CHAPTER 1
INTRODUCTION

A decisive first step towards the industrialisation of building construction is the adoption of precast elements. While precast roofing elements are common, precast wall elements - which could fulfill the dual functions of space covering and load bearing - have not been too common except for thick wall panels. Thick wall panels are heavy and cumbersome, pose serious erection problems and leave much to be desired aesthetically. Ideally, precast wall panels need to be strong and light elements with a wide range of forms. In this context, the advanced technologies such as high strength concrete and mechanised casting and construction hitherto confined to the manufacture and erection of roofing panels appear to hold much potential in the development of concrete folded plates wall elements as a practical proposition.

Such facade load bearing walls for shed type industrial buildings can have all types of cross sections, hitherto familiar to roof panels, such as ribbed panel, tee, trapezoidal, folded, angular, and curved shell. In many
cases, practice precedes theory. Many existing examples can be cited. A few among them are:

1. The channel units of shed building at Wettingen, Switzerland [24] (Fig.1.1)

2. The ribbed panels of a structure at Vancouver, Canada [24]

3. The Trough panels of a structure of Sesto Fiorentino, Italy [24]

4. The Panels with triangular cross section used in a power station building at Pecsujhegy, Hungary [24]

5. The curved shell units of a multipurpose storage building, USA [24] (Fig.1.2)

6. The precast wall panels cited by Koncz [24] (Fig.1.3)

7. The curved shell units of the Toronto City Hall and Civic Square at Toronto, Canada [40,46]

8. The curved shell units of community service blocks at Bombay, India [22]

9. The ferrocement panels with triangular cross section for a building at Tel-Aviv [51]
10. The folded plate troughed panels used as end wall of the grand hall of the UNESCO Palace in Paris [19]

Where does the theory stand? Being slender and open these folded plate wall panels have hardly any similarity with the solid reinforced columns of the present day. It is clear that the methods based on traditional RC column analysis will not be relevant.

Some consolence can however be drawn from the fact that such sections are already prevalent in steel structural design. Taking guidance from the steel design rules it can be noted that such open thin-walled folded plate columns have low torsional strength and may fail in Euler type flexural buckling mode, or in a mode where cross sections may twist and flexurally deform called the torsional-flexural mode or by local buckling of the component plates. Although a few concrete structures of the form do exist, rarely have they been formed on sound engineering principles because torsional-flexural buckling and component plate buckling are unheard of terms in the realm of reinforced concrete column behaviour.

Thus the concepts of design and analysis of open web folded plate columns have necessarily to be distinctly different from those of traditional reinforced concrete
columns in practice. But existing situation related to the development of rational analysis and design leaves much to be desired. Specifically the following points can be made:

1. Rarely has the practice of such construction been backed by any organised theoretical and experimental study.

2. Even where studies have been conducted the conclusions drawn have been over simplified.

3. Designs have often been based on Rankine type empirical column equations.

4. Failures by torsional-flexural buckling and/or local buckling have received scant attention from researchers.


The present study is an attempt to fill the near vacuum in the theoretical basis for thin-walled folded plate RC wall element. The study uses rational principles and observations drawn from behaviour, to develop the theory and seeks to validate it by experimental studies on folded plate column elements subjected to axial loads and loads with small eccentricity.
FIGURE 1.1 CHANNEL UNITS OF SHELL TYPE BUILDING (WETTINGEN, SWITZERLAND) [24]

FIGURE 1.2 CURVED SHELL UNITS OF A MULTIPURPOSE STORAGE BUILDING (USA) [24]
FIGURE 1.3 PRECAST WALL PANELS CITED BY KONCZ [24]