Effective Use of Data for Assessment and Management of Complex Structures

inspecttech

Presented by:
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Commodore Barry Bridge

- Maintained by Delaware River Port Authority
- Other DRPA Bridges – Benjamin Franklin, Walt Whitman, Betsy Ross Bridges
- Longest cantilever through truss bridge in the U.S. (4th longest in the world)
- In-depth inspections once every two years

Original System

- Combination of paper and very limited computer databases
- Standard and special inspection forms
- Programs not integrated – manual entry of data in multiple locations (also certain data submitted to PennDOT and NJDOT systems)
- Narrative data kept in printed folders or computer hard drives

Previous Problems

- Increased the potential for typing errors from redundant entry of data
- Time-consuming task of manually retrieving data from multiple hard copies and databases
- Each biennial inspection report is ~2,000 pages
- Nearly impossible to try to manually do complex queries from paper reports
- In case of emergency – needed a better plan to obtain data
- Needed to centralize data to one location for easy access

Hundreds of Pages of this

- There is a notch in top surface of the L2 inside connection plate to truss lateral diagonal bracing top flange (**Photo 54**).

L4:
- Moderate corrosion at connection between lower diagonal lateral bracing and bottom chord at panel point 4 and splices between FB and FB bracket to lower chord connection.

L6:
- Three (3) 1" long tack welds on backer bar at end of FB connection to lower cord.

L9:
- Two (2) 1" long tack welds on top of weld between backer bar of lower diagonal lateral bracing and lower chord at L9.

L10:
- Moderate corrosion on splice plate and several splice bolts at L9-L10 at panel point 10.
- Heavy corrosion on few interior bottom plate splice bolts at L9-L10 to L10 chord splice.

L12:
- Four open/misdrilled holes on truss vertical member flange connection to L12 at flange thickness transition.
- One missing bolt on L11-L12 to L12 chord splice for drainage from truss chord interior mid-depth plate.
- Moderate to heavy rust on all interior bolts and plates at L11-L12 to L12 truss chord splice including the underside of the truss chord interior mid-depth plate.
- Heavy to severe corrosion on several truss chord bottom plate interior splice bolts.

L13:
- Weephole on outside of truss bottom chord at L13 has heavy corrosion around the perimeter with heavy rust stains.
- 8" long vertical weld along backer bar at west side of FB13 to L13 connection plate and L13 inside gusset plate.

L14:
- Ponding water and water stains on top surface of L14-L15 chord member. One missing bolt at mid-depth of L14-L15 outside web splice plate to L15 with moderate corrosion along hole perimeter. Hole is actually leaking with rust stains.

- One missing bolt/open hole on truss vertical connection to outside gusset plate. Note that there is no hole in the far side plate at this location.

L15:
- Ponding water up to ½" on top surface of bottom chord at L15 between inside and outside gusset plates on both sides of vertical.

L16:
- One missing bolt on outside L15-L16 to L16 truss chord splice for drainage from truss chord interior mid-depth plate.

South Truss:

L0:
- Heavy spalling of concrete pad on top surface of bottom chord at L0.

L2:
- Moderate to heavy corrosion on five interior bottom splice plate bolts at L2-L3 to L2 truss chord splice.

L3:
- Vertical backer bar on west side of FB3 connection to L3 inside gusset plate terminates two-thirds up floor beam connection plate and a weld continues from that point to top.

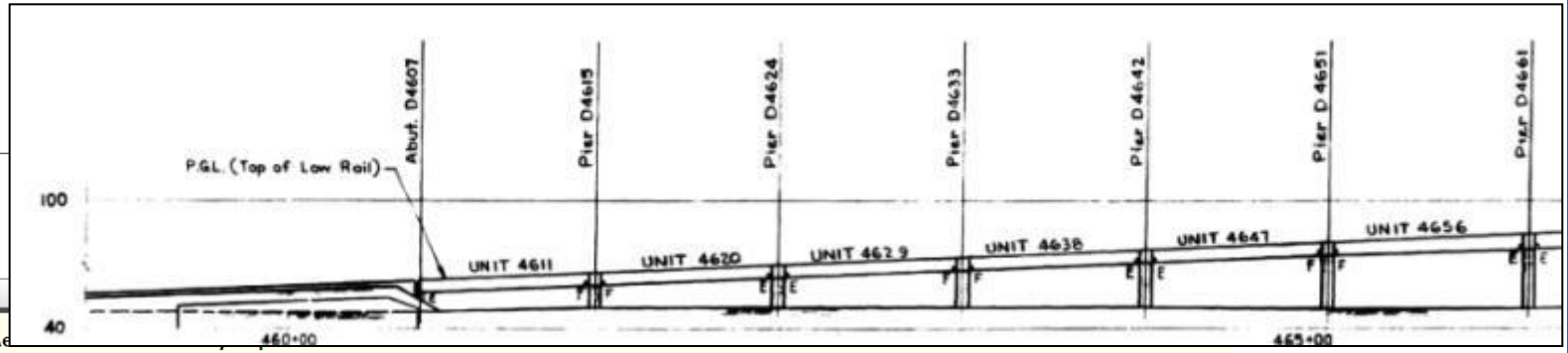
L9:
- One (3/4") tack weld between truss bracing member connection plate backer bar and inside gusset plate at L9.

L10:
- Moderate to heavy rust on few interior truss chord L9-L10 to L10 bottom plate splice bolts.
- Water stains and evidence of ponding water on top surface of bottom chord between gusset plates on east side of truss vertical at L10.

L11:
- Weephole on outside gusset plate has heavy corrosion around perimeter with heavy rust stains (**Photo 51**).

L12:
- One missing bolt on outside L11-L12 to L12 chord splice for drainage from interior mid-depth plate.
- Moderate to heavy rust on all interior bolts and plates at L11-L12 to L12 truss chord splice including the underside of the truss chord interior mid-depth plate.

DC Metro – 2D Approach



metro

Main | Administration

Minnesota Avenue Ae

Inspection Date	Asset Code	Asset Name	Owner	Asset Type	Submitted To	Status		
12/08/2009	Minnesota Avenue Aerial Structure	Minnesota Avenue Aerial Structure	Webb, Gerald	Bridge		Approved on 6/24/2010		

Minnesota Avenue Aerial Structure Sub-Assets:

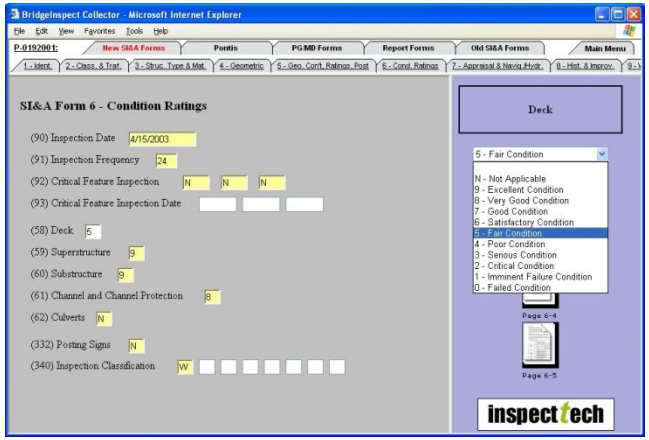
Show Assets in Minnesota Avenue Aerial Structure by [All Assets] Filter Displayed Inspection Type: Routine

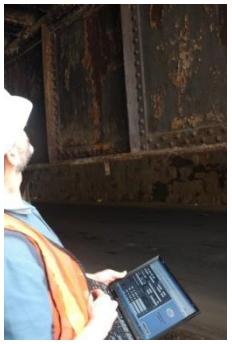
Inspection Date	Asset Code	Asset Name	Sub-Assets	Owner	Asset Type	Submitted To	Status		
12/08/2009	1116600	Abutment 2432 IB&OB	None	Webb, Gerald	Bridge		Approved on 6/24/2010		
12/08/2009	1116700	Span 2437 IB	None	Webb, Gerald	Bridge		Approved on 6/24/2010		
12/03/2009	1116800	Span 2437 OB	None	Limones, Jose	Bridge		Approved on 6/24/2010		
12/03/2009	1116900	Crossbox/Pier 2442 IB&OB	None	Limones, Jose	Bridge		Approved on 6/24/2010		
12/08/2009	1117000	Span 2447 IB	None	Webb, Gerald	Bridge		Approved on 6/24/2010		
12/03/2009	1117100	Span 2447 OB	None	Limones, Jose	Bridge		Approved on 6/24/2010		
12/03/2009	1117200	Crossbox/Pier 2452 IB&OB	None	Limones, Jose	Bridge		Approved on 6/24/2010		
12/08/2009	1117300	Span 2457 IB	None	Webb, Gerald	Bridge		Approved on 6/24/2010		
12/03/2009	1117400	Span 2457 OB	None	Limones, Jose	Bridge		Approved on 6/24/2010		
02/04/2010	1117500	Crossbox/Pier 2462 IB&OB	None	Webb, Gerald	Bridge		Approved on 6/24/2010		
02/04/2010	1117600	Span 2467 IB	None	Webb, Gerald	Bridge		Approved on 6/24/2010		
12/07/2009	1117700	Span 2467 OB	None	Limones, Jose	Bridge		Approved on 6/24/2010		

Inspection Software

StructureSuite Collector

For high quality data collection on complex structures.





Project Approach

- Customize the core system and products for DRPA
- Establish consistent, high quality, and reliable format for collection and management of data
- Allow for pictures, sketches, interactive manuals, and any other resources to be attached to every component
- Integrate with existing business processes
- Develop an easy-to-use system for DRPA and its Consultant

Commodore Barry Bridge

- An advanced inspection system which integrated data from a variety of sources was used on the latest inspection to assist in the data overload
- Fully supports inspection forms and required information
- Ability to allow all other information to be linked and stored in one Place
- Field data collection module available on tablets for on site entry

Web Based – Central Repository

BridgeInspect Manager - Windows Internet Explorer

https://drpa.bridgemanage.com/main.aspx

Favorites

BridgeInspect Manager | BridgeInspect Manager

Page ▾ Safety ▾ Tools ▾

StructureSuite

Delaware River Port Authority

Bridge and Structure Inspection Management System

inspecttech

Tuesday, January 24, 2012

Messages: 0 new (view)

Quick Select: Type Asset name here

View Asset

Main | GIS | Query | Reports | Administration | Help

Most Recent Bridges Accessed:

All Assets: Commodore Barry Bridge

Commodore Barry Bridge: Spans

Deck: E16

Spans: Deck

Superstructure: E2

Most Recent Inspection Reports Approved:

Commodore Barry Bridge

Conditions of Use

Central Repository

- All bridge data in a single location with easy to use and powerful modules for past, current, and future info/tasks.
- Information automatically flows in from inspection sources
- Users can directly add files, historic data, or day-to-day maintenance accomplishments into the system

BridgeInspect Collector - Windows Internet Explorer

http://mndot.bridgeinspect.com/bridgedetail.aspx?type=0&as_id=103719

File Edit View Favorites Tools Help

Favorites | excel bridge deterior... | http://onlinepubs.trb... | http://onlinepubs.trb... | BridgeInspect Coll...

Page Safety Tools

Filter Files/Pictures

File Date: From: To:

File Description:

Filter

Sketches

No Sketches found.

Photos

There are 610 photos linked to this asset. Files 1 through 48 are displayed. If you need to see different files, use the filter or page the the results with the 'Next' and 'Previous' buttons.

1 2 3 4 5 6 7 8 9 10 11 12 13 Next

File: 6874 Span #19 WT L11' (floorbeam end).JPG
Date: 6/4/2008
Originally attached via the manager software
Description:

Edit Details | Delete

File: 6941 Span #19 WT L19 (interior gusset - roadway face).JPG
Date: 6/4/2008
Originally attached via the manager software
Description:

Edit Details | Delete

File: 6942 Span #19 WT L19 (interior gusset - roadway face).JPG
Date: 6/4/2008
Originally attached via the manager software
Description:

Edit Details | Delete

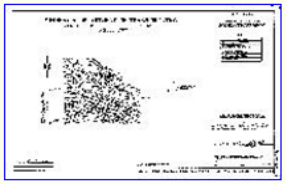
File: 6943 Span #19 WT L19-U19 at L19 (interior channel).JPG
Date: 6/4/2008
Originally attached via the manager software
Description:

File: 6944 Span #19 WT L19-L18' (typical corrosion).JPG
Date: 6/4/2008
Originally attached via the manager software
Description:

File: 6945 Span #19 WT L19-L18' (typical pitting & corrosion).JPG
Date: 6/4/2008
Originally attached via the manager software
Description:

Internet 105%

Drawings



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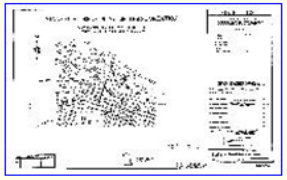

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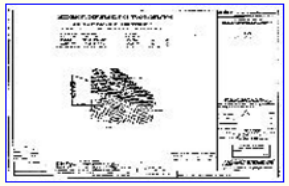

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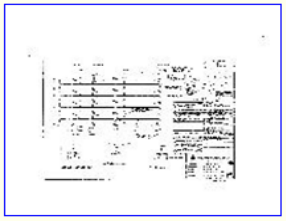

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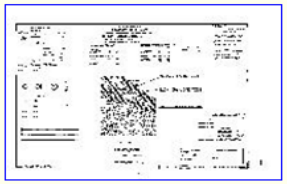

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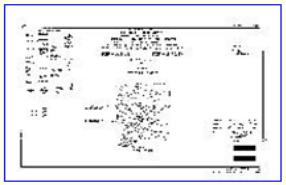

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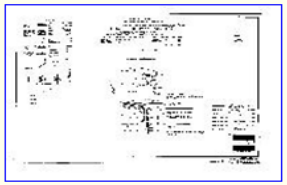

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Edit Details ☐ Delete

Delete Selected Drawing(s)

Delete Selected Drawing(s)

Historical Report

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File Name: MNDOT_DOCS-#635715-v1-BRIDGE_5900_GUSSET_REPAIR_(2008).PDF **Date:** 6/25/2008 **Description:** Gusset Repair Edit Details ☐ Delete	**File Name:** MNDOT_DOCS-#771272-v1-BRIDGE_5900_FRACTURE_CRITICAL_INSPECTION_REPORT_(2008)_REVIEW-D6_REPLY_PDF.PDF **Date:** 6/5/2008 **Description:** Fracture Critical Inspection Report Edit Details ☐ Delete	**File Name:** MNDOT_DOCS-#715651-v1-BRIDGE_5900_FRACTURE_CRITICAL_INSPECTION_REPORT_(2008).PDF **Date:** 6/5/2008 **Description:** Fracture Critical Inspection Report Edit Details ☐ Delete
File Name: 5900 span 21 L8.pdf **Date:** 6/2/2008 **Description:** No Date Sketch Edit Details ☐ Delete	**File Name:** MNDOT_DOCS-#667208-v1-BRIDGE_5900_FRACTURE_CRITICAL_INSPECTION_REPORT_ACKNOWLEDGMENT_(2007).PDF **Date:** 1/1/2007 **Description:** Fracture Critical Inspection Report Acknowledgement Edit Details ☐ Delete	**File Name:** MNDOT_DOCS-#768537-v1-BRIDGE_5900_UNDERWATER_INSPECTION_REPORT_(2000).PDF **Date:** 10/24/2000 **Description:** Underwater Inspection Report Edit Details ☐ Delete

Delete Selected Historical Report(s)

Rating Document

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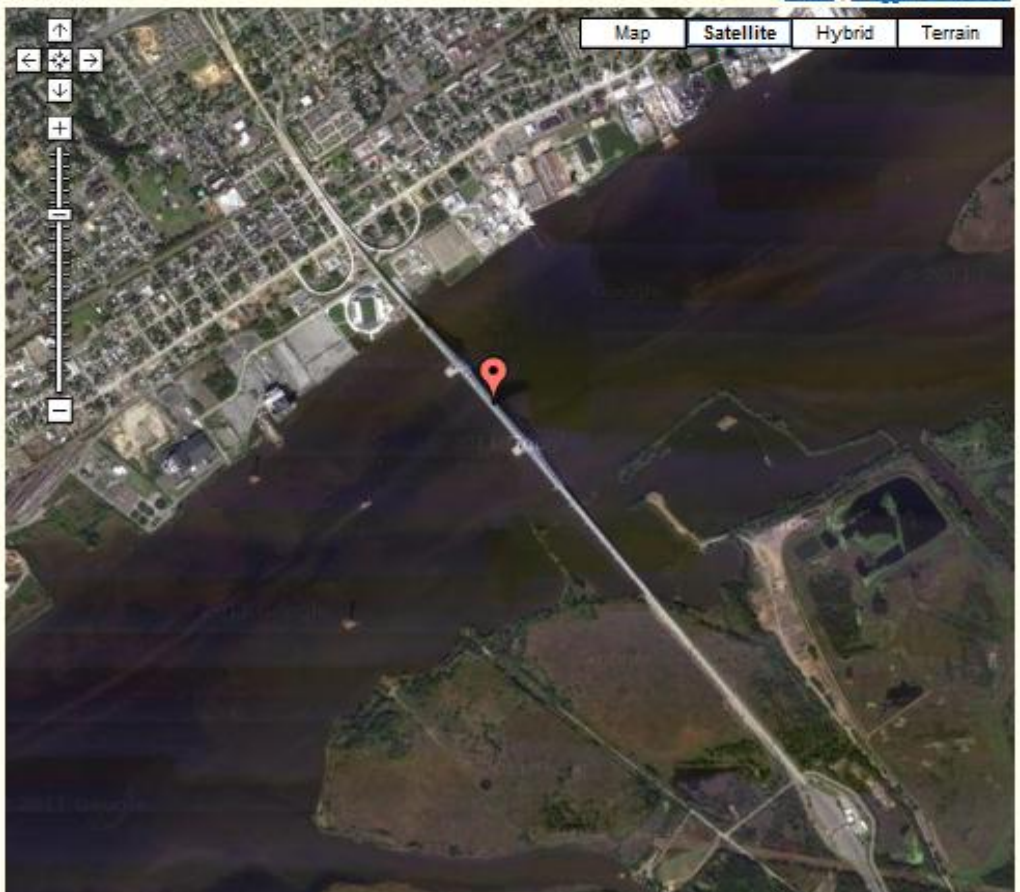
Maps

No Maps found.

Show Assets in All Assets by [All Assets] Show Assets

Count:2

Print | Toggle Controls



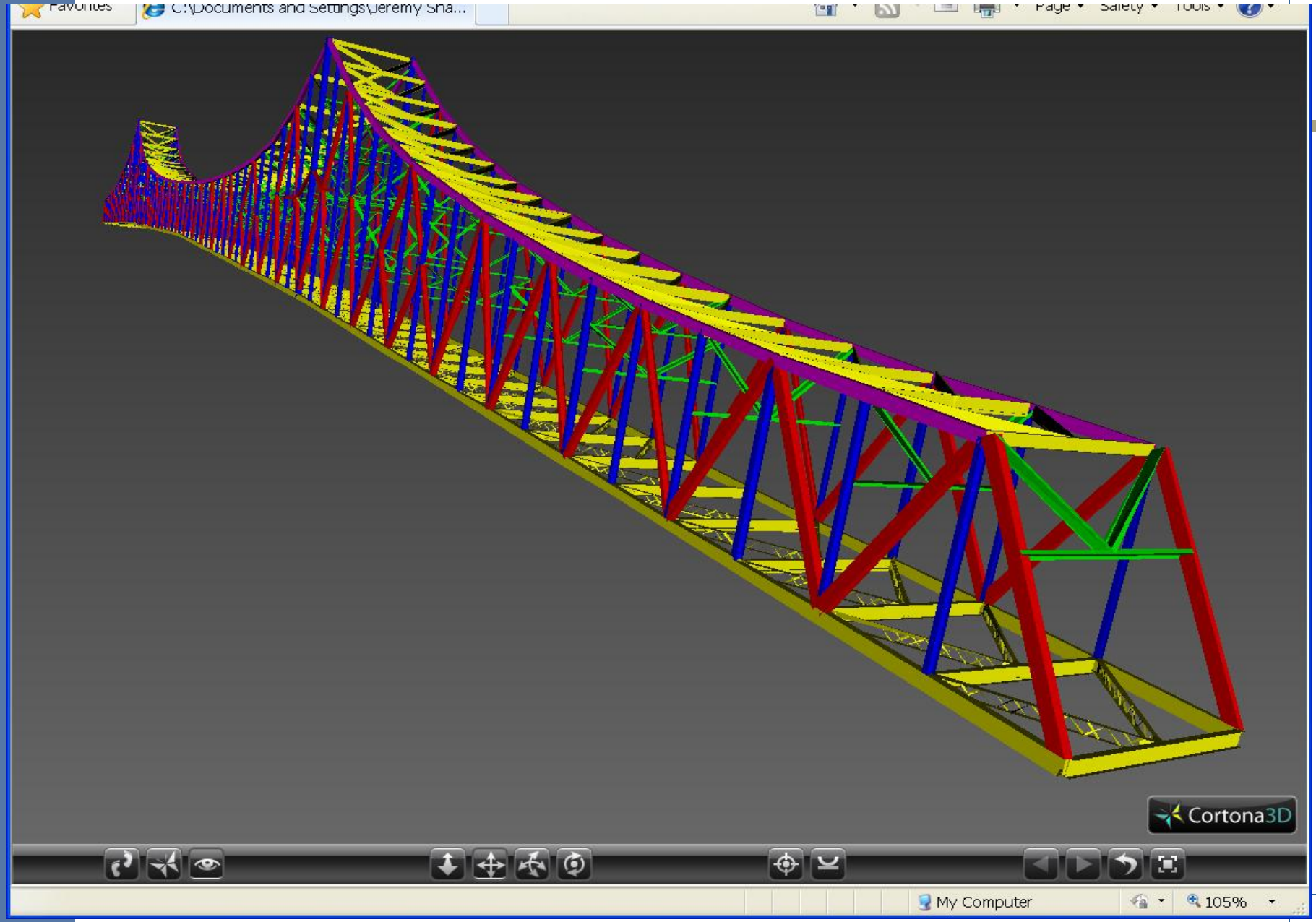
Information | Street View

Commodore Barry Bridge

Parent Asset: All Assets
Asset Name: Commodore Barry Bridge
Asset Code: 4500001
Asset Type: Bridge

Go to Bridge Detail Page

Zoom Map to Bridge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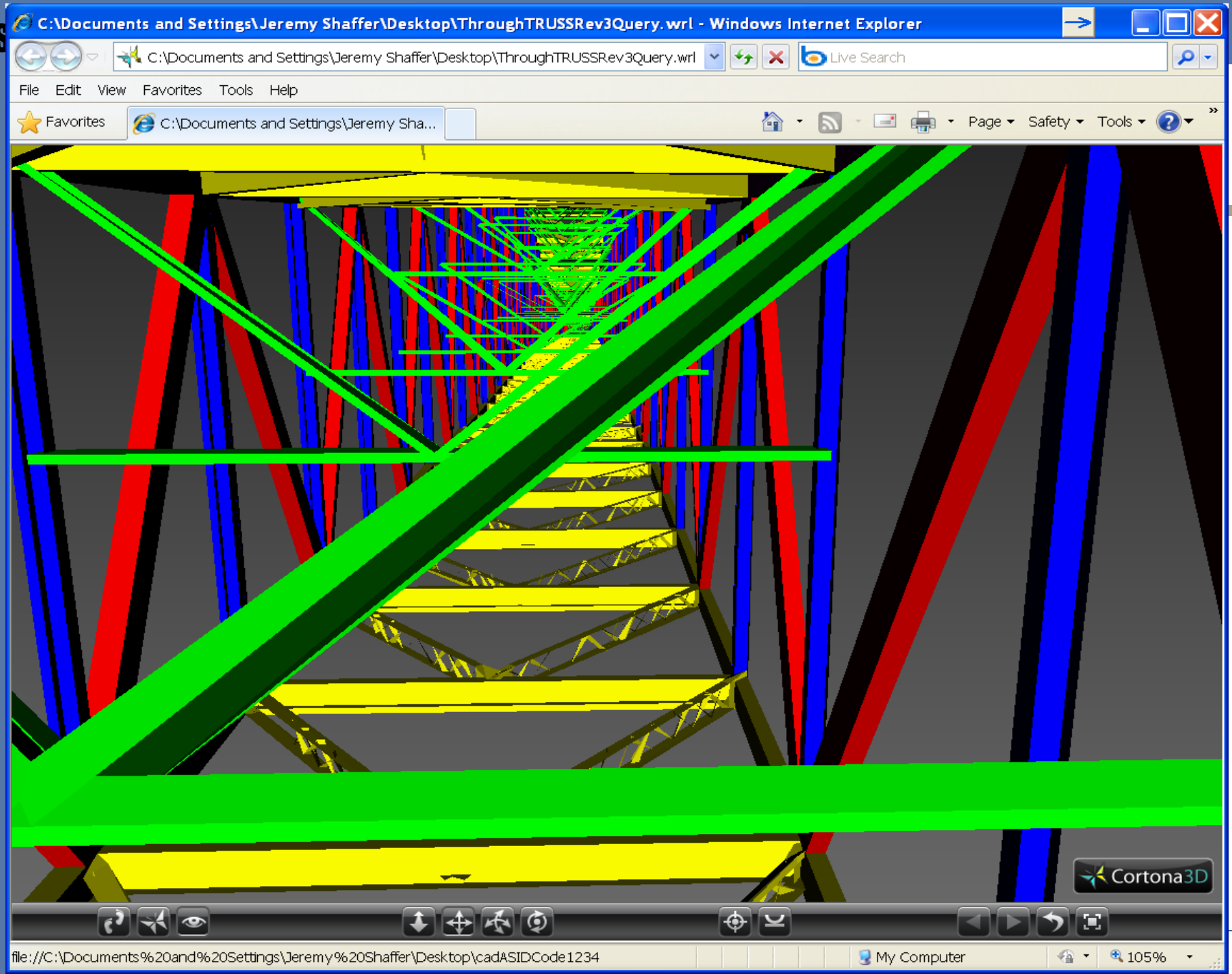
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Live Search
File Edit View Favorites Tools Help
Favorites
C:\Documents and Settings\Jeremy Sha...
Page Safety Tools
Cortona3D
file://C:\Documents%20and%20Settings\Jeremy%20Shaffer\Desktop\cadASIDCode1234
My Computer
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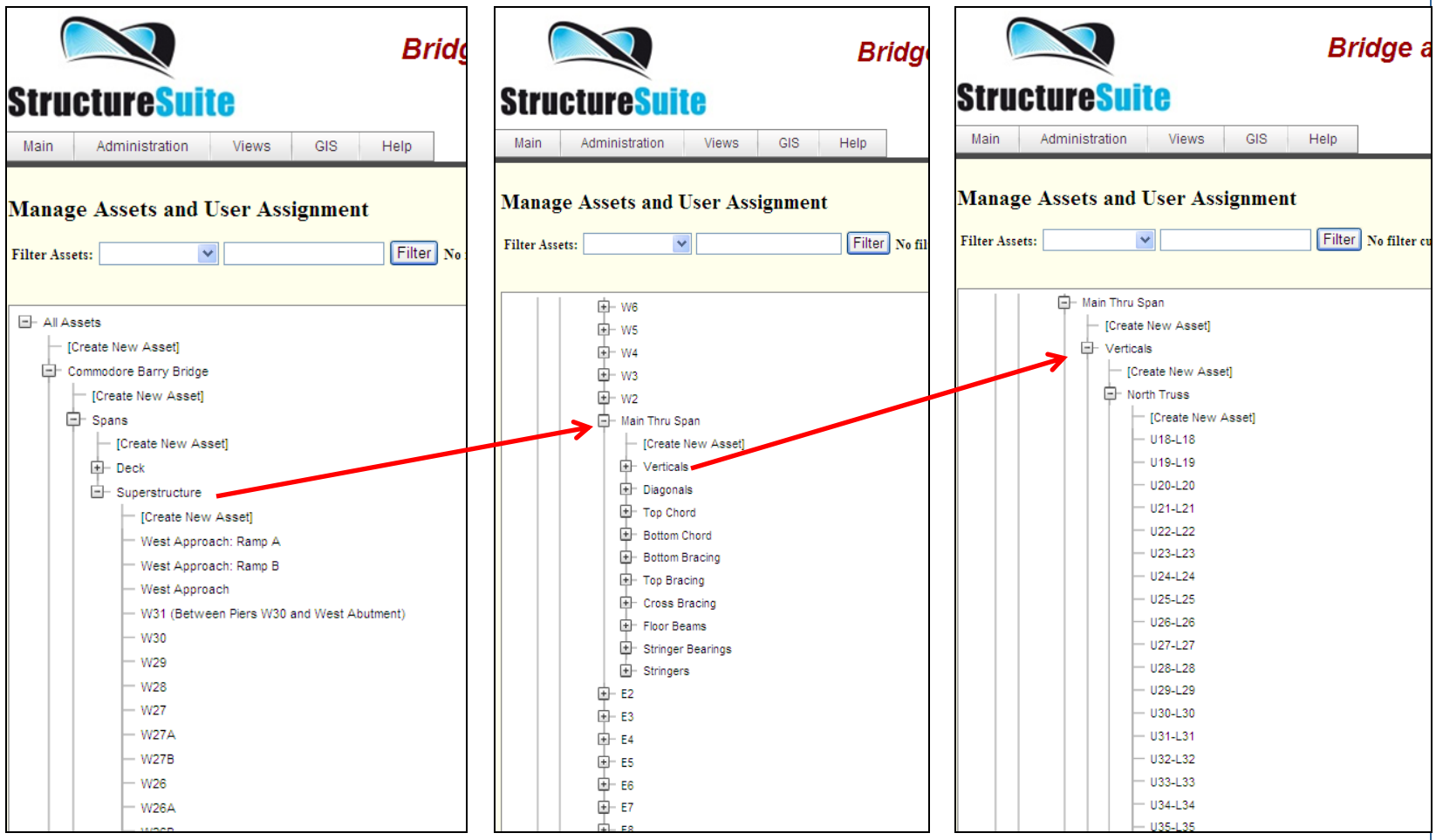
Details

- 3D Solid Model
- Represent only the details that user cares about
- Utilize color for different layers – condense to single color for search results
- Ability to turn on/off layers
- Information all driven off database and web-interface

Drill down into detail of bridge to add ratings, comments, pictures

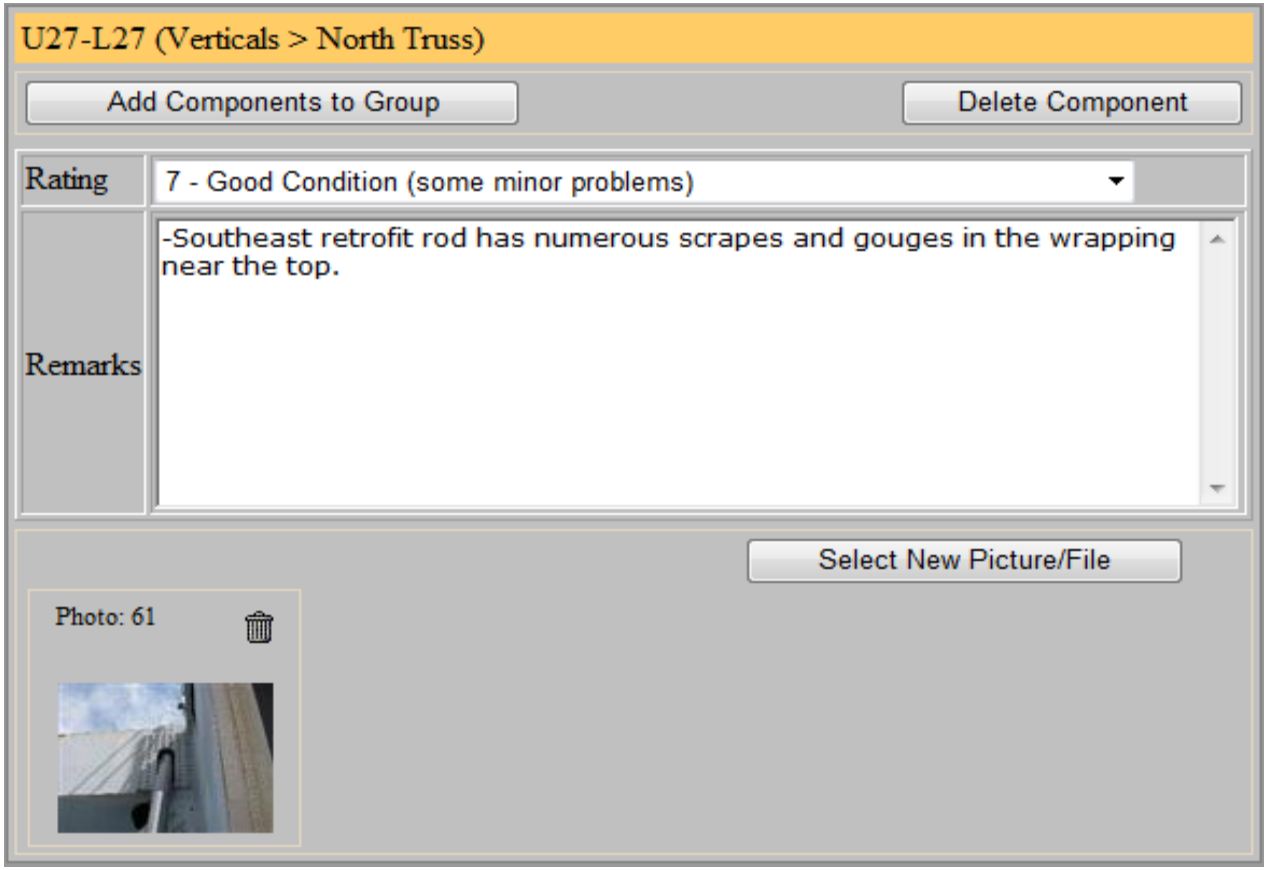
User drilling down to bridge, span, superstructure, main span, verticals, north truss and specific parts



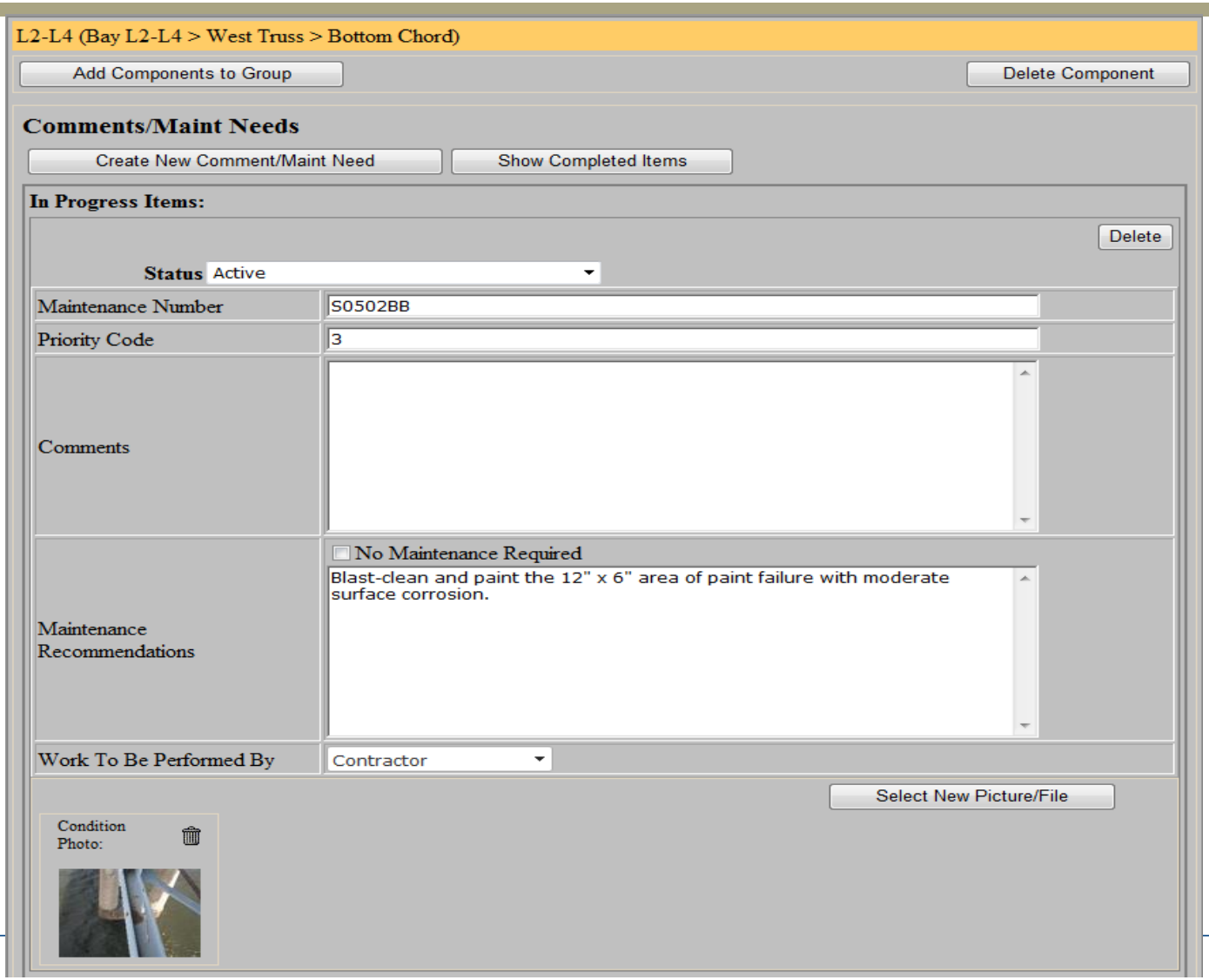
Bridge and Span have a Detailed Page Created

- Complex bridges can have enormous amounts of data that needs to be organized.
- Specialized data collection for different component types
- All pictures, sketches, and other electronic files stored in one easy to use place
- All historic data available

Inspection Entry Example (specific steel chord)



Create, Tag, and Prioritize Maintenance Needs



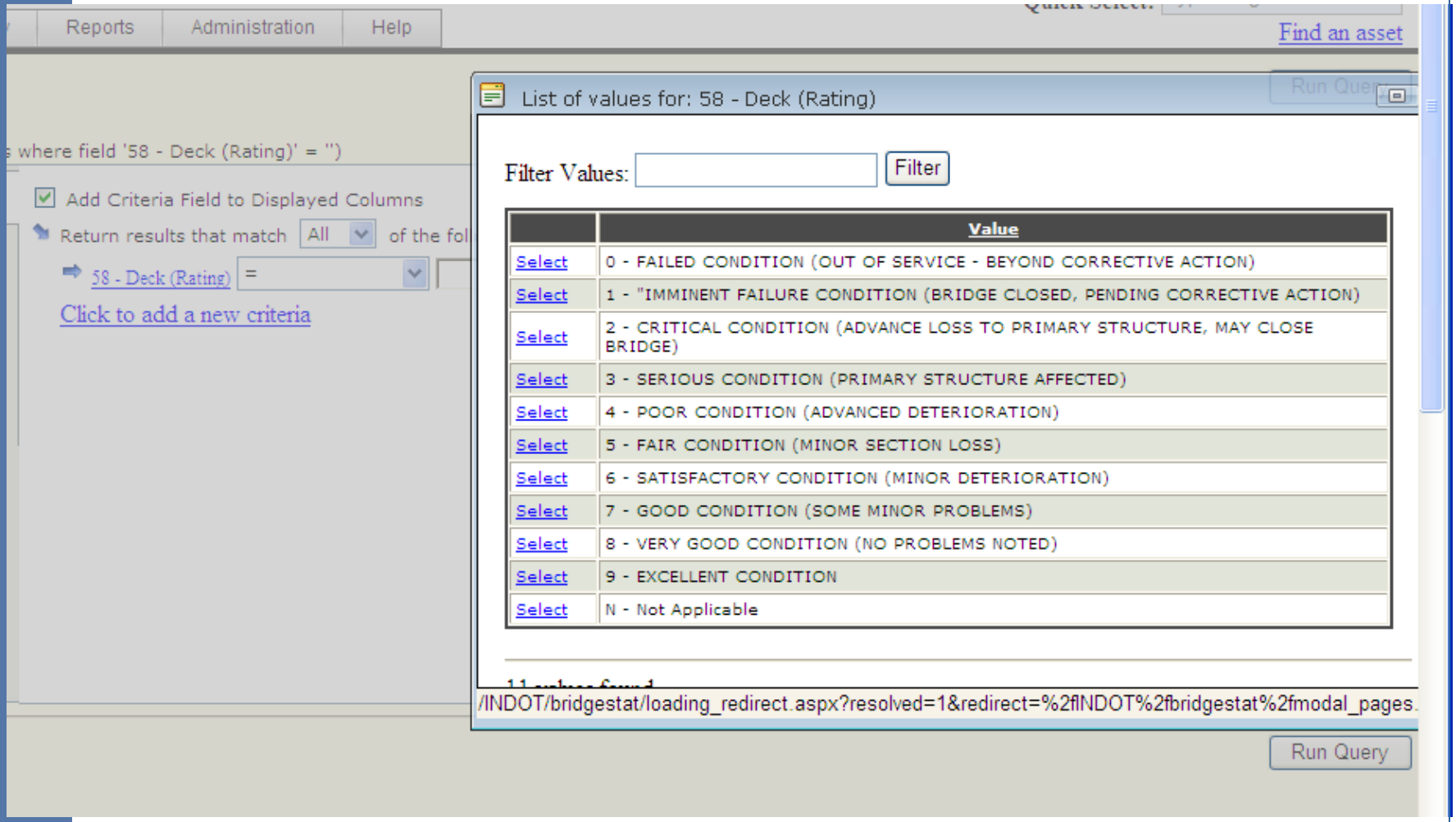
Commodore Barry Bridge

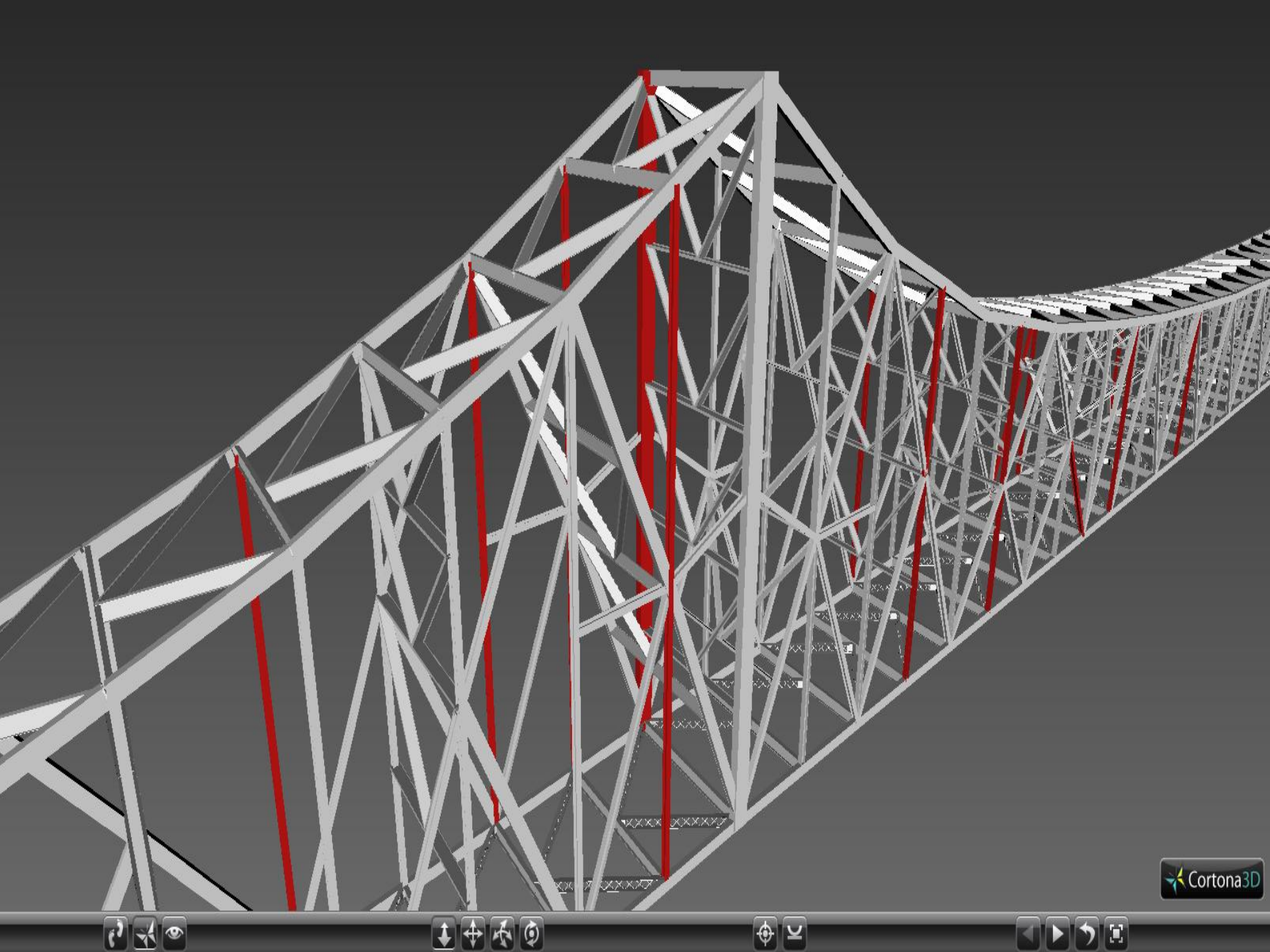
- Allows for full searching using ad-hoc query tool to return the exact dataset you are interested in
- Provides visualization of data in 3D model and other output formats
- Problem areas and component relationships can be seen quickly and easily
- Dramatic improvement over past paper booklets

Special Searching Criteria

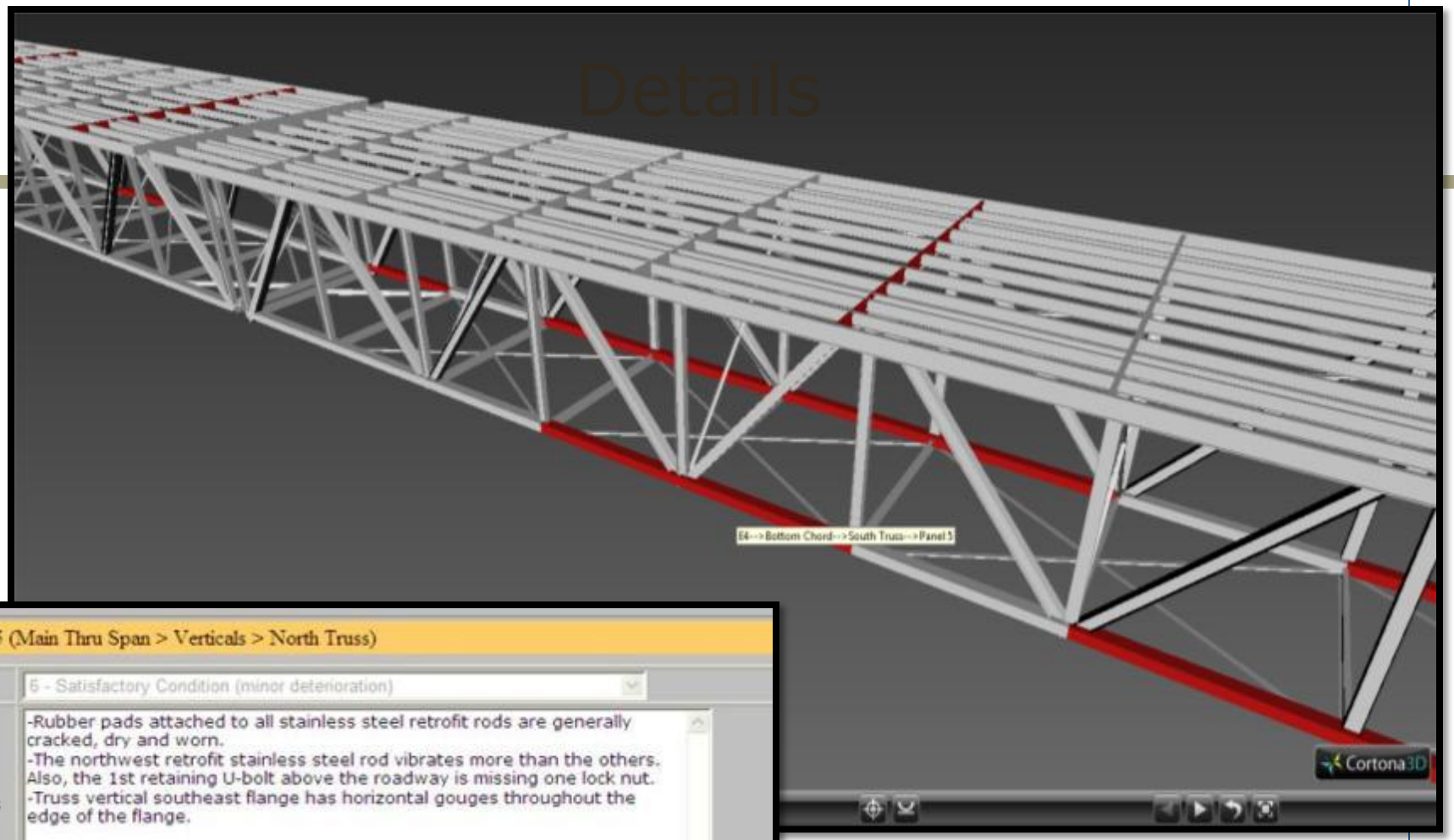
- Search by entire structure, span or specific component type
- Ability to drill down into the specific parts of the asset tree to the desired level
- Can combine fields and criteria as needed to make simple or complex queries using boolean logic

Field Selections in Queries




Cortona3D

Details



U45-L45 (Main Thru Span > Verticals > North Truss)

Rating: 6 - Satisfactory Condition (minor deterioration)

Remarks:
-Rubber pads attached to all stainless steel retrofit rods are generally cracked, dry and worn.
-The northwest retrofit stainless steel rod vibrates more than the others. Also, the 1st retaining U-bolt above the roadway is missing one lock nut.
-Truss vertical southeast flange has horizontal gouges throughout the edge of the flange.

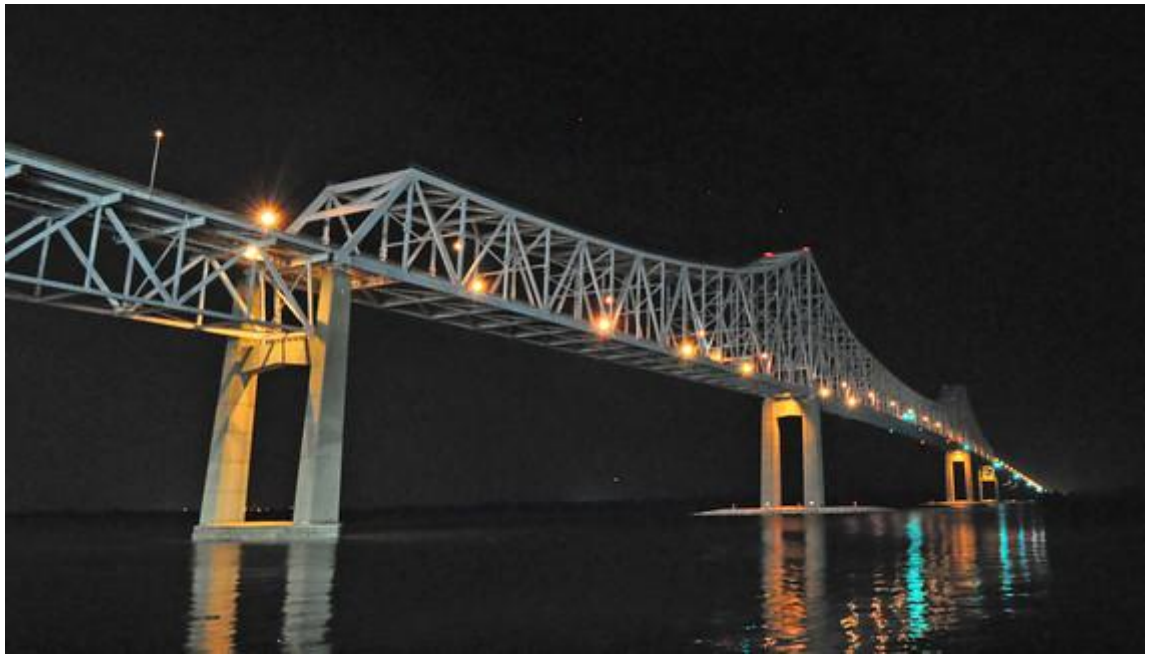
Photo: 64

Photo: 65

Photo: 66

Video Demonstration

- ***3D Visualization of the Commodore Barry Bridge***



Thoughts on 3D detailed modeling for large bridges

- Very powerful approach for complex bridges
- Relatively straight-forward to do
- Still supports traditional paper output
- Able to summarize data and generate traditional SI&A / Pontis style reports
- Not applicable for all bridges, but most agencies have a handful that would see huge benefits from this approach

Questions