Modelling of Self-piercing riveting with ALE, CEL and SPH based on Abaqus/Explicit

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ABSTRACT

SPR (Self-piercing riveting) is a cold forming process that is used to fasten together two or more sheets of different materials mechanically with a rivet. Also SPR emulate the results and quality of spot welding without many of the risks, such as toxic fumes, sparks and noise. Thus circumstanced, this technique is widely used on the various filed especially within automobile industry. SPR, in particular, is excellent for lightweight manufacturing and for precise working while dramatically reducing cost and production time. The process deformation depends on the sheet size, shape of die, material flow, stiffness, etc. Also material deformation in both of rivet and workpiece sheets is tremendous large, for instance thinning, necking, shear and penetration [1]. Therefore it is very hard to analyze this forming process with FEM which uses normal stress element formulation due to the collapse. On the other hand, recent commercial FEM code, for examples Abaqus/Explicit, has superb analysis methods such as ALE, CEL and SPH [2]. These analysis methods can treat the large material deformation, while they have weak and strong points respectively. Hence this paper investigated three modeling techniques of Abaqus/Explicit for simulating and optimizing SPR process. In addition, the effectiveness of these analysis methods were discussed and compared for evaluating SPR process forming in order to achieve an optimal die, material properties and suitability of deformations.

REFERENCES

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[2] Abaqus Users Manual, Version 6.14-1, Dassault Systémes Simulia Corp., Providence, RI.