INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title: RESPONSE SURFACE FUNCTION FOR DETECTING CRACK PARAMETERS IN THIN WALLED BEAMS

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SHORT ABSTRACT

Damage or crack can be expressed as changes arising in a structure that may affect its ongoing or future performance, concerning its safety and serviceability. It needs to be mentioned that damage forming cracks rapidly propagate under repeated and reversal loading. Therefore, early prediction of this damage can help in increasing their life span and avert unexpected modes of failure.

In the present work, a generalized finite element (FE) model for arbitrary cross-sectional thin-walled uncracked and cracked beams has been developed. Element stiffness and mass matrix have been derived based on energy formulations. The FE model has been improved by including the warping stiffness in the uncracked and cracked beams. Line-spring elements have been assumed to model the cracks. In the present study, beams with one axis of symmetry and with no axis of symmetry have been considered since these types of thin walled beams exhibit coupled bending–torsion behavior. For practical implementation of the FE model, channel and angle section beams of mild steel are considered in the study. Present study outlines an integrated inverse approach for health monitoring of straight and horizontally curved thin walled open section beam using a combined Finite element method (FEM), Response surface methodology (RSM) and Genetic algorithm (GA) for the detection of crack parameters. Finite element (FE) simulations based on Central composite face-centered (CCF) design approach has been chosen in order to obtain the coefficients of a polynomial model for the Response surface function (RSF). Once a model (RSF) has been found significant, the optimum crack parameters are obtained by minimizing an objective function using a searching tool, GA. The objective function has been established by root mean square (RMS) of the residuals between the computed responses from RSFs and measured responses. The present identification approach has great potential in crack detection as it does not require the response of an uncracked beam as baseline criteria. Moreover, the present hybrid approach can identify external force satisfactorily through optimization process.