A THESIS ON

# LARGE DEFORMATIONS OF SHORT CYLINDERS UNDER UNIAXIAL COMPRESSION

BY

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## CERTIFICATE

This is to certify that the thesis entitled 'Large deformations of short cylinders under uniaxial compression', submitted by Mr. Chandrakant Shah, for the award of the degree of Doctor of Philosophy, to the Indian Institute of Technology, Delhi, is a record of bonafide research work carried out by him. The contents of this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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# LARGE DEFORMATIONS OF SHORT CYLINDERS UNDER UNIAXIAL COMPRESSION

## ABSTRACT

Thesis presents an experimental study of large deformations of short cylinders under simple compression without lubricant. About 300 specimens of different sizes and made of aluminium and low carbon steel were tested in a 50T Instron Machine. The measurements recorded during the test included the applied load, resulting cylinder shortening, current diameters of different sections including equatorial and end sections, changes in distances between the circles originally marked at short distances along height of specimen and changes in diameters of concentric circles originally marked on the endfaces of each specimen. Shapes of deformed specimens were measured using profile projector at 10 times magnification.

With the help of this data, empirical relationships were developed between:

a) average stress and strain values at equatorial section;

b) strains defined in terms of changes in area, changes in small gaugelength and changes in height; and

c) the barreling parameter and test parameters.

With the help of above relationships, shapes of deforming specimens were computed, which compare well with actual ones. Further, an attempt was made to understand the nature of stress and strain distribution within a

specimen by testing specimens which were composed of number of discs and some other specimens which were remachined to predetermined sizes after having been tested to different degrees of deformation.

Results show that even when specimens of higher $L_o/d_o$ ratios show double barreling as well as some buckling in the initial stages, their shapes start becoming circular when a particular level of stress is reached. Attainment of this stress level appears to correspond also to the stage when rolling of material begins from sides of the specimen. Further, it is observed that even though load - specimen shortening and stress strain curves turn out to be function of aspect ratio, the stress and barreling profile radius curves are function of diameter only, and curve, between area strain at equatorial section and strain based on reduction in height, is independent of both geometry as well as material of the specimen.

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