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# Reliability Based Design Optimization for High-Strength Steel Tailor Welded Thin-Walled Structures under Crashworthiness

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## Abstract

Tailor welded blanks (TWB) have been widely applied in automobile industry for their noteworthy weight and performance ratio. This paper firstly conducts experimental tests to investigate the crashworthiness of three different types of TWB hat-shaped structures. Their combinations provide three representative TWB configurations: namely the same material grade (DP590) with different wall thicknesses (1.0 mm, 1.5 mm); different material grades (DP590, DP780) with the same wall thickness (1.5 mm), different material grades (DP590, DP780) with different wall thicknesses (1.0 mm, 1.5 mm), respectively. Secondly, the finite element (FE) models corresponding to each of experimental samples are established to perform crashworthiness analysis. It is exhibited that the FE simulations are in good agreement with experimental tests. Thirdly, surrogate models are constructed to approximate the crashworthiness responses of these TWB structures. Fourthly, a sensitivity analysis is conducted to explore the effects of the weld line location, wall thickness and material properties for each segment of TWB structures subject to crashing load. The results showed that the wall thickness is most sensitive to the crashworthiness of TWB structures. Finally, reliability based design optimization (RBDO) is carried out by taking into account the uncertainties in TWB configuration. The results demonstrate that the optimized TWB tubes are capable to significantly improve energy absorption as well as increase the reliability, potentially being an ideal structural configuration for crashworthiness.