

Visualization of Residual Stress Generation Process in Press-Formed Parts through Coupled FE Analysis of Shearing and Forming Using Solid Elements

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There is a strong demand to apply ultra-high strength steel to press parts; however the difficulty of processing also increases, and the residual stress near the sheared edge is one of the most important issues. To understand the residual stress generation process in press-formed parts made of ultra-high strength steel, coupled FE analysis of shearing and forming using solid elements was conducted. Fig.1 shows the specimen used for the analysis which is made of 1.5GPa ultra-high strength steel sheet. Fig.2 and Fig.3 show the model setups for shearing process and forming process respectively. X-stress time history of picked up elements (Fig.4) from coupled analysis is shown in Fig.5. It is found that some elements retain the tensile stress generated during the shearing process even after forming, others go through both tensile and compressive stress state during forming. Coupled analysis can provide information about which stage of manufacturing process the final residual stress is mainly generated at. Fig.7 shows one of comparisons between the analysis result and the actual measurement of X-stress distribution in the thickness direction. The predicted residual stresses at the sheared edge after forming process are generally consistent with the trends observed in actual measurements. These results indicate that this approach can be an effective tool for evaluating the influence of various factors during processing.

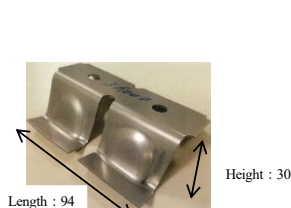


Fig.1 Specimen

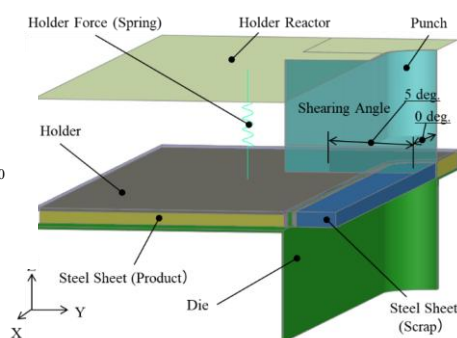


Fig.2 Model of Shearing Process

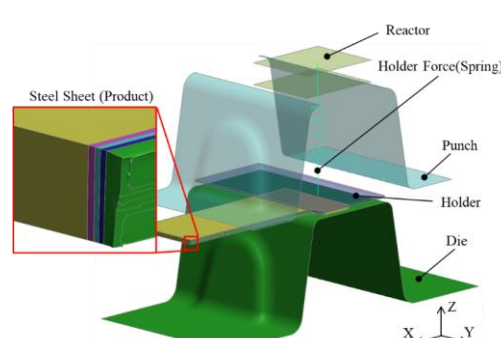


Fig.3 Model of Forming Process

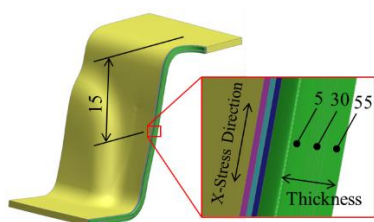


Fig.4 Location of Monitoring Elements

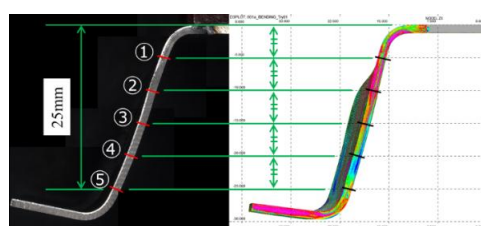


Fig.6 Stress Measurement Positions

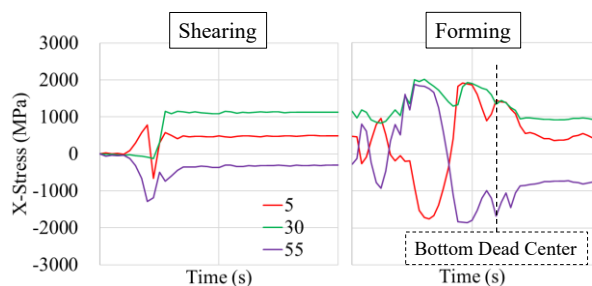


Fig.5 X-Stress Time History

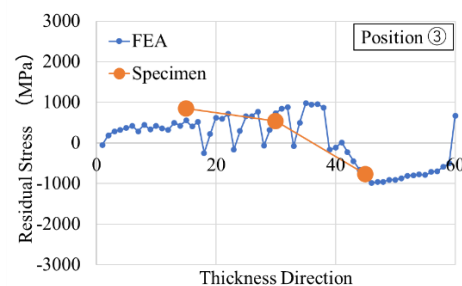


Fig.7 Residual X-Stress Distribution in the Thickness Direction