# Utilizing 3-D Models for Better Bridge Asset Inspection and Management

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# Why Use 3D Models?

- We are nearing the End of an Era
  - Relied solely on “Paper” for years, as a primary representation for engineering and construction
  - Bridge is still the only industry constructing 3D projects using mainly 2D drawings.
- We need a Fundamental “Re-Thinking” of the antiquated processes that are still being used in bridge projects


The world is becoming INSTRUMENTED

The world is becoming INTERCONNECTED

The world is becoming INTELLIGENT

 

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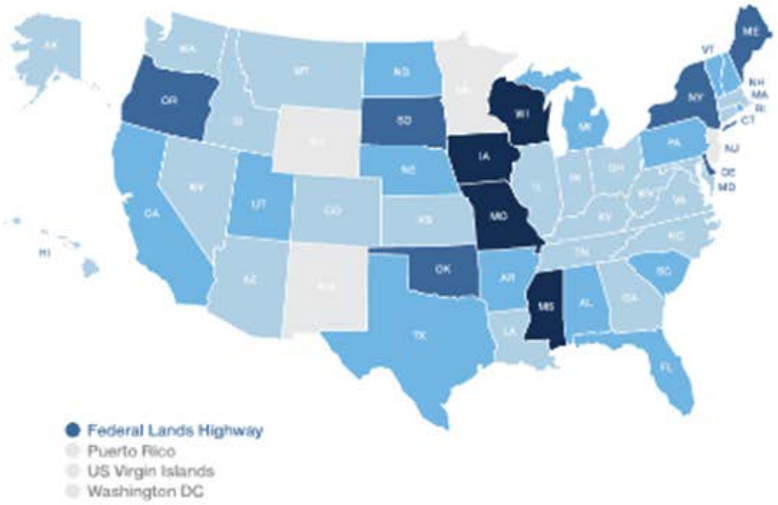
# 3D Modelling At US DOT's

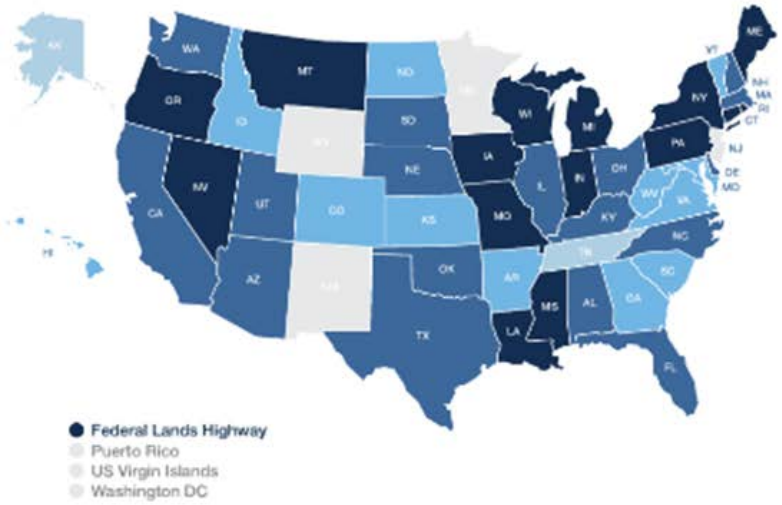
## 3D Engineered Models: Project Planning, Design and Construction

Using 3D engineered models in project planning, design and construction is becoming a widespread practice in the United States, with 29 states planning to implement it in 2015 and 2016. An additional 15 states and Federal Lands Highway plan to integrate 3D modeling in planning, design and construction into highway agency culture by the end of the two-year EDC-3 cycle.

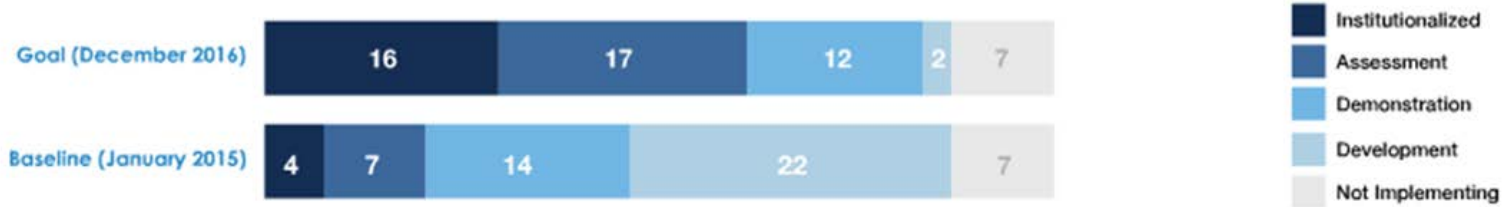
**Baseline (January 2015)**




**Goal (December 2016)**




**Number of States in Various Implementation Stages**



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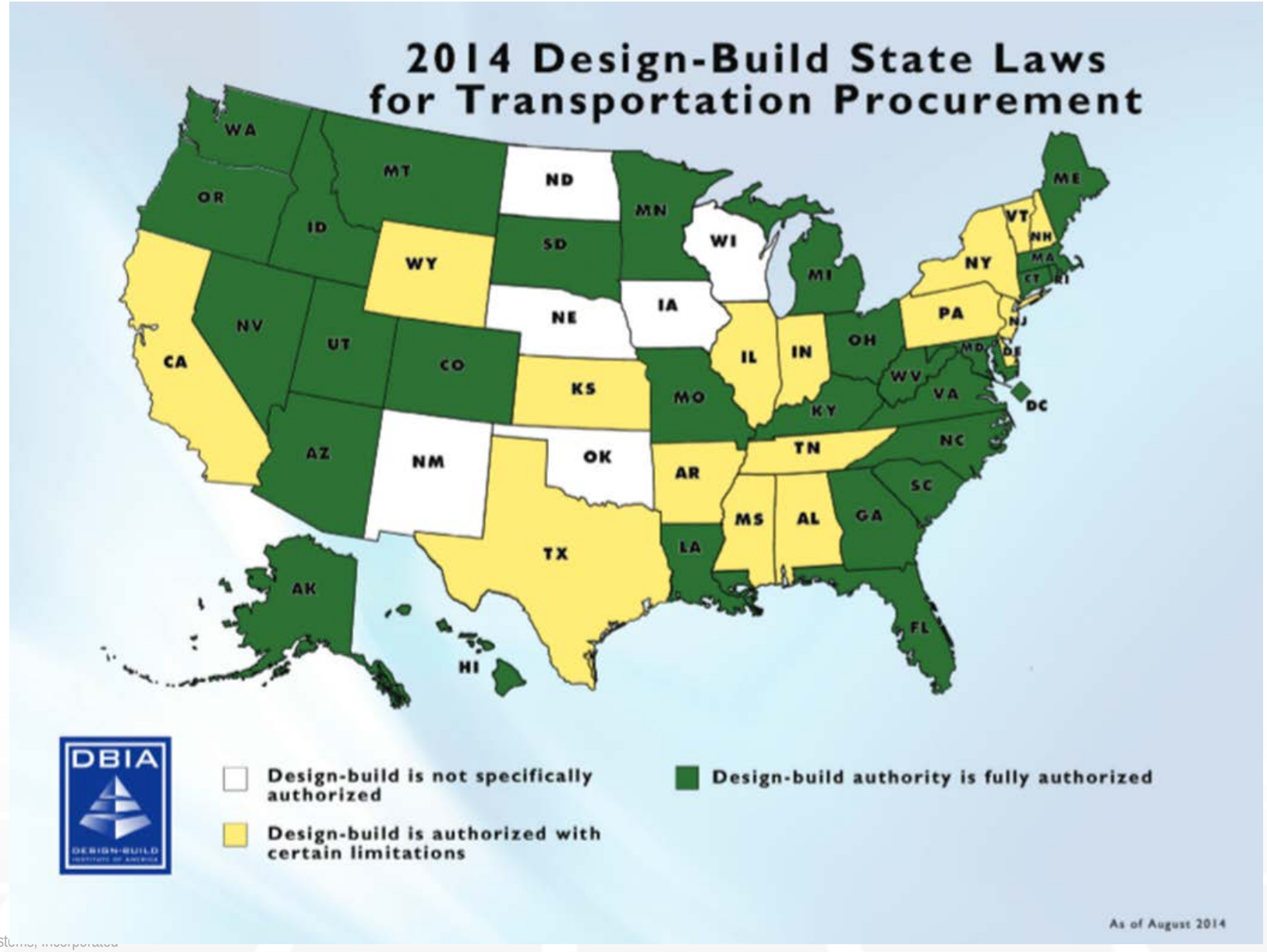
# Contracting Trends At US DOT's



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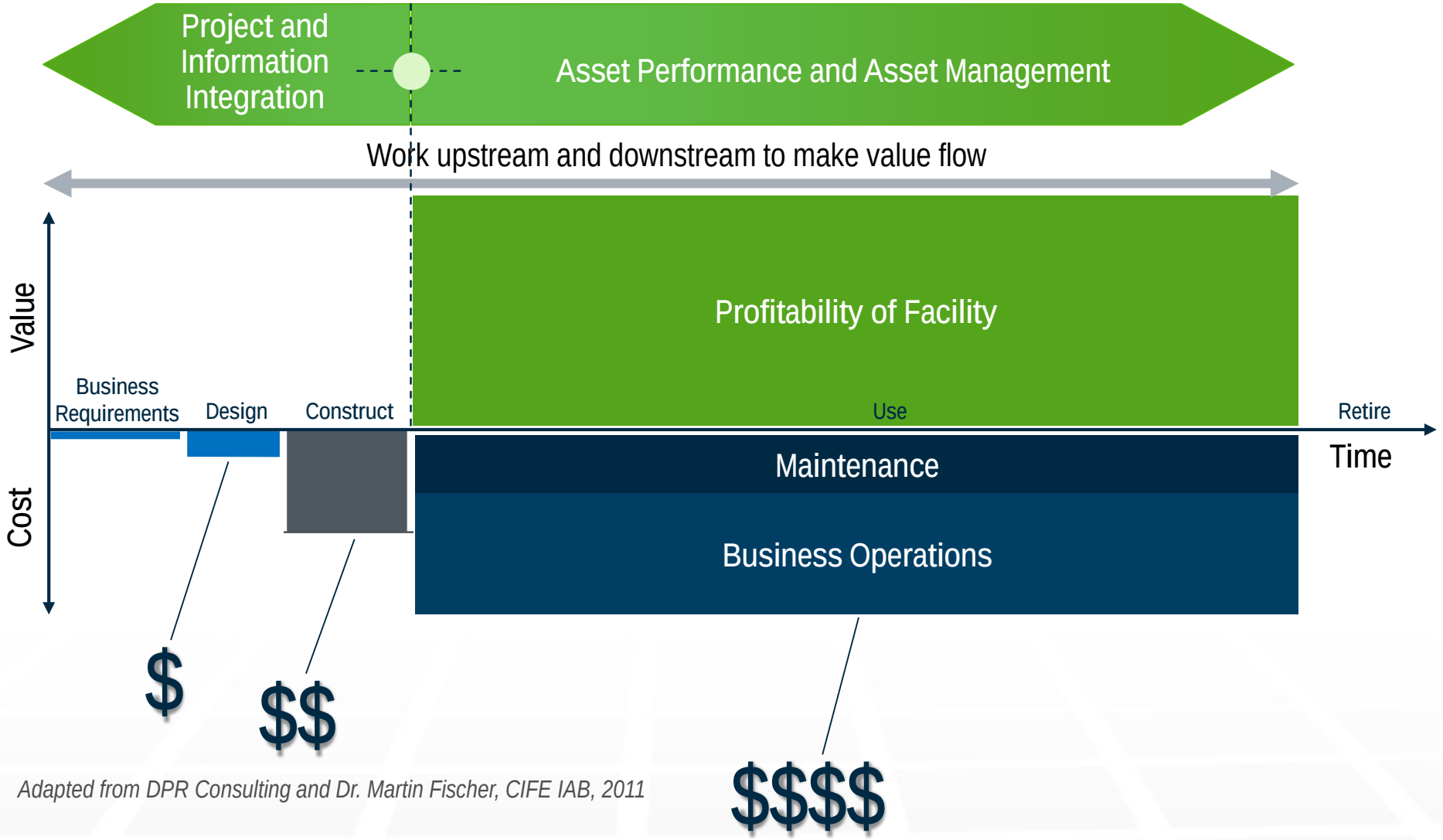
# Whole Life Value




*Adapted from DPR Consulting and Dr. Martin Fischer, CIFE IAB, 2011*

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# Complex Bridge Inspection & Management

- Complex bridges can have *enormous* amounts of *data* that needs to be *collected* and *organized*.
- Requires the ability to collect specialized data for different *component types* and trades (electrical, mechanical, etc.).
- A necessity to have access and *reference* to large volume of *pictures*, *sketches*, and other electronic files that may be stored in multiple locations
- Usually contains a massive amount of *historic data*

 

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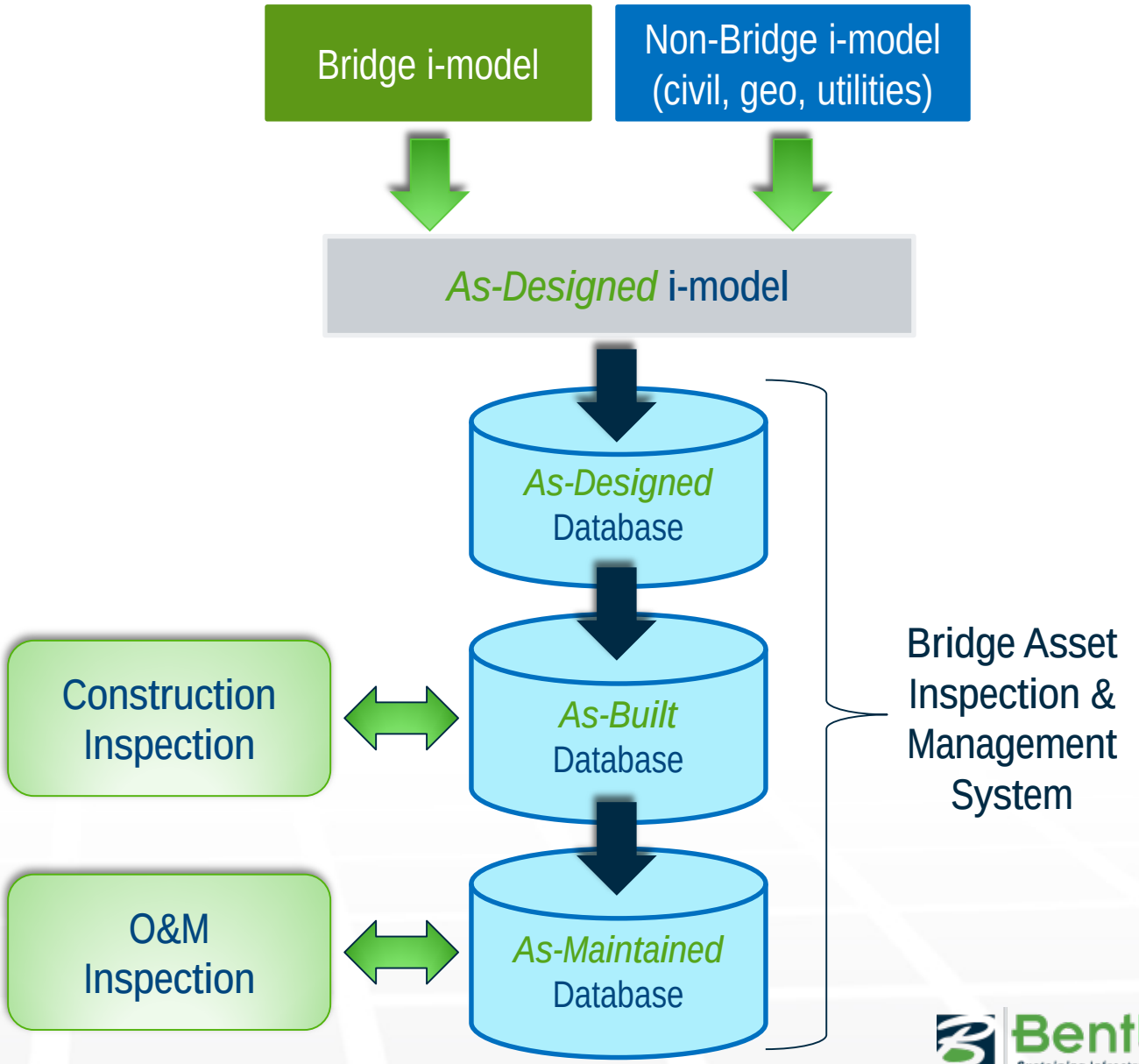
# As-Designed → As-Built → As-Maintained

- Import *As-Designed* i-model into BIMS and create a new Asset, in the “under construction” status.
- Capture construction information with Field Inspection mobile tablets to create an *As-Built Database*
- Once construction is completed, move asset into “active” status.
- Proceed with O&M inspection, for an *As-Maintained* Asset



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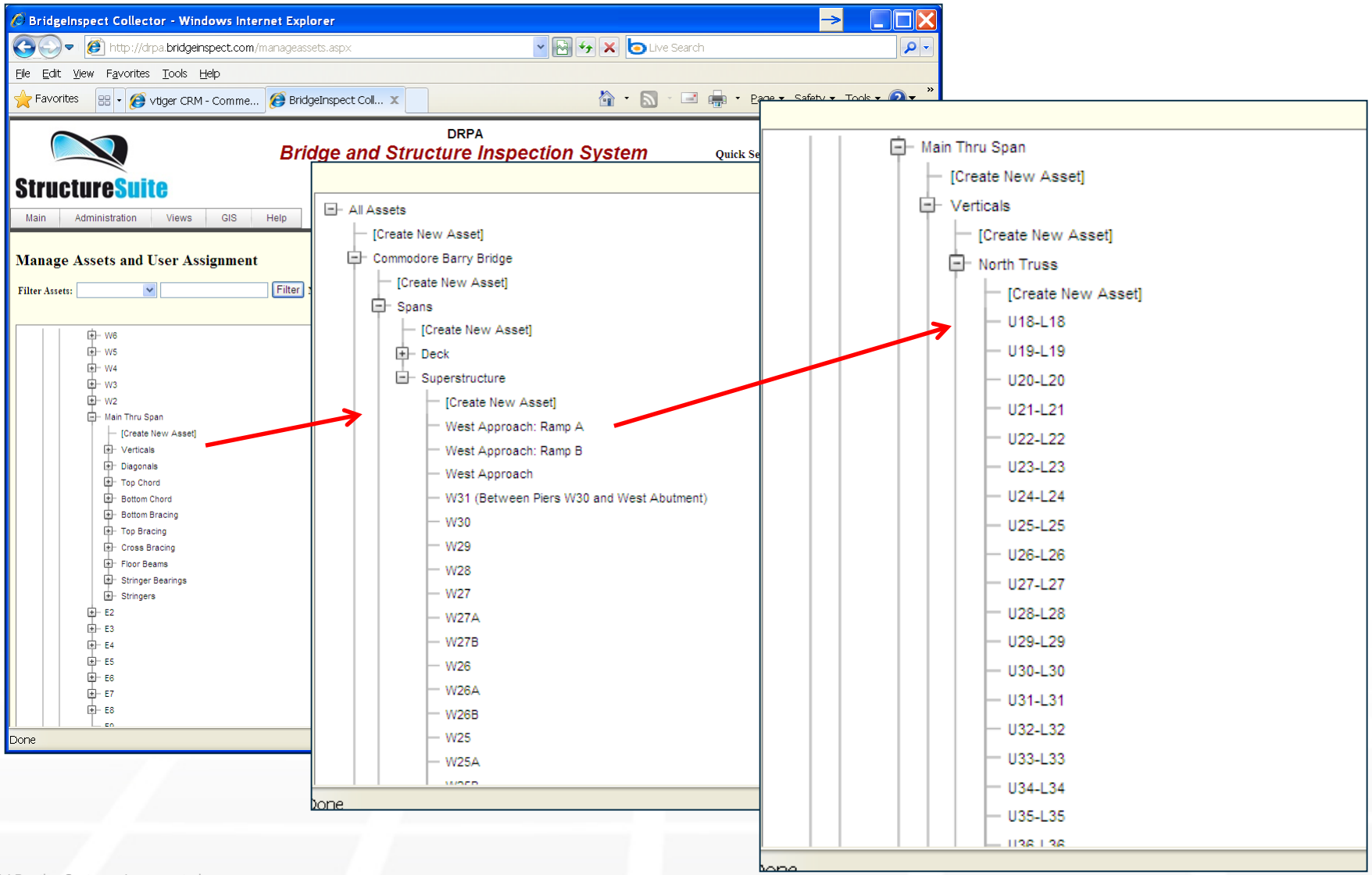
# Element Based Bridge Detail

Ability to drill down to bridge, span, superstructure, main span, verticals, north truss and whatever specific parts required.



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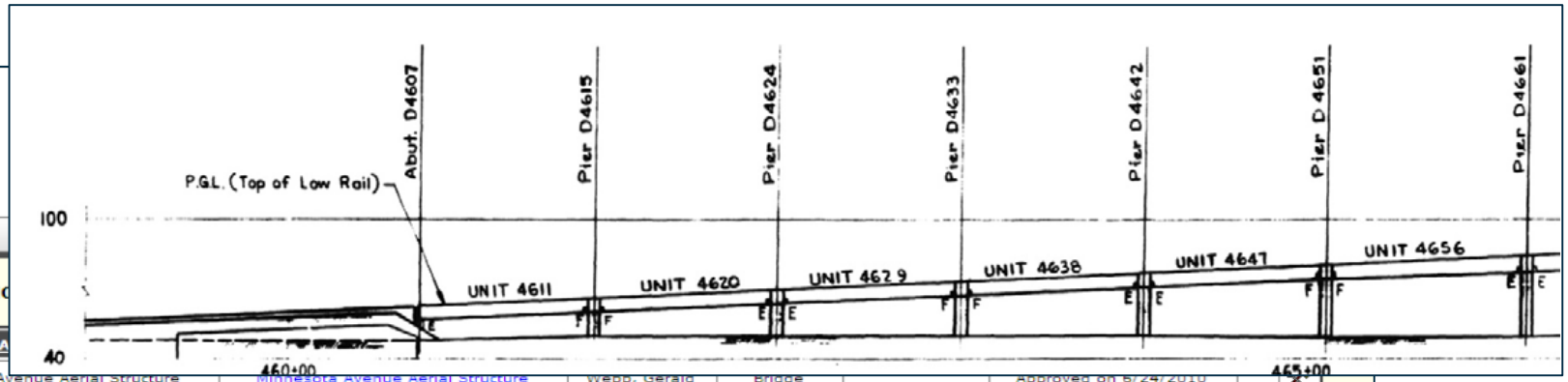
# Extensive Structure Details




metro

Main | Administration | Views

**Minnesota Avenue Aerial Struc**

| Inspection Date | A | | | | | | |
|---|---|---|---|---|---|---|---|
| 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 | | |

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# Tablet Field Data Collection

- Allows inspectors to spend more time in the field and less time writing reports
- Advanced mobility for inspectors in the field
- Sleek, intuitive graphical interface
- Enables offline data collection
- Capture photos, video, audio and GPS information
- Cloud service synchronization with home system


 

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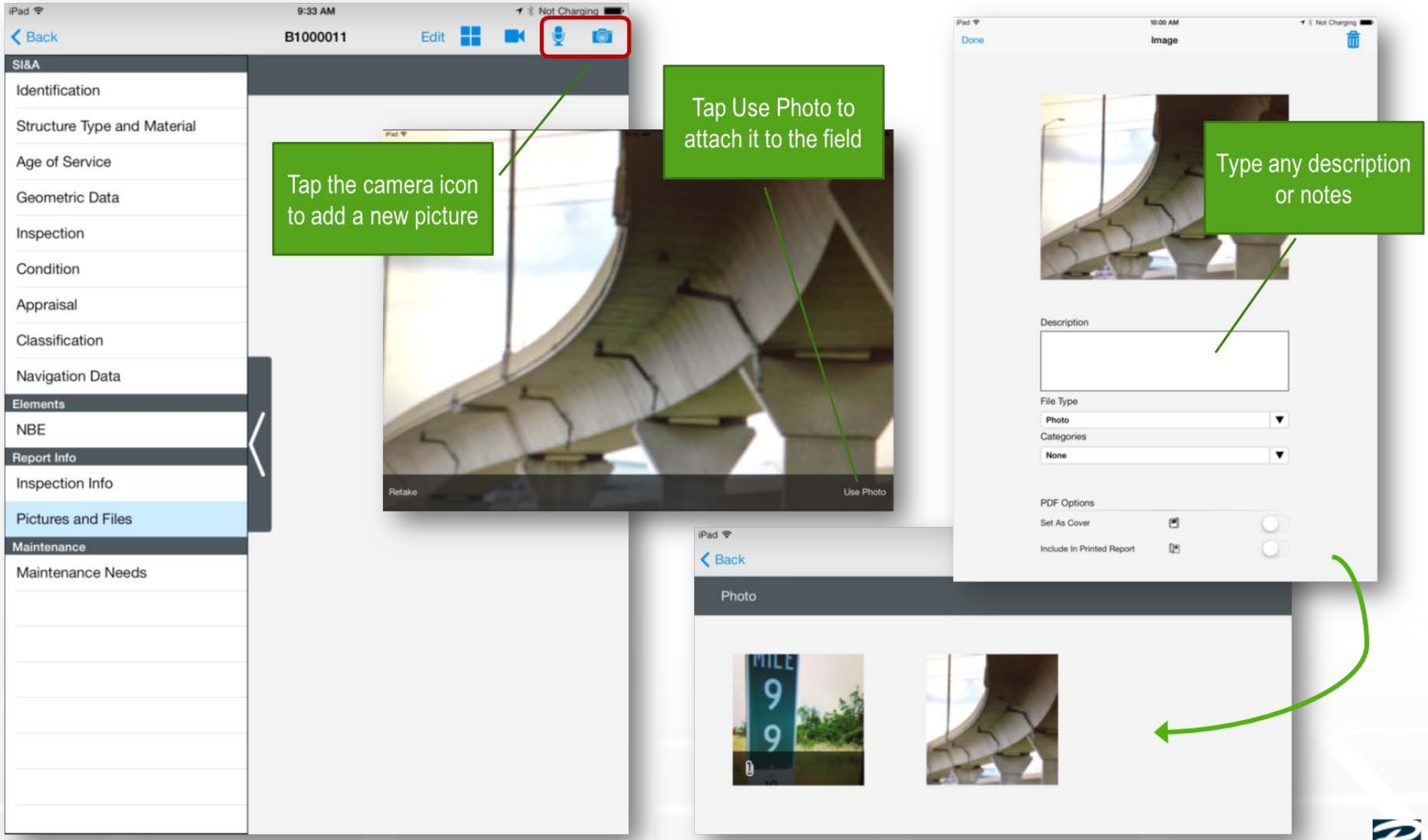
# Capture & Reference Geolocated Media



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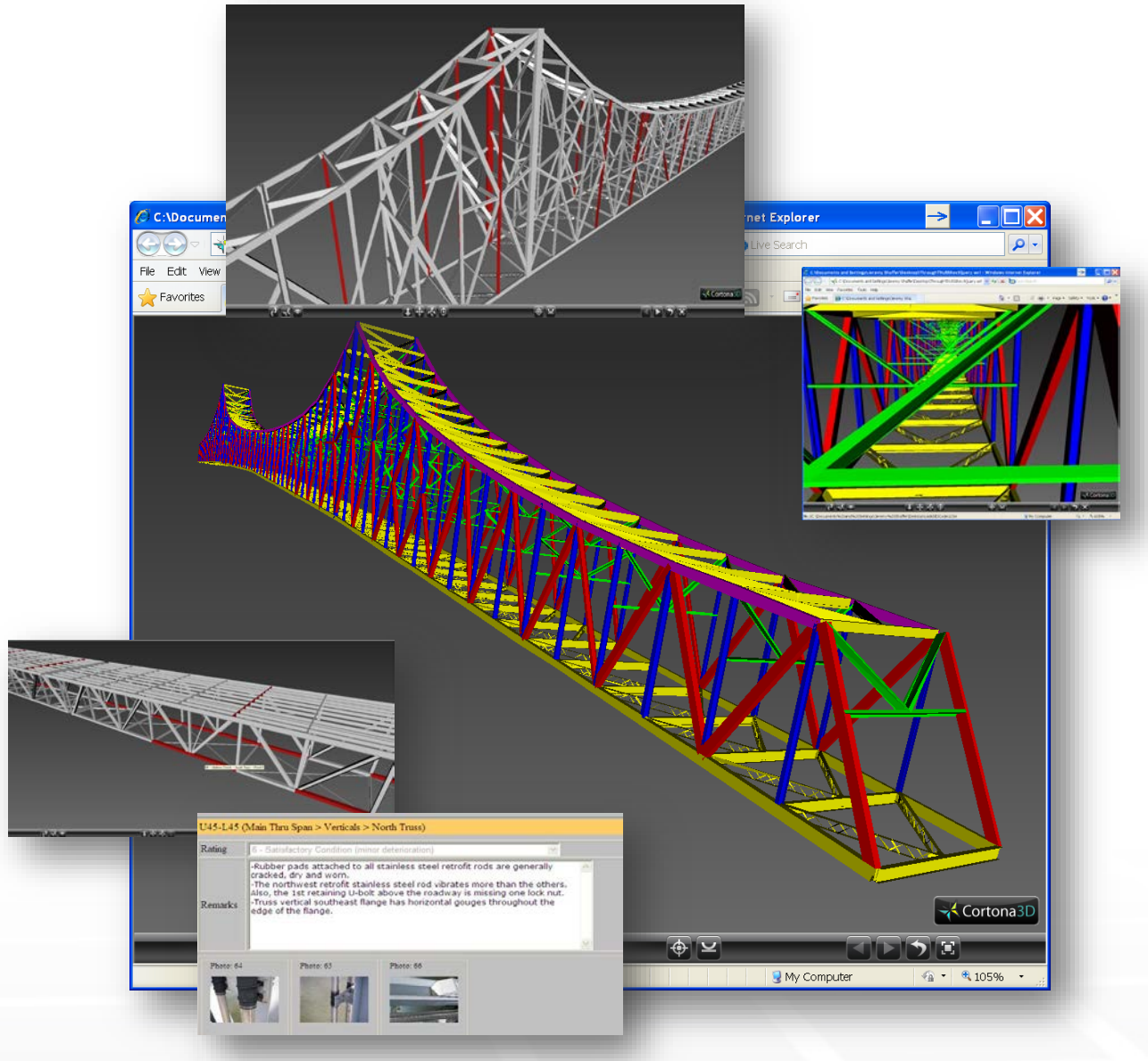
# 3D Comprehensive Models

- Reuse analytical or As-Build 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



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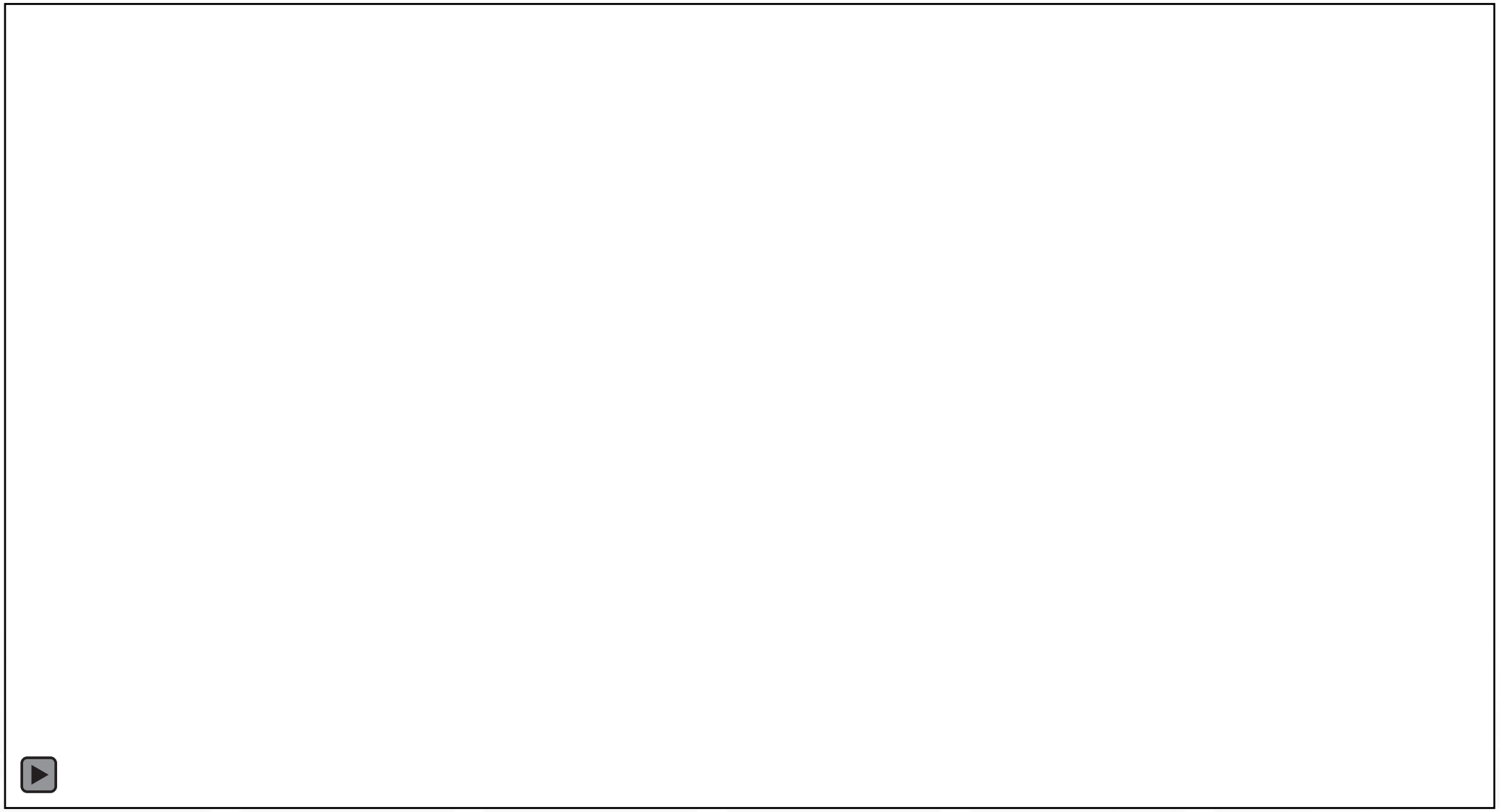
# Integration Of 3D Models



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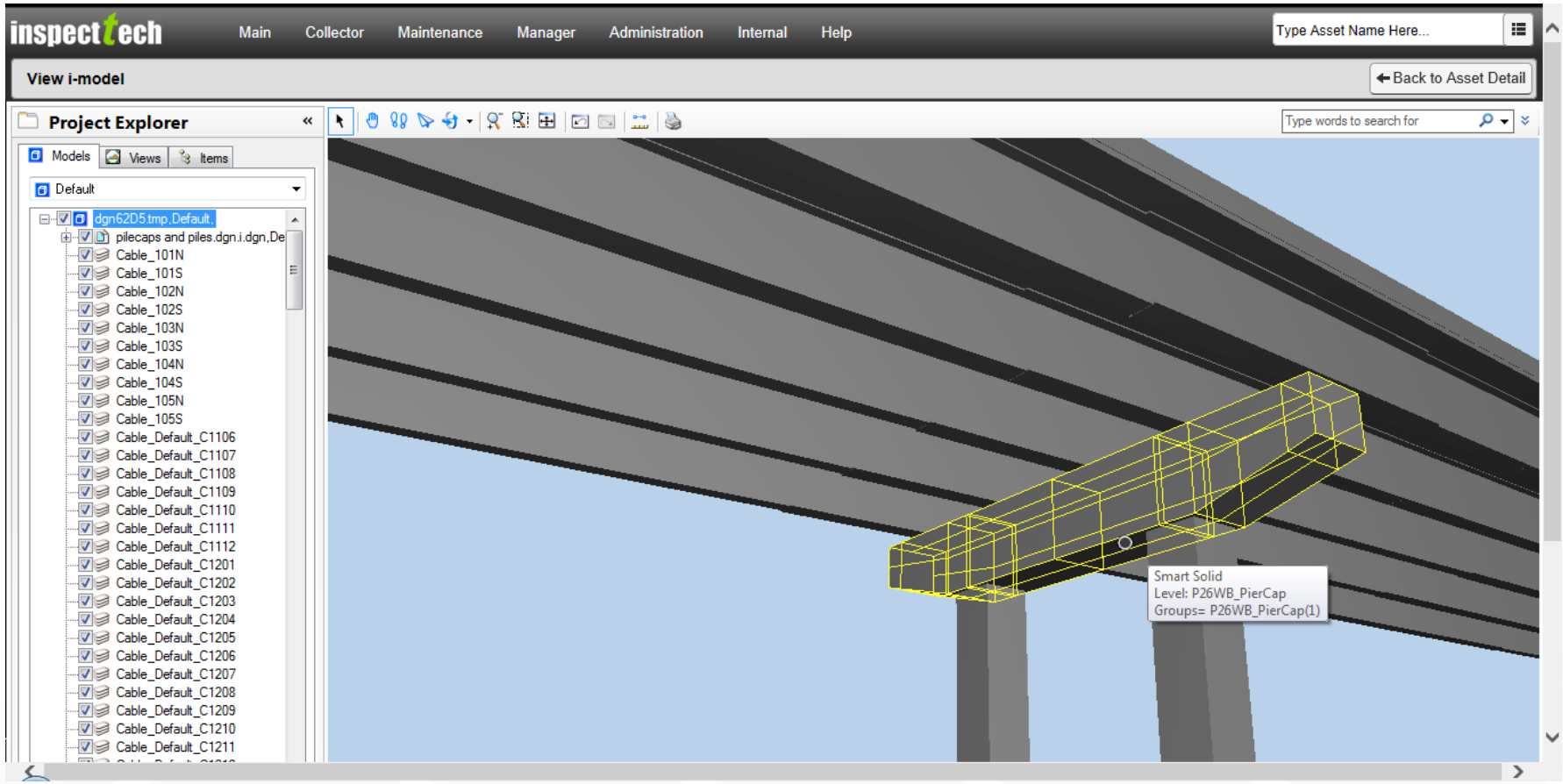
# Interactive Inspections

- Collect and report condition data at the component level



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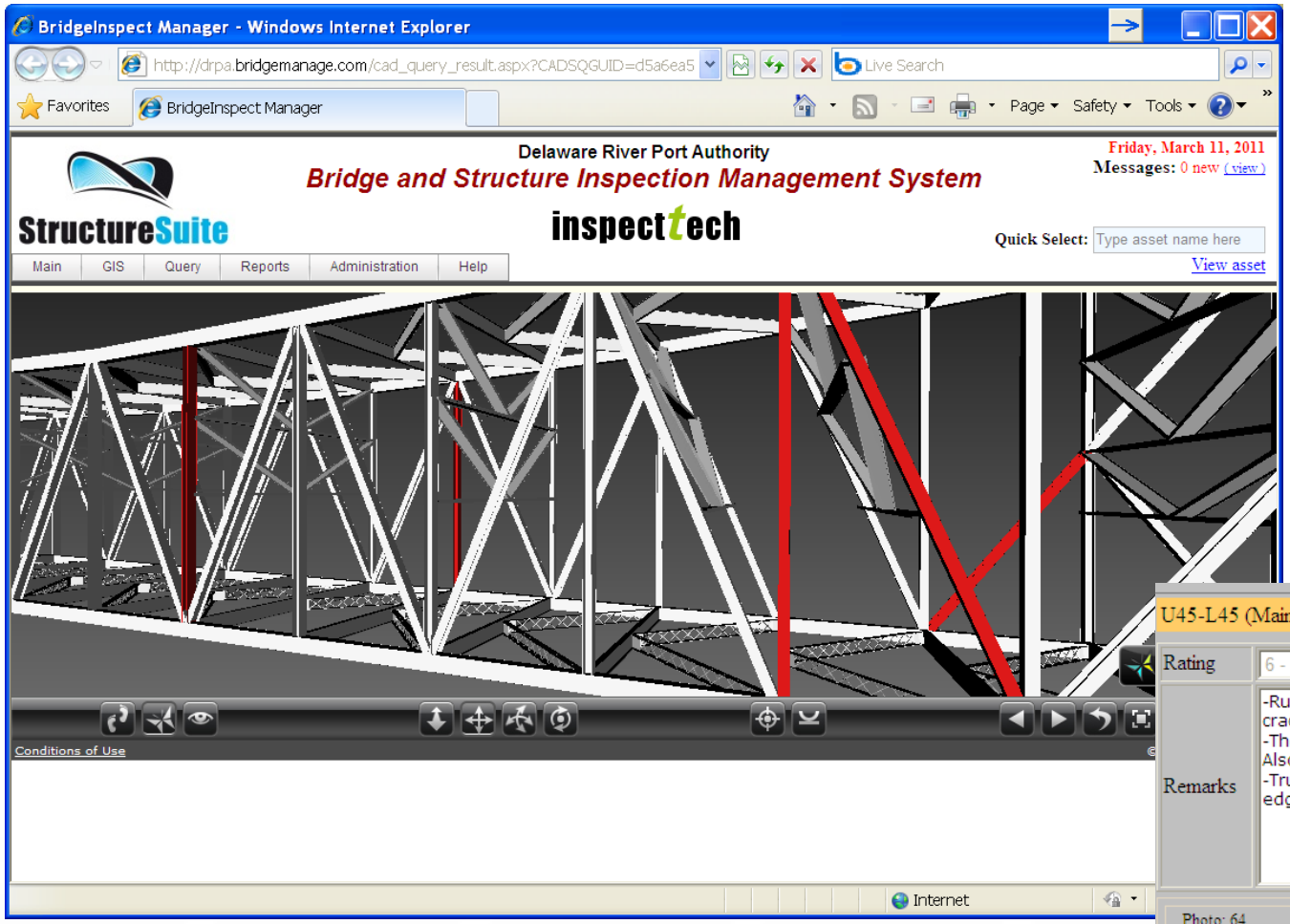
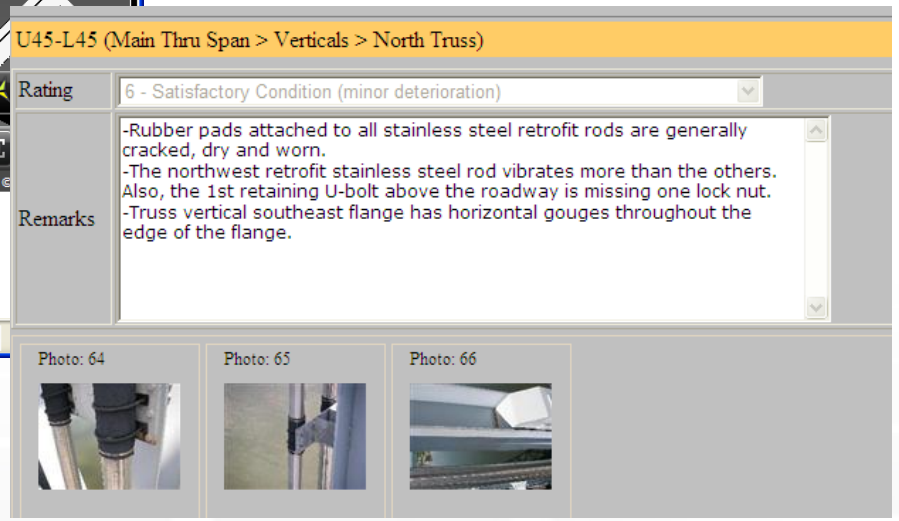
# Interactive Query Results On The 3-D Model



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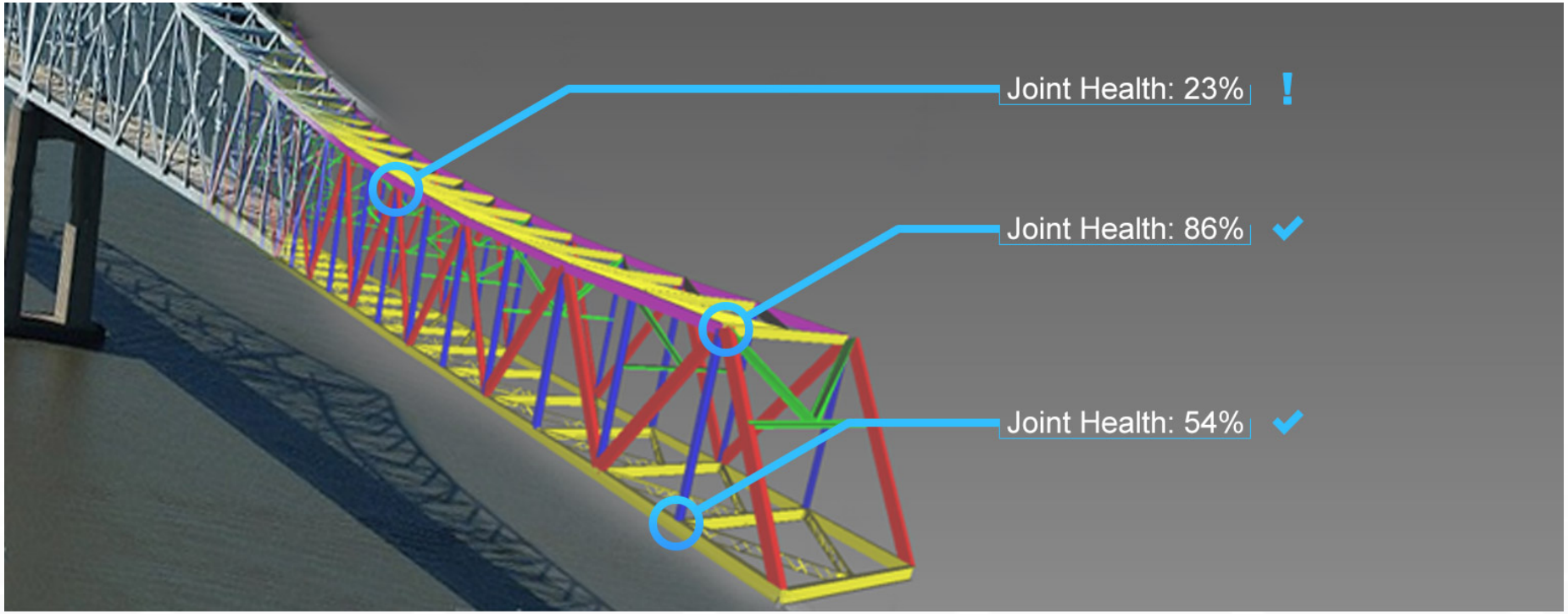
# Visual Display Of Critical Information

- i-Models support encapsulation of all data from simple to complex asset



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# Case Studies

 

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# Tappan Zee Bridge


 

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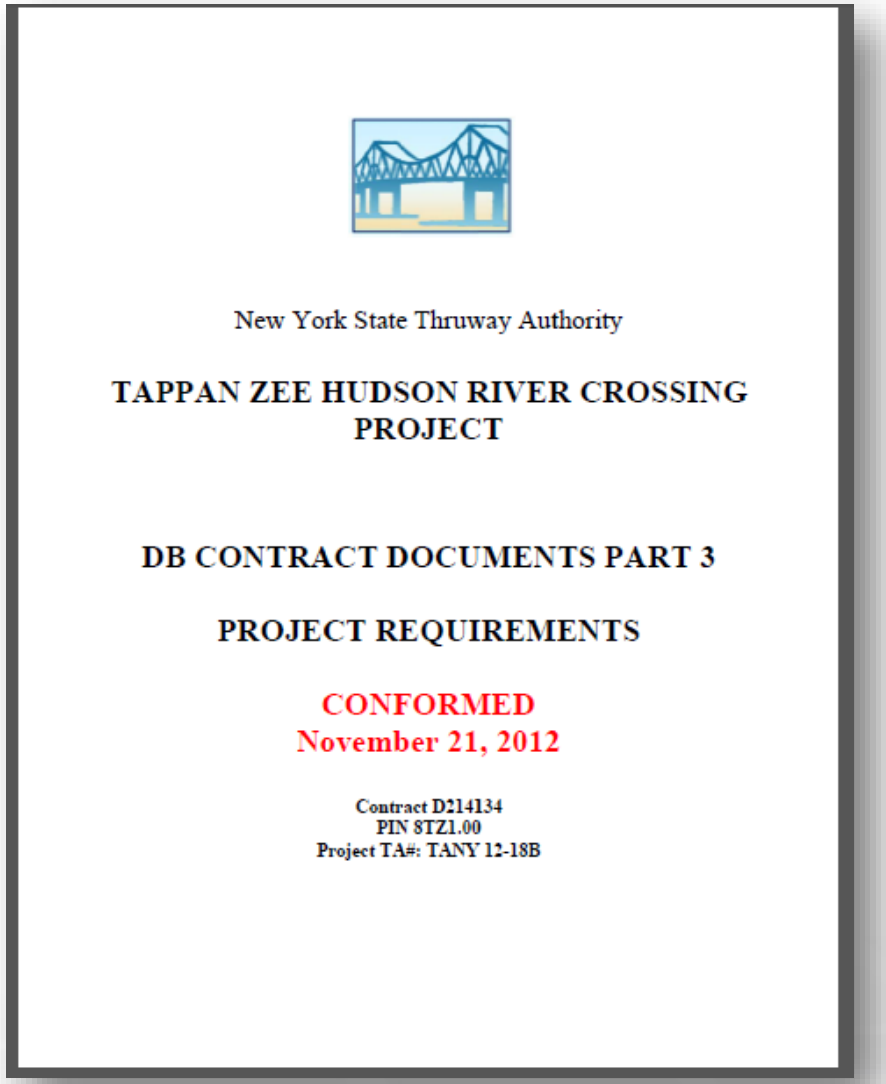
# Unique Project Requirements

- For the first time, an entire section (28.7) dedicated to providing a 3-D GIS spatial model of the project:
  - Table-based line items for all parts (AASHTO Guide Manual for Bride Element Inspection 1st edition; 2011)
  - Unique Reference Identifier – linked to the design model
  - Groupings/Sub-groupings/Sets of relevant parts
  - Specifications, Ratings, and/or Maintenance records associated with the part
  - Spatial support : X,Y, N, S, Beg/End, Span #, Barrier #, EB/WB, NYSDOT standard inspection orientation
  - Etc.



New York State Thruway Authority

TAPPAN ZEE HUDSON RIVER CROSSING PROJECT

DB CONTRACT DOCUMENTS PART 3

PROJECT REQUIREMENTS

CONFORMED
November 21, 2012

Contract D214134
PIN 8TZ1.00
Project TA#: TANY 12-18B

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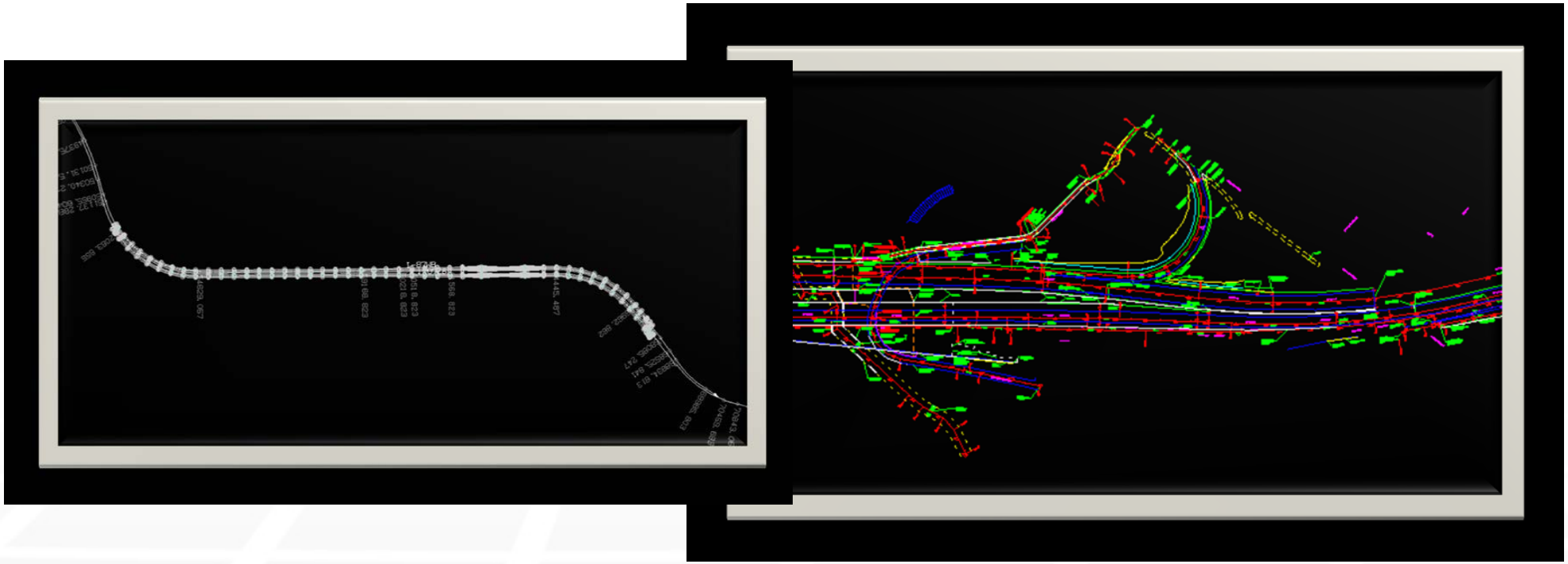
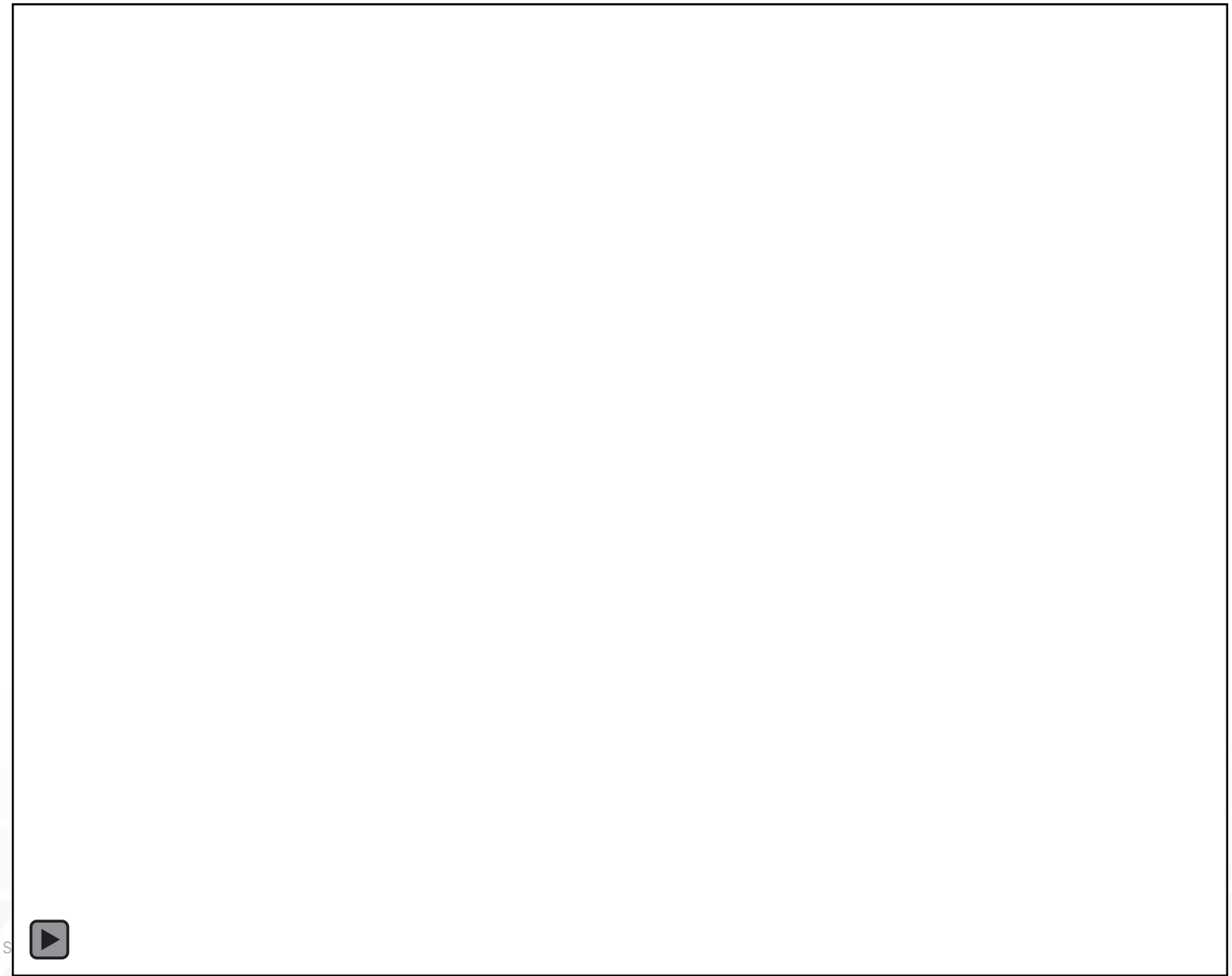
# As-Designed Geo-Referenced Database

- Design Models – Civil / Roadway
  - Roadway Geometry (Alignment / Profile / Super elevation) models
  - Information used by other Design Teams

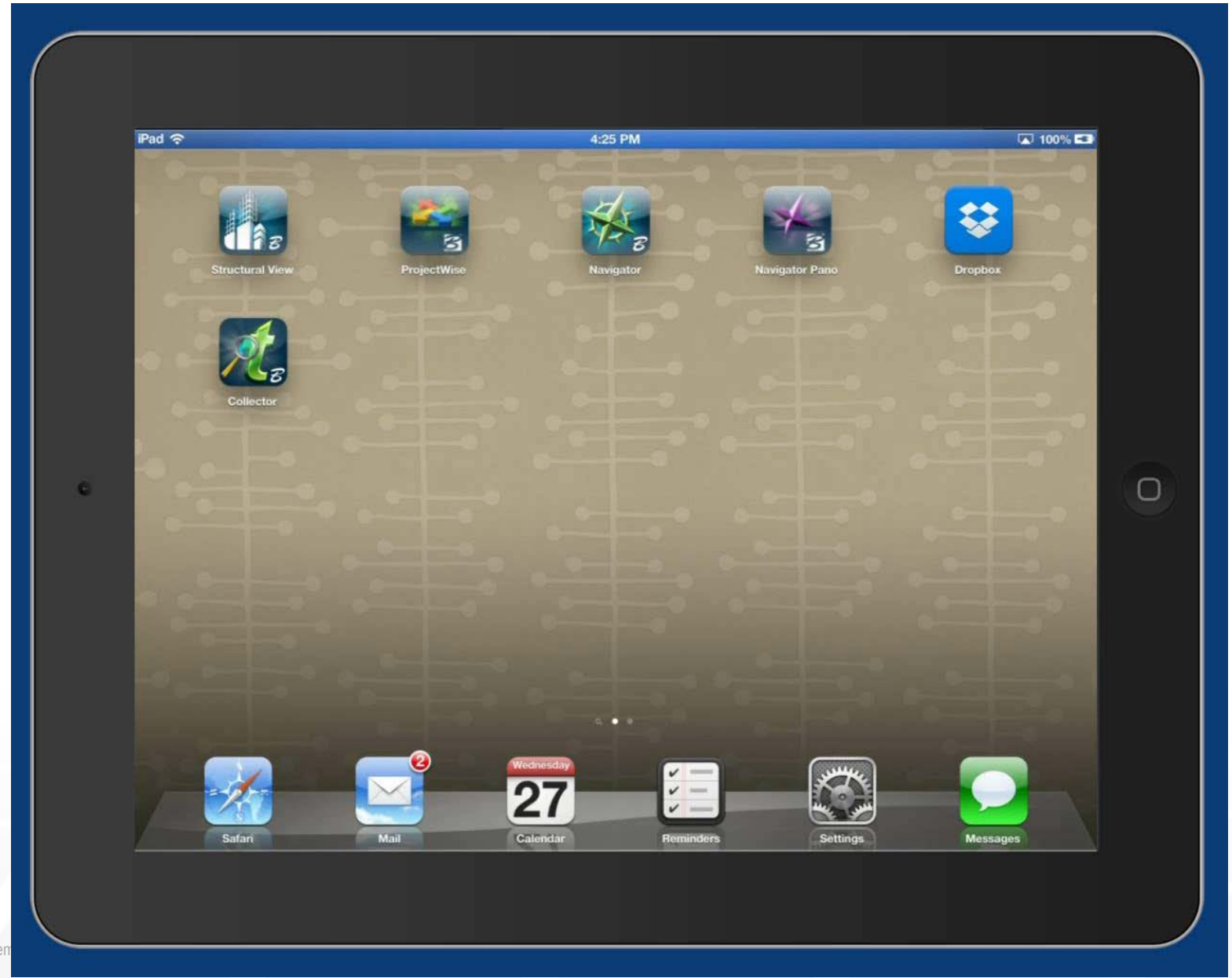


# Project Hybrid Model



# Mobile Inspection



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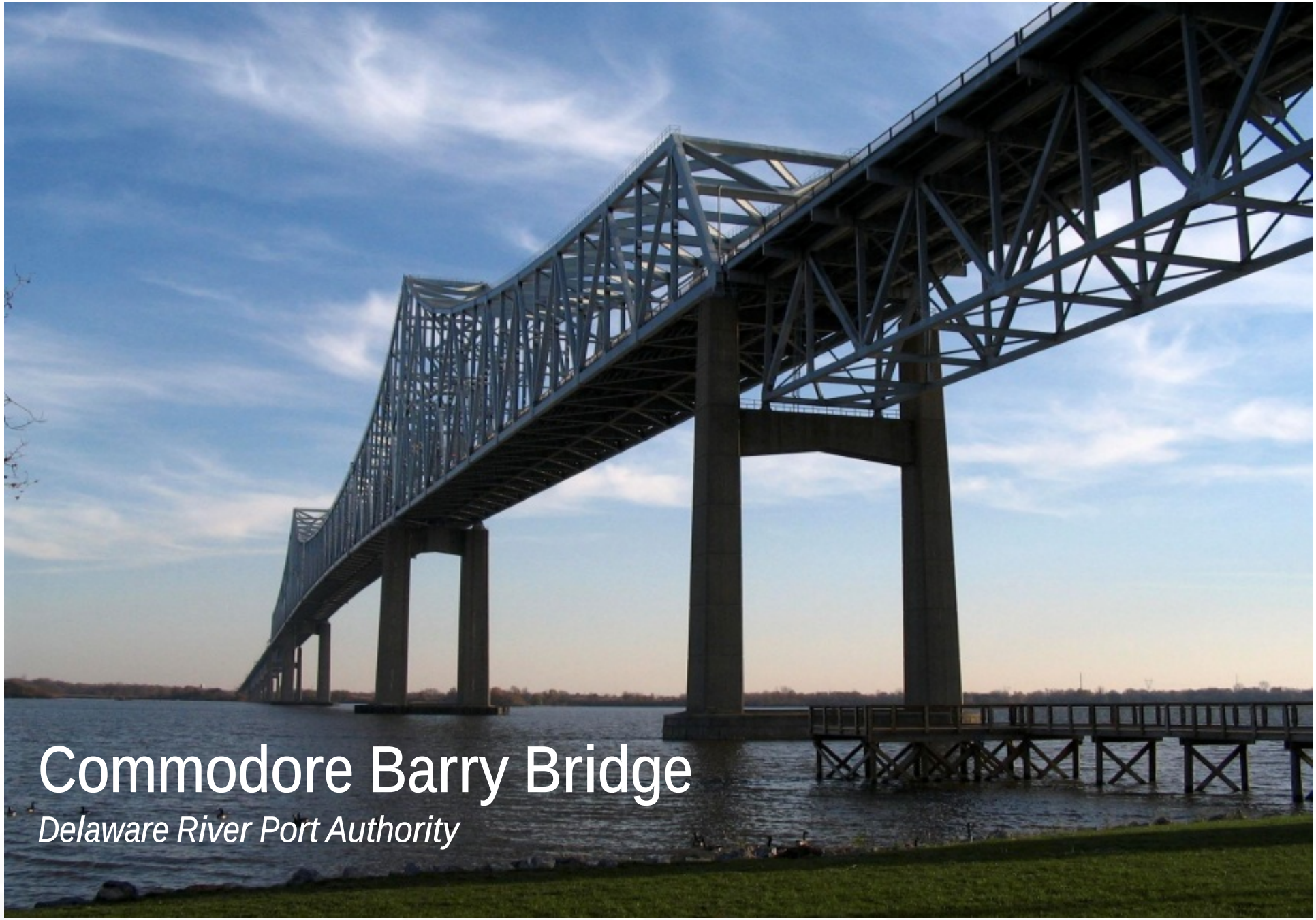


 

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# Existing Conditions

- Maintained by Delaware River Port Authority
- Longest cantilever through truss bridge in the U.S. (4th longest in the world)
- In-depth inspections once every two years

 

# Original Inspection System

- Combination of paper and very limited computer databases
- Databases 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
- Time-consuming task of manually retrieving data from multiple hard copies and databases
- Each biennial inspection report is ±2,000 pages
- Nearly impossible to manually query from paper reports

 

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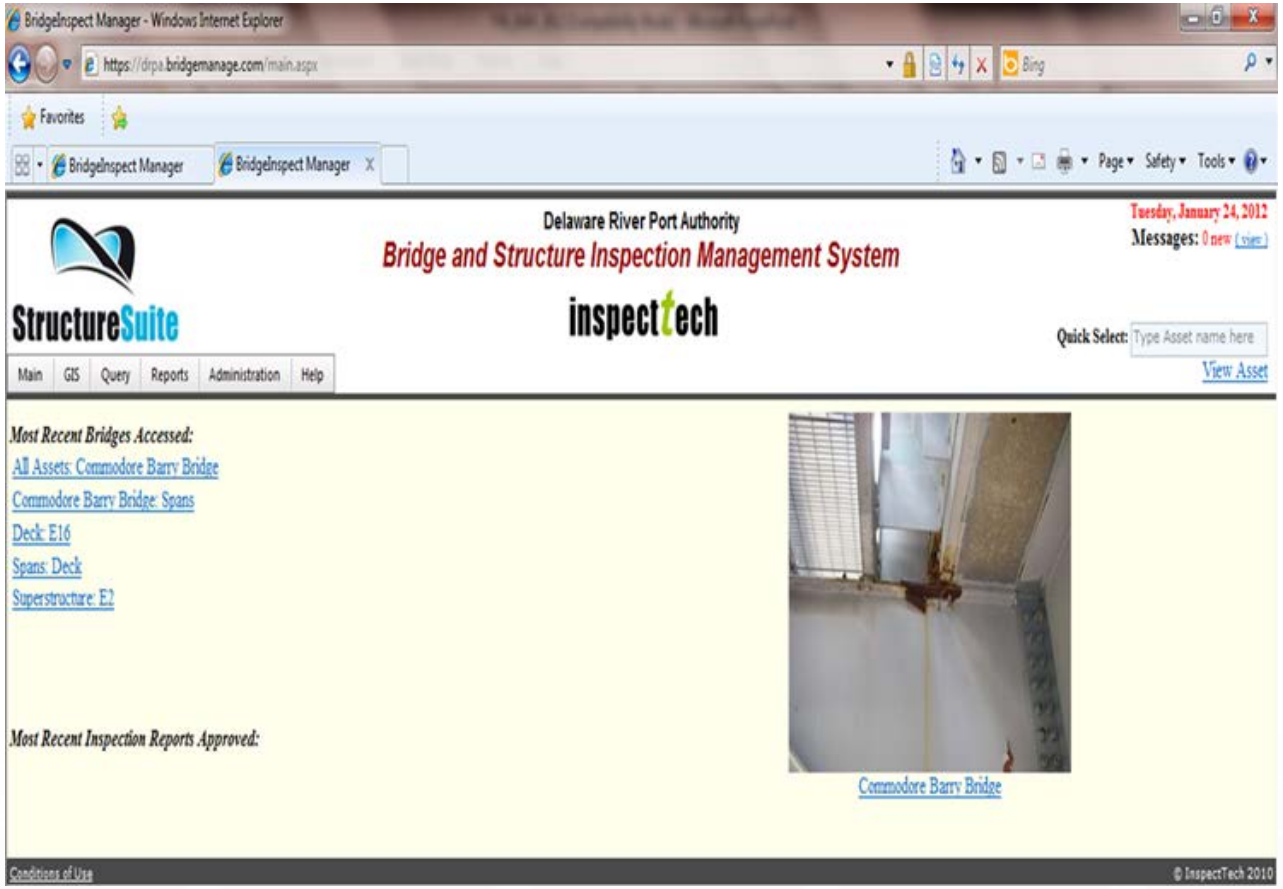
# Modern System




- The new system that *integrates data* from a *variety of sources*
- Fully supports *multiple* types of *inspection forms*
- Ability to allow all *other information* to be *linked* and stored in “central source of truth” location
- *Tablet* based field data collection
- Users can directly *add files*, historic data, or day-to-day *maintenance tasks* into the system

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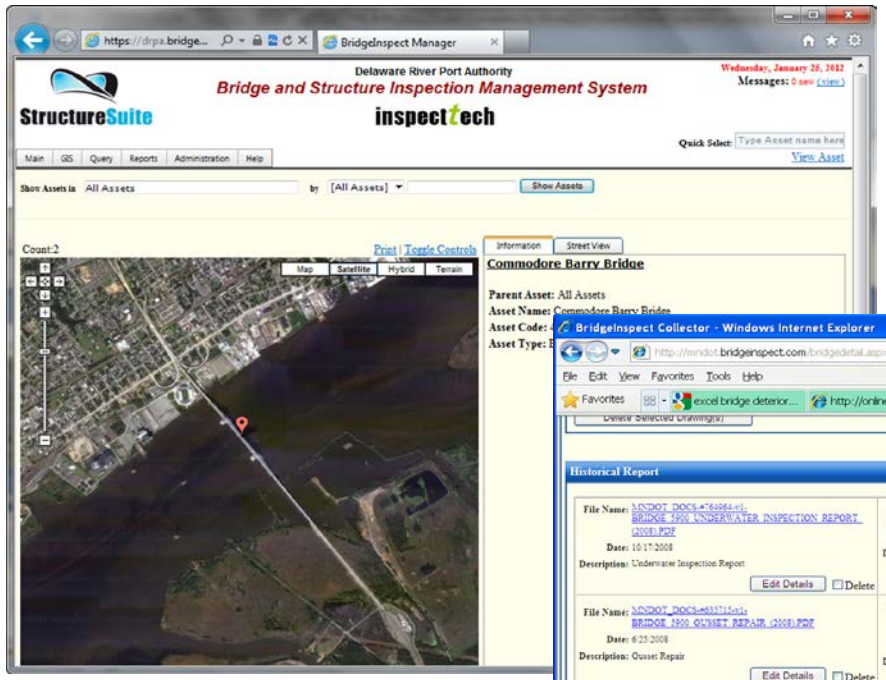
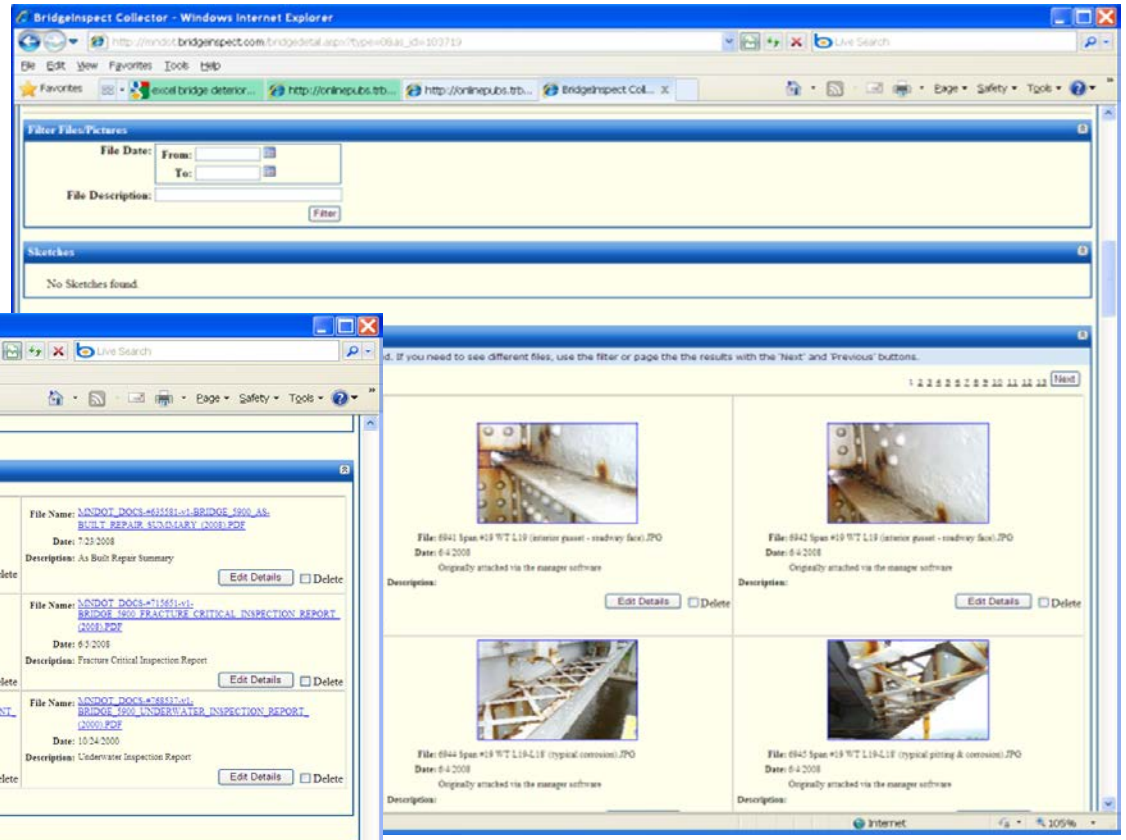
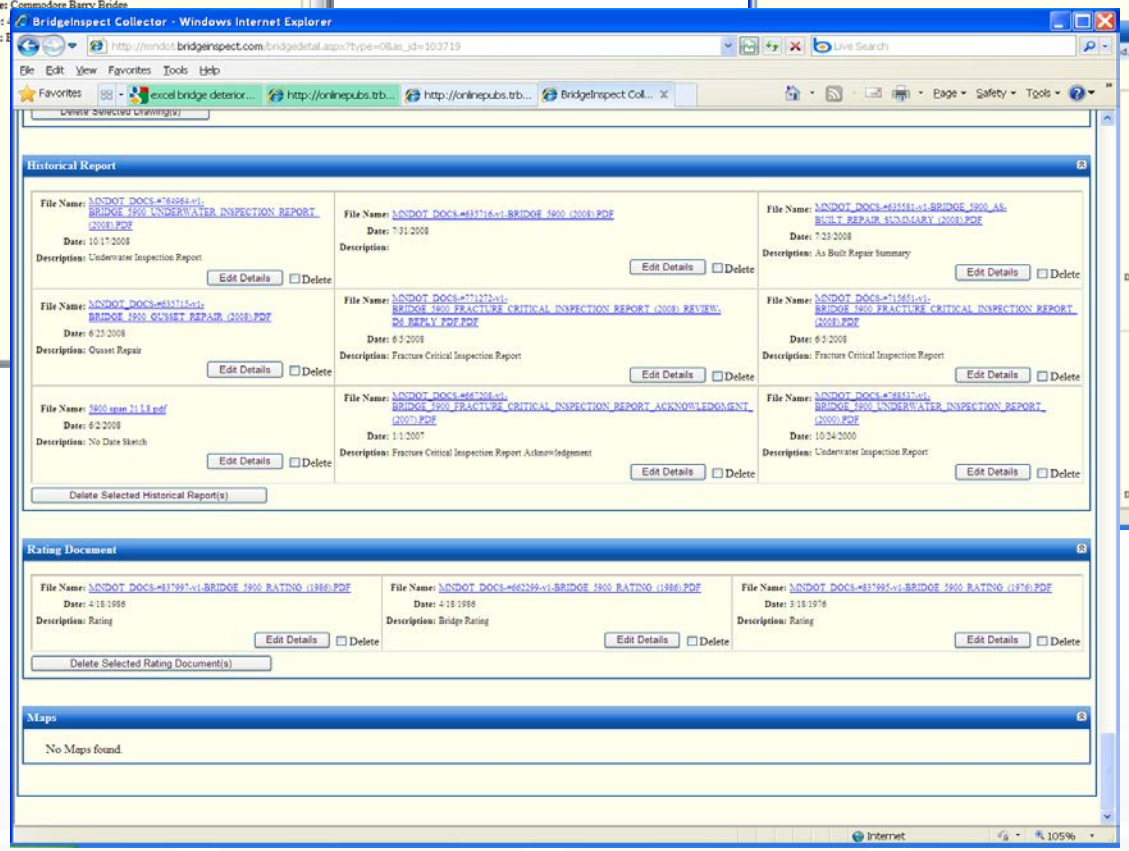
# Central Repository



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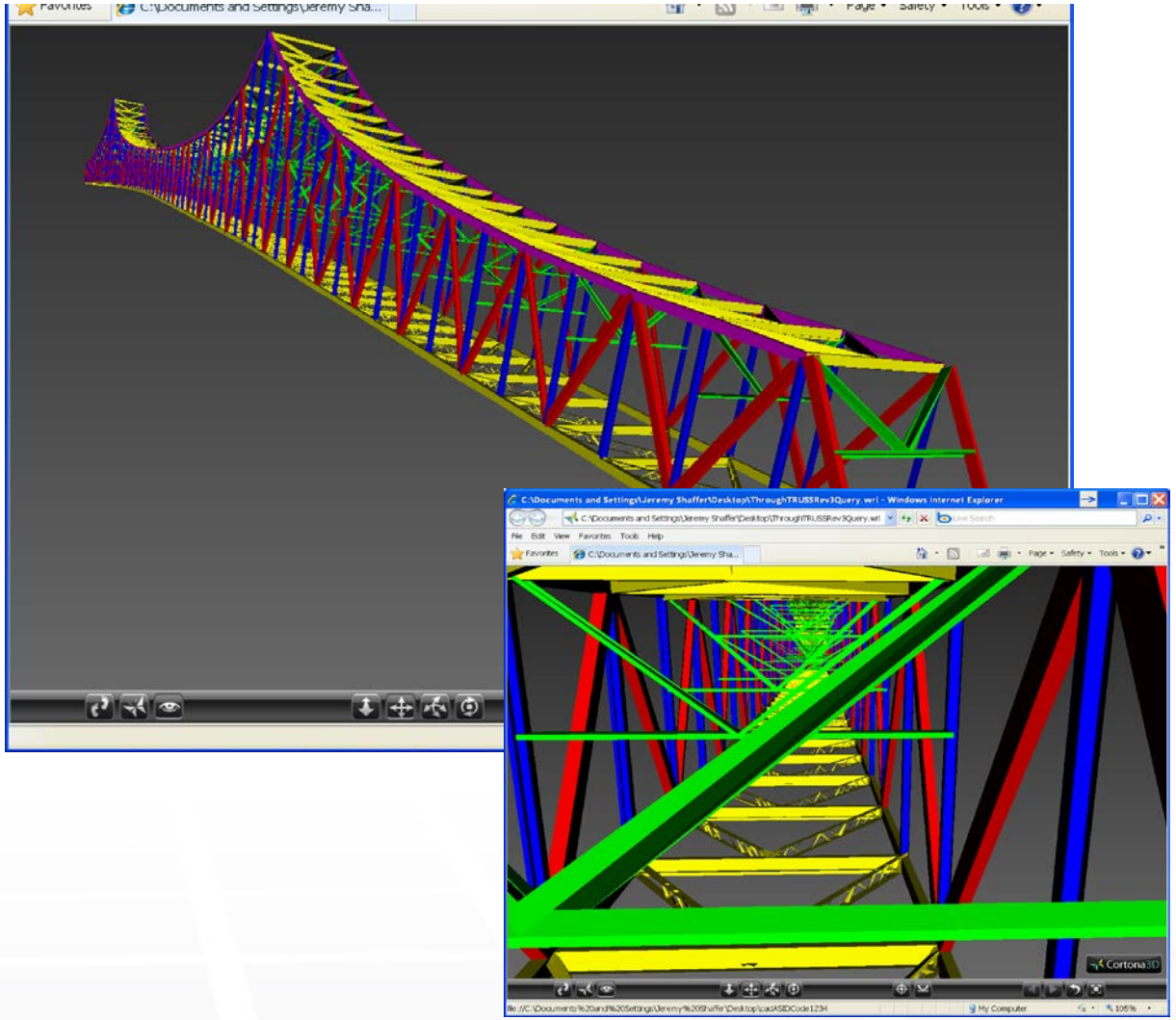
# 3D Model Capabilities

- Represents *only* the *details* that are *important*
- *Problem areas* and component relationships can be *seen quickly* and easily
- Utilizes color for different layers, or condense to single color for search results
- Ability to *turn on/off* layers of complexity



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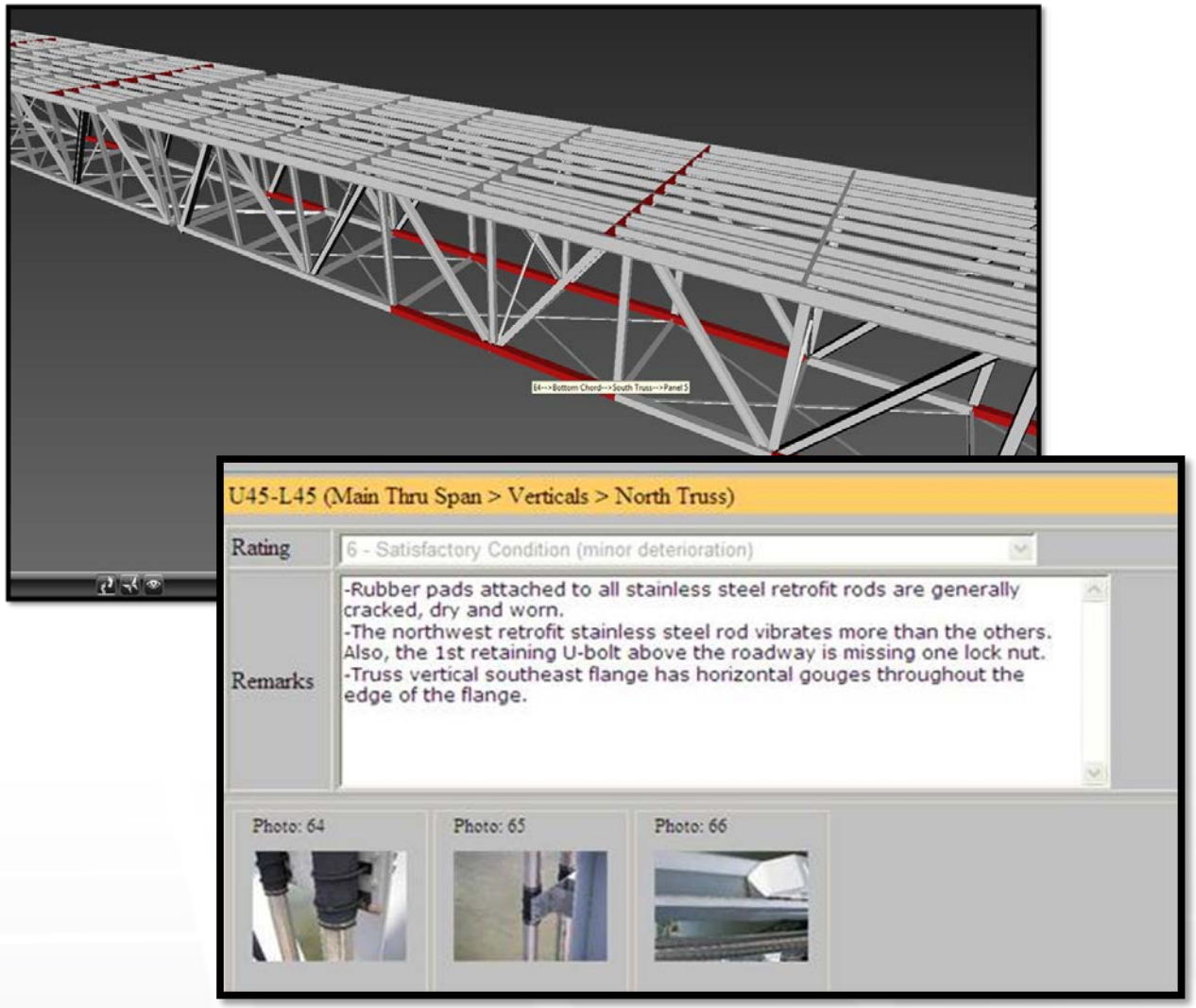
# Powerful Query Capabilities

- Allows for full searching using ad-hoc query tools to return the exact data users are interested in
- Search by entire structure, span or specific component type
- Can combine fields and criteria as needed to make simple or complex queries using Boolean logic (AND, OR, etc.)



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# Advantages Of 3D Models For Bridge Inspection

- Provides a clear, and *interactive spatially located* visual reference of the bridge and its elements
- Model is *linked to report data, historic data*, uploaded and attached files, or any other crucial information (inspections, as-built drawings, load ratings, work orders, etc.).
- Ability to *continually add valuable* historical *information* connected to 3D model.
- Information *can be taken mobile*, as a 3D model
- One "*single source of truth* " to find all the information


 

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# Thank You!

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