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LIMIT STRAINS ANALYSIS OF ADVANCED HIGH STRENGTH STEELS SHEETS BASED ON THE SURFACE ROUGHNESS MEASUREMENTS

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In this work, the plastic behavior of cold-rolled zinc coated dual-phase steel sheets DP600 and DP800 grades is firstly investigated by means of mechanical tests, namely, uniaxial tensile, hydraulic bulge, disk compression and Forming Limit Curve technique. The uniaxial tensile tests were carried out at 0o, 45o and 90o angular orientations with respect to the rolling direction to evaluate the mechanical properties and the plastic anisotropy Lankford r-values. The forming limit strains are defined according to Nakajima's procedure. The biaxial stretching behavior is evaluated from hydraulic bulge tests whereas the biaxial anisotropy by means of disk compression. The corresponding mechanical properties are then used as input data to identify the material parameters of an orthotropic yield function. A localization model is used to predict the limit strains of DP600 and DP800 sheets. This model is formulated for plane-stress conditions using elasto-plastic constitutive equations under isotropic linear elasticity and isotropic work-hardening assumptions. In this model, an imperfection parameter must be calibrated from the sheet nominal thickness and average surface roughness values. In order to define this parameter, the surface roughening of both dual-phase steels was evaluated as a function of the plastic strain level under uniaxial tensile deformation mode. The resulting average surface roughness values were obtained with the help of confocal laser scanning microscopy technique. In order to quantify the ferrite and martensite phases of DP600 and DP800 steels as well as the average grain sizes, microstructure characterization was performed using optical microscopy technique and image analysis. From the proposed experimental-modelling combined approach, a good agreement was found between the predicted and experimental limit strain owing to the definition of the imperfection parameter as a function of the surface roughness values of both DP600 and DP800 sheets.