# Predictive maintenance: innovative monitoring systems for a new era in structural engineering.

**ABSTRACT**

The article analyzes the evolutionary potential of infrastructure management through the adoption of digital technologies for predictive monitoring. In particular, it illustrates an innovative system that integrates IoT sensors on bolted joints to detect in real time the evolution of clamping force, dynamic behavior, and other fundamental operating parameters for monitoring the health of steel structures, with particular reference to joint nodes. The system involves data collected by a distributed network of field sensors, sent to the cloud platform through cutting-edge communication technologies, being analyzed using advanced machine learning algorithms capable of identifying patterns, anomalies, and predicting critical structural behavior. Two case studies demonstrate its effectiveness: the first concerns support for the development of the FREEDAM technology at the University of Salerno, culminating in the continuous monitoring of bolted beam-column connections designed with resilience criteria for anti-seismic applications and implemented on a three-story pilot building; the second case study concerns the monitoring of the support structure of a warehouse roof during the testing and commissioning phases, where the system detected variations related to the redistribution of stresses acting on the joints, promptly supporting structural reinforcement maintenance actions. The paper highlights how monitoring, the development of digital solutions applied to the world of structures and infrastructure, and predictive analysis are strategic tools for safety, efficiency, and sustainability in the management of the life cycle of structures.