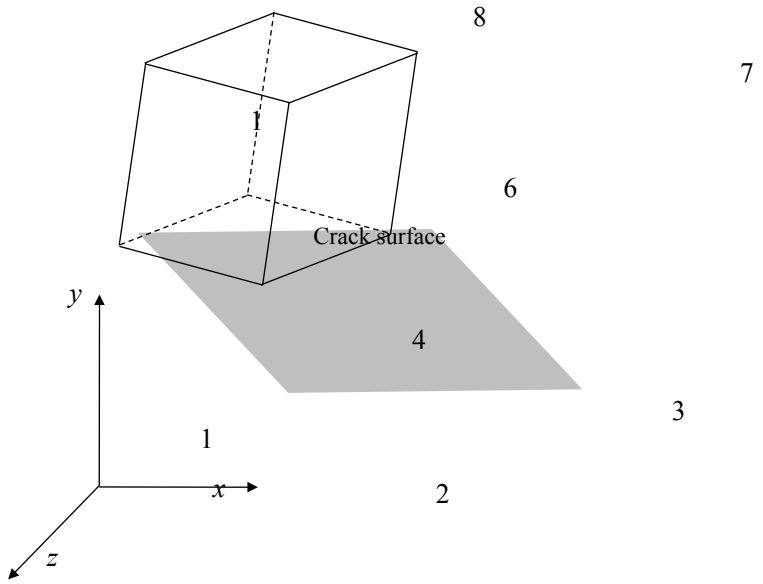


Fig. 1 Spatial location diagram of three-dimensional element and crack face

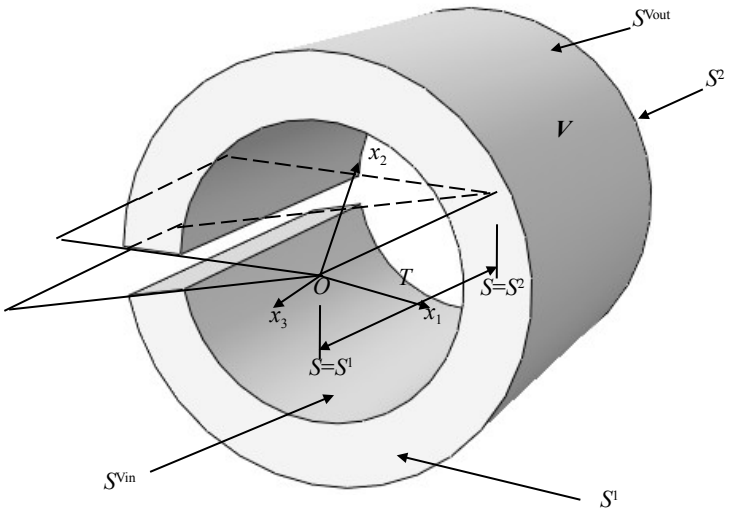


Fig. 2 three-dimensional J integral region[14]

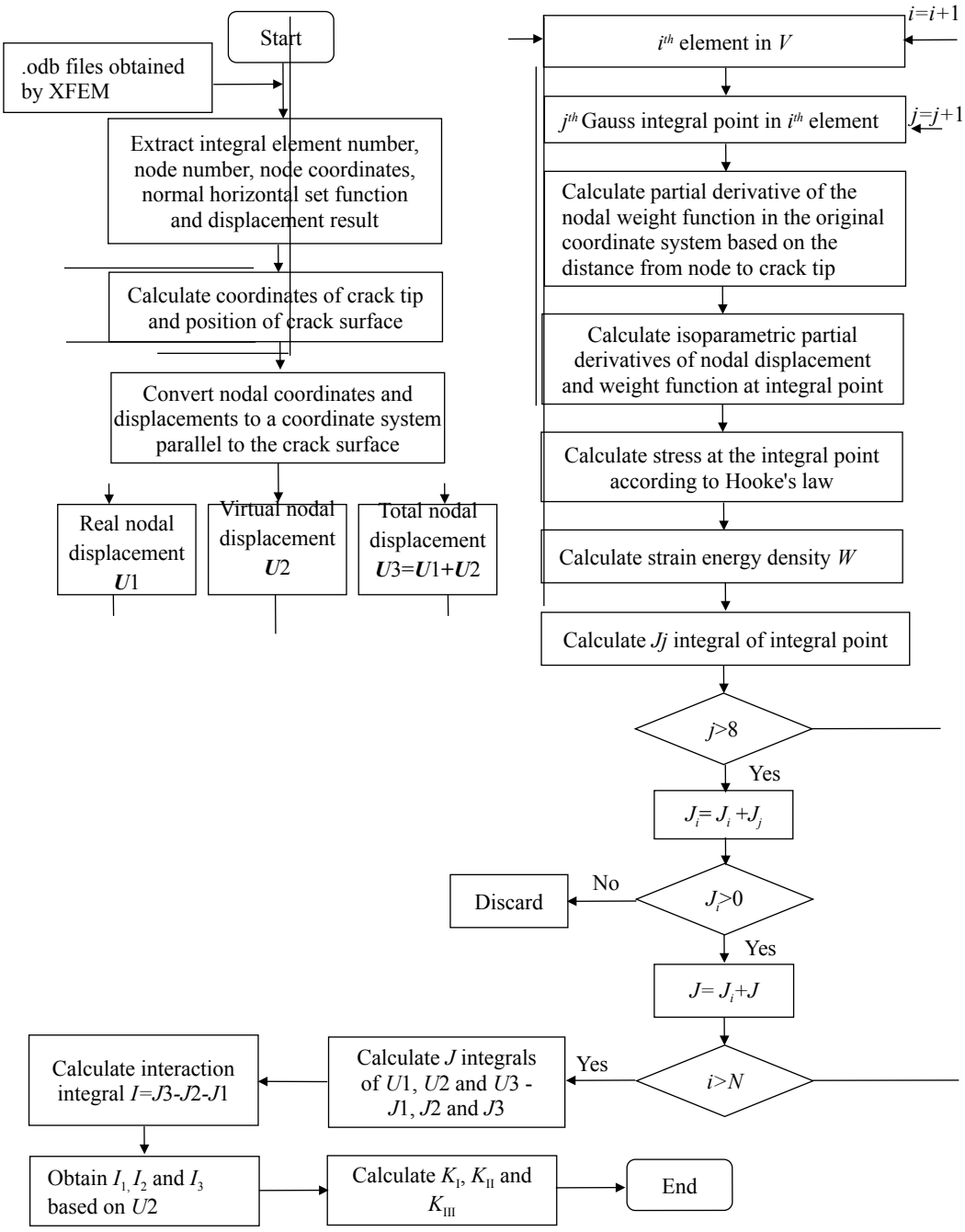


Fig. 3 Implementation process of interaction integral

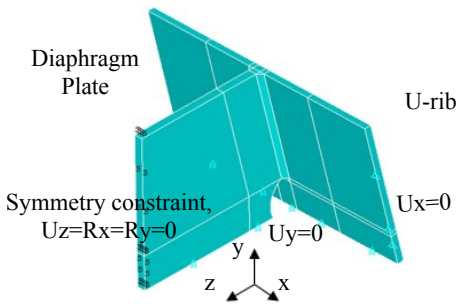
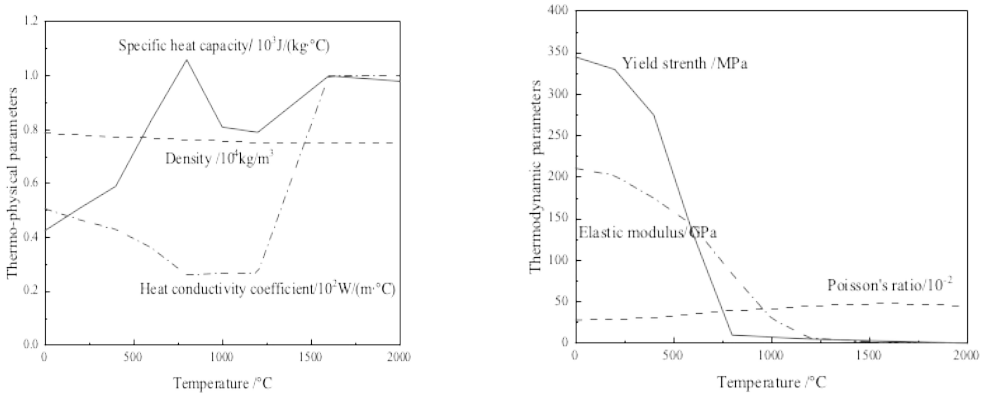


Fig. 4 Welding analysis model of the joint of U-rib and diaphragm plate



(a) Thermophysical parameters of Q345 steel (b) Thermodynamic parameters of Q345 steel

Fig. 5 Thermodynamic analysis parameters of Q345 steel

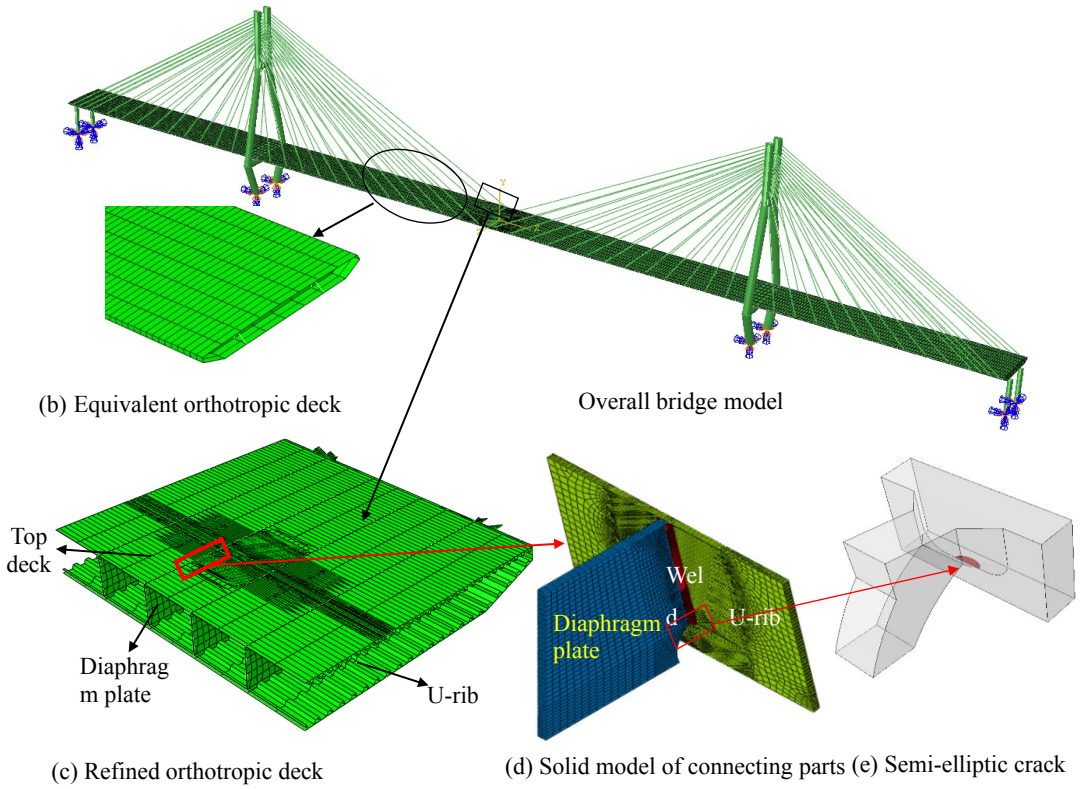


Fig 6. Runyang multi-scale finite element model of cable-stayed bridge

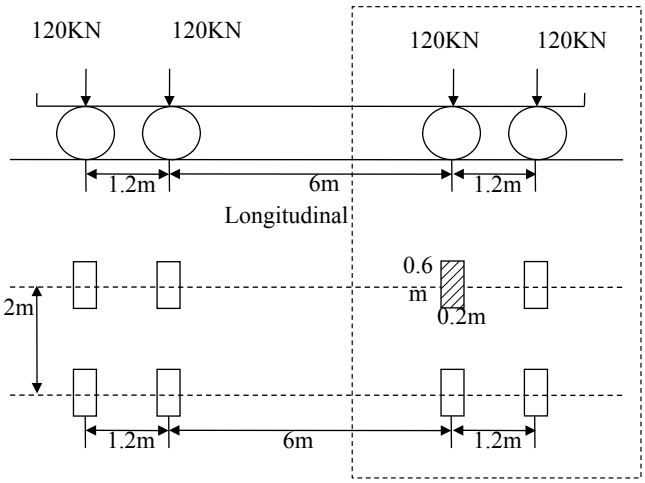


Fig. 7 Fatigue Load Model III [27]

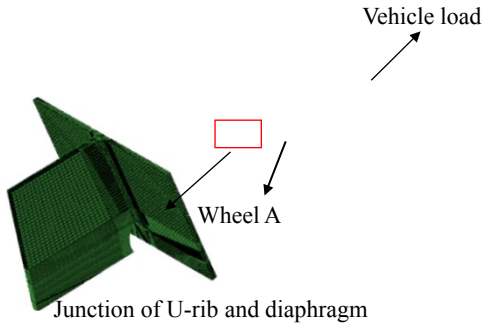


Fig. 8 The loading position of vehicle with fatigue crack at U-rib welding toe

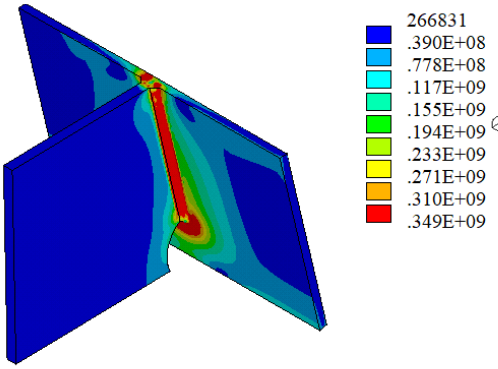


Fig. 9 Von Mises stress (unit: Pa) at the connections of U-rib-diaphragms

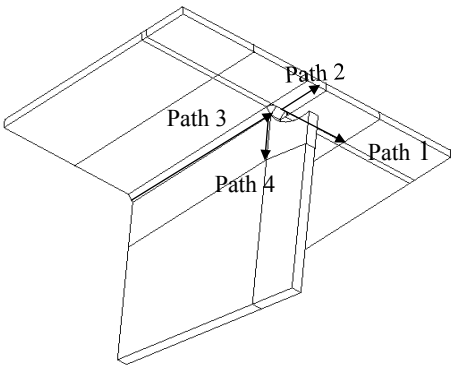
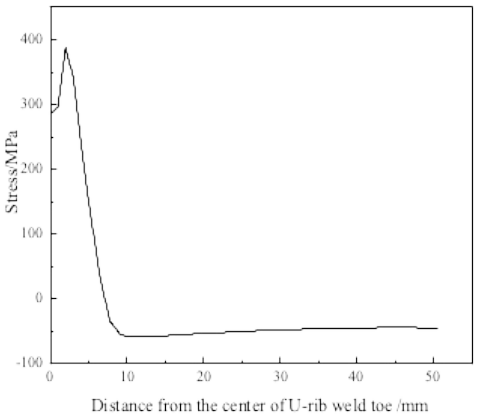
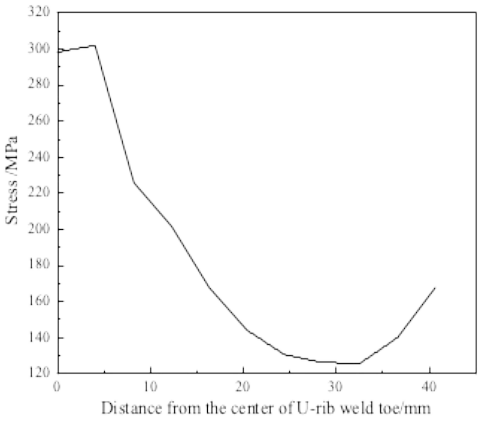


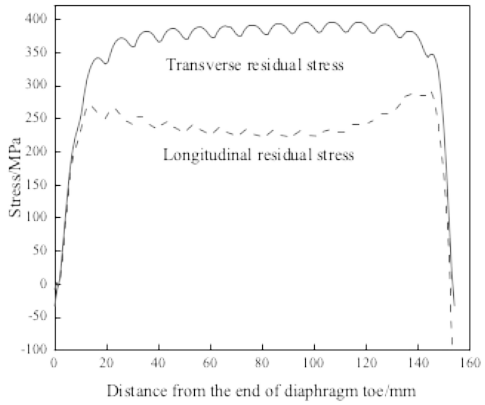
Fig. 10 Path diagram of the connections of U-rib-diaphragms



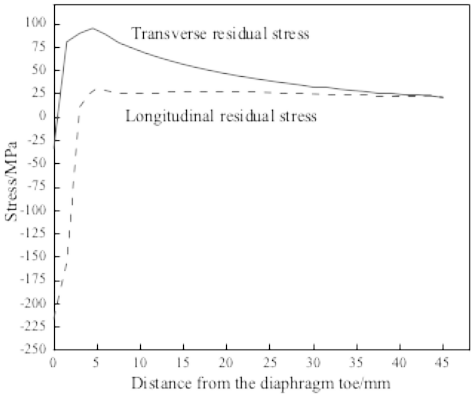
(a) Path 1 transverse residual stresses



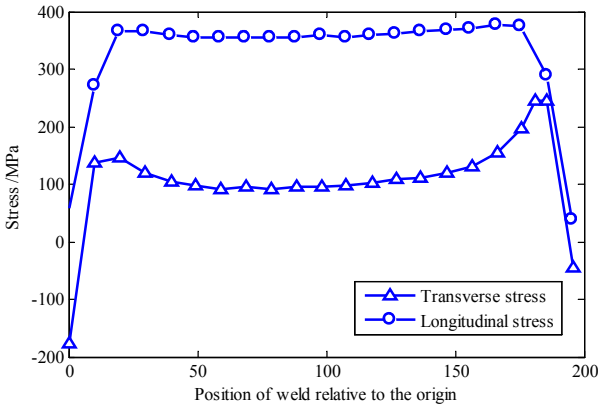
(b) Path 2 transverse residual stresses



(c) Path 3 transverse and longitudinal residual stresses



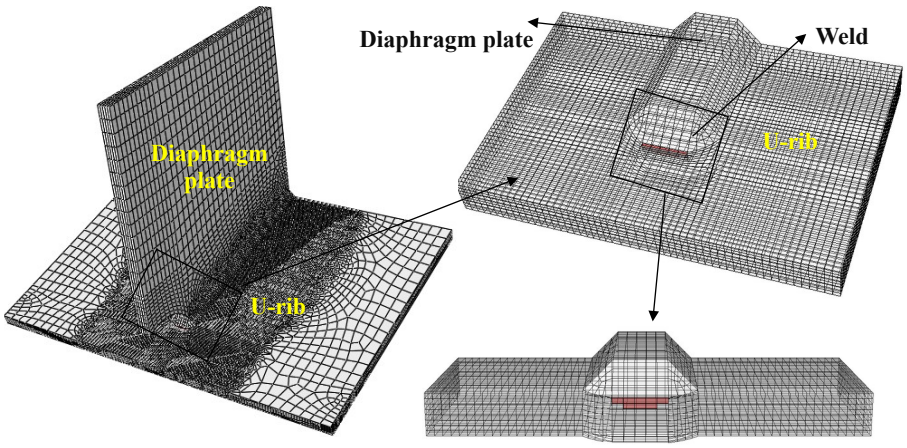
(d) Path 4 transverse and longitudinal residual stresses



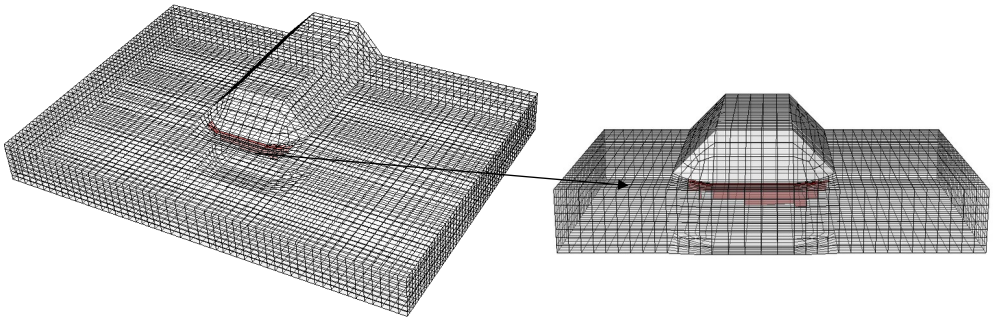
(e) Transverse and longitudinal welding residual stress of diaphragm toe [25]

(f) U-rib welding residual stress[10]

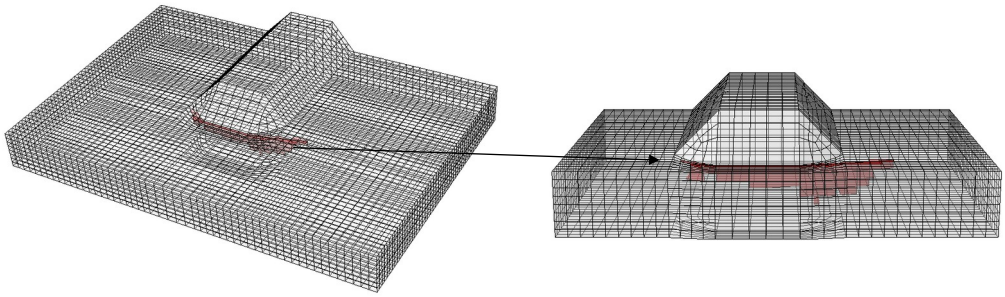
Fig. 11 Distribution curve of residual stress at the junction of U-rib-diaphragm



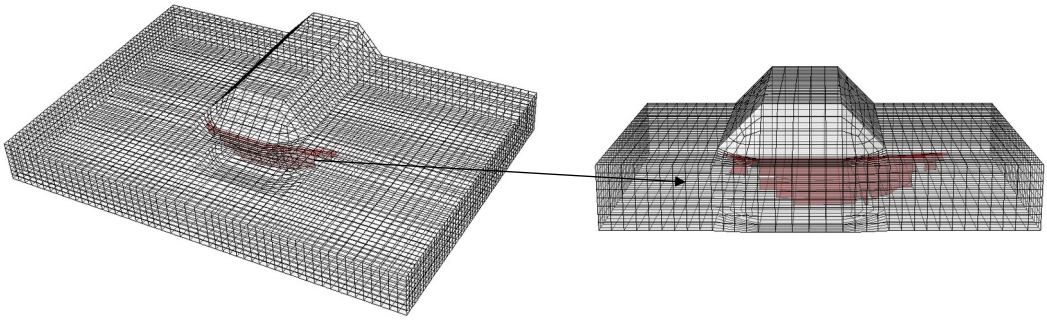
(a) Initial crack surface



(b) 600,000 cycles

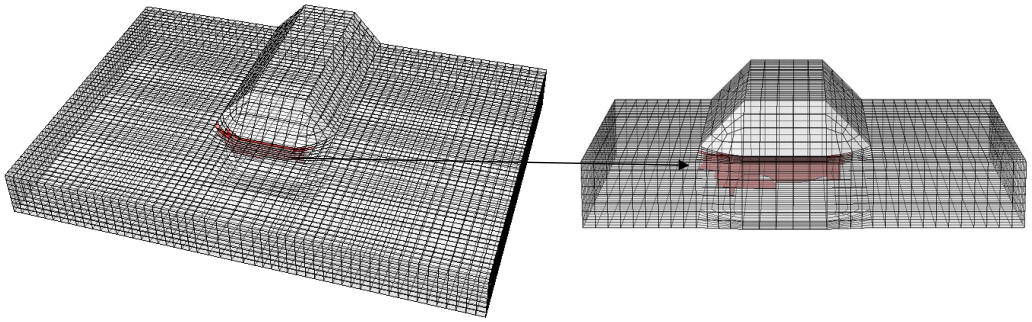


(c) 2 million cycles

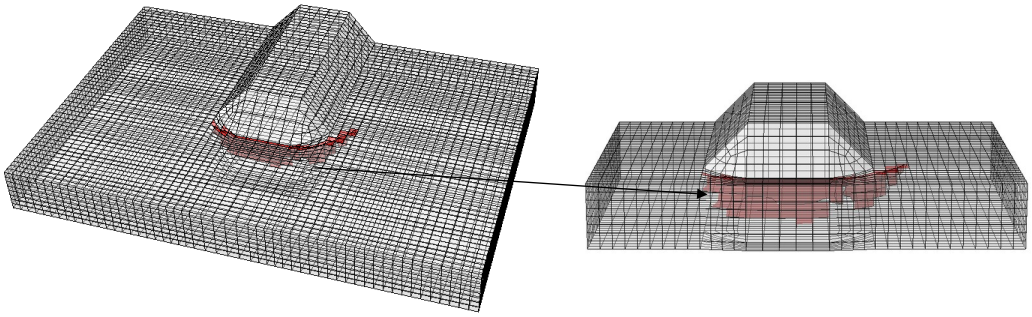


(d) 3.5 million cycles

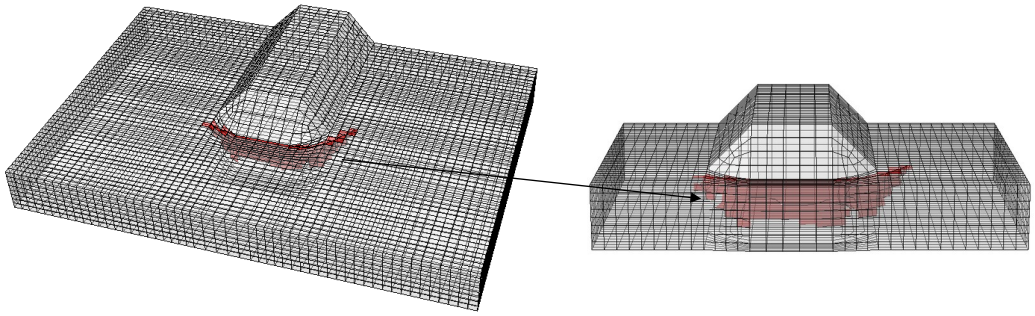
Fig. 12 Fatigue crack propagation path at U-rib welding toe without considering residual stress field (plastic material)



(a) 30,000 cycles

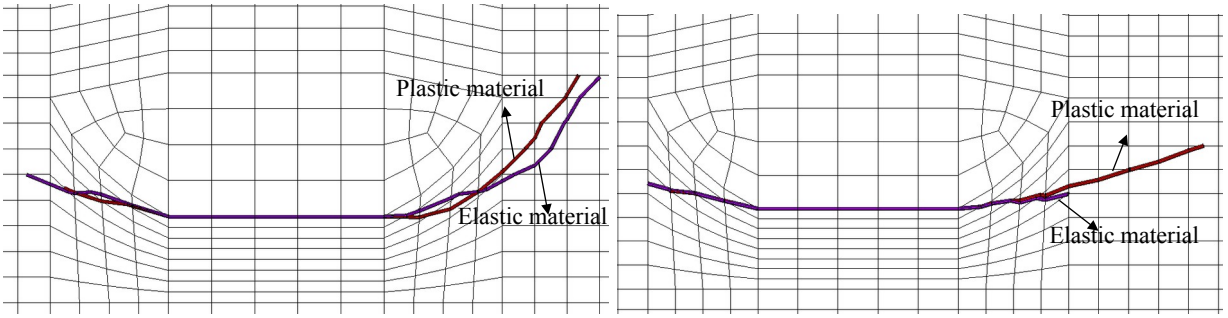


(b) 200,000 cycles



(c) 250,000 cycles

Fig. 13 Fatigue crack propagation path at U-rib welding toe considering residual stress field (plastic material)



(a) Consider the residual stress field (b) Without considering residual stress field

Fig. 14 Fatigue crack propagation path at U-rib toe under different conditions

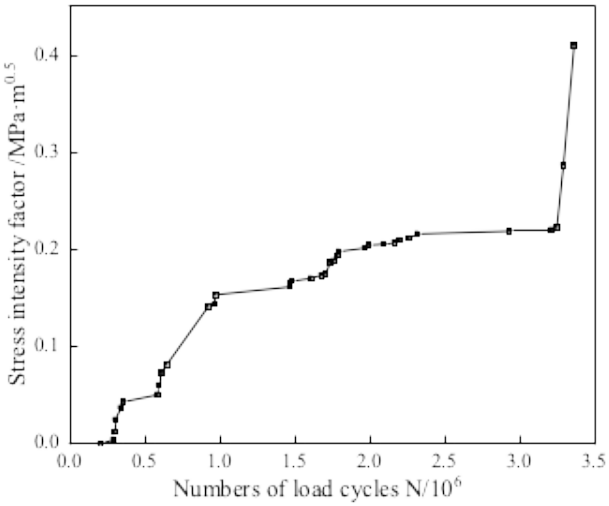
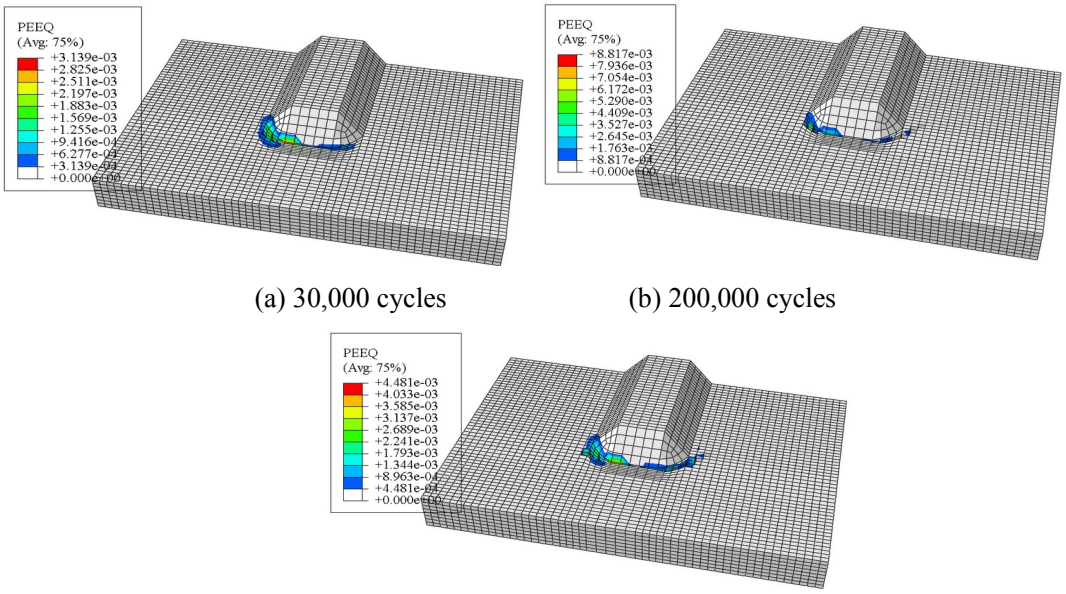


Fig. 15 Crack opening stress intensity factor K_I at U-rib weld toe without residual stress field



(a) 30,000 cycles (b) 200,000 cycles

(c) 250,000 cycles

Fig. 16 The equivalent plastic strain in the crack tip area of U-rib welding toe when the residual stress field is introduced

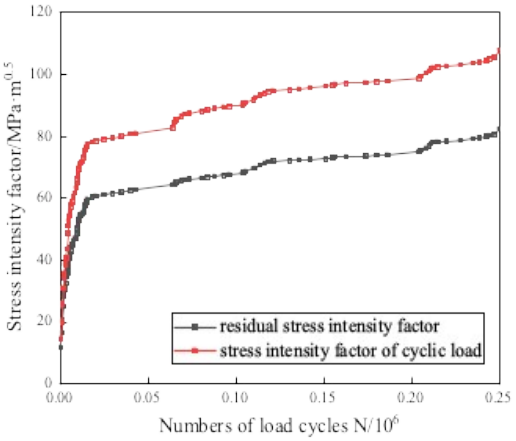


Fig. 17 Cumulative stress intensity factor of fatigue crack in U-rib toe when residual stress field is introduced

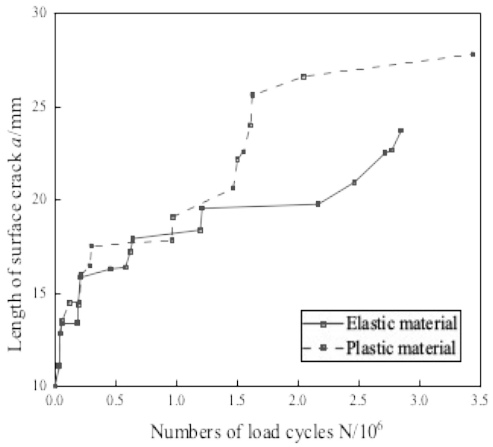


Fig. 18 Fatigue crack propagation rate of U-rib weld toe without residual stress field

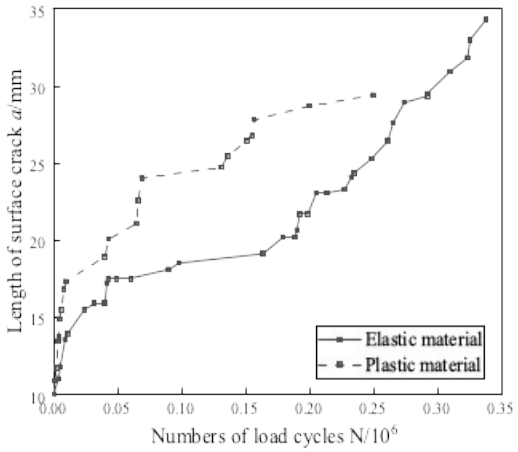


Fig. 19 Fatigue crack propagation rate of U-rib weld toe with residual stress field