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AN ANALYSIS OF DEFECTS INFLUENCE ON AXIAL FATIGUE STRENGTH OF MARAGING STEEL SPECIMENS PRODUCED BY ADDITIVE MANUFACTURING

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ABSTRACT

Structural parts in metal materials such as steels, aluminium and titanium alloys can be manufactured by powder bed processes, where powder layers are locally melted by laser beam melting (LBM) or electron beam melting (EBM). Referring to maraging steels, the influence of the building direction and of the heat treatment on static and axial fatigue strength was investigated previously. However, a certain scatter of the fatigue test results had been found, because of the presence of detrimental surface and subsurface defects. New axial fatigue test results of maraging steel specimens characterized by different building orientations are presented in this contribution. An analysis of the defects influence on fatigue behaviour is performed on the basis of the initial stress intensity factor of the killer defects examined by SEM observations of the fracture surfaces. The short crack effect has been taken into account by means of the El-Haddad-Smith-Topper model; the relevant material length parameter has been calibrated by matching this model with Murakami's expression of the threshold range of mechanically short cracks. The advantage of the adopted engineering approach is that only Vickers hardness of the material is necessary. By using short crack-corrected stress intensity factors correlation of experimental data could be improved.

Keywords: short crack effect; additive manufacturing; defects; maraging steel; Fracture Mechanics