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A THESIS ON
LARGE DEFORMATIONS, INCLUDING NECKING UNDER
UNIAXIAL TENSION

by

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submitted
in fulfilment of the requirements of
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to the

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Dedicated to the memory

of

LATE PROFESSOR B. KARUNES

(i)

CERTIFICATE

This is to certify that the thesis entitled "LARGE DEFORMATIONS, INCLUDING NECKING, UNDER UNI-AXIAL TENSION" by Shri Baikunth Prasad Ambasht has attained a standard required for a Ph.D. Degree of the Indian Institute of Technology, Delhi. Shri B.P. Ambasht worked under the joint guidance of late Prof. B. Karunes and myself. The research report and the results presented in this thesis have not been submitted for any degree in any other university.



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ABSTRACT

The thesis presents an empirical analysis of the data obtained from the tension tests on about a hundred specimens of aluminium and copper. These specimens were varied in geometry and were tested up to different stages of necking including fracture. The data consisted of the running measurements of load, specimen extension (of its parallel length) and the diameter measurements at two sections. This data was used to construct experimental load-extension as well as the true stress (P/a) and the true strain ($\ln \frac{a_0}{a}$) curves for both the materials. The neck shapes were obtained with the help of profile projector. An attempt was then made to identify certain parameters which could (i) help in the description of the stress-strain behaviour; and (ii) in the determination of the neck shape at any stage of necking.

(v)

(11)

The load extension data indicates that the load having reached its maximum, stays constant over a period of deformations. This manifests in an instability region in the stress-strain plot. By incorporating the parameters associated with this region, a set of equations has been proposed to describe the stress-strain relation of a material right up to fracture.

The stress-strain relation, as described above, seems to be independent of the initial geometry. The initial geometry, however, has an effect on the load-extension plot.

A semi-empirical method, incorporating the parameters associated with instability region, is then presented to predict the neck shape at any stage of necking. The successive freezing of specimen geometry, after the initiation of necking, has been taken into consideration. The theoretical neck shapes have been compared with the actual neck shapes obtained experimentally. This formulation has further been verified by computing the extension of the specimens, which compare well with the actual extensions.

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