

RAW DATA. REFINED RESULTS.

SHM FOR MAINTENANCE SUPPORT AND ASSET MANAGEMENT FOR ALL TYPES OF BRIDGES

Tom Weinmann & Nathan Dubbs, Ph.D., P.E.



AGENDA

- WHO IS BDI?
- TECHNOLOGY
- DATA MANAGEMENT
- SERVICES
 - NDE/NDT
 - FIELD LOAD TESTING
 - INNOVATIVE TECHNOLOGIES
 - BEST PRACTICES
- SHM CASE STUDIES



WHO IS BDI?



“Home” for 2 Years: 1989-1990

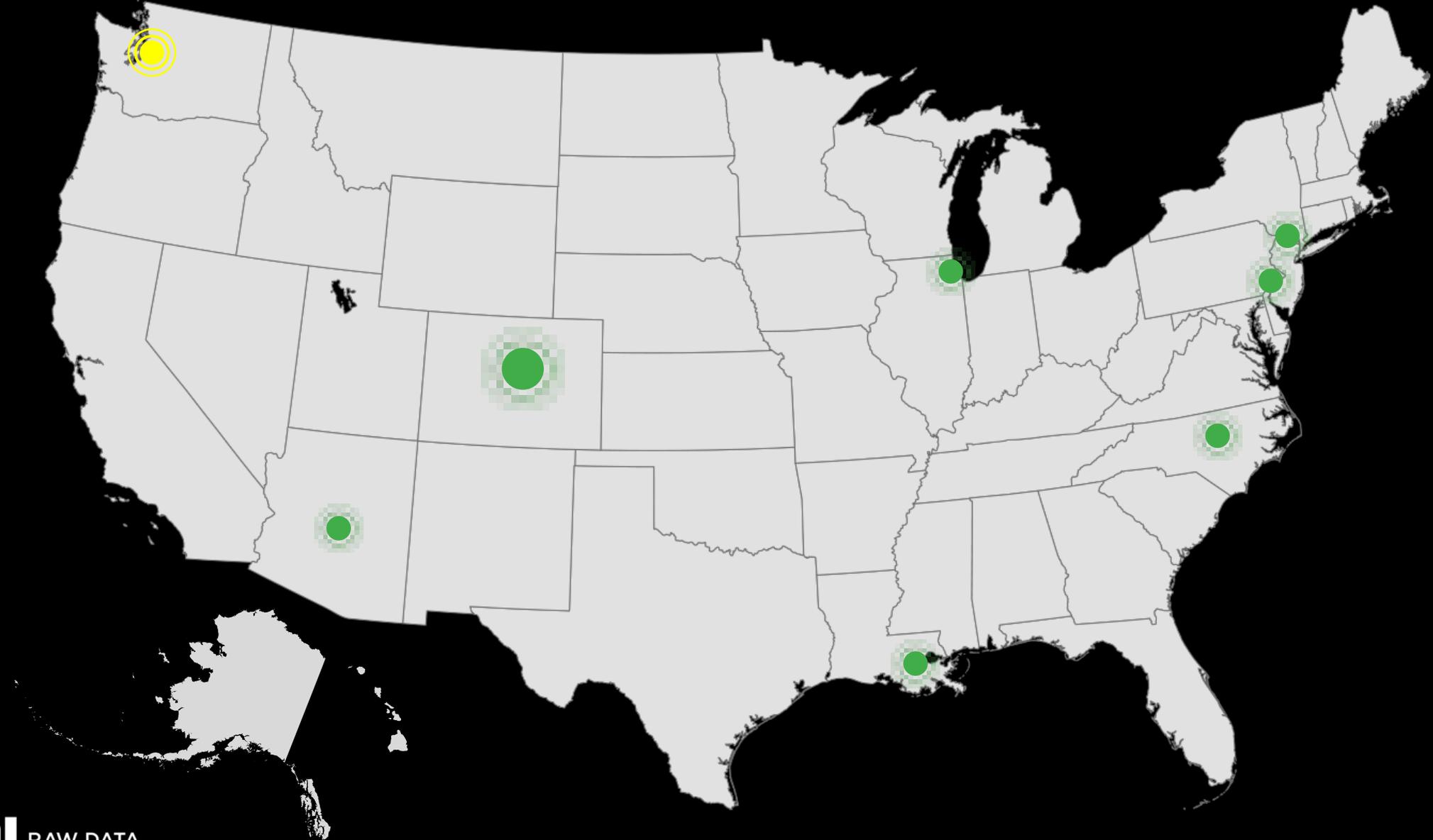


BDI International Headquarters 2020

- Began research in **1987** at the University of Colorado sponsored by PennDOT and FHWA where basic techniques were developed for using live-load test data to better analyze bridge behavior.
- The initial project, also **funded by the USACE**, was to develop equipment and analysis techniques to measure the integrity of existing lock systems.
- BDI formed in 1989 and began development of Structural Testing System and FE analysis software. In 1991, began adapting both hardware and software for use in field projects, and both are **still under constant development today**.
- To date, BDI personnel have tested and **evaluated thousands of structures** around the world including bridges, lock gates, and even rockets!
- We're an engineering services provider and product manufacturer – a **combination that keeps us sharp!**

**30+ YEARS IN THE
TESTING/MONITORING/NDE BUSINESS**

LOCATIONS



OVERVIEW

INSTRUMENTATION SERVICES



Diagnostic Testing

Short term sensor and data acquisition installation for issues such as force imbalances, misalignments, or failing members

Structural Monitoring

Permanent installation of sensor and DAQ for monitoring a variety of potential issues within a structure.

ANALYSIS SERVICES



Structure Evaluation

Complete structural analysis using FEA and model correlation through the test results

Data Evaluation

Simplified analysis through evaluating the collected data and providing feed back on the results

INSTRUMENTS



Sensors

Strain Transducers
Accelerometers
Tiltmeters
Foil Strain Gages
Displacement

Data Acquisition

STS4-4: 4-Ch rugged, modular field oriented DAQ
STS4-16: Multi-use data acquisition system

DATA ANALYSIS & MANAGEMENT



Data Collection

Remote Data collection
Web Hosting
Data analytics

NDT



Full Service NDE Shop

Concrete NDE
Steel NDT (Welds, Pin and Hangers, ASNT L3 Technicians)
High Speed Bridge Deck Evaluation
Material Testing
Unknown Foundations

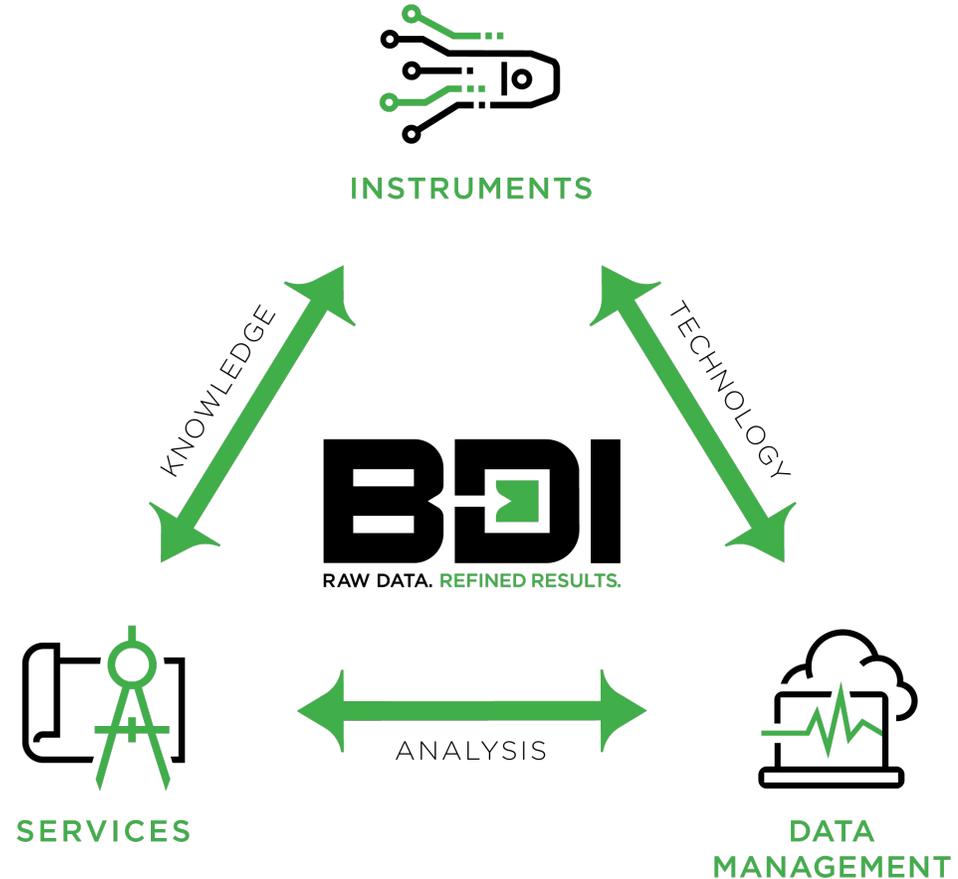
BDI OFTEN DEVELOPS CUSTOM SOLUTIONS FOR OUR CLIENTS

MISSION

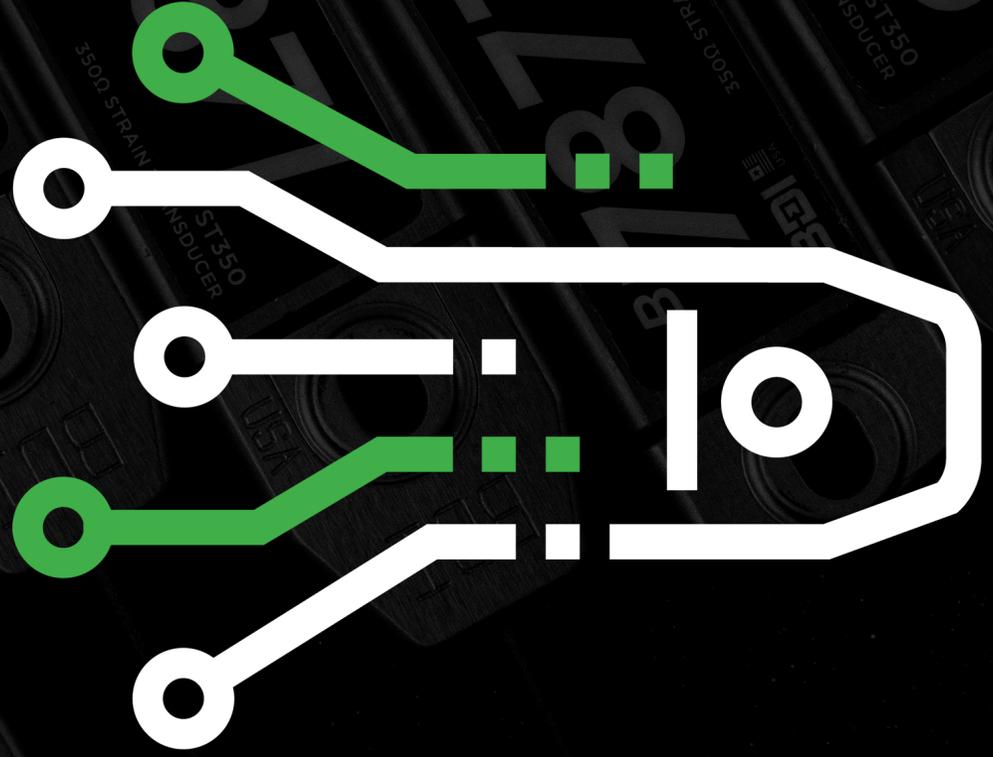
We deliver the most reliable results that enable advanced infrastructure evaluation. Our trusted approach revolves around custom-built instruments, skilled engineering and field crews, and intelligent data analysis and presentation.

VISION

To be the definitive answer whenever and wherever civil infrastructure performance is questioned.



INSTRUMENTS



BDI INSTRUMENTS

During our extensive field-testing experience, we have determined the weaknesses of most existing data acquisition systems and sensors, usually the hard way: while in the cold wind and bouncing in a man lift!



Custom Software



STS4-4: 4-Channel Node

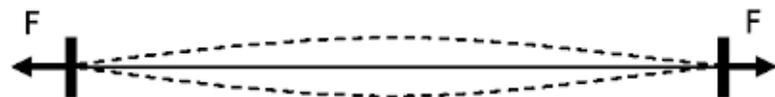


Custom sensors developed for harsh field environments



STS4-16: 16-Channel Node

OTHER DISCRETE SENSORS



Drive coil



Pickup coil



Vibrating Wire



Load Cells



Wind Speed



Weather



Pressure



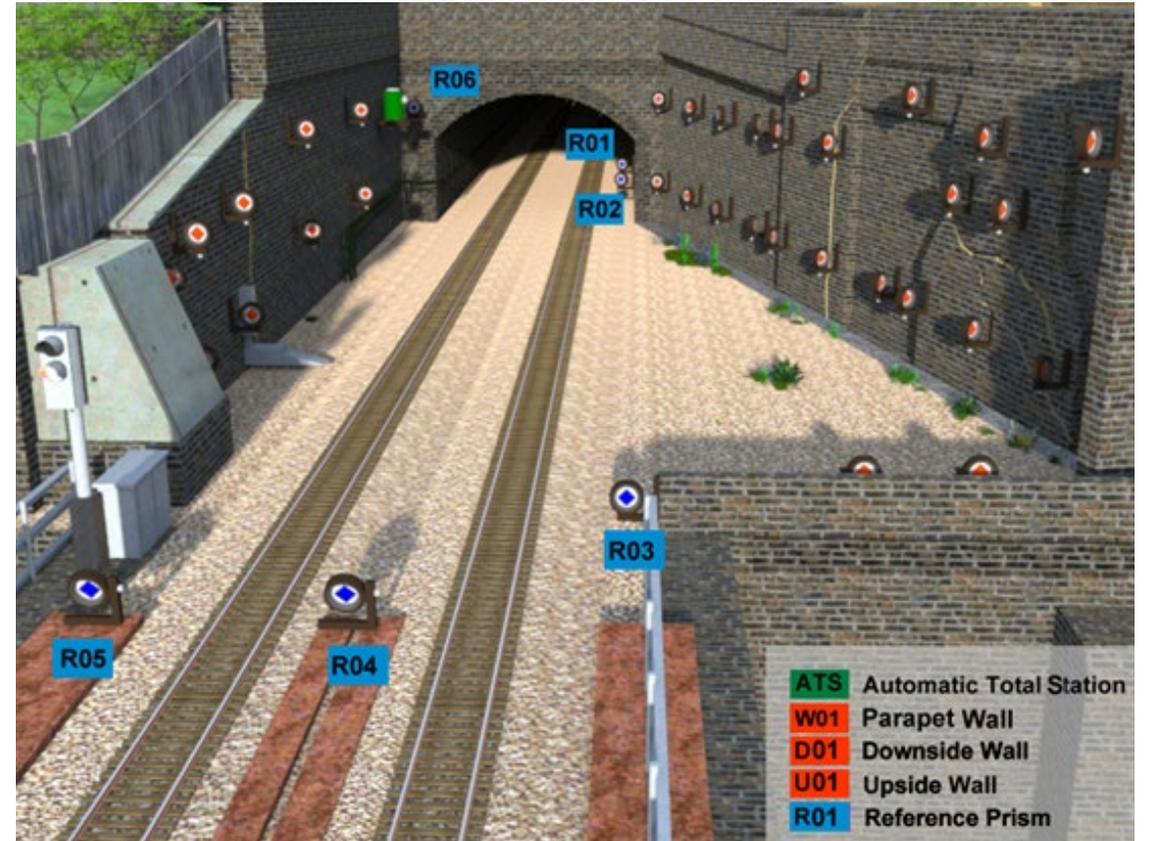
Weigh in Motion (WIM)

STS4 is a general purpose DAQ and can handle most analog sensors

GPS AND AMTS INSTRUMENTATION

GPS; 12-24 hour filtered

AMTS; seconds per prism



GEOTECHNICAL INSTRUMENTATION



Settlement



Soil Interaction



WIRELESS!

BDITEST.COM



Piezos



Ground Anchors

VIBRATION INSTRUMENTATION



Remote Monitoring



Structural Vibrations



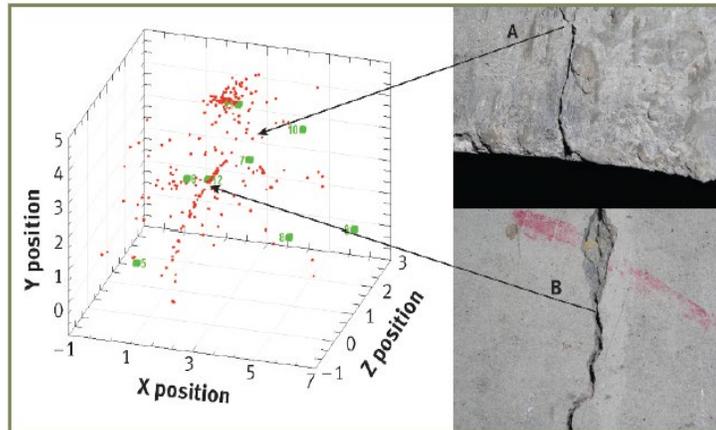
Ground Vibrations

ACOUSTIC EMISSION

AE has the advantages of real-time detection and monitoring for crack initiation and/or propagation in steel & concrete structures, detection and monitoring for potential wire breaks in post-tensioned and cabled structures

CONCRETE

- Crack identification
- Concrete crack growth
- PT breaks



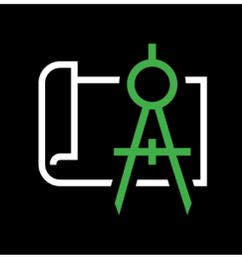
CABLES AND FRACTURE CRITICAL STRUCTURES

- Wire breaks
- Crack identification
- Crack propagation



WEIGH IN MOTION (WIM)

STRUCTURAL LOADING IS AN INVALUABLE PARAMETER FOR ENGINEERING ANALYSIS.



Why?

- ADT
- Fatigue cycle comparison
- Real-time load testing
- Validation of actual service loads

In-road Piezo Strips

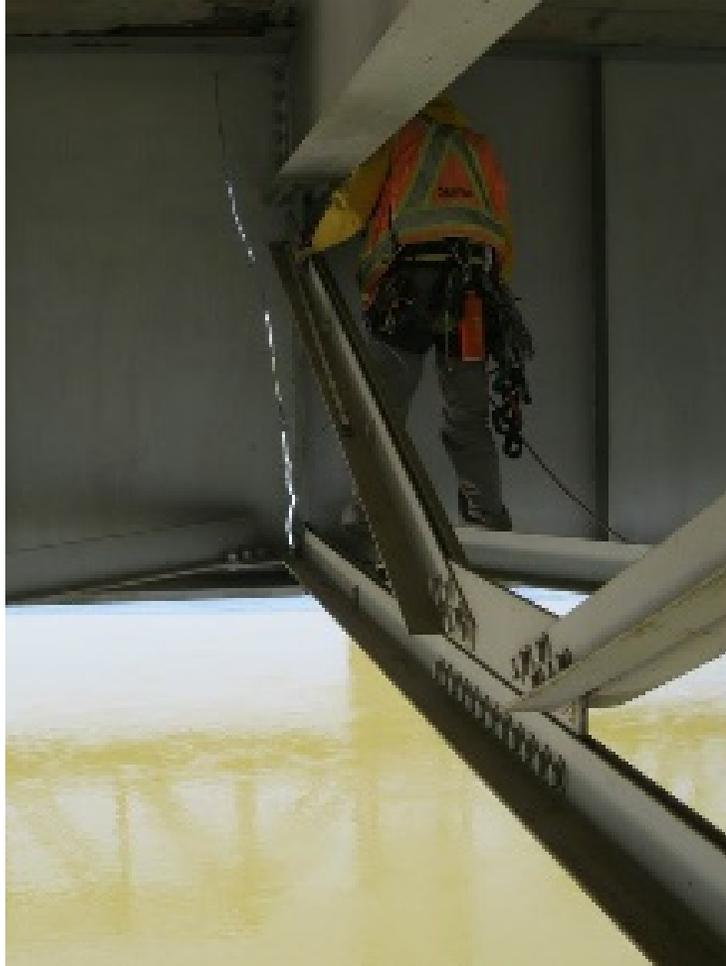
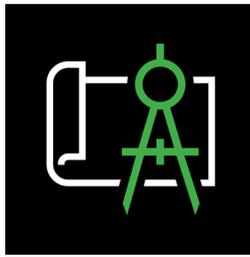
- Economical
- Approx. 80% accuracy
- Ideal for truck classification & load estimation

In-road Scales

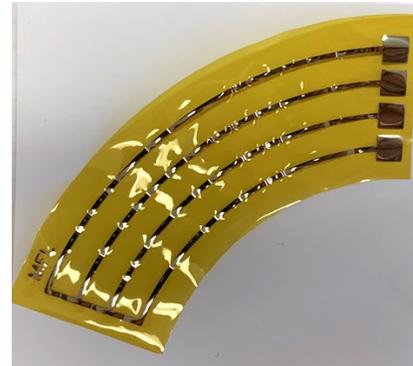
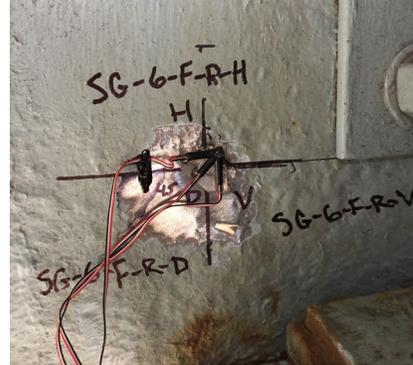
- Better than 95% accurate
- Ideal for refined analysis and real-time load testing



FRACTURE CRITICAL & FATIGUE MONITORING



NDE may be a better tool!



Strain Gaging

- Mainly for further evaluation
- Cycle counting
- Stress levels
- Performance evaluation
- Model Calibration

Acoustic Emissions

- Best for ongoing monitoring
- Don't need to know exactly where crack is
- Locating Cracking
- Crack detection
- Crack propagation

Binary Crack Gage

- Low power and economical ongoing monitoring
- Need to know where crack is
- Crack detection
- Crack propagation

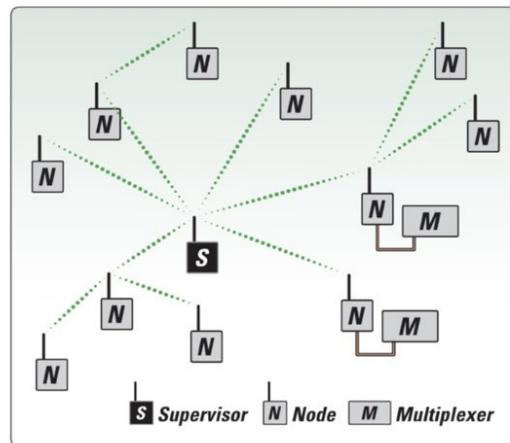
WIRED VS WIRELESS

- GENERAL ATTRIBUTES (WIRED)
 - LONG TERM INSTALLATION
 - BETTER FOR STORM INTERFERENCE
 - BETTER FOR DYNAMIC MEASUREMENTS

- GENERAL ATTRIBUTES (WIRELESS)
 - SHORT TERM INSTALLTION
 - QUICKER SETUP
 - BETTER FOR STATIC MEASUREMENTS

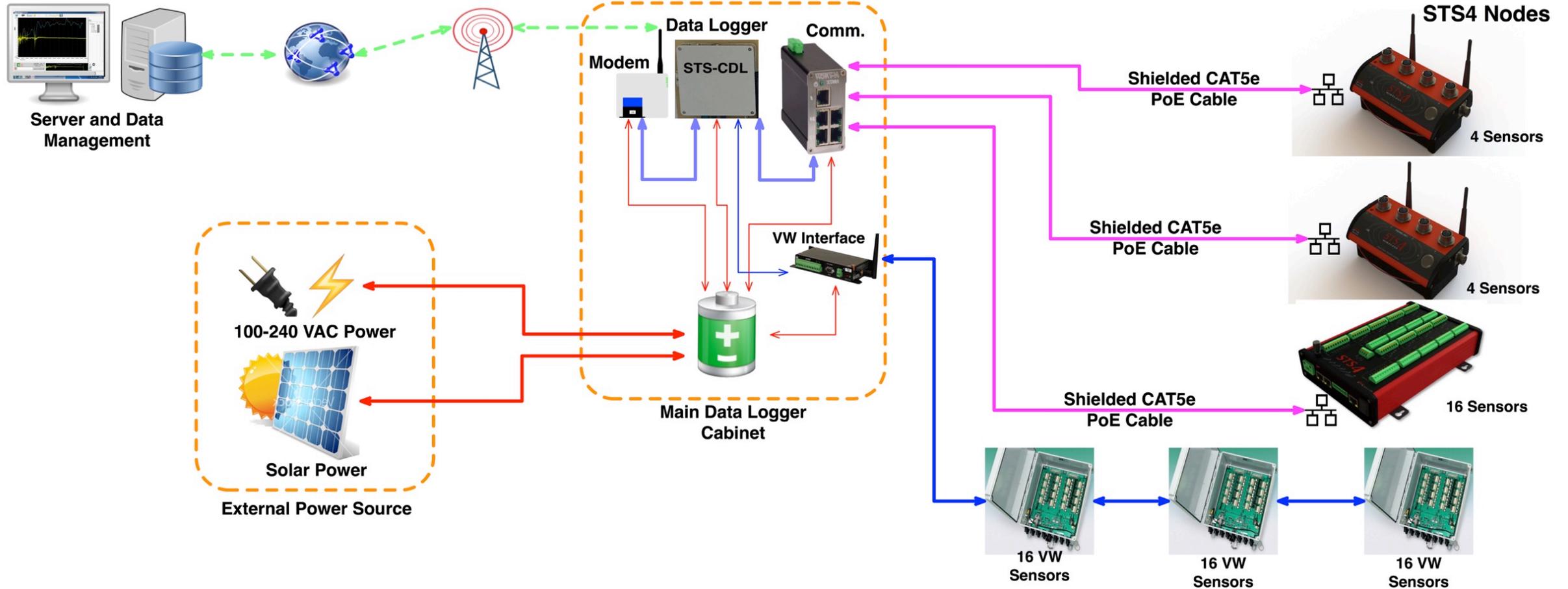
WIRELESS TECHNOLOGY

Wireless technology is a very simple way to control costs on highly dispersed instrument locations. Ideal for slow measurements but cannot be used for dynamic data collection or data that requires heavy filtering.



HOW IT ALL COMES TOGETHER

MONITORING SYSTEMS



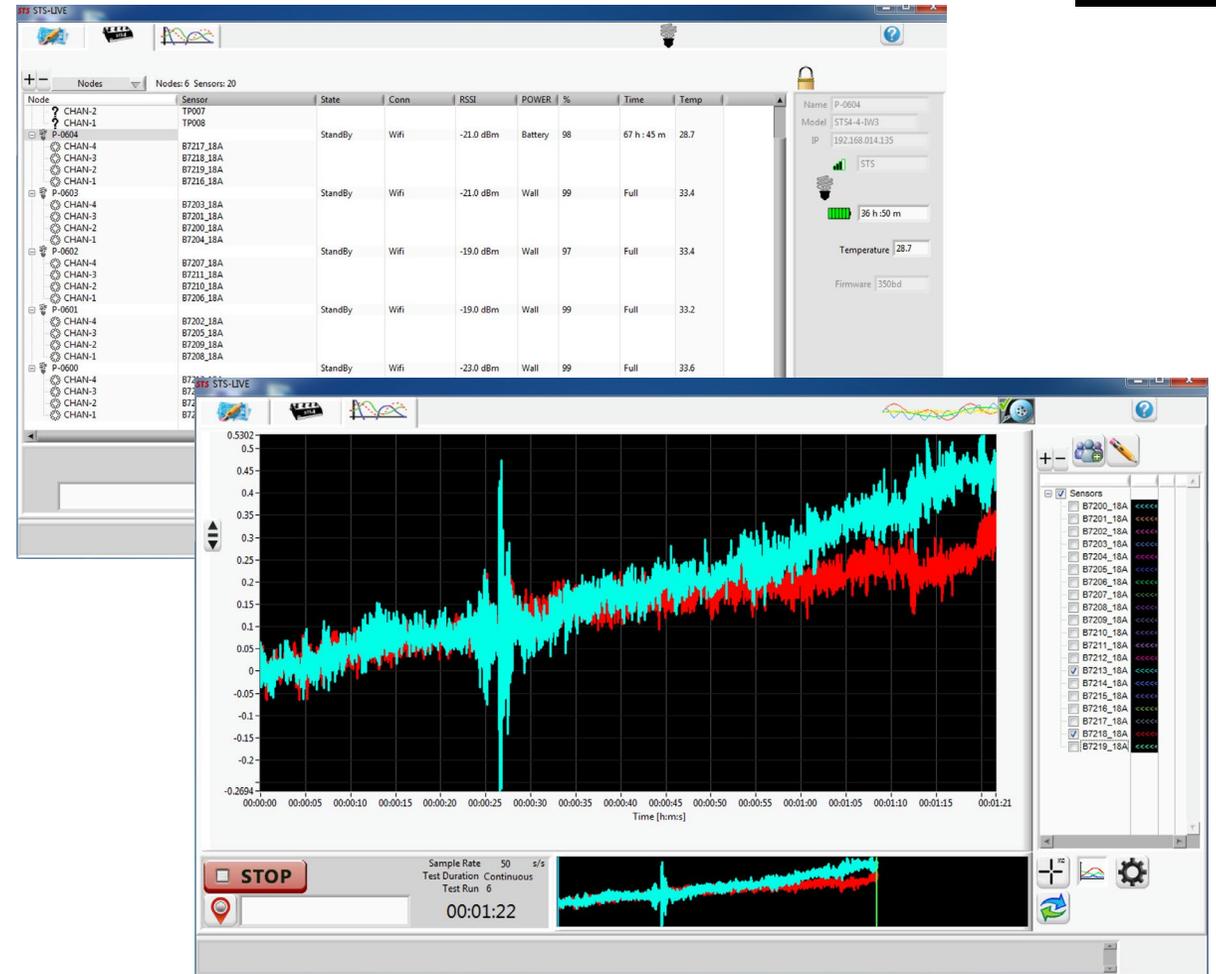
DATA MANAGEMENT



DATA COLLECTION SOFTWARE (NO PROGRAMMING!)



- Automatic recognition of all hardware!
 - All calibration data is automatically applied.
- Real-time data display
 - Group sensors within data display
 - Range of filtering options
 - Convert data to frequency domain
- Virtual Sensors
 - Create virtual sensors using mathematical functions
- Monitoring Configuration
 - Capture event-based data blocks
 - Rainflow histogram data (fatigue analysis)
 - Historic trend data
- Custom programming
 - Open STS-CORE software for clients to develop custom programs
 - BDI can develop custom applications for our clients



DATA PROCESSING SOFTWARE



Compatible data files

- Works with BDI *.tdms & *.dat data file structure
- Compatible with Campbell Scientific data files

Data display options

- Response, curvature, neutral axis plots
- Group sensors for averaged range calculation
- Range of filtering & decimation options
- Convert data to frequency domain

Input Options

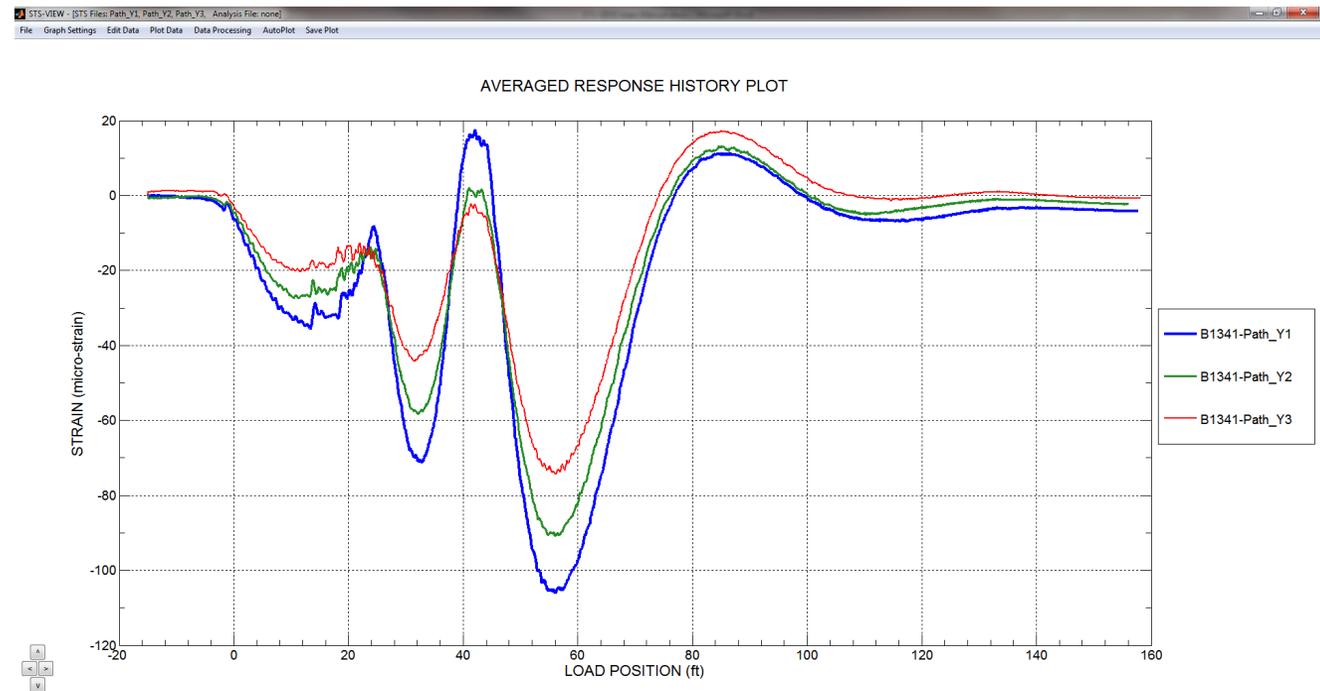
- Load finite element analysis results for direct
- Graphical comparison with collected data

Extract Data

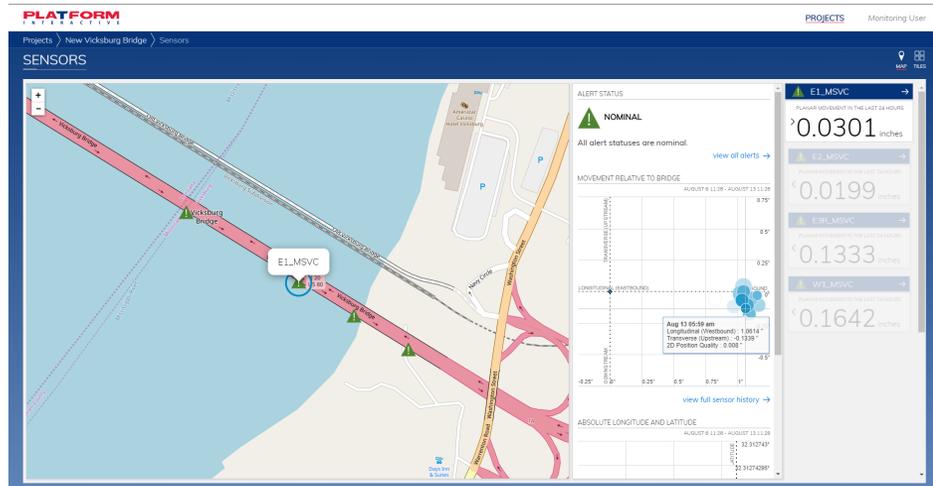
- Excel spreadsheet
- Text file
- Max/Min value extraction

Auto Plot Graphs

- Generate graphs for reports



DATA MANAGEMENT AND VISUALIZATION



- Custom software package
- Client monitoring system portal
- Microsoft AZURE cloud-based hosting service
 - Enterprise level security
 - 99.99% uptime
 - Multiple layers of redundant backup
- 24/7/365 Helpdesk support

Features:

- Scalable architecture
- Drag-and-drop setup and configuration to minimize site development time
- Sensor agnostic
- Fully customizable
- Automated & manual data compatible
- Microsoft IoT ready

MONITORING THE MONITORING SYSTEMS



System Monitoring:

- Data age
- Modem connectivity
- Disk space
- Data traffic

Off-site backup technical support :

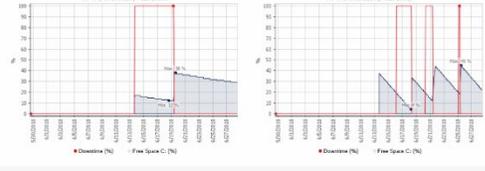
- BDI technical staff can support help desk at any time using mobile based and RDP applications
- Review data integrity

BDI STRUCTURAL MONITORING SYSTEMS

Alarm List

3 Alarms, 0 Ack'd Alarms, 6 Warnings, 0 Unusuals (Root)

Down for	Device	Sensor
	Probe Device	Folder
	Probe Device	Folder
	Probe Device	Clone of Folder
	Probe Device	Disk Free
	Probe Device	Disk Free
	Probe Device	Disk Free



Top 10: Least Available Diskspace (Root)

Last Value	Sensor	Probe Group Device
22%	Disk Free	NY-TTC-1488 South (159,253,75,45) *
25%	Disk Free	NY-TTC-1488 North (159,253,48,85) *
28%	Disk Free	NY-TTC-1488 North (159,253,50,75) *
33%	Disk Free	NY-TTC-1488 North (159,253,104,8,1) *
34%	Disk Free	NY-TTC-1488 North (159,253,107,178) *
45%	Disk Free	NY-TTC-1488 North (159,253,125,105) *
47%	Disk Free	NY-TTC-1488 North (159,253,125,105) *
51%	Disk Free	NY-TTC-1488 North (159,253,104,8,1) *
55%	Disk Free	NY-TTC-1488 North (159,253,107,178) *
67%	Disk Free	NY-TTC-1488 North (159,253,107,178) *

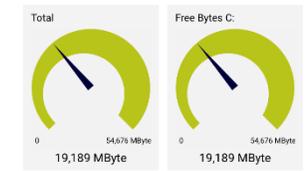
Verizon 10:17 AM 70%

Back Sensor

Disk Free

★ ★ ★ ★ ★

Last Message
16 % (Free Space C:) is below the error limit of 20 % in Free Space C:.



Free Space C:

Last Update: 6/29/18, 10:17 AM

AirVantage Register Monitor Configure Develop

Everything Systems Alerts Operations

Recent activity

Comm. Status	Last Conn. date	RSSI
CA - Millennium Tower (	4 minute ago	🟢
NY - TTC - 1488 South	2 minutes ago	🟢
NY - ANA - Newark II	2 minutes ago	🟢
LA - TTC - Ramon Clark	2 minutes ago	🟢
NY - Rubin (D, 9-2)	2 minutes ago	🟢

Communication status

System Operations

- Apply settings 5 hours ago
- Apply settings 3 hours ago
- Apply settings 3 hours ago
- Restart System 3 hours ago
- Apply settings 12 minutes

Deployed Firmware

RSSI

Signal strength

Fibers

Name	Signal strength	Last Conn. date	Firmware	Technology	Month to date	IP Address	Last applied to	Alert state	Actions
AZ - Flagstaff	🟢	12 minutes ago	ALECS RW50 (4.9.002)	LTE	397.41 MB	166.21.33.116	Custom		
CA - Millennium Tower (	🟢	12 minutes ago	ALECS RW50 (4.9.2.004)	LTE	1.12 GB	166.241.147.6			
CA - Millennium Tower (	🟢	10 minutes ago	ALECS RW50 (4.9.2.004)	LTE	1003.12 MB	166.164.33.96			
CA - Millennium Tower (	🟢	4 minute ago	ALECS RW50 (4.9.2.004)	LTE	1022.62 MB	166.21.33.137			
CO - Strucatus We- Mar...	🟢	9 minutes ago	ALECS RW50 (4.9.2.004)	LTE	21.10 MB	166.253.143.87			

WHAT KIND OF DATA?



ATS



Acoustic Emissions



Fiber Optics



Weather Stations

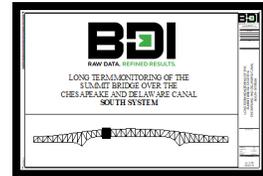


WIM



High Speed

Insp. Reports



Web Available



Cameras



Wireless

QUALITY MANAGEMENT PROGRAM

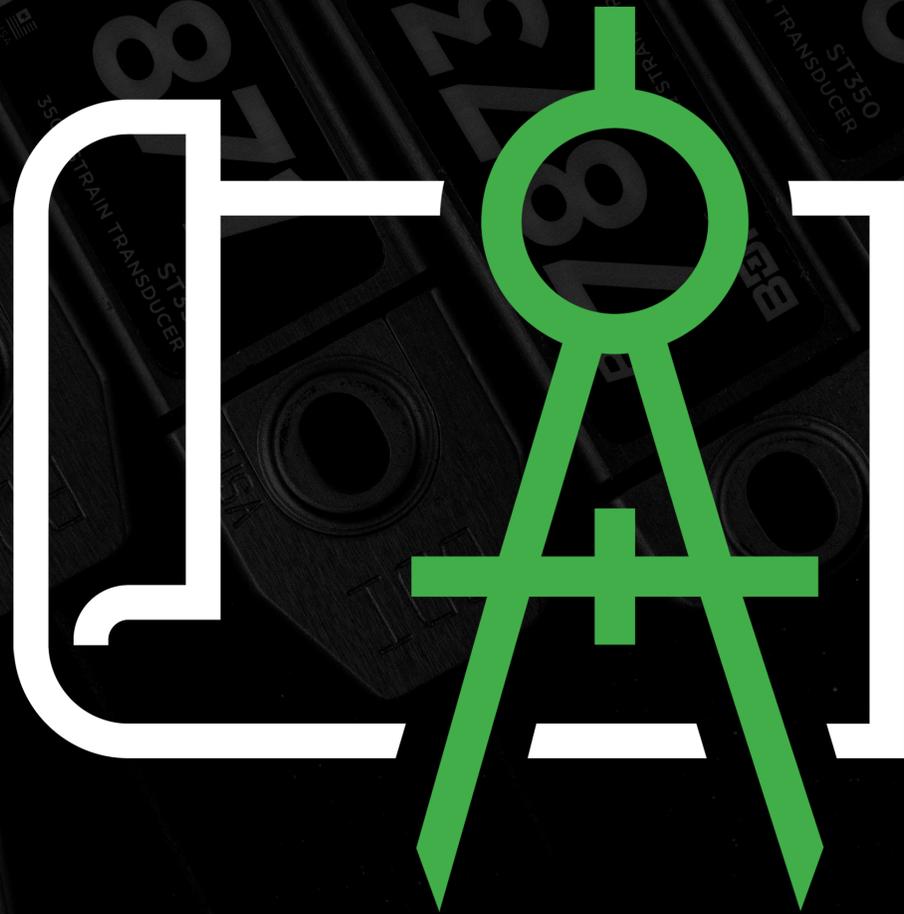
- PREPARE LAYOUT DRAWINGS
- LAYOUT SCHEMATICS
- BUILD THE SYSTEM
- TEST THE SYSTEM
- INSTALL THE SYSTEM
- SITE ACCEPTANCE TEST
 - SENSORS
 - SYSTEM
 - SOFTWARE
 - COMMUNICATION



Project: _____
PM: _____

SAT – MONITORING SYSTEM COMMISSIONING CHECKLIST	
Field Engineer: _____	Date & Time: _____
Office Engineer: _____	System ID: _____
POWER AND COMMUNICATIONS	
<input type="checkbox"/> Core clock is properly set, and time zone for install location is verified <input type="checkbox"/> System is powered on and can be connected to remotely using login credentials from BDI Wiki <input type="checkbox"/> Modem signal is of good quality and requires no adjustments – limits for excellent shown below RSSI: ____ (>-70dBm) RSRP: ____ (>-90dBm) RSQR: ____ (>-9dBm) SNIR: ____ (>10) <input type="checkbox"/> Battery backup system has been verified by turning off input voltage and system remains on <input type="checkbox"/> Cold start from battery confirmed (no AC power, all breakers off) <input type="checkbox"/> Remote reset capabilities verified and confirmed onsite (remote node reset and remote system reset) <input type="checkbox"/> Remote restarted PC and verified STS-Core comes back on automatically	
SENSOR VERIFICATION – SEE SEPARATE FULL SYSTEM SENSOR CHECKLIST	
<input type="checkbox"/> Response of each sensor verified coming in of good quality with acceptable noise/offset levels <input type="checkbox"/> Push/tap/cold test for each sensor to ensure proper mapping and functionality	
DATA VERIFICATION	
<input type="checkbox"/> Test spec running properly <input type="checkbox"/> Auto sequence routine setup and verified <input type="checkbox"/> Data files coming in and readable <input type="checkbox"/> 24-hours of data viewed and analyzed for any noise/sensor issues <input type="checkbox"/> Zero values set (if applicable) – Temperature: _____ Load Configuration: _____ <input type="checkbox"/> Auto sequence protocol setup and verified <input type="checkbox"/> General STS-Core alarms setup and tested <i>As Applicable</i> <input type="checkbox"/> Alarms set within system and verified being sent <input type="checkbox"/> Data streaming to website <input type="checkbox"/> Secondary data transfer/storage confirmed	
CORE BACKUP & DOCUMENTATION	
<input type="checkbox"/> Entire STS folder backed up onto server <input type="checkbox"/> All commissioning data download onto thumb drive <input type="checkbox"/> BDI Wiki site complete and verified <input type="checkbox"/> Commissioning notes reviewed and all actions taken	
COMMISSIONING COMPLETION SIGN OFF	
Notes: <input style="width: 100%; height: 20px;" type="text"/>	
Office Project Manager Initials: _____	Date: _____

SERVICES





RAW DATA. REFINED RESULTS.

SERVICES

NONDESTRUCTIVE EVALUATION (NDE)

NDE/NDT Services Offered

■ Acoustic

■ Concrete:

- Impact/Pulse Echo
- Ultrasonic Surface Wave (USW)
- Spectral Analysis of Surface Waves (SASW)

■ Steel:

- ASNT Level II/III UT, PT, MT, ET, RT
- Phased Array Ultrasonic Testing (PAUT)
- Stress Wave for Defects and Tension in Trunnion Anchor Rods

■ Electromagnetic

- Ground Penetrating Radar (GPR)
- Infrared Thermography
- Radiography
- Magnetic Methods (Eddy Current, Magnetic Flux Leakage, Magnetic Particle, Ferrosensing)

■ Electrochemical

- Half Cell Potential
- Electrical Resistivity

■ Unknown Foundations

- Parallel Seismic, Downhole and Crosshole testing
- Ultraseismic and Sonic Echo/Impulse Response

■ Physical Methods

- Coring
- Petrography
- Chloride Sampling and Testing
- Rebound Hammer



BRIDGE DECK INSPECTION



Phase 0



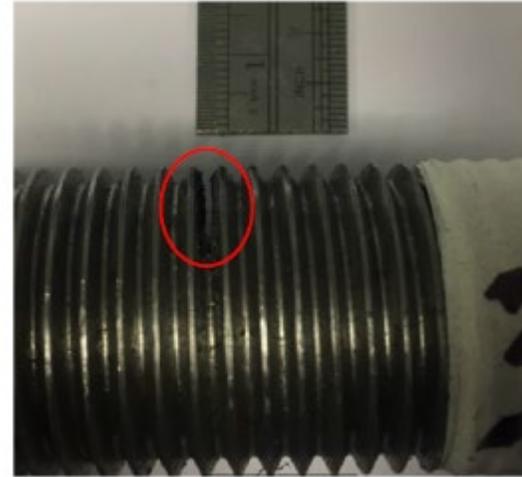
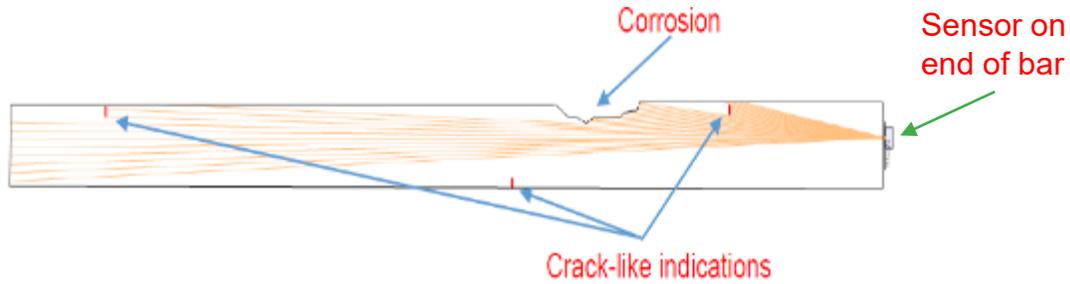
Phase I



Phase II

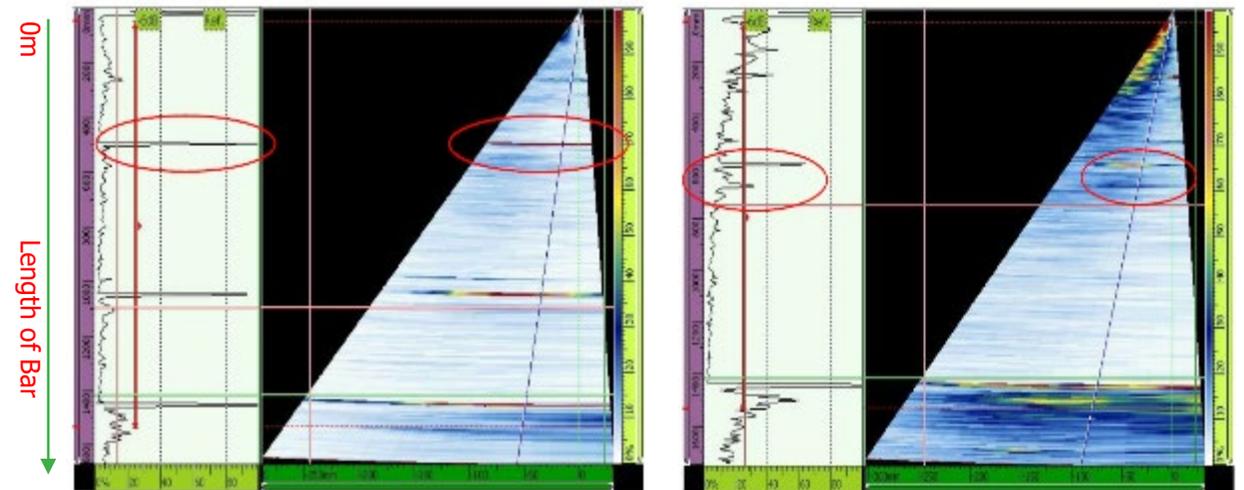
INSPECTION OF WIRES, TIE RODS AND ANCHOR BOLTS

Pre-works Verification



Imitation crack, by notching

Imitation corrosion region with section loss



The procedure has been tested and qualified using a known sample with defects inflicted.



RAW DATA. REFINED RESULTS.

SERVICES

FIELD LOAD TESTING

DIAGNOSTIC FIELD TESTING - BRIDGES



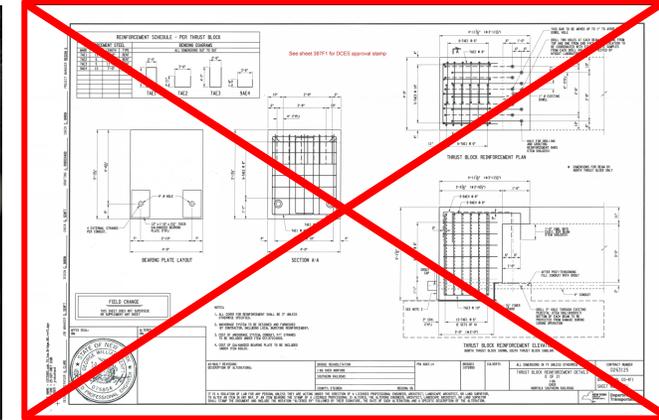
Undesirable ratings
or load changes



Permit / special
loads



Retrofit / construction
evaluation



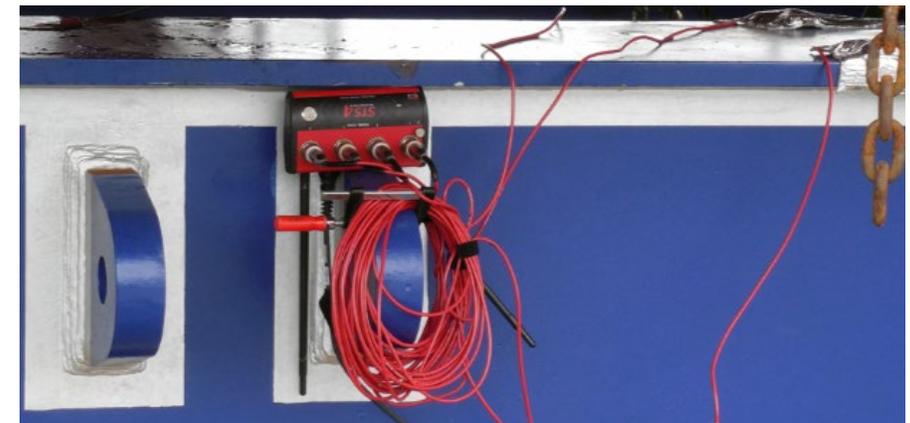
Missing / incomplete
plans

BDI'S integrated approach

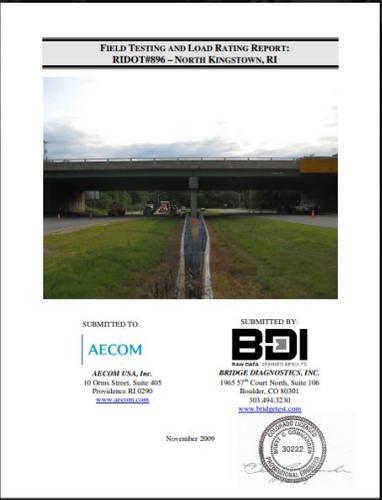
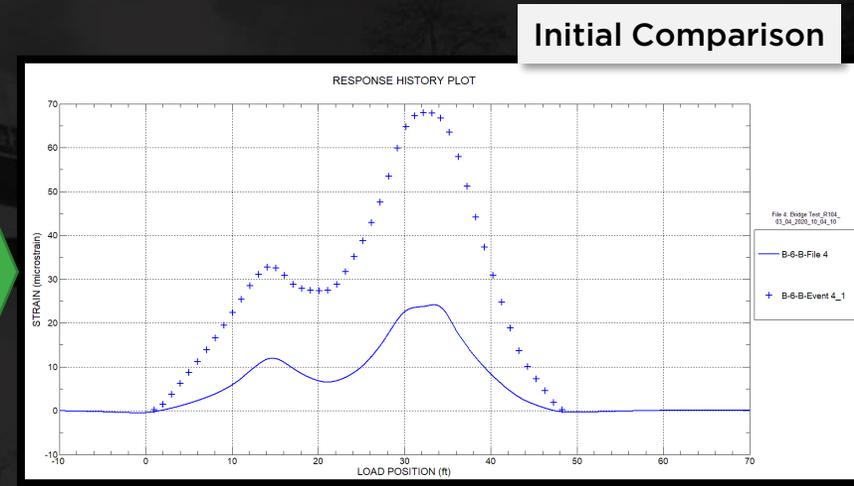
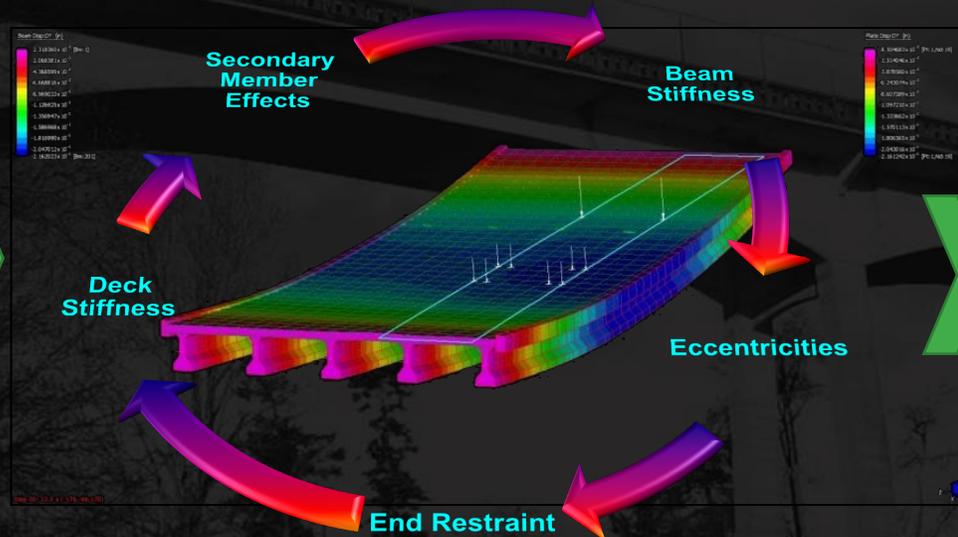
- Confirmation / Reconstruction of as-builts using NDE and inspection
- Rapid field testing using wireless hardware and in-house sensors
- Streamlined FE analysis and model calibration procedures
- Reporting and QC by licensed professionals

LOAD TEST PROCESS

- Work with client to develop objectives
- Design instrumentation plan
 - Max pos/neg moment
 - Max displacement
 - Max rotation
 - End restraint
 - Composite action
- Specify load
- Install the sensors and execute test
 - Typically 1-2 days install depending on access with 1 day for testing / teardown
 - BDI has ropes access staff to cut down on install logistics costs!

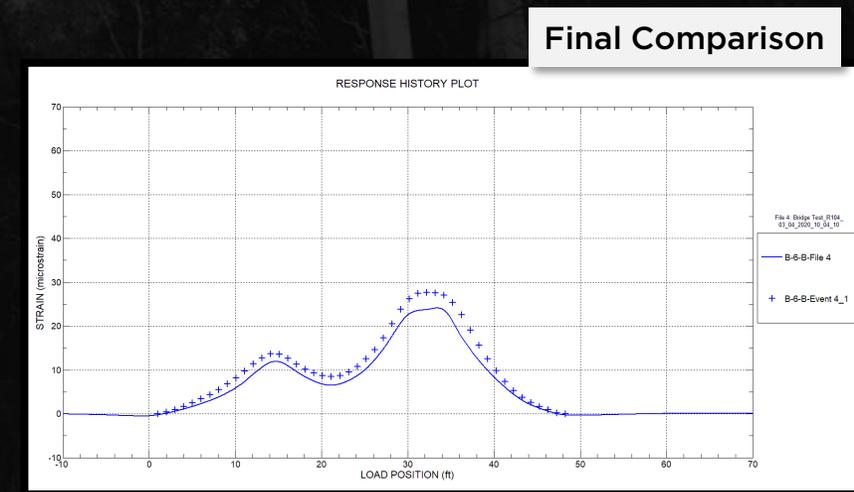


REFINED BRIDGE LOAD RATING PROCESS



Can we rely on updated parameters for rating?

- Unintended composite action
- Barrier participation
- End restraint

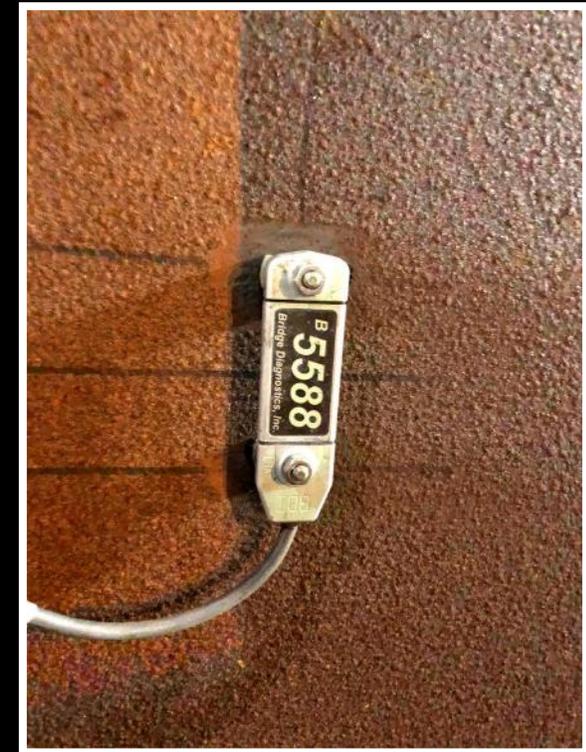


EXAMPLE - LOAD TEST FOR PERCEIVED LARGE DEFLECTIONS

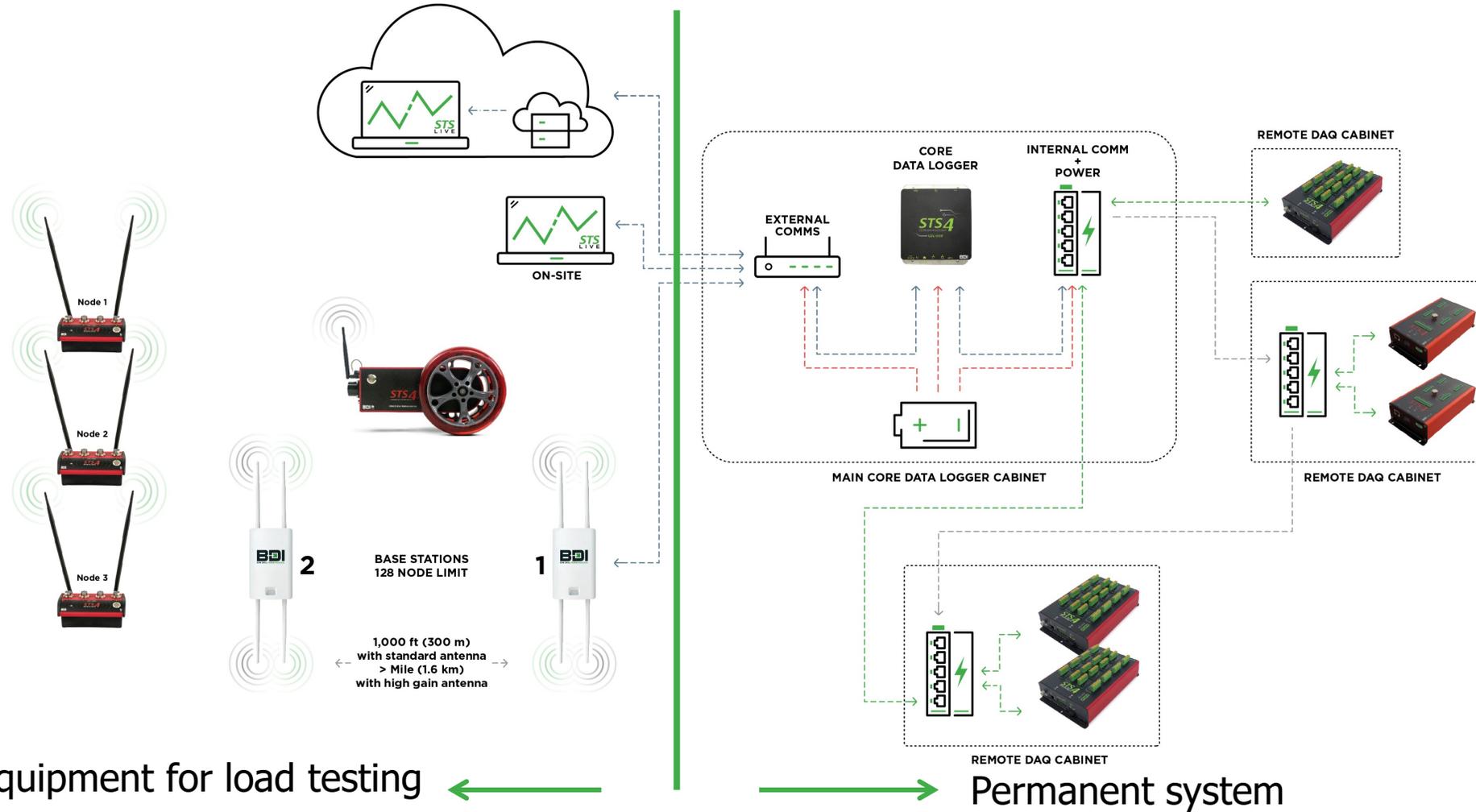


BDI provided load testing services to calibrate an FE model of a newly constructed multi-girder structure. There were perceived large deflections in the multi-girder system and suspected poor construction (designed composite but level of composite action was questioned).

Load testing and refined load rating using BDI instrumentation (strain gage shown).



EXPANDING THE FUNCTIONALITY OF DISCRETE MONITORING: SHORT-TERM TESTING





BDI

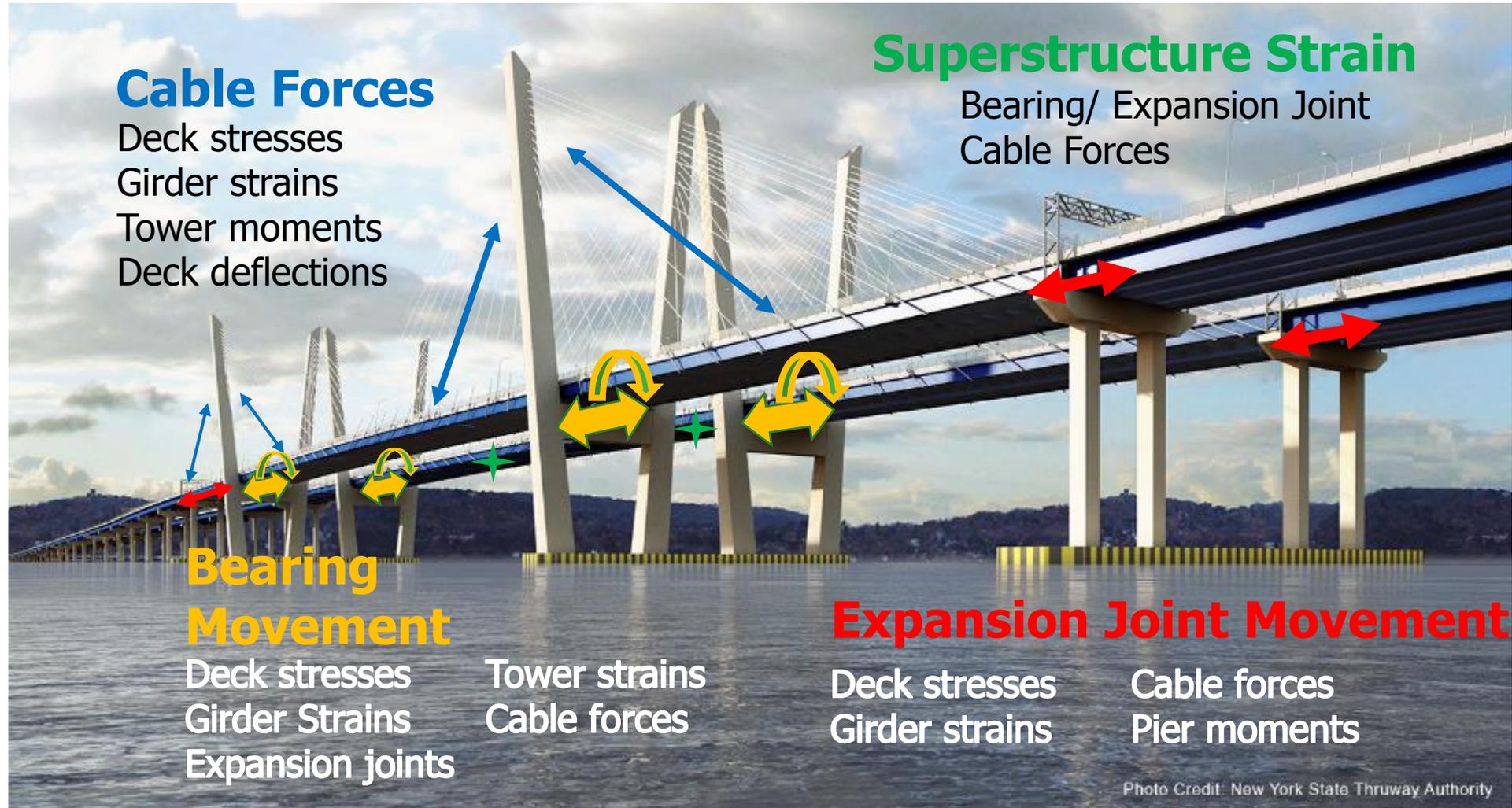
RAW DATA. REFINED RESULTS.

SERVICES

INNOVATIVE TECHNOLOGIES

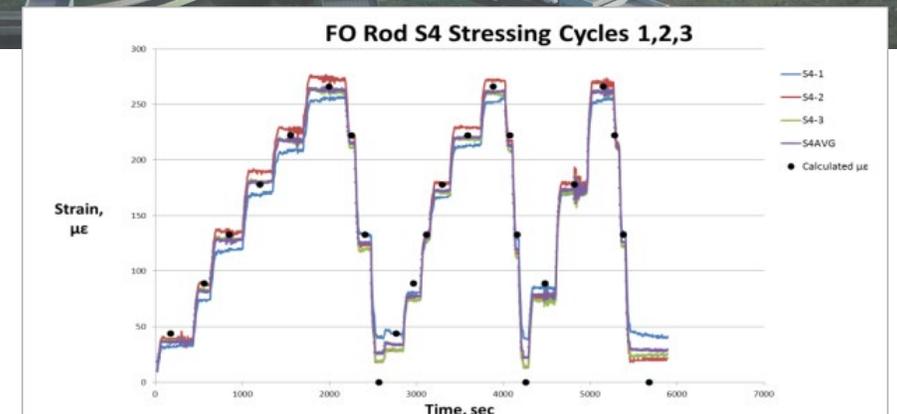
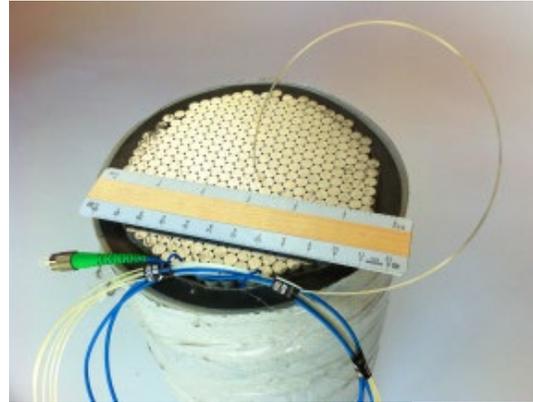
SHM- COMPONENT PERFORMANCE INTERACTION

(Replaceable components over life of structure)



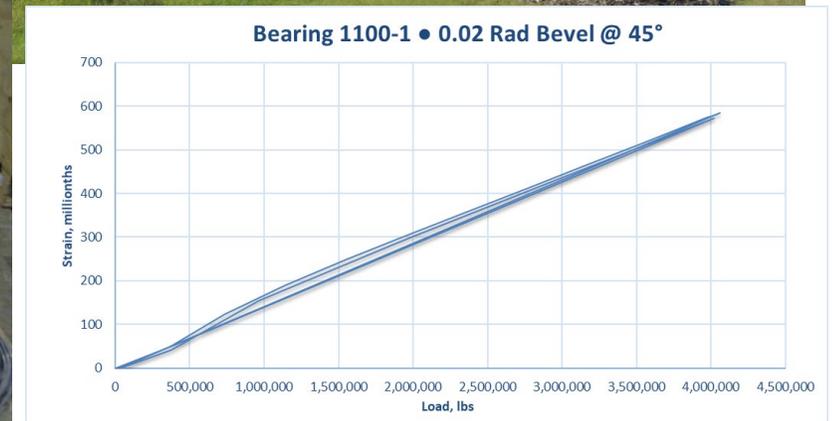
SMART COMPONENTS – CABLE STAYS

- ▶ Shanghai Pujiang Cable Co.
 - ▶ Force Measurement in stay cables using fiber optics
 - ▶ Monitor
 - Cable force
 - Cable temperature
 - Moisture/humidity
 - ▶ Verify Calibration
 - ▶ Assess Performance
 - ▶ Predict Maintenance



SMART COMPONENTS - BEARINGS

- ▶ Large Scale Bearings
 - ▶ Permanent SMART Bearings (3900 kip fixed and guided)
 - ▶ Monitor
 - Bearing load
 - Bearing rotation
 - Bearing displacement
 - ▶ Verify Calibration
 - ▶ Assess Performance
 - ▶ Predict Maintenance



INNOVATIVE TECHNOLOGY – INERT GAS

- Penobscot Bridge
 - Corrosion protection- Inert (Nitrogen) gas
 - Cable replacement – CFRP strand through saddle
 - Monitor
 - Gas pressure
 - Gas flow
 - Strand forces
 - Predict Maintenance



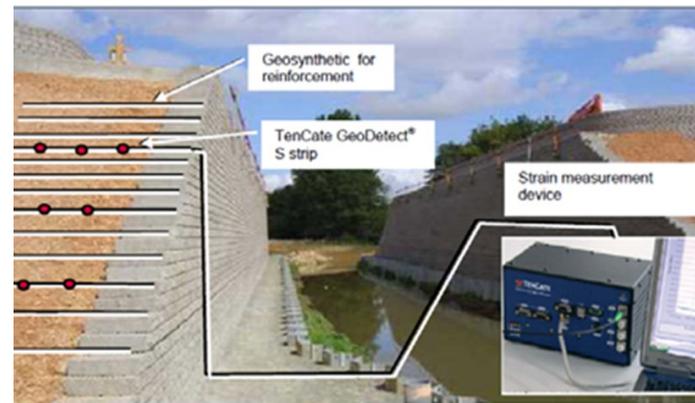
INNOVATIVE TECHNOLOGY – FBG FO

Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS)

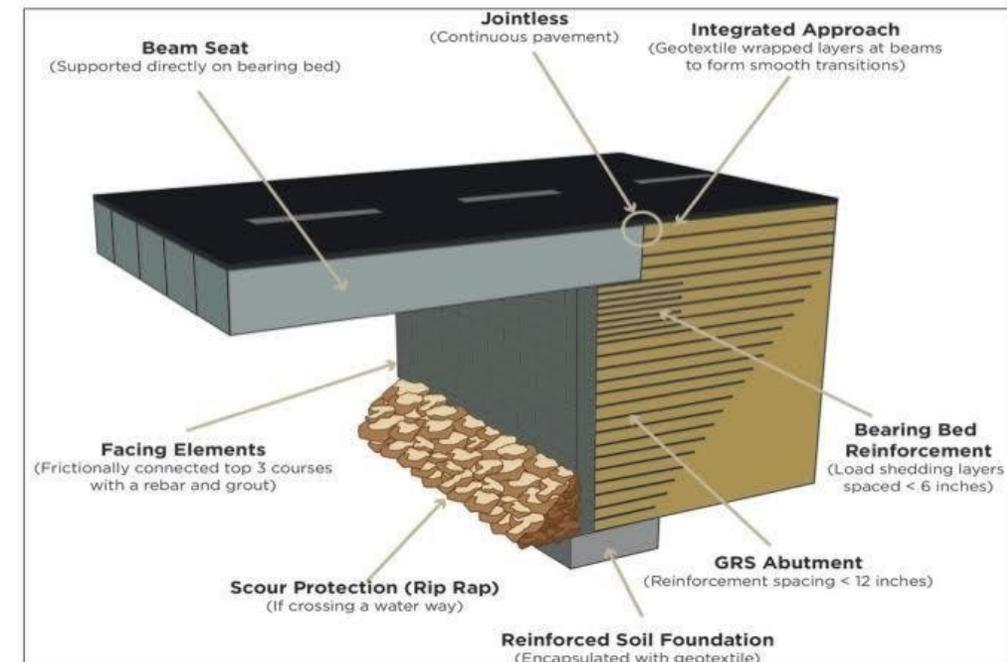
Supplement Traditional Instrumentation

Undisturbed Soil Measurements;

- Horizontal Strain
- Layer Pressure Distribution

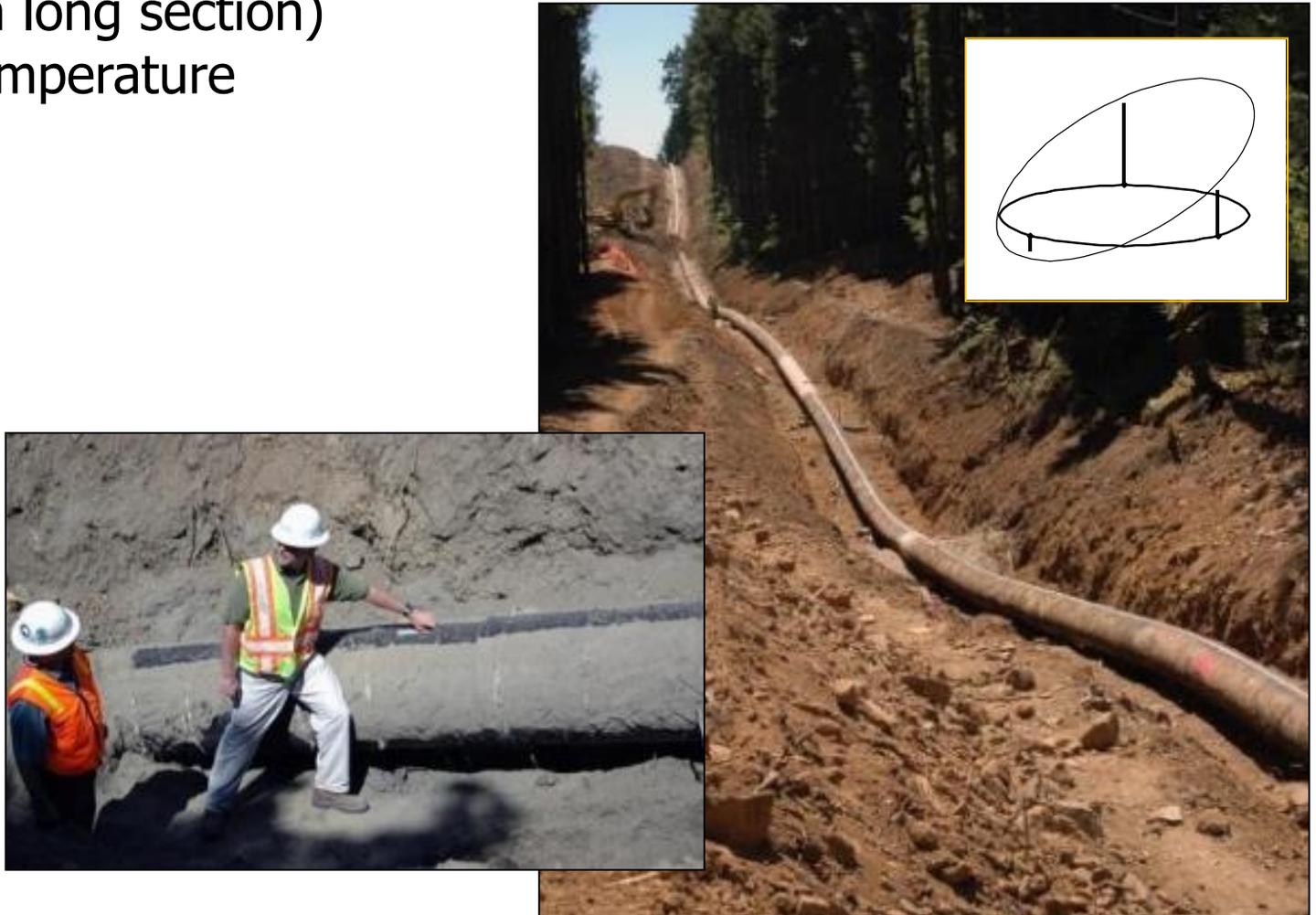


Section View of GRS IBS



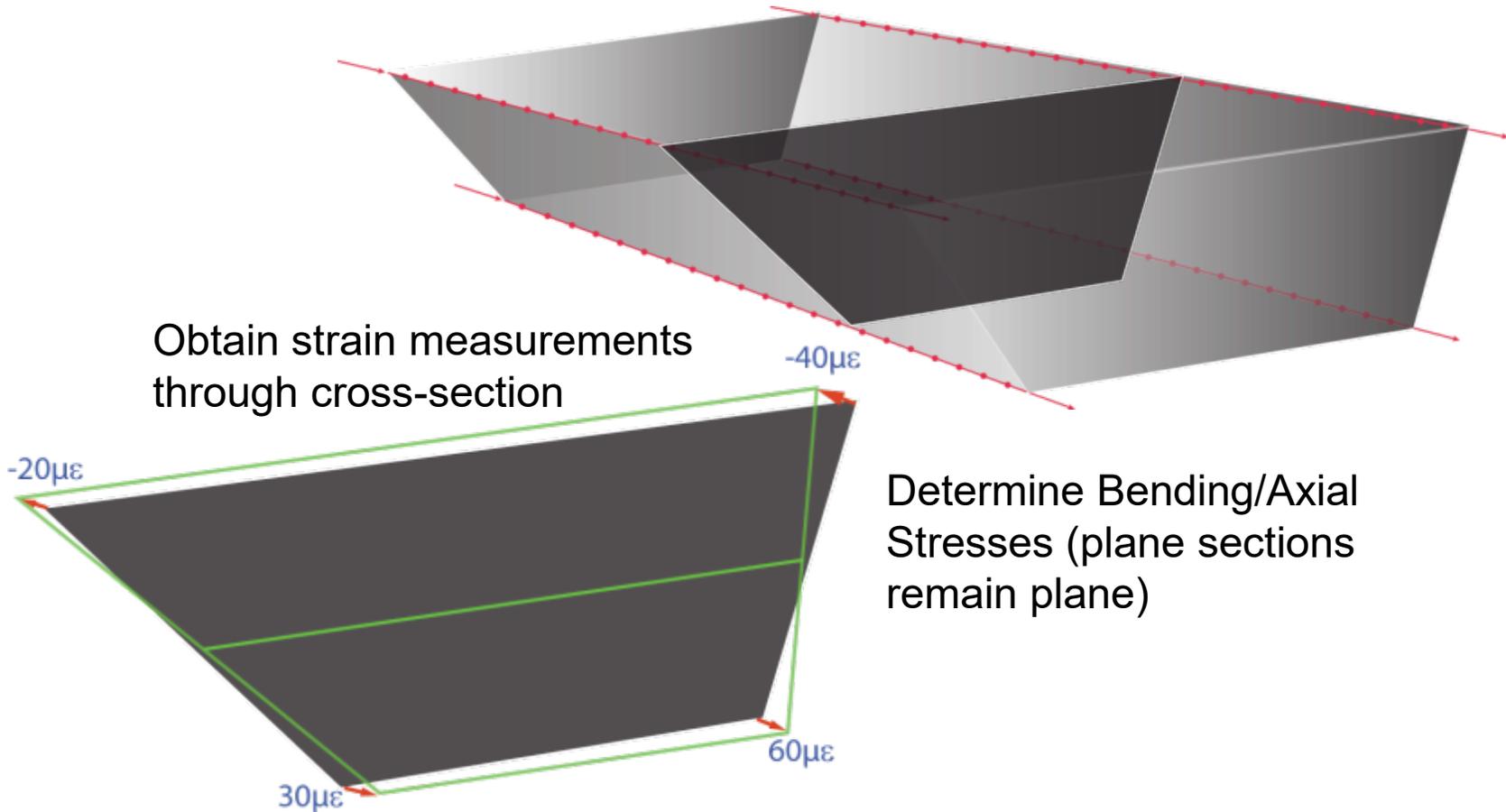
INNOVATIVE TECHNOLOGY – DST FO

- Williams Gas Pipeline (500m long section)
 - Distributed Strain and Temperature (DST) fiber optics
- Monitor
 - Bending strain
 - Temperature
 - Leaks
- Predict Maintenance
- Monitor ROW



DST – *POTENTIAL* BRIDGE APPLICATION

One Meter Section Measurements



Maintenance Tool to Help Focus Areas of Inspection



RAW DATA. REFINED RESULTS.

SERVICES

STRUCTURAL MONITORING CASE STUDIES

STRUCTURAL HEALTH MONITORING (SHM)

WHY MONITOR A STRUCTURE?

- ▶ Monitor long-term performance
- ▶ Identify conditions influencing operational issues
- ▶ Forensic analysis to define cause of damage/cracks
- ▶ Construction retrofit
- ▶ Temperature induced stress
- ▶ Keep a remote eye on potential problems
- ▶ Stress cycle monitoring for fatigue
- ▶ Maintenance support



Dewatering Tower Vibrations



Turbine Crack Evaluation



Vibration Monitoring



Performance Monitoring

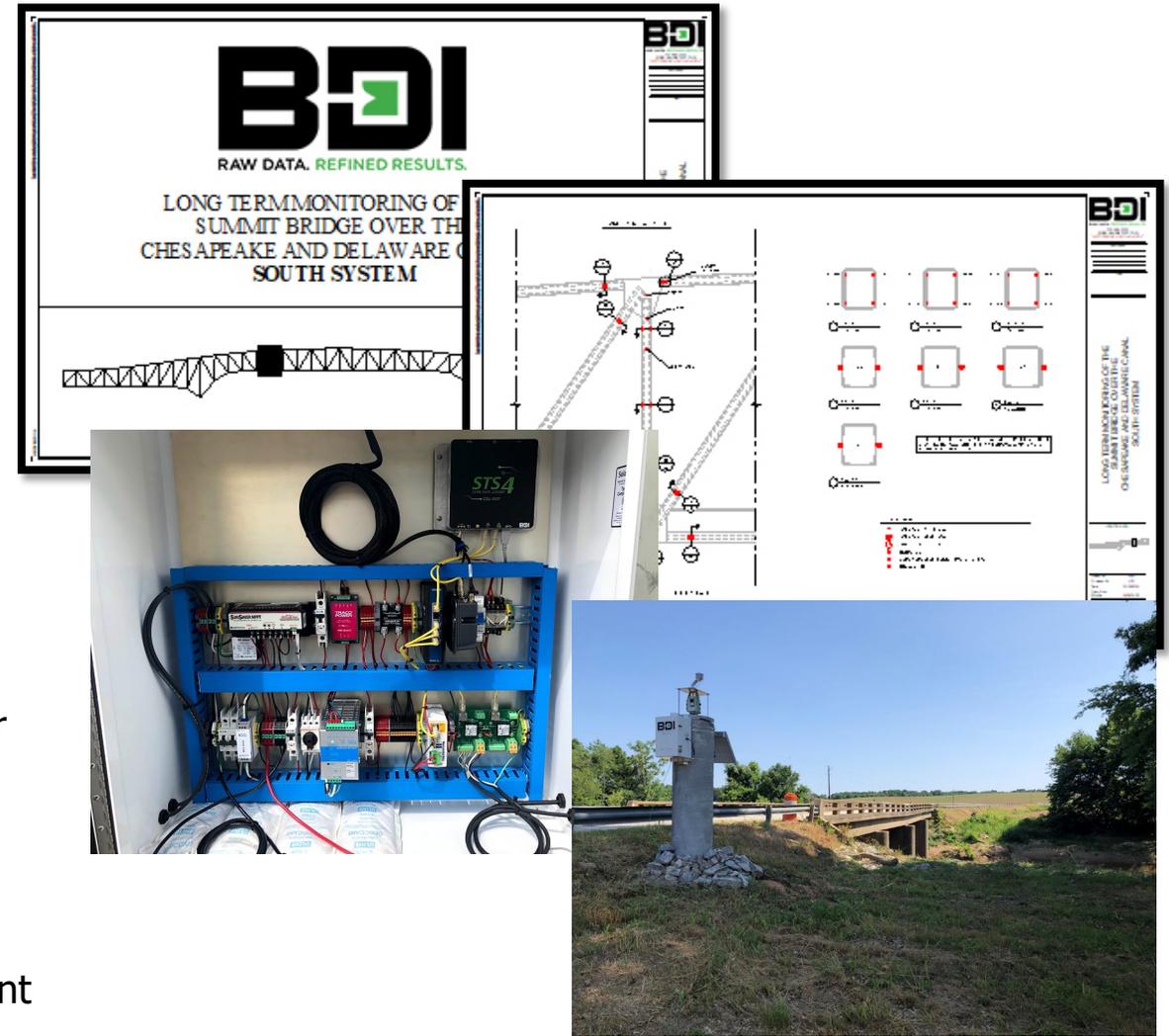
MONITORING SERVICES

How?

- Help define the tender specifications
- Complete SHM system design and configuration
- Develop custom instrumentation plans for the project, including all installation procedures
- Project management
- System installation, testing and commissioning
- Data management
- Reporting

We control our own fate on monitoring projects with in-house ...

- R&D department to help design new and innovative technologies
- Electrical engineers to design properly functioning power systems
- Engineers to develop instrumentation drawings
- Production to manufacture equipment
- Trained field technicians for installation
- Engineers for interpretation / analysis / data management & reporting



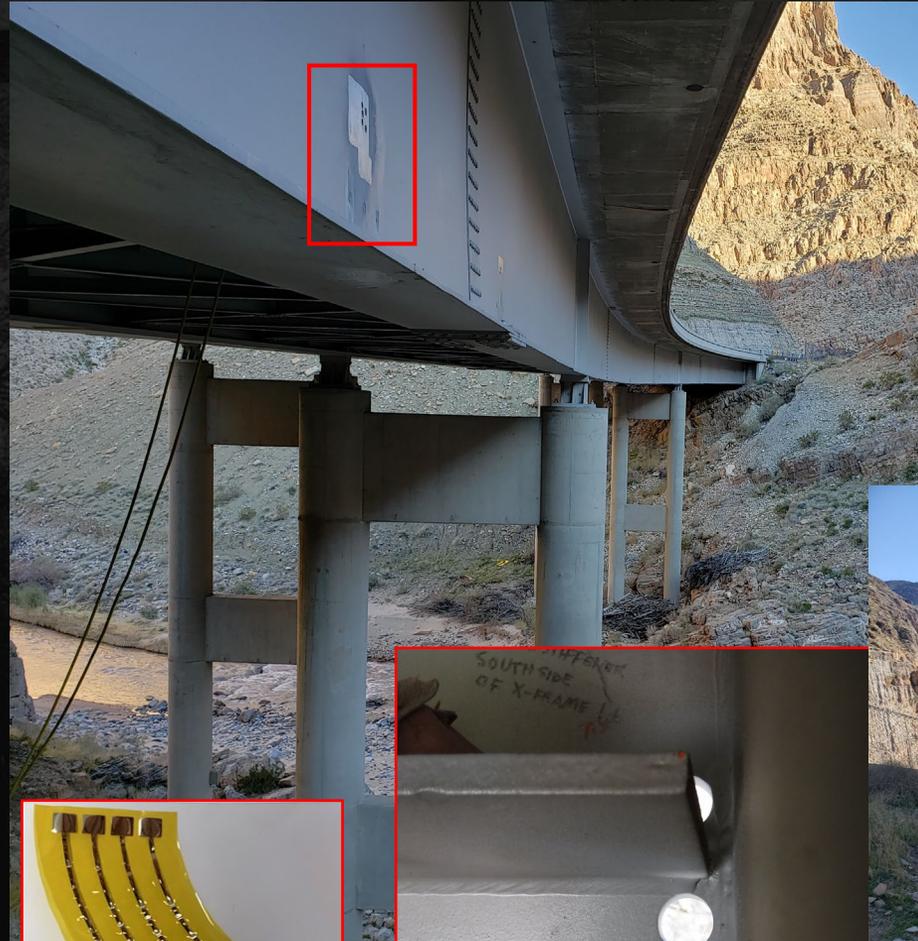
ROPE ACCESS

BDI Technicians and Engineers are SPRAT Certified. This reduces need for Access Equipment costs, lane closures and traffic control.

- Forensic Inspection/Documentation
- Instrumentation Installation
- System Maintenance
- NDE Testing



SHMS – ADOT I15 PAIR OF BRIDGES (critical conditions)



SHMS – ADOT I15 PAIR OF BRIDGES (critical conditions)

PlatformInteractive ONLINE SENSOR MANAGEMENT
Projects > 2368C ADOT I-15

PROJECTS HARDWARE Tom Weinhmann (FD)

IMAGE LAYOUT



All Sensors Bridge 5 (1617 & 1618) Bridge 7 (1236) Events



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7:57 PM 6/24/2020

PlatformInteractive ONLINE SENSOR MANAGEMENT
Projects > 2368C ADOT I-15 Bridge 5 (1617 & 1618)

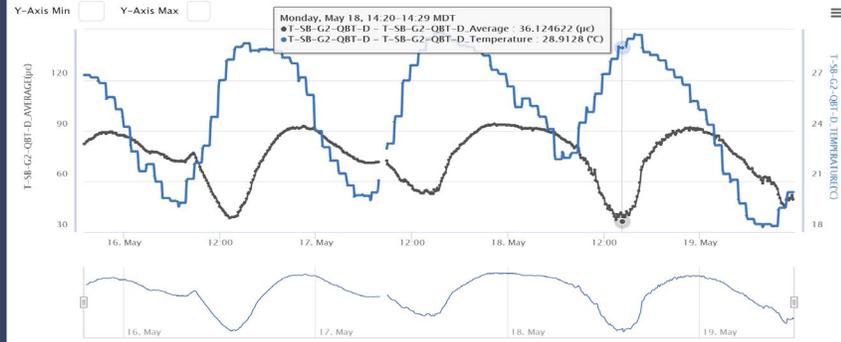
PROJECTS HARDWARE Tom Weinhmann (FD)

CHART

05/15/2020 06:59:21 PM MDT - 05/20/2020 06:59:21 PM MDT

Date From 05/15/20 19:59:21 Date To 05/20/20 19:59:21 Update

Y-Axis Min Y-Axis Max



Monday, May 18, 14:20 - 14:29 MDT
 ● T-SB-G2-QBT-D - T-SB-G2-QBT-D Average : 36.12462 (µC)
 ● T-SB-G2-QBT-D - T-SB-G2-QBT-D Temperature : 28.9128 (°C)

Select all sensors

- T-SB-G1-TH (EM)-T_Min
- T-SB-G2-CM-T
- T-SB-G2-CM-T_Average
- T-SB-G2-CM-T_Max
- T-SB-G2-CM-T_Min
- T-SB-G2-QBT-B
- T-SB-G2-QBT-B_Average
- T-SB-G2-QBT-B_Max
- T-SB-G2-QBT-B_Min
- T-SB-G2-QBT-B_Temperature
- T-SB-G2-QBT-D
- T-SB-G2-QBT-D_Average
- T-SB-G2-QBT-D_Max
- T-SB-G2-QBT-D_Min
- T-SB-G2-QBT-D_Temperature
- T-SB-G2-QBT-T
- T-SB-G2-QBT-T_Average

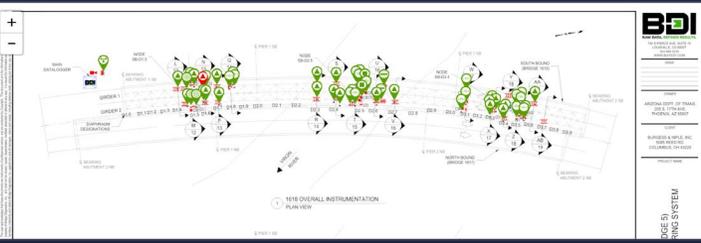
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PlatformInteractive ONLINE SENSOR MANAGEMENT
Projects > 2368C ADOT I-15 Bridge 5 (1617 & 1618)

PROJECTS HARDWARE Tom Weinhmann (FD)

IMAGE LAYOUT



SECTION K SECTION L SECTION M



A-NB-G1-CM-B

- 1.77 Volts A-NB-G1-CM-B_Average
- 1.77 Volts A-NB-G1-CM-B_Max
- 1.77 Volts A-NB-G1-CM-B_Min

AA-SB-G1-CM-T

- 2.94 Volts AA-SB-G1-CM-T_Average
- 2.95 Volts AA-SB-G1-CM-T_Max
- 2.94 Volts AA-SB-G1-CM-T_Min

AB-SB-G2-CM-T

- 2.94 Volts AB-SB-G2-CM-T_Average
- 2.94 Volts AB-SB-G2-CM-T_Max
- 2.94 Volts AB-SB-G2-CM-T_Min

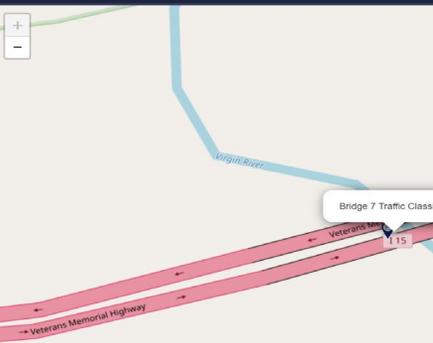
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PlatformInteractive ONLINE SENSOR MANAGEMENT
Projects > 2368C ADOT I-15 Events

PROJECTS HARDWARE Tom Weinhmann (FD)

MAP



06/24/2020 11:15:22 AM MDT



06/24/2020 10:58:32 AM MDT



06/24/2020 10:53:46 AM MDT



06/24/2020 10:51:31 AM MDT



Bridge 7 Camera

ADOT Bridge 7 Event

Latest event occurred on 06/24/2020 11:15:22 AM MDT

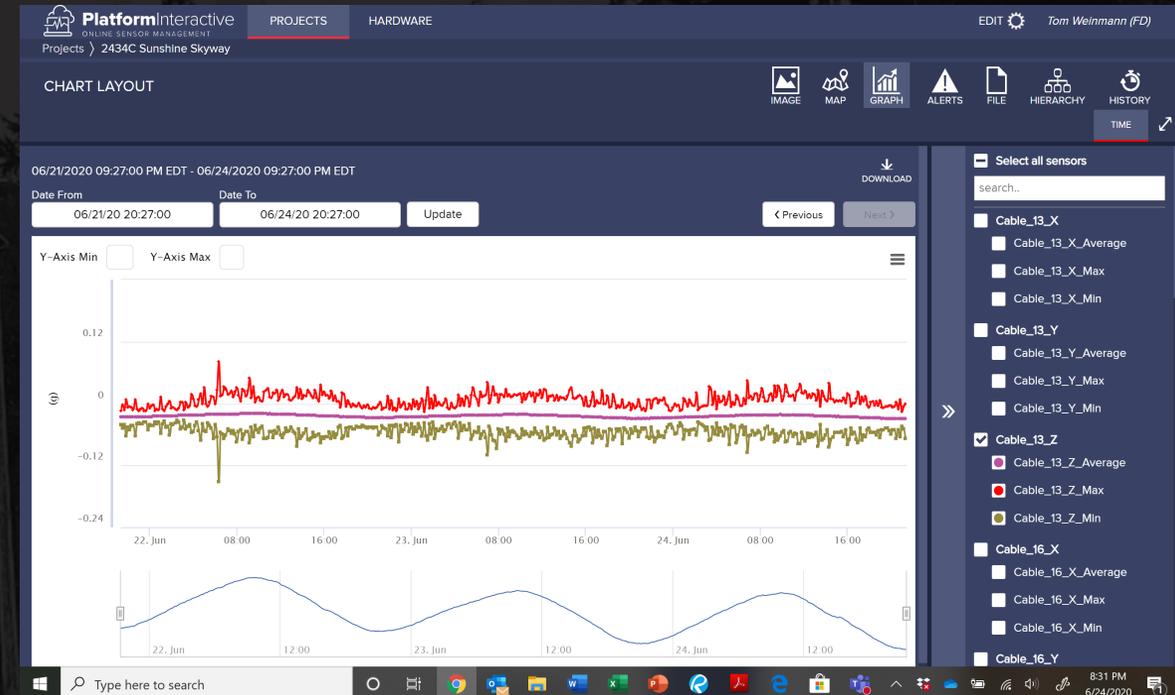
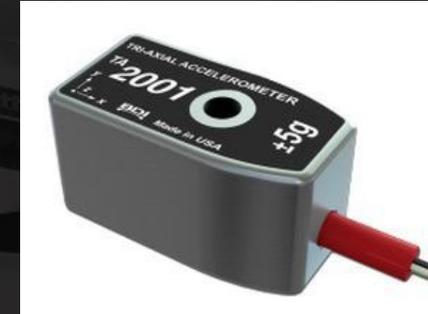
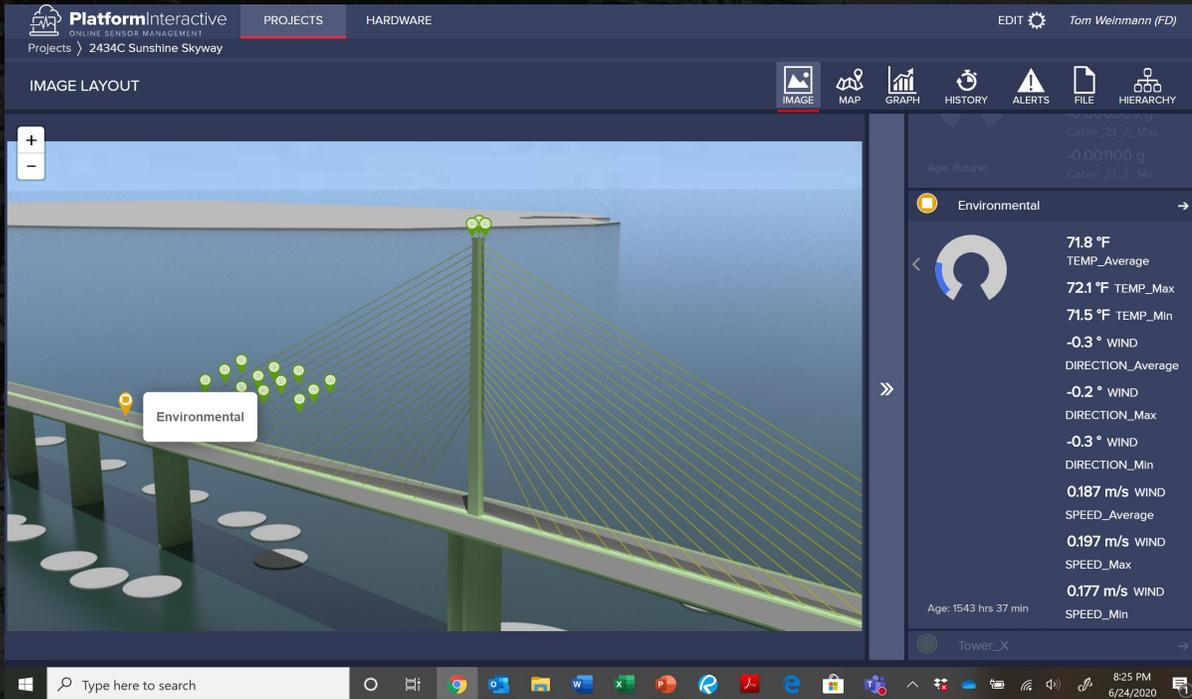
Bridge 7 Traffic Classifier

Document uploaded on 06/24/2020 11:15:22 AM MDT

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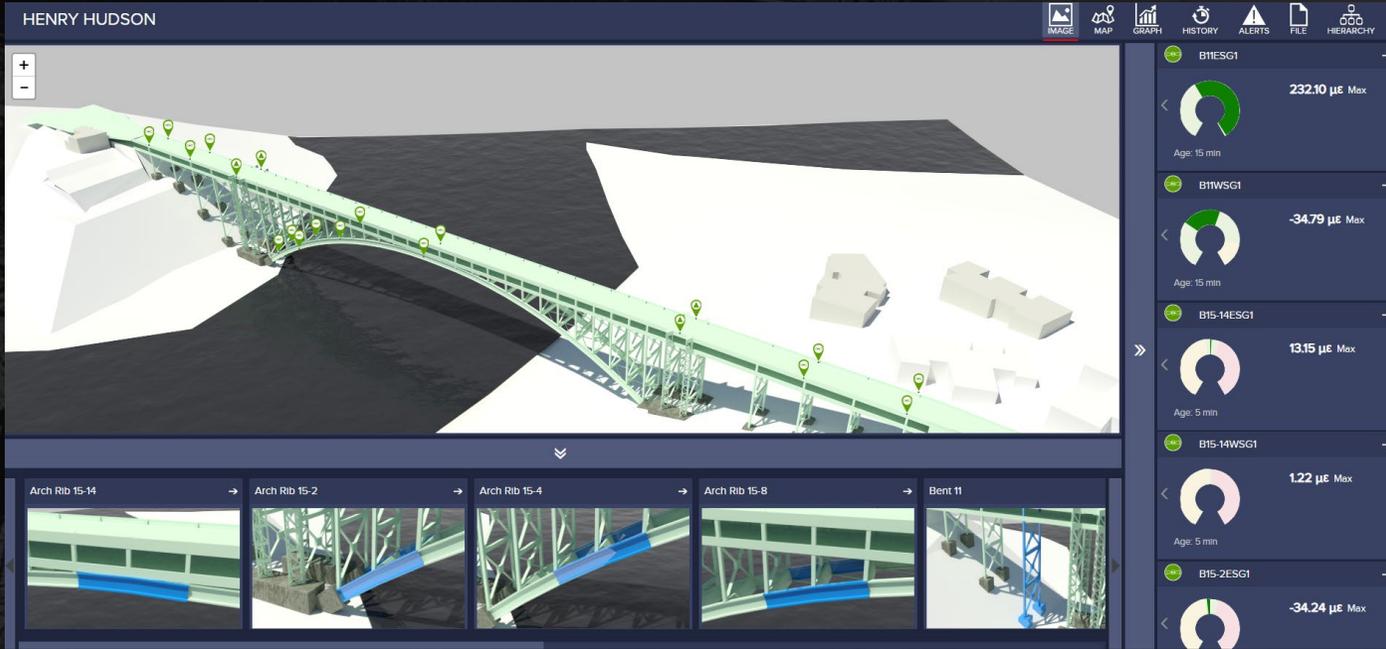
SHMS – SUNSHINE SKYWAY BRIDGE (performance assessment)



SHMS – HENRY HUDSON BRIDGE (construction retrofit)



SHMS – HENRY HUDSON BRIDGE (construction retrofit)



WHAT YOU NEED TO KNOW- PLANNING

- DEFINE YOUR NEEDS (CURRENT ISSUE, MAINTENANCE SUPPORT, ASSET MANAGEMENT?)
- DEFINE YOUR MEASUREMENT SPECIFICATIONS- NOT SENSORS
- MAKE SURE SYSTEM IS SCALABLE
- DEFINE YOUR DATA MANAGEMENT PLAN (WHO WILL BE RESPONSIBLE FOR DATA?, WHO IS INTERPRETING AND ACTING UPON CHANGES IN DATA?)
- DEFINE YOUR ACTION PLAN
- DEFINE YOUR SYSTEM MAINTENANCE SUPPORT PLAN
- SET YOUR BUDGET

WHAT YOU NEED TO KNOW- CONTRACT AND AWARD

- CONTRACT THROUGH OWNER OR OWNER'S ENGINEER IS BEST- WHY?
- LOW BID IS NOT BEST- WHY?
- QUALIFICATIONS BASED CAN HIDE UNSUCCESSFUL PROJECTS
- BEWARE OF THE "ONE TRICK PONY"
- CAN SUPPLIER PROVIDE ENGINEERING SUPPORT FOR MEASUREMENT EVALUATION
- LOOK FOR LONGEVITY

Owner' Perspective and Final Thoughts

Data and Information for:

- Asset Management
- Safety
- Forensic Studies
- Maintenance & Repair
- Risk Management



Folsom Dam Spillway Gate Failure

ASSET MANAGEMENT AND PERFORMANCE DATA

What are some of the issues plaguing agencies?

- **Unknown conditions** or properties of current assets resulting in overly conservative assumptions (no as-builts, unknown foundations, unknown materials)
- **Change in regulations** that require re-analysis and re-prioritization of assets (FHWA's memo on revised load models for highway bridges – SHV & EV)
- How to **evaluate efficacy / life-cycle cost of innovative and/or novel approaches** to maintain current inventory of assets compared to full replacement or major rehabilitation?

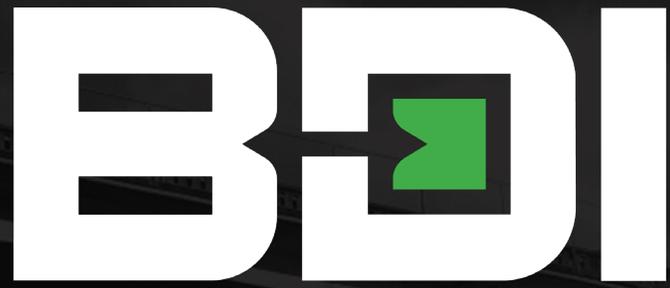
While technology-based approaches can't solve all problems, they :

- Serve as a compelling alternative when traditional assessment fails to provide a path forward
- Are additional measures of condition and performance
- Can help streamline and optimize asset management plans by helping managers allocate resources where they are truly needed.

AGENDA

- Questions?
- Contact us at:
 - tomw@bditest.com
 - nathand@bditest.com
- Check out and **download** **the Handouts** shown in the handout section of this webinar





RAW DATA. REFINED RESULTS.



DATA YOU CAN TRUST.
RESULTS YOU CAN BUILD ON.