

Comparative Study of Crash Performance and Lightweight Effect between Steel Roll-formed and Aluminum Extruded Bumper Beams

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Automobile bumper beam which is one of the most important safety parts during front crash accident, is mainly subjected to a bending load and plays a key role in absorbing energy in collisions and protecting occupants. In this study, firstly a benchmark study about the material, manufacturing method and key external dimensions of bumper beam was performed. It is found that it has mainly the following kinds of structures: steel or aluminum press forming, steel roll forming and aluminum extrusion, and the external dimensions of central cross section, i.e. the height of flange at collision side H and width of cross section L , focus on the ranges of 90mm~160mm and 30mm~80mm, respectively. And then steel roll-formed and aluminum extruded bumper beams (Fig.1) which have a characteristic of constant cross section along the longitudinal direction were chosen, and a comparative study of crash performance and lightweight effect was conducted via 3-point bending numerical simulation. In which, the lightest aluminum extruded bumper beams according to required performance were obtained by using optimization design technology and the design guidance for thickness values of bumper beam walls became clear (Fig.2). The applicable areas of steel roll-formed part and aluminum extrusion were clarified by comparing the structural results of five types of external dimensions (Fig.3). The steel roll-formed and aluminum extruded bumper beams have almost the same lightweight effect when the external dimensions of central cross section is small, but when the external dimensions become big, the aluminum extruded ones are much lighter than the steel roll-formed ones.

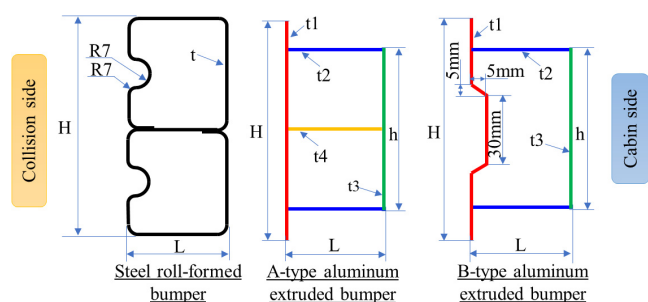


Fig.1 The cross sections of bumpers in this study

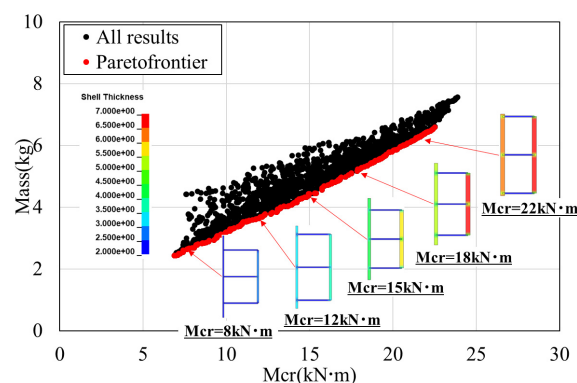


Fig.2 The optimized results of A-type aluminum extruded bumper

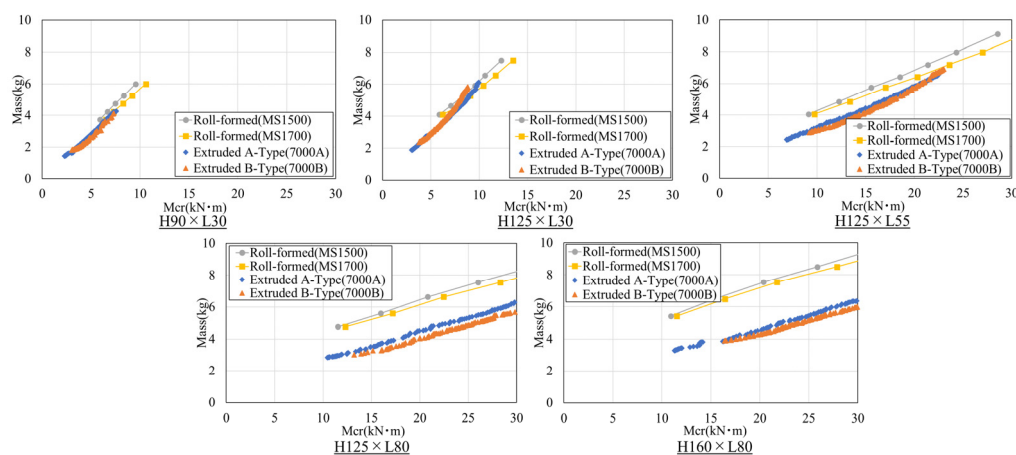


Fig.3 The comparison between steel roll-formed and aluminum extruded bumpers with different external dimensions