

NEWS FROM L.B. FOSTER

Remote Condition Monitoring
Special Edition

Velocity

LBFoster®





Why Remote Condition Monitoring?

Network owners and operators are transitioning to 'predict and prevent' maintenance regimes. Deploying sophisticated Remote Condition Monitoring technologies is core to this achievement.

But challenges persist, such as the use of advanced analytics to understand asset condition and define timing and type of maintenance intervention; the integration and analysis of data sources to understand how the railway is performing as a system; and the deployment of sensor capability to both fixed and mobile infrastructure.

What remote condition-monitoring technologies are available for deployment to predict and prevent asset failure and/or replace existing manual maintenance regimes?

At L.B. Foster we are working collaboratively with rail operators around the world, deploying a range of innovative Remote Condition Monitoring solutions to keep the railways running on time.

Our solutions integrate the most up-to-date CCTV, sensor, alert, control and video technologies to deliver always-on monitoring of conditions including flood, avalanche and rockfall.

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Keeping obstacles off the track using sophisticated laser technology



In the past, the application of remote condition monitoring on UK rail infrastructure has been an expensive and tactical exercise. Benefits have been difficult to sustain and even harder to measure.

Network Rail's Intelligent Infrastructure strategy addresses these failings and enables the infrastructure manager to develop a business driven solution that is scalable and sustainable.

Innovat

At L.B. Foster we use our knowledge and experience to develop new solutions for monitoring safety and security from a discreet distance. Our comprehensive portfolio of smart Remote Condition Monitoring solutions combines video analytics, CCTV, sensor technology, mobile and wireless communications to keep a watchful eye on valuable assets and issue alerts when compromised.

Our solutions include:

- > flood
- > rockfall
- > avalanche.

Our solutions apply a range of different sensing technologies, including **L.B. Foster insight** active sensing and **L.B. Foster inline** passive sensing.

insight

— by **LB Foster**

Highly reliable and accurate active sensing using LiDAR laser technology and WAN/4G communications

inline

— by **LB Foster**

Self-powered passive sensing technology using innovative tilt and flood sensors and 3G/4G communications



ion in motion

Video analytics

Our Remote Condition Monitoring solutions draw on the latest high definition, low energy video and CCTV technology to deliver high quality visual content.

Solar Gateway CCTV

The L.B. Foster Solar Gateway CCTV is a unique solution for use in remote, off-grid locations where power and data cables are not practicable.

As part of a comprehensive Remote Condition Monitoring scheme, the Solar Gateway is a fully integrated monitoring, recording and communication device in one.

Cameras are self-powered, with up to 20 'TAG' wireless detectors monitoring various conditions and sending alerts and images via 3G/4G communications for security or environmental events.

Sensor and alert technology

Our Remote Condition Monitoring solutions use a range of different sensor technologies to measure,

record and report changes in temperature, movement and conditions, such as water level.

Flood monitoring poles contain sophisticated electronics that use capacitance sensor technology to detect if water is present and at what depth.

Avalanche poles use long-life battery-powered tilt and position sensors. These are attached to posts that are swept along during an avalanche. When a change in their position is detected, data is relayed wirelessly to a local gateway receiver. This launches an avalanche alert over the local train communications network.

L.B. Foster's **rockfall** monitoring system uses safety critical, SIL3 LiDAR light detection and ranging units. A 'detection zone' is a critical area within the LiDAR monitoring plane that sets off an alarm if predetermined hazard criteria are met, including size or position of the object.

Anatomy

asset intelligence system

— by **LB Foster**

Data management software

L.B. Foster Anatomy TTM is our powerful data management software. Event data from rockfall, avalanches or flood is captured, stored and analysed, providing detailed intelligence on event regularity and severity. Over a period of time, data analysis can build a more detailed picture of events for operators to make more informed, proactive decisions about maintenance and operating.

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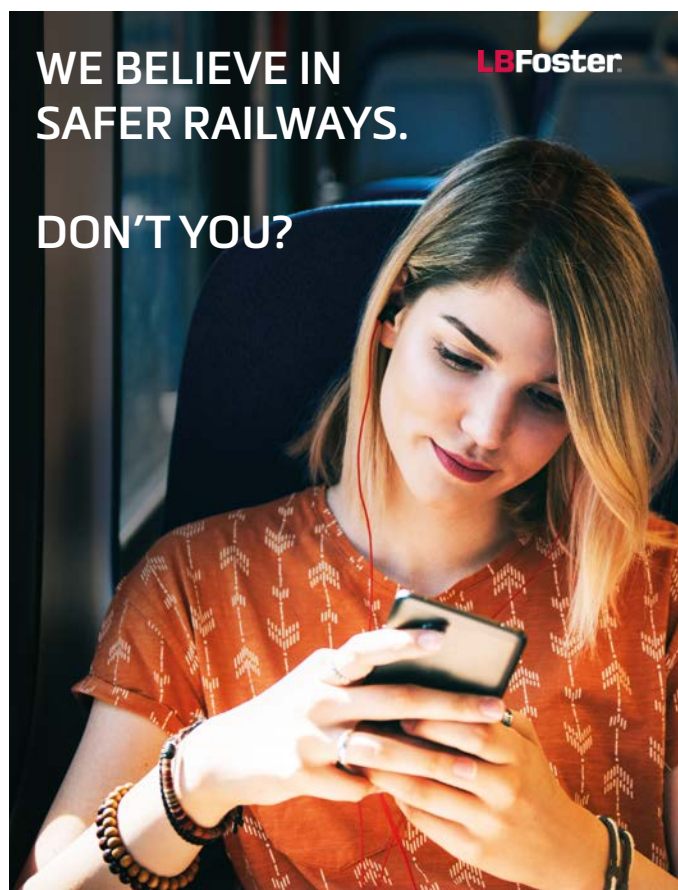




Optimising lifetime return on
assets using the Digital Railway



Always moving



WE BELIEVE IN
SAFER RAILWAYS.

DON'T YOU?

LBFoster

Dr Mark Aston is Chief Technology Officer at L.B. Foster Europe. Here he explores how the advent of the Digital Railway is delivering far beyond modernising train command, control and signalling systems designed in a pre-digital age.

Breakthrough technologies applied to all aspects of the railways - from remote performance monitoring of trackside and on-board friction management to digital asset monitoring and digital asset maintenance - are releasing real lifetime value through proactive and pre-emptive management. L.B. Foster's end-to-end track management and performance monitoring solutions integrate conventional rail products with intelligent, always-on, digital technologies that improve performance, deliver cost efficiencies and enhance safety.

Moving away from manual

In the past, rail track and infrastructure maintenance has relied on timely preventative interventions, such as walking the track and having a historic understanding of the use of consumables. The thousands of miles of track and unpredictable performance of assets can make this approach both arduous and inaccurate.

As train operators look to run more services closer together, the need for a safer and more reliable approach is driving the adoption of new, smart technologies that remove the manual aspect of operating the railways, providing data and analytics on which to base informed decisions and investment.

forwards

Remote Condition Monitoring

Our range of smart monitoring solutions covers a diverse collection of rail operating and safety condition challenges. These include:

- > rockfall
- > flood
- > avalanche
- > embankment
- > bridge strike
- > level crossing
- > trackside friction management
- > wheel load impact detection
- > wheel sensing
- > security surveillance.

Data from remote monitoring solutions is fed back to a central server. This allows operators to interrogate information to determine actions, as well as being able to build profiles of behaviours and events and take necessary actions.

Data gathering & analytics

Monitoring the performance and operating condition of assets across the network requires that our solutions can be addressed remotely via:

- > IP networks
- > 4G/5G networks
- > trackside telecoms.

Analysis of this critical information by maintenance, infrastructure management and network operating teams shape decisions about when, where, what and how to target expenditure and resources. In addition, it is imperative that the data we supply has a seamless interface with existing railway control systems.

Low energy and solar power

Alongside our smart digital solutions, we use a number of innovative low energy battery technologies, as well as rechargeable solar powered options, such as CCTV. This means that once in the field, our solutions keep on working, delivering mission critical data that saves costs, enables informed operating and maintenance decisions, whilst all the time ensuring operating uptime for network owners and train operating companies.

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A site for a trial LIDAR fence was on BNSF's Washington track along the banks of the Columbia River. The area known as Fallbridge possesses 600 feet (185 metres) of fracturing shale rock in near vertical cliffs adjacent to the track.

Flood monitoring

"Our flood monitoring technology combines advanced internal know-how and sophisticated external sensing, ensuring system longevity and cost-effective maintenance over time."

Ahead of the rest

Remote monitoring of flood risk

L.B. Foster's Flood Monitoring System is designed to accurately track water levels in flood-prone areas.



Flood water can pose major problems on the railway, leading to costly delays and cancellations. L.B. Foster's Flood Monitoring is part of our Total Track Monitoring™ solution. It applies technology to accurately identify water levels "down to the millimetre."



A wireless flood pole lets users set alarm responses at various depths. The alarms are activated at levels predetermined by customers. When flood water reaches the alarm level, nearby solar-powered cameras are triggered and zoom in for a live view of the area that generated the alarm. This initiates a customer emergency response. The live feed is delivered immediately to the customer via a web portal showing actual flood depths.

L.B. Foster Flood Monitoring also issues notifications when the water has receded, providing trains with safe passage through the once-flooded area.

L.B. Foster Flood Monitoring is currently installed on a number of Class I railroad lines in the US, where simulated flood tests have shown impressive results, alerting customers within two minutes from the start of water testing to the alarm being delivered digitally.



"Many flood detecting devices in place use a float mechanism, live in water, and because they are prone to sediment build-up, require ample maintenance," explains Dr Mark Aston, Chief Technical Officer, L.B. Foster. "Our Flood Monitoring combines advanced internal know-how and sophisticated external sensing, ensuring system longevity and cost-effective maintenance over time."

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View flood events as they happen

L.B. Foster Flood Monitoring incorporates a smart, online customer interface which is accessed via a web browser. It is designed to enable designated administrators to access the flood monitoring system's remote cameras for one hour while the system is in an alarm state.

Total Track Monitoring™ by L.B. Foster features sophisticated data management software. Event data resulting from a flood event is captured, stored and analysed, providing detailed intelligence on event regularity and severity. This allows railroad operators to build a detailed event profile and identify actions to prevent or offset future events.



A site for an Avalanche Monitoring trial was on BNSF's Montana track outside of Whitefish. The mountainous area is prone to avalanches capable of burying the line in 30 ft of snow.

Avalanche monitoring



What's the latest thinking when it comes protecting the railroads against avalanches?

Keeping the

Protecting the railroad against disruption caused by avalanches takes any number of forms, from physical infrastructure such as snow sheds, built of structural timber with concrete retaining walls that protect the track in the path of avalanches, to avalanche forecasters and wired slide fences.

We apply our considerable capability in digital communications to remote condition monitoring (RCM) on the railroads.

Peter Jones is Vice President of Global Technology. He says: "Working with a number of leading Class 1 freight railroad operators in the US and the transit network operators in the US and across Europe, we have created a comprehensive suite of software and hardware solutions that deliver real-time data, CCTV images, SMS and email alerts to keep the railways moving.

"Our Avalanche Total Track Monitoring is an innovative piece of engineering that demonstrates how, as a business, we are joining up the skills from different parts of the company to produce new ways of doing things.

"Previously we could be accused of

providing standalone products, but now we're all about integrated solutions that add value to our customers' businesses."

Neil Roberts is L.B. Foster's product manager for Total Track Monitoring. He says: "One of the main products installed in areas at risk of avalanche in North America is slide fences. Avalanches run into these systems from the slopes above, breaking wires strung between the poles, this alerts personnel who can quickly react by implementing trains at caution or imposing closures on the railway.

"But they are not infallible. Whilst they are designed to provide alerts against avalanches, they require a high level of maintenance through the winter due to ice breaking through them, wild animals breaking them, or the cables breaking on their own accord. Such events inevitably lead to false alarms,

with expensive maintenance crews dispatched unnecessarily. Furthermore, slide fences can cost the railroad an awful lot of money to maintain."

The issue of maintenance cost has encouraged a Class 1 railroad to look at alternative solutions, including wireless avalanche detection systems. This includes Avalanche Monitoring by L.B. Foster. The system is an end-to-end solution that sends alerts to operators about events in often remote locations that can lead to snow, trees and debris on the track. Proactively monitoring such events increases safety, minimises costs through a reduction in service delays, and enhances reputation resulting from guaranteed continuity of service provision.



tracks clear

Avalanche Monitoring

Part of the company's broader Total Track Monitoring capability, L.B. Foster's Avalanche Monitoring applies innovations in mobile technology, CCTV, low energy and software to deliver a system that can be installed where fixed infrastructure is unavailable. The system uses long-life battery-powered RCM tilt and position sensors attached to vertical posts. When an avalanche occurs, the posts are knocked over triggering an alert that is automatically relayed to a control centre. The small sensors have the cost potential to be used over hundreds of miles of track susceptible to avalanche or mudslide events.

Controllers are alerted when integral G-force accelerometer sensors installed on top of the system's vertical posts are activated. The system is programmed so that the posts must go from being completely vertical to a 30-degree tilt within one second. If just one sensor is knocked over it will cause an alarm, but the system will not indicate there is an avalanche. However, if two sensors are knocked over, the system identifies that an avalanche has been detected and an alarm is sent to the control room. The railroad operator can then investigate the scene and react if the track is not passable.

"By the nature of their often remote location, the railroad network has a lot of areas where communications can be challenging, plus the locations generally do not have power," adds Neil Roberts. "So with our avalanche monitoring solution we are building a number of different systems for them to use out in these hard to reach areas."

That includes using L.B. Foster's innovative solar powered CCTV where power and data cables are unavailable. The self-powered system sends alerts and images via 3G communications for security or environmental events.

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Rockfall



A site for a trial LIDAR fence was on BNSF's Washington track along the banks of the Columbia River. The area known as Fallbridge possesses 600 feet (185 metres) of fracturing shale rock in near vertical cliffs adjacent to the track.

monitoring

Obstacles on the track are a major concern for rail operators in terms of potential risk of accidents, lengthy delays and cost. Detecting obstacles in remote locations is a challenge that L.B. Foster's rockfall detection solution is tackling in the US with the application of innovative light technologies and remote condition monitoring.

Rockfall

In the world of Class One Freight Transport any delay, no matter how small, has a knock-on effect in both the profitability of a specific train load as well as the lateness of subsequent trains. Fallen rocks blocking rail lines is especially likely where the train line passes through steep rock cuttings and mountainous areas prone to sizeable objects breaking off the rock face.

Conventional rockfall detection uses physical wire fences; when a rock breaks the wire a signal is sent to the local maintenance engineers who attend site to establish the extent of the incident. Freight trains must run with a restricted speed of 10mph pending this investigation. If a rock or rock-fall has blocked a line, then the delays can be significant.

L.B. Foster was tasked by BNSF to innovate the use of active Light Detection and Ranging (LIDAR) technology to detect rockfall and whether it remains an obstacle on track, size and its position in the zone susceptible to rockfall.

Our solution

We installed 10 LIDAR heads mounted to the existing break-wire rockfall fence to verify the added benefits of LIDAR over the break-wire fence.

Each LIDAR covers its own area of track, as well as that of its neighbouring LIDAR. This provides dual redundancy in the design to detect if an obstacle sits on the track should one LIDAR head fail.

The system relies on simple obstacle detection within the area of interest set for each LIDAR head; this area of interest can be changed depending on track layout, configuration and number of parallel track lines.



96 per cent of
all slidefence
rockfall alarm
activations are
false.



Dr Mark Aston is L.B. Foster's Chief Technical Officer. He explains about the challenge of safeguarding against rock debris on the line: "Conventional rockfall monitors use wires across the top of the track that break when a rock falls through them.

"The problem with this technology is that it does not indicate if the rock has ended up on the track or rolled off, plus it requires engineers to re-string the monitors each time they break.

"If a rock of sufficient size to pose a threat to a train is detected on the track, L.B. Foster's Insight LIDAR technology remotely alerts controllers about the size and location of the obstruction, without an engineer ever needing to visit site and re-string a wire detector.

"The rockfall LIDAR can monitor hundreds of miles of cuttings and rock faces adjacent to train lines."

Studies in the US reveal that **96 per cent** of all slidefence rockfall activations are false alarms. On average, every false activation is **\$25k** in direct cost to the railroad. That equates to an annual cost of **\$30-50m** and railroad downtime of upwards of **4,000-9,000 hours** per year.

L.B. Foster's rockfall monitoring solution reduces false negatives to virtually zero. The safety critical system comprises multiple light detection and ranging units. Each LiDAR unit is capable of detecting individual rocks and maps its exact location on a 100 foot monitoring plane on a 190 degree arc. This 'detection zone' is a critical area within the monitoring plane that sets off an alarm if predetermined hazard criteria are met, including size or position of the object.

The system's Transient Object Elimination Capability distinguishes between moving objects, such as people and animals, and actual objects such as rocks, boulders and landslides. The system also automatically closes its mechanical shutters before a train enters the monitoring zone and reopens once the train has passed. Where optional CCTV is included in the configuration, live video can be reviewed to determine the extent of the event.

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