



## FlexiMeasure™

Application Focus: Tunnel Monitoring



### Tunnel Monitoring Challenges

Construction of every tunnel presents unique challenges and can be unpredictable. Monitoring is necessary to alert stakeholders to subtle changes in subterranean conditions to protect the integrity of the structure, third party assets and the safety of people. Monitoring tools such as inclinometers have been used to measure deformation for at least 30 years. Widely available inclinometer options share a number of limitations however: they tend to be heavy and hard to handle, power-hungry and not very flexible. This limits their value in tunnelling applications.

Other survey based options are also widely used, such as automated total stations and laser scanners but their value is often limited by factors such as lack of mains power and satellite/cellular coverage, restricted access opportunities, no line of sight, aggressive environmental conditions (including extreme temperatures, moisture, vibration, dust, acidity/alkalinity and combustible gases), and lack of space, particularly near the tunnelling face where most movement occurs.

### Solution: FLEXIMEASURE™

FlexiMeasure™ from Senceive provides an alternative that is easy to install, lightweight, wireless and robust, provides reliable and accurate data in the most difficult environments and is ideal for use during construction, or for long-term structural health monitoring.

Due to its highly flexible joints, simple masonry fixings and short carbon fibre segment lengths, a FlexiMeasure™ string can be installed around a tunnel arch with minimal effect on clearance. Applications can range from the biggest road tunnels to much smaller utility tunnels with a diameter of as little as two metres, FlexiMeasure can be fitted quickly and simply to monitor convergence or divergence for many years.

The carbon fibre segments can be connected in seconds and are available in four lengths, ranging from 0.5 metre to 3 metres. Up to 32 segments can be used per string. Segment lengths can be mixed to fit the structure. With a single one metre segment weighing just 250 grammes it is often possible for one person to carry a full system to site and install it in less than an hour.

Because it is quick to install and easy to re-deploy it is ideal for use on structures that are under construction, FlexiMeasure™ self-configures on site, with data transmitted via a smart gateway immediately after it is installed, cutting the need for a detailed installation report. The robust IP67 gateway has internal memory and provides a 4G communication uplink to WebMonitor – Senceive’s cloud based visualisation software. It is engineered for low power operation and to supply the system with uninterrupted communications and power from its on-board battery or optional solar PV panel or DC supply.

**FlexiMeasure™ simplifies complex monitoring applications, providing a precise, robust way to monitor movement. If you are responsible for the long-term integrity of underground structures whether in transport, utilities or mining you should consider FlexiMeasure™ for your next project.**