



Wireless Bridge Bearing/Expansion Joint Monitoring

With Resensys Technology

Key Monitoring Capabilities

- Detecting excessive movements or frozen bearings using tilt SenSpot™ sensors.
- Monitoring linear displacements and thermal responses in expansion joints.
- Assessing structural responses to temperature changes with integrated temperature sensors.
- Enable timely detection of bearing or expansion joint malfunctions to prevent structural damage.

The Importance of Monitoring Bridge Bearing/Expansion Joints

Bearing malfunction can lead to excessive strain in bridge load bearing members and can cause damage to bridge piers and abutments.

Resensys Unique Solution!

Resensys offers two types of wireless devices for long term remote monitoring of bridge bearings and expansion joints:



Wireless Tilt SenSpot™ sensor



Wireless Displacement SenSpot™ sensor

Wireless Tilt SenSpot™ sensor: Helps monitor tilting on rotary bearing systems such as rocker bearings.

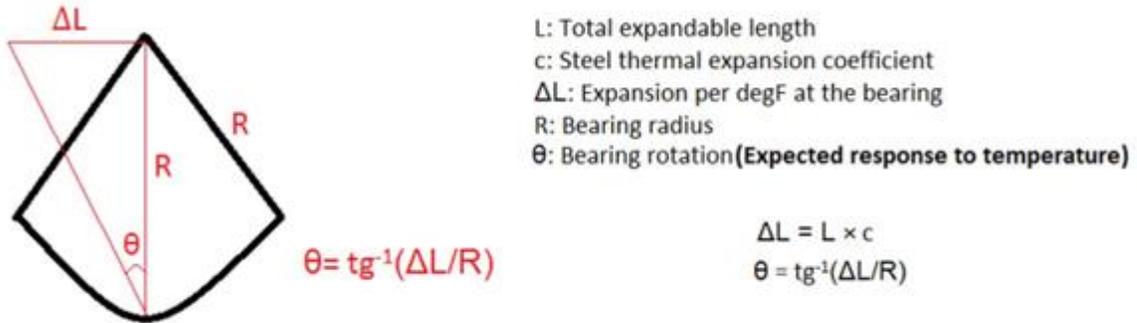
Wireless Displacement SenSpot™ sensor: Helps monitor linear movements at expansion joints.

Both types of devices report temperature which helps analyze the readings and compare the measured movements with expected thermal responses as a quick and reliable way to assess structural health of bearing systems.

Technical Note: Bearings Rotation

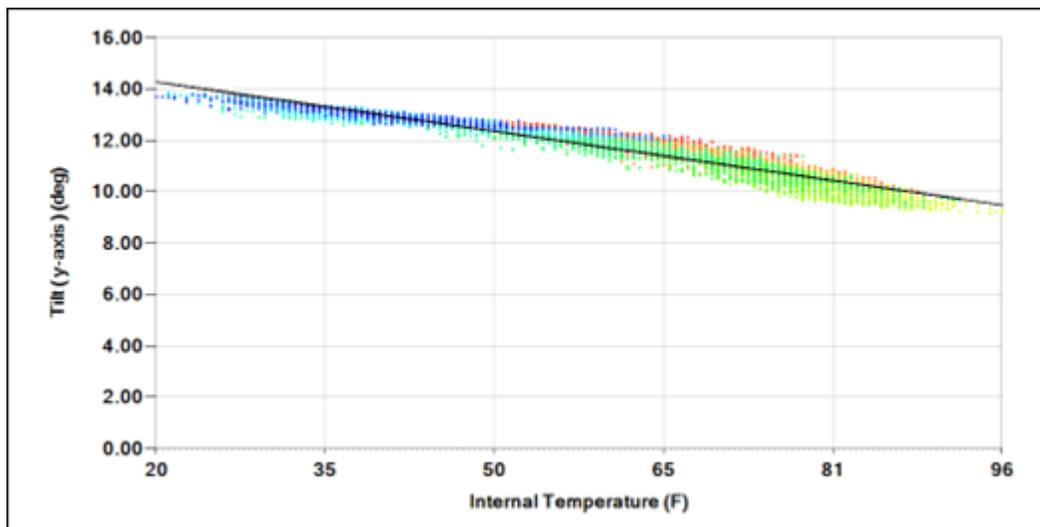
Functionality of the bearings rotation and responsiveness of pier bearings are assessed by comparing measured responses rate (attained from regression analysis of tilt and corresponding temperature data during monitoring time period) with expected valued (attained from effective length of spans and steel thermal expansion coefficient).

The expected response to temperature for a bearing would be obtained as follows:



Bridge bearing front view and definition of its geometric properties

The measured response to temperature for tilt gauges would be obtained from the following regression analysis:



Example: Linear Equation Trend Line: Tilt = 15.5104 - 0.0629*Internal Temperature

Linear regression between tilt (bearing rotation) and temperature for a bridge bearing in a specific time period

It can be found whether there are excessive movements of bearings or not. Furthermore, it can be seen bearings are responsive or non-responsive (frozen bearings).

Technical Note: Longitudinal Expansion Joint

Functionality of the expansion joint movement and responsiveness of expansion joint are assessed by comparing measured responses rate (attained from regression analysis of displacement and corresponding temperature data during monitoring time period) with expected valued (attained from effective length of spans and steel thermal expansion coefficient).

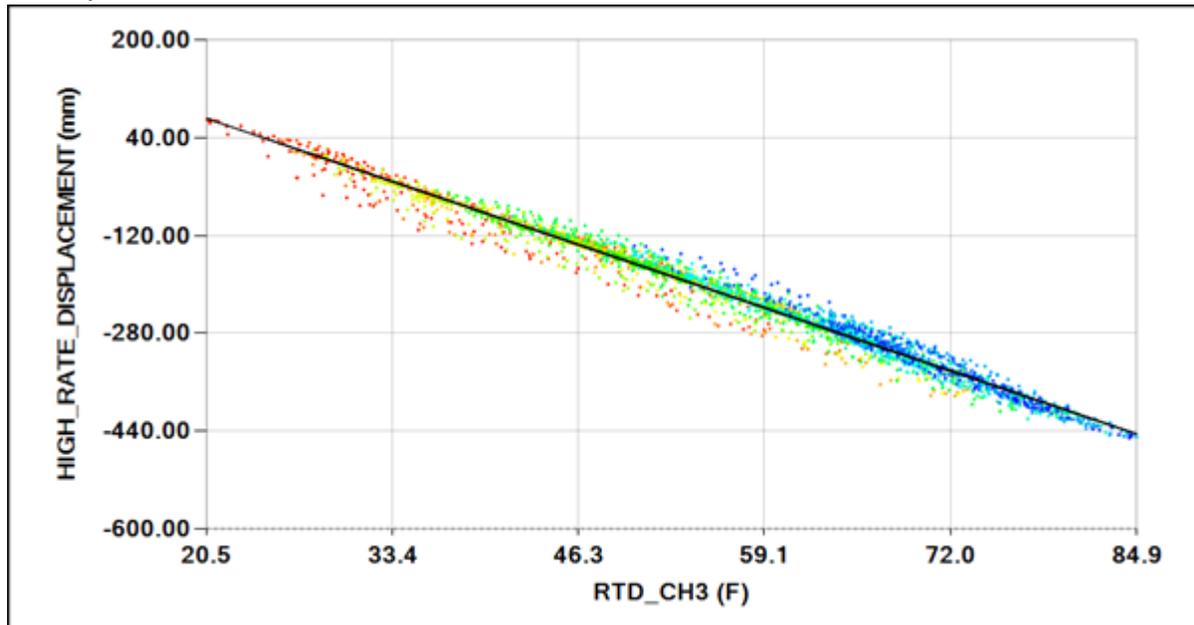
The expected response to temperature for an expansion joint would be obtained as follows:

L=Total expandable length of Span (m)

c=Steel thermal expansion coefficient (/°F)

$\Delta L / \Delta T = \text{Expected response to temperature} = L \times c \text{ (m/°F)}$

The measured response to temperature for displacement gauges would be obtained from the following regression analysis:



Example: Linear Equation Trend Line: $\text{HIGH_RATE_DISPLACEMENT (mm)} = 6.026 - 0.204 * \text{RTD_CH3(°F)}$

Linear regression between displacement/movement (expansion joint) and temperature for a bridge bearing in a specific time period

It can be found whether there are excessive movements of bearings or not. Furthermore, it can be seen bearings and expansion joints are responsive or non-responsive (frozen bearings or expansion joints).

How Resensys System Works?

The system includes the following components:

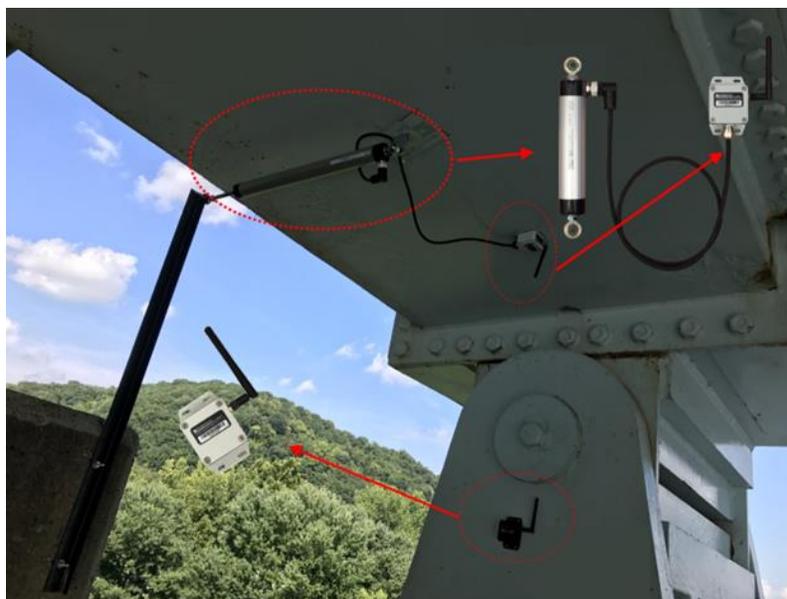
- [SenSpot™](#) sensors (displacement and tilt SenSpots): which are attached to a bridge (A few tens of sensors per structure, depending on design and monitoring needs).
- [SeniMax™](#): which collects SenSpot data at the site and sends it to a remote server (one unit can cover as many as 100 SenSpots).
- Repeater: may be used to extend the range of the SenSpot sensors.
- [SenScope™](#): software for data analysis and visualization



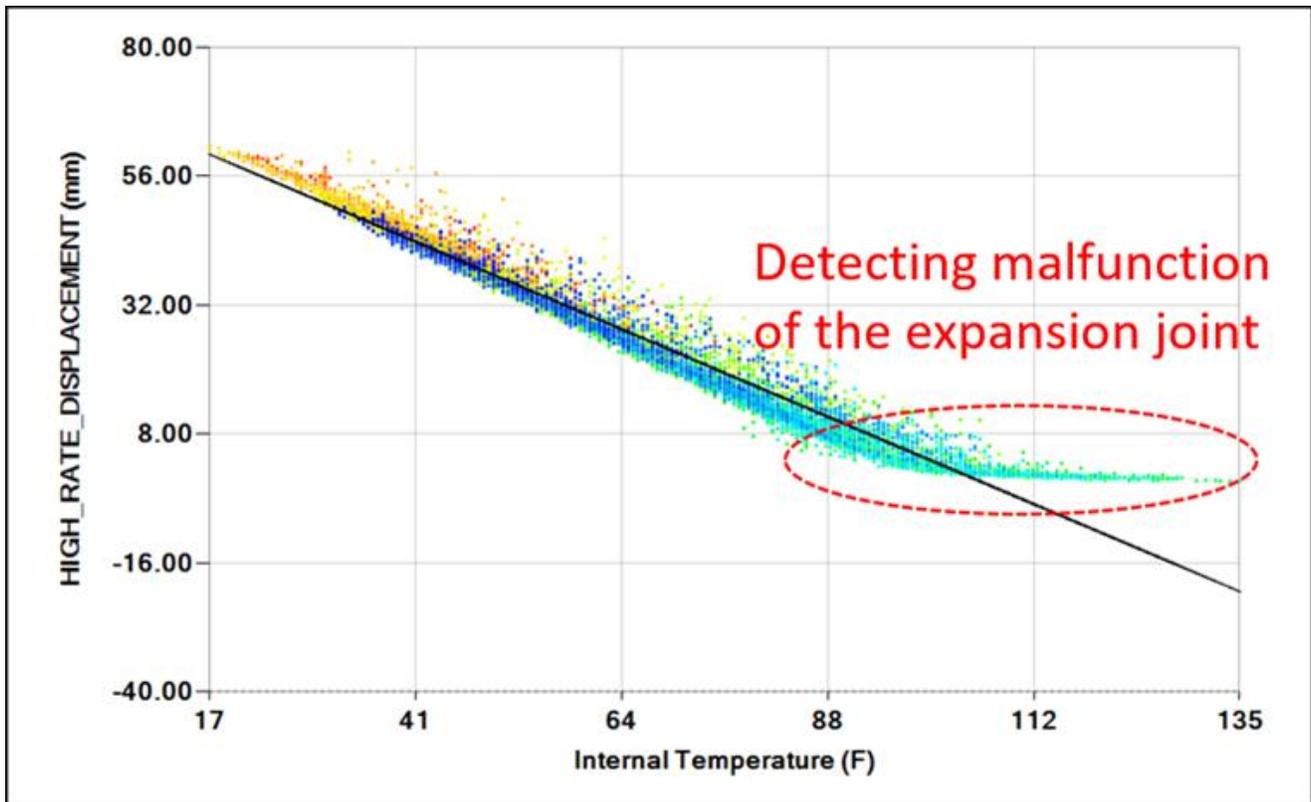
Resensys Wireless Tilt SenSpot sensor on a bridge bearing to assess bearing functionality



Resensys Wireless Displacement SenSpot sensor on a bridge expansion joint



Tilt (bearing rotation) SenSpot sensor and displacement SenSpot sensor on bridge bearing to assess bearing functionality



Linear regression of displacement at a finger joint of a bridge versus girder temperature in a specific time period. The data shows bearing reach their end point at high temperature (flat line at the end of graph).

Resensys Benefits

- 10+ years Battery Life
- Easy to install & self-adhesive
- Small in size & lightweight
- Usable on different kinds of materials
- For short and long term monitoring
- No need for calibration in the field
- Quick Testing
- Rugged, weatherproof, & corrosion resistant
- High precision
- Lightweight design
- Immediate alert services
- Infrastructure less & energy self-sufficient system