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Abstract: Numerical models have been successfully developed to predict plasticity induced crack closure (PICC). However, despite the large research effort a full understanding of the links between physical parameters, residual plastic wake and PICC has not been achieved yet. The plastic extension of material behind crack tip, Dyp, obtained by the integration of vertical plastic deformation perpendicularly to crack flank, is proposed here to quantify the residual plastic field. The values of Dyp and PICC were obtained numerically in a M(T) specimen using the finite element method. An excellent correlation was found between PICC and Dyp which indicates that this parameter controls the phenomenon, and can be used to quantify the effect of physical parameters. An empirical model was developed to predict PICC assuming that the residual plastic field is a set of vertical plastic wedges, that the linear superposition principle applies and that the influence of a particular wedge exponentially decreases with distance to crack tip. The model was applied successfully to predict PICC for different residual plastic fields which provided an additional validation of Dyp as the parameter controlling PICC.