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Torsion and secondary warping constants for a bulb angle

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TORSION AND SECONDARY WARPING CONSTANTS FOR A BULB ANGLE

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TORSION AND SECONDARY WARPING CONSTANTS FOR A BULB ANGLE

1. NOTATION

d	width of base of section	m	in
h	depth from bulb centre to heel	m	in
J	torsion constant of section	m ⁴	in ⁴
J_0	torsion constant for plain angle = $st^3/3$	m ⁴	in ⁴
r	radius of bulb	m	in
s	developed length of section along median line to bulb centre	m	in
t	thickness of leg carrying bulb	m	in
t'	thickness of base leg	m	in
Γ_2	secondary warping constant	m ⁶	in ⁶

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

2. TORSION CONSTANT

The ratio J/J_0 is plotted against r/t for various values of s/t in Figure 1, for a bulb angle having legs of equal thickness. J is the torsion constant defined in ESDU Struct. 00.07.00*. The contribution of the corner fillet to the value of J has been computed as the torsion constant of a circular bar of radius t . This is sufficiently accurate for a fillet radius in the range $1.2t$ to $1.8t$.

3. SECONDARY WARPING CONSTANT

The ratio $\Gamma_2/(t^3h^3/18)$ is plotted against r/t for various values of the parameters h/t and $t'd/th$ in Figure 2. Γ_2 is the secondary warping constant defined in Data Item Struct. 00.07.00. The quantity $t^3h^3/18$ is the value of Γ_2 for a plain angle with equal legs, the effect of the corner fillet being negligible.

4. DERIVATION

1. HOFF, N.J. Stresses in space-curved rings reinforcing the edges of cut-outs in monocoque fuselages. *Jl r. aero. Soc.*, Vol. 47, p.35, February 1943.

Unpublished work leading to the formula,

$$J/J_0 = \frac{4.14 + 4.71(r/t)^4}{s/t} + 1. \quad (4.1)$$

* ESDU Struct. 00.07.00, "Information on the use of Data Sheets of the 00.07 Series"