

# Norwich Northern Distributor Road - Trackbed Monitoring

**CLIENTS: BALFOUR BEATTY / NETWORK RAIL**

**How wireless tilt sensors installed on steel, wood and concrete sleepers helped to safeguard a railway adjacent to a three-year highway construction project**

## Challenge

The Norwich Northern Distributor Road, now officially named the Broadland Northway is a 12.4 mi (20 km) dual carriageway near Norwich, United Kingdom. The road was built by Balfour Beatty between 2015 and 2018 to improve access to Norwich Airport and developments to the north of the city.

The project included construction of a bridge at Rackheath spanning Network Rail tracks carrying passenger and freight traffic between Norwich and Cromer. Due to the proximity of the construction works to the track, it was considered necessary to monitor the trackbed in order to detect and manage any deformation.

Balfour Beatty chose a monitoring solution based on high-precision Senceive wireless tilt sensors because of their ease of installation, reliability and accuracy – which had been demonstrated on previous trackbed projects for Network Rail.

## Solution

Balfour Beatty installed 106 FlatMesh™ triaxial tilt sensor nodes, split equally between the Up Line, which had steel sleepers/ties, and the Down Line, which had a mixture of timber and concrete sleepers/ties. The nodes were easily installed on all three materials using trackbed mounting plates and adhesive. Antenna caps were used to protect the sensors nodes in the harsh track environment. All nodes were fixed to the sleepers at a position outside the outer rails and configured to measure changes in cant and twist.

Data from the FlatMesh™ wireless network was transmitted to two 3G Gateways powered by solar panels, providing a completely mains free solution. The Gateways used the GSM cellular network to transmit data to a secure cloud server. Registered users were able to view and interact with the data using Senceive WebMonitor™ software.



## Outcome

Movement levels early in the monitoring campaign exceeded pre-set trigger levels, which resulted in automated SMS messages being sent to stakeholders. Analysis of the data over a period of time showed that movements were relatively low magnitude (31 mm for the Up Line and 35 mm for the Down Line) and fitted a regular temporal pattern.

Through careful analysis and site testing by Balfour Beatty and Senceive, it was established that the movement detected by the highly sensitive triaxial tilt nodes was associated with diurnal temperature patterns. Further analysis showed that all three sleeper types were affected, but to varying degrees.

In order to remove the effects of normal diurnal movement, a 24 hour rolling median was applied to the raw displacement data. This enabled subsequent movements to be attributed to other factors, such as the interaction of train traffic with the ballast and formation.