

## Expansion Joints and Bridge Bearings as Smart Monitoring Devices

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### Abstract

Expansion joints and bridge bearings are ideal devices for Smart Structural Health Monitoring.

Expansion joints are suitable for the determination of actual vehicle loads, as they are installed in all large span bridges and are directly loaded by overrolling traffic. Knowing the precise traffic loading is crucial for e.g. determination of the remaining bridge service life for the numerous bridges in need of rehabilitation measures.

Bridge bearings enable a pooled load transfer and movements and rotations with small restraining effects. The majority of changes in the state of the bridge have a direct effect on the loading and the rotation and displacement of bearings. E.g. a change of stiffness will lead to a change of the bearing load and the bearing rotation resp. displacement. Monitoring the reactions and loading of bridge bearing is a cost-effective monitoring measure for the primary structural system. If the bearing system is completely replaced by smart monitoring bearings it is feasible to determine the exact dead load which allows a reduction of the partial safety factor  $\gamma_G$  [4].

This paper describes a smart monitoring expansion joint and two smart monitoring spherical bearings, which are installed in a real bridge, i.e. the German pilot project "Smart Bridge in the Digital Motorway Test Bed". The devices have been extensively tested in laboratory tests and on a test bed, but it is the first application of both smart monitoring devices in a real bridge with normal traffic.

**Keywords:** bridge monitoring; expansion joints; load, rotation, displacement measurements; traffic load measurement; spherical bearings for monitoring; smart bridge

### 1 Introduction

Periodic inspection is currently the basis of bridge maintenance management. Maintenance measures are planned and executed based on the observation of visible damages. It is a damaged-based and reactive approach, since damage must be visible to be recorded.

The aim of numberless research projects is to monitor bridge properties with sensors to provide

information about deterioration processes. In addition many research activities were conducted to develop Weigh-in-motion systems and/or bridge-weigh-in-motion systems to measure the traffic loading.

By equipping bearings and expansion joints with sensors and using post-processing tools the target is to observe the damage before it is happened.