PROJECT CASE STUDY

Structural monitoring to protect a live railway during Barmouth sea wall renewal Project

- Continuous structural monitoring of a live railway viaduct during adjacent construction works
- Dynamic monitoring system utilising long-term and rapid response data collection
- Provided safety confidence to site operation teams
- Maintained live railway and public access during works
- Supplier first UK deployment of Worldsensing GNSS monitoring sensors

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How we helped our customer

Summary

Barmouth Viaduct, part of the Cambrian Coast Line in North Wales, operates in a highly aggressive marine environment where tidal movement and saltwater exposure all contribute to the degradation of its sea wall. As part of a redevelopment scheme, next to the foundations of a live railway viaduct, sheet piling works were planned close to reinforce the sea wall defence. Any ground movement had the potential to affect the stability of the viaducts foundations and supporting columns due to close excavation.

To support safe construction and inform refurbishment planning, DYWIDAG deployed event detection tilt sensors and GNSS sensors, powered by Worldsensing. The system delivered continuous real-time structural performance data, enabling engineers to monitor movement behaviour during construction and make evidence-based decisions regarding long-term asset management.

- **Location** Barmouth, Gwynedd, Wales, UK.
- **Client** Network Rail.
- **Timeline** February 2025.- ongoing
- **Partners** Alun Griffiths.
  Ymgynghoriaeth Gwynedd Consultancy (YGC).
- **Products** DYWIDAG's event detection tilt sensors and GNSS sensors, powered by Worldsensing with integration into DYWIDAGs Infrastructure Intelligence platform. This project represents the first commercial deployment of Worldsensing GNSS on a live monitoring project.

Project Wins

Construction risk management supported by structural monitoring data: Structural monitoring used to give the client asset safety confidence.

Supplier first UK deployment of GNSS: Long-term trend structural behaviour under live train loading

Reduced inspection risks in a tidal marine environment: Remote monitoring reduced the need for inspections with difficult access over water.

Installation under operational railway constraints: Monitoring equipment installed without disrupting either railway and pedestrian access.

Improved long term asset management: Continuous data supports maintenance planning and evidence-based investment decisions

Case Study: Barmouth Viaduct

The Problem

Redevelopment works were planned along the seafront at Church Street in Barmouth, directly adjacent to a railway viaduct carrying the Cambrian Coast Line. The works included reconstruction of the existing sea wall and significant piling activities close to the railway structure.

These construction activities had the potential to induce ground movement and unwanted settlement that could affect the viaduct piers. To safeguard the railway asset, monitoring was required to confirm that no undue movement or settlement occurred during the construction works.

The monitoring system needed to detect both short term movement caused by construction activity and long term settlement behaviour of the viaduct piers.

The Challenge

The constrained nature of the site made conventional monitoring approaches unsuitable.

A traditional survey-based monitoring regime using prisms and automated total stations was considered. However, this approach was not feasible due to several constraints:

- Restricted line of sight caused by varying areas of the viaduct structure
- Changing construction conditions during the works
- Security and site compound restrictions affecting equipment placement
- The need for continuous monitoring rather than periodic manual surveys

A monitoring solution was required that could provide reliable long-term settlement data whilst also detecting any sudden structural movement.

The Solution

To manage these risks, DYWIDAG deployed its event detection tilt sensors and GNSS sensors, powered by Worldsensing with integration into DYWIDAGs Infrastructure Intelligence data hosting platform.

The system was designed to deliver:

- Baseline structural movement data prior to construction
- Continuous monitoring during piling operations
- Immediate visibility of structural behaviour
- Automated alerts if predefined thresholds were exceeded

Wireless tilt sensors with event detection were installed at key structural locations on the viaduct piers to record rotational movement of the viaduct piers. These type of sensors operate with a real-time alerting latency of sub 5 seconds, therefore allowing site teams to work confidently all whilst knowing that if works caused issues these would be notified without delay.

GNSS monitoring, a relatively new adoption of this technology within the SHM sector was implemented as a direct alternative to an ATS, this was used to measure long-term settlement trends across the structure rather than the fast response.

Together, the monitoring network gave the client a full view of the structure with the fast response safety element at the forefront of the monitoring solution.

The Result

The monitoring system provided continuous real-time data on the structural behaviour of the viaduct during adjacent sea wall upgrade works.

This enabled the project team to:

- Track structural movement during construction
- Verify that the viaduct remained within defined tolerance limits
- Maintain confidence in construction progress near a live rail asset
- Receive rapid alerts if structural movement thresholds were exceeded
- Monitor structural behaviour without interrupting railway operations

The monitoring data provided clear visibility of the viaduct's response throughout the works, allowing construction activities to proceed safely while supporting future maintenance planning.

> "The works we were undertaking involved sheet piling in close proximity to a Network Rail viaduct, so high precision monitoring was required to establish baseline movement and define acceptable tolerance levels before works began.
>
> DYWIDAG's monitoring solutions allowed us to track the response of the viaduct piers in real time while the piling works were underway. This gave the project team confidence in how the structure was reacting and allowed us to progress the works with clear visibility of movement thresholds.
>
> Communication and technical support from DYWIDAG throughout the project was excellent, with the team working closely with both ourselves and Network Rail to explain how the monitoring system operated."
>
> **- Petra Irvine, Principal Engineer, Ymgynghoriaeth Gwynedd Consultancy - YGC**

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