



Little Hagloe

LiDAR

Earthwork

Monitoring

System Trial



“As technologies such as L.B. Foster’s Insight Earthwork Monitoring are introduced, we will be able to monitor the performance and condition of our infrastructure more closely and accurately, placing us in an even better position to handle the consequences of extreme weather.”

Network Rail manages a portfolio of more than 190,000 earthworks assets, including slopes, embankments, soil cuttings and rock cuttings. Many of these assets are over 150 years old and pose a significant risk to the railway especially after heavy rainfall, making the earth saturated and more prone to movement.

Landslips or landslides can be hazardous to the track and surrounding environment when soil, rocks and earth fall on to and cover the track. This potentially causes significant delays and increases the risk of derailment and the potential for serious injury and death to passengers and staff.

Little Hagloe is located on the coastal rail line adjacent to the River Severn near Chepstow in Gloucestershire. The site has a history of a number of failures of the cutting slope, making it a perfect trial site for the first field installation of L.B. Foster’s new Insight LIDAR Earthwork Monitoring system. Insight uses proven scanning laser technology to detect movement of earthworks and provide a warning alarm to nominated staff and a CCTV camera provides further remote visual evidence and verification of an event.

The system’s LiDAR units scan the earthwork slope, comparing against previous scans to detect tiny movements of the earthwork. Software ignores non-valid movement, such as wildlife and vegetation detection, and determines if the slope has moved sufficiently to raise an alarm. The amount of valid movement depends on the slope, soil type, vegetation, and water saturation and threshold limits for alarms can be configured to meet customer requirements.

Requirement

L.B. Foster TEW Engineering was commissioned by Network Rail to undertake a pilot installation of its Insight Earthwork Monitoring system at a site with a history of earth movement known as Little Hagloe, near Chepstow.

The railway runs along the bottom of a steep embankment adjacent to the River Severn. Network Rail's project team was keen to explore the opportunities for proactive

maintenance interventions afforded by L.B. Foster's Insight Earthwork Monitoring system. The system uses LiDAR technology to scan, record and report on movement of the earthworks within a specified 'detection zone'.



Our solution

The monitored area at Little Hagloe is the length of track that is susceptible to potential earth slides, along which four LiDAR units are installed. The Monitoring Plane radius of each LiDAR unit is a maximum 30 metres (100 feet) on a 190 arc. The monitoring plane intersects the slope of the earthwork cutting to create a detection zone. The height of the monitoring plane is influenced by the cutting slope, material and total height.

Vegetation is removed from the data measured by a custom algorithm in the LiDAR Software. The algorithm also ignores movements of people and animals, and does not alarm on transient events, although an alert can be set if required.

The LiDAR Units are positioned for optimum scanning of the bank in front, but also scan further along the earthwork and overlap to provide redundancy in the event of a failure of an individual LiDAR head. If an alarm is made in the overlap area, data from the nearest LiDAR is

used to produce an alarm text or email that can include a profile of the bank before/after the alarm event, and also include pictures from the optional CCTV system if installed on site.

The complete Insight monitoring system at Little Hagloe comprises four LiDAR sensor heads, a local processing unit and a mobile telecommunications router to pass data to the on-line reporting system. The system uses local 230VAC power that is stepped down to 12V and 24V power to the processor and LiDAR heads. Typical power requirements for the Insight system vary depending on the number of heads, as each LiDAR unit consumes typically 400mA.

Each of the installed LiDAR heads is mounted on a post and adjustable bracket to optimise the scanning performance of the LiDAR system.

“Our earthwork portfolio is as old as the railway itself – most of our infrastructure slopes are more than 150 years old. Therefore, futureproofing our infrastructure is crucial – we aspire to and are actively working towards creating a safer, reliable and sustainable infrastructure that continually improves.”

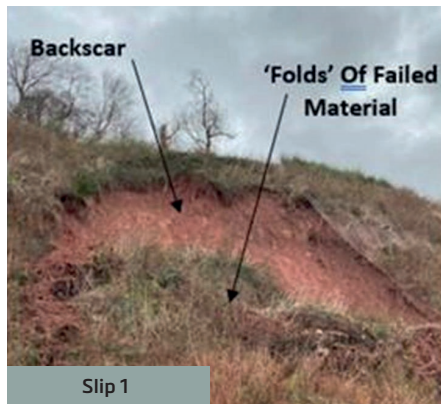
The Results

During the data gathering and analytics work required to complete the development of the Insight Earthworks Monitoring system, two actual slippage events were recorded by the system:

Slip One – 6pm on the 15th December 2019

Slip Two – 1pm on 16th February 2020

Neither of these events posed a significant risk for the rail, but provided excellent evidential data for the agreement of size of slippage that could cause an issue for trains.



Photograph provided by NWR, © Network Rail

On Friday 28th August 2020, the Insight Earthwork Movement system measured a slippage that was reported in real time. This is after the system going live in June 2020 for full site reporting to the local infrastructure management team.

The report generated from Network Rail noted that the system measured a slip with dimensions of 1.6m x 641mm. LiDAR head 2 recorded the movement at 129m 0460yds on the track point measurement. The Insight system recorded the slip at precisely 07:24:31am, with Network personnel receiving the email alarm notification at 07:25am.

For this site the local Control Centre technicians are designated to respond to these alarms. The CCT received the alarm, looked at the graphs/camera images on the email, then immediately notified the signaller to stop trains as per the process implemented with Network Rail for this Insight system. From receiving the alarm to informing the signaller to stop trains on the affected lines, the process took no longer than three minutes.

This event during live reporting operation of the system showed the excellent response time of the system to a detected cutting slippage of sufficient dimensions to cause concern. Of particular importance was the ability of the train controllers to action signalling to halt trains on receipt of a critical alarm prior to potential concern for a derailment.

In this case, the slippage was assessed, and trains allowed to run normally. Further investigation of the site stability was afforded by the system alert and this highlights the enhancement of preventative action in using a system like Insight Earthwork Monitoring.



What they said

“The vulnerability of our infrastructure slopes is often apparent after prolonged periods of wet weather or more intensive short duration rainfall events, when landslips can happen. That’s clearly evident in the results generated during the trial installation of L.B. Foster’s Insight Earthwork Monitoring system at Little Hagloe. The exceptional weather conditions caused by Storm Dennis can cause all sorts of problems on the railway. Insight is a system that has proven it is capable of monitoring earthworks movement in real time, providing essential alerts that enable the railway to be stopped or run at caution. The adoption of this kind of advanced automated technology will ensure the safer, more reliable running of the network for all of our passengers.”