Slope Monitoring - SUKE Highway, Malaysia

Protecting SUKE Expressway users with real-time wireless slope monitoring

Clients: Meridian2000 / Lembaga Lebuhraya Malaysia (Malaysian Highway Authority)

Challenge

The Sungai Besi–Ulu Kelang Expressway (SUKE) is a 24.4 km, three-lane dual carriageway spanning Selangor and Malaysia's capital, Kuala Lumpur. Serving an average of six million vehicles travelling to and from the city each month, SUKE is a vital part of the region's transport network.

At Chainage Ch.13440 – Ch.13490 Bukit Saga, signs of distress in the form of scars were detected on a steep slope close to the expressway bridge viaduct. The slope's height and proximity to the structure presented a serious risk: any potential failure could damage the viaduct and endanger the safety of highway users.

Ensuring the stability of the slope and protecting the public were top priorities for Prolintas/Turnpike Synergy Sdn. Bhd. and Lembaga Lebuhraya Malaysia (LLM).

Monitoring specialist Meridian 2000 Sdn. Bhd. was appointed to deliver a reliable, real-time monitoring solution capable of detecting early signs of movement during and after slope stabilisation works.

The Sungai Besi–Ulu Kelang Expressway (SUKE)

Wireless Triaxial Tilt Sensor nodes and 4G Gateway

Solution

In collaboration with the appointed consultants HSS Integrated and Mohd. Asbi & Associates, Meridian 2000 selected Senceive wireless technology to monitor the stability of the slope near the viaduct.

Senceive's FlatMesh™ wireless monitoring communications platform was chosen for its proven reliability, robust mesh networking, and suitability for dense sensor configurations in complex environments.

Ten wireless Triaxial Tilt Sensor Nodes were installed on debris-flow barrier posts using magnetic mounts, connected to a 4G Gateway for near real-time data transmission.

The Gateway collected the sensor data and transmitted it to WebMonitor – Senceive's data visualisation platform, for analysis. Remote users were able to access an overview for a quick snapshot of the measurement data status, or detailed data graphs for more in-depth analysis.

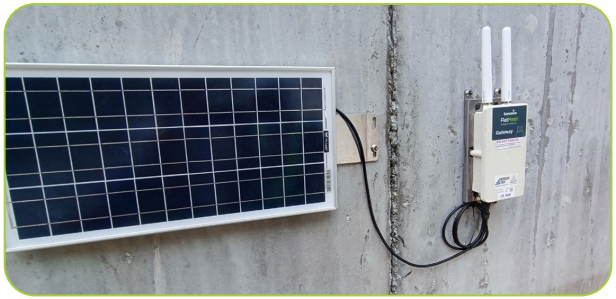
Monitoring was carried out during and following the stabilisation works, which included soil nailing and the construction of a Terramesh wall.

To further enhance safety, Meridian 2000 chose to use Senceive's InfraGuard™ critical asset monitoring system. While the FlatMesh network already monitored displacement and impact on the debris-flow barriers, InfraGuard added advanced capabilities, including sudden movement detection, dynamic sampling and automatic triggering of all sensors within the network if thresholds were exceeded.

Data was collected every 30 minutes, with automated alerts sent via SMS and email for rapid response when any of the following movement alert thresholds were breached:
Level 1: 0.25° Level 2: 0.5° Level 3: 1.0°

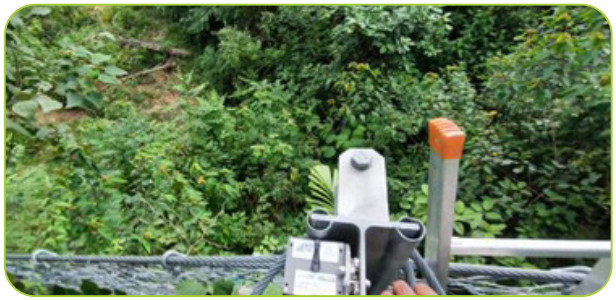
The installation of the Gateway required the use of a skylift to securely mount the unit onto the bridge parapet wall. Both the gateway and the solar panel were bolted firmly to the parapet wall to ensure stability and long-term durability.

In contrast, the installation of the tilt sensors was more straightforward. Using magnetic mounts, the sensors were installed on top of the steel posts of the rockfall barrier. These installation points were accessible via ladder, allowing the team to complete the process efficiently and safely.



4G Gateway and solar panel installed on bridge wall

Installation of the Gateway required the use of a skylift to mount the unit onto the bridge wall



Wireless Tilt Sensors with magnetic mounts installed on steel posts of the rockfall barrier

Outcome

The wireless monitoring system delivered continuous, automated data and early warnings, providing engineers with near real-time insight into slope behaviour.

This gave the on-site team confidence to carry out stabilisation works, knowing they would be immediately alerted to any concerning movement. By enabling proactive intervention, the system helped safeguard both the bridge structure and highway users.

Through close collaboration between Meridian 2000, Turnpike Synergy, and the consulting engineers, the project successfully mitigated slope failure risk, ensuring the long-term stability of one of Malaysia's busiest and most critical expressways.

Throughout the 2-year monitoring period, one alert which breached Level 1 (0.25°) was received. The integration of automated alerts ensured immediate notification of any movement, allowing timely intervention and informed decision-making by the monitoring team.

Throughout the stabilisation works and post-construction monitoring period, the system demonstrated consistent performance, minimal maintenance requirements, and strong communication reliability, even within the challenging terrain and environmental conditions.