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ABSTRACT:

Application of Distributed Fiber Optic Sensor (DFOS) Technique for Structural Health Monitoring (SHM) in Civil Engineering

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The preservation of existing building structures is a task of increasing importance worldwide. Through appropriate long-term monitoring, it is possible to obtain information about the existing building conditions. By analyzing the collected data, essential unfavorable changes can be detected in a timely manner offering the basis for development of effective maintenance or strengthening measures.

There are many different monitoring techniques available, differing in their technological basis. Distributed fiber optic measurement systems based on Rayleigh and Brillouin scattering offer many advantages in comparison to other monitoring technologies. They enable strain measurement in a maximum measurement range of up to 50 m to 100 m (Rayleigh scattering), respectively 50 km to 80 km (Brillouin scattering). In case of low measurement range, the spacing between ajacent measurement points is less than 1 mm, resulting in a quasi-continuous strain measurement over the entire sensor length.

Distributed fiber optic sensors (DFOS) consists of an optical fiber, mostly glass fiber, that is protected by cladding and coating. DFOS are usually fixed at the surface on construction members. But it is also possible to arrange DFOS inside of concrete members if they are set in position during the casting process of fresh concrete. The accuracy of the strain measurement is influenced by the bond between the DFOS and contacted construction material. Therefore, a quality assurance concept was developed to ensure the effectiveness of DFOS. Furthermore, a research program was performed to investigate the influence of moisture on measurement results.

With DFOS, a powerful tool for monitoring building structures is available. Numerous practical applications, for example in bridge construction or wide-span roofs, have already proven its suitability.