I INTRODUCTION

The problem of the buckling of arches is one which has received considerable attention in the past. When an arch subjected to lateral loading reaches an elastically unstable condition, there are two possible modes of buckling as follows:-

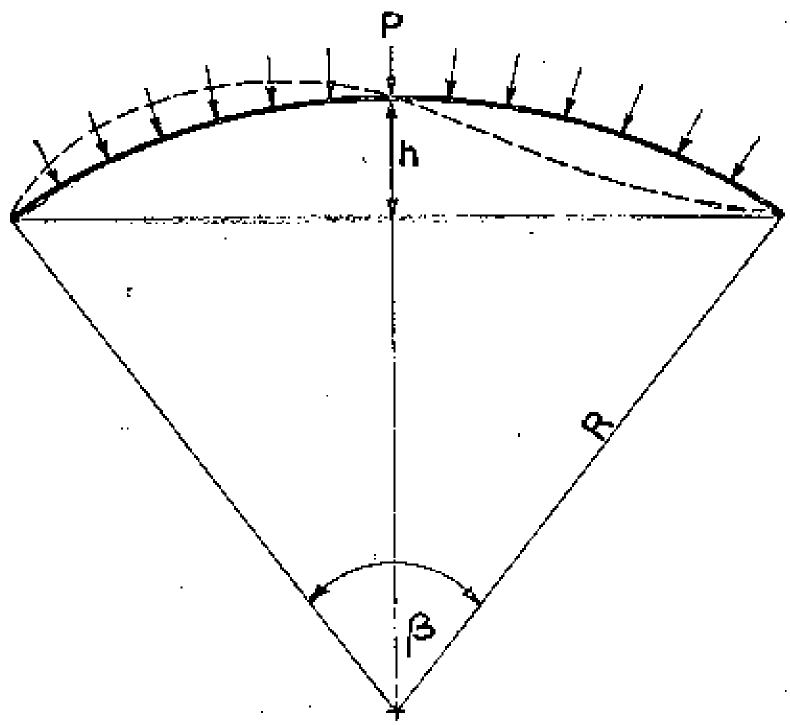

Figure 1. Buckling mode for a high arch under uniformly distributed lateral load.

(1) If the rise of the arch ("h" as shown in figure 1) is of the same order as the radius of the arch R, then it is possible for the arch to buckle at the critical lateral load in the mode as indicated by the dashed line in figure 1. Buckling of this type can be assumed to be "inextensional" as discussed by Timoshenko, and Gere (1).

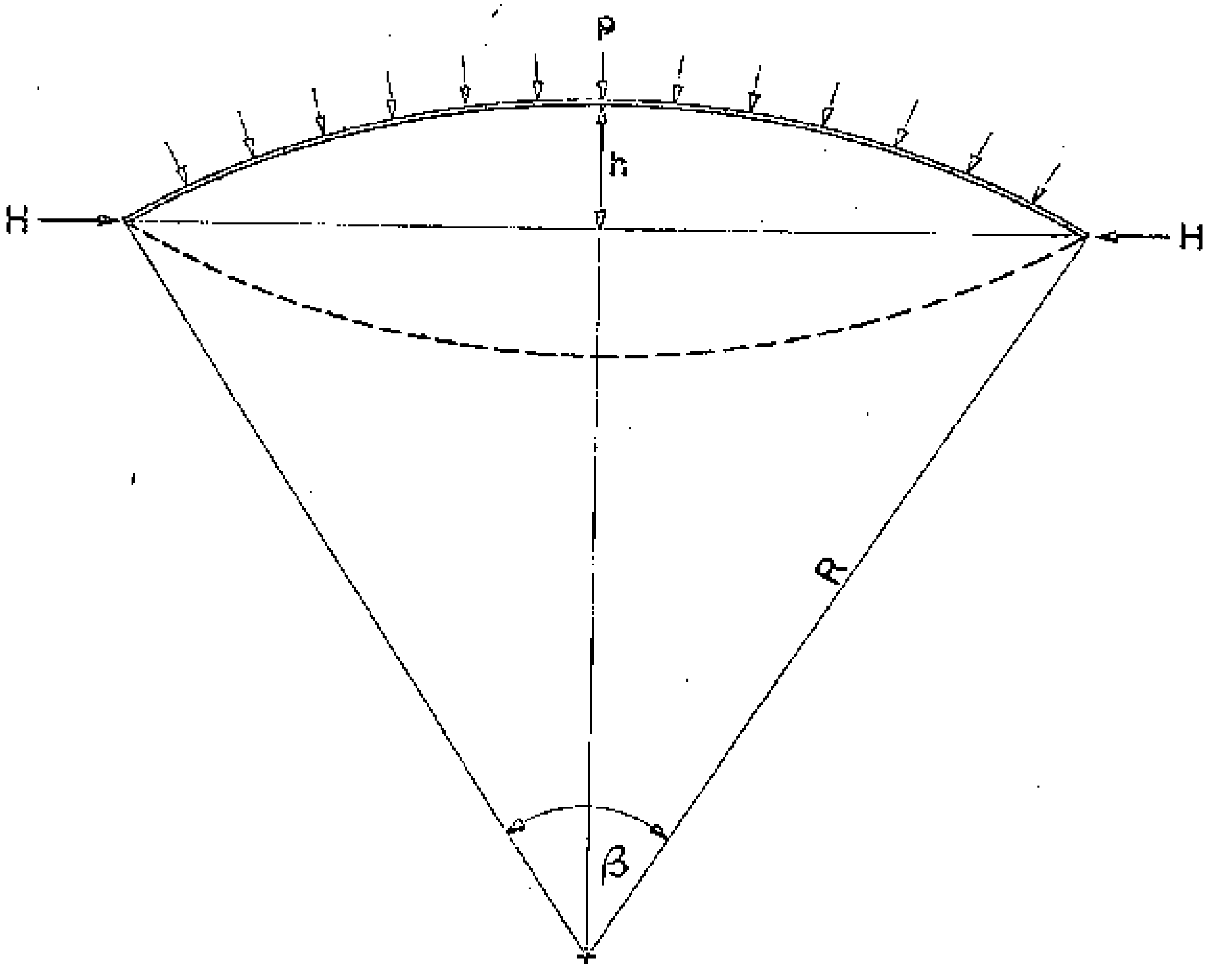

Figure 2. Possible buckling mode for a low arch under uniformly distributed lateral load.

(2) If the rise "h" of the arch is much smaller than the radius R of the curvature (as shown in figure 2.), then the induced axial thrust plays an important role in the elastic stability. The arch may become unstable and suddenly reverse its curvature, jumping, or "snap buckling", from the solid line position to the dashed line position. This elastic lateral buckling of a hinged low

arch, has been studied by Timoshenko, and Gere, (1) & Fung, and Kaplan, (2). The corresponding low arch with clamped ends has been investigated by Gjelsvik, and Bodner, (3) & Schreyer, and Masure, (4).

The buckling criterion used in reference 1 and reference 2 is the classical one which is based on the stability with respect to infinitesimal displacements about the equilibrium positions. But in reference 3 and refefence 4 the buckling load is calculated on the basis of an energy criterion, which is itself based on finite displacements.

Purpose of Research

The object of this research is to study the instability and the elastic lateral buckling behavior of a low arch having an initial axial thrust, which would cause an initial bowing, subjected to a central lateral concentrated load. Therefore the buckling deformation would be "extensional" rather than "inextensional". To determine the critical lateral load required to produce the snap buckling in the bowed strut, and it will be shown that the variation of initial curvature and the types of end fixing of the bowed strut have a very important affect on the critical lateral load.

There are two buckling criteria as introduced above, and the energy criterion yields a critical buckling load higher than that obtained from the classical one. It is not evident which of these two criteria corresponds to the real practical situation. Therefore, in this research, the theoretical values for the hinged ends of a bowed strut calculated from both of these criteria will be compared with the experimental results.

<u>Scope of Research</u>

Two important factors which affect the critical lateral concentrated load of a constant cross-sectional bowed strut will be studied herein:

a) The types of end fixation

b) The initial curvature

The experimental work investigated the above effects by testing eighteen specimens made of mild steel with dimensions of 48" long, 2" wide and ¼" thick. All of them were equally divided into two different groups, one for hinged ends and another one for clamped ends to investigate the effect of (a). Tha specimens of each group were tested in initial curvatures corresponding to values of "h" ranging from 0.500" to 1.500" for the effect of (b).