



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : Sumantra Sengupta

Roll Number : 146104019

Programme of Study : Ph.D.

Thesis Title: **STUDIES OF LONG HIGH LEVEL RAILWAY BRIDGES IN HIGH SEISMIC ZONE**

Name of Thesis Supervisor(s) : Prof. Anjan Dutta

Thesis Submitted to the Department/ Center : Civil Engng. Deptt.

Date of completion of Thesis Viva-Voce Exam : 13.12.2023

Key words for description of Thesis Work : Long span tall pier bridge, Confinement effect in large hollow pier, Asynchronous ground motion effect, TMD for reduction of CDA

SHORT ABSTRACT

Studies of long, high-level railway bridges in seismically active areas are presented in the thesis. For the current study, three different topics have been selected: 1) The response reduction factor (R) of large diameter hollow circular pier section, 2) Asynchronous motion and its impact on tall pier railway bridge response, and 3) The impact of tuned mass damper (TMD) on vehicle-induced vertical response of long span railway bridges. R is significantly affected by the pier's slenderness effect. Therefore, non-slender piers with slenderness ratios less than 50 should use the recommended values. The code recommended single values for similar structural elements are found to be on the higher side in some cases, leading to uneconomic design, and on the lower side in some other cases, leading to unsafe design when compared to the recommended R values for the hollow circular pier under the current study.

The ground motion input in the pile spring for asynchronous motion has been converted from acceleration time history to displacement time history because the governing equation requires the displacement time history. For this study, two distinct seismic occurrences, the Koyna earthquake and the El Centro earthquake, have been considered. As we consider those piers along the direction of earthquake motion, we find that under the considered earthquake excitation for the bridge under study, the pier top displacement decreases in the case of asynchronous motion as compared to synchronous ground excitation, but the relative displacements at pier tops are higher than those of the synchronous case. Additionally, it has been discovered that the impact of track curvature caused by synchronous and asynchronous motion is case-sensitive and dependent on the properties of ground motion itself.

For better comprehension of the impact of vehicle-induced response in the steel superstructure, the Vehicle Bridge Interaction model has been developed. In the current study, a 27 DOF vehicle model, as suggested by Young and Wu (2001), has been used. To obtain the actual dynamic augmentation during vehicle movement, the impact of track irregularity has also been taken into consideration. The use of a single TMD results from the vehicle-induced response occurring primarily in first mode due to the structure's simple support. With a single bogie loading at a speed slightly above the typical speed range, it has been discovered that the effect of TMD is significant. As the resonance effect does not happen, it is not at all significant for multiple bogie loading at any speed. In light of this, it has been determined that TMD is ineffective for long-span steel railway bridges.

