FEM Analysis on Fundamental Relationship between Hydrostatic Stress and Strain Obtained from Uniaxial Tensile Test Using Axial Symmetric Tapered Specimen

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ABSTRACT

In sheet metal forming, it is very important to grasp the forming limit for various in-plane strain paths [1], [2]. And the method to obtain the forming limit diagram was decided in ISO standard. However, the hydrostatic stress changes depending on the strain path. It is known that magnitude of hydrostatic stress affects largely on the occurrence of fracture. Therefore, in order to evaluate the forming limit for each strain path more precisely, a certain new evaluation method considering the hydrostatic stress would be probably necessary. As for the uniaxial tension state, it would be possible to conduct the test with various hydrostatic stress states by using axial symmetry specimen with various shapes. However, there have been few studies in such a sight. So, in this study, we examined the possibility of axial symmetric tapered tensile specimen to evaluate the forming limit of uniaxial tension state in various hydrostatic stress states.

By FEM analysis, hydrostatic stress-strain responses for elastic deformation and in plastic deformation of axial symmetric tapered tensile specimen during uniaxial tensile test were investigated. By changing the taper angle, the possibility of control of hydrostatic stress in tensile tests was also examined.

Form the results, in the elastic deformation region it was found that the hydrostatic stress could be controllable by changing taper angle of axial symmetrical specimen. Hydrostatic stress increased with increasing taper angle. In the plastic deformation region, hydrostatic stress at the centre of the specimen varied non-lineally. The non-lineal curve of hydrostatic stress and equivalent stress became larger with increasing the taper angle. Some trials for correlating the equivalent strain to the hydrostatic stress in terms of the taper angle were conducted, and possibilities of the methods to evaluate forming limit at various hydrostatic stress states using axial symmetry tapered specimen were considered.

REFERENCES

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