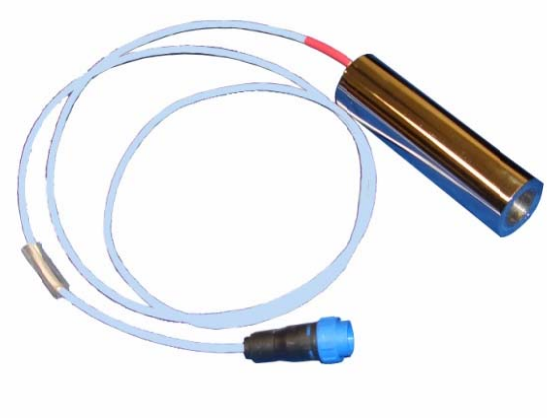
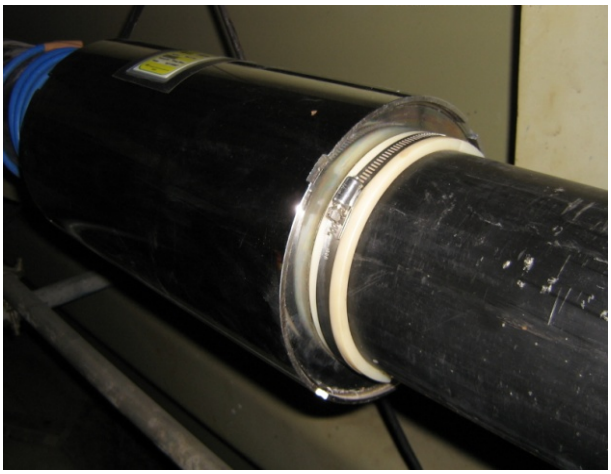
Intelligent Instrument System, Inc.

Elasto-Magnetic Sensor





EM sensor installed on Stonecutters Bridge, Hongkong

Contents

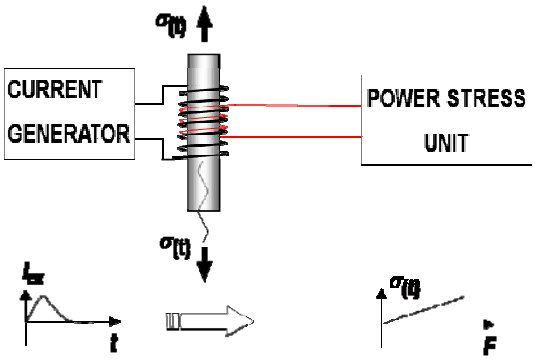
General

- Elasto-Magnetic Sensor

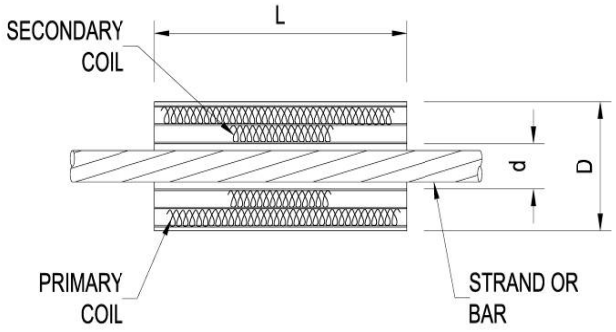
The Elasto-Magnetic sensor (EM sensor) which can measure the force in steel cable directly has been used in infrastructures of cable bridges, pre-stressed concrete structures, earth anchor systems, tie-back systems, and high-rises. The EM sensor is based on the magneto-elastic phenomenon of ferromagnetic material discovered in 1862. The magnetic properties of ferromagnetic material are dependent on applied mechanical stress, such as pull, bend and torsion. The EM sensor has been approved to be an effective means of non-contact and direct determination of the stress/force in steel components with a high accuracy in which the accuracy has within 2% difference from load cell. The cover of the sensor is carbon steel with chrome coating. Polyurethane fills the inside of the sensor. All circuit and connection are protected using epoxy sealant.

The EM sensor is composed of a primary coil and a secondary coil (sensing coil) by passing current through primary coil. Ferromagnetic material is magnetized sensing coil picks up induced electromotive force that is proportional to change rate of applied magnetic flux and relative permeability. As permeability of core changes, output voltage changes. The output voltage is calibrated to measure force.

- Applications
  - Cable-supported Bridge
  - PC Tendon
  - Nuclear power plant
  - Steel Hanger
  - Earth Anchor



Theory of EM sensor



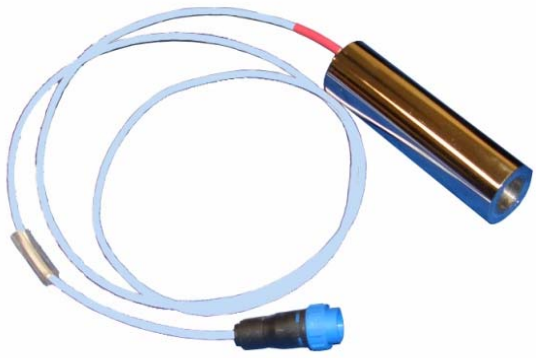
Structure of EM sensor

General

- PowerEM™

The PowerEM™ is a stand-alone and easy-to-use reading units for the type of EM sensors from 12.7mm (0.5”) strand to 250mm bundle cable. The unit can take the temperature reading from the temperature sensor inside an EM sensor and compensate for the temperature effect of the steel. It is housed in a cast aluminum enclosure. A rugged, weather-resistant enclosure designed for use in field environments is available. The unit can store 16 types, total 1024 EM sensors parameters. User-friendly Windows® based software allows easy programming of sensor channels, selecting sensor types, setting of calibrations, and taking measurement.

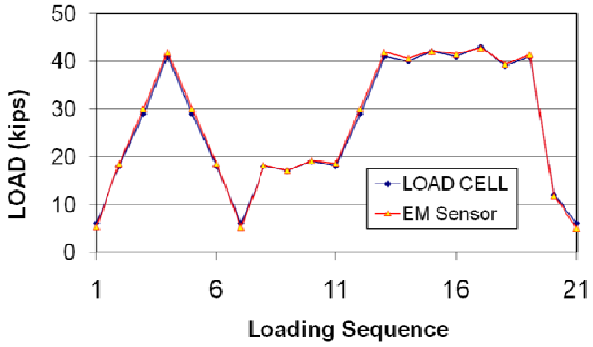
PowerEM™



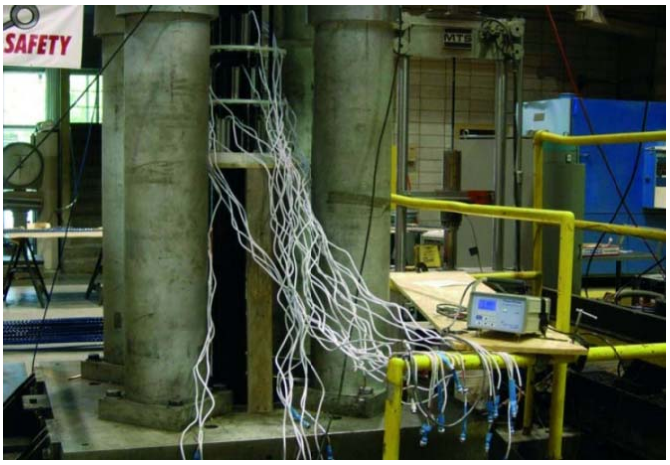
EM Sensor (0.6” strand)

In-situ EM sensor

Performance Test



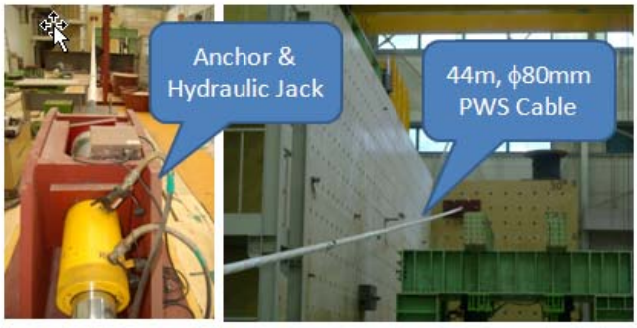
Performance Testing conducted by Dywidag System International (DSI), accuracy within 2%



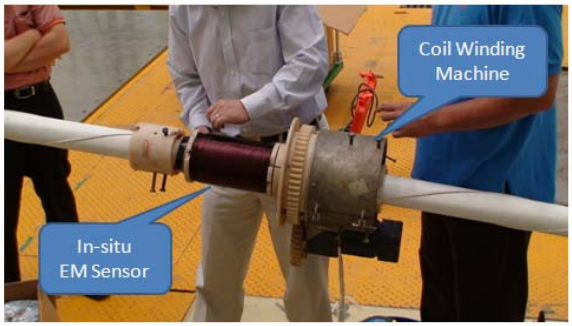
Fatigue Test at Construction Technology Laboratory (CTL), 2 million Cycles of Loadings

Performance Test

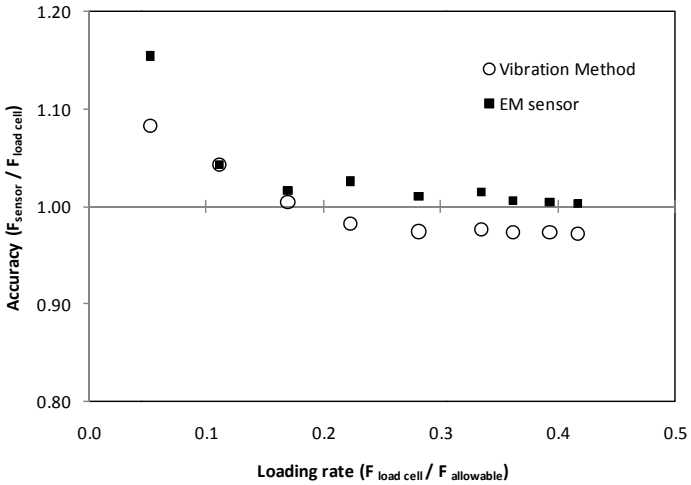
IIS cooperated with the research institute of Hyundai Engineering and Construction, Ltd. (HDEC) had implemented the verification test of the in-situ EM sensor fabricated at HDEC's research facility at Korea. The parallel wired strand (PWS) cable of 44 meter long and 80 mm diameter installed to the reaction wall is the same size with one of original cables used in the Ma-Chang Grand Bride, cable-stayed bridge. The in-situ EM sensor is fabricated at the arbitrary position over the polyethylene (PE) cover, and an accelerometer is located at a quarter positions. EM sensor as an alternative to the vibration method has advantages that there is no limitation of geometric conditions such support conditions, length of cable, and sag effect, because the sensor relies on the material property itself on a certain point. At this verification test the accuracy of the EM sensor was better than the vibration method from above the 5% of the allowable force. However, the difference is negligible, and both are acceptable as an accurate sensor.



HDEC test bed and specimen



Installation of in-situ EM sensor

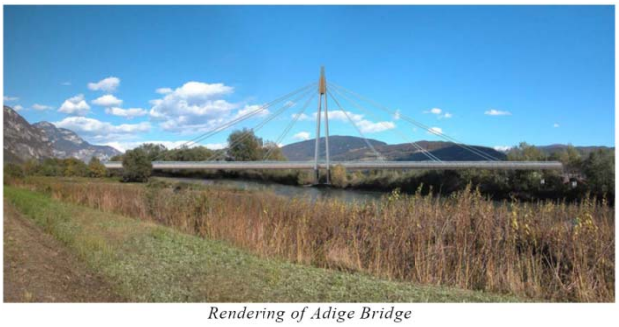


Comparison with EM sensor and vibration method

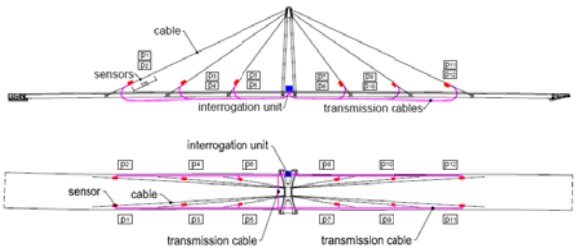
Applications – Bridge

PENOBSCOTT NARROWS BRIDGE, MAINE, USA

ADIGE BRIDGE, TRENTO, ITALY



Rendering of Adige Bridge



EM sensor installation in each cable.

STONECUTTERS BRIDGE, HONG KONG

Applications – Bridge

ASHIDAGAWA BRIDGE, JAPAN

ZHANJIANG BAY BRIDGE, CHINA

HSING-TUNG BRIDGE, TAIWAN

Applications – Earth Anchor

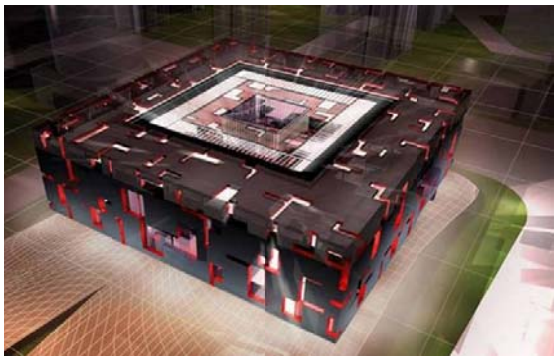
PATTON CREEK WALL STABILIZATION, USA

TIE DOWN ANCHOR- BOUNDARY DAM, CANADA

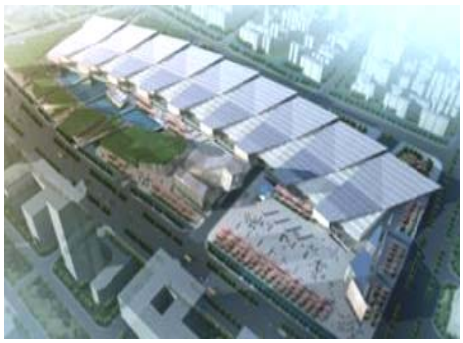
Applications – Architecture

TIANJIN, CHINA


GUANG ZHOU, CHINA




NANNING, CHINA




Intelligent Instrument System, Inc.

IIS was founded in 2005. The founder of the company have been involved in which are supported by government agencies and private owners. Kishwaukee Bridge project initiated the transformation from health monitoring concept to a real application. Zhanjiang Bay Bridge project in China further allow us to perfect our monitoring technology both in hardware and software package. We therefore standardize a bridge health monitoring system for bridges. In sensor technology, DSI adoption of EM sensor technology in their anchor system applied on Penoscot Cable-stayed Bridge. Several major cable companies worldwide have approached us for the adoption of our technology into their patented cable post-tensioning systems. Wireless sensors for rapid inspection and measurement of bridge health were also developed. In short, we have many achievements in the past few years; these accomplishments have been recognized both nationally and internationally. A lot of experiences have been gained and accumulated through projects over the years. We are on the early stage of market on advanced sensor technology and health monitoring of infrastructures. Our effort has a tremendous and long-lasting contribution to the field of sensor technology and health monitoring, and will undoubtedly have a great effect on maintenance, system reliability, and overall cost since it enables use of a condition based rather than time-based maintenance schedule for bridges and structures in general.

Vision of IIS

We envision the dominance and leadership role of the EM technology and structural health monitoring and inspection market through our innovation, quality products and service. Not only being at cutting edge of technology, our technical support and product design-on-demand plays an important role in promoting IIS in the market. We provide quality product and guideline in their application. We have the capability to provide our product in a timely fashion. Our technical supporting team helps to design and to finish the project. Our package in health monitoring technology both in hardware and software is also in a leading position for future market as attested through many existing projects and future projects. We have the ability to design and assemble a health monitoring system for a major bridge or structures timely after initiation of a contract. We have the ability to develop new products for meeting customer requirement in a timely fashion.

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