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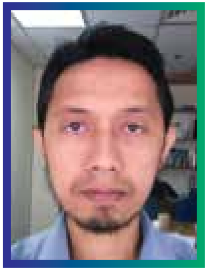

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Title : BENDING COLLAPSE AND ENERGY ABSORPTION OF CONVENTIONAL AND INSERT-REINFORCED CLOSED-HAT-SECTION BEAMS

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Closed-hat-sections are a generic form of structural profiles used in vehicular structures. The bending behavior of a closed-hat-section beam is largely dependent on its section shape, dimension, and material. Despite being used widely in many applications, extensive study on design development and research information are still lacking. Introducing the insert-reinforcement into conventional design of closed-hat-section beam offers possibility of improving the bending resistant as well as energy absorption performance such as SEA, CFE, and DAF for energy absorber application. The primary aim of this thesis was to generate research and design information on the collapse mechanism, impact, and energy absorption characteristics of conventional and insert-reinforced closed-hat-section beams in order to facilitate their application in energy absorbing systems. A series of validation procedures of FE models through experiment and remodel were described. The validated FE models were used in parametric study of quasi-static and impact bending. To further analyze their collapse mechanism and analytical solution, two established analytical models for pure bending and one for three-point bending condition were modified and validated via FE simulation. Both analytical models for pure bending were derived using energy method and the three-point bending was derived using force-moment equilibrium method. Research findings show that the energy absorption response can be controlled by varying some of the geometries and number of insert. The wall thickness, web, and flange width can be used as parameters to control the amount of absorbed energy. However, the greatest effect on absorbed energy is the wall thickness. It was also evident that insert reinforcement can enhance the energy absorption capacity and reduces the inertia effect sensitivity by providing more plastic deformation during bending. Nevertheless, as far as energy absorption performance is concerned, higher number of insert seems to have a lower or similar performance with fewer insert reinforcement or even with conventional beam. Here, the use of ultra light-weight insert such as Magnesium and hybrid composite is desirable. The modified analytical models for pure bending have resulted in complex limit equations and were solved using numerical approach. Moment-rotation relationships acquired from both solutions showed good agreement with simulation. Another analytical solution has successfully predicted the pattern of load-deflection relationship under point bending. Useful empirical models to simplify the lengthy analytical solutions were also developed to predict the moment-rotation curves of conventional and insert-reinforced closed-hat-section beams as described in this thesis.