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Numerical Investigation on Optimizing Fatigue Life in a Lap Joint Structure

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Abstract : The riveting process is one of the important ways to keep fastening the lap joints in aircraft structures. Failure of aircraft lap joints directly depends on the stress field in the joint. An important application of riveting process is in the construction of aircraft fuselage structures. In this paper, a 3D finite element method is carried out in order to optimize residual stress field in a riveted lap joint and also to estimate its fatigue life. In continue, a number of experiments are designed and analyzed using design of experiments (DOE). Then, Taguchi method is used to select an optimized case between different levels of each factor. Besides that, the factor which affects the most on residual stress field is investigated. Such optimized case provides the maximum residual stress field. Fatigue life of the optimized joint is estimated by Paris-Erdogan law. Stress intensity factors (SIFs) are calculated using both finite element analysis and experimental formula. In addition, the effect of residual stress field, geometry, and secondary bending are considered in SIF calculation. A good agreement is found between results of such methods. Comparison between optimized fatigue life and fatigue life of other joints has shown an improvement in the joint's life.

Keywords : fatigue life, residual stress, riveting process, stress intensity factor, Taguchi method
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