Measurement & Analytics – Measurement made easy

ABB load monitoring system helps extend life of London's landmark Tower Bridge



ABB Pressductor® load cells serve to balance drawbridge loads, preventing damage to bearings and pivot mechanisms.

Background

London's historic Tower Bridge across the Thames, opened in 1894, operates more smoothly these days thanks to an ABB load monitoring system. The bridge's central 200-foot roadway span opens draw-bridge style to allow the passage of shipping. Hydraulically powered gear mechanisms housed in the towers at each end raise and lower the two bridge decks, called bascules. The decks each weigh over 1,000 tons, and are counterbalanced to minimize the force required and to allow raising and lowering them in about five minutes. The counterbalance weight consists a ballast box filled with lead and iron.

Modern traffic weight loads and volumes over the bridge were adversely affecting the main bearings on which the deck structures pivot. The dead weight of the bascules and the live load of the traffic were not being carried fully on the resting blocks and locking pawls, but also on the shaft bearings. Because of misalignment and wear, the pawls didn't properly lock the ends of the bridge decks in the down position and they didn't correctly engage.

The challenge

As a result some bearings were taking on more load than others. Left unresolved, the bearings and pivot mechanisms would suffer further damage, leading to a major bridge shut-down for repairs. In addition uneven loading causes misalign-ment of the two bridge decks.



ABB Millmate Pressductor load cells installed at Tower Bridge.

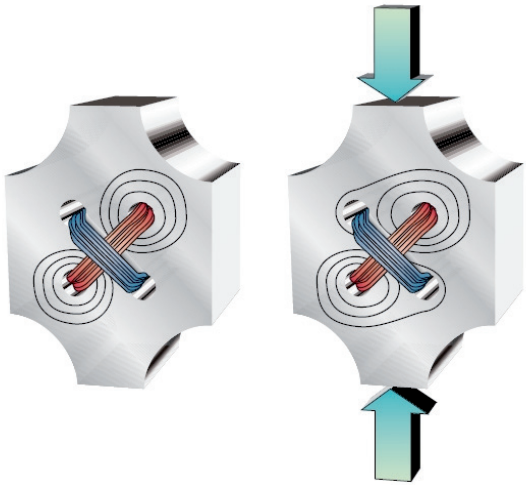
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If the PLC senses imbalanced weight from the ABB Millmate Pressductor load cells, it activates hydraulic cylinders to adjust the position of the resting blocks.

Balancing loads

To overcome the problem, the old stationary resting blocks for the decks were replaced with active blocks capable of movement. With this new system, ABB Millmate Pressductor load cells housed in each of the new blocks continuously measure the load across the bridge decks. The load cells, capable of measuring up to 600 tons, relay load data for each deck via a 4-20 mA signal to a programmable logic control (PLC) system.

If the PLC senses imbalanced weight from the load cells, it activates hydraulic cylinders to adjust the position of the resting blocks. This action maintains equal loads across the deck bearings, which will help to both increase their life and that of the overall bridge structure.



Pressductor principle of operation: Subjected to force (load) in the direction of measurement, the alternating magnetic field from the primary (red) winding affects the AC voltage induced in the secondary winding.

Magneto-elastic principle

The sensing principle of ABB's Millmate Pressductor load sensor depends on how the permeability of a magnetic material changes under mechanical stress. The sensor is a membrane machined in the load cell. Primary and secondary windings in the sensor cross at right angles. Alternating current passes through the primary winding creating a magnetic field surrounding it. With no load on the sensor, this magnetic field doesn't induce a current in the secondary winding.

When, however, the sensor experiences a mechanical force in the direction of measurement the propagation of the magnetic field changes. Now the primary winding does affect the secondary winding, inducing an alternating voltage in it. A control unit converts this alternating voltage into a DC voltage proportional to the applied force. If the measurement force changes direction, the sensor signal also changes polarity.

ABB's Millmate Pressductor load cells have been widely used in many applications since first developed in 1954. Common applications include monitoring of hot and cold rolling in the steel industry, as well as measurement of tension and flatness.

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