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Compressive stresses play an important role on tension–compression fatigue which can be attributed to plasticity induced crack closure (PICC). The objective here is to study numerically the effect of compressive stresses on PICC and to discuss the applicability of PICC to explain the effect of negative stress ratios on fatigue crack growth rate. The compression produces reversed plastic deformation at the crack tip, reducing linearly the crack opening level. The incursion to negative stress ratios did not produce sudden changes in the behavior of PICC and no saturation with the decrease of minimum load was observed for DK*eff*. Crack closure was able to collapse da/dN–DK curves with negative stress ratios, indicating the applicability of the crack closure concept to explain the effect of negative R. The analysis of crack tip plastic strain range with and without contact of crack flanks confirmed the validity of crack closure concept.