



STEEL INDUSTRY
GUIDANCE NOTES

Castings in Construction

This SIGNS recommends why castings should be considered for use in construction, and that early discussions are held between all parties to ensure that appropriate casting methods and quality requirements are specified.

What is a casting?

Steel castings are formed by pouring molten metal into a mould containing a cavity which has the desired shape of the component. The liquid metal cools and solidifies in the mould cavity and is then removed for cleaning. Heat treating may be required to meet desired properties, but there is no need for subsequent hot or cold working. Castings can be produced as one off components or in many thousands. They can be made in a wide range of sizes and weights, the upper limits being governed by the particular casting process used, and the required mechanical properties and surface finish. It is possible to achieve high strength, high ductility and high toughness in the cast form. Castings can have excellent surface finish and good welding and machining characteristics.

Castings can operate at high and low temperatures, under high pressure and in severe environments. They do not exhibit the effects of directionality on mechanical properties that exist in some wrought steels. Providing the correct grade of material is selected and an appropriate inspection and testing regime implemented, there is no reason why the composition, properties or performance of castings should be inferior in any way to that of fabricated components.

Reasons to use castings

Unlimited choice and range of sizes and sections - from simple block or plate-like structures to highly intricate forms.

Streamlined shapes for minimum stress concentration - castings permit the use of shaped fillets and blended sections at any location, including highly stressed areas (streamlined designs also tend to be best from the standpoint of castability).

Shaping for maximum strength and minimum weight - metal can be added where it is needed for greatest

resistance to bending, compression and tension forces.

Single integral components - single piece construction leads to greater structural rigidity and avoidance of misalignments and assembly errors.

High dimensional accuracy - tight tolerances can be achieved depending on service requirements, pattern equipment, size of casting, process employed and finishing requirements.

Desirable surface finish - a wide range of surface finishes can be achieved, depending on the casting process employed. It is easier to achieve a consistently higher standard of surface finish with a casting than with fabrication.

Ease of integration within the overall structure - a cast connection is formed offsite, within a quality controlled foundry environment and facilitates simple site assembly. With a casting it is possible to displace welded joints to locations of reduced stress, usually where welding can be carried out more easily.

Castings may be a cost-effective design solution for:

- large quantities of repetitive components,
- complicated tubular connections, with incoming members at different angles,
- connections subject to very high forces, where large welds would be difficult to inspect and test and expensive to repair,
- tapered sections, or where thick sections are required adjacent to thin sections,
- thick plate details where isotropic material properties are required,
- visibly exposed connections where aesthetics are important,
- fatigue-sensitive joints.

Design of castings

A number of new European Standards have been issued over the last two years giving physical and mechanical properties of grades of steel castings (see Sources of further information). BS 3100 *Specification for steel castings for general engineering purposes* has now been superseded and withdrawn. The closest equivalent grade to A4 (BS 3100) is G20Mn5 (1.6220) in BS EN 10293.

For carbon steel castings, the adequacy of the proposed cast component to withstand the design loads can be determined using the provisions in BS 5950: Part 1. The design strength of the material may be taken as the 0.2% proof stress (or lower yield strength in the case of some cast carbon steels).

Castings must be designed both with production and performance in mind, so early collaboration between structural engineer, fabricator and founder is essential. It is also important for the architect, engineer and fabricator to understand the method of casting production so they are aware of any problems that the founder may have to overcome and the kinds of shape which may be difficult to form. The founder will be able to advise on the type of pattern and the method of moulding required to produce a casting of the desired surface finish and dimensional accuracy. The method of casting manufacture has a major impact on the delivery time and cost.

Inspection and testing

The extent of inspection and testing is specified by the structural engineer and depends on the process of casting manufacture and the foundry's usual testing procedures (which can vary considerably from foundry to foundry). If castings are to be provided to the correct quality at an economic price, then it is essential that inspection and testing are limited to those features which are relevant to the service use of the casting. This applies both to the methods specified, the extent to which they are invoked and whether inspection can be restricted to certain parts of the casting.

It is extremely important that early discussions are held between the parties so that the implications of the various processes and desired quality requirements are fully understood, taking due account of project schedule and cost.

Key Points

1. Casting provides a direct means of manufacturing complex shapes.
2. The mechanical properties, quality, integrity and consistency of cast steels are generally comparable with those of hot rolled and fabricated structural steels.
3. Early collaboration between designer, fabricator and foundry are essential.
4. The total value of the castings in the structure usually needs to be high to justify the design and verification time needed.

Further sources of Information

N R Baddoo, *Castings in Construction SCI P172*,
The Steel Construction Institute, 1996

www.castmetalsfederation.com The Cast Metals Federation is the trade association representing the UK cast metals industry.

www.castingstechnology.com Castings Technology International (Cti) is a research and development organisation providing technical support and consultancy services to the castings industry.

BS EN 10283:1999 Corrosion resistant steel castings

BS EN 10293:2005 Steel castings for general engineering uses

BS EN 10340:2007 Steel castings for structural uses

BS EN 10213: 2007 Steel castings for pressure purposes