

Cast Steel and Hollow Sections – New Applications and Technologies

Marian Veselcic, Stefan Herion & Ram Puthli

University of Karlsruhe, Research Centre for Steel, Timber and Masonry
Karlsruhe, Germany

ABSTRACT

In this paper, results of fatigue investigations dealing with end-to-end CHS connections are presented. Different variants for connections between castings and hollow sections are investigated and evaluated. Suggestions for detail categories for different weld geometries between steel castings and steel hollow sections are made, to provide selection criteria for designers.

KEY WORDS: fatigue, cast steel, CHS, end-to-end

INTRODUCTION

Cast steel in structures under fatigue loading is being increasingly used nowadays. These structures provide an improvement towards a slender and aesthetic design, ease in manufacturing of complicated joint types with optimized distribution of stresses. Furthermore, the stress concentration is reduced, which improves fatigue life. To introduce these joints in structures, an end to end connection between the cast node and a steel tube is necessary. Due to hitherto rare usage, the advantages of new cast steel grades, improvement in material technology, as well as economic considerations are unknown to a majority of engineers. Also, the existing rules and design guides are seldom adequate.

After presenting the first results at the 17th ISOPE 2007 conference in Lisbon, the research work is continuing. Fatigue results of investigations under tension and bending loads for end-to-end CHS connections will be presented in this paper with different variants for connections between cast steel and hollow section. In the evaluation, detail categories for different weld geometries between cast steel joints and steel hollow sections are suggested. With this selection criteria for designers and planners are provided. Detailed information on the manufacturing process is presented in former publications mentioned above. Details on quality levels and welding parameters described in this section are described in detail in Veselcic et al. (2006, 2007).

The results can be used as an aid as to which alternative is preferable for the design of end to end connections for fatigue, as well as under economical points of view; these are also applicable for a steel to steel end to end connection. This research is carried out with a financial

grant by the German Forschungsvereinigung Stahlanwendung (FOSTA) (Project P591- Economic use of structural hollow sections for highway and railway bridges) and by CIDECT (Project 7W - Fatigue of end-to-end connections).

FABRICATION OF THE TESTING SPECIMEN

For all delivered steel and cast steel members, material testing and chemical analysis has been carried out to determine the properties. All obtained values were satisfactory with respect to their normative regulations.

Also, non-destructive tests on the individual members were carried out by the cast steel manufacturers and the University of Karlsruhe. In all examined test specimens, the necessary cast quality was achieved. Furthermore all parts were tested with the following testing methods:

- Radiographic inspection
- Ultrasonic inspection
- Magnetic particle inspection
- Dye penetration test

For the research project steels according to Table 1 are considered for the tests. With the use of high strength steel, a reduction of the member thickness can be realized in practice. To ensure good weldability, especially at the weld surface, the cast quality is chosen according to table 2. For the welding, preheating was omitted, which entails a significant cost reduction.

Table 1. Steel grades for the hollow sections and corresponding cast steels

hollow sections	standard	cast steel	standard
S355J2H	EN 10210	G20Mn5(V)	EN 10293
S460NH	EN 10210	G10MnMo V 6-3	EN 10293

Table 2. Cast steel quality levels according to EN 12680-1

Welding area	Quality level 1	V1 S1
Surface:	Quality level 2	V2 S2
Within cast steel	Quality level 3	up to V3