2025 SURVEYORS' Conference

Bridge and Structural Surveys

Stephen Reisinger, PLS

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Introduction

- Personal
- Experience
- Participation
- What is your experience?

Types of Structures

- Beam Bridge
- Truss Bridge
- Arch Bridge
- Suspension Bridge
- Cantilever Bridge
- Dams
- Statues
- Walls
- Railroad Catenary

Reinforced Concrete Slab Bridge

This bridge is poured on site. It was a popular design into the 1960’s.

Located near Lewisberry. SR 177 over Bennett Run

Steel I-Beam Bridge

Located on SR 309 over the Susquehanna River at Wilkes-Barre.

Spread Box Beam Bridge

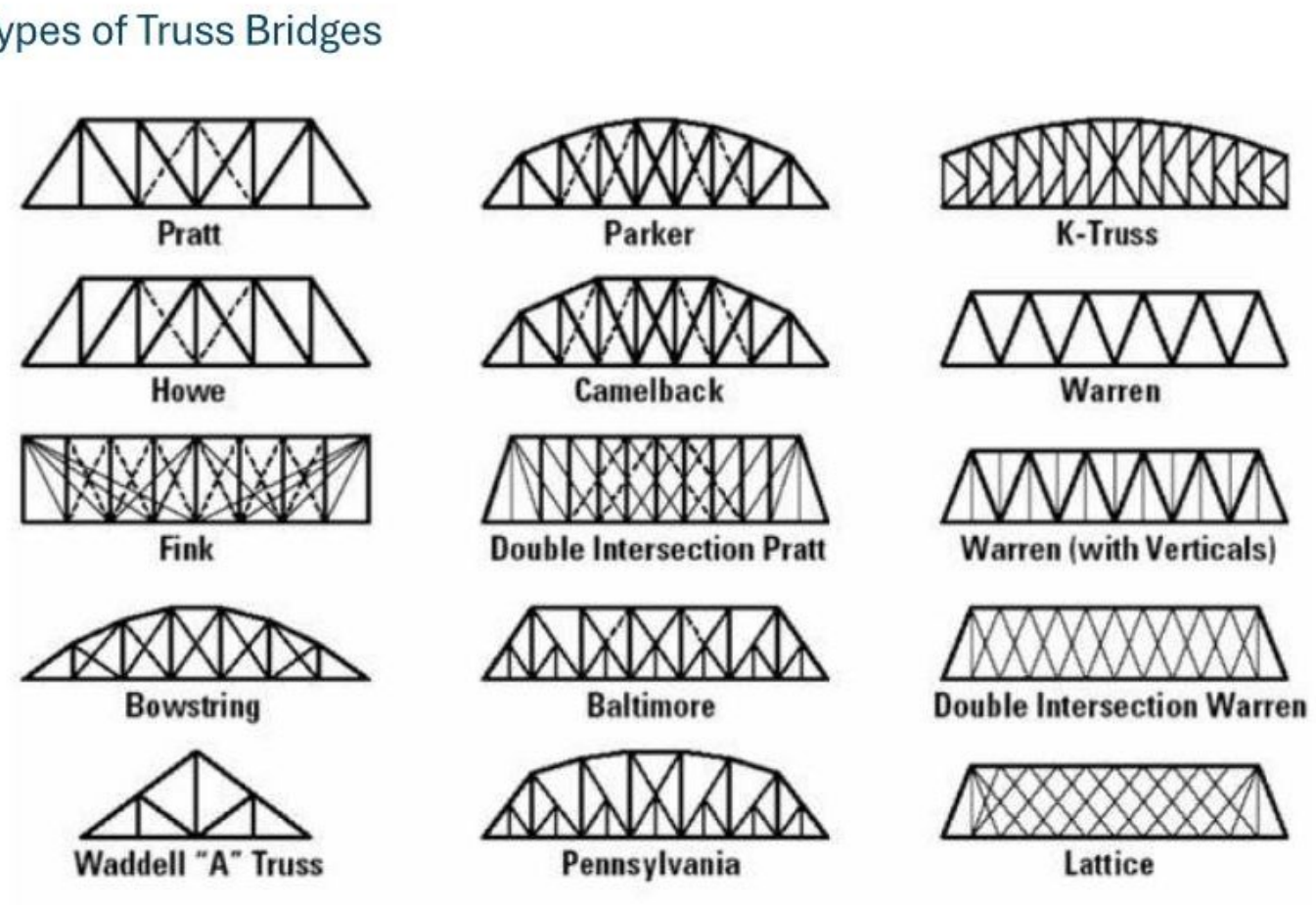
This design and the next are similar. The difference being the spacing between beams.

Adjacent Box Beam Bridge

Pre-Stressed Concrete Box Beam (Adjacent Boxes)

DSC_0024

Truss Bridge



- There are a variety of truss designs

Through Truss

A through truss bridge has beams that connect the tops of the trusses.

Located on Sheepbridge Road over Conewago Creek

Pony Truss

In the back country of Newfoundland, I saw dozens of these.

Arch Bridges

- Arches can be constructed from concrete, stone, steel, or wood
- The arches can be part of the superstructure or the substructure
- This is one example of a concrete arch located near Bowmansdale

Concrete Arch

SR 61 bridge over the Schuylkill River near Hamburg

Stone Arch

Located on Kise Mill Road over Bennett Run

Stone Arch

Can anyone tell me which bridge this is and what makes it significant?

Steel Arch Superstructure

Located in Oil City. Center Street over Oil Creek

Steel Arch Substructure

New River Gorge Bridge. Located in Fayette County, West Virginia. Carries US 19 over New River. The longest single span steel arch bridge in the US.

Wood Arch

Zimmerman Covered Bridge. Carries Covered Bridge Road over Lower Little Swatara Creek.

This style of arch is called a Burr Arch after the inventor.

Suspension Bridge

Benjamin Franklin Bridge carries Interstate 676 across the Delaware River in Philadelphia

Cantilever Bridge

Commodore Barry Bridge carries US 322 across the Delaware River in Chester

Cable Stayed Bridge

This is an artist’s conception of the New Monongahela River Bridge that will carry the Monfayette Bypass over the Monongahela River near Pittsburgh.

Statues

Irish Memorial at Chestnut Street and Interstate 95 in Philadelphia

- Dams

McMichaels Creek Near Broad Street in Stroudsburg

Walls

Retaining Wall along Interstate 95 in Philadelphia

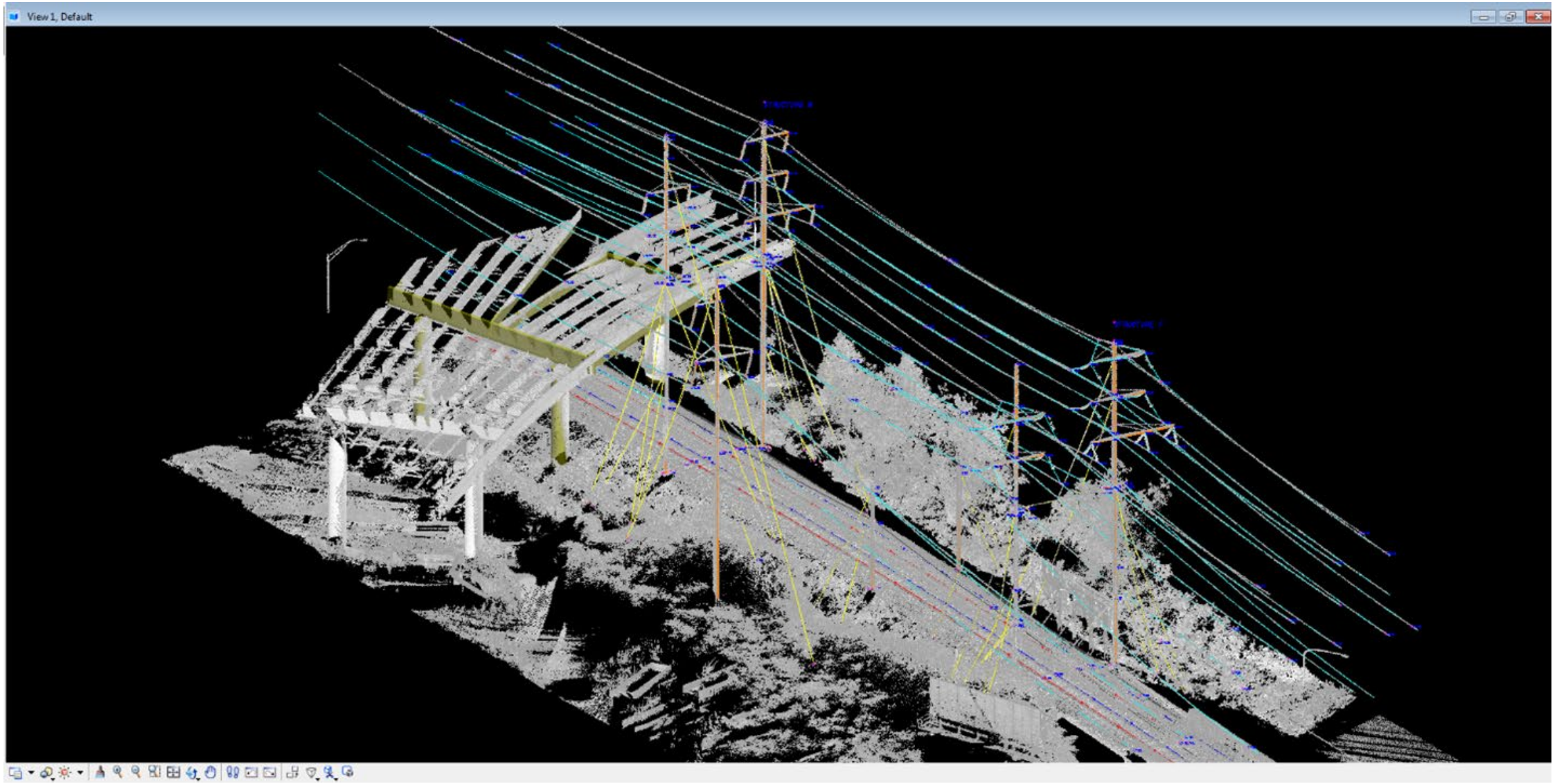
Catenary

These can be surveyed using a total station in reflectorless mode but can be difficult to survey if there is any wind at all.

Scanning is recommended.

Railroad permits, safety training, and watchmen will always be required when on a railroad.

Scan of Catenary



Methods of Survey

- Total Station
- GPS
- Scanning
- Photogrammetry
- Digital Photo Vectorization
- Drone
  - Scanning
  - Thermal Imaging
- Other?

Special Equipment or Services

- Traffic Control
- Snooper Truck
- Aerial Lifts
- Bucket Truck
- Other?

Traffic Control

This can be as simple or as involved as you want to make it. The main purpose is to keep your workers and the general public as safe as possible.

Snooper Truck

Advantages:

1. Allows access to all parts of the bridge
2. Safe work environment
3. Operator is provided
4. Usually includes traffic control

Disadvantages:

1. Expensive
2. Requires lane closures

Aerial Lifts

Advantages:

1. Allows access to higher bridges
2. Safe work environment
3. Can be operated by field personnel
4. Traffic control not usually needed

Disadvantages:

1. May be unstable on sloped ground
2. May be hard to gain access under the bridge
3. Cannot be used in the stream

Bucket Truck

Advantages:

1. Allows access to higher bridges
2. Safe work environment
3. Can be operated by field personnel

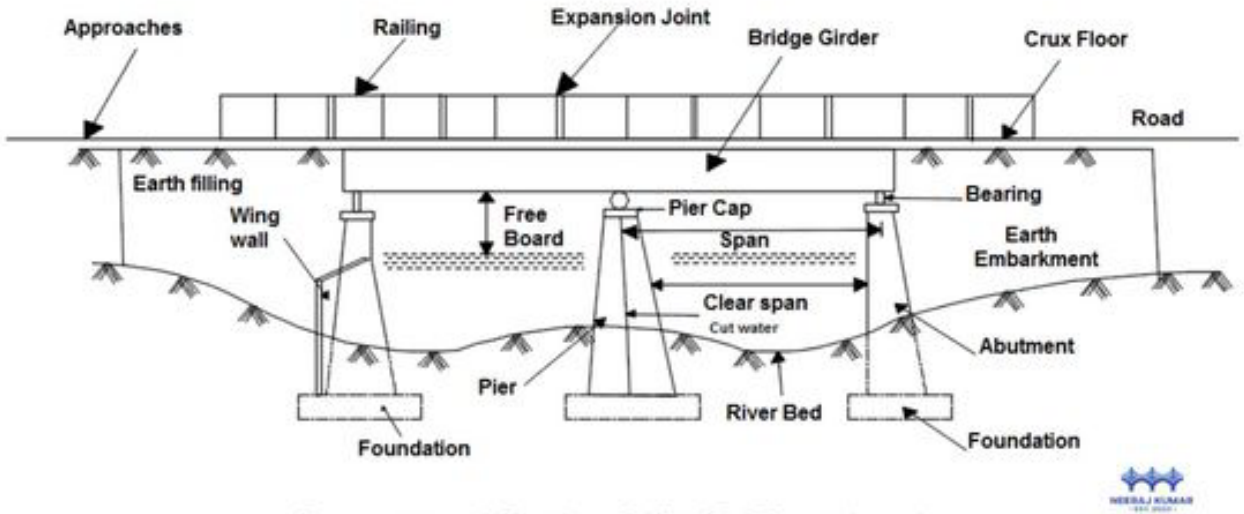
Disadvantages:

1. Can only be used on drivable surfaces
2. Usually will require traffic control

Parts of a Bridge

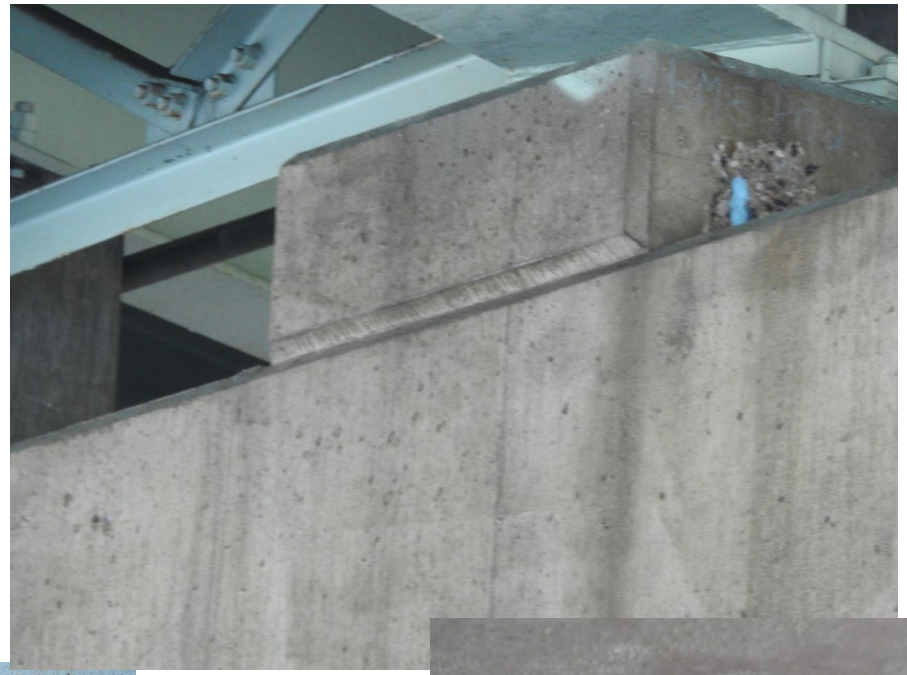
When surveying bridges you need to be familiar with the parts of a bridge.

This can be hard because all engineers do not call them the same thing.



Component Parts of the Bridge structure

Beam Seats



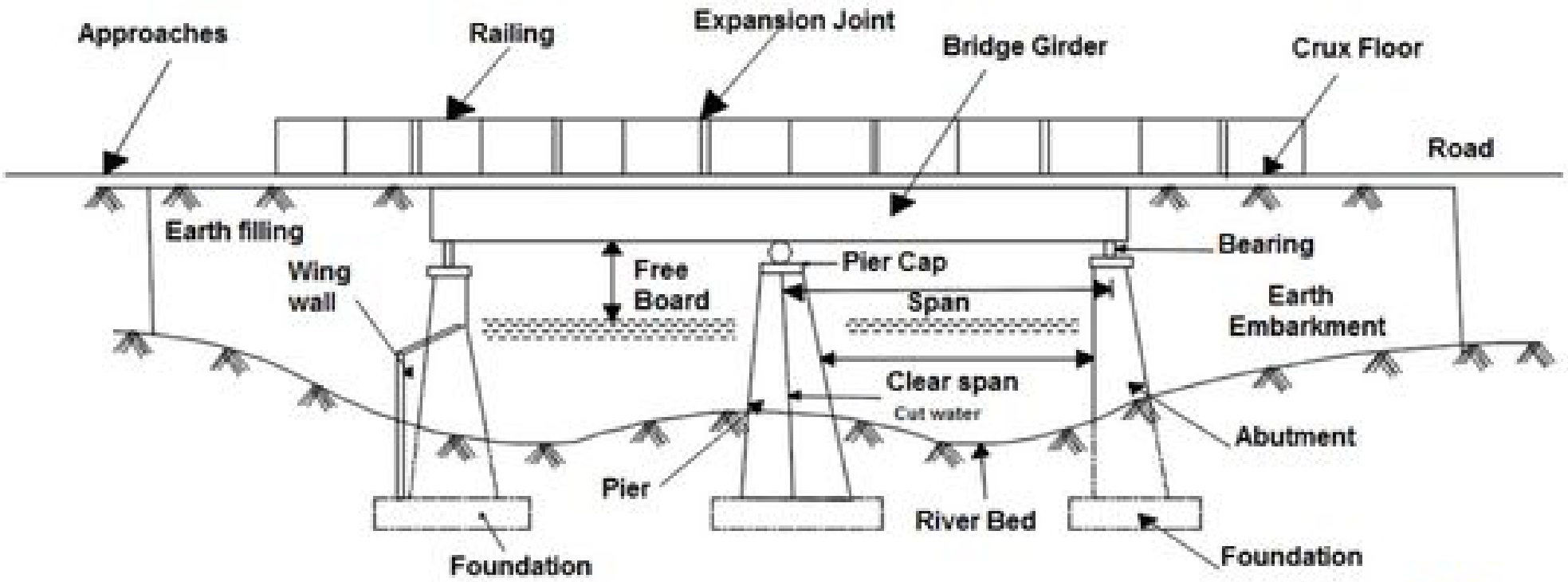
Hydraulic Opening

- Can anyone tell me what the hydraulic opening is?

Hydraulic Opening

- A "hydraulic opening" of a bridge structure refers to the effective cross-sectional area of the bridge opening that allows water to flow through it, essentially the available space under the bridge deck for water to pass, which is crucial for designing a bridge to handle floodwaters without causing excessive water level rise upstream; it takes into account factors like the bridge span, pier size, and the water surface elevation at high flow conditions.

Hydraulic Opening



Component Parts of the Bridge structure

What are quarter or tenth points?

What are quarter or tenth points?

- In bridge construction, "tenth points" refer to specific locations along the span of a bridge, dividing the length into ten equal sections, used primarily for calculating and designing the bridge deck profile, particularly when determining the elevation at various points across the span.

Survey Requirements for Various Projects

- I believe the most important factor when surveying a bridge is surveying what the designer needs to complete his or her work
- Another critical factor is setting good control
- I would classify bridge surveys into four types
- Each will require a different level of detail

Types of Projects

- Land Development
- Replacement
- Redecking
- Rehabilitation

Land Development

- In most cases, the survey requirements will be an outline of the deck and wingwalls, and the hydraulic openings.
- Unless the bridge is going to be modified, details of the substructure should not be needed
- The outline will be needed for the plan views.
- The hydraulic openings will be needed for the drainage calculations

Replacement

- In most cases, the survey requirements will be an outline of the deck and wingwalls, and the hydraulic openings.
- In many cases the designer will ask for more info
- Be sure the ask questions rather than assume what is needed

Redecking

- As with the other projects, make sure you have communicated with the designer to see what he or she needs
- Since the hydraulic openings should not change, surveys of the stream bed and hydraulic openings will probably not be needed
- The superstructure of the bridge will need more detail than the previous projects
- The substructure surveys should include the beams, abutments, piers, and beam seats

Rehabilitation

- As with the other projects, make sure you have communicated with the designer to see what he or she needs
- This type pf project requires the most amount of detail since parts of the bridge will be replaced and parts will remain
- The superstructure of the bridge will need detail similar to the redecking project
- The substructure surveys should include the beams, abutments, piers, beam seats, footings (foundations), and stream bed, including scours

Typical Bridge

What to survey on a bridge deck

- Parapets
- Guide rail attachments
- Joints
- Wheel stops or sidewalks
- Railings
- Approach slabs
- Any breaks in grade
- Scuppers
- Wing walls

What to survey on a bridge substructure

- Abutments
- Piers
- Beams
- Quarter or tenths points
- Footings
- Beam seats
- Roadway or stream
- Scupper outlets

Covered Bridges

Most covered bridges will be surveyed for rehabilitation

Scanning is a good option for surveying them

Surveying Arches

To properly define the hydraulic opening of an arch, a series of points on each face of the bridge need to be surveyed.

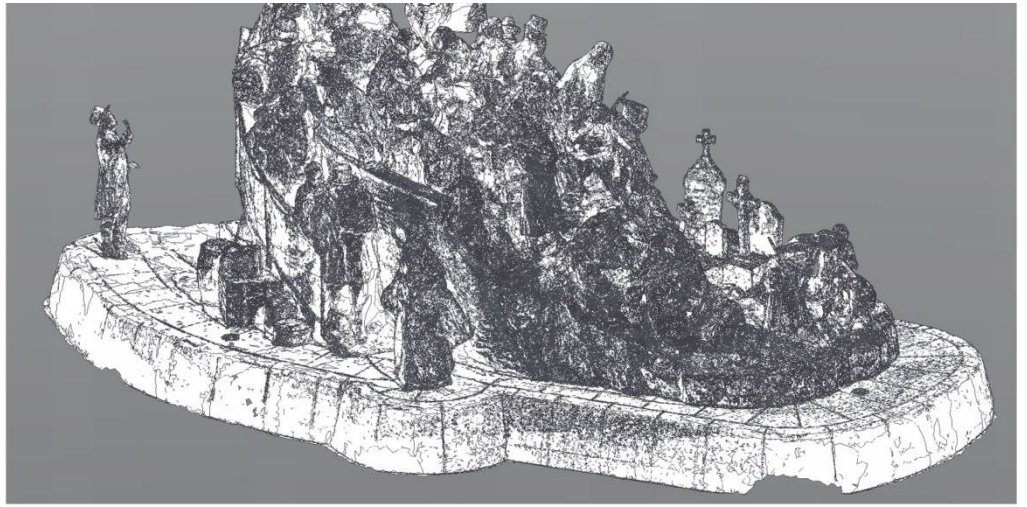
The number of points will be determined by the size of the arch and the radius of the curve.

The smaller the radius, the closer the points need to be to each other.

Our interval would typically b 5 to 10 feet.

Truss Bridge

Statues



Dams

Working around dams can be dangerous. They are typically slippery on top. The undertow on the downstream side can cause drowning.

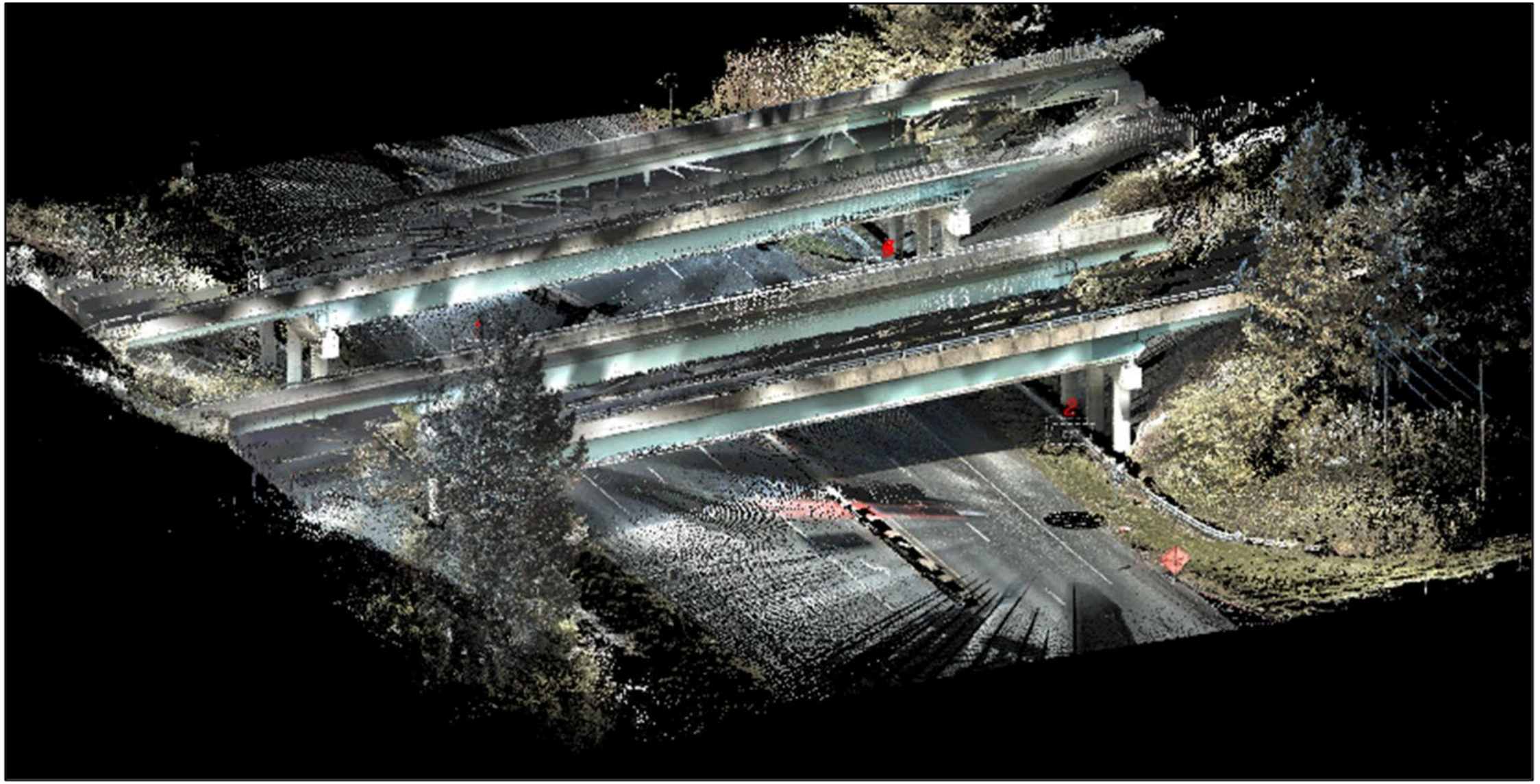
When possible, survey the top and the stream bed on the upstream and downstream sides.

Walls

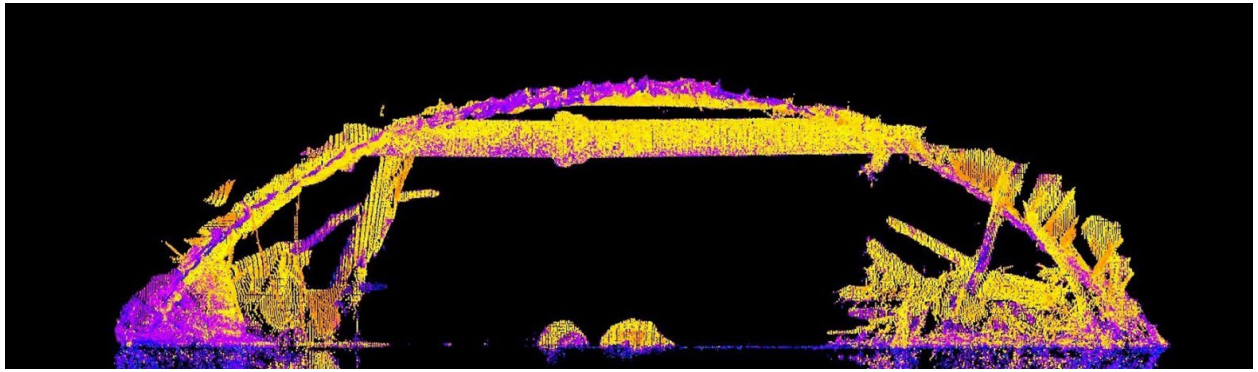
Surveys of walls are usually simple. The key points are the bottom front, top front, top back, and bottom back.

Sometimes when they are being altered, the survey can become more difficult.

Scan of Bridge



Scan of culvert



Other things to survey at bridges

- Utilities – Overhead, underground, and attached
- Trees within the proposed construction area
- Anything that may obstruct the movement of a crane

Creating Surfaces

- Once you have surveyed the structure you need to put it into a format that is usable by the designer.
- Typically, this will be a CAD format like AutoCAD/Civil 3D, MicroStation/InRoads, or Open Roads Designer
- Deck joints should not be included, unless a complete section was surveyed along the joint
- Points may need to be added in some cases

Issues that may arise

This brush pile at the upstream will cause a problem when surveying this bridge.

Survey as much of the pier as you can at the stream bed level. Then survey the outer limits of the brush.

Spalling

There is a lot of spalling on this arch.

To properly survey this bridge, you should survey points on the face of the structure and on the barrel of the arch.

Confined Spaces

A confined space is a space that has limited entry and exit points, and is not designed for continuous employee occupancy. It must also be large enough for an employee to fit inside and perform work.

There are additional requirements, equipment, personnel, and training required for working in confined spaces.

SESSION EVALUATION

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