



# ESDU Struct 02.01.16

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## Strength of stringers in panel in compression

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## STRENGTH OF STRINGERS IN PANEL IN COMPRESSION

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## STRENGTH OF STRINGERS IN PANEL IN COMPRESSION

### 1. NOTATION

|            |                                                                                                  |                  |                     |
|------------|--------------------------------------------------------------------------------------------------|------------------|---------------------|
| $A_s$      | cross-sectional area of stringer                                                                 | m <sup>2</sup>   | in <sup>2</sup>     |
| $b$        | plate width between stringers, measured as distance between adjacent rivet lines                 | m                | in                  |
| $E$        | modulus of elasticity of material of sheet and stiffener                                         | N/m <sup>2</sup> | lbf/in <sup>2</sup> |
| $E_{te}$   | tangent modulus of stringer material at stress $f_{edge}$                                        | N/m <sup>2</sup> | lbf/in <sup>2</sup> |
| $E_{ts}$   | tangent modulus of stringer material at stress $f_s$                                             | N/m <sup>2</sup> | lbf/in <sup>2</sup> |
| $f_a$      | average stress in plate at edge stress $f_{edge}$                                                | N/m <sup>2</sup> | lbf/in <sup>2</sup> |
| $f_b$      | stress at which plate first buckles in compression                                               | N/m <sup>2</sup> | lbf/in <sup>2</sup> |
| $f_{edge}$ | edge stress at failure of stiffened panel                                                        | N/m <sup>2</sup> | lbf/in <sup>2</sup> |
| $f_s$      | failing stress of stringer alone, constrained to fail by flexure in direction normal to sheet    | N/m <sup>2</sup> | lbf/in <sup>2</sup> |
| $I_s$      | second moment of area of stringer section about axis through stringer centroid parallel to sheet | m <sup>4</sup>   | in <sup>4</sup>     |
| $I_x$      | second moment of area of stringer section about axis in median plane of sheet                    | m <sup>4</sup>   | in <sup>4</sup>     |
| $l$        | panel length                                                                                     | m                | in                  |
| $t$        | sheet thickness                                                                                  | m                | in                  |
| $\eta$     | slope of the curve of $f_a$ against $f_{edge}$ from ESDU Struct 02.01.03 or ESDU Struct 02.01.23 |                  |                     |

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

### 2. NOTES

In Figure 1 the ratio  $f_{edge}/f_s$  is plotted against the ratio  $A_s/(\eta bt)$  for various values of  $I_x/I_s$ . The curves apply only to failure of the stringers due to flexural instability. The possible failure due to local or torsional instability must also be considered.

The effect of buckling of the sheet has been taken into account in assessing the contribution of the sheet to the flexural stiffness of the stringer. The effects of any tendency for the stringer and the panel to buckle in different forms and of inter-rivet buckling along the length of the stringer have been ignored; this will be permissible if the stringer is of greater wall thickness than the sheet, but may not apply to heavy gauge sheet with relatively light stringers.

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