

## 2.13 Hot Dip Galvanized Castings

### 1. General

Although iron and steel castings are not as widely used in the building and construction industry as rolled or hollow section steel, they are used for specific applications and in some areas are enjoying something of a revival (fig. 1).

The hot dip galvanizing of cast iron provides excellent protection from corrosion and the coating is applied by immersion in molten zinc at 450 °C forming a tough adherent coating which is bonded to the base material by a series of zinc-iron alloy layers overlaid with free zinc.

When problems are experienced with hot dip galvanized castings, they can usually be traced back to the surface condition of the casting. When problems do arise they are frequently due to burnt-on moulding sand, oxides from the annealing process, traces of graphite or pollution, or surface flaws, such as shrinkage holes (fig. 2).

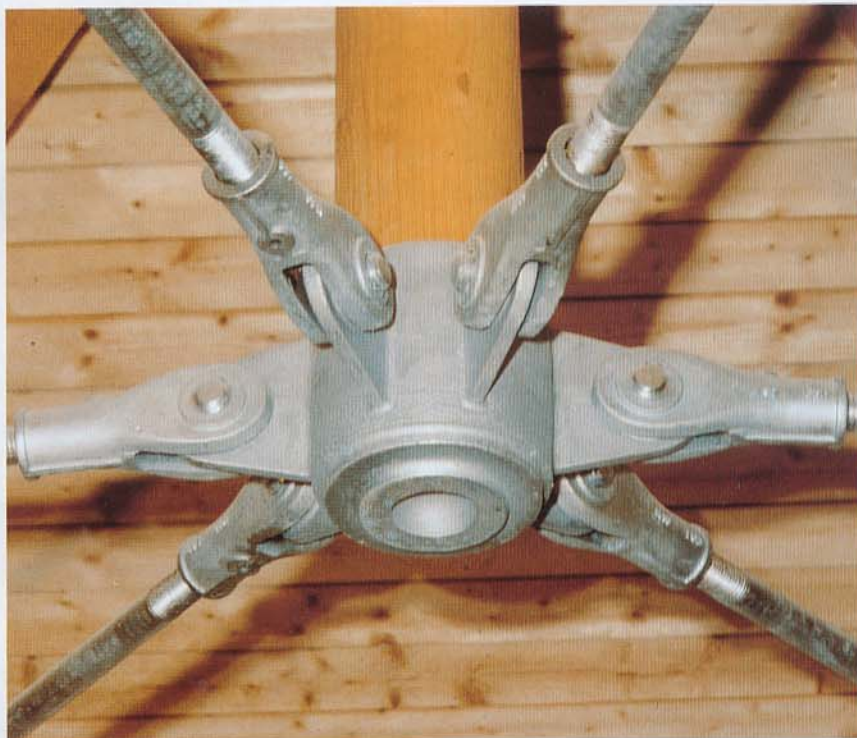
### 2. Types of castings

Cast iron is a compound of iron and carbon usually with a carbon content of more than 2 % and silicon and phosphorus levels significantly higher than in normal steel. The composition of the cast material must be taken into account when considering galvanizing as a method of protection, especially the silicon and phosphorus contents.

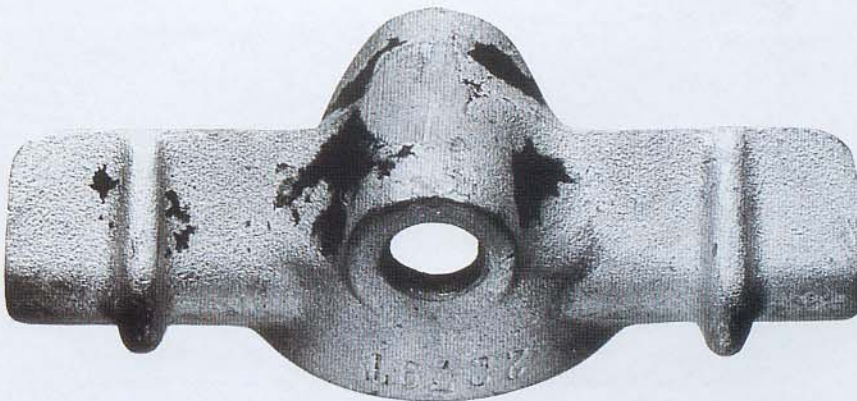
- Cast Steel: Cast steel is often used when design considerations point to a casting as the best answer but superior tensile strength is required. The chemical composition and properties of these castings are essentially similar to steel sections. Therefore, the preparation and suitability for hot dip galvanizing are the same.
- Cast Iron: Iron castings of any type and any chemical composition can be hot dip galvanized. The term covers a wide range of ferrous alloys usually containing more than 2 % carbon and from 1 – 3 % silicon. Wide variations in properties can be achieved by varying these elements and additionally alloying with various metallic and non-metallic elements plus casting and heat treatment techniques.

The most widely galvanized types are as follows:

- Grey iron castings: Grey iron has a carbon content of greater than 2 %, the majority of which is graphite in flake form.
- Spheroidal graphite (SG) castings: Similar to grey iron in composition but with carbon present principally as graphite in spheroidal form caused by the additions of magnesium or cerium.



**Fig. 1: Cast iron nodes are combined with steel tie rods in the German Besista Space Frame System.**



**Fig. 2: Faults in the galvanized coating are often caused by faults on the surface of the casting.**



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- Malleable iron castings: Basically three types of malleable iron; Blackheart, Whiteheart and Pealitic. Malleable castings derive their mechanical properties of toughness and workability from a complex and lengthy annealing process. No primary graphite is permissible. Typical carbon contents for malleable castings are as follows:  
Blackheart C = 2.2 to 2.8 %  
Whiteheart C = 2.8 to 3.4 %

### 3. Surface preparation

Conventional hydrochloric acid based pre-treatment for hot dip galvanizing of steel does not remove moulding sand deposits, temper carbon or graphite from the surface of cast iron. (fig. 3). The necessity of sound preparation by grit blasting cannot be overstated. Surface cleaning of complex shapes is undertaken using hydrofluoric acid and it is important to approach specialist galvanizing companies who operate this process or alternatively to consult your Galvanizers Association.

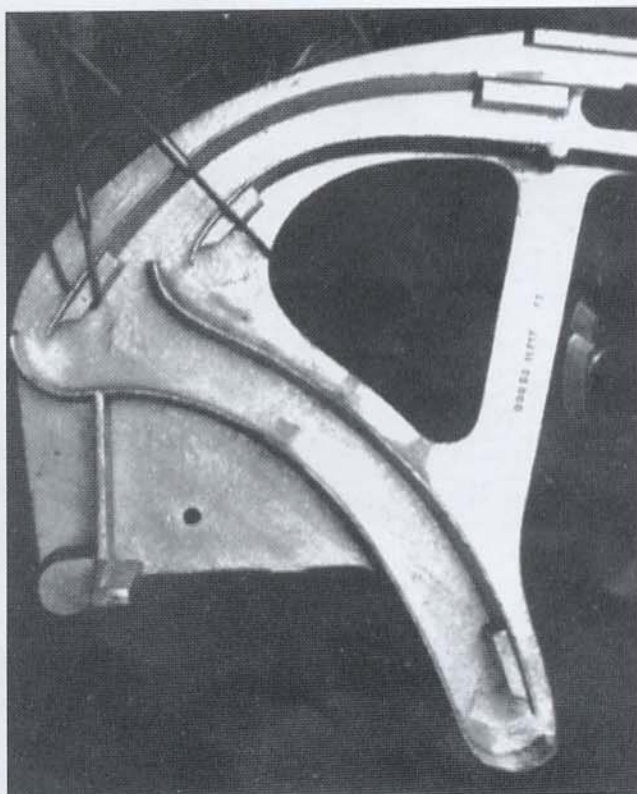
Surface flaws such as shrinkage holes should be filled in prior to galvanizing, otherwise problems may ensue.

### 4. Design

Care needs to be exercised in the design of cast iron sections. Small castings of simple shape and solid cross section (e.g. levers, clamps, bushes etc.) do not present any problems for galvanizing providing that the material and the surface condition are suitable.

Larger castings should have a balanced design with uniform sectional thicknesses to avoid distortion and thermal stress cracking. Always use large fillet radii, large pattern numbers and avoid sharp corners and deep recesses.

The rough surface finish which castings tend to have may result in thicker zinc coatings than on rolled components.



**Fig. 3: If sand from the mould is not properly removed it can cause bare spots in the galvanizing.**