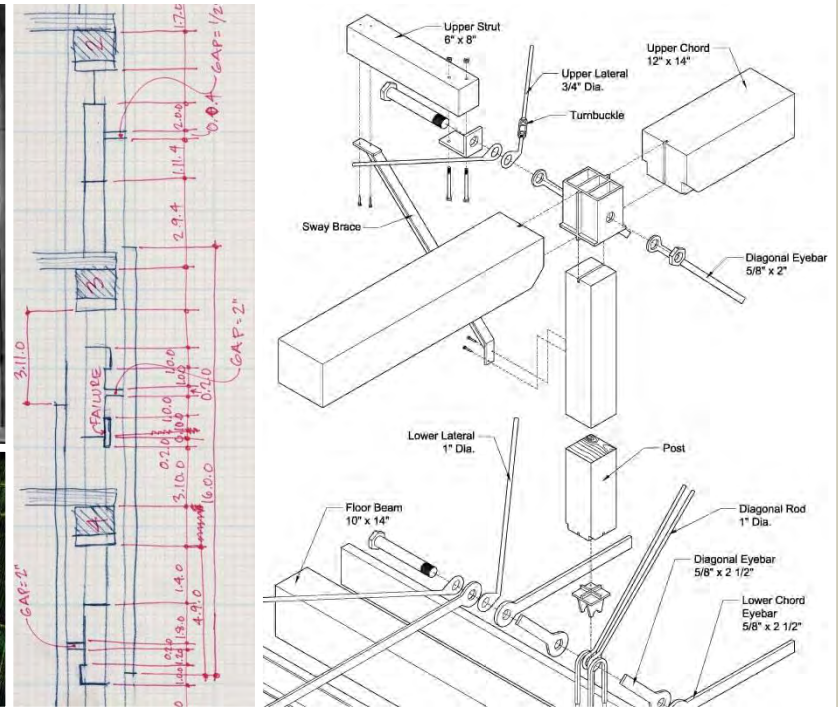


Strategies for Documenting Covered Bridges Using 3D Laser Scanning and 3D Modeling



Jeremy Mauro
National Park Service, Heritage Documentation Programs
Historic American Engineering Record



Goals of Documentation

“The goal of the collections is to provide architects, engineers, scholars, and interested members of the public with comprehensive documentation of buildings, sites, structures and objects significant in American history and the growth and development of the built environment.”

Standard I Documentation Shall Adequately Explicate and Illustrate What is Significant or Valuable About the Historic Building, Site, Structure or Object Being Documented.

Standard II. Documentation Shall be Prepared Accurately From Reliable Sources With Limitations Clearly Stated to Permit Independent Verification of the Information.

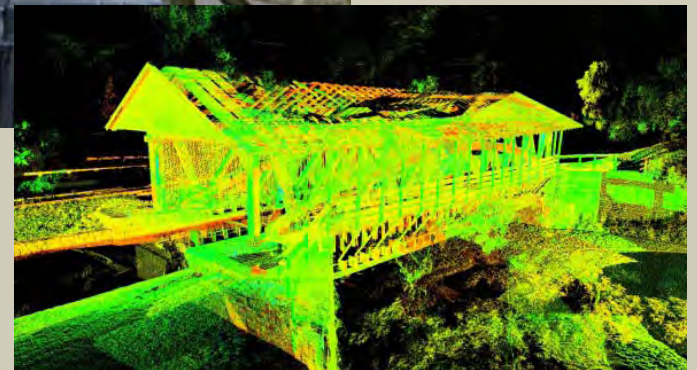
Standard III. Documentation Shall be Prepared on Materials That are Readily Reproducible, Durable and in Standard Sizes.

Standard IV. Documentation Shall be Clearly and Concisely Produced.

The Secretary of the Interior's Standards for Architectural and Engineering Documentation

http://www.nps.gov/history/local-law/arch_stnds_5.htm

Capturing scan data in the field





Leica ScanStation 2

Range: 300m

50,000 points/sec.

Noise: 2mm

3R class laser



Leica ScanStation C10

Range: 300m

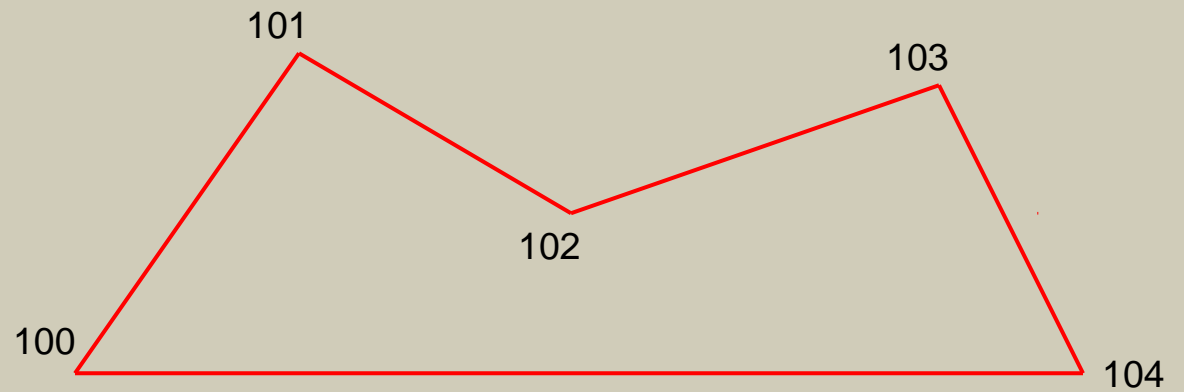
50,000 points a sec.

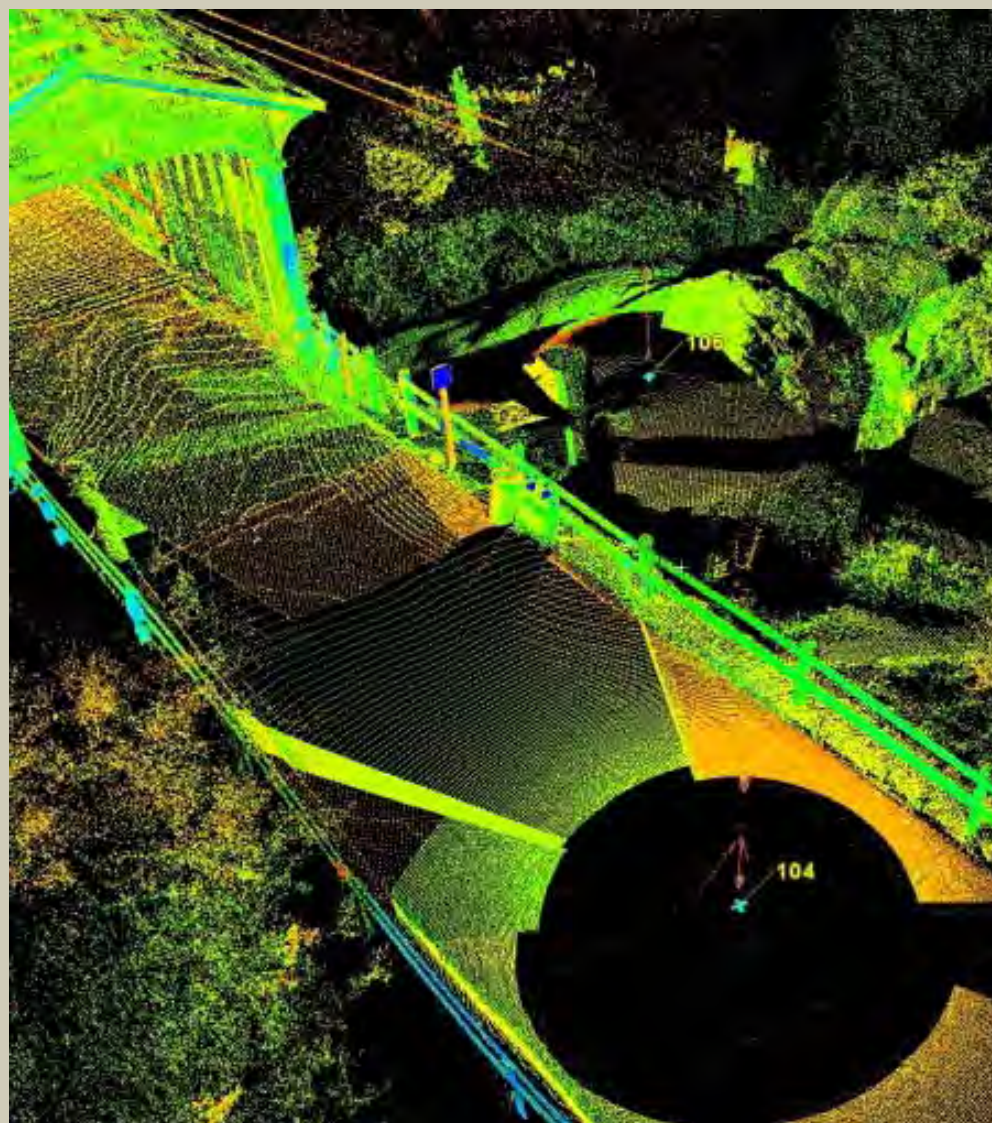
Noise: 2mm

3R class laser

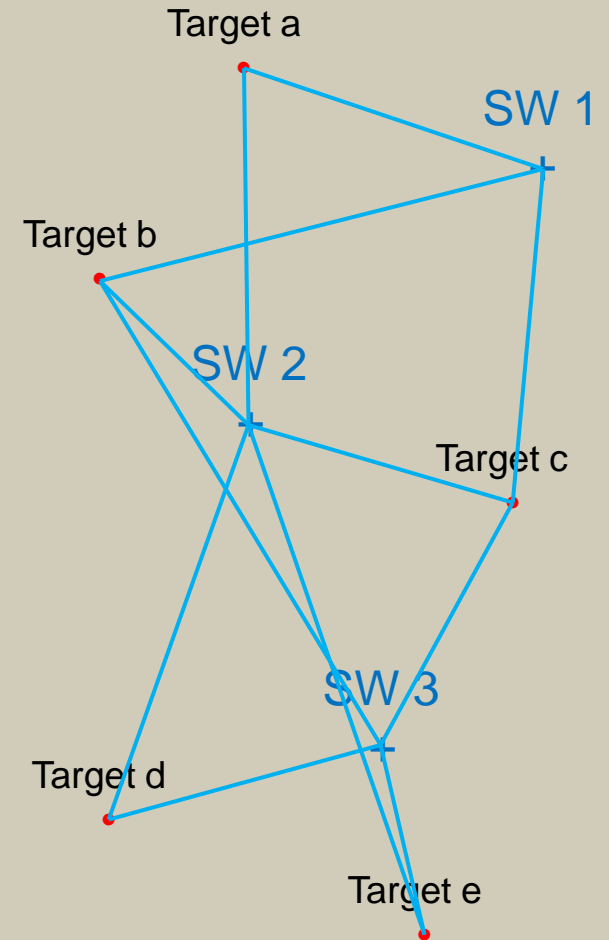
Much lighter, faster, and less
field equipment required.

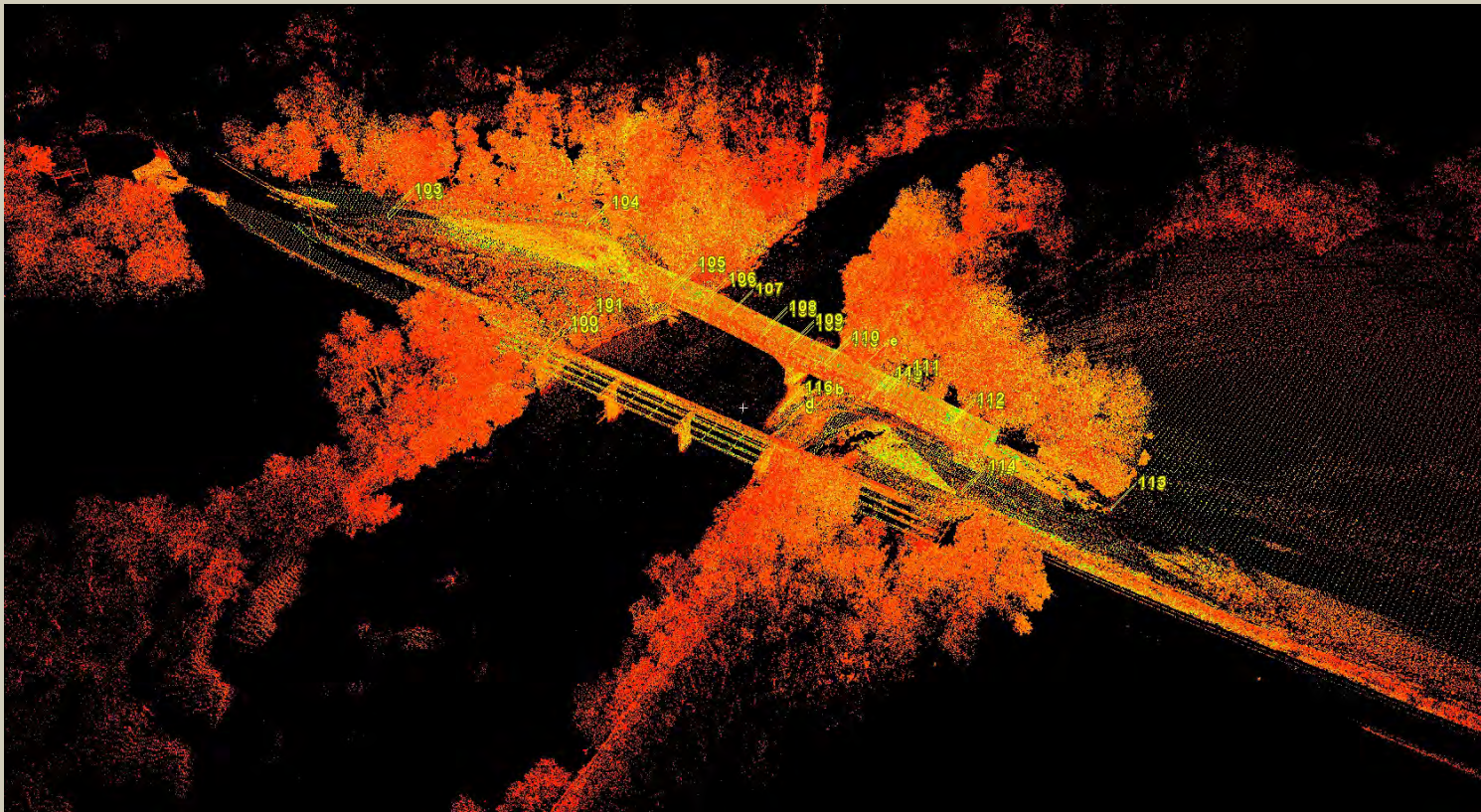
Traverse scan method



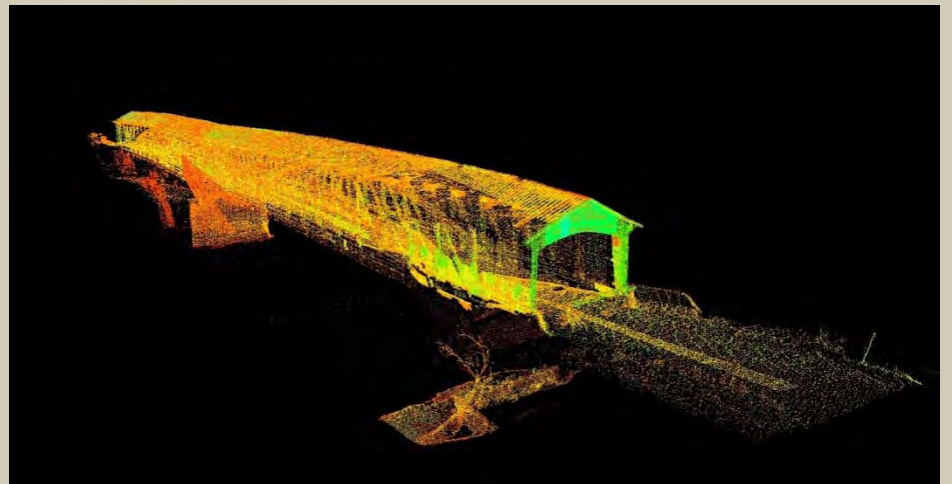


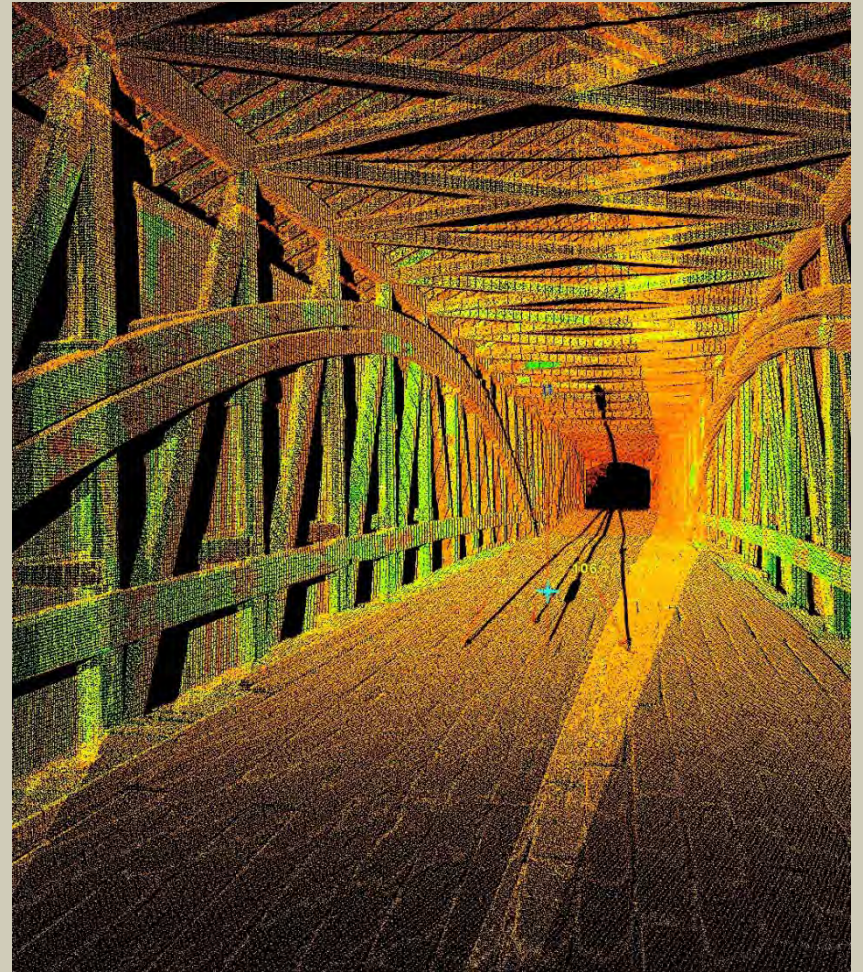
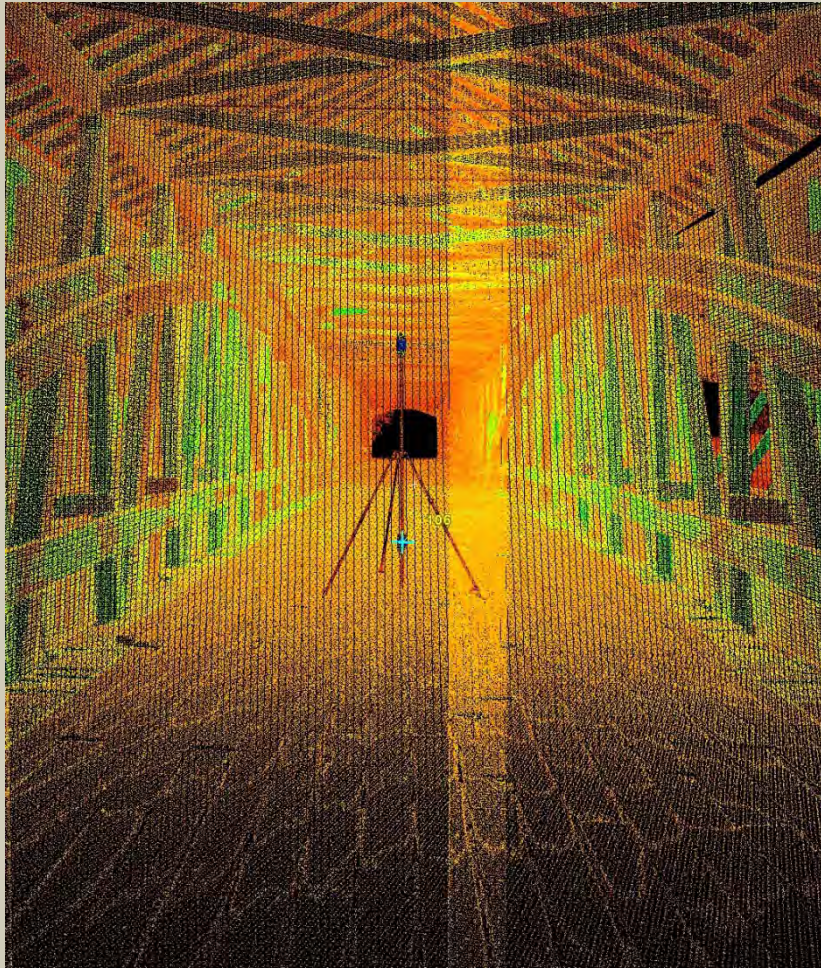
Free Target Scan Method



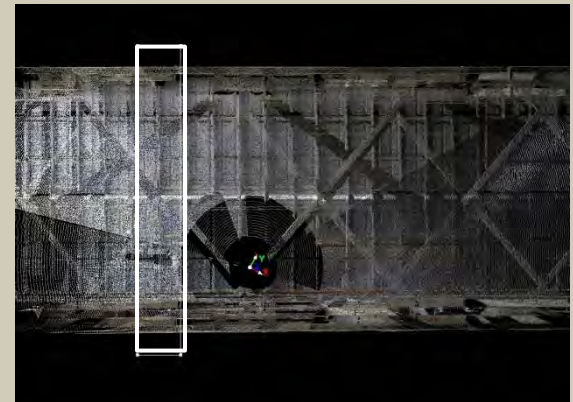
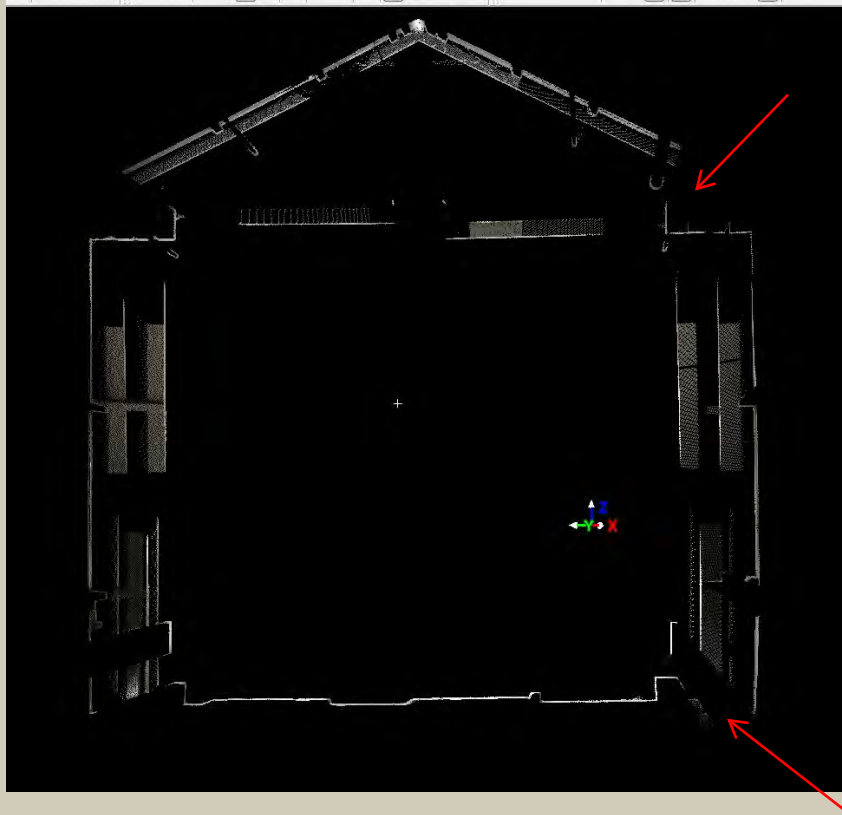


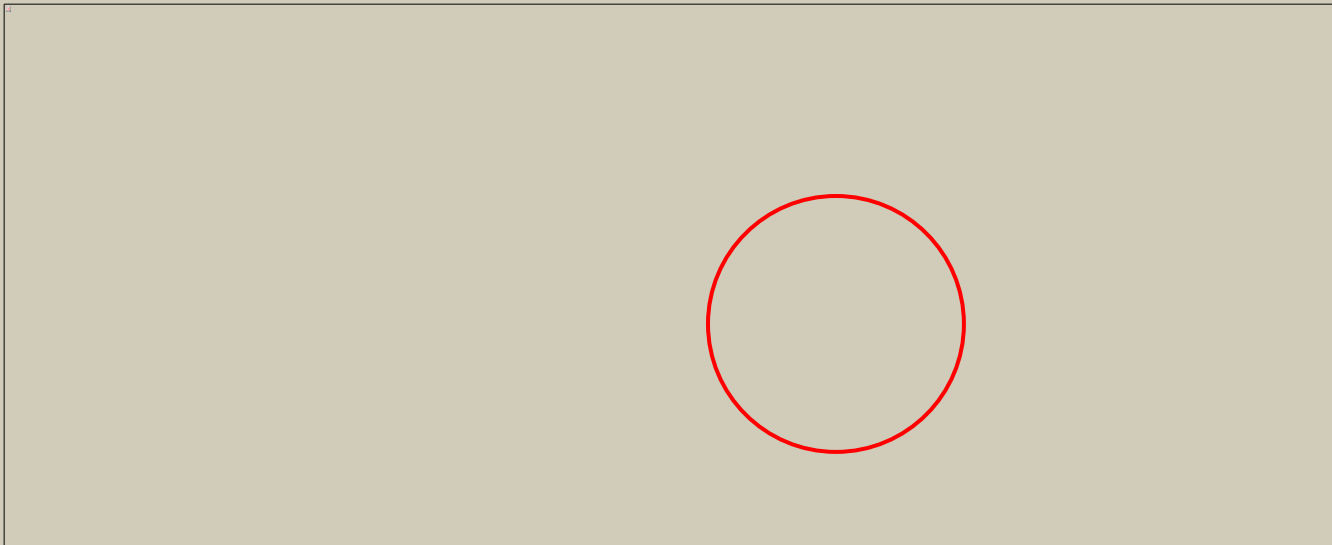
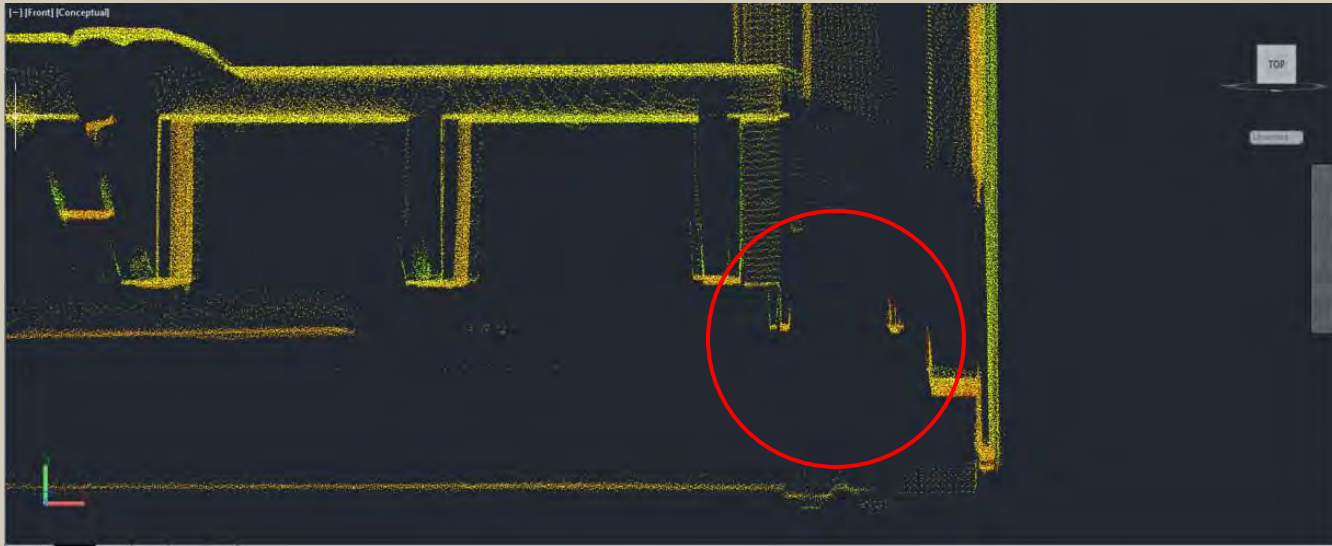
Recent fieldwork:
17 Stations
297,306,453 points





Scan-shadows

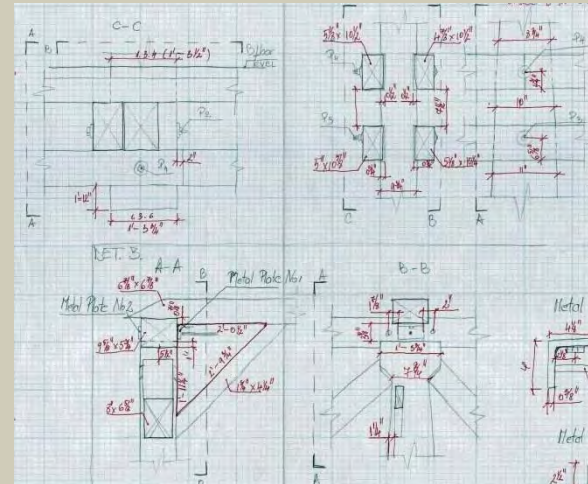




Filling the gaps in scan data



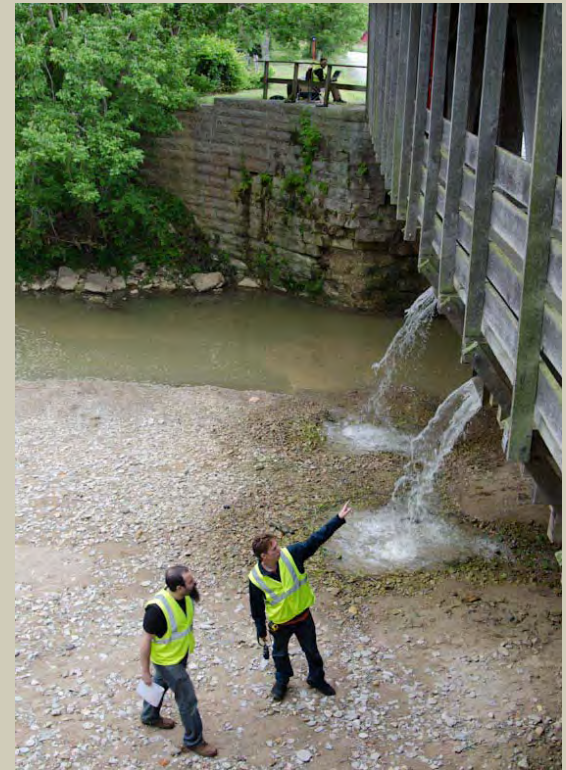
Hands-on investigation and measuring



Field notes

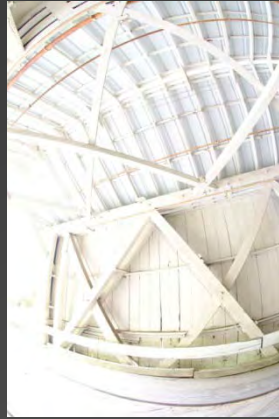


Field photos





Normal
Exposure



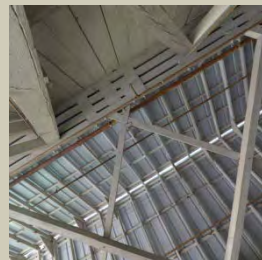
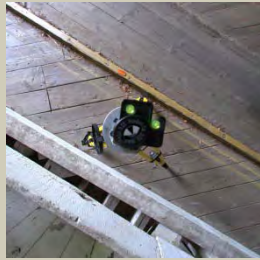
Overexposure

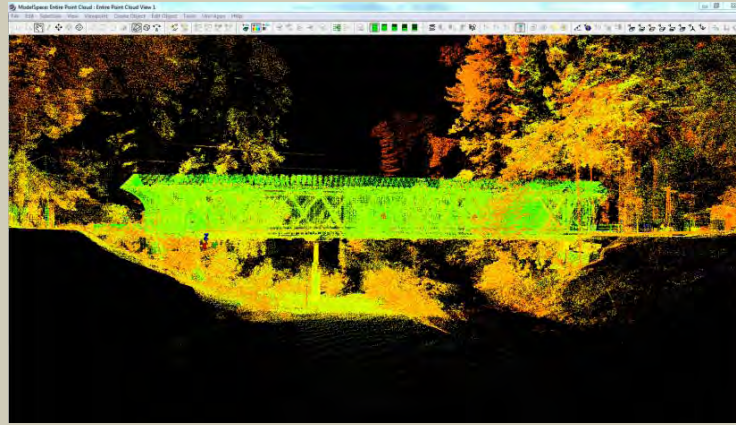
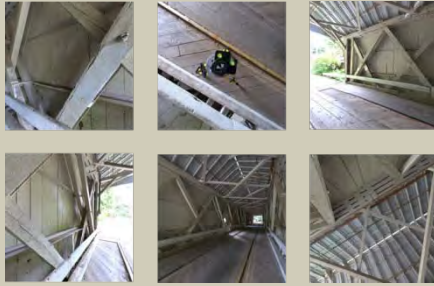


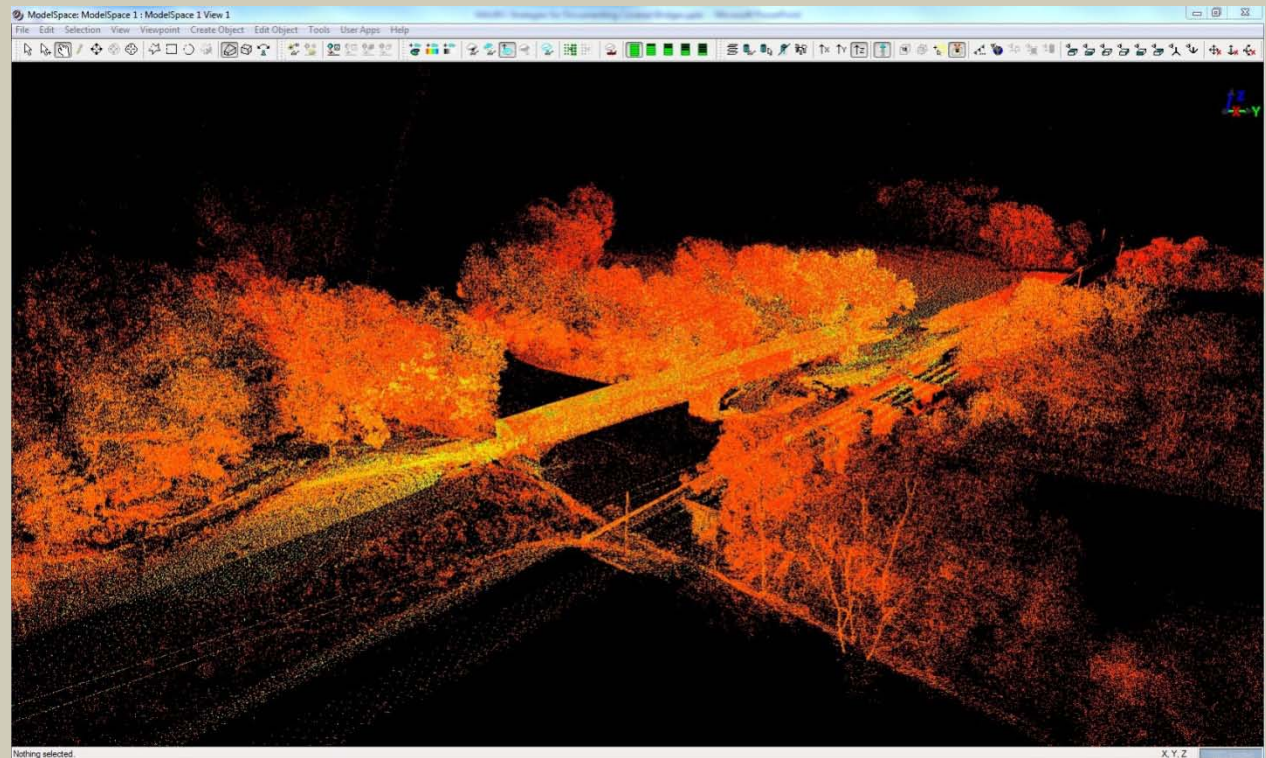
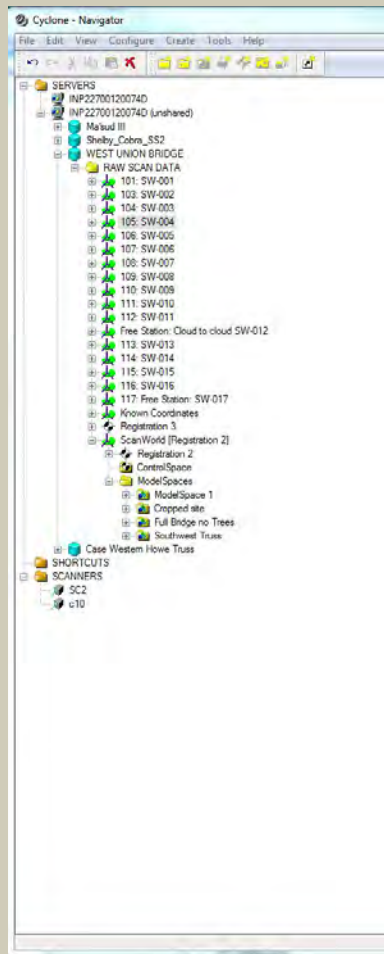
Underexposure

Twenty-four shots with a fish-eye lens to complete 360° HDR Panorama

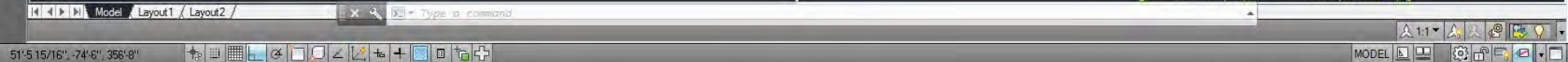
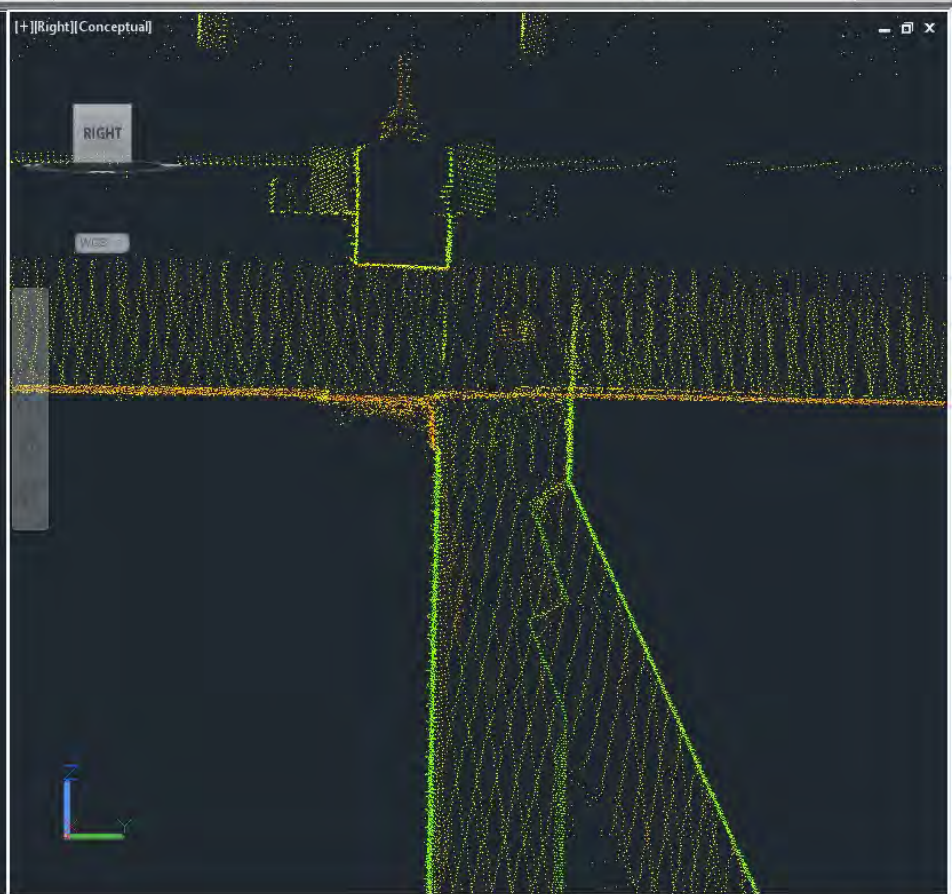
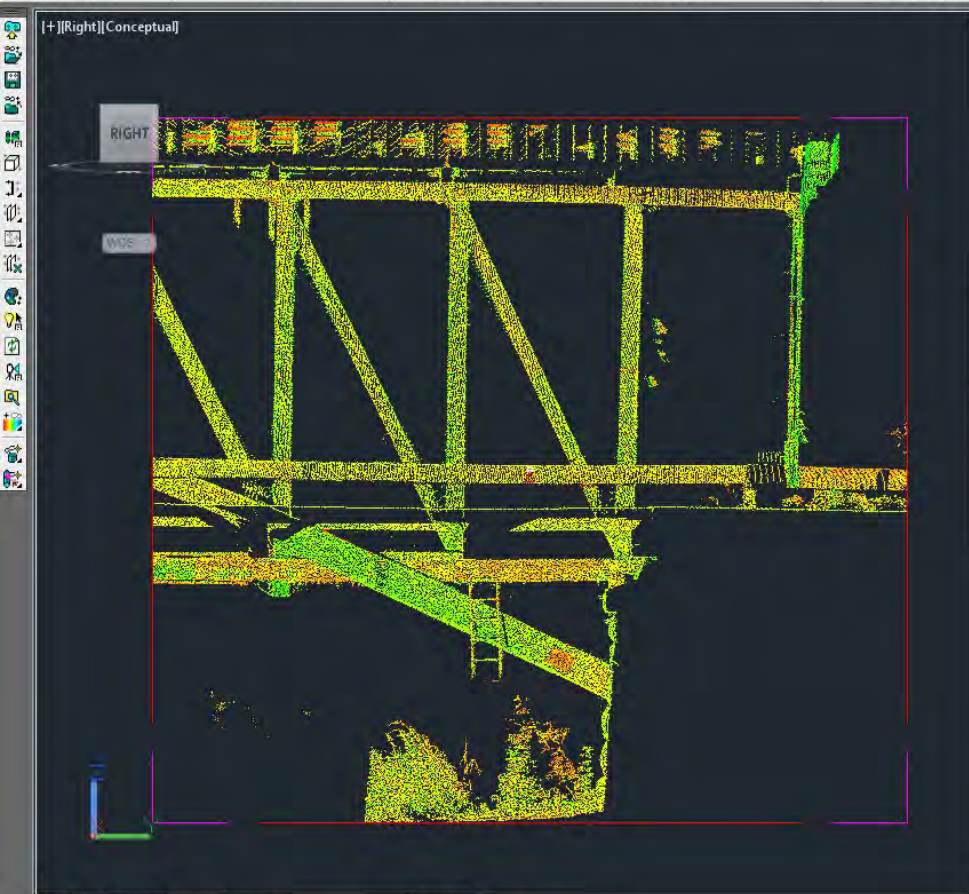
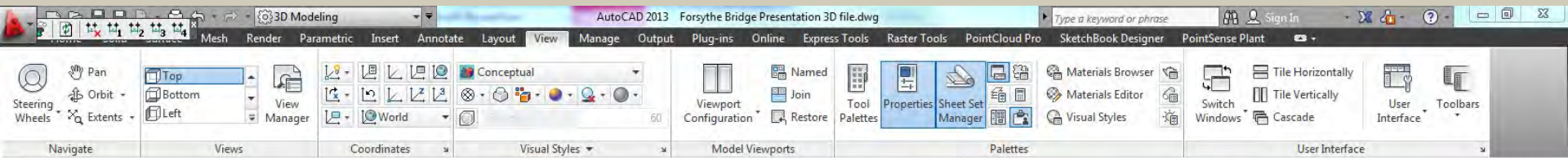






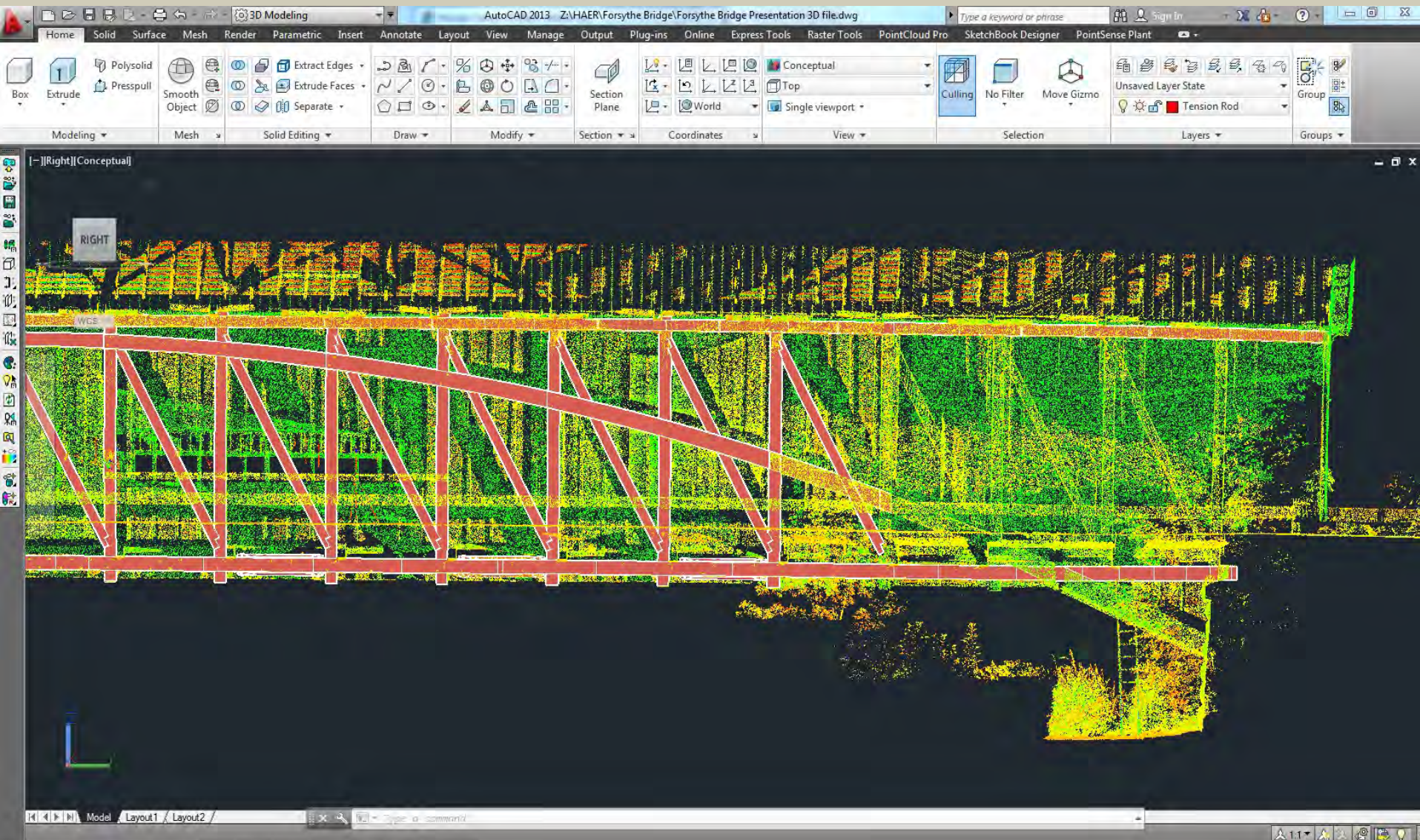


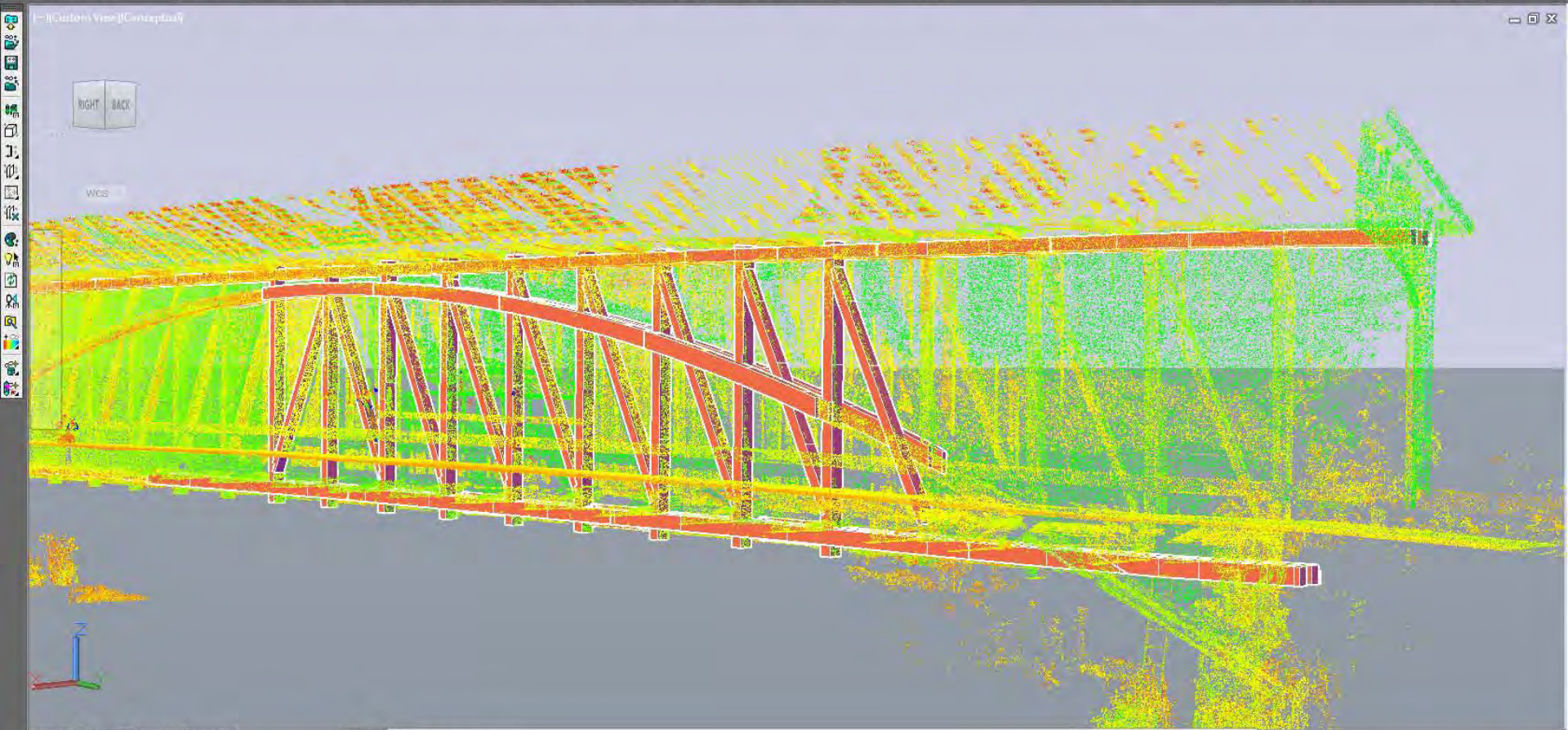
Software used to view pointclouds in AutoCAD
Kubit (.ptx, .pts)
Leica Cloudworx (.imp)
AutoCAD (.pcg)



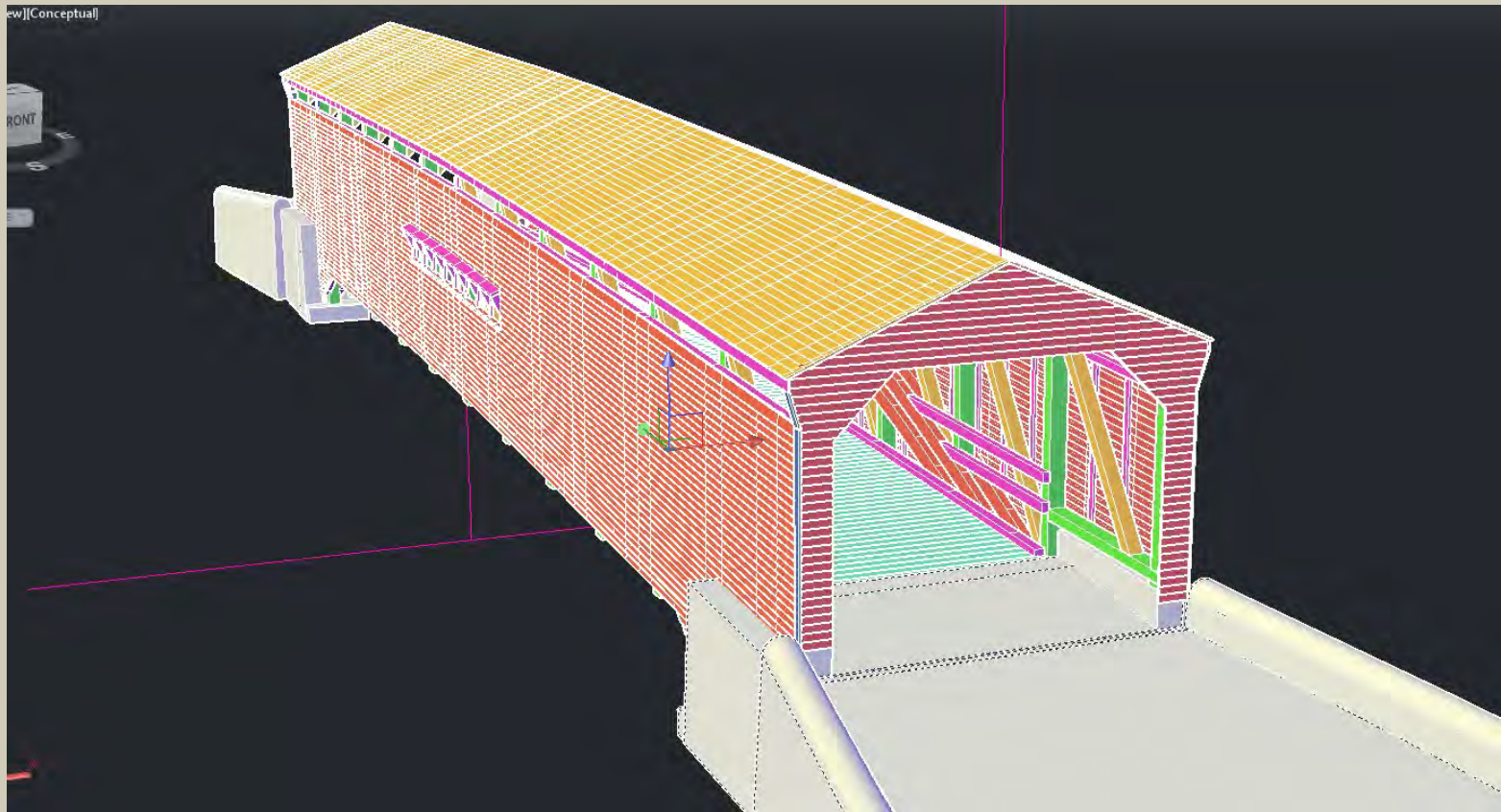
Parametric 3D modeling

Parametric: A set of measurable factors that define a system and determine its behavior.
A factor that determines a range of variations; a boundary.

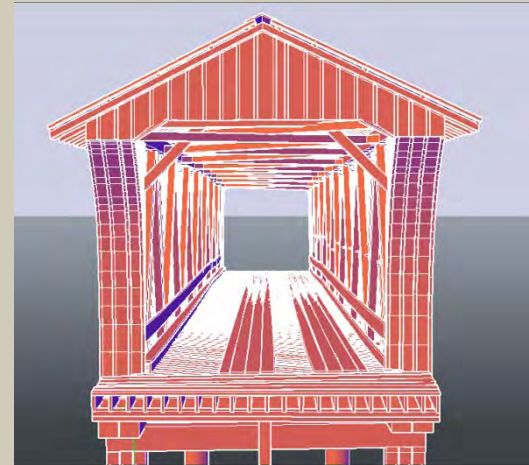
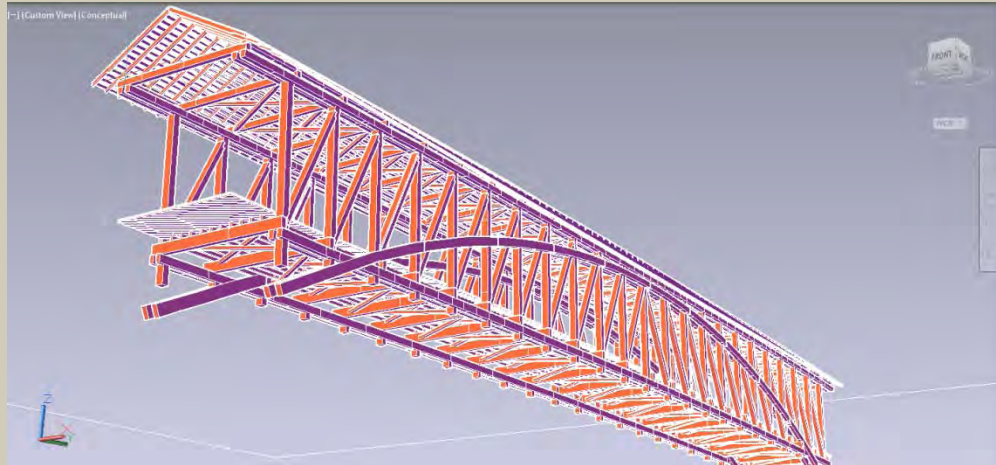


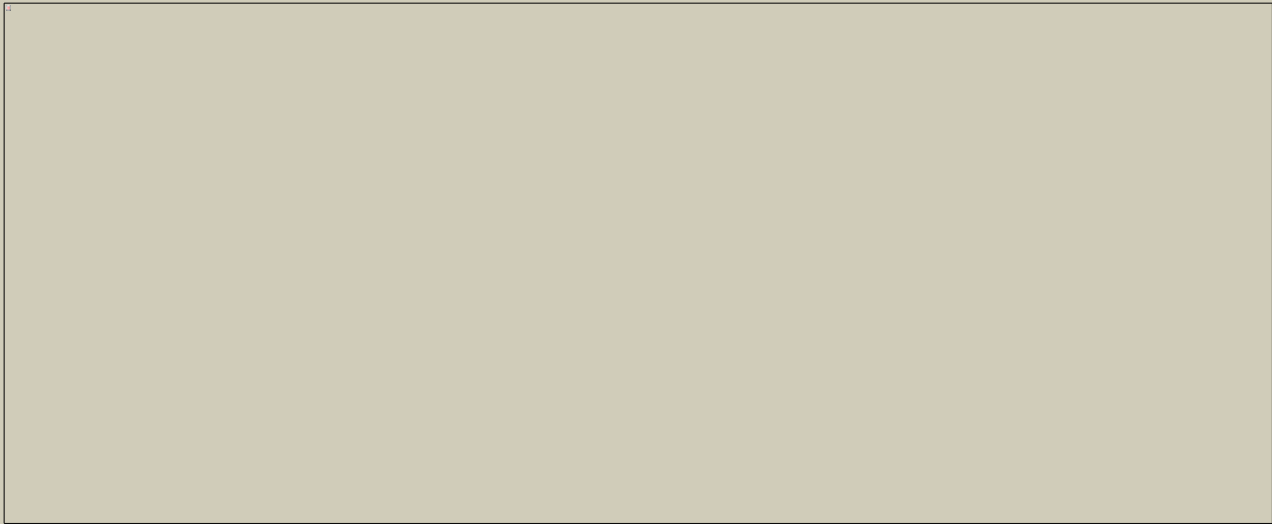
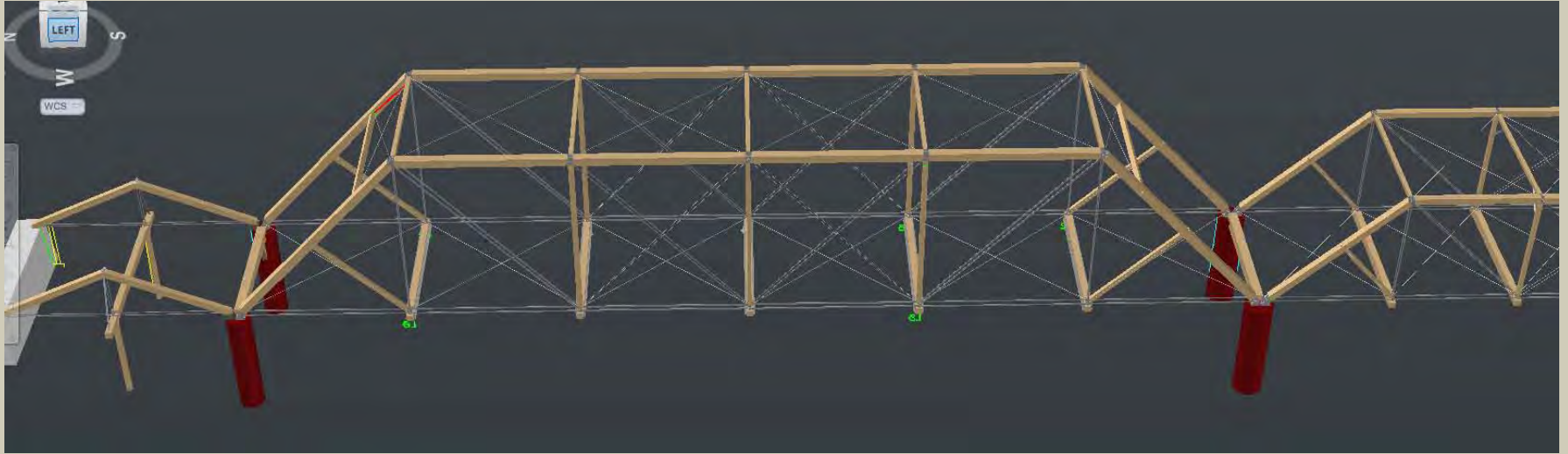


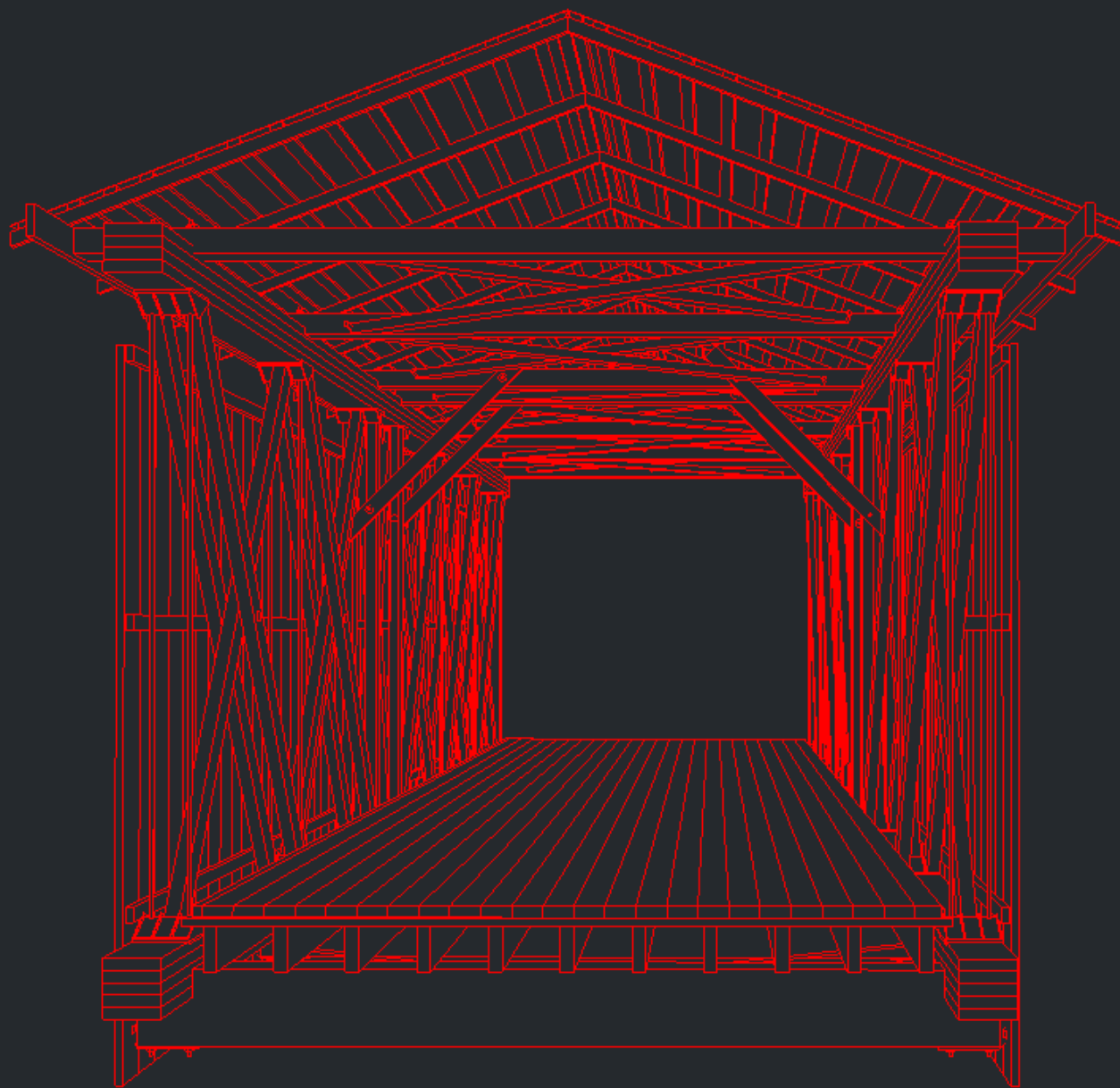
ew][Conceptual]



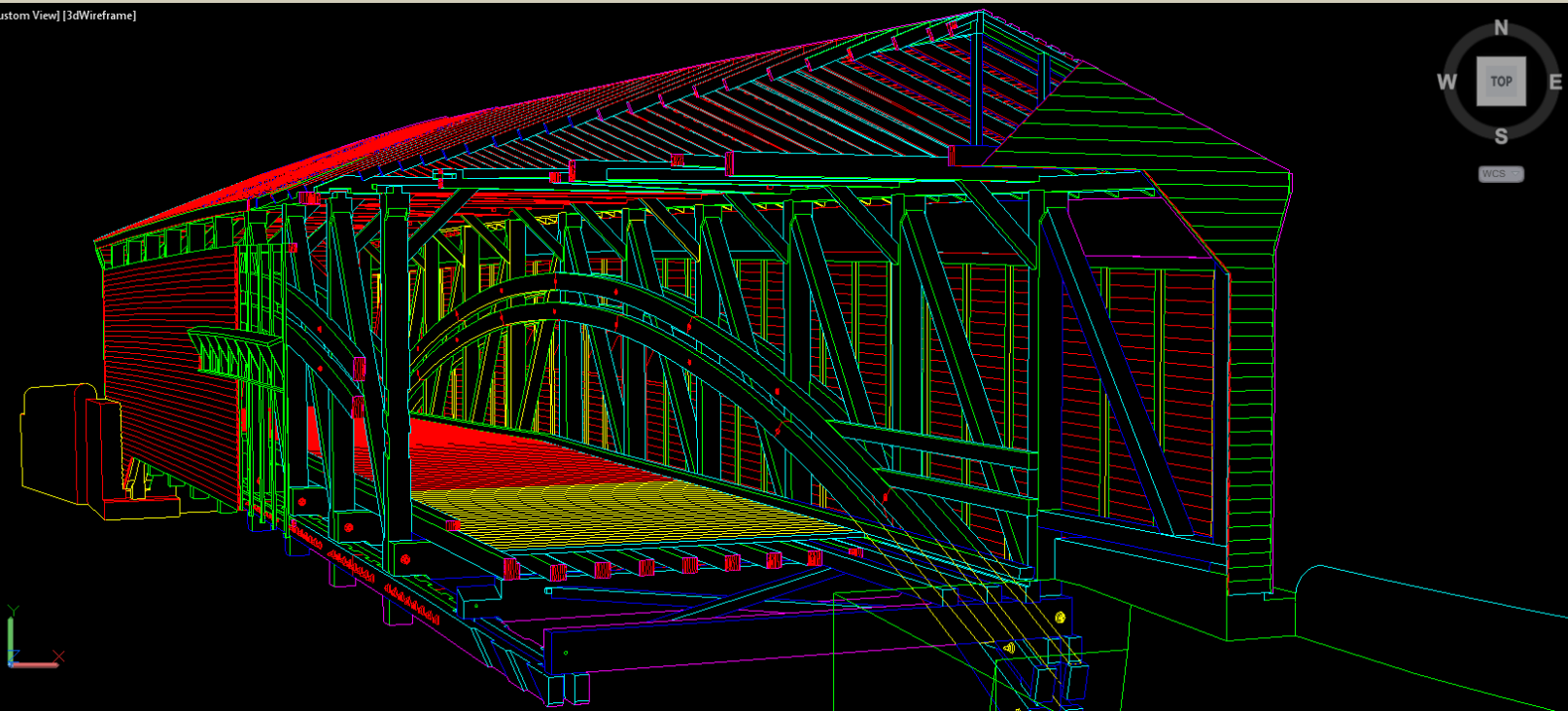
1-1 [Custom View] (Conceptual)

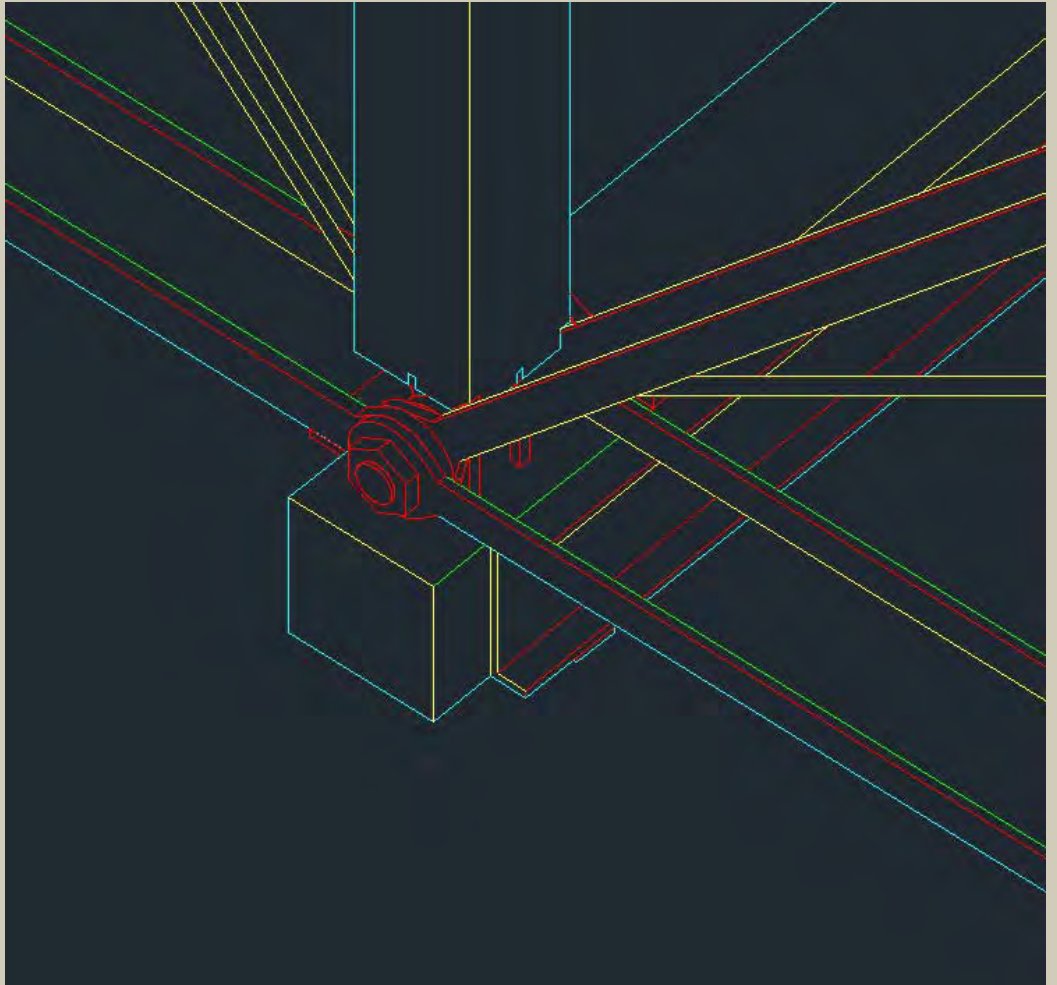
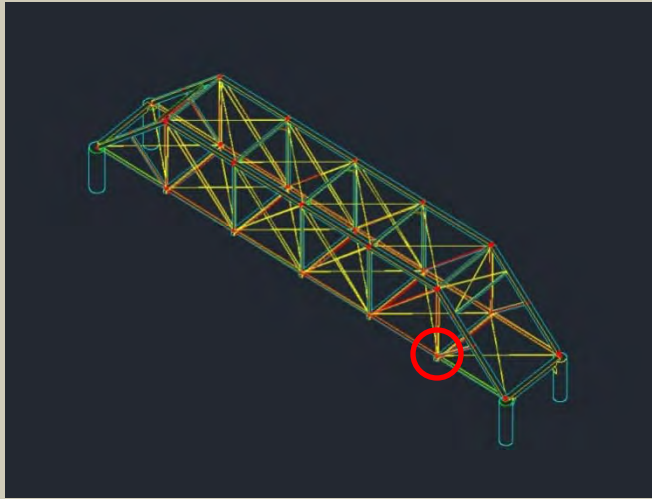


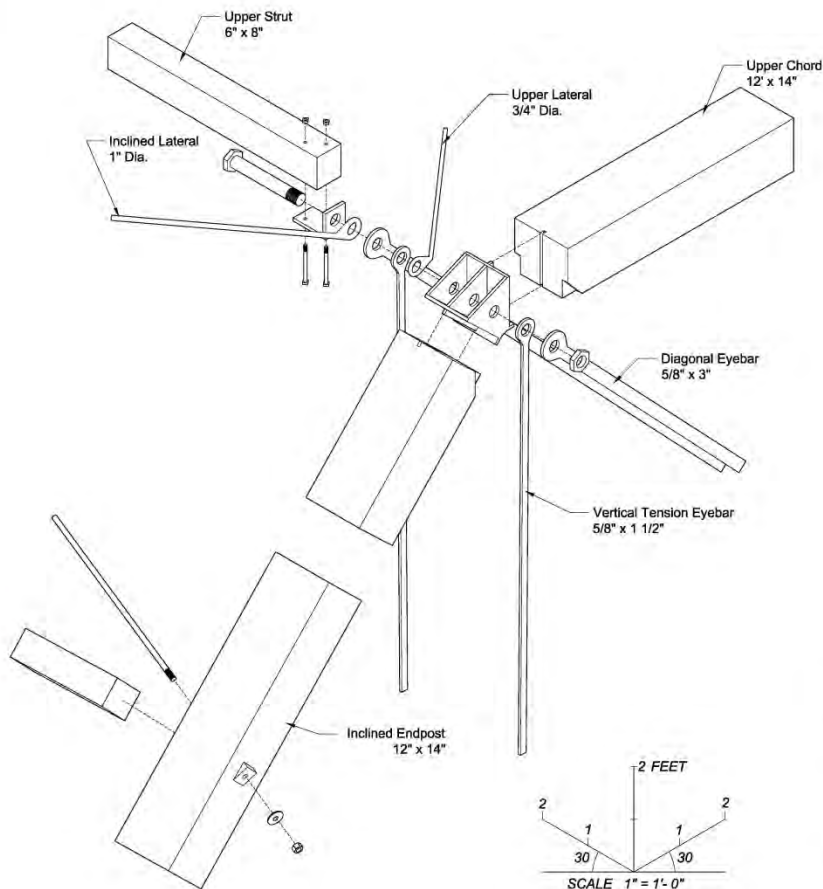




[-] [Custom View] [3dWireframe]

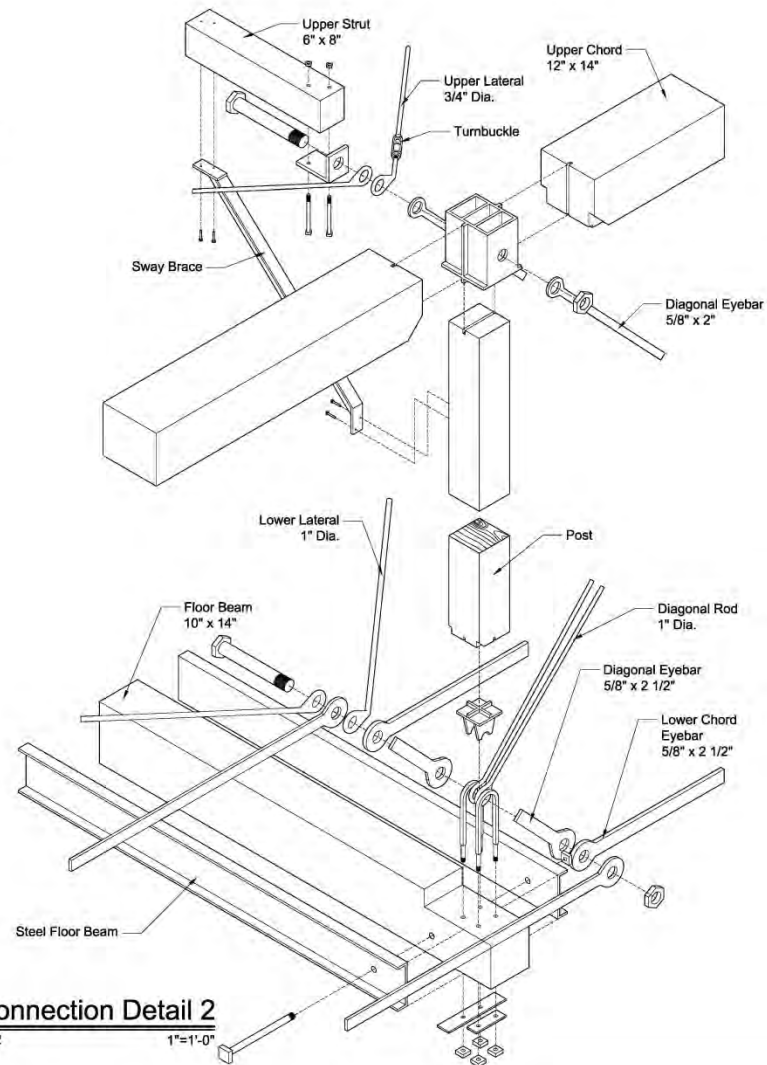






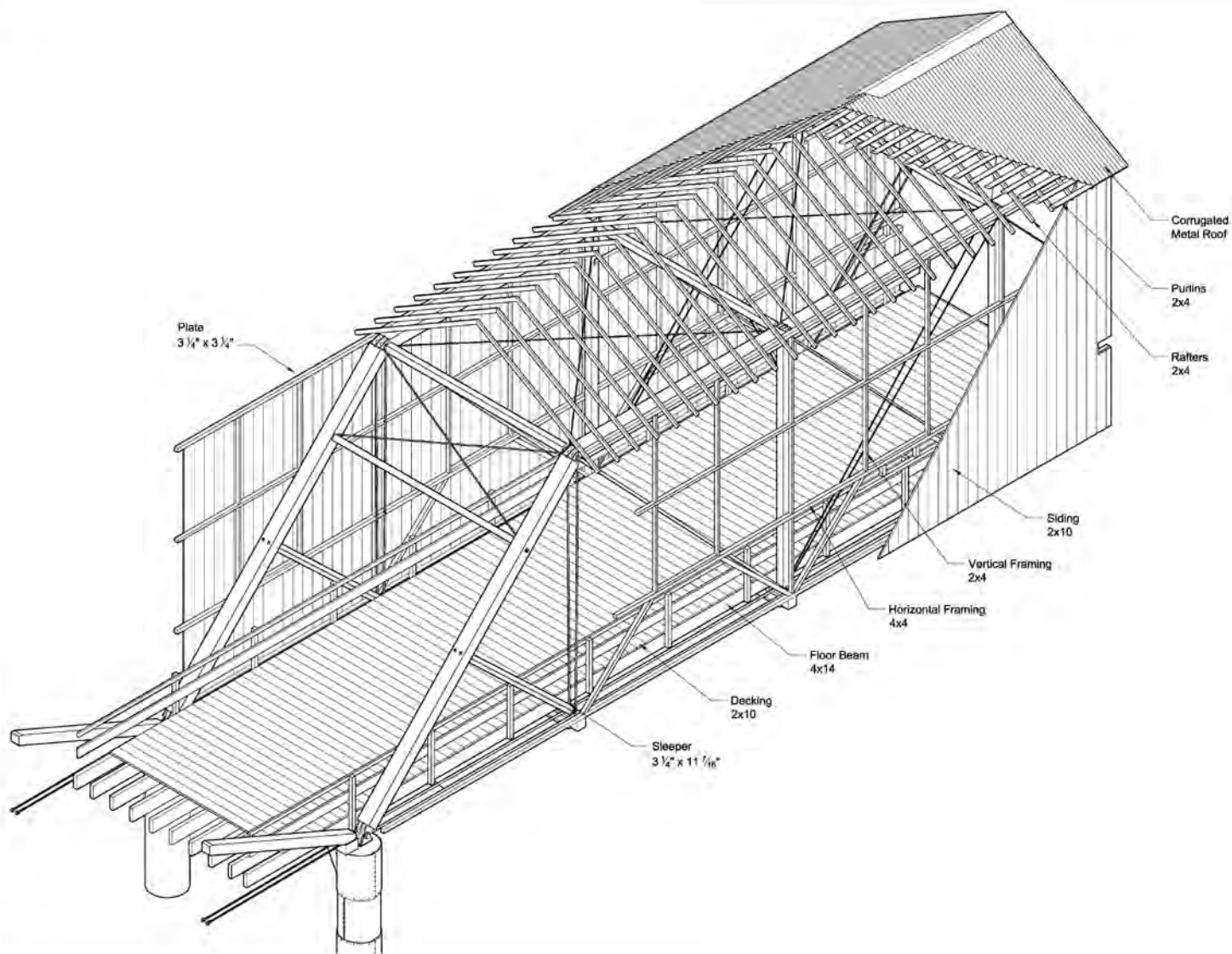
Connection Detail 1

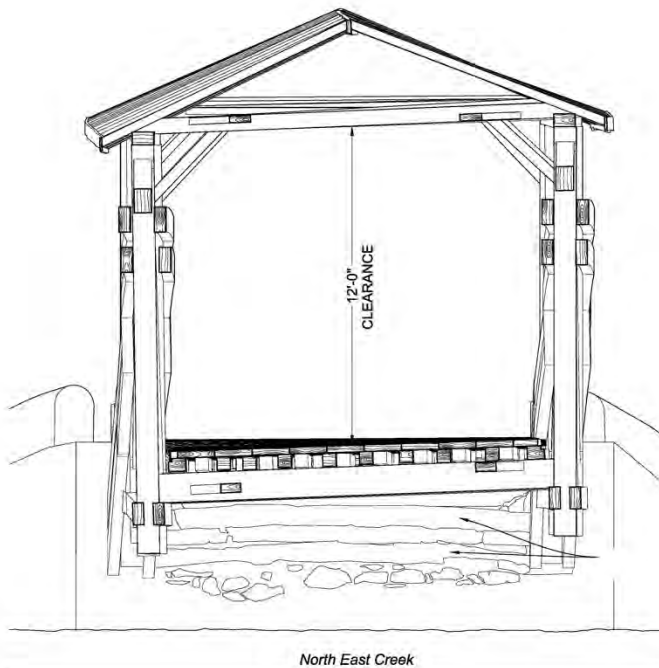
1:12 1"=1'-0"



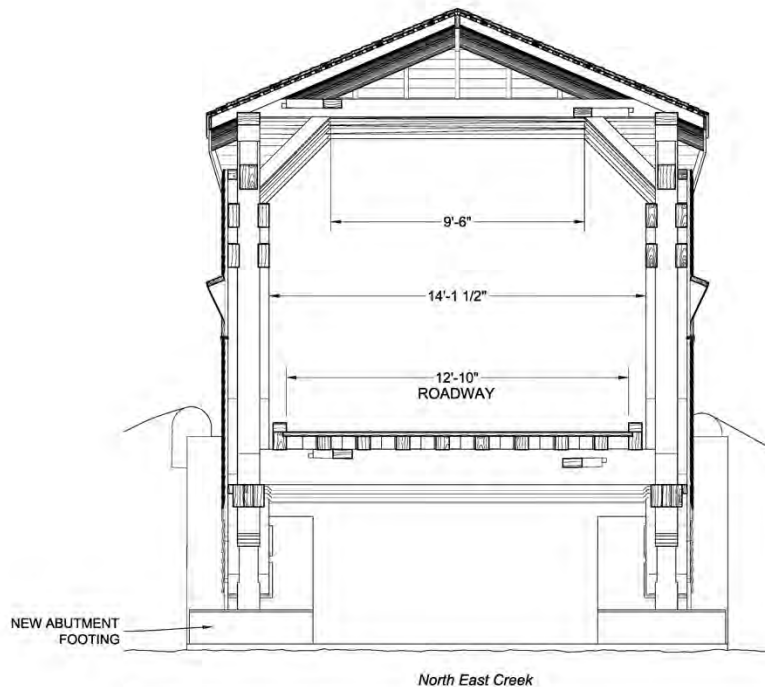
Connection Detail 2

1:12 1"=1'-0"

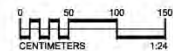
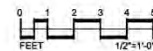


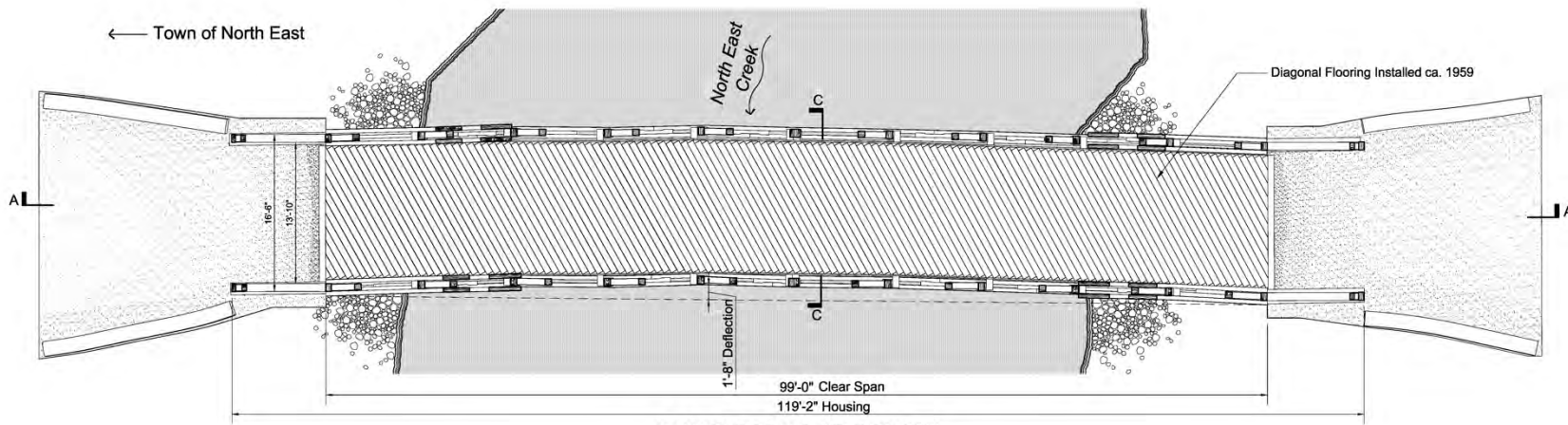


SECTION C-C PRE-REHABILITATION 2009
1/2"=1'-0" 1:24



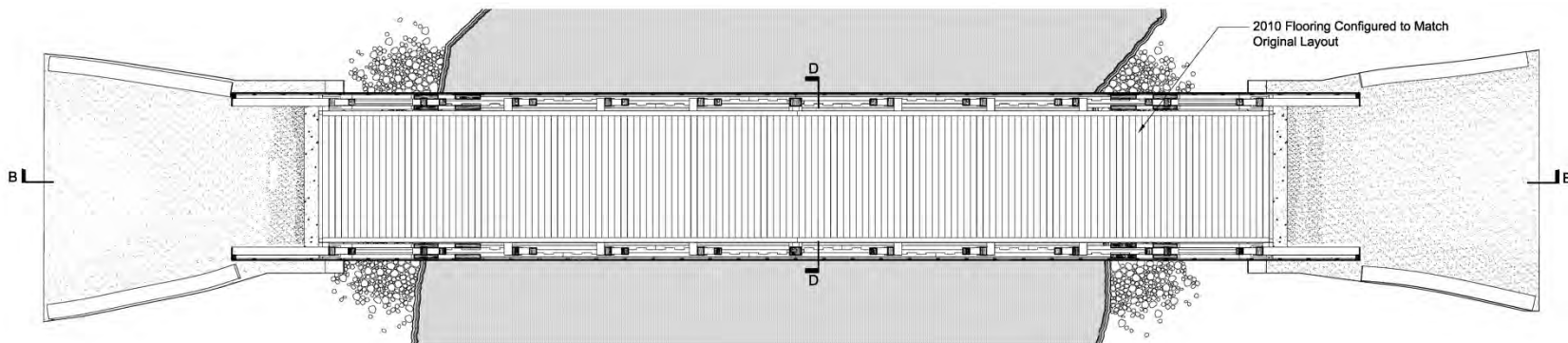
SECTION D-D POST-REHABILITATION 2010
1/2"=1'-0" 1:24





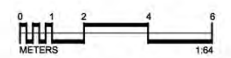
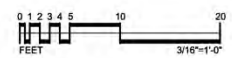
PLAN PRE-REHABILITATION 2009

3/16"=1'-0" 1:64



PLAN POST-REHABILITATION 2010

3/16"=1'-0" 1:64

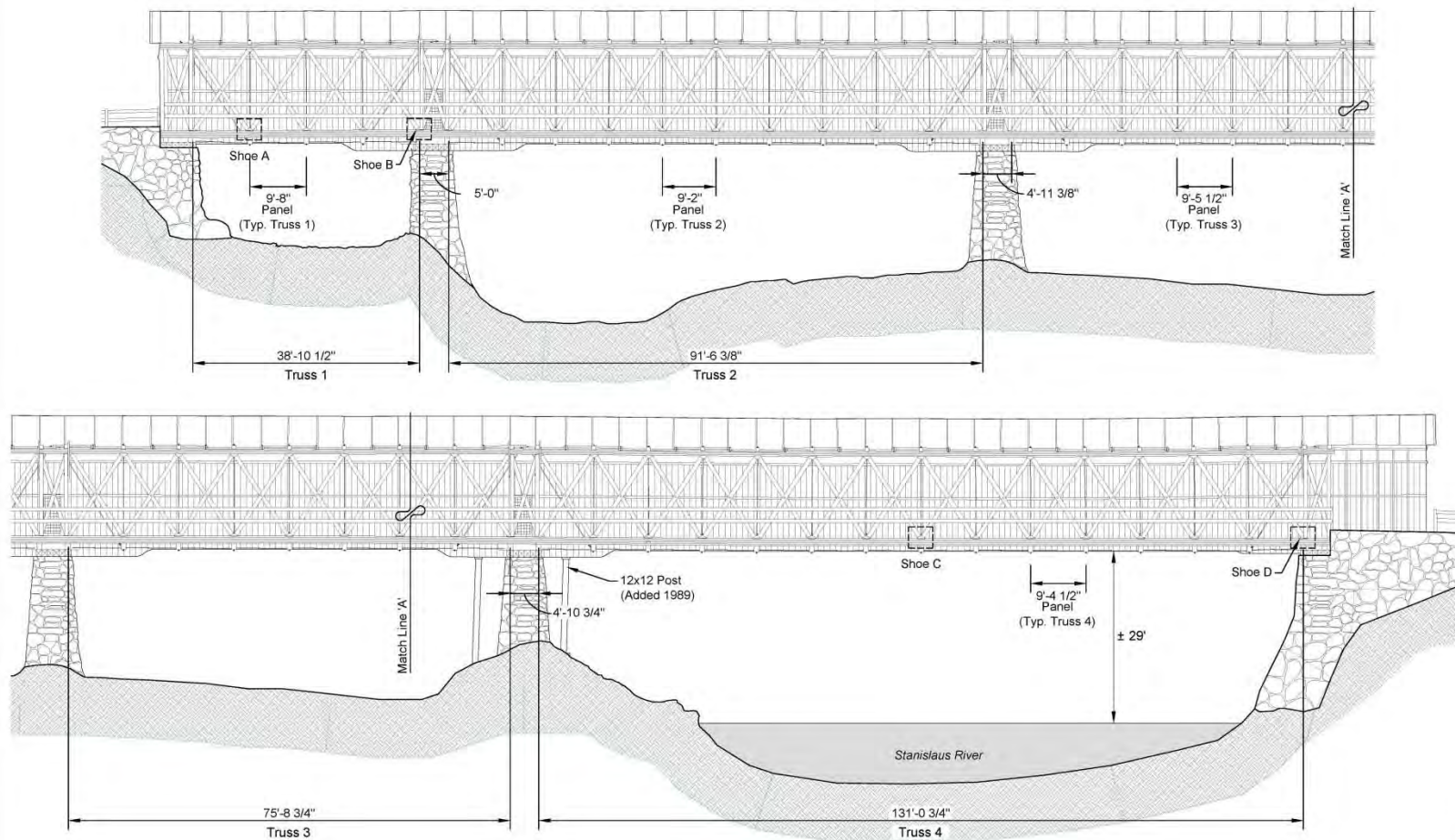


DELINEATED BY: JEREMY T. HARRIS, ANNE E. KIDD, 2010
NATIONAL PARK SERVICE
RECORDING PROJECT
UNITED STATES DEPARTMENT OF THE INTERIOR

GILPIN'S FALLS COVERED BRIDGE
SPANNING NORTH EAST CREEK AT FORMER BY-PASSED SECTION OF NORTH EAST ROAD (SR 272)
NORTH EAST
JACKSON COUNTY, MARYLAND

SHEET 2 OF 9
HISTORIC AMERICAN
ENGINEERING RECORD
MD-174

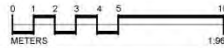
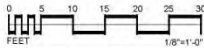
IF REPRODUCED, PLEASE CREDIT THE HISTORIC AMERICAN ENGINEERING RECORD, NATIONAL ARCHIVE SERVICE, LAND OF BUILDINGS, LAND OF SHAPES



Section A-A

1/8"=1'-0"

1:96



DESIGNED BY: PAVEL GORUNOV, 2011
NATIONAL ARCHIVES
RECORDING PROJECT
UNITED STATES DEPARTMENT OF THE INTERIOR

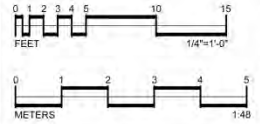
KNIGHT'S FERRY

STOCKTON-SANJOAQUIN STANISLAUS RIVER
STANISLAUS COUNTY

CALIFORNIA 17 OF 9

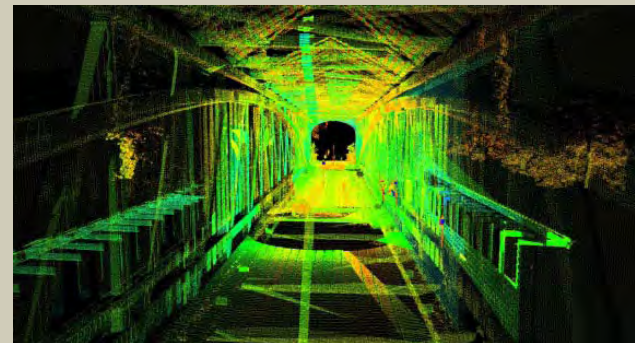
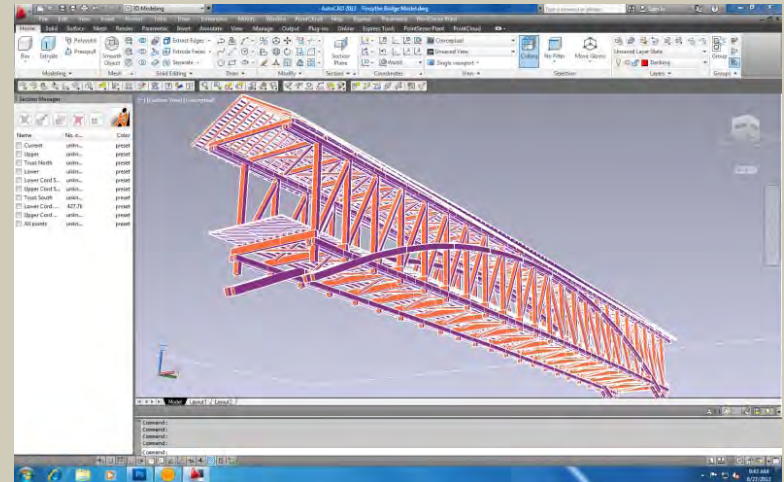
PROJECT: KNIGHT'S FERRY
ENGINEERING RECORD
CA-31/L

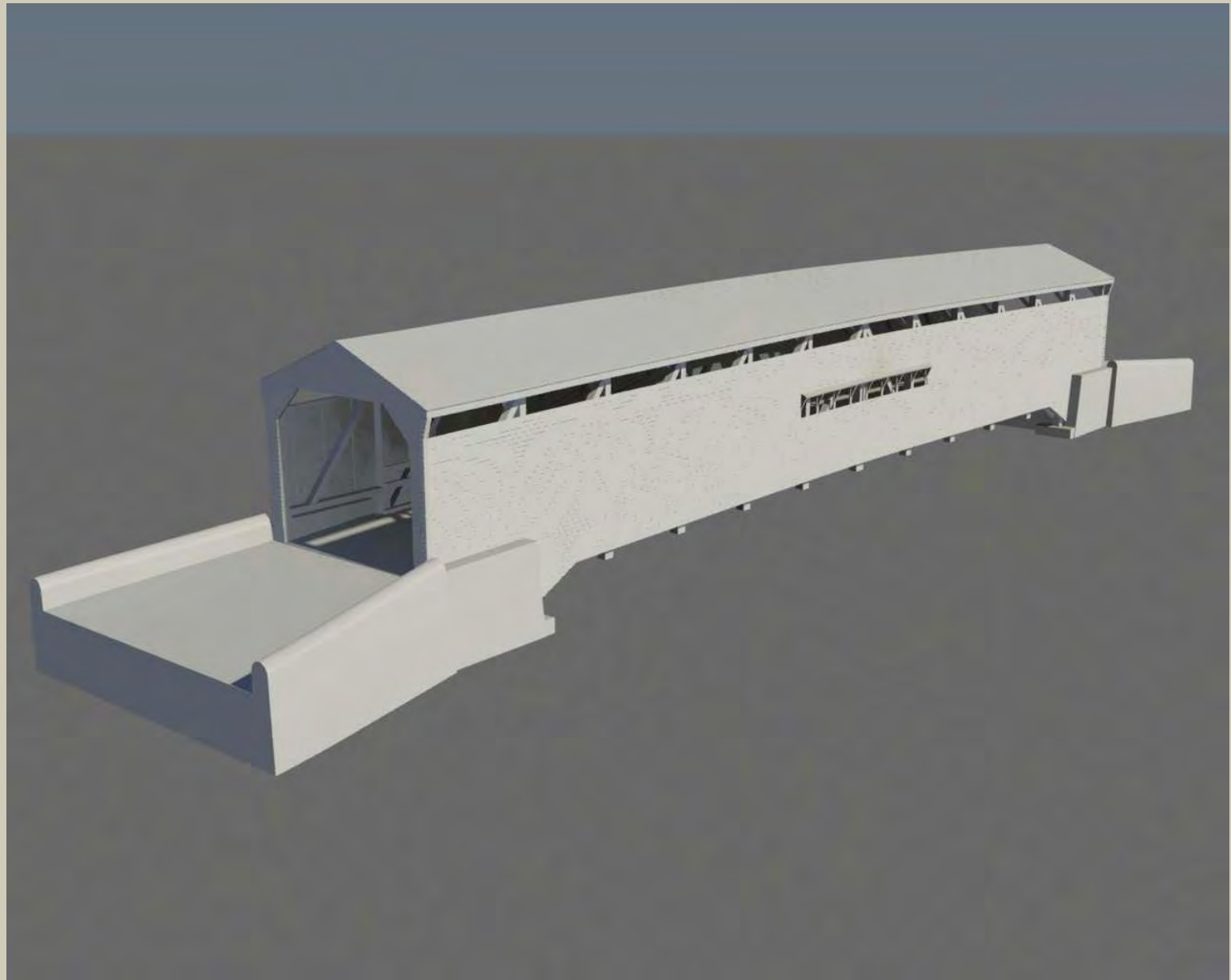
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By-Products

Non-archival data that exists outside the collection. Pano-photos, 3D models, fly-throughs, animations.

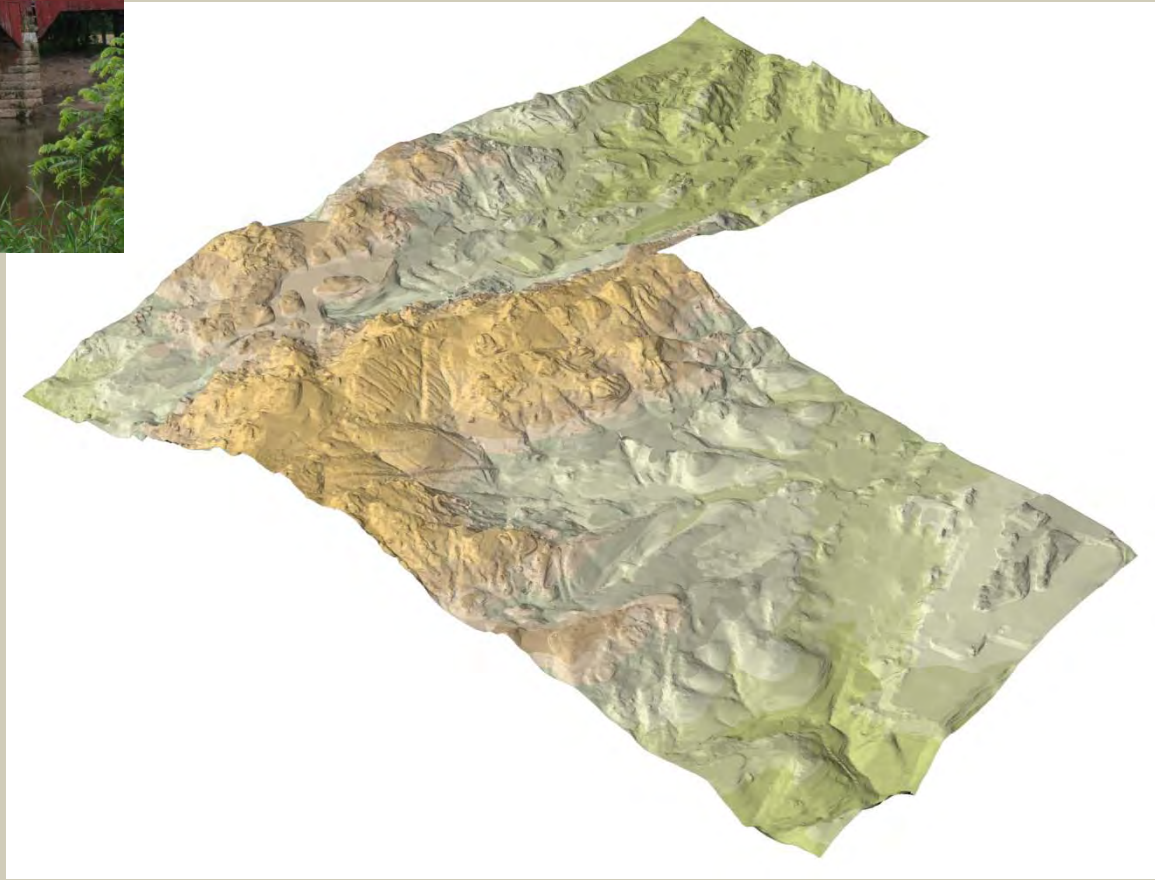




Geospatial Data



GPS Feature Points

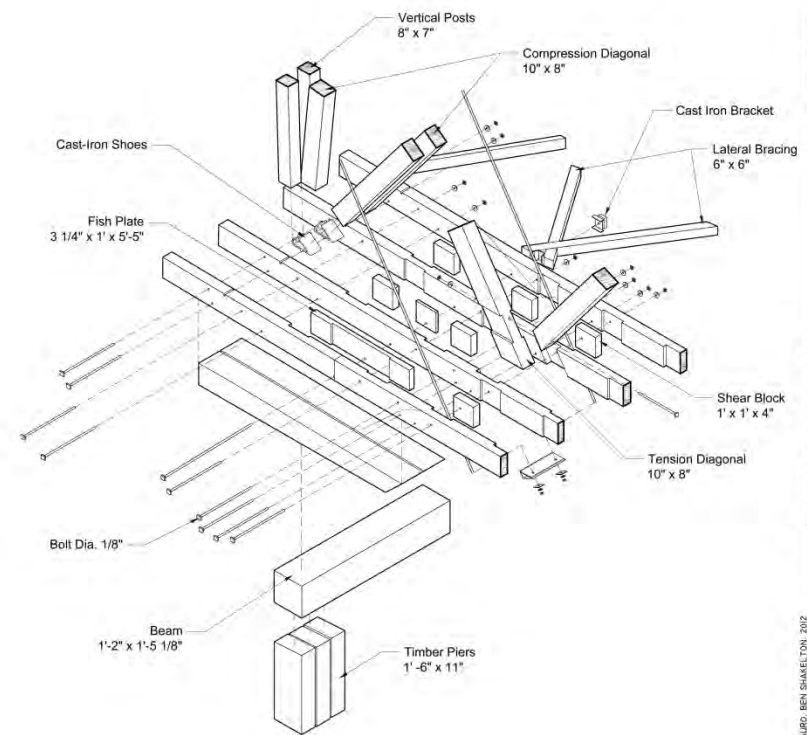
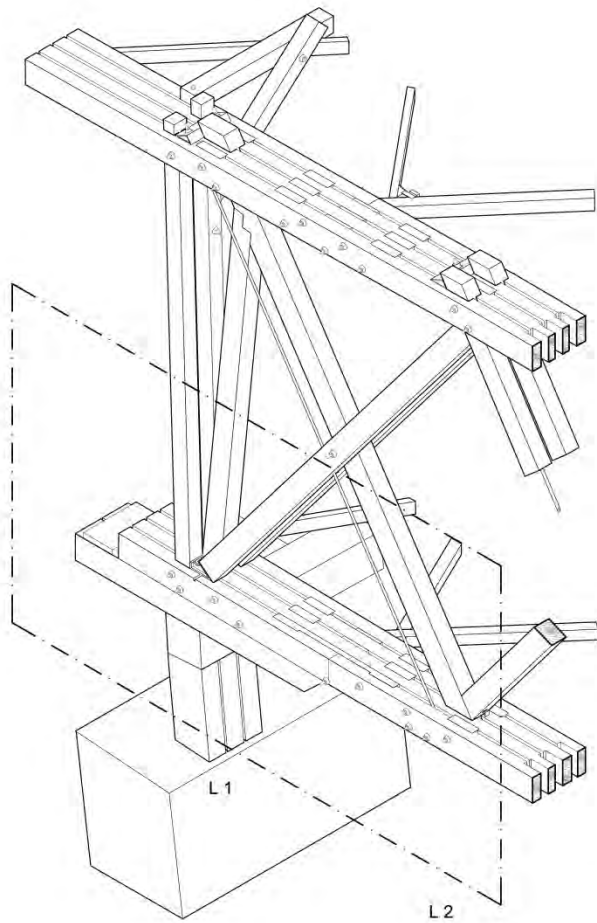


Mapping topography

360° High Dynamic Range (HDR) Panoramic Photography

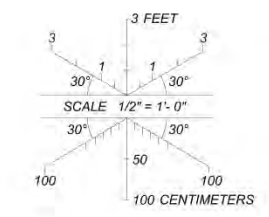






Truss Detail End Post, South Side

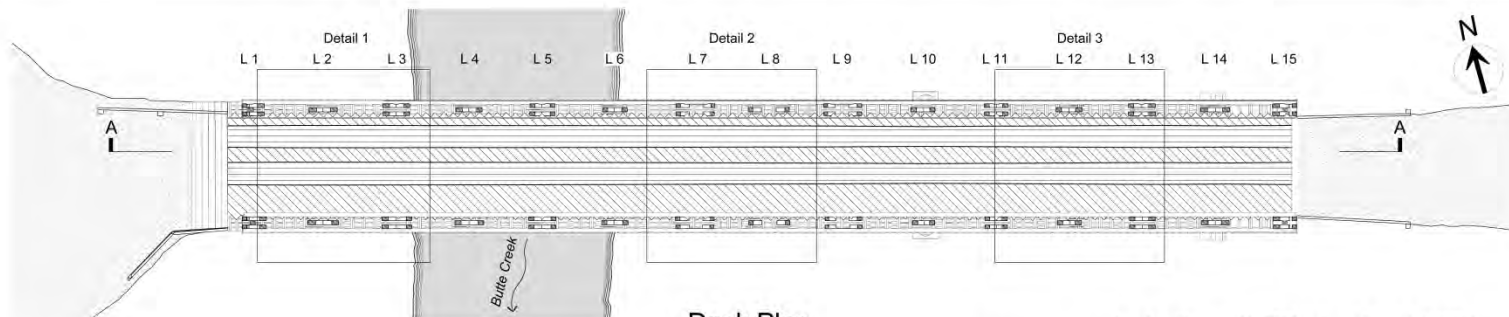
1/2"=1'-0" 1:24



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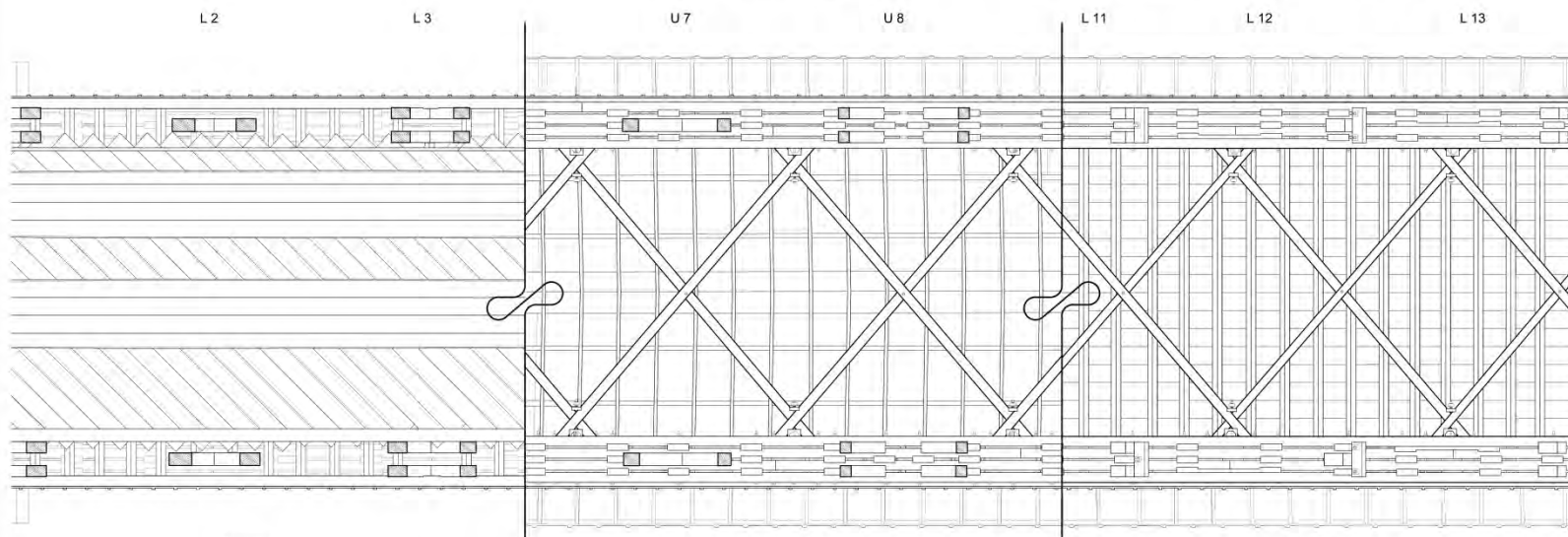
POWDER WORKS BRIDGE
SPANNING SAN JOAQUIN RIVER AT KENTDALE WAY, PARADISE PARK,
SANTA CRUZ COUNTY

SHEET 17 OF 9
CALIFORNIA
HISTORIC AMERICAN
ENGINEERING RECORD
CA-313



Deck Plan
1/8"=1'-0" 1:96

SCALE: 1/8" = 1'-0" 0 5 10 20 FEET 0 1 2 4 METERS



Deck Plan
3/8"=1'-0" 1:32

Reflected Ceiling
3/8"=1'-0" 1:32

Reflected Deck
3/8"=1'-0" 1:32

SCALE: 3/8" = 1'-0" 0 2 4 8 FEET 0 1 2 METERS

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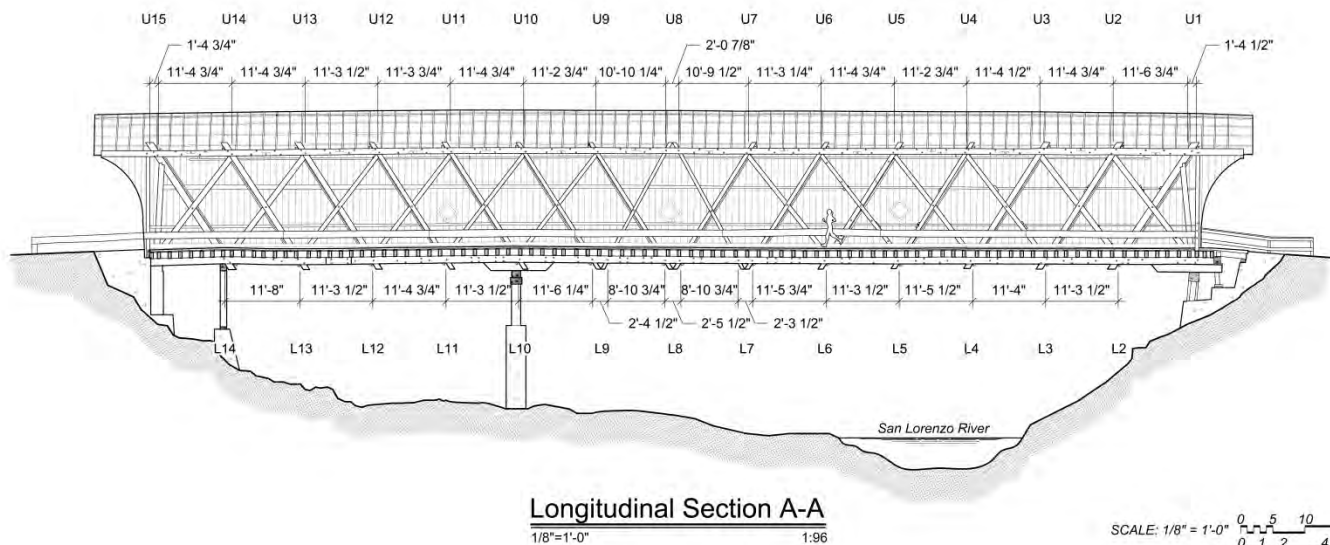
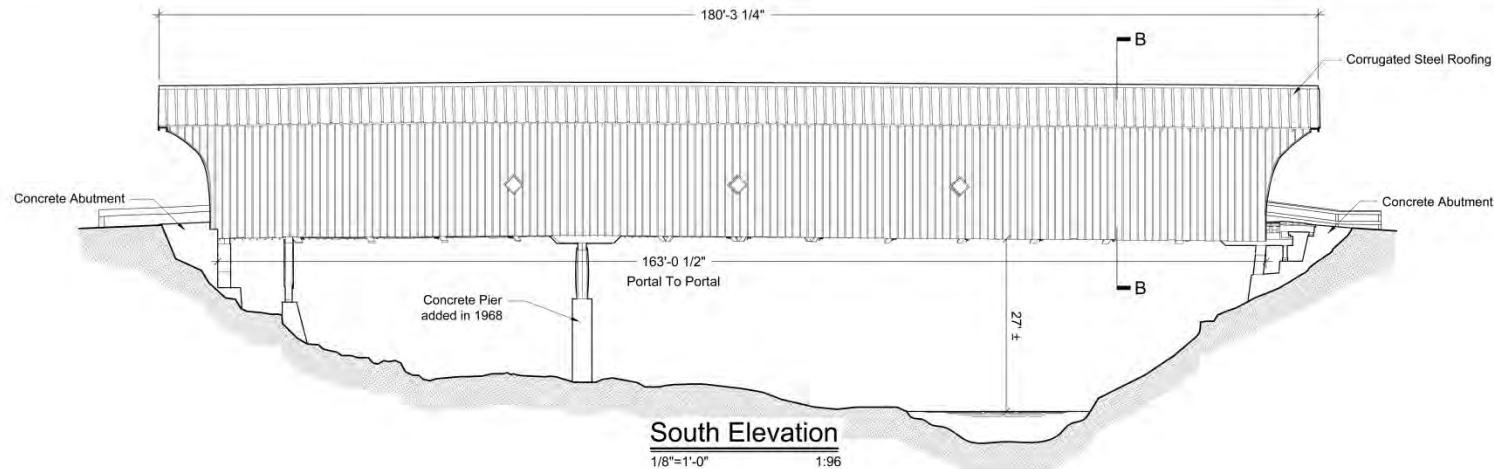
SANTA CRUZ

POWDER WORKS BRIDGE
SPANNING SAN LORENZO RIVER AT KEYSTONE WAY PARADISE PARK
SANTA CRUZ COUNTY

SHEET
CALIFORNIA 2 OF 9

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CA-315

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SCALE: 1/8" = 1'-0"

0 5 10 20 FEET

0 1 2 4 METERS

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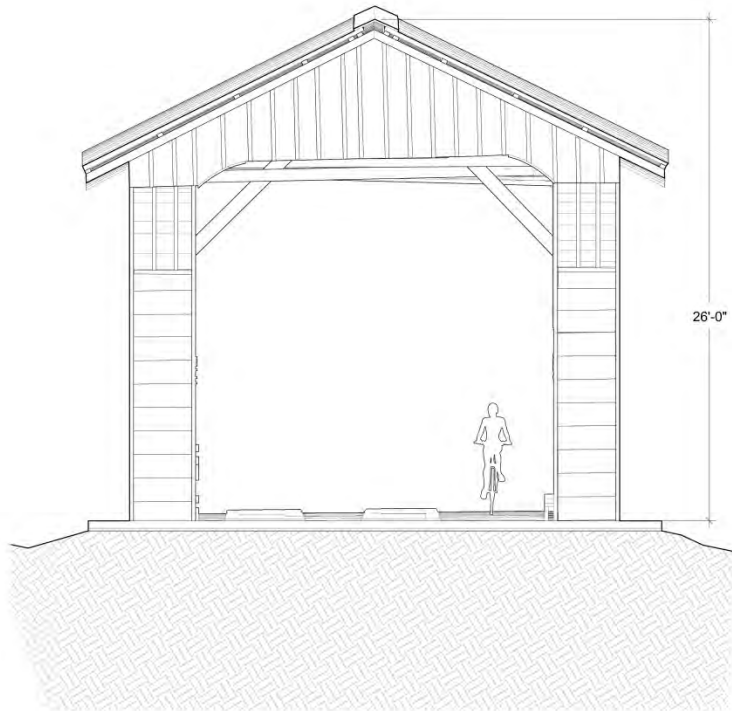
SANTA CRUZ

POWDER WORKS BRIDGE
SPANNING SAN LORENZO RIVER AT KEYSTONE WAY PARADISE PARK
SANTA CRUZ COUNTY

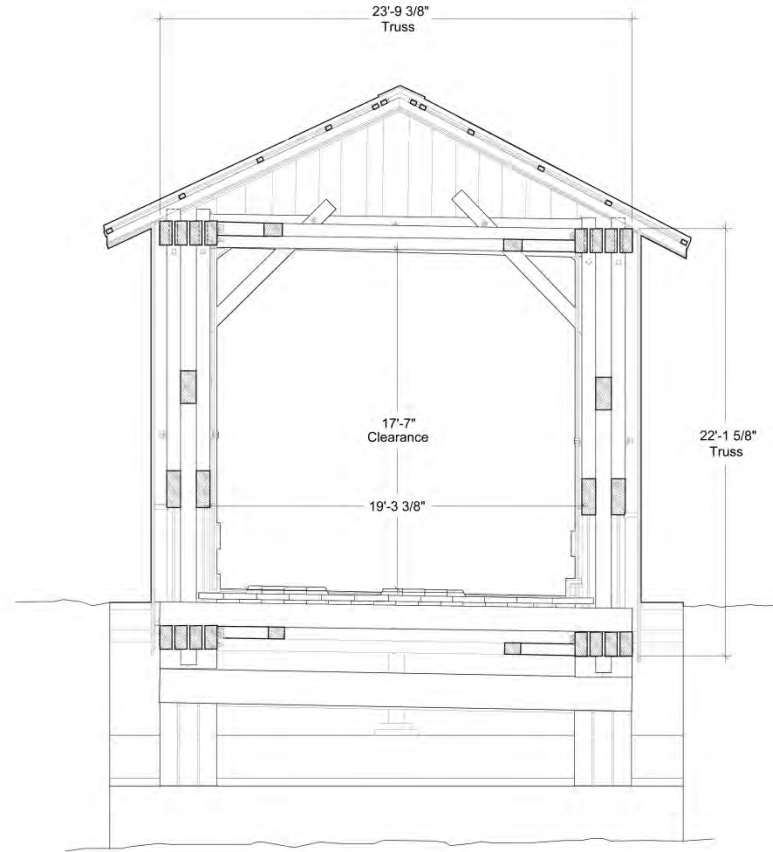
SHEET
CALIFORNIA 4 OF 9

HISTORIC AMERICAN
ENGINEERING RECORD
CA-315

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East Portal Elevation
 3/8"=1'-0" 1:32



Section B-B
 3/8"=1'-0" 1:32

SCALE: 3/8" = 1'-0"

0 2 4 8 FEET

0 1 2 METERS

DELINEATED BY: MELISSA ALICIA DECATUR JEREMY MAURO BEN SHAKELTON 2012

NATIONAL COVERED BRIDGES
 RECORDING PROJECT
 UNITED STATES DEPARTMENT OF THE INTERIOR

SANTA CRUZ

SPANNING SAN JUAN RIVER AND SAN JUAN AVENUE PARK
 SANTA CRUZ COUNTY

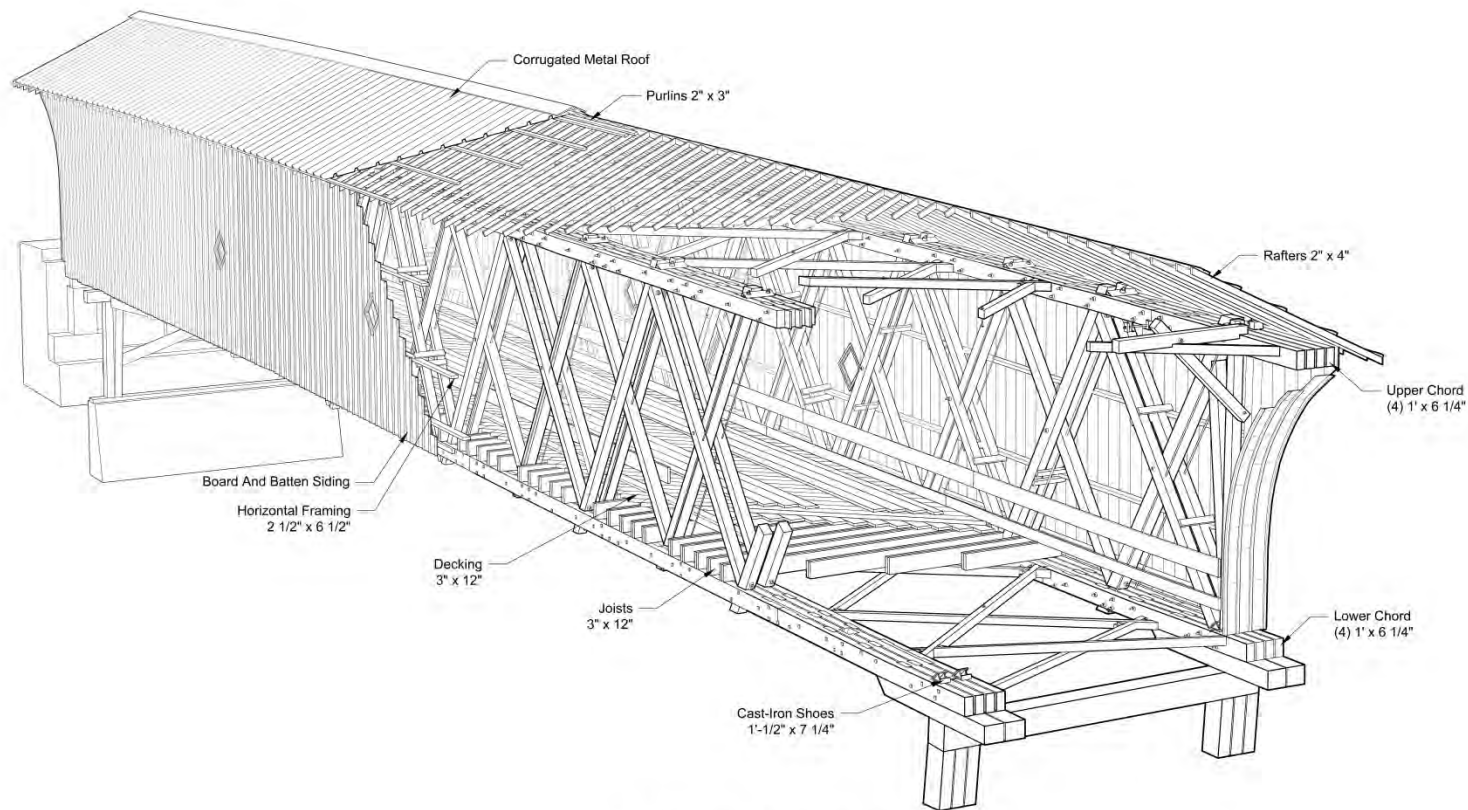
CALIFORNIA 5 OF 9

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Jeremy Mauro
jeremy_mauro@nps.gov
202-354-1814

National Park Service
Heritage Documentation Programs
Historic American Engineering Record
Washington, DC



Perspective Cut Away

DEVELOPED BY: CHRISTOPHER MARSTON, JEREMY MAURO, BEN SHAWELTON, 2012

NATIONAL COVERED BRIDGES
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

SANTA CRUZ

POWDER WORKS BRIDGE
SPANNING SAN LORENZO RIVER AT KEYSTONE WAY
PARADISE PARK
SANTA CRUZ COUNTY

CALIFORNIA

SHEET 9 OF 9

HISTORIC AMERICAN
ENGINEERING RECORD

CA-315

ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED ARE IN FEET AND INCHES. DIMENSIONS ARE GIVEN TO THE CENTERLINE OF THE STRUCTURE UNLESS OTHERWISE SPECIFIED.