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Development of Ultra Lightweight Parts Using Hot Stamping and Laser Welded Patchwork Technology (1st Report)

-Design Optimization of Patchwork Blank and Manufacturing Method Exploration-

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Hot stamping patchwork technology is gathering attention because it can achieve both crashworthiness performance and lightweight by locally increasing strength or thickness. In this study, an optimization method for determining the minimum patchwork blank was developed (Fig.1). Then it was applied to the design of patchwork structures of two hot-stamped parts, a hat-shaped part (Fig.2) and a B-pillar (Fig.3) that are subjected to a bending load, and it was known that it is effective to attach patchwork blanks to the areas near top corners, and the optimized parts with patchwork blanks had the same crashworthiness but became lighter than the original structures with reinforcement. The effects of material strength and thickness on patchwork blank and lightweight effect were investigated. In addition, taking a hot-stamped hat-shaped part as an example, the two manufacturing methods (arc welded overlay patchwork and laser welded patchwork) for realizing the optimized patchwork structure were examined through trial-manufacture, performance evaluation and feature comparison. It was confirmed that two types of patchwork structures had almost the same bending performance and the weight efficiency was about 1.75 times as high as that of the structure without patchwork (Fig.4). However, laser welded patchwork seems to be more realistic than arc welded overlay patchwork from the viewpoint of productivity, manufacturing cost and shape accuracy.

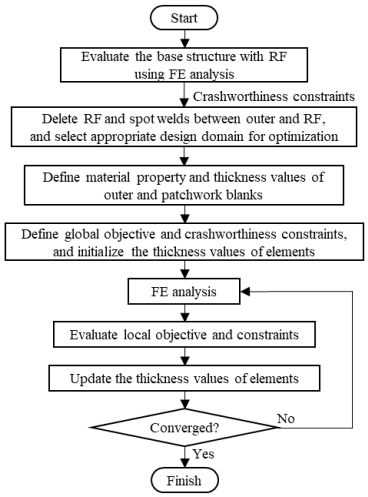

Fig.1 Flowchart of optimization procedure for patchwork blank

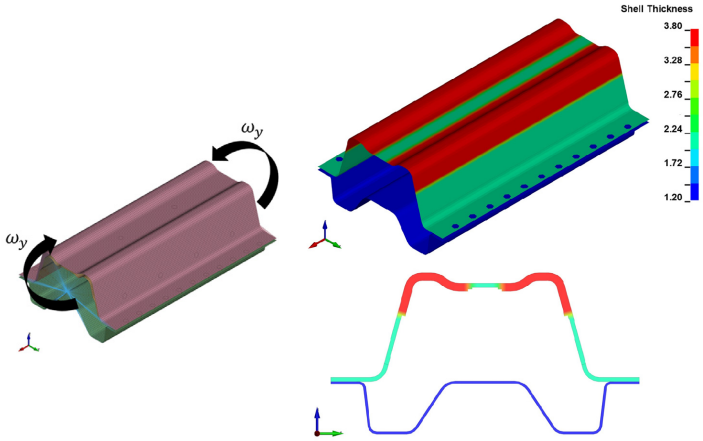

Fig.2 Finite element model of hat-shaped part and optimized result

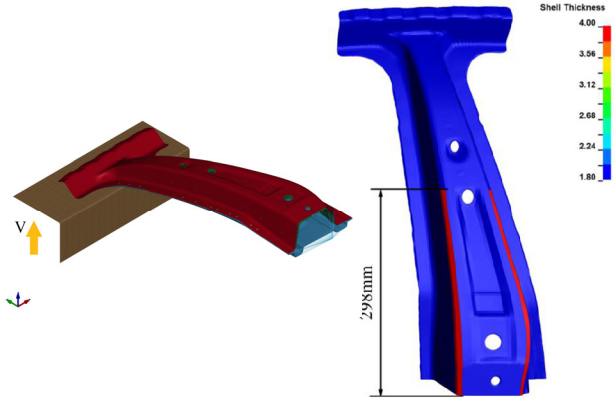

Fig.3 Finite element model of B pillar and optimized result

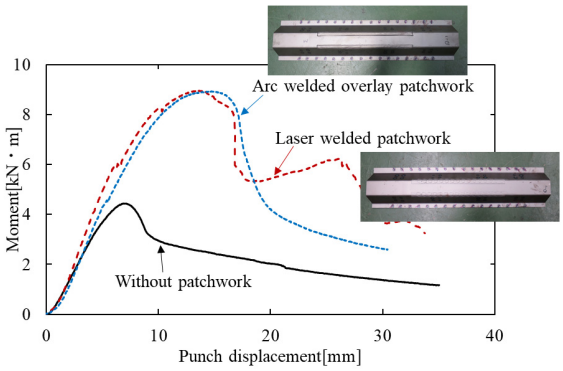

Fig.4 Four-point bending test results of hat-shaped parts