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Guide to stress concentration data

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ESDU DATA ITEMS

Data Items provide validated information in engineering design and analysis for use by, or under the supervision of, professionally qualified engineers. The data are founded on an evaluation of all the relevant information, both published and unpublished, and are invariably supported by original work of ESDU staff engineers or consultants. The whole process is subject to independent review for which crucial support is provided by industrial companies, government research laboratories, universities and others from around the world through the participation of some of their leading experts on ESDU Technical Committees. This process ensures that the results of much valuable work (theoretical, experimental and operational), which may not be widely available or in a readily usable form, can be communicated concisely and accurately to the engineering community.

We are constantly striving to develop new work and review data already issued. Any comments arising out of your use of our data, or any suggestions for new topics or information that might lead to improvements, will help us to provide a better service.

THE PREPARATION OF THIS DATA ITEM

The work on this particular Data Item was monitored and guided by the Stress Analysis and Strength of Components Committee. This Committee first met in 1964 and now has the following membership:

Chairman	
Prof. T.G.F. Gray	— University of Strathclyde, Glasgow
Members	
Mr J. Baghurst	— Independent
Dr I.J. Bickley	— Independent
Mr L.A. Doig*	— Independent
Dr M. Heller*	— Air Vehicles Division, DSTO, Victoria, Australia
Mr R. Mamidi	— Meggitt Polymers and Composites, Leicestershire
Dr N.L. Pedersen*	— Technical University of Denmark, Denmark
Mr T. Spencer	— Lloyd's Register Global Technology Centre, Southampton

* Corresponding Member

The Item was accepted for inclusion in the Structures Series by the Aerospace Structures Committee which first met in 1940 and now has the following membership:

Chairman	
Mr K. Fitzsimons	— Westland Helicopters Ltd
Members	
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Mr J. Baldwin*	— Spirit AeroSystems, USA
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Mr M.K. Hughes*	— The Boeing Company, Seattle, USA
Mr A. Missenden	— Cranfield Aerospace Ltd, Bedfordshire
Dr A. Murphy	— Queen's University, Belfast
Mr B. Popham	— Independent
Prof. A. Rothwell	— Professor Emeritus, Delft University of Technology, The Netherlands
Mr J.H. van der Sloot	— Independent.

* Corresponding Member

GUIDE TO STRESS CONCENTRATION DATA

The Data Items listed herein provide data on stress concentration effects arising from discontinuities in the shape of a component, or because of inclusions or due to variations of the local load distribution.

The following conventional definitions are used in these Data Items.

STRESS CONCENTRATION: A local increase in the intensity of the stress field due to a discontinuity.

STRESS CONCENTRATION FACTOR: The ratio of the highest stress to the reference stress in the component calculated using simple theory.

GEOMETRIC STRESS CONCENTRATION FACTOR: A stress concentration factor resulting solely because of the shape of the component.

The reference stress evaluated by simple theory may be based upon either the net cross-section through the discontinuity or on the gross cross-section of the member ignoring the discontinuity. A reference stress based on the net cross-section is preferable and used wherever practicable. In a number of cases considered in these Data Items it is not possible to express (in simple terms) the nominal local stress based on the net cross-section and for these cases the gross section is used. In the Data Items examining joints, the stress concentration factors were not always evaluated therefore the maximum stresses are reported directly. Where the stress concentration factor for joints is given it is found to be convenient to use a reference stress based on the joint bearing stress.

Stress concentration factors that are based on the net cross-section are given by the notation K' , and those based on the gross cross-section and the bearing cross-section are K and K_B , respectively.

Care should be exercised when using these Data Items to ensure that the appropriate cross section is used when calculating the maximum stress from the stress concentration factor. Complete expressions defining the factors are given in the notation section of each Data Item.

Note that the data in these Data Items apply only to isotropic materials that obey Hooke's Law but as the majority of engineering materials are approximately isotropic this data may be used without significant error. The Poisson's ratio is assumed to be 1/3 for all the calculations that require it in the Data Items. However, this may not always have been included in the notation so for such cases it is reasonable to expect that a variation of between 0.2 and 0.5 will produce less than ± 5 per cent difference in the resulting stress concentration factor.

Where it is practical to do so, the limiting curves or values are presented to allow the interpolation of near limit cases.

Finally, throughout this series of Data Items the term "bars and strips" applies to bodies having solid rectangular sections, the term "rods and tubes" applies to bodies having solid or hollow circular sections and the term "plate" applies to bodies that is usually infinite (with respect to the discontinuity) in any direction.

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