

BUCKLING LOADS IN SHEAR OF FLAT SANDWICH PANELS (ISOTROPIC FACE PLATES AND CORRUGATED CORES, ALL EDGES SIMPLY-SUPPORTED)

1. NOTATION

a	length of panel in x -direction	m	in
b	width of panel in y -direction	m	in
D_{qx}	shear stiffness in xz -plane per unit width	N/m	lbf/in
D_{qy}	shear stiffness in xz -plane per unit width	N/m	lbf/in
D_x	flexural stiffness per unit width for bending about y -axis	N m ² /m	lbf in ² /in
D_y	flexural stiffness per unit width for bending about x -axis	N m ² /m	lbf in ² /in
P_E	$\frac{4\pi^2 D_y}{b^2 [1 - \nu^2 (D_y/D_x)]}$	N/m	lbf/in
Q_b	shear load per unit width in xz -plane at which panel first buckles	N/m	lbf/in
ν	Poisson's ratio for face-plate material		

The x - and y -axes are chosen so that $D_x \geq D_y$.

Both SI and British units are quoted but any coherent system of units may be used.

2. NOTES

Figures 1 to 4 show the ratio Q_b/P_E plotted against a/b for various values of P_E/D_{qy} ; each figure relates to a different value of D_x/D_y . The chain-dotted lines indicate changes in the mode of buckling. The curves are applicable to simply-supported sandwich panels having isotropic face plates and corrugated cores, stressed in the elastic range.

It has been assumed that during buckling the face plates remain a constant distance apart and that $\nu = 0.3$. The shear stiffness ratio D_{qx}/D_{qy} has been taken to be infinite. However, the curves are applicable to panels with finite values of D_{qx}/D_{qy} within the limits shown in Table 2.1. It should be noted that for the $P_E/D_{qy} = \infty$ curves it has been assumed that D_{qx}/D_{qy} and P_E/D_{qy} are infinite but that D_{qx} is large compared with P_E . However, provided that $D_{qx}/D_{qy} \geq 10P_E/D_{qy}$, Table 2.1 is still applicable.

TABLE 2.1

D_{qx}/D_{qy}	D_x/D_y	a/b	Percentage reduction in Q_b
Between ∞ and 180 Between 180 and 100 Between 100 and 60	$\left. \begin{array}{l} \\ \\ \end{array} \right\}$ All values	$\left. \begin{array}{l} \\ \\ \end{array} \right\}$ All values	≤ 2 ≤ 5 ≤ 10
Between ∞ and 120 Between 120 and 70 Between 70 and 35	$\left. \begin{array}{l} \\ \\ \end{array} \right\} \leq 1.5$	$\left. \begin{array}{l} \\ \\ \end{array} \right\}$ All values	≤ 2 ≤ 5 ≤ 10
Between ∞ and 70 Between 70 and 40 Between 40 and 12	$\left. \begin{array}{l} \\ \\ \end{array} \right\} \leq 1.5$	$\left. \begin{array}{l} \\ \\ \end{array} \right\} > 2.5$	≤ 2 ≤ 5 ≤ 10

The buckling loads provided by this Data Item may also be computed using ESDUpac A8147 or ESDUpac A9405. Both of these programs are available in two formats: (a) a Fortran source code with example input and output files, and (b) an executable program for PCs. Both versions can be found on the Compact Disc and on disk in the Sub-series Software Volume. ESDUpac A9405 uses the same sandwich panel notation as is used in this Data Item. ESDUpac A8147 treats the sandwich as a laminated plate and therefore uses laminated plate notation. The programs of both ESDUpacs deal with any combination of in-plane loads acting on panels with symmetrical combinations of clamped and simply-supported edges. Additional notes on buckling of sandwich panels are available in Data Item No. 68029 and notes linking sandwich panel theory to laminate plate theory are available in Data Item No. 94003. Further data on sandwich panels may be located by reference to the ESDU Index.

ESDUpac A8147 is associated with Data Item No. 81047 "Buckling of flat rectangular plates. (Isotropic, orthotropic and laminated composite plates and sandwich panels.)" and ESDUpac A9405 is associated with Data Item No. 94005 "Buckling of flat rectangular orthotropic plates".

3. DERIVATION

- BRUCE, J.
ROBINSON, J.R.

The buckling and bending of orthotropic sandwich panels in compression and shear. Unpublished work at Handley Page Ltd, 1956.

