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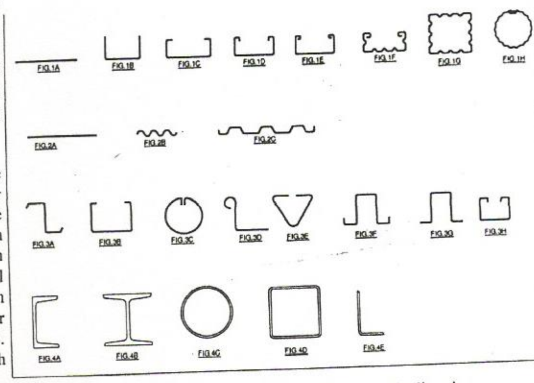
ROLL FORMING

"High Strength to Weight Radio Sections"

A S Shetty

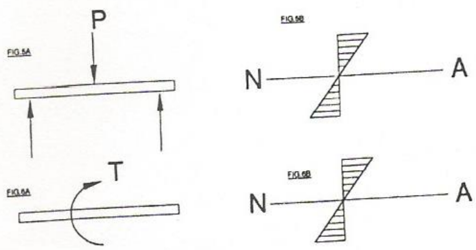
In this tenth series of continuing articles on Rollforming we discuss about the various types of high strength to weight ratio sections. With the cost of steel skyrocketing during the last few years in India it becomes imperative to find ways and means of increasingly developing and employing high strength ratio structural sections. Engineers efforts all along from time immemorial has been to make the best use of the available building materials.



If the members in a structure or the machine elements could be formed or shaped in such a way that the maximum area of their cross section could be subjected to the maximum allowable stresses, the material utilisation is most efficient. In practice, Pure tensile, shear or compressive loads are rarely applied. They are invariably combined with bending or torsional loads.

As soon as bending or torsional loads are applied, it is well known in the theory of STRENGTH OF MATERIALS that the distribution of stresses over the cross section of the member is not uniform. They are highest at the farthest portion of the area from the neutral axis and lowest or almost zero at the nearest portion of the neutral axis.

It is as shown in Fig.5 &6. Fig.5A shows a bar subjected to bending load and Fig.5B shows the distribution of stresses over the cross section. Fig.6A shows a bar subjected to torsional load and Fig.6B shows the distribution of stresses over its cross section.



Hence if we could from or shape the section in such way that material near about the neutral axis could be minimized, great economy in material utilisation could be achieved. That is the reason why I sections, channel, angle or hollow closed sections (shown in Fig.4) were initially developed and are increasingly being used. With these measures savings upto 60% in weight as compared to the use of solid, rectangular, square or round sections are achieved.

Hot rolled sections have certain production limitations i.e. The depth of the sections cannot be increased at will without a corresponding increase in the web thickness. Normally the minimum web or flange thickness that are available are 3mm or more. The minimum thickness being about 2mm. Using Roll Forming technology there is practically no limit to the shapes that could be produced. Here, the depth of Section could be increased without having to correspondingly increase the web thickness.

Let us take the recent developments in Structural Engineering. For placing the Roofing-Sheets over the trusses a secondary supporting system called Purlins are required. Purlin is a roof member that runs at right angles to the lay of the roof sheeting and supports the sheets.

Purlins are in turn supported by trusses or portals which in turn rest on columns. Conventional practice used to be- to uses Angles, I sections or Channel sections as purlins.

By switching over to Z-purlins (shown in Fig 3A) which are Roll Formed Sections as against hot-rolled sections as against hot-rolled sections a saving in weight uoto 50% could be achieved.

As a result of this, the supporting structures like trusses and columns could also be made further lighter. In the advanced countries they have even gone to the extent of eliminating these secondary supporting system and directly use load carrying light-weight roll formed roof-deck sections of greater depth. Let us consider how we could increase the strength of sections. Fig1&2 show how the starting material of plain sheet progressively get increased stiffness/strength by shaping the sheet as shown in the left to right direction.

In Fig1B providing lips on the legs(single lipped C section) the strength increases. Further providing lips, i.e double or treble lips as shown the strength increases much more. A closed hollow section as shown in Fig4C &4D gives the highest torsional rigidity.

A further rigidity is achieved by providing ribs on the closed sections as shown in Fig. 1G & 1H. In Fig.2 it is shown how roofing sheets get increased strength by providing corrugations. Here also deeper corrugations give much higher strength. Some of the simple sections could be produced using press brakes/presses. Once it becomes of intricate shape or longer than say 3 meters it makes it difficult to produce them on press brakes.

Rollforming is the only way to produce such sections. Rollforming makes it possible to develop shapes which combine economy of material with versatility ease of mass production and provision for effective and simple connection to structural members. Fig. 3 shows some of the typical rollformed sections.

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