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Estimation of the Dynamic Fragility of Padre Jacinto Zamora Bridge Due to Traffic Loads

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Abstract : The Philippines, composed of many islands, is connected with approximately 8030 bridges. Continuous evaluation of the structural condition of these bridges is needed to safeguard the safety of the general public. With most bridges reaching its design life, retrofitting and replacement may be needed. Concerned government agencies allocate huge costs for periodic monitoring and maintenance of these structures. The rising volume of traffic and aging of these infrastructures is challenging structural engineers to give rise for structural health monitoring techniques. Numerous techniques are already proposed and some are now being employed in other countries. Vibration Analysis is one way. The natural frequency and vibration of a bridge are design criteria in ensuring the stability, safety and economy of the structure. Its natural frequency must not be so high so as not to cause discomfort and not so low that the structure is so stiff causing it to be both costly and heavy. It is well known that the stiffer the member is, the more load it attracts. The frequency must not also match the vibration caused by the traffic loads. If this happens, a resonance occurs. Vibration that matches a systems frequency will generate excitation and when this exceeds the member's limit, a structural failure will happen. This study presents a method for calculating dynamic fragility through the use of vibration-based monitoring system. Dynamic fragility is the probability that a structural system exceeds a limit state when subjected to dynamic loads. The bridge is modeled in SAP2000 based from the available construction drawings provided by the Department of Public Works and Highways. It was verified and adjusted based from the actual condition of the bridge. The bridge design specifications are also checked using nondestructive tests. The approach used in this method properly accounts the uncertainty of observed values and code-based structural assumptions. The vibration response of the structure due to actual loads is monitored using installed sensors on the bridge. From the determinacy of these dynamic characteristic of a system, threshold criteria can be established and fragility curves can be estimated. This study conducted in relation with the research project between Department of Science and Technology, Mapúa Institute of Technology, and the Department of Public Works and Highways also known as Mapúa-DOST Smart Bridge Project deploys Structural Health Monitoring Sensors at Zamora Bridge. The bridge is selected in coordination with the Department of Public Works and Highways. The structural plans for the bridge are also readily available.

Keywords : structural health monitoring, dynamic characteristic, threshold criteria, traffic loads
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