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ESTIMATION OF FAILURE INITIATION IN LAMINATED COMPOSITES BY MEANS OF NONLINEAR SIX-FIELD SHELL THEORY AND FEM

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LIST OF THE MOST IMPORTANT SYMBOLS AND NOTATIONS

$\boldsymbol{Q}(\boldsymbol{x})$ – tensor of mean rotary deformation of the shell cross sections
$\boldsymbol{T}(\boldsymbol{x})$ – the structure tensor in the current configuration
$\boldsymbol{T}_0(\boldsymbol{x})$ – the structure tensor in the reference (initial) configuration
x – the position vector of initial configuration M
$\mathbf{e}$ – vector of shell strains
$\mathbf{s}$ – vector of shell stress and couple resultants
$\mathbf{C}$ – constitutive matrix
$\varphi_{(k)}$ – angle of fibre orientation in k^{th} lamina
$(a_{(k)}, b_{(k)}, c_{(k)})$ – orthogonal material coordinate system of k^{th} lamina
$\tilde{\mathbf{T}}_k$ – transformation matrix
$\underset{4\times4}{\mathbf{A}}$ – extensional stiffness matrix
$\underset{4\times4}{\mathbf{B}}$ – extension – bending coupling matrix
$\underset{4\times4}{\mathbf{D}}$ – bending stiffness matrix
$\underset{2\times2}{\mathbf{S}}$ – transverse shear stiffness matrix
$\underset{2\times2}{\mathbf{G}}$ – drilling resultants stiffness matrix
σ_{aa} – normal stress in the 1st material direction
σ_{bb} – normal stress in the 2nd material direction
σ_{ab} – in-plane shear stress in the 2nd material direction
σ_{ba} – in-plane shear stress in the 1st material direction
σ_a – transverse shear stress on the a-c plane
σ_b – transverse shear stress on the b-c plane
E_a – elastic modulus of lamina in the 1st material direction
E_b – elastic modulus of lamina in the 2nd material direction
G_{ab} – in-plane shear modulus of lamina
G_{ac} – transverse shear modulus on lamina a-c plane
G_{bc} – transverse shear modulus on lamina b-c plane
v_{ab} – major Poisson's ratio of lamina
X_t – absolute value of lamina tensile strength in the 1st material direction
X_c – absolute value of lamina compressive strength in the 1st material direction
Y_t – absolute value of lamina tensile strength in the 2nd material direction
Y_c – absolute value of lamina compressive strength in the 2nd material direction
S_l – lamina in-plane shear strength
S_t – lamina transverse shear strength
σ_{nn} – normal stress component acting on lamina failure plane
σ_{nl} – shear stress component acting on lamina failure plane in the fibre direction
σ_{nt} – shear stress component acting on lamina failure plane perpendicular to σ_{nl}
θ_f – lamina failure plane inclination angle
η_{w1} – Puck's criterion weakening factor