

Long-Term Seismic Monitoring Of Multi-Span Highway Bridge And Bearing Malfunction Detection By Wireless Sensor Network

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This paper describes a research work on the long-term seismic monitoring of multi-span highway bridge using wireless sensor network. The monitoring system implements a newly developed wireless sensor network, which is based on simultaneous high-speed flooding technique. Object of the study is a continuous 12-span highway bridge with the total length of 381.8-m in Ibaraki prefecture, Japan. The structure is supported by natural rubber bearings at the piers and abutments. Some of the bearings were damaged by the 2011 Great East Japan (Tohoku) Earthquake and was retrofitted afterwards. Wireless sensor network consisting of 20 triaxial accelerometers were installed on the bridge at several locations on the piers, abutments, girder and on the ground. The monitoring system had been in place since 2017 and successfully recorded structural responses from 63 small-to-moderate scale earthquakes until December 2020 in the 45 months of monitoring period that include the responses due to near-field and far-field earthquakes. This paper describes the wireless sensor network system, the scheme for monitoring system and analysis of recorded earthquakes including the girder, piers, and bearings response characteristics. One of the monitoring objectives is to detect seismic bearing condition directly from seismic records. For this purpose, instantaneous frequency of continuous wavelet and detail components of discrete wavelet transform are utilized as structural features, and they characterize isolation bearing condition via statistical clustering technique.