Numerical analysis of forming sheet panels with stiffening ribs

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ABSTRACT

The transport industry, especially aviation, pays special attention to vehicle weight because lower weight means lower fuel consumption and in turn lower environmental pollution. Not only light metals like aluminium and magnesium alloys or titanium and its alloys are of interest in the transport industry but also new producing technologies are taken into consideration as factors decreasing structure weight. Sheet metal forming offers light and strong components, therefore monolithic e.g. casting components are often replaced by drawn parts made of sheet metals. To form large panels of thin sheets, especially hard-to-deform sheets with high susceptibility to spring back, is a huge challenge. Forming both aluminium and titanium alloy sheets as well as nickel based steel sheets, which are main structural materials in aviation, is difficult. Titanium, particularly titanium alloys, in comparison to steel and aluminium has a much more beneficial specific strength (strength-to-weight ratio) so it is used where high mechanical strength and low weight of construction are especially essential. On the other hand nickel based superalloys are better suited for service in extreme environments with high pressures and temperatures. Although all these materials have properties, which are sought after by the aviation industry, they are generally difficult in cold sheet-metal forming [1, 2]. There are many technological problems, such as: poor drawability [3], high spring back and low tribological properties [1] that have to be overcome in sheet-metal forming.

In the paper a numerical analysis of forming a part of a large sheet panel will be presented. The numerical simulation will be performed using the PamStamp program specially dedicated to sheet-metal forming. The program is based on the finite element method (FEM). The stress and strain distributions in the panel will be analysed. The effect of the blank-holder force and frictional coefficient on the forming process will be studied. The quality of the obtained drawn part will be assessed based on the correctness of its shape and dimensions with the reference ones, as well as on the thickness of the drawn part material.

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