Nomenclature

\( a \) Length of the panel between the supports

\( b \) Width of the panel between the supports/ width of the beam

\( c \) Sandwich beam/ panel core thickness

\( f \) Thickness of the panel face sheet

\( h \) Sandwich beam/ panel overall thickness

\( m, n \) Number of terms in double Fourier series

\( p(x,y) \) Pressure in xy-plane expressed in double Fourier series

\( p_{2k+1}, q_{2k+1} \) Constants used in the shear load equations before core yielding

\( p_{2k+1}^*, q_{2k+1}^* \) Constants used in the shear load equations after core yielding

\( p_{mn} \) Unknown coefficient for pressure

\( q_{mn}, q_{mn}^* \) Unknown coefficient for bending deflection before and after core yielding

\( r_{mn}, r_{mn}^* \) Unknown coefficient for shear deflection before and after core yielding

\( t \) Thickness of the beam face sheet

\( u \) In-plane displacement of the panel parallel to x-axis

\( v \) In-plane displacement of the panel parallel to y-axis

\( w \) Out-of-plane displacement of the panel parallel to z-axis

\( w_b \) Beam/ panel deflection due to bending before core yielding

\( w_s \) Beam/ panel deflection due to shear before core yielding

\( w_b^* \) Beam/ panel deflection due to bending after core yielding

\( w_s^* \) Beam/ panel deflection due to shear after core yielding
$A_{eff}$  Effective contact area of the bladder with the panel

$B$  Bending rigidity of sandwich structure about its mid-plane

$B_f$  Bending rigidity of beam face sheet about its own neutral axis

$C_1$  Constant of integration for $w_p$

$D$  Constant used in bending moment equations

$D_1, D_2, D_3$  Constant of integration for $w_p$

$D_{sf}, D_{sf}$  Flexural rigidity of the panel face sheet

$E_1$  Constant of integration for $w_p$

$E_c$  Modulus of elasticity of core

$E_{c0}$  Modulus of elasticity of core before yielding

$E_{c1}$  Modulus of elasticity of core after yielding

$E_f$  Modulus of elasticity of face sheet

$F_1, F_2, F_3$  Constant of integration for $w_p$

$F_L$  Load measured by the load cell

$G_c, G_f$  Shear modulus of core and face sheet respectively

$G_{c0}$  Shear modulus of core before yielding

$G_{c1}$  Shear modulus of core after yielding

$H_1, H_2, H_3$  Constant of integration for $w_p$

$I$  Constant used in shear stress equations

$J$  Constant determined by the face sheet and core thickness

$K$  Constant used in shear force equations

$K_{pl}$  Material parameter for bi-linear material model

$L$  Distance between the support rollers
\( L^* \) Total length of sandwich beam

\( M \) Bending moment

\( M_{sf}^{(1)} \) Moment on the face sheets due to loading

\( M_{sf}^{(2)} \) Moment of the face sheets due to the bending about its own mid-planes

\( M_x, M_y \) Bending moments in the panel per unit length/ width before core yielding

\( M_{xtot}, M_{ytot} \) Total bending moments in the panel per unit length/ width after core yielding

\( M_{xy}, M_{yx} \) Twisting moments in the panel per unit width before core yielding

\( M_{xytot}, M_{yxtot} \) Total twisting moments in the panel per unit width after core yielding

\( N_{BF} \) Normal/ membrane load in bottom face sheet

\( N_{TF} \) Normal/ membrane load in top face sheet

\( N_{BF(xg)} \) Global X-axis component of the bottom face sheet membrane force

\( N_{BF(yg)} \) Global Y-axis component of the bottom face sheet membrane force

\( N_{TF(xg)} \) Global X-axis component of the top face sheet membrane force

\( N_{TF(yg)} \) Global Y-axis component of the top face sheet membrane force

\( N_x, N_y \) Normal forces in the faces per unit length

\( N_{xy}, N_{yx} \) Shear forces in the faces per unit length

\( P \) Total load applied in four point bending

\( P_b \) Measured bladder pressure

\( Q_c, Q_{xc}, Q_{yc} \) Shear load carried by the core before core yielding

\( Q_c^* \) Shear load carried by the core after core yielding
$Q_{x0}$  
Shear component at core yielding initiation

$Q_{sf}^{(1)}, Q_{sf}^{(1)}$  
Shear load carried by the face sheet due to bending curvature

$Q_{sf}^{(2)}, Q_{sf}^{(2)}$  
Shear load carried by the face sheet due to shear curvature

$Q_{tot}, Q_{xtot}, Q_{ytot}$  
Total shear load before core yielding

$Q_{tot}^*, Q_{xtot}^*, Q_{ytot}^*$  
Total shear load after core yielding

$R_{BF(yg)}$  
Total resultant force in global Y-axis in bottom face sheet

$R_{C(yg)}$  
Total resultant force in global Y-axis in core

$R_{TF(yg)}$  
Total resultant force in global Y-axis in top face sheet

$R_{TOT(yg)}$  
Total resultant force in global Y-axis for sandwich panel

$S, S_c$  
Shear stiffness of the core

$S_{c0}$  
Shear stiffness of the core before core yielding

$S_{c1}$  
Shear stiffness of the core after core yielding

$V$  
Shear load

$V_c$  
Shear load in core

$V_{BF}$  
Shear load in bottom face sheet

$V_{TF}$  
Shear load in top face sheet

$V_{C(Xg)}$  
Global X-axis component of the core shear force

$V_{C(Yg)}$  
Global Y-axis component of the core shear force

$V_{BF(Xg)}$  
Global X-axis component of the bottom face sheet shear force

$V_{BF(Yg)}$  
Global Y-axis component of the bottom face sheet shear force

$V_{TF(Xg)}$  
Global X-axis component of the top face sheet shear force
\( V_{TF(Y_g)} \)  Global Y-axis component of the top face sheet shear force

\( X_G \)  Global X-axis in I-DEAS

\( Y_G \)  Global Y-axis in I-DEAS

\( \alpha, \beta \)  Constants used in the double Fourier series

\( \varepsilon_x, \varepsilon_y \)  In-plane strains before core yielding

\( \varepsilon_x^*, \varepsilon_y^* \)  In-plane strains after core yielding

\( \phi \)  Width of the unloaded panel region

\( \gamma_0 \)  Shear strain at yield

\( \gamma \)  Shear deformation in the beam core

\( \gamma_y \)  In-plane shear strain

\( \gamma_{xzc} \)  Core shear strain component

\( \gamma_{xy}^* \)  In-plane shear strain after core yielding

\( \varphi \)  Distance from the support point to the elastic/plastic interface

\( \lambda_0, \lambda_1 \)  Constants used in shear load equations before and after core yielding

\( v_f \)  Poisson’s ratio of face sheet

\( \sigma_0 \)  Yield point in uniaxial tension

\( \tau_0 \)  Shear stress at the yield point

\( \tau_{xy} \)  In-plane shear stress

\( \tau_{xz}, \tau_{yz} \)  Shear stress components in sandwich panel

\( \tau_{xzc}, \tau_{ycc} \)  Shear stress components in core