RELIABILITY STUDIES ON RC BRIDGE PIERS CONSIDERING ULTIMATE LIMIT STATE

A THESIS

submitted by

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“You have a right to perform your prescribed duties, but you are not entitled to the fruits of your actions. Never consider yourself to be the cause of the results of your activities, nor be attached to inaction.”

-Bhagavad Gita 2.47

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ABSTRACT

Keywords: Structural reliability, High-dimensional model representation, Hammer head pier, Railway Bridge.

Bridge piers are considered key structural elements of a bridge because of the higher stress concentration in them. Reliability studies on single column hammer head piers have been studied extensively for different loading conditions and limit states. However, the same needs to be explored with respect to railway bridges using rational numerical methods. The present study aims to evaluate the safety index of commonly used double column hammer head piers in rail bridges using Monte Carlo simulation by considering uncertainties in demand and resistance.

Variability in demand is limited to live load (variation of rail loads), self-weight of the super-structure and the super-imposed dead loads, wind load and seismic load. Material and geometric parameters have been considered as random variables to include the effect of uncertainties in the sectional resistance of the pier. Variability in characteristic strength of concrete, yield strength of steel, diameter of the pier, effective cover of the pier and cross sectional area of the reinforcement bars are considered in the current study. In order to arrive at more realistic values of reliability, ready mix concrete strength data was collected and the strength model of corresponding concrete is used.

Reliability of the piers are calculated considering axial-flexural and axial-shear interactions. In order to reduce the computational time of simulations using actual model, High-dimensional model representation formulations are used in determining an explicit relationship between the uncertainties considered and capacity of the pier section. Correlations of the random variables up to second order are considered in generating the Response Surface using Lagrange interpolation function. HDMR approximate function is generated only for the capacity model.

Additionally, parametric studies have also been conducted to obtain results of practical significance.

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