

Understanding the Effect of Adhesive Interlayer on the Ballistic Performance of Armor System

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Objective: Incorporate and validate rate-dependent adhesive model (start with MAT_240) used to bond ceramic tiles to a metal backing in a composite armor. Expand model for temp. and pressure effects before linking to system model.

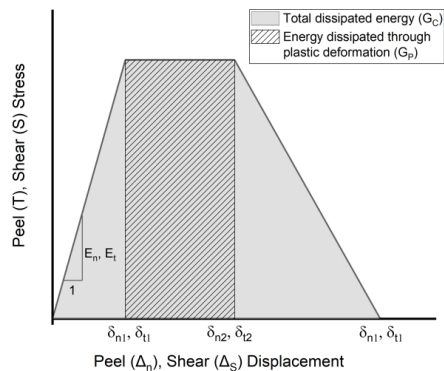
Cohesive Zone Modelling – Trapezoidal traction separation law (MAT_240 in LS-DYNA)

Plastic separation:

$$u_{n,P} = \max(u_{n,P,\Delta t-1}, u_n - \delta_{m1} \sin \gamma, 0)$$

$$u_{t1,P} = u_{t1,P,\Delta t-1} + u_{t1} - u_{t1,\Delta t-1}$$

$$u_{t2,P} = u_{t2,P,\Delta t-1} + u_{t2} - u_{t2,\Delta t-1}$$

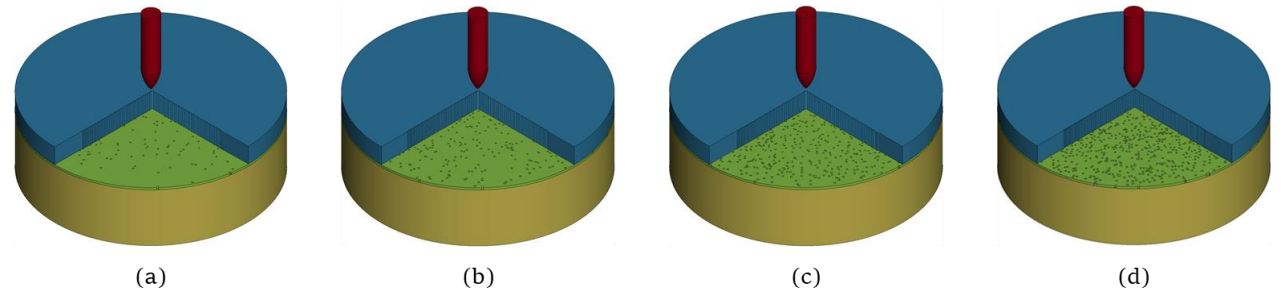


Mixed mode damage behavior:

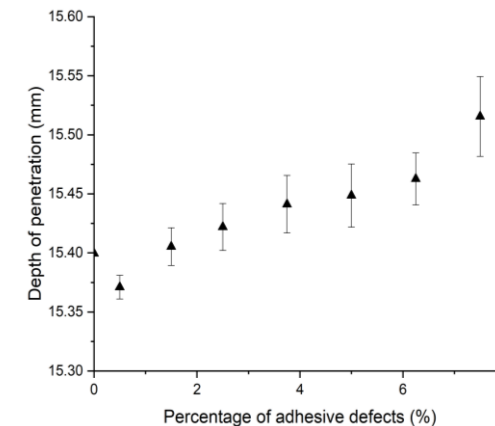
Damage variable, D , starts to increase when $\Delta_m > \delta_{m2}$:

$$D = \max\left(\frac{\Delta_m - \delta_{m2}}{\delta_{mf} - \delta_{m2}}, D_{\Delta t-1}, 0\right)$$

When $\Delta_m > \delta_{mf}$, $D = 1 \Rightarrow$ Complete damage and element fails



Investigation on the effect of manufacturing defects on ballistic performance with gap ratios of: (a) 1%, (b) 2.5%, (c) 5%, and (d) 7.5%



Depth of penetration for interlayer defect percentage ratios of 0% to 7.5%