RESENSYS

Application Note

Monitoring Bridge Piers with Resensys High Precision Wireless Tilt SenSpot Sensors

By: Mehdi Kalantari Khandani, PhD (email: mehdi@resensys.com)

Resensys structural health monitoring (SHM) solution can be used for monitoring tilt of bridge piers to ensure the integrity and safe operation of the structure. Change in tilt can happen as a result of settling, deformation, or permanent change in loading. Resensys high precision wireless tilt sensors detect and report any unhealthy change in tilt that may affect overall safety of the structure.

Figure 1: A Resensys Wireless Precision Tilt SenSpot

Resensys manufactures wireless SenSpot sensors as a versatile sensing and wireless communication platform for long term structural health monitoring; SenSpot sensors are capable of monitoring strain, vibration, tilt, inclination, displacement, temperature, and humidity. Precision tilt SenSpots are suitable for monitoring operation of bridge piers by measuring tilt of piers with arc second accuracy. Using this technology; movement, settling, deformation and over-tilting of bridge piers are detected at an early stage, before it becomes a major issue and leads to safety compromise and/or road closure.

Important features of Resensys precision tilt SenSpot:

- **Ultra-low-power** (minimum of 10 years of operation without battery replacement)
- **Power source:** replaceable lithium-ion battery
- **Wireless communication** (IEEE 802.15.4)
- **Small size and lightweight**, about 90 gr. Dimensions: 2in × 4in × 1in
- **Easy mounting** and quick installation (Self-adhesive or Flange mount)
- **Resolution**: 3 arc seconds (0.001 degrees)
- **Working temperature:** -40 to +150°F (-40 to +65°C)
- **Long communication range:** 0.62mi (1.0Km) free space
- **Ingress Protection:** IP65

A complete Resensys SHM system includes software and hardware components for (1) the reliable collection of SenSpot data, (2) aggregation of the data, (3) the addition of timestamps, (4) communication of data to a remote server, and finally, (5) an interface for data visualization and detection of structural issues. Figure 1 shows a practical Resensys SHM system that can be used for bridge monitoring. The system includes the following components:

- **SenSpot sensors:** which are attached to a bridge (A number of sensors per bridges, depending on design and monitoring needs).
- **SeniMax:** which collects SenSpot 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.

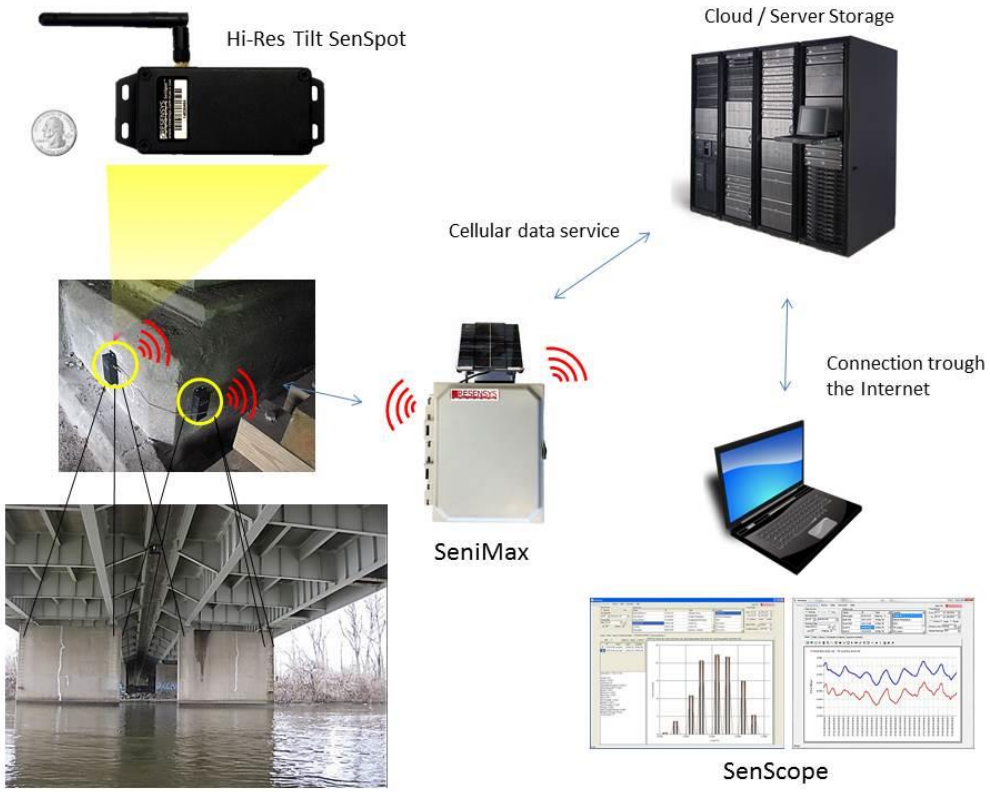

Figure 2: Illustration of Resensys SHM based on SenSpot sensors.

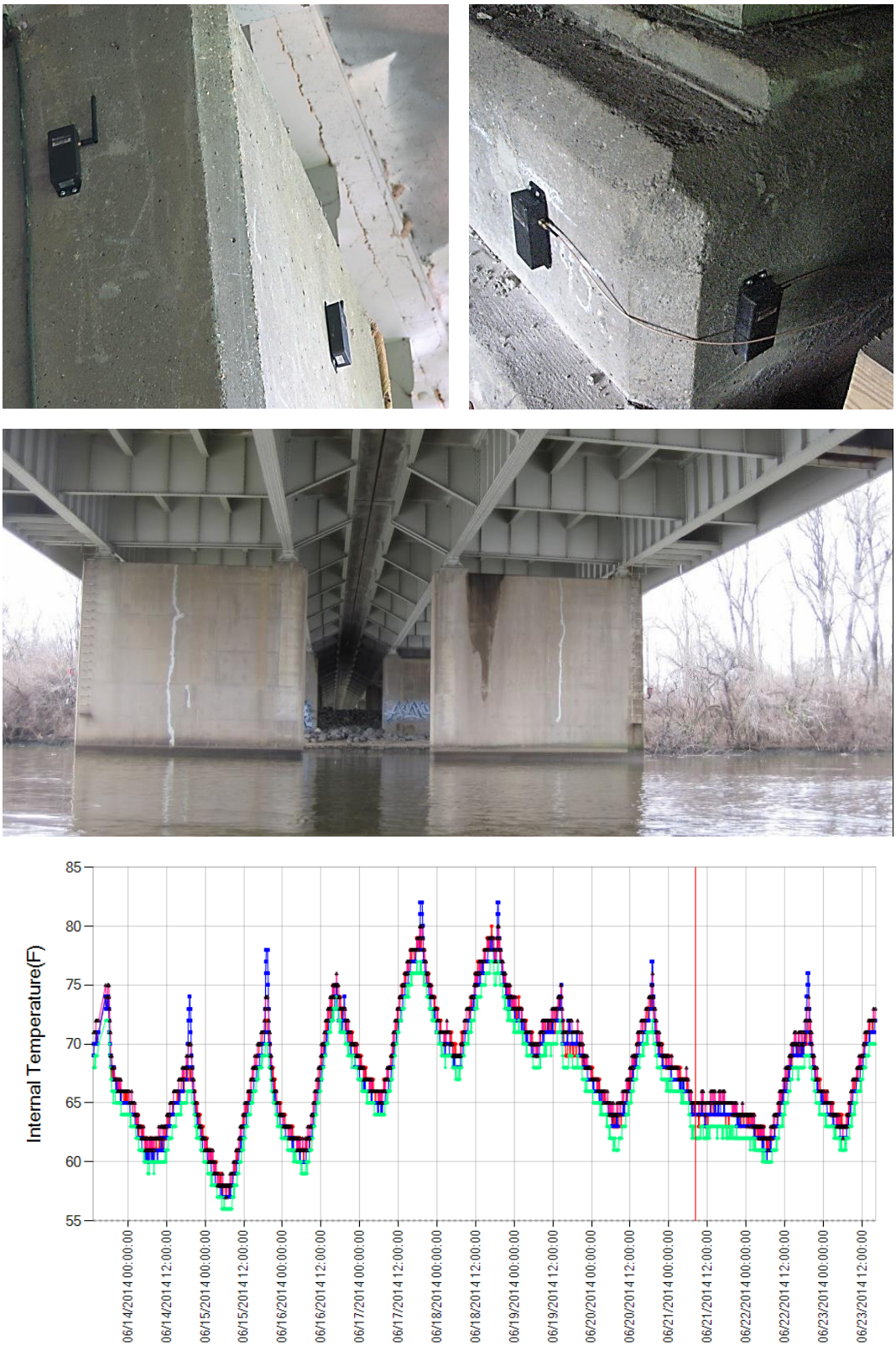

Figure 3: Comparison of measured temperature for some of the deployed SenSpots

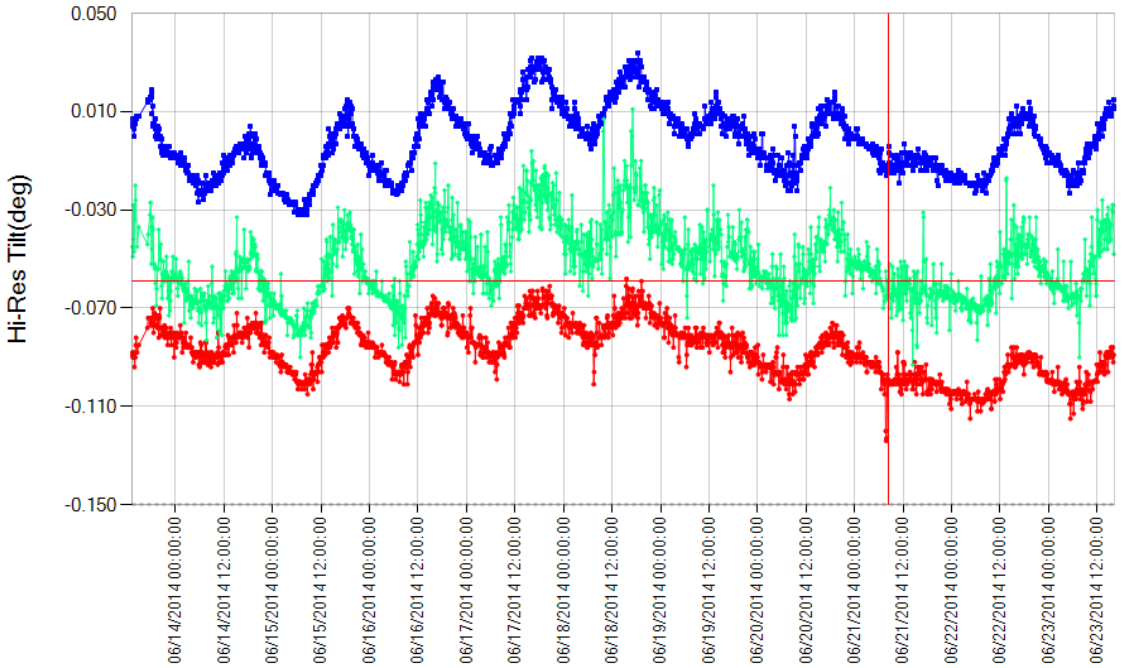

Figure 4: Daily variation of measured tilt for some of the deployed SenSpots.

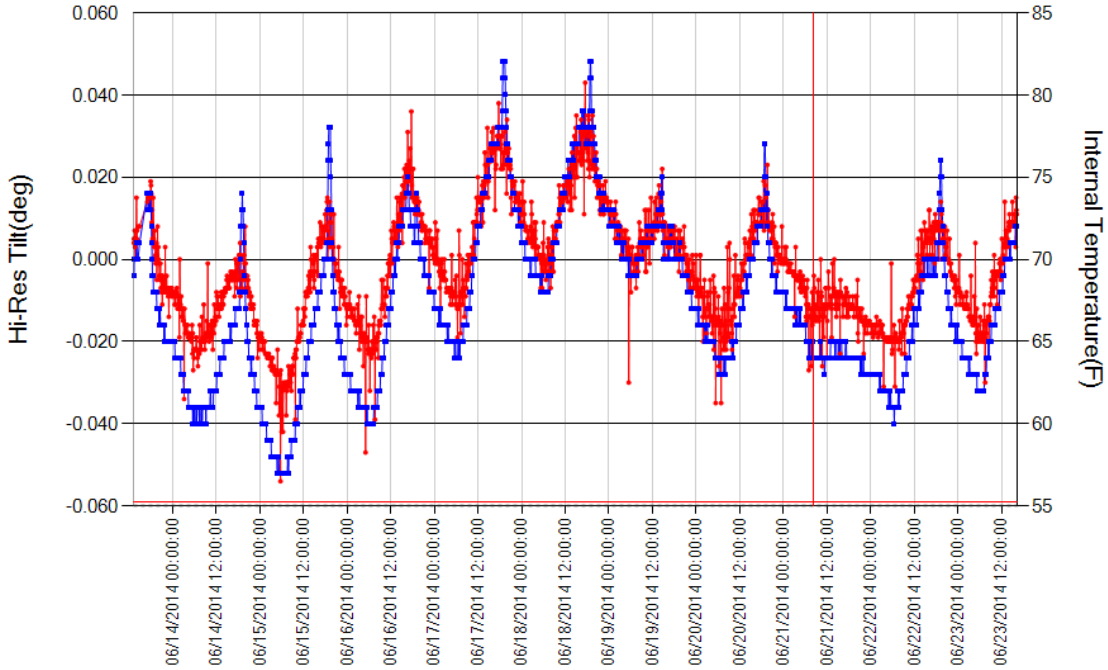

Figure 5: Tilt and temperature measurements of one SenSpot installed on a pier.