

HOLLOW STEEL SECTIONS (HSS) IN STRUCTURAL APPLICATION

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INTRODUCTION

Structural Steel members is used as a load bearing member in various structures throughout the world.

Many shapes and profiles of steel are used, to cater to various requirements and to resist loadings of different nature. Each and every profile of structural steel manufactured have their domain of ef-

fective use. Structural Engineers have to select the best possible profile to counter external loads considering all the functional and architectural requirements of the structure and the strength and fabrication aspects of the profile in a balanced way.

Various cross-sectional shapes of rolled steel sections are used in the steel construction like I- sections/ H-sections, Channels, Angles etc. All these sections are called open sections with a well-defined flange and web.

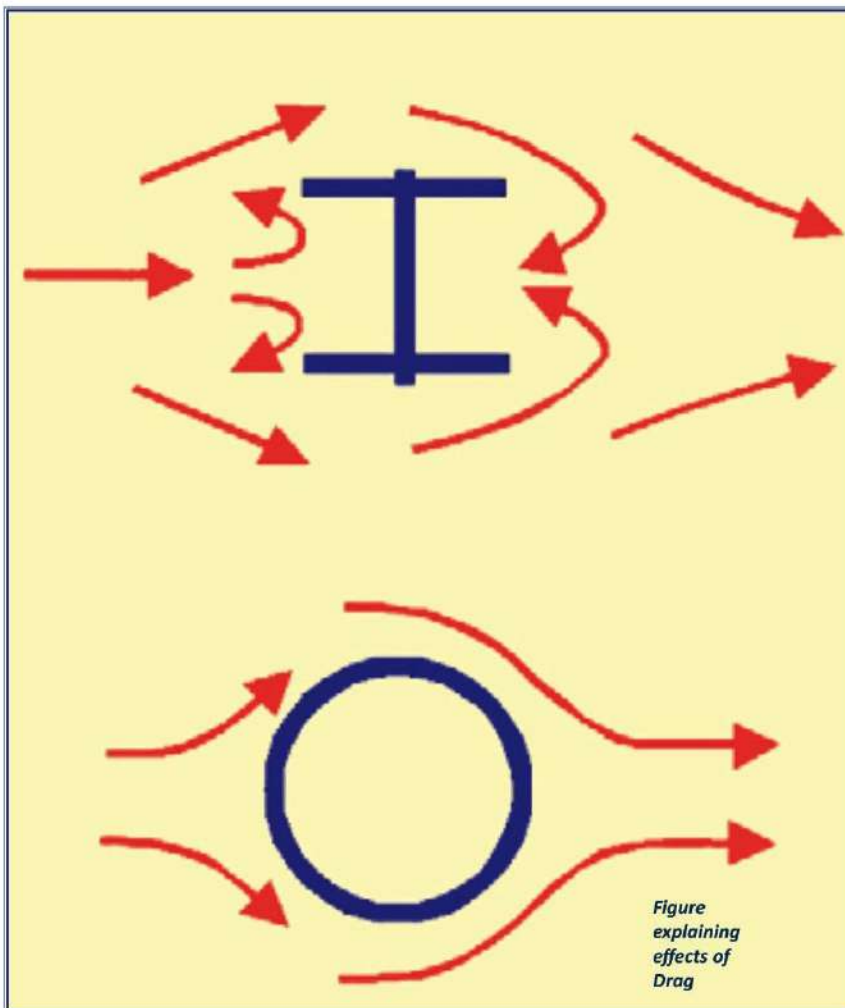
The other set of shapes which are called closed sections are generally circular, square or rectangular in shape and these can be produced seamless or welded. They do not have a distinct flange or web, especially for circular section.

Many other sections with various shapes may also be manufactured by fabricating from two or more sections and connected by bolting or welding from these lists of primary sections and plates. They are termed as compound sections.

Hollow structural sections (HSS) are the closed steel section of high-strength welded steel tubes, formed from hot rolled steel plates which are bent and formed in cold condition.

Three types of steel hollow section are used in steel industry

- Square hollow sections (SHS)
- Rectangular hollow sections (RHS)
- Circular hollow sections (CHS)



APPLICATION

INDIAN SCENARIO AND MATERIAL AVAILABILITY

Among the many manufacturers few primary manufacturers in India are

- Tata Structura – Tata Steel
- APL Apollo Steel Tubes Ltd

The sections manufactured in India are

- Thickness varying from 2 mm to 12 mm
- SHS/ RHS with overall depths varying from 25 mm to 500mm
- CHS with outer diameter varying from 21.3mm (15 NB) to 355.6 mm (350NB)

However other varieties of larger sizes are manufactures by Tata Steel International (erstwhile Corus Steel, UK) and are available in Indian market. Sections which are not available in the Indian market are imported if it is commercially viable. Steel hollow section for steel grade Yst 310 and Yst 355 are also available.

DIFFERENCE BETWEEN HOT ROLLED VS COLD FORMED STEEL

Hot rolled steel, is steel that has undergone the rolling process at a temperature above its recrystallization temperature (usually 1700° F or greater). All open sections, like I, Channels, Angles are Hot rolled Sections.

Cold-formed steel (CFS) is the steel products shaped by cold-working processes carried out near room temperature, such as rolling, pressing, stamping, bending. Sheets of cold-rolled steel (CRS) are commonly used in all areas of manufacturing of Cold formed sections. Hollow Steel Sections in India are man-

ufactured from hot rolled steel and these are bend in cold condition to get the shape of square, rectangular or circular and finally the ends are welded along the length of tubes.

CODES & STANDARDS USED FOR HOLLOW STEEL SECTION

Material Specification:

Material grade steel of hot rolled steel plates/sheets used for HSS section conforms to IS 10748:2004- Hot-rolled Steel Strip for Welded Tubes and Pipes.

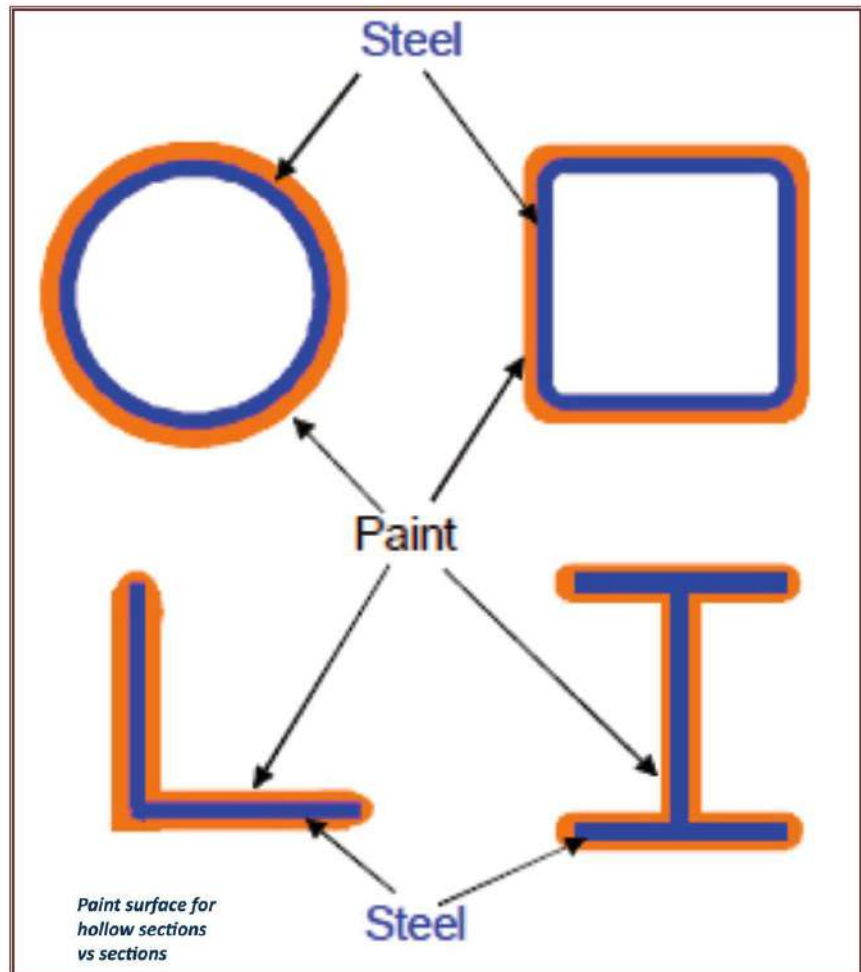
Steel grade and sectional properties

for Hollow Steel Sections are as per IS 4923:2017 for RHS/SHS & IS 1161-2014 for CHS.

Basis of Structural Design

IS 806:1968, Code of Practice for Use of Steel Tubes in General Building Construction is available for design of structures with Hollow Steel sections (HSS) in working stress method. It is undergoing revision at present under Bureau of Indian standard (BIS).

As per IS 806: 1968, Clause 3.1.1, Tubes made by other than Hot Finishing processes or which have been subjected to cold working, shall be regarded as hot finished if they have subsequently been heat treated and are supplied in the normalized conditions. So Hollow Steel Sec



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tions can be designed as hot rolled sections in Limit State Methodologies using IS 800:2007 for General construction in steel.

CHARACTERISTICS & ADVANTAGES OF HOLLOW STEEL SECTION (HSS)

Hollow sections are a combination of internal elements only. Internal elements are plate elements which are joined at both longitudinal edges with the adjacent element. Thus, no edge of an element is free. So, the elements are stiffer, resistant to distortion and displacement out of plane. This very phenomenon of edge support creates more strength and stability of the section.

Geometrical properties of hollow section make it more advantageous compared to the open sections when used in structure under different conditions.

i) More buckling strength: As the radius of gyration in the weaker axis is more than the open-ended sections of equal area and sizes, the hollow sections have more strength against bending and buckling in minor axis. These are especially favourable compared to other sections in case of biaxial bending and torsion.

ii) More resistant to torsion, warping: The shape being closed it itself creates a continuous path of distributing torsion in the form of shear all through the cross section. Hence the shear developed is distributed over a larger section of the cross section uniformly and the section is thus strong in torsion.

iii) Lighter structure & Economy: Cross sectional stability against buckling and bending is more than the open section profiles. Lesser cross section and hence lesser steel may be required to resist the same forces in

case of steel hollow section thus making the structure lighter and more economic.

iv) Low Drag coefficient: The shape of the hollow section has no external incumbents or sharp edges due to which the external loads like wind, fluid currents etc flow smoothly and get least resistance.

v) Aesthetic Appeal: HSS are often favored architecturally because of their smooth sides, rounded corners and closed sections making them an ideal choice when exposing the structure is desired

vi) Better Fire protection & Less Surface Area Exposed to Corrosion:

Structures with hollow sections are less prone to damages by corrosion due to the rounded corners. If the open ends are plugged the section maintenance for against corrosion is easy as the corrosive materials are resisted from attacking the inner surfaces.

Along with many benefits of steel hollow section it also brings some difficulties with it while using in any structure.

- i) As the elements of hollow section are thin, they have a tendency to deform in a localized zone when subjected to heat due to welding.
- ii) Access to all parts of the section is restricted & connection between the members is complicated. So proper fabrication scheme is to be planned in advance before structural design.
- iii) Connections often become robust and cumbersome.

APPLICATION AREAS

Large Span column free public utility structures: Airport Terminal Buildings, Airport Hangers, Storage Godowns, Modern workplace and offices etc.

Large span roofs over: Railway / Metro

Platform Shed, Indoor Stadiums, Playing courts, Bus Terminuses, Community / Ceremonial Halls, Shopping Malls.

Light but long span structures: Foot over bridges, Road side hoardings, signage .

Industrial Structures: Conveyor Gallery structures, Pipe trestles, Purlins, Sheeting supporting structures, Crusher Houses main structures etc.

Scaffolding: Circular hollow sections are used as scaffoldings due to its lighter weight, strength in all directions, easy transportability and stacking, easy connection by clamping.

New Area: Towers for Solar Cells, Telecom/ mobiles, wind energy, supporting structures for sound barriers.

CONCLUSION

Hollow Steel sections can be used most effectively for axial load carrying members like columns, truss members, long span trusses etc. With proper connection design and details RHS & SHS section can also be used in flexural members like beam also in the members carrying torsion in the steel structures.

