SUCCESS STORY

WIRELESS MONITORING OF BRIDGES DURING CONSTRUCTION AND REFURBISHMENT

REGION:

Asia

PROJECT TYPE:

Bridge Monitoring

SECTOR:

Construction and Structural Health Monitoring

MAIN PRODUCT:

Loadsensing | The Wireless Monitoring System

loadsensing
WORLDSENSING

Challenge

Shenyang is the provincial capital and the largest city of Liaoning Province, People's Republic of China, as well as the largest city in Northeast China by urban population. The East Tower Bridge on the Hunhe River has a total length of 1290 meters and is a key project in Shenyang's comprehensive upgrading plan. During construction, the project needed to monitor the cables and main tower of the 1300 meter suspension bridge all the way from their site office in order to ensure the safety of motorists. They also needed real-time monitoring of the bridge's loading capacity, stability and structure.

Meanwhile in Indonesia, the Cisomang bridge had to be refurbished after one of the pillars got deformed and shifted causing alarm with the locals and authorities. It reached a point when trucks were not allowed to cross, traffic to the bridge had to be reduced and the state railway had to increase trips just to compensate for the diverted traffic.

Also in Indonesia, The Kutai Kartanegara Bridge (also known as the Mahakam II Bridge) was a 710-meter-long suspension bridge crossing the Mahakam River that was intended to resemble San Francisco's Golden Gate Bridge. Unfortunately, the bridge collapsed in 2011, killing at least 11 people and injuring 39. It was rebuilt and reopened in 2015 but more stringent monitoring had to be put in place to prevent another tragedy in the future.

Solution

Together with Worldsensing's partner Earth Products China Ltd, Loadsensing data nodes were connected to strain gauges and were used to monitor the tilt in the Shenyang Bridge main tower, cable / diagonal member and main beam. Loadsensing also integrated with EPC software together with sensors that were read by other systems (Anemometer, GPS monitoring, temperature sensors, VW strain gauges, tiltmeters etc).

Bridges are integral parts of a city and any activities related to its construction, refurbishment and repair can disrupt traffic flow and volume not only on the bridge per se but also on its surrounding transportation network. Loadsensing, the wireless monitoring system was installed on several bridges in Indonesia and China to monitor the stability of structures and to ensure the safety of construction workers and motorists.

ADVANTAGES

- Real-time, long-range wireless monitoring of sensors that can be covered by a minimal number of gateways
- Easy to install even on the most remote parts of the bridge structure
- No need for tedious and expensive cabling

In partnership with PT Struktur Pintar Indonesia, for the Cisomang Bridge refurbishment, Loadsensing data nodes were connected to strain gauges that were installed on the bridge pillars. For the Makham II bridge, 7 tiltmeters and 5 vibrating wire 5-channel data nodes are sending information to 1 gateway to gather data from different points of the bridge structure.

Loadsensing uses LoRa: a long-range, low-power wireless technology used by IoT networks worldwide. It has a proven range of up to 15 kms and a battery life of up to 10 years, is proven to be robust (IP67), is easy to install and significantly less expensive than cables and manual monitoring.

Loadsensing uses a star network topology which has a longer range, is not affected by radio signal obstructions, does not need repeaters or network planning and is not critical path dependent. Loadsensing wireless sensor networks can be easily expanded by adding new wireless units to the network. The advanced network management tools allow for the automatic addition of new nodes in the network in a transparent way. Moreover, the network protocols have been designed to be highly scalable, and a single Loadsensing gateway can manage up to 500 nodes.

Figure 1:
Loadsensing wireless tiltmeter, a 2-in-1 sensor + data node, is among the various wireless data units deployed for bridge monitoring projects.

Benefits

The Cisomang Bridge decided to implement wireless monitoring for the long term only after cracks appeared, the pillars got deformed and the bridge was proven unstable. The Mahakam II bridge collapse was an unfortunate case and it is possible that if the bridge was properly monitored, the tragedy that claimed lives and injured several people could probably have been avoided. Wireless monitoring enables early detection of structural instability thus preventing more serious damage, longer and more costly repairs and even fatal disasters. By implementing regular bridge monitoring and maintenance, major repair activities that cause traffic disruptions and congestions can be minimized or even avoided. It eliminates the need for manual monitoring and expensive cabling on a complicated bridge structure. Ultimately it ensures the safety of bridge management employees and motorists anytime from construction to refurbishment.

Figure 2:
Cisomang Bridge during refurbishment

WORLD SENSING

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