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Study Concerning the Welding of the Grozavesti Arc Bridge over the Dambovita River

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Abstract

Welding is on of the most important step of the steel bridges construction. Welding ensure the bridge compactness, bad welding means broken bridge. A correct welding technology is the essential prerequisite for the fabrication of welds which meet bridges requirements. In this study was determined the necessary steps in bridge welding according with EN 1090-2:2008.

Key words: *Low hydrogen content, preheating*

Introduction

Welding structural steel for bridges can be make only by an EN ISO 3834 authorized Company (S.C. COIFER IMPEX S.R.L.BUCHAREST have EN ISO 3834-2:2006 authorization).

The welding procedure start, according EN 1090-2:2008, with the preparation of the welding plan, including the welding procedure specifications, measures to be taken to avoid distortions during and after welding, the sequence of welding with any restrictions or acceptable locations for start and stop positions, requirements for intermediate checking, measures to be taken to avoid lamellar tearing, etc.

Site welding may be performed with EN 15614-1:2008 authorized welding procedures, by the following processes, defined in EN ISO 4063:
- 111: Manual metal-arc welding
- 114: Self-shielded tubular cored arc welding
- 135: Metal active gas welding; MAG welding
- 136: Tubular-cored arc welding with active gas shield

Welders shall be qualified in accordance with EN 287-1.

Welding coordination shall be maintained during the execution of welding by coordination personnel suitably qualified for, and experienced in the welding operations they supervise as specified in EN ISO 14731.

Experimental Procedure

Before starting the assembly work of the bridge were drawn up following welding documents:

- Order of each joint welding, the layers and rows;
- NDE - plan: visual (VT), RP, UT, PT (MT) and destructive: witness plate test (production welds).

Welding on site was done by manual arc process, 111, with H5 basic coated electrodes, EN ISO 2560:2006, dried in the oven and kept in thermos before use, Fig.1.

Fig.1. Thermos for electrodes

The welding was, in many cases, with gas-air flame preheating, Fig.2 and butt welds with full penetration had the arc-air and polishing roots cleaning Fig.3.

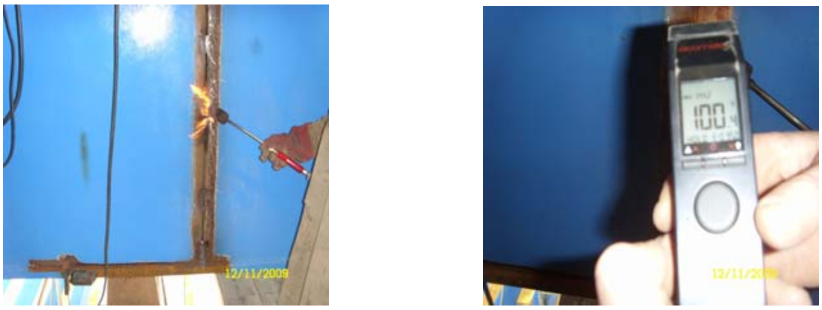

Fig.2. Preheating

Fig.3. Arc-air roots cleaning

Preheat and welding was carried out simultaneously on each item (hearts, feet) to balance the internal tensions and strains.

At the each joint the butt weld was executed simultaneously, with 2 or 4 welders. The fillet welds were done after NDT check of the butt welds. We went on the principle that a Joint, must be weld - start and end simultaneously at all elements.

During the welding, with the increase bevels, was made the full side cladding of a part, and then was completed the welding .During the cladding, transverse tension and contractions were not significant.

Non-destructive testing with RP, U.S., LP (PM) and the destructive control of the witness plates test was performed by companies authorized thereto.

The main problems appeared in bridge welding were:

- The weld joists of transverse beams to longitudinal beams, Fig.4, must be obtained zero contraction (the beams were caught on the heart and lower foot with screws and after welding, the holes should be concentric).The solution was to keep the Interpass temperature constant and to monitor and maintain of the minimum value the heat input (to weld with out oscillation, respecting strictly the prescribed welding order)

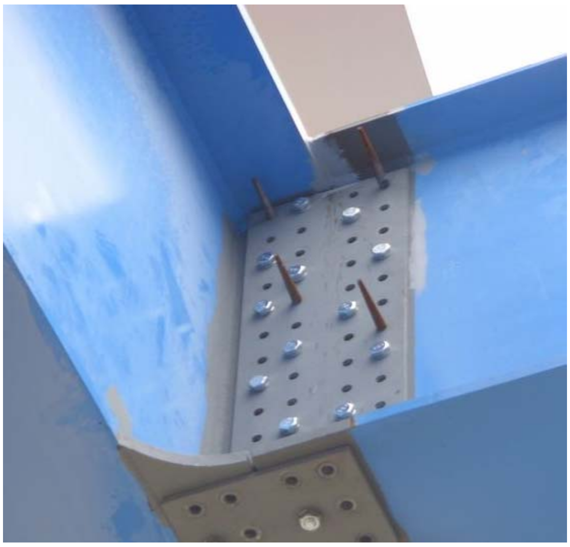

Fig.4. Transversal beams welding

- Junctions of hearts, both longitudinal beams and arches were full penetration butt welds, vertical-up welded only. These welds were checked RT, Gamma, Two films on weld - to the extremities, and 100% UT. All non-destructive inspections were performed at 48 hours after welding. Given the short implementation period required, so the need to obtain good welds from the start, we tested all the welding techniques for this position. Technique with the best results (98.6% admitted) was, Fig.5:
  - First pass with either a whipping technique;
  - Following apply box weave pass;
  - Last layer straight weave pass.
- The same techniques was used to the fillet welds of end transverse beams to longitudinal beams, Fig.6.
- Overhead welds, Fig.7, and horizontal welds, Fig.8, were made with stringer beads.


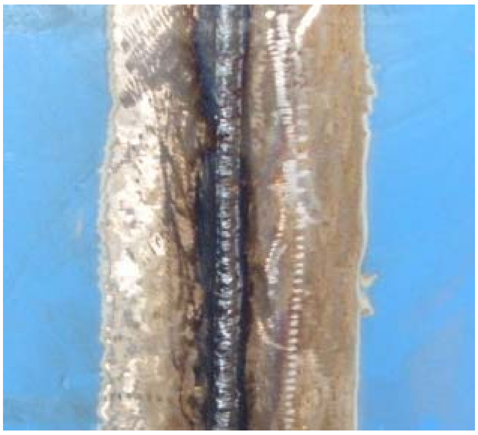

Fig.5. Vertical-up welds

Fig.6. The fillet welds of end transverse beams with longitudinal beams


a)


b)

Fig.7. Overhead welds: a) FW, b) BW

Fig.8. Horizontal weld

- Welds section of the inner stiffenings must be made with slow thickness change to ensure the item continuity, Fig.9

Fig.9. Inner stiffenings welding

Conclusions

Based on experience and made tests, the authors wanted to prove, again, that the welding work is one of the most important steps to achieve a metal bridge. Therefore must be made a very good technological welding preparation before welding:

- Must prepare welding technology for each type of joint, very clear and explicit;
- Must train the welders and they should be checked on all work time, to have certainty that they respect Welding Technology;
- Must be avoided deformations caused by tension concentrator because it is not allow the hot straightening and heat treatment are very expensive (the elotherme treatment, the only on could be used).

On site welding must be used only very good welders for welding process chosen, approved according to EN 287-1 (they should be able to weld in all positions, quickly and well, the repairs being a very serious problem, when they are in a large number).

To the site work preparation must be kept in mind to assure good lighting and well ventilation in the welding area (at the caissons, for example, the interior is weld by 4 welders in the same time). Also must ensure the stability and comfortableness of welders at the work place.

This study offers, to those interested in, practical solutions for welding with manual coated electrodes of steel bridges in accordance with European standards.

References

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Studiu privind sudarea podului în arc peste râul Dâmbovița la Grozăveşti

Rezumat

Sudarea este una dintre cele mai importante etape în construcția de poduri metalice. Sudura asigură compactitatea podului, o sudură proastă înseamnă un pod care se poate rupe. O tehnologie de sudare corectă este o condiție esențială pentru a îndeplini cerințele de execuție a sudurilor la fabricarea podurilor. În acest studiu au fost determinate etapele care trebuie parcurse la sudarea unui pod în vederea respectării cerințelor standardului EN 1090-2:2008.