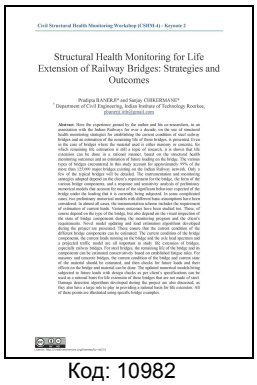
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Structural Health Monitoring for Life Extension of Railway Bridges: Strategies and Outcomes

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Here the experience gained by the author and his co-researchers, in an association with the Indian Railways for over a decade, on the use of structural health monitoring strategies for establishing the current condition of steel railway bridges and an estimation of the remaining life of those bridges, is presented. Even in the case of bridges where the material used is either masonry or concrete, for which remaining life estimation is still a topic of research, it is shown that life extension can be done in a rational manner, based on the structural health monitoring outcomes and an estimation of future loading on the bridge. The various types of bridges encountered in this study account for approximately 99% of the more than 125,000 major bridges existing on the Indian Railway network. Only a few of the typical bridges will be detailed. The instrumentation and monitoring strategies adopted depend on the client's requirement for the bridge, the form of the various bridge components, and a response and sensitivity analysis of preliminary numerical models that account for most of the significant behaviour expected of the bridge under the loading that it is currently being subjected. In some complicated cases, two preliminary numerical models with different basic assumptions have been considered. In almost all cases, the instrumentation scheme includes the requirement of estimation of current loads. Various outcomes have been studied too. These, of course depend on the type of the bridge, but also depend on the visual inspection of the state of bridge components during the monitoring program and the client's requirements. Novel model updating and load estimation algorithms developed during the project are presented. These ensure that the current condition of the different bridge components can be estimated. The current condition of the bridge components, the current loads running on the bridge and the axle load spectrum and a projected traffic model are all important to study life extension of bridges, especially railway bridges. For steel bridges, the remaining life of the bridge and its components can be estimated conservatively based on established fatigue rules. For masonry and concrete bridges, the current condition of the bridge and current state of the material should be estimated, and then checks for future loads and their effects on the bridge and material can be done. The updated numerical models being subjected to future loads with design checks as per client's specifications can be used as a rational basis for life extension of these bridges that are not made of steel. Damage detection algorithms developed during the project are also discussed, as they also have a large role to play in providing a rational basis for life extension. All of these points are illustrated using specific bridge examples.

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Ключевые слова:

Содержание