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Study Concerning the Site Assembly of the Grozavesti Arc Bridge over the Dambovita River

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Abstract

Welding on steel bridges has been practiced for many years. The increasing frequency of traffic conditions increases the risks involved in welding of high resistance bridge parts.

The execution of steel bridge was made in order to ensure adequate levels of mechanical resistance and stability, serviceability and durability.

Until now, in Romania, the bridge construction standard was STAS 9407-1975. Starting with 2009 - the standard is EN 1090-2: 2008 - Execution of steel structure and aluminum structure - Part2: Technical requirements for the execution of steel structures.

In this study were determined the necessary steps in bridge construction according to EN 1090-2:2008.

Key words: *Bridge construction preparation and assembly conditions*

Introduction

The globalization of the construction market comprising construction products, engineering- and construction services requires International Standard Families in order to avoid inconsistencies due to the use of various national codes [3].

So far there are two sources of International Standard Families: one in the USA, the other in Europe, each consisting of a design code in connection with product standards and testing codes - AWS D1.5 for USA and European Standard Family for Europe.

The European Standard Family is being prepared by CEN and so far includes 10 Eurocodes with 58 parts, ~500 EN-standards for products and ~700 EN-standards for testing. It also contains ~170 European Technical Approvals and European Technical Approval Guidelines worked out by EOTA [3].

EN1090-2:2008 give Technical requirements for the execution of steel structures.

The technical building conditions for the Grozavesti arc bridge over the Dambovita river were:

- The project specification was drawn up by Spanish FHECOR designer MADRID, based on American, AWS D1.5 Code and European standards, EN 1090-2.

- Constructive solution is an arch bridge, with 117.7 m opening, with steel-concrete cooperation, this being achieved through 19 mm diameter connectors welded on longitudinal beams top and the cross beams top (bridging).
- Overall dimensions are:
  L = 123,5 m.
  l = 22,5 m.
  H = 20,45 m.

Experimental Procedure

Assembly of components shall be carried out so as to fulfill the specified tolerances.

Precautions shall be taken so as to prevent the bridge unnecessary pretension.

- The bridge is composed of:
  - Open caisson-type longitudinal beams at the top;
  - Closed caisson type Cross-beams (bridging) completely welded. A roof was needed in order to weld inside the building profile section at the longitudinal beams with cross - beams connections.
  - Current full heart Cross-beams (bridging). Top base of the girder were combined with soles upper longitudinal beams by welding. The hearts and down feet were fixed with high strength black bolts. Before joining, the surfaces in contact have been sandblasted and primed (inorganic silicate Zn) necessary for corrosion protection and simultaneously to ensure appropriate friction coefficient (authorized procedure according ASTM A325 and EN 1090-2:2008).
  - Closed caisson-type bridge Arch with variable section. Every Joint were required one large and one small round cover. Small cover was necessary to allow the inside weld of the high profile, Fig.1.
  - 70 mm diameter coupling bars between arches and longitudinal beams.

Fig.1. Closed caisson - type of closing

- The steel used is EN 10025:2005, S355 J2 G3 type, 50 mm maximum plate thickness (in feet above the longitudinal beams).
- Where indicated in the project, at the direction of thickness of sheets required, they were checked by ultrasound on the entire surface and through thickness direction tensile testing on the requirement Z 35.

- Welding on site was done by manual arc process with Basic coated electrodes, E 42 5 B, EN ISO 2560:2006, dried in the oven and kept in thermos before use, preheat air and gas flame welding clearing roots arc-air and polishing process.
- Company executing COIFER BUCHAREST is authorized provider for welded structures, DIN 18800-7:2002-09 -class E and EN ISO 3834-2:2006, welders qualified (authorized as EN 287-1:2004/A2:2006) and welding procedures qualified specifications (approved as EN 15614-1- 2008) for the bridge.
- Particularity
  - Manufacturing preparation: - The succession of assembly of subassemblies, starting simultaneously from both ends.
  - Before starting welding the joints was required to confirm the topographic measurements, the coordinates and correct forms adjacent sub-assemblies in accordance with the project and specifications.
  - In the plant was made at least one assembly (the sections of longitudinal beams and arches) for the future the bridges trend is to eliminate total the assembly in factory, asking for precise execution of sub-assemblies and factory joints.
  - In rare cases of mismatch the construction of welded joints, lower arch were remedied by polishing and large through-loading control ultrasonic welding Fig.2.

Fig.2. The subassemblies adjustment

  - For the soles butt welding were practiced in heart (wall) cuttings -out, which were later plugged Fig.3.

Fig.3. Cuttings-out for soles butt welding

- For protection against wind, rain, snow and low temperatures, around the joints were created light materials enclosures, for the inside temperature needed, using heat sources to achieve temperature min. 5^0 C, Fig.4.

Fig.4. Light materials enclosures for protection

- At the end of the bridge welding were done topographic measurements which confirmed the tolerances permissible classification of the dimensions and forms of the bridge subassemblies.
- After Removing the support of the longitudinal beams, fixed the bolts in the joints and removal of all devices and helpful parts, without affecting the base material, were cleaned joints surfaces by sandblasting and paint damaged areas. The final painting of the bridge will be make in spring, when the temperature will be positive Fig.5.

Fig.5. Grozavesti arc bridge over the Dambovita river

The main problems appeared in assembling and welding preparation were:

- Harmonization of requirements of the project, stating "in accordance with AWS D1.5 and European standards, rules have not the same requirements (for example, the UT ultrasonic test, admitted defects in the welds is more permissive in the AWS D1.5 than EN 1090-2). The problems were solved by devising a protocol between the performer and designer to specify what part is respecting the AWS D1.5 requirements and what EN 1090-2 (so to be technically correct but also easier to execute in the site).

- Transmission of dimensional deviations from the mainstay devices to the longitudinal beams was solved by topometrical measurements Fig.6. After every construction stage, was analyzed each result to take the best decision, depending on compensation possibilities, when they have appear. A special attention should be given to this aspect because, due to large size, in rare cases the bridge can be completely preassembled in the building factory, so, in the site are "collect" all deviations (even if each, in turn, have correct standard deviations, the deviations amount is possible not meet the requirements - and it sees the end, at the bridge "closing", it is possible the last sections do not longer "meet" - clearly not our case Fig.7).

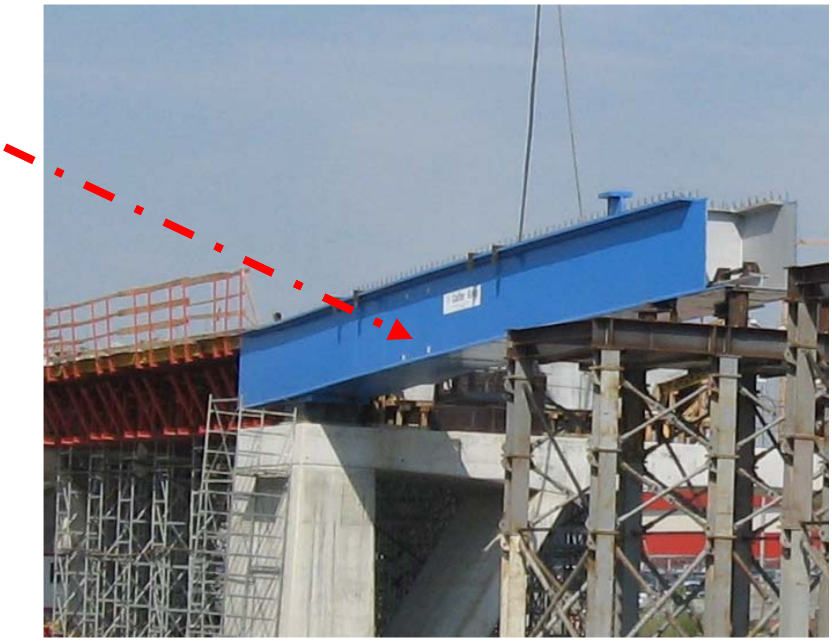

Fig.6. Placing the section No.1 of the beam longitudinal on the support device

Fig.7. Arc bridge "Closure"

- Adjustment of the last sections, closure sections, should be carefully made (known that in those sections, it is generally higher added to compensate the deviations of execution) in order to ensure correct form of groove joints, root opening max. 3 mm (EN 29692 – No.2.3.3, 2.3.9). To the closing welds of the bridge, was paid special attention to the exterior temperature when the adjustment cut was made (the expansion coefficient of material has big variations when the day temperature vary greatly.

Conclusions

Based on problems analysis in assembling and welding of steel bridges, conjunction with the requirements of standards, this study presents the solutions adopted for the construction Grozăveşti bridge over the Dâmboviţa River.

The adoption of these solutions was taken into account such factors as safety operating and possibilities, time and cost of implementation (the work was done in 3 months). Study authors, contractor - SCCOIFER IMPEX - Ms. Ewe. F. Mateescu and inspection by the customer – ASTALDI - FCC Construction Delhi - Mr. Ewe. A. Oltean, proposed those solutions to the designer, Spanish FHECOR MADRID designer, and he has endorsed.

Authors are designed this study in order to offer alternatives, based on experimentation, successfully, scroll to the stages of building steel bridges, taking into account of large number of bridges to be build in Romania.

References

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Studiu privind asamblarea în şantier a podului în arc peste râul Dâmboviţa la Grozăveşti

Rezumat

La execuţia podurilor, sudarea s-a folosit de foarte mulţi ani. Intensificarea condiţiilor de trafic - creşterea parcului auto la nivel mondial şi diversificarea modului de exploatare au dus la necesitatea impunerii de condiţii foarte stricte procesului de sudare a podurilor.

Execuţia podurilor din oţel trebuie făcută astfel încât să asigure nivelul de calitate adecvat în conformitate cu cerinţele privind rezistenţa mecanică, stabilitatea, siguranţa în funcţionare şi durabilitatea construcţiei.

Până acum, în România, la construirea podurilor se aplica standardul STAS 9407-1975. Începând din anul 2009 - standardul aplicabil este EN 1090-2: 2008 - Execuţia construcţiilor metalice din oţel şi aluminiu - Part2: Cerinţe tehnice pentru execuţia structurilor din oţel, dacă nu este altfel specificat în proiect.

În acest studiu au fost determinate etapele care trebuie parcurse la construirea unui pod în vederea respectării cerinţelor standardului EN 1090-2:2008.