INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title:

STUDIES ON RESTRAINED STEEL BEAMS AND ITS MATERIAL CHARACTERIZATION UNDER HEATING AND COOLING FIRE

Name of Thesis Supervisor(s)	:	Prof K Darunkumar Singh (IITG) Prof S Arul Jayachandran (IITM)
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This thesis presents results from material level experimental tests on E350 steel and 10.9 grade level bolts as well as numerical studies on steel beams having an I shaped cross-section. The experimental program comprised of subjecting specimens to monotonic heating as well as heating followed by cooling scenarios to simulate natural conditions as expected during fire exposure. Post—fire properties were evaluated as part of the experimental studies as well. The results from the experimental program were used to derive temperature dependent mechanical properties of E350 steel during heating, cooling, and residual conditions of fire exposure. These results were then combined with studies published in literature to propose reduction factors in mechanical properties of E350 steel. Similarly, results from experiments conducted on tensile and shear capacity of 10.9 grade bolts during heating, cooling and residual phases are presented. A three-dimensional numerical model of a steel I beam was developed using general purpose software Abaqus. The numerical studies were focused on predicting evolution of axial (catenary) forces that develop in the steel beam for varying support conditions (restraint levels) and load levels. The mechanical properties derived for the heating and cooling phases through experimentation were applied in this numerical model. Furthermore, the axial (catenary) forces that develop during heating and cooling phases of fire exposure were predicted with the help of the numerical model. A parametric study was conducted using the validated numerical model. An analytical model to calculate the catenary forces and critical temperature of the beam for design purposes is also proposed.