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Leveraging Technology

3D Laser Recordation for Historic Structures

Brooklyn Subdivision Bridge, Oregon

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Presentation Outline

- Overview of Bridge Replacement at MP 662.98 Brooklyn Subdivision
- Federal U.S. Army Corps of Engineers Permit Process
- Section 106 of National Historic Preservation Act
  - Determination of Bridge Significance
  - Memorandum of Agreement (MOA)
- 3D Laser Scan Technology and Recordation
- Process Challenges and 3D Laser Solutions
- Benefits of Approach

Bridge at MP 662.98 Brooklyn Subdivision

- Located 2.1 miles south of Harrisburg, Oregon
- Spans Willamette River in Linn and Lane counties
- Replace 1906 through-truss bridge with modern deck plate girder ballasted-deck bridge
- Required U.S. Army Corps of Engineers approval under Section 404 Clean Water Act and Section 10 Rivers and Harbors Act
- Federal permits triggered consultation with SHPO under Section 106 of National Historic Preservation Act

Significant Swing Span Design

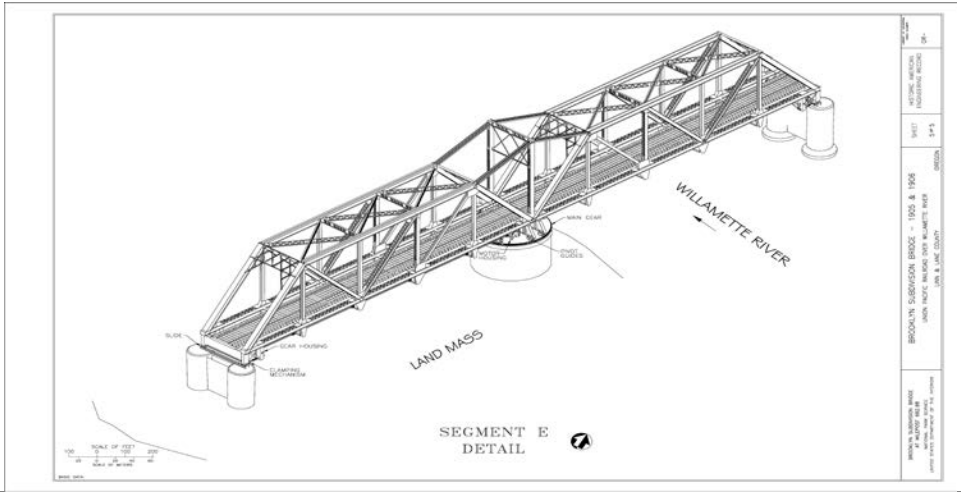
- Swing-span design was one of the reasons the bridge was historically significant.

- Swing-span was designed to accommodate Willamette River traffic, but engines were never installed and it was never operated.

Federal USACE Permits and Section 106

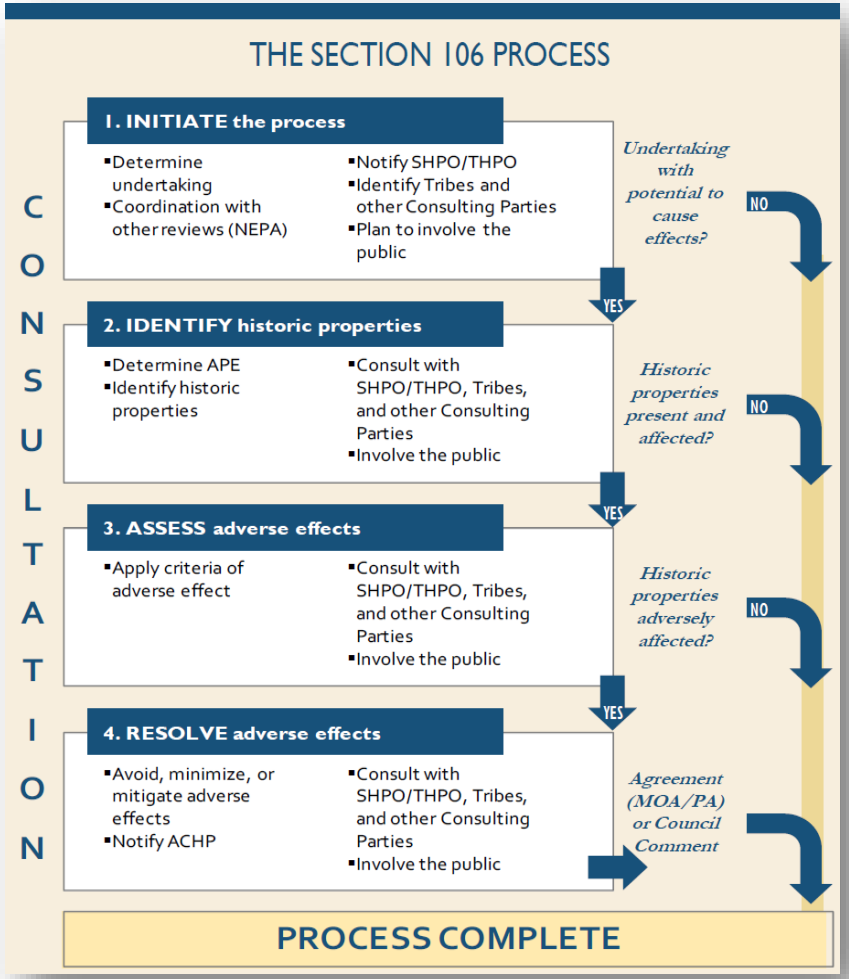
Federal Permits

- Section 404 permit required for fill within waters of the U.S. because new bridge required excavation and installation of new bridge bents
- Section 10 Rivers and Harbors Act for construction of any structure in or over navigable water



SHPO Consultation

- Section 404 requires USACE to consult with SHPO under Section 106 of the NHPA
- USACE, in consultation with SHPO, applies Section 106 criteria to the project
- USACE considers effects on historic properties (listed in or eligible for listing in the National Register of Historic Places) in its permit process
- Historic rail properties can include bridges, railway, culverts, depots, and related buildings

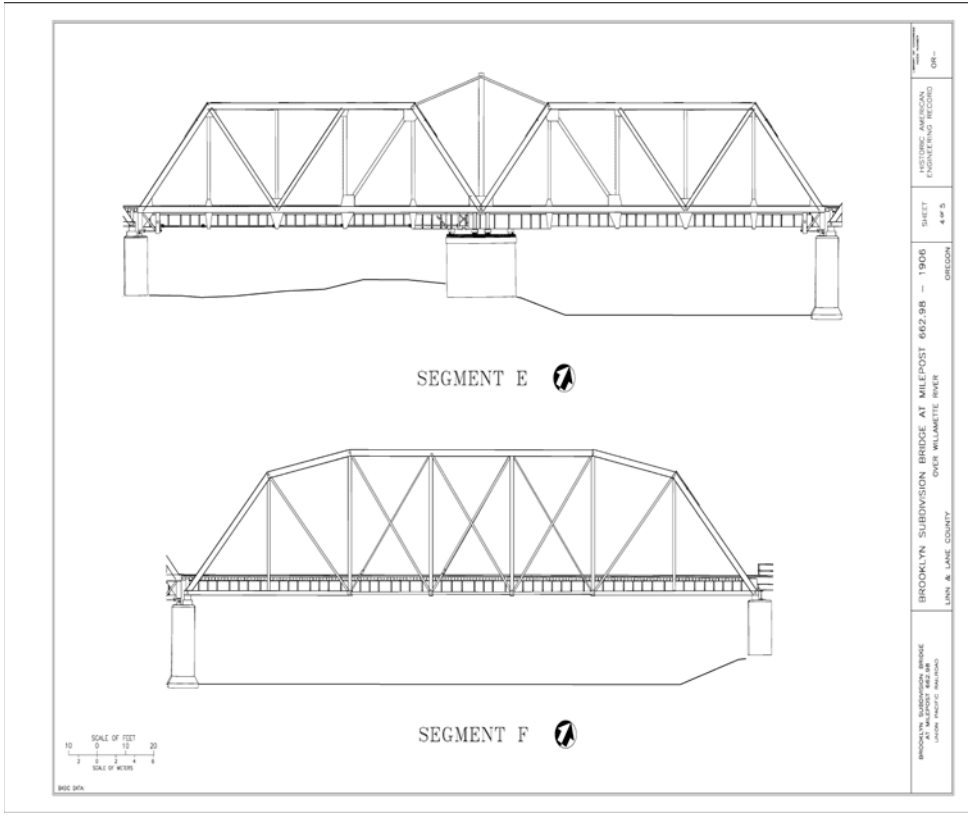


USACE Requirements under Section 106

- Notify SHPO and Tribes
- Determine Area of Potential Effects
- Conduct literature search and surveys
- Assess potential effects to historic properties and mitigate if needed
- Mitigation is stipulated in MOA or Programmatic Agreement

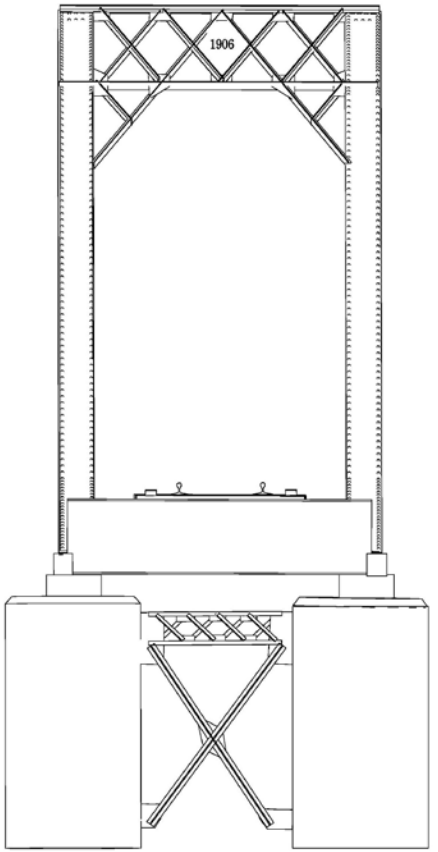
Bridge 662.98 Determined Eligible for NRHP

- Bridge previously determined eligible for listing in 1984
  - Association with O&C Railroad Company and early railroad network
  - Significant swing span design and combination of riveted and pin-connected construction
- Memorandum of Agreement
  - Record the bridge following Historic American Engineering Record Guidelines
  - Good faith effort to advertise and make available for donation to interested parties all or portions of the bridge
  - MOA decision and compliance document signed by USACE, SHPO, and UPRR



NRHP Eligibility Requires Extensive Documentation

- Prior to demolition of bridge, Historic American Engineering Record documentation was required to provide permanent record of existing conditions.
- Goal of documentation is to interpret “industrial processes, cultural values, and patterns of use.”*
- Drawings must be highly detailed and extremely accurate, yet understandable by the general public.
- Documentation includes:
  - Historic context and property description
  - Photographs
  - Measured drawings



*National Park Service HABS/HAER Program

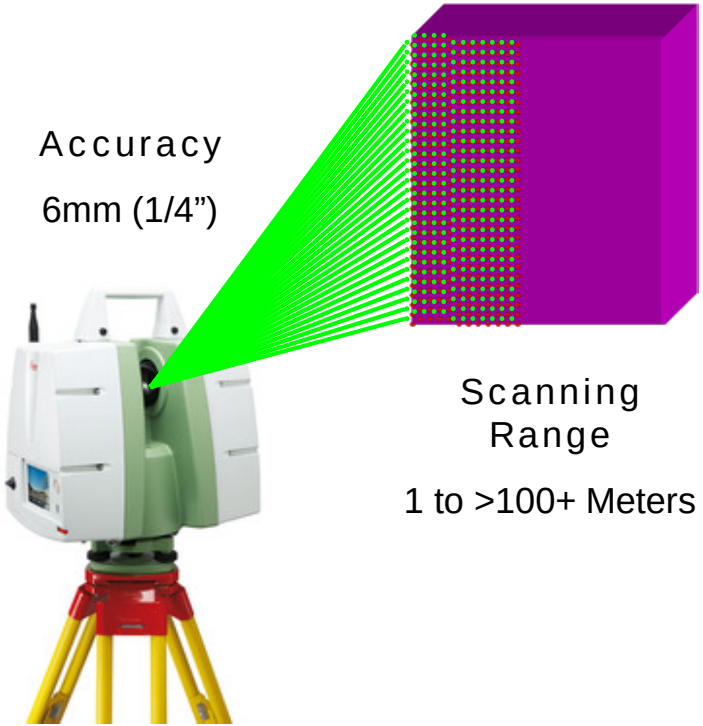
Site Conditions and Construction Timeline Posed Recordation Challenges

- Large bridge size
- Location over a waterway
- Active railway
- Construction schedule required expedited recordation

3D Laser Scan Technology Helped UPRR Meet These Challenges

- Remote sensing technology captures data by sending/receiving millions of pulses of light
- The scanner collects upward of 500,000 points per second and can reach points up to 975 feet away
- Scans 360 degrees horizontally and 270 degrees vertically
- Creates a “point cloud” or “scan world” from each scan position
- These scan worlds are stitched together to create a comprehensive 3-dimensional set of points

3D Laser Scanning Technology Benefits



Accuracy

6mm (1/4”)

Scanning Range

1 to >100+ Meters

Range of Motion

360° (H) x 270° (V)

Challenge 1: Large Bridge Size and Survey Costs

Traditional Method

- Requires extensive costs to support multi-member recordation team onsite for many weeks
- Impossible to capture in single photograph

3D Laser Solution

- Small team of 3 staff to record entire bridge in 4 days
- Gathers data in a way that produced a single continuous image of the entire bridge in compliance with recordation requirements

Challenge 2: Location Over Waterway Used by Active Railroad

Traditional Method

- Hand recordation is time consuming
- Longer time spent on bridge and over river = increased health and safety risk
- Bridge closed to train traffic for long period of time to ensure staff safety

3D Laser Solution

- Recordation time on bridge and over water is minimized
- No track down time needed

Challenge 3: Construction Timeline Required Expedited Bridge Documentation

Traditional Method

- Hand survey method requires multiple weeks to complete
- Weather delays likely based on location and seasonal constraints
- Finite construction start date at risk

3D Laser Solution

- Survey took one week
- Able to schedule survey to avoid inclement weather
- Survey and complete documentation finished well before proposed construction start date

Benefits of 3D Laser Scanning for Project

- Documents large or hard-to-access structures
- Saves costs of using traditional methods
  - Quicker to survey by fewer staff
  - UPRR flagger required for shorter period of time
- Provides greater detail and more accuracy than could be gained with traditional methods
- Improves safety over traditional methods
- Gathers data with minimal impact to train traffic, resulting in further savings
- Requires less time than traditional methods, avoiding further schedule delay
- Provides 3D data as well as traditional CAD drawings

Photo Source: 2016. Hamilton Construction. http://www.hamil.com/projects_union-pacific-railroad.php