Case Study – Bridges
Arsenal Bridge

Rock Island, IL, 2009-2010

Arsenal Bridge - General Characteristics

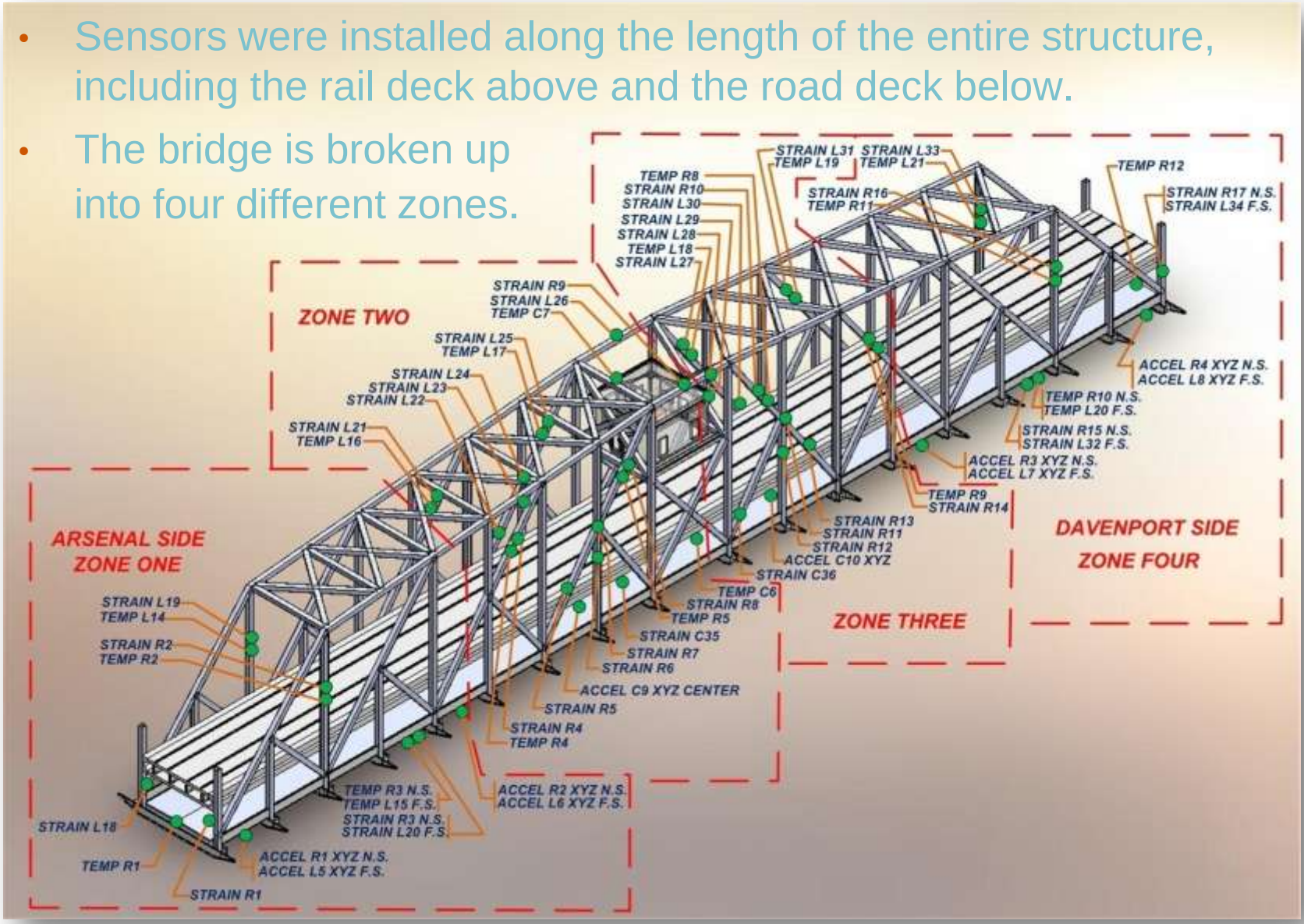
- Constructed 1896, Steel Through Pratt Truss, 8 Spans
- Combined Two Lane Highway-Railway Structure
- Length: Rail (Spans 1-8)1,848 ft, Vehicle (Spans 2-6) 1,556 ft
- 360° Swing Span 2: 336 ft, 2,000 Tons
- Swing Span Average Turn Time: 12 Min
- Traffic: Rail 1,881/yr, Vehicle 10,297/day, Barges/Boats 18,568/2,884/yr

Arsenal Bridge – Structural Monitoring System Overview

Aim	To monitor the integrity and behavior of the bridge structure, and effects due to high traffic and heavy truck loads that could cause possible damage & fatigue.
Location	Rock Island, IL
System Integrator	Chandler Monitoring Systems, Inc. http://www.chandlermonitoring.net
Customer	Concurrent Technologies Corporations
Date	November 2009
Instrumentation	(1) Micron Optics sm130-500 Optical Sensing Interrogator (1) Micron Optics sm041-416 Optical Channel Switch Extension
Sensors	(36) Micron Optics os3100 Strain Sensors (21) Micron Optics os4300 Temperature Sensors (10) Micron Optics os7100 3D Accelerometers (1) Fiber Optic Tilt Meter Conventional AE, weather and corrosion sensors
Project Scope	Employ system on the bridge to greatly reduce risk of catastrophic failure by providing advance warning of growing structural problems caused by corrosion/materials degradation. Demonstrate and validate state-of-the-art and emerging innovative technology approaches for remote structural health and corrosion degradation monitoring of steel bridges.

Arsenal Bridge - Structural Monitoring System Overview

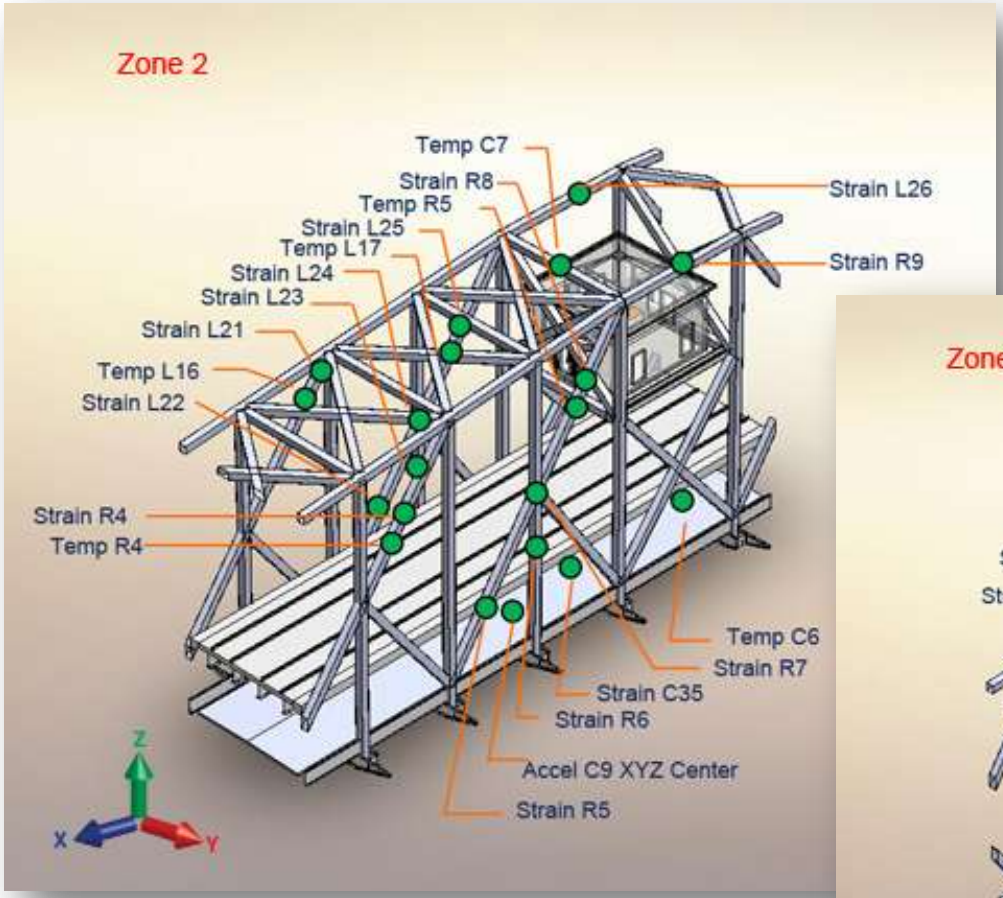
- Sensors were installed along the length of the entire structure, including the rail deck above and the road deck below.
- The bridge is broken up into four different zones.



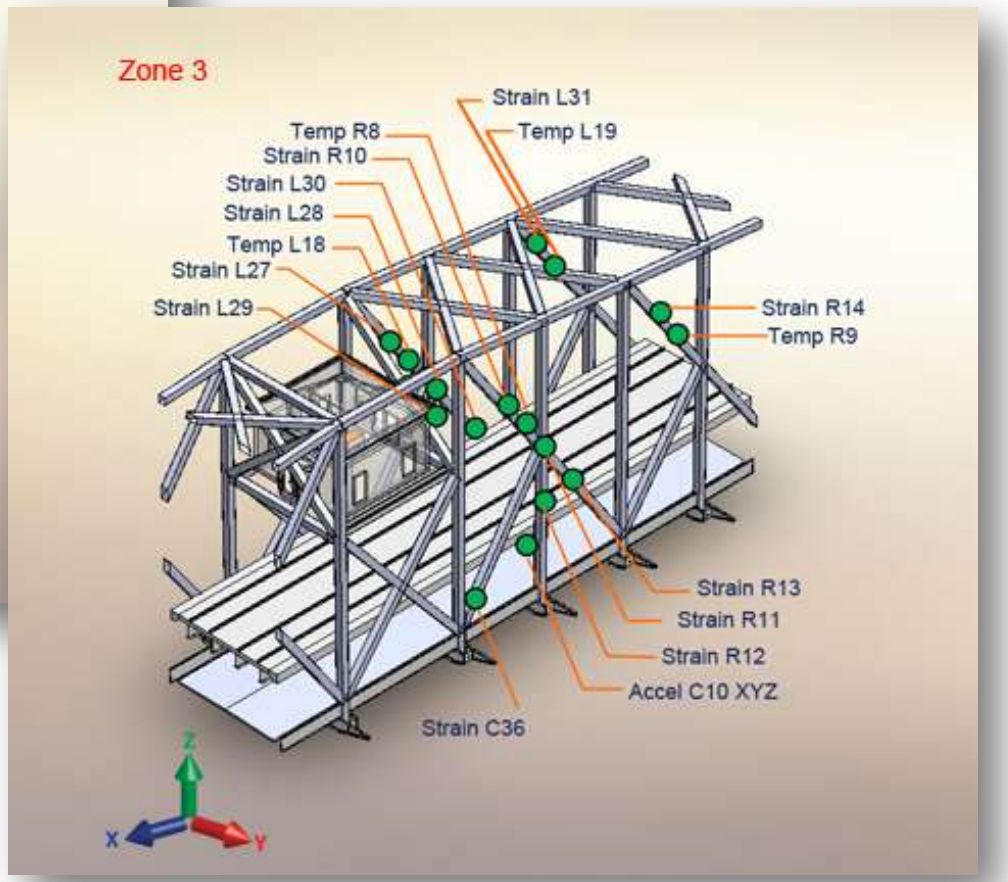
Arsenal Bridge - Rock Island Arsenal Side & Sensor Locations

- A total of 15 sensors cover the upper and lower deck.
- Sensors consist of :
  - (6) Strain
  - (5) Temperature
  - (4) 3D Accel

Arsenal Bridge - Swing Span And Sensor Locations

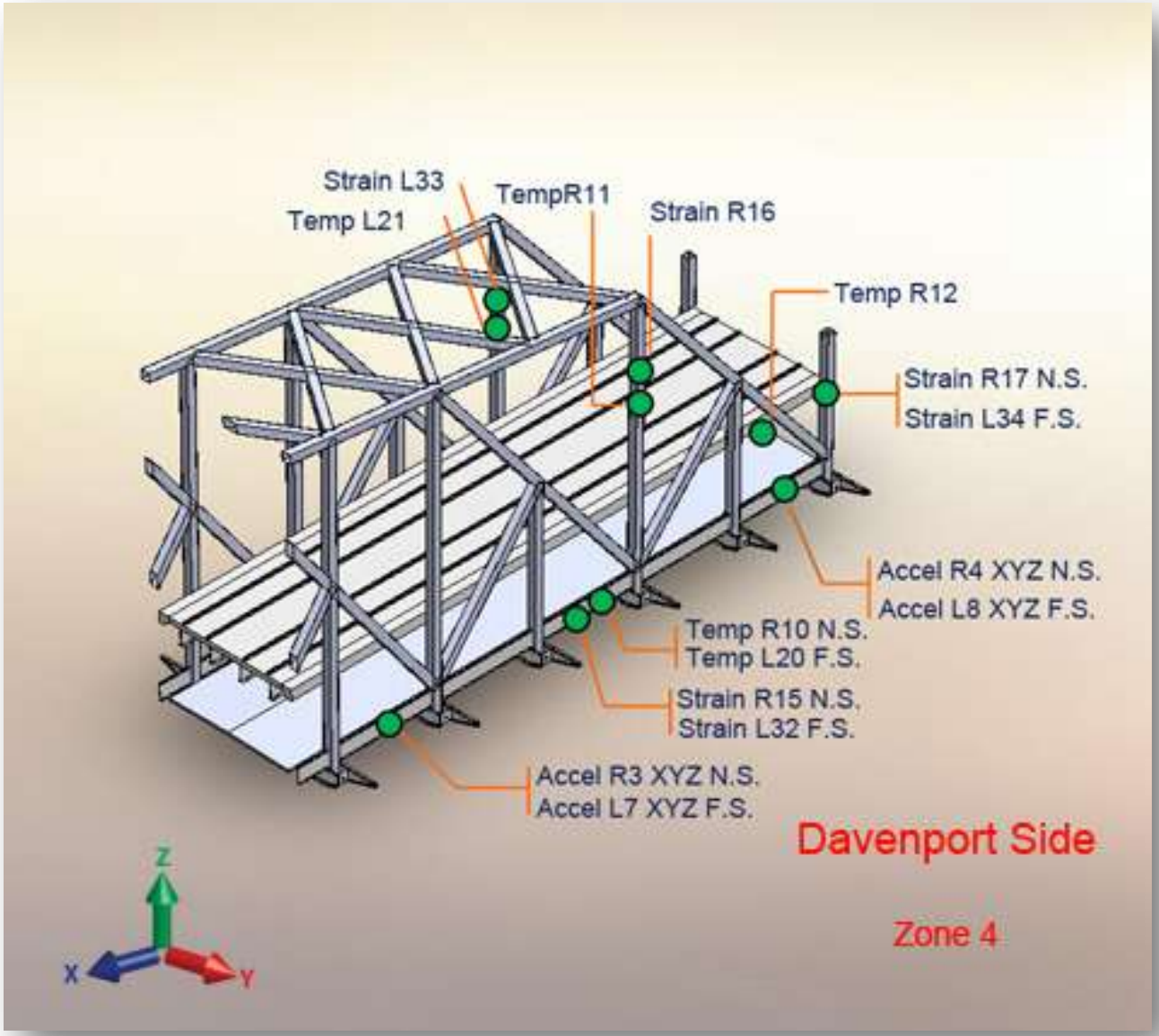


- Zone 2 - Arsenal side of the swing span.
- (13) Strain Sensors
- (6) Temperature Sensors
- (1) 3D Accelerometer
- (1) Tilt Meter



- Zone 3 – Davenport side of the swing span.
- (11) Strain Sensors
- (4) Temperature Sensors
- (1) 3D Accelerometer

Arsenal Bridge – Davenport Side & Sensor Locations



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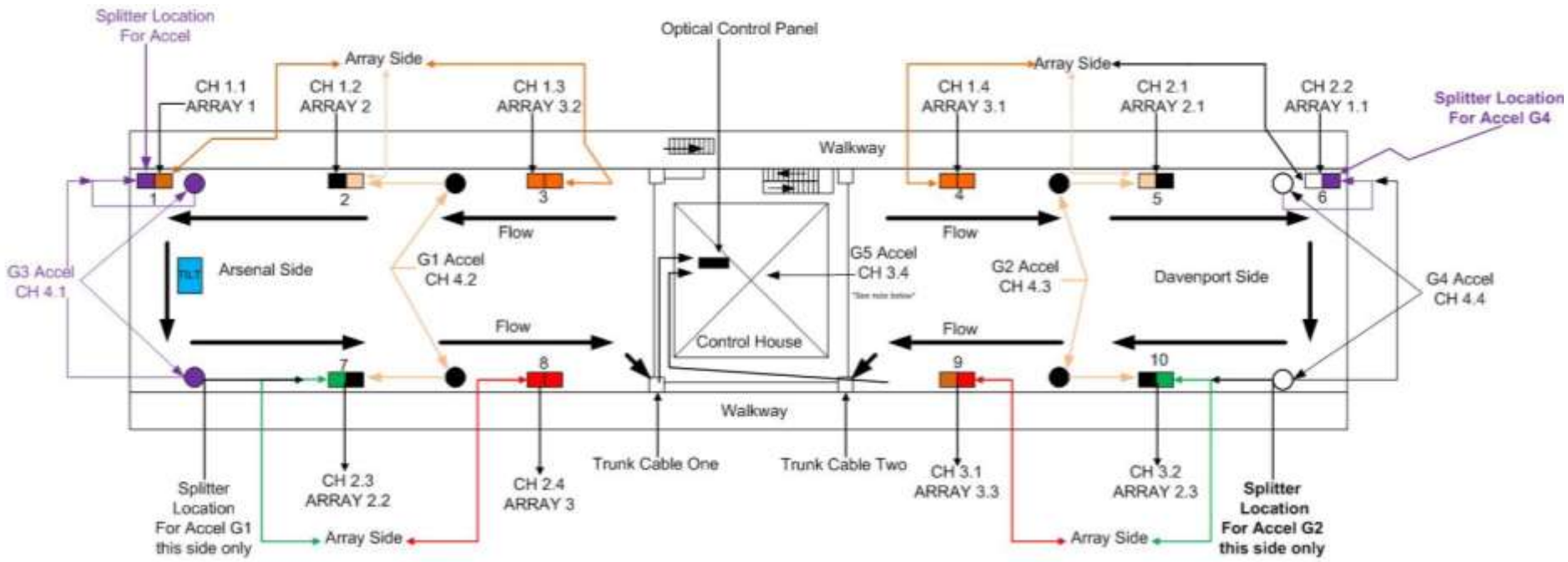
Arsenal Bridge - Sensor Network Configuration



Splice Tray Cable Color Guide

The monitoring system instrumentation is composed of:

- Single optical interrogator (model sm130-500), 1Khz, 4 channels
- 4x16 channel sensor multiplexer (model sm041-416)
- sp130 controller and data acquisition module

Controller & Data Storage
sp130

Sensor Interrogator
sm130-500

Sensor Multiplexer
sm041-416

Strain

Temp

Acceleration

Temp

Tilt

Arsenal Bridge – Installation

FBG sensor arrays were pre-assembled to length for each bridge segment.

Arsenal Bridge – Installation

Once on-site, sensors are unpacked and prepared for installation.

Access via man-lift and scaffolding

Arsenal Bridge – Installation of Swing Span Sensors

3D Accelerometer being installed on the swing span

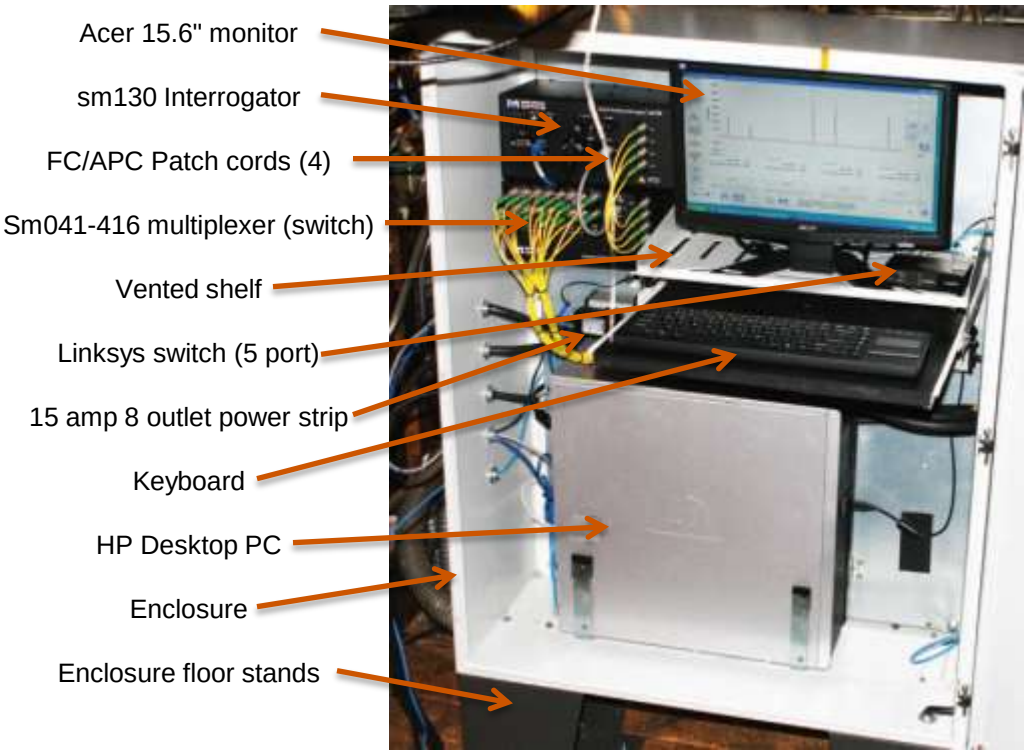
Arsenal Bridge – Installation (Splicing to Trunk FO Cable)

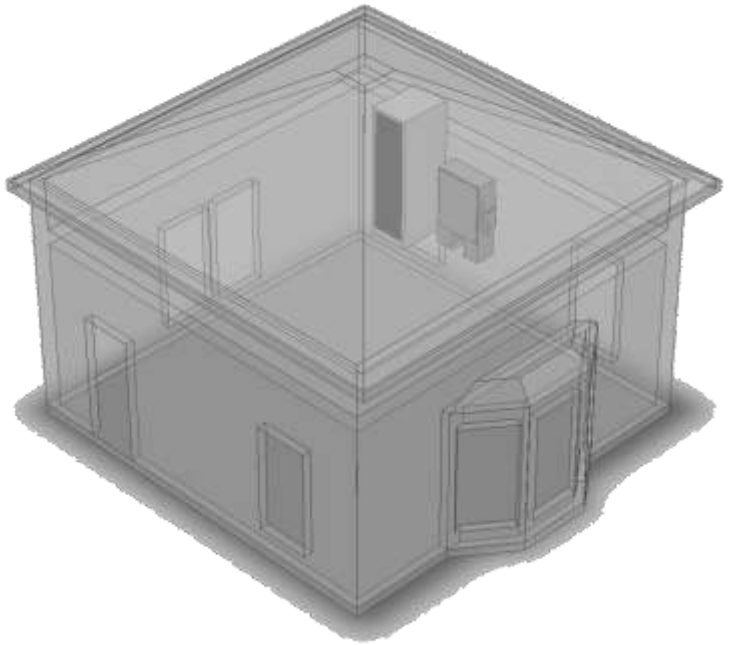
Tapping into the main cable feed at various locations along the bridge. *(above)*

Main cable feed tapping point and industrial grade IP69 splice tray. *(below)*

Arsenal Bridge – Protective Cabinet

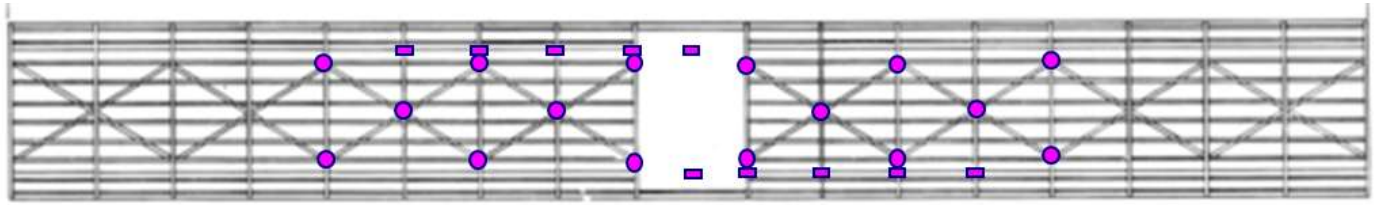
The optical system is housed inside a NEMA rated box with controlled temperature and humidity.



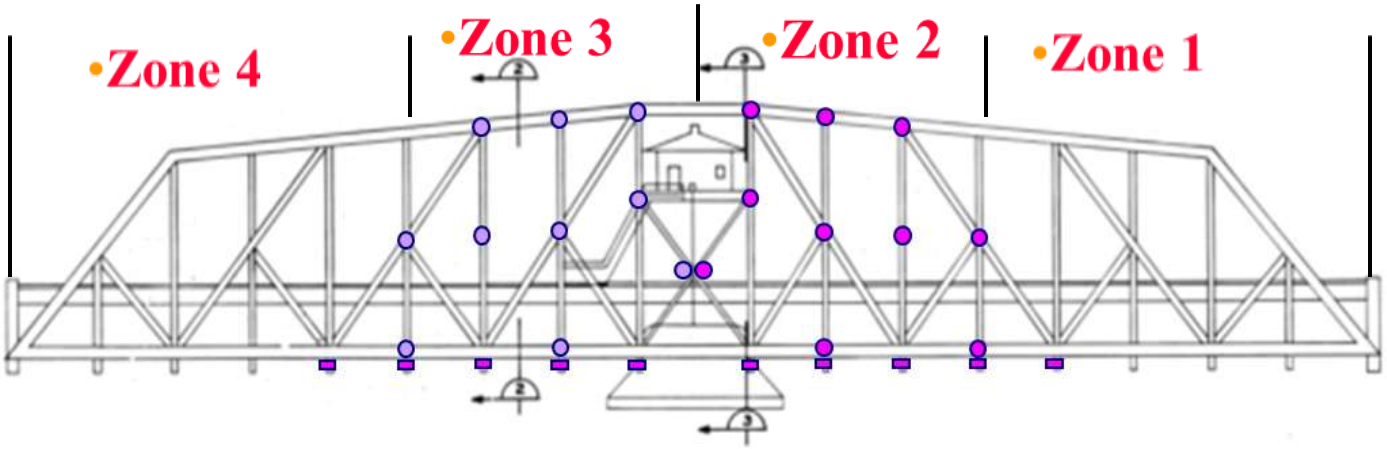


Control House with optical panel in attic.

AE System Installation Layout By Zone



HIGHWAY DECK – UNDERSIDE PLAN

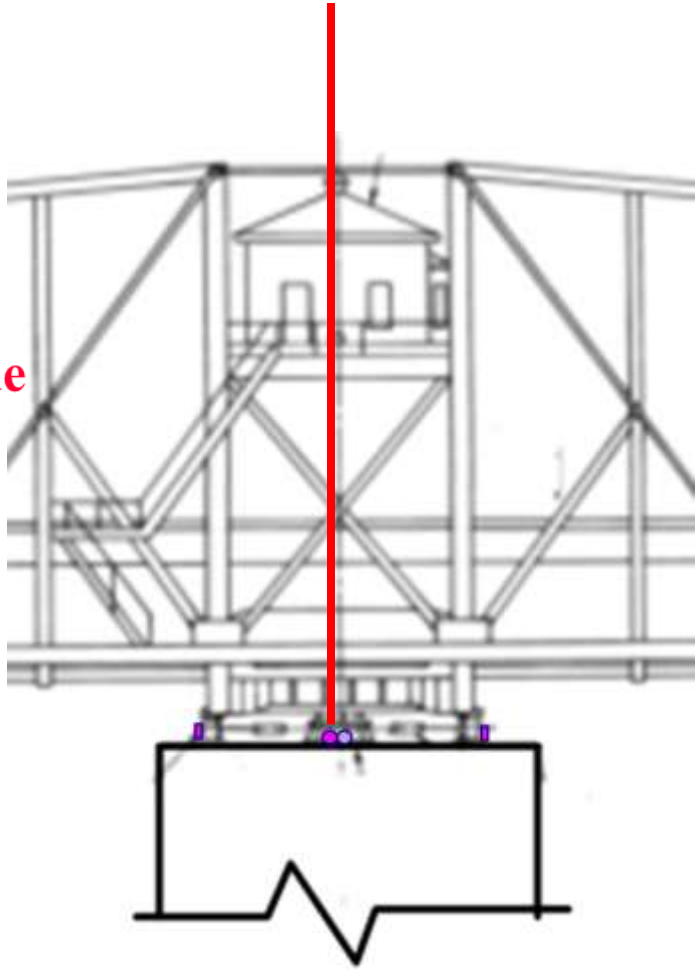


- 16 AE sensors on underside of road deck (8 per side)
- 20 AE sensors on vertical trusses (10 per side)

Sensor on front side Sensor on back side Side view of sensor

Acoustic Emissions System Installation Layout For Swing Span

- 4 AE sensors staggered around turntable structure



- Davenport Side
  - Zone3
- Arsenal Side
  - Zone 2

- Sensor on front side
- Sensor on back side
- Side view of sensor

Acoustic Emissions System Installation and Protective Cabinet

Acoustical Emission Sensors are installed and tied into the IntelOptics Software Program.

IntelOptics Software

- Chandler Monitoring Systems' customized GUI software
  - Monitors, gathers data and provides alerts and analysis when various sensing systems approach or exceed established limits.
  - Communicates with numerous sensing systems to display status and provide information in one centralized user program which can be accessed remotely.
  - Electrical Resistance Corrosion Sensors, Weight in Motion Sensors, Weather Stations, Security sensors, and Water depth sensors are some sensors that may be fully integrated into the IntelOptics™ software.

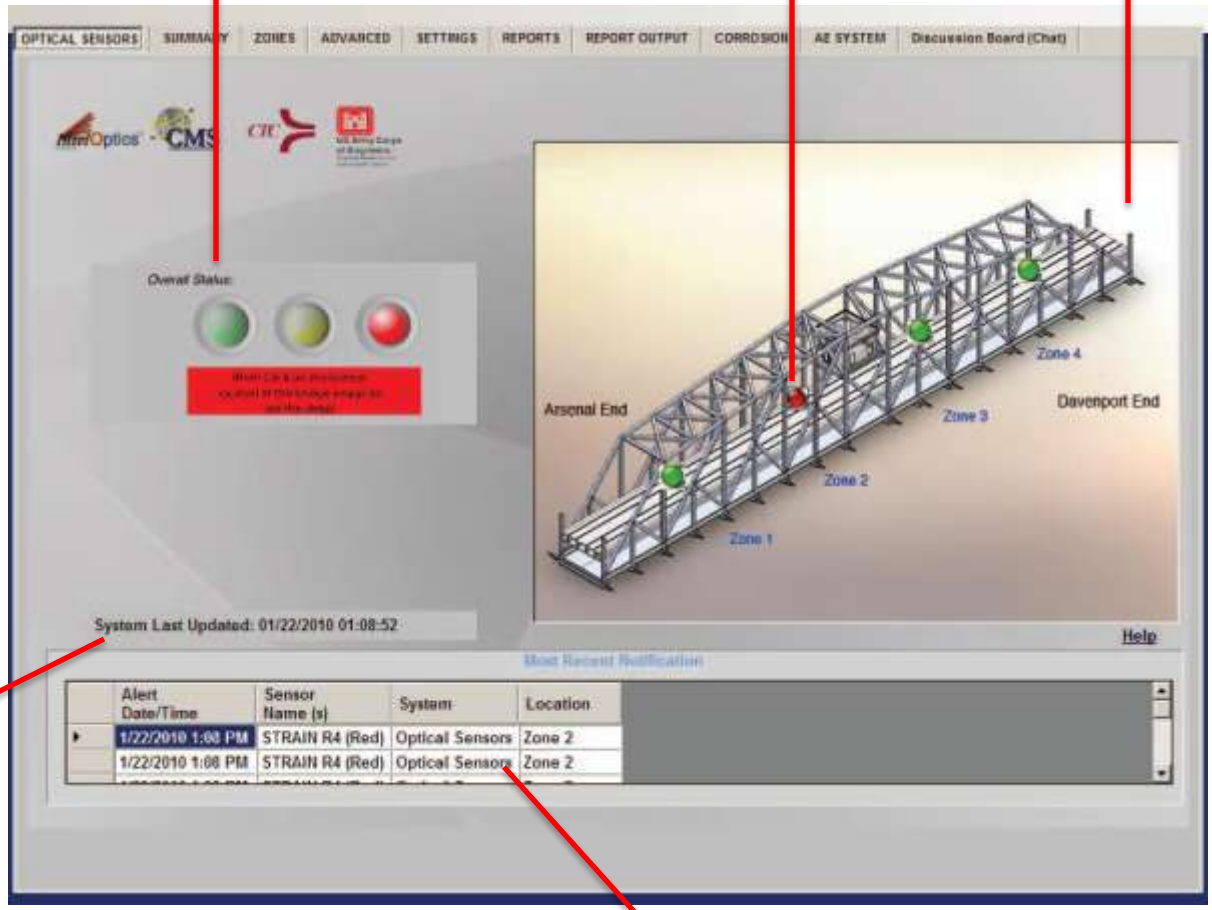
- Micron Optics ENLIGHT application software is used for FBG sensor setup and to stream sensor data to IntelOptics™.

IntelOptics Software

Overall Status Indicator

Zone Status Indicator
Button To Zone 2 page

Bridge Image with Zone
Indications



System Last
Updated
Indication

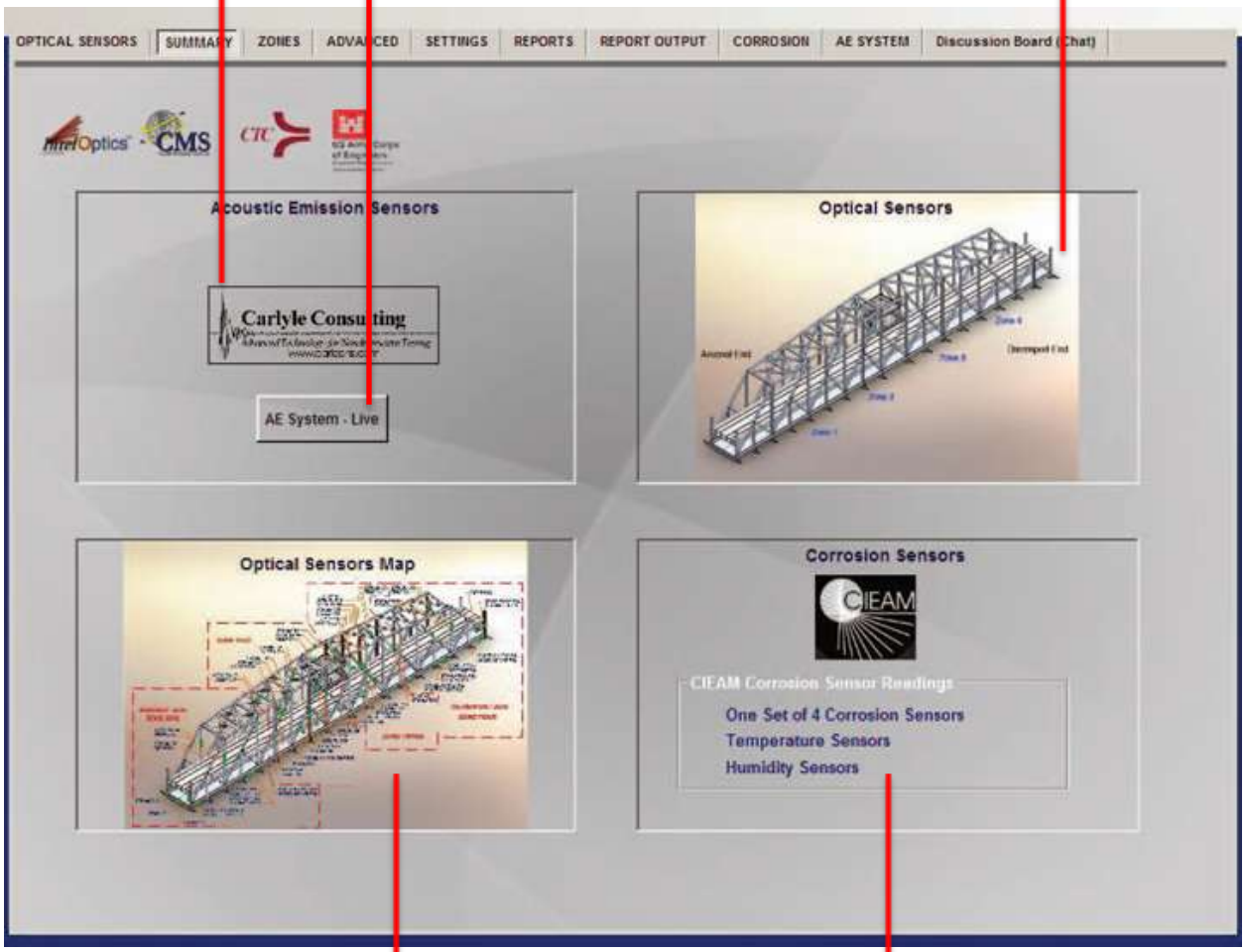
List of Previous Alarm
Status

IntelOptics Software

Button linked to AE System Page

Button linked to AE System Computer located at the bridge

Button linked to Optical Systems Page



Button to zoom in on the sensor map

Button linked to Corrosion Systems Page

IntelOptics Software

Zone 1 Button

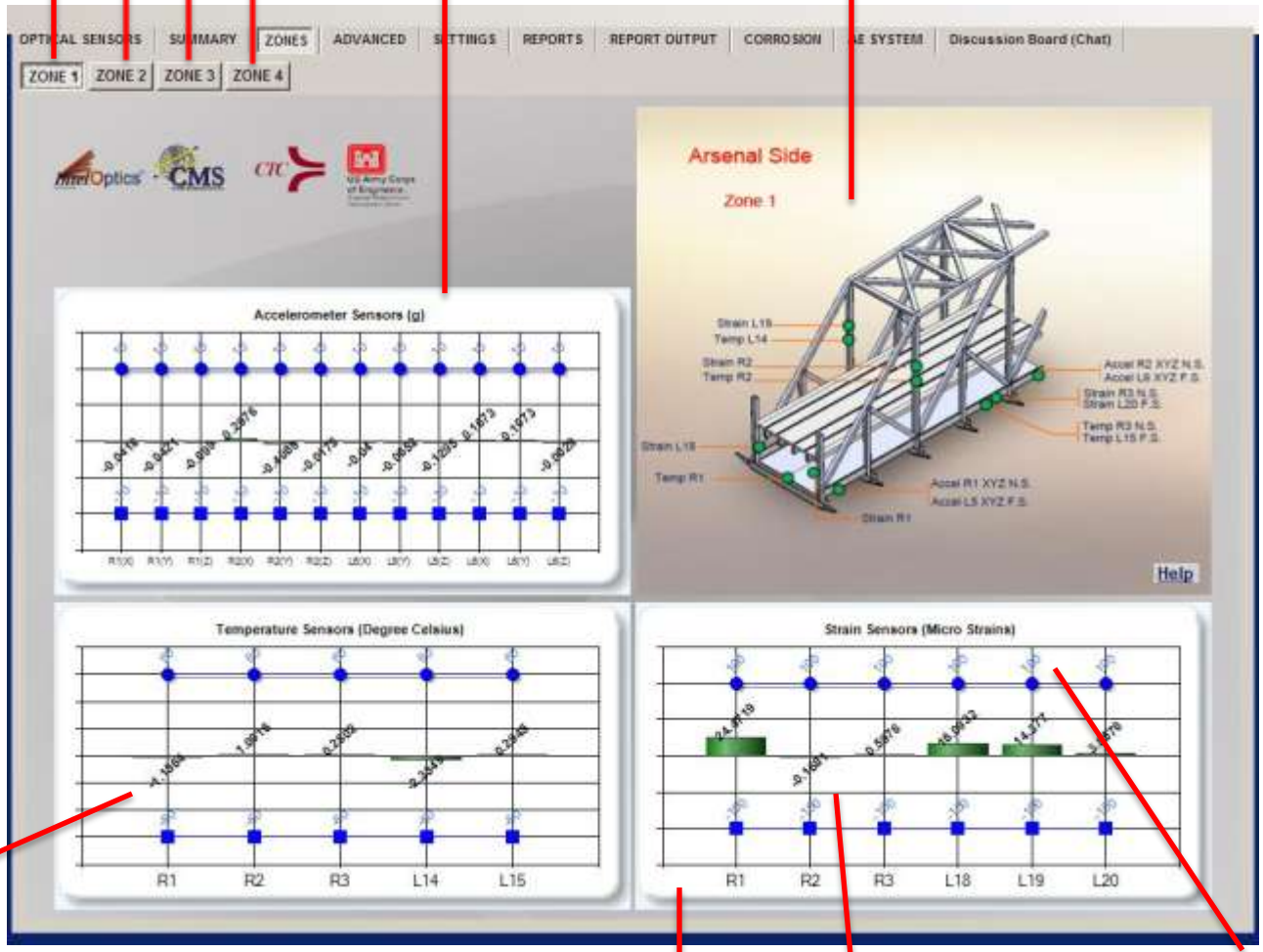
Zone 2 Button

Zone 3 Button

Zone 4 Button

Accelerometer Sensor Graph

Optical System Zone 1 Sensor Map



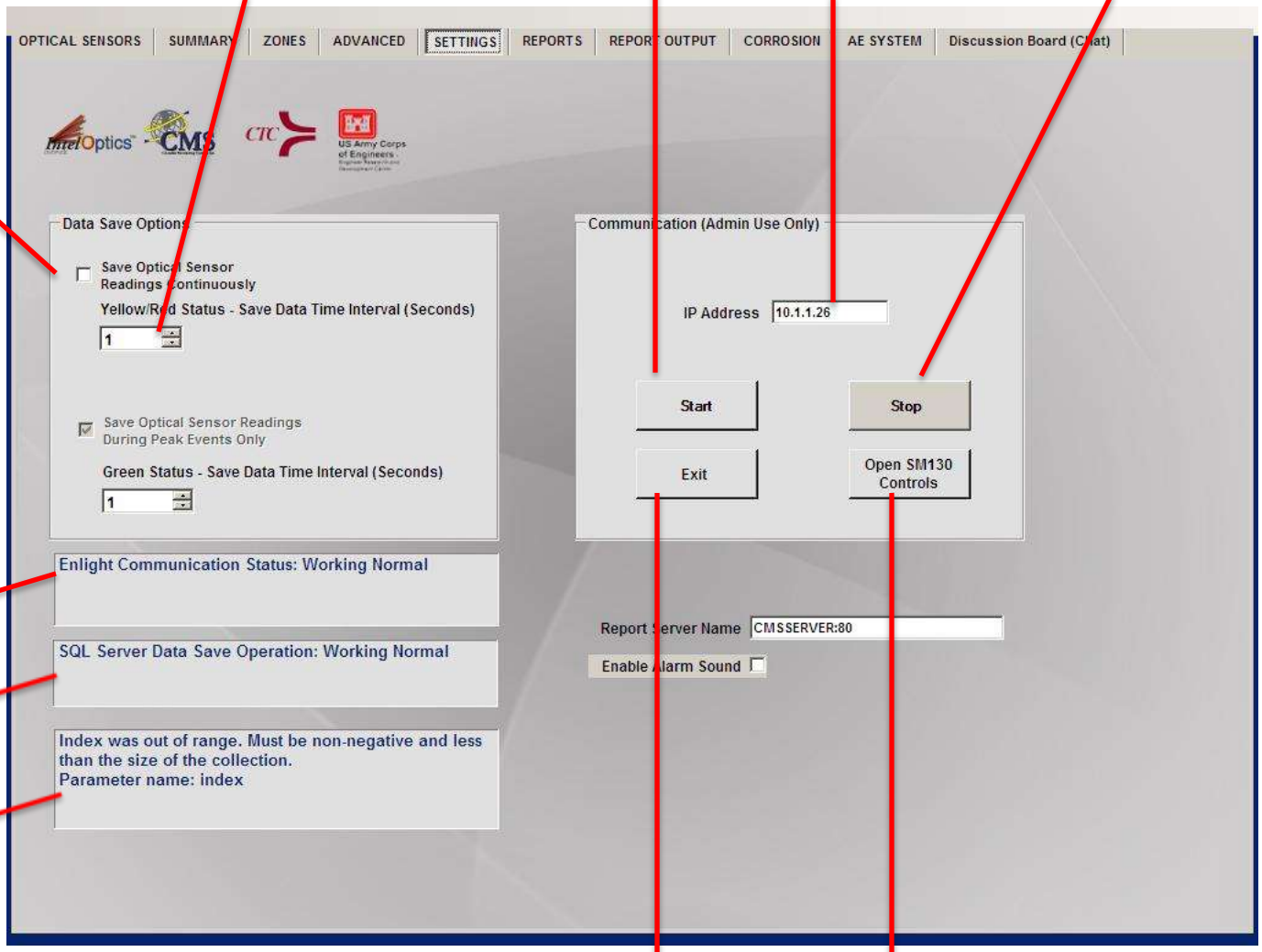
Temperature Sensor Graph

Strain Sensor Graph

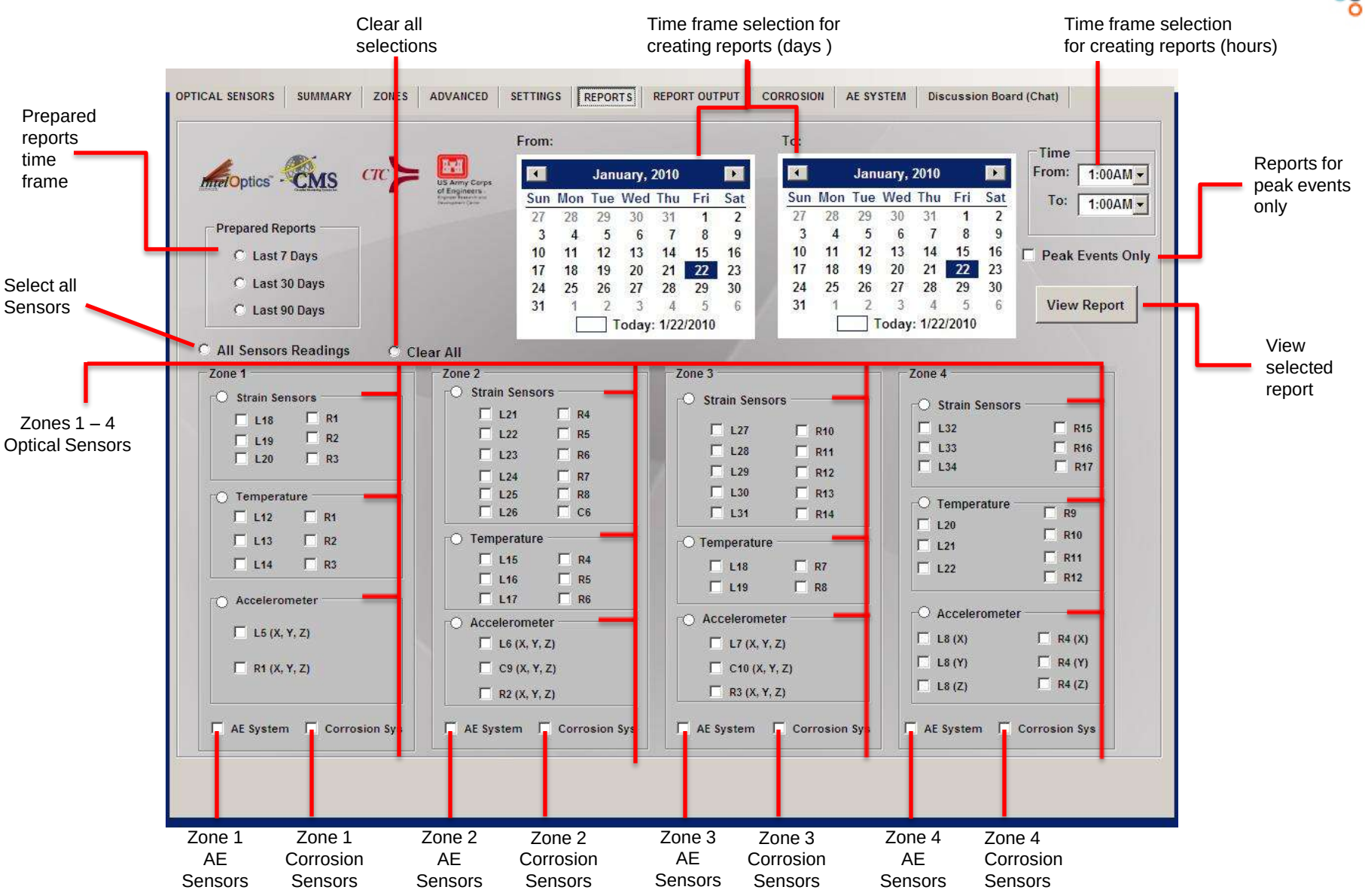
Minimum Sensor Limit (when exceeded status will turn)

Maximum Sensor Limit (when passed status will turn red)

IntelOptics Software : Navigation



IntelOptics Software : Reporting Capabilities

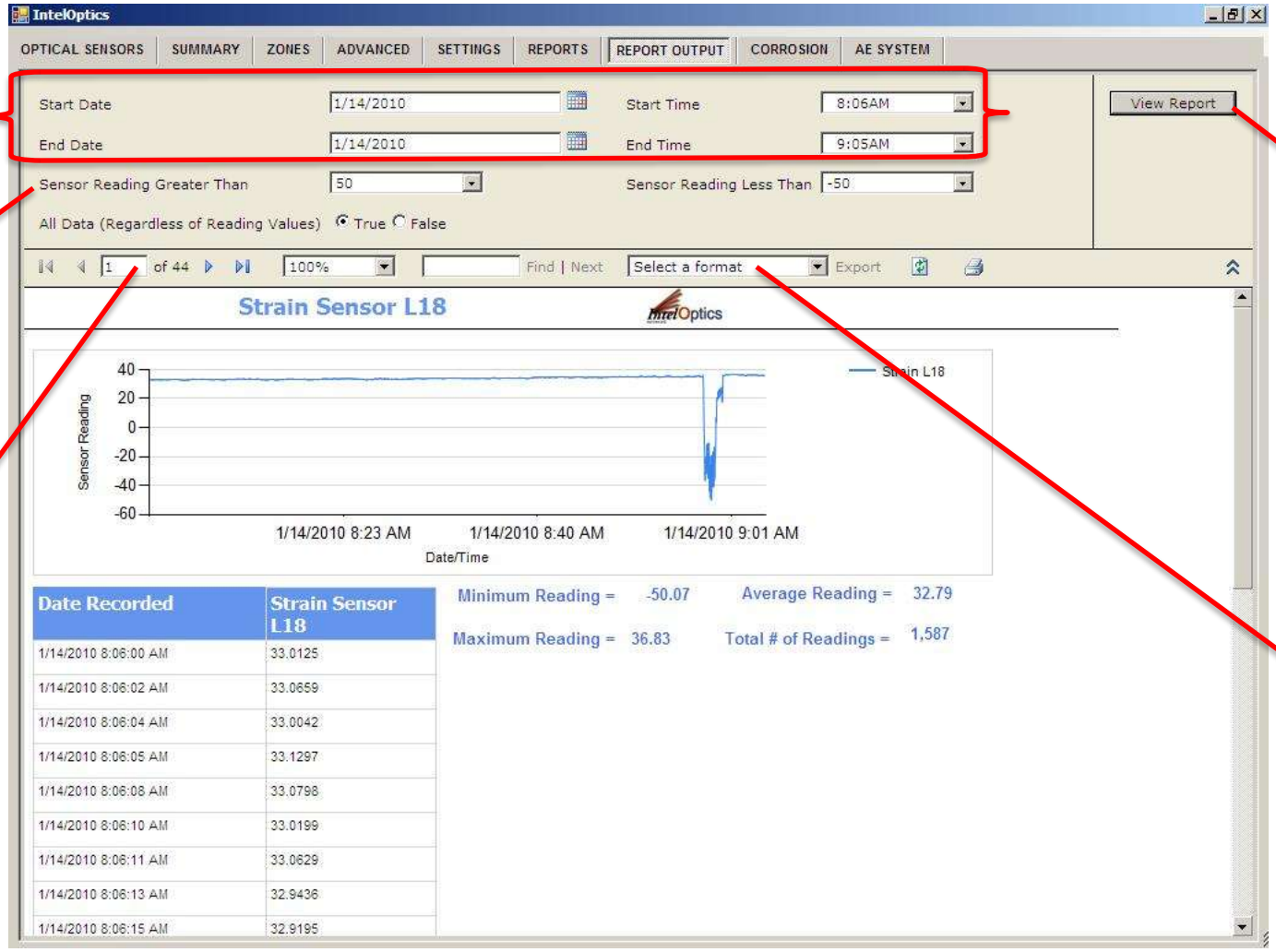


IntelOptics Software: Reporting Capabilities

Reports time frame selection (days/hours)

Sensor reading value selection

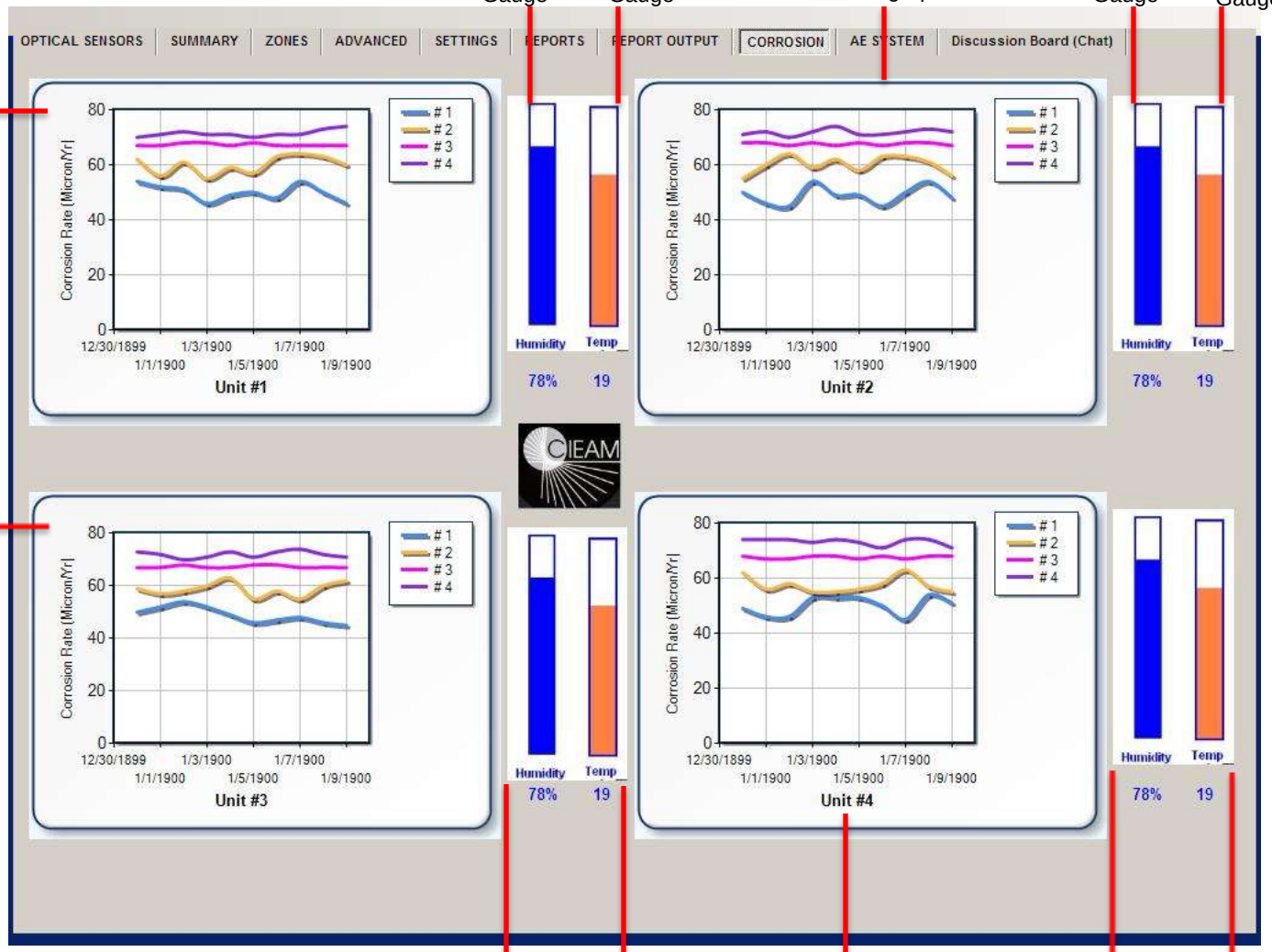
Reports page indication and selection



View report selection

Reports export file type sélections

IntelOptics Software : Corrosion Sensor Reporting



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