfer loads appropriately are difficult, isolation should be investigated (no anticipated cost advantage)
  - Understanding of grades and movements
    - Encourage 3-D modeling and sophisticated visualization

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