World Academy of Science, Engineering and Technology
International Journal of Civil and Architectural Engineering
Vol:16, No:09, 2022

Structural Health Monitoring using Fibre Bragg Grating Sensors in Slab and Beams

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Abstract : Many existing and newly built structures are constructed on the design basis of the engineer and the workmanship of the construction company. However, when considering larger structures where more people are exposed to the building, its structural integrity is of great importance considering the safety of its occupants (Raghu, 2013). But how can the structural integrity of a building be monitored efficiently and effectively. This is where the fourth industrial revolution step in, and with minimal human interaction, data can be collected, analysed, and stored, which could also give an indication of any inconsistencies found in the data collected, this is where the Fibre Bragg Grating (FBG) monitoring system is introduced. This paper illustrates how data can be collected and converted to develop stress – strain behaviour and to produce bending moment diagrams for the utilisation and prediction of the structure's integrity. Embedded fibre optic sensors were used in this study– fibre Bragg grating sensors in particular. The procedure entailed making use of the shift in wavelength demodulation technique and an inscription process of the phase mask technique. The fibre optic sensors considered in this report were photosensitive and embedded in the slab and beams for data collection and analysis. Two sets of fibre cables have been inserted, one purposely to collect temperature recordings and the other to collect strain and temperature. The data was collected over a time period and analysed used to produce bending moment diagrams to make predictions of the structure's integrity. The data indicated the fibre Bragg grating sensing system proved to be useful and can be used for structural health monitoring in any environment. From the experimental data for the slab and beams, the moments were found to be64.33 kN.m, 64.35 kN.m and 45.20 kN.m (from the experimental bending moment diagram), and as per the idealistic (Ultimate Limit State), the data of 133 kN.m and 226.2 kN.m were obtained. The difference in values gave room for an early warning system, in other words, a reserve capacity of approximately 50% to failure.

Keywords : fibre bragg grating, structural health monitoring, fibre optic sensors, beams
Conference Title : ICCET 2022 : International Conference on Concrete Engineering and Technology
Conference Location : San Francisco, United States
Conference Dates : September 27-28, 2022