The Effect of Geometric Discontinuity and Weld Region on Formability of Tailor Welded Blanks (TWB)

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Abstract

Numerous advantages of application of tailor welded blanks (TWBs) in automobile industry, namely reduction of weight, fuel consumption and air pollution, have made the manufacturers eager to investigate in this field. In this research, the effect of weld zone presence on the formability of transversely CO_2 laser welded TWBs was studied experimentally and numerically (FE-method). The studied TWBs were consisted of IF-steels with different thicknesses (0.8 and 1.2 mm), and limiting dome height as well as forming limit diagram were used for formability assessment. Experiments in regard with limiting dome height test showed that the decisive factor in decreasing the dome height is geometric discontinuity and the effect of weld zone is about 6%. Moreover, simulation results indicated that the consideration of weld zone did not have any observable effect on limiting strains, although tearing occurred at lower punch stroke.

Keywords*:* tailor welded blanks, geometric discontinuity, weld region.

1. Introduction

To meet restricting fuel economy standards while remaining economically competitive, the automotive companies are constantly looking for innovative means of reducing vehicle weight and manufacturing costs, respectively. The use of tailor welded blanks (TWBs) is an opportunity to meet these seemingly conflicting requirements. A TWB consists of two or more base metal sheets with different materials and/or thicknesses and/or coatings welded together in a single plane prior to forming [1]. However, due to great advantages of application of TWBs, it is important to understand and predict the formability of TWBs in the automotive industry during deep drawing process.

A Forming Limit Diagram (FLD) is a graph which depicts the major strains (ε_1) for all values of the minor strain (ε_2) at the onset of localized necking. Experimental determination of a FLD is usually very time consuming and requires special equipments. Many researchers [2-3] have developed analytical and numerical models as an alternative approaches for coping with these difficulties.

As a matter of engineering knowledge, Gurson-Tvergaard-Needleman (GTN) approach is one of the well-known mesomechanical models for ductile fracture [4]. Brunet et al. [5] have

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