

Fatigue Reliability Analysis of Tunnelling Boring Machine Cutterhead with Cracks

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Abstract

The cutterhead of tunnel boring machine is a large-scale metal welding structure, which is prone to problems such as wear and cracking during the tunnelling process. For the issue, the fatigue crack propagation rate model of cutterhead under different reliability was established, based on the damage tolerance of cutterhead. Its dangerous position of cutterhead failure was determined by using finite element method. According to the fatigue load spectrum, the fatigue propagation life of cutterhead under different reliability was calculated, the main factors affecting the reliability of cutterhead were analyzed and the engineering experiment is carried out. The results show that three dangerous positions of the cutterhead failure are the junction of the split plane, the maximum deformation of the block and the central cutter seat. The load stress amplitude and initial crack size are the main factors affecting the crack propagation life and the reliability of cutterhead. With the increase of load stress amplitude and initial crack size of cutterhead, the fatigue crack propagation life of cutterhead decreases and the reliability is worse. When the initial crack size of cutterhead is greater than 0.5mm, the fatigue crack propagation life of cutterhead decreases obviously. The research results provide a scientific basis for crack detection, life prediction and reliability evaluation of cutterhead structure.

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