5. COLD FORM STEEL

5.1 Introduction

Thin sheet steel products are extensively used in building industry, and range from purlins to roof sheeting and floor decking. Generally these are available for use as basic building elements for assembly at site or as prefabricated frames or panels. These thin steel sections are ***cold-formed***, i.e. their manufacturing process involves forming steel sections in a cold state (i.e. without application of heat) from steel sheets of ***uniform*** thickness. These are given the generic title ***Cold Formed Steel Sections***. Sometimes they are also called ***Light Gauge Steel Sections*** or ***Cold Rolled Steel Sections***. The thickness of steel sheet used in cold formed construction is usually 1 to 3 mm. Much thicker material up to 8 mm can be formed if pre-galvanised material is not required for the particular application. The method of manufacturing is important as it differentiates these products from ***hot rolled steel*** sections. Normally, the yield strength of steel sheets used in cold-formed sections is at least 280 N/mm^2, although there is a trend to use steels of higher strengths, and sometimes as low as 230 N/mm^2.

Manufacturers of cold formed steel sections purchase steel coils of 1.0 to 1.25 m width, slit them longitudinally to the correct width appropriate to the section required and then feed them into a series of roll forms. These rolls, containing male and female dies, are arranged in pairs, moving in opposite direction so that as the sheet is fed through them its shape is gradually altered to the required profile. The number of pairs of rolls (called **stages**) depends on the complexity of the cross sectional shape and varies from 5 to 15. At the end of the rolling stage a flying shearing machine cuts the member into the desired lengths.

An alternative method of forming is by press - braking which is limited to short lengths of around 6 m and for relatively simple shapes. In this process short lengths of strip are pressed between a male and a female die to fabricate one fold at a time and obtain the final required shape of the section. Cold rolling is used when large volume of long

products is required and press breaking is used when small volumes of short length products are produced.

Galvanizing (or zinc coating) of the preformed coil provides very satisfactory protection against corrosion in internal environments. A coating of 275 g/m^2 (total for both faces) is the usual standard for internal environments. This corresponds to zinc coating of 0.04 mm. Thicker coatings are essential when moisture is present for long periods of time. Other than galvanising, different methods of pre-rolling and post-rolling corrosion protection measures are also used.

Although the cold rolled products were developed during the First World War, their extensive use worldwide has grown only during the last 20 years because of their versatility and suitability for a range of lighter load bearing applications. Thus the wide range of available products has extended their use to primary beams, floor units, roof trusses and building frames. Indeed it is difficult to think of any industry in which Cold Rolled Steel products do not exist in one form or the other. Besides building industry, they are employed in motor vehicles, railways, aircrafts, ships, agricultural machinery, electrical equipment, storage racks, house hold appliances and so on. In recent years, with the evolution of attractive coatings and the distinctive profiles that can be manufactured, cold formed steel construction has been used for highly pleasing designs in practically every sector of building construction.

In this chapter, the background theory governing the design of cold formed steel elements is presented in a summary form. Designs of cold formed steel sections are dealt with in IS: 801-1975 which is currently due under revision. In the absence of a suitable Limit State Code in India, the Code of Practice for Cold Formed Sections in use in the U.K. (BS 5950, Part 5) is employed for illustrating the concepts with suitable modifications appropriate to Indian conditions.

In the last chapter, the special features and attractions of cold formed steel sections for many industrial applications were presented and discussed. In view of the use of very thin steel sheet sections, (generally in the 1 mm - 3 mm range), particular attention has to be paid to buckling of these elements. Stiffened and unstiffened elements were compared and the concept of effective width to deal with the rapid design of compression elements together with suitable design simplifications, outlined. Finally, the methods adopted for the design of laterally restrained beams and unrestrained beams were discussed. The techniques of eliminating lateral buckling in practice, by providing lateral braces or by attachment to floors etc were described so that the compression flanges would not buckle laterally.

In this chapter the design of columns for axial compression, compression combined with bending as well as for torsional-flexural buckling will be discussed. The diversity of cold formed steel shapes and the multiplicity of purposes to which they are put to, makes it a difficult task to provide general solution procedures covering all potential uses. Some design aspects are nevertheless included to provide a general appreciation of this versatile product. It is not unusual to design some cold formed steel sections on the basis of prototype tests or by employing empirical rules. These are also discussed in a summary form herein.