INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: **Hybrid Simulation of Retrofitted RC Bridge with Fe-based Shape Memory Alloy**

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SHORT ABSTRACT

A new scheme for active confinement of concrete using cost-effective Fe-shape memory alloy (Fe-SMA) strips was explored as an alternative to the expensive NiTi-based SMAs. The axial stress-strain behaviour of concrete partially wrapped by Fe-SMA strips was experimentally investigated. An empirical stress-strain model was proposed for accurate prediction of behaviour of Fe-SMA confined plain concrete. Further, 3D FE analyses of concrete specimens with varying concrete strength, internal reinforcement and external Fe-SMA confinements were carried out and an empirical model was proposed for further improved prediction of uniaxial compressive behaviour of Fe-SMA confined RC specimens.

The use of Fe-based shape memory alloy (SMA) strips for seismic retrofitting of rehabilitated RC bridge pier models was investigated in this study. Three configurations of Fe-SMA strips namely hoop (H), end-anchored (EA) and a combination of previous two approaches (EAH) were adopted. To compare the seismic performance of the various Fe-SMA retrofitted test specimens with respect to the control specimen, hybrid simulation of an existing highway bridge located in Tripura, India was carried out with the scaled bridge pier test models as experimental elements. Bridge pier specimen with Fe-SMA in the form of EA reinforcement exhibited enhanced load carrying capacity but marginal improvement in ultimate displacement while Fe-SMA hoops improved the ductility of the test specimen with marginal improvement in peak lateral load. Combination of EA and hoop Fe-SMA reinforcement was found to be more efficient in improving all the seismic performance parameters.

The comparison of experimental results with those from the numerical model highlighted the need for model calibration to improve the response. Bond-slip effects and slip at the jacket-pier interface was approximately accounted for in the updated model. The parameters of Fe-SMA confined plain as well as reinforced concrete were obtained from the empirical stress-strain models developed earlier. The force-displacement hysteretic behaviour of the test specimens obtained from the updated model agreed well with those obtained from experiments. Additionally, the bridge pier specimens with different Fe-SMA strip configurations were simulated using ABAQUS. The resulting base shear-time histories generated at the base of the pier in the FE model were compared with the experimental results for validation of the 3D FE model.