

## THE LATEST IN PROVEN STRUCTURAL TESTING TECHNOLOGY



Newsletter on Structural Testing Technology

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# FastGBSAR-R

## Key features

- Interferometric ground-based radar operating at 17.2GHz
- Accuracy: 0.01 mm
- Maximum range: 4 km
- Spatial resolution: up to 0.5m
- Proprietary ViMon software for data analysis
- Two hardware versions: single and dual polarization

## Advantages

- The most accurate measure of displacement for static and dynamic structural health monitoring
- Complete frequency and modal analysis of the entire structure in just a few minutes
- Easy and fast setup
- Remote measurements with no need for in situ sensors
- No need to stop traffic when monitoring bridges
- Designed for all weather conditions

Our radars can be fixed or, when using the SAR (Synthetic Aperture Radar) and Interferometric SAR techniques, they can be installed on a moving platform.

Whether the platform is a linear rail on the ground, an aircraft, an UAV or a satellite is up to the user's need. By combining different platforms, we can overcome the limitations of single carriers.

Thanks to our flexibility in the choice of the frequency band and of the observation geometry, we can provide innovative solutions for a wide variety of applications, from natural and man-made hazard prevention to aerial mapping



The FastGBSAR-R operates in Real Aperture Radar (RAR) mode for remote static and dynamic structural health monitoring of man-made structures. Easily transportable, the FastGBSAR-R can quickly be installed on a tripod. In a few minutes the user can obtain displacement profiles along the complete structure with an accuracy of 0.01 mm.

## Monitoring a highway bridge

A mode shape is the vibration pattern of a structure seen at one particular frequency. It only varies according to the structure's mechanical and thermal properties, and does not depend on the exciting force.

## Monitoring a railway bridge

The fixed installation of the FastGBSAR-R on a tripod, allows for simultaneous measurement of deformations of different spans of the bridge, and gives the complete picture of the dynamic response of the bridge while trains cross over it

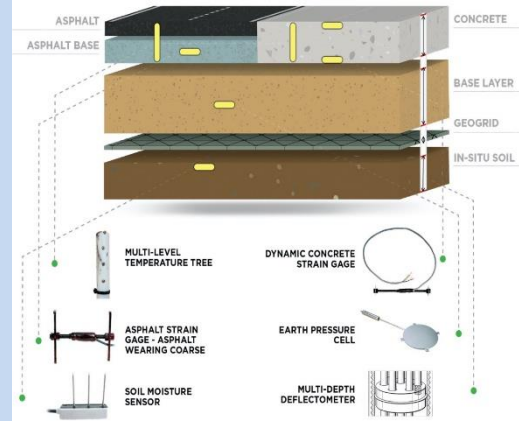
# Pavement Monitoring

## What we do in Pavement Monitoring

- High speed, event-driven data collection (1 kHz)
- Asphalt Strain
- Concrete Strain
- Thermal Gradient (Temperature Trees)
- Soil Moisture
- Earth Pressure
- Multi-Depth Deflectometer (MDD)
- Geogrid Strain
- Weigh-in-Motion (WIM) systems
- Triggered camera capture for vehicle identification
- Data Hosting and Management

There are many variations of “structural health monitoring” systems depending on structure sensor types, data collection frequency, whether or not there is power available at the site, type of cable routing (such as in conduit), data storage, and off-site communications. BDI has not only developed our own Structural Monitoring System to cover the many variations but have integrated many other third party structure sensors and systems to provide our clients with turn-key infrastructure monitoring systems that are proven reliable in the harsh field conditions that exist all over the world.

While similar instruments may be supplied by others, only BDI provides the in-house expertise for the design, installation and integration of complete turn-key system solutions based on user experience and feedback from these leading institutions.



## Pavement Monitoring

BDI provides instrumentation and services for pavement performance evaluation by providing sensors, monitoring systems and non-destructive evaluation services to help understand pavement performance and underlying support conditions. This service is provided to Accelerated Pavement Test (APT) facilities, construction road and airport projects and in-service roads where existing conditions may need repairs and/or rehabilitation.

BDI's pavement sensor design Engineer has been providing this line of pavement instrumentation to research institutions for more than 20 years. These institutions include the accelerated pavement test facilities for the FAA, FHWA, NCAT, MnRoad, USACE, Korean Highway Department and Universities across the globe. Coupled with BDI's data acquisition hardware and software capabilities, complete pavement instrumentation solutions can be provided.

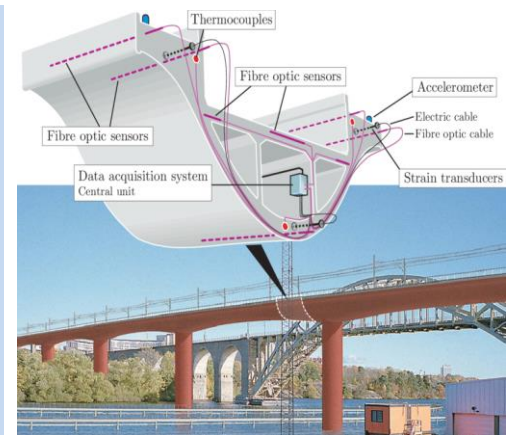
# Bridge Monitoring

## What we do in Bridge Monitoring

- Long-Term Performance
- Recording responses to live loads & temperature variation
- Monitor effects of damage or rehabilitation
- Bridge impact monitoring
- Cable Stay vibration & wire break detection
- New Signature Structures
- Corrosion monitoring
- Bridge Scour

BDI began pioneering accurate highway bridge evaluations in the late 1980's by collecting field data for creating analytical models. Since then, we have solidified our industry-leading expertise by developing and manufacturing our own structural testing systems. Using our vast experience in data collection, analytical modeling, and hardware development, we can provide all levels of highway and railroad bridge evaluation services including:

- Developing instrumentation and testing plans
- Qualitative data review, finite element modeling & calibration
- Recording responses to live loads & temperature variations
- Accurate AASHTO Load Ratings (LRF/LRFD) for highway bridges
- Accurate AREMA load ratings for design loads and heavier rolling stock
- Permit Load Verification
- Determining bridge deck conditions
- Structural dynamic performance
- Movable structure performance testing and/or monitoring
- Pier, abutment, and other foundation movements
- In-situ stress analysis
- Investigate effects of damage or proposed repairs



## Bridge Monitoring

Performance of structures can be monitored through repeated multi-technology surveys or via dedicated on-site data collection systems.

BDI's Structural Testing System (STS) and Structural Monitoring System (SMS) are integrated to evaluate pavement performance utilizing specialized sensors and data acquisition components for Accelerated Pavement Test (APT) facilities, road construction, airport projects, and in-service roads across the US and around the world. They can also be applied in laboratory or field settings allowing for research projects or large scale, high-speed, permanent monitoring systems.

BDI's NDE division utilizes its advanced technologies to provide improved NDE service solutions for pavement thickness and defect identification and mapping.

# Structural Testing Technology

## STS4

The new STS4 from BDI is the world's only data acquisition system that has been designed by structural engineers for structural testing. This next-generation wireless system is rugged, highly efficient, and now supports long-term monitoring applications. Once you see how much time this system saves you in the field, you won't use anything else!

The STS4 is smaller, lighter, and will make your testing operation even more efficient:

- No programming required—Our STS-LIVE software is very easy to use!
- STS4 Base Stations have wireless repeater capabilities, increased range, and POE support.
- Hardware and software can now support long-term monitoring projects.
- Efficient power saving modes for longer battery life.
- Increased sensor voltage input ranges and programmable excitation voltages.
- Auto-temperature compensation support for sensors with thermistors.
- Compatible with existing STS-WiFi hardware and WinSTS Software.
- STS4 Extension Nodes: Communication and power for up to 16 data channels at a much lower cost than a full STS4 system.

## STS4-4 nodes

The STS4-4 nodes are 4-Channel data acquisition devices with 4 analog and 4 temperature inputs per node.

They are the 4th generation design based on our experiences over 25 years of structural testing and data acquisition designed specifically with our experience in mind.

Battery-powered and water-resistant with 40/15 hours of data collection time make these rugged nodes ideal for all diagnostic testing applications. Intelliducer connectors simplify the installation by automatically applying all sensor settings and can be used with the full range of BDI sensors, in addition to most analog sensor types.



# Structural Testing Technology

## ST350 Strain Transducer

### Features:

- Cost-effective
- Installs in 5 minutes or less
- Reusable, lasts for >10 years
- Waterproof to 20ft (6 m)
- Industrial cable, custom lengths
- Standard millivolt output
- N.I.S.T traceable calibration

### APPLICATIONS:

- Steel
- Pre-stress/post-tension concrete
- Reinforced concrete
- Timber
- Fiber Reinforced Polymer (FRP)
- Live-Load testing & monitoring
- Laboratory testing
- Fatigue monitoring
- Tension rod forces

## ST350 Strain Transducer

The ST350 Strain Transducer has been designed for structural testing in tough field conditions. These accurate, rugged, and fully weatherproofed units can be installed very quickly for all types of measurement applications.



## Tiltmeter

The T500 electrolytic tilt sensor is a high precision sensor with integrated mechanical offset adjustment, designed for short-term testing applications. The T600 MEMS tilt sensors are ideal for longer term installations due to their temperature stability.



## Accelerometers

The A1521 & A2521 Accelerometers have been designed for dynamic structural testing in tough field conditions. These accurate, rugged, and fully-weatherproofed units can be installed very quickly and are available in ranges between 2g and 100g



## Strain Gage Completion Modules

Available in both 120Ω and 350Ω configurations, as well as standard or amplified outputs, these rugged and re-usable Strain Gage Completion Modules significantly reduces field installation time since only the lead wires from either a ¼-arm or ½-bridge foil gages are connected with a waterproof connector



# Structural Testing Technology

## Temperature Sensor

The BDI Thermistor Probes are supplied inside a housing at the end of a cable ready to be attached to a structure, or buried in concrete or in the ground. Thermistor Probes are particularly well suited for measuring the heat of hydration in concrete and RCC dams.

Thermistors have a negative temperature coefficient (NTC) where their resistance decreases with increasing temperature. The NTC can be as large as several percent per degree C, which allows the thermistor to detect minute changes in temperature. Thermistors are very small, which means they will respond quickly to temperature changes.

## Displacement Sensor

LVDTs are spring-loaded units that provide the "gold standard" for structural deflections when scaffolding or another reliable reference is available. In addition to LVDTs, we offer cable potentiometers, resistive displacement transducers, and ultrasonic displacement sensors.



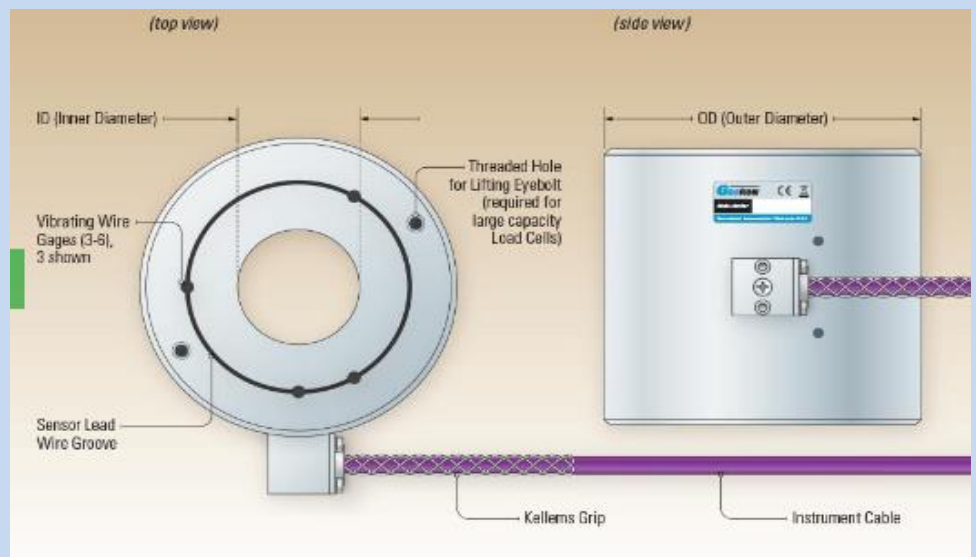
## Automatic Load Position Tracker

Designed specifically for load testing bridges, this device wirelessly tracks the longitudinal position of the loading vehicle during the test so that data can be viewed as a function of load position rather than time.



## VW Load Cells

The Model 4900 Vibrating Wire Load Cell consists of a cylinder of high-strength steel with 3, 4 or 6 vibrating wire strain gages located around the circumference of the cell. Loads applied to the cell are measured by the vibrating wire strain gages. The effects of uneven and eccentric loading are minimized by averaging the output of all 3, 4 or 6 individual readings.



# Structural Testing Technology

## STS-LIVE Software

In order to take advantage of the new hardware features in our STS4 data acquisition hardware, we've developed the STS-LIVE application that is not only more versatile, but retains the ease-of-use of our original WinSTS program. As current STS users know, our systems do NOT require any programming! With the Intelliducer nodes, the system is ready to collect data seconds after connecting to the hardware. Terminal nodes can be configured quickly through simple drop-down menus.

### Features:

- Allows user to configure STS4 hardware for data acquisition
- View data in real time either using time history, x-y type scatter plot, or in the frequency domain
- Real-time filtering options
- Programmable test lengths with sampling rates up to 1,000 Hz
- Programmable excitation voltages and sensor gain settings
- Automatic or manual sensor zeroing routine
- Automatic temperature compensation for sensors equipped with thermistors

## STS-VIEW Software

**STS-VIEW** is a user-interactive graphing application specifically designed for viewing data obtained from our STS4 data acquisition systems. Rather than spending endless hours formulating and checking spreadsheets, STS-VIEW allows the engineer to quickly interpret the responses with many easy-to-use features. For example, the user can view data as a function of time, load position, load event, or even as a function of one of the recorded sensor measurements (e.g., pressure, temperature, etc.).

### Features:

- Import raw data files directly into STS-VIEW
- Process your data by applying different gage/correction factors and offset methods to either specified sensors or entire data files
- Remove data spikes and noise from data using the filtering feature that allows the user to graphically compare the original and filtered responses
- Compute average responses from single and groups of sensors to calculate axial forces
- Data can be compared to computed responses calibrated from BDI's WinSAC and Strand7 structural analysis software to visually evaluate the accuracy of a structural model
- Run an FFT on a given sensor output to evaluate the structural member's frequency content
- Extract processed data to a text file or spreadsheet complete with a sensor legend and envelope information
- Data decimation options can be used to reduce file size
- Merge multiple data files into one file



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