# FABRICATION TOOLS FOR CORRUGATED WEB I-BEAMS

## A machine tool manufacturer in Austria has developed an economical method to positively weld light gauge corrugated webs to hot rolled steel plate flanges

ONE OF THE FUTURE DEVELOPMENTS IN STRUCTURAL STEEL OFTEN TOUTED at steel conferences during the past few years has been the imminent availability of corrugated web I-beams. One Austrian company, Zeman + Co in Vienna, is now manufacturing machinery to economically produce built-up girders consisting of plate flanges welded to a corrugated web.

Engineers have long realized that corrugations in webs enormously increase their stability against buckling and can result in very economical designs. Therefore, Corrugated Web I-Beams have the potential to eliminate many costly web stiffeners. In addition, the use of thinner webs results in less raw material cost—with savings estimated at 10-30% compared with conventional built-up sections and more than 30% compared with standard I-beams. Corrugated Web I-Beams provide a high strength-to-weight ratio and reduce the depth of steel when compared to truss systems—while also reducing costs as the clear spans increase. Finally, erection costs may be reduced. Since the corrugation in the web provides the members with a higher resistance against bending over the weak axis and rotation, none of the auxiliary lifting equipment normally needed is required when unloading the beam and lifting it into its final position. The same resistance against rotation also reduces the need for brace angles or tubes, further reducing erection cost and time.

The newly available method of producing these members, consisting of light gage corrugated webs welded to hot-rolled plate flanges, is a continuous process for high volume requirements. Corrugated Web I-Beams have been used in a variety of applications, ranging from a simple span in a one-story building to a load-bearing component in a multi-story building. In addition, the rigidity of the webs makes the Corrugated Web I-Beam effective in the crane beam market and may even be usable as box girders for the design of bridge cranes. Finally, it is expected that Corrugated Web I-Beams will prove useful in the highly competitive short-span bridge market.

Using the Zeman + Co. system, the flanges of Corrugated Web I-Beams are made from steel plate or bar material. The flange width may be different between the upper and the bottom flange; however, each width has to be maintained over the length of the beam. They may have step downs in the flange thickness and the flange dimensions vary between 120 mm width by 5 mm thickness up to a flange size of 450 mm width by 30 mm thickness.

The webs are taken from coil material that is continuously corrugated to a sine curve. The depth of the corrugation should measure between 30 mm and 45 mm, but can also have other dimensions. The web sizes may range from 1.5 mm to 3 mm in thickness and 200 mm to 1500 mm in height.

The minimum length of a Corrugated Web I-Beam is 6.00 m and the maximum length is 20.00 m.

## Design Premises

The corrugation of the web generally avoids failure of the beam due to loss of web stability before the plastic limit-loading is reached. However as a result of the corrugation the web does not

*The European projects shown above and on the opposite page (bottom) utilize Corrugated Web I-Beams for both columns and girders. The Corrugated Web I-Beams have been used in Europe on a wide range of projects, ranging from supermarkets to industrial buildings.*

*Pictured on the opposite page (top) is the machinery used to produce the corrugated webs.*

participate in the transfer of longitudinal normal forces from bending. This means that the Corrugated Web I-Beam behaves like a lattice girder in which the bending moments and the normal forces are transferred via the flanges, while the transverse forces are transferred through the diagonals and verticals of the lattice girder (in this case, the corrugated web.)

On the basis of static analogy dimensioning and testing, the verification of the load carrying capacity is ideally provided at the level of internal forces and the cross section properties of the individual cross section components—flange and web.

Zeman + Co. has developed substantial design information to aid engineers in calculating load capacities and member dimensions. For more information, contact the authors via the information at the end of this article.

## FABRICATION

The Corrugated Web I-Beam is being assembled in the course of a continuous and highly automated manufacturing process. At the beginning of the assembly line a decoiler feeds the thin web material into a stretch leveler for stress reduction before the flat material is fed into the corrugating unit. After the corrugation has been induced and after the desired length of the web has been fabricated, the web is cut off by means of a flying shear.

While the finished web is transported through the assembly line continuously, both flanges—which were preassembled in a separate process—are put in place and fixed to the web by means of a hydraulic device. Together they pass the welding unit where the flanges and the web are welded together under submerged arc. Speed and angle of the welding pistol are automatically controlled in order to achieve a high quality one sided weld. The entire manufacturing process takes place at a speed of 2 m/minute.

Splice plates or other accessories then complete the finished beam before it receives its corrosion protection.

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