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RESEARCH ON THE DEVELOPMENT OF HETEROGENEOUS MATERIALS WELDING TECHNOLOGY

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Keywords: welding technology, metallographic structure, corner joints, welding parameters

Abstract: This paper presents results of research conducted to establish the connection by welding technology of heterogeneous materials, research on the influence of welding parameters on joint structure and physicochemical owners. Keywords: welding technology, metallographic structure, corner joints, welding parameters

INTRODUCTION

In high voltage substations of the national energy system are periodically modernization, replacement of old transformers regarding overcome technical or maintenance and repairs to existing transformers. To limit the time of interruption and switching in substations are provided and arranged for special areas to be transported for repair and maintenance processor. In this case a transformer with experience is always replaced with new or repaired a transformer to transformer problems with failure to minimize the time of power interruption to the action zone. In a high voltage transformer station was imposed extension of the line inside the existing transformer station for transport to a new alignment for the repair and maintenance thereof and replacing it with a new and modern transformer. This paper presents research on the establishment of joint welding technology of the railroad tracks and support base plates embedded in concrete foundation line.

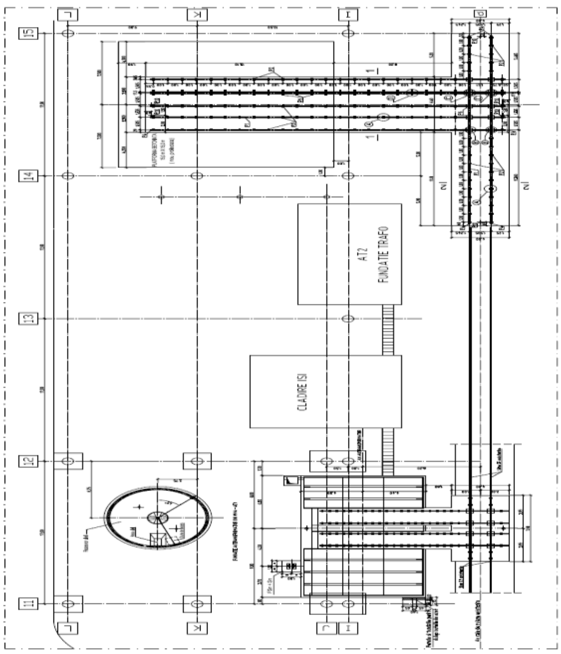


Figure .1. The drawing for the execution of work

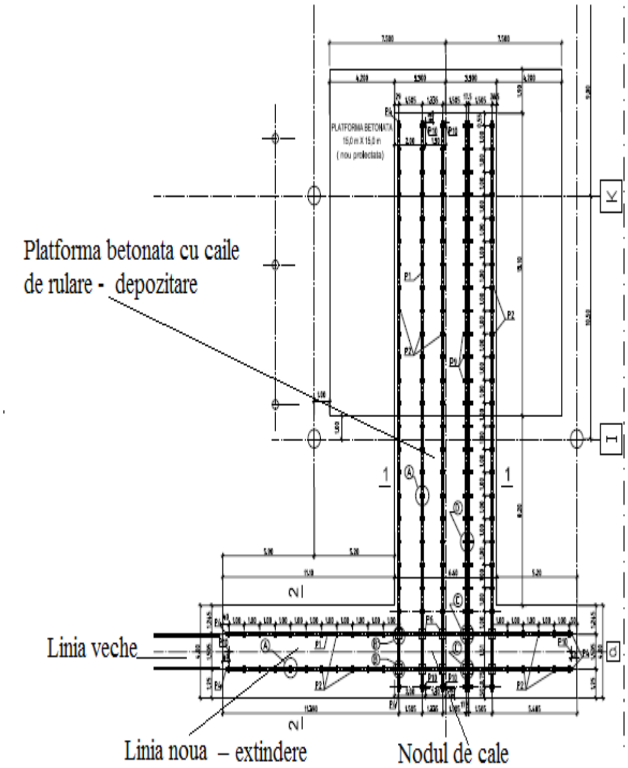


Figure 2. Extension of the tread (area)

1. PRODUCT DESCRIPTION

Drawings of the new tread is shown in Figure .1. The placement of this tread was made a concrete foundation for the expansion of the old site to the new location of the transformer has been made a concrete platform to keep the transformer during repairs and new running path , Figure 2, consists primarily of an extension of the old lines portion

To build tread rails using the type CF40 STAS 1900/80. Positioning and fixing rails on concrete foundation is achieved by means of steel base plates S235J0 SR EN 10025/2004 size of 250x120x10mm. The plates are encased in concrete through reinforcing plates of 16mm diameter, called panzers. Figure 3. that presents the structural attachment of plates welded rails through the corner joints unsearchable
120mm length of weld thickness 7 mm respectively

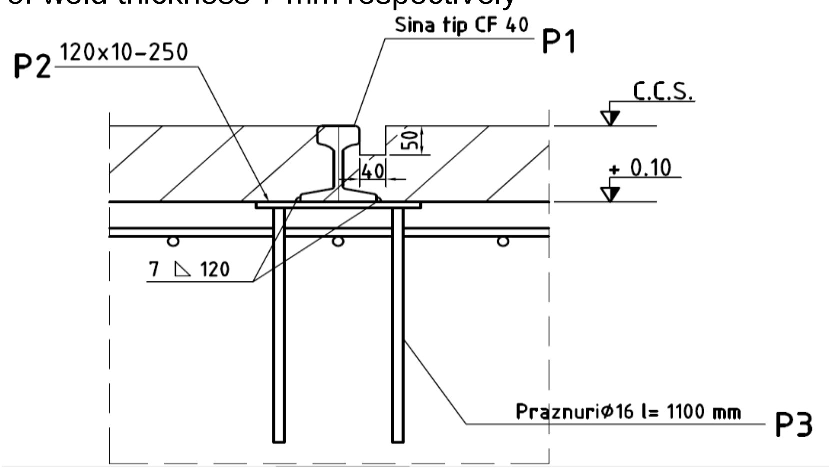


Figure 3. Structural attachment of plates welded rails

2. DETERMINATION OF WELDING TECHNOLOGY
2.1. BASIC MATERIALS

The base material for the slide adapter that was chosen as first quality track, used in railroad construction. Chemical composition and mechanical characteristics are as tabelului.1.

Table 1 Chemical composition and mechanical characteristics

Chemical composition	Carbon%.................................0,40…0,55 Siliciu%..................................max. 0,35 Mangan%...............................0,80…1,20 Fosfor% (max.).......................0,05 Sulf% (max.)…………………0,05
Mechanical characteristics	Tensile strength N/mm^2 (kgf/mm^2), (min.) 690(70)[1*] Elongation at break, % (min)…………………..14 Resistance soc2[*] (nr.of break): -varianta a…………….2 -varianta b…………….1

[1] * With the agreement of the permitted values decrease with 20N/mm2 aceti (2kgf/mm2).
[2] * Samples should withstand without breaking sauf country to crack. Observations:
1) Provided the mechanical characteristics: high-limit may be 0.60% for carbon, manganese-low limit may be 0.70%.
2) exceeding the 0.55 R, S and P content should be max. 0.04 each.
3) In case the electric steel process is worked through, the contents of S and P will be up to 0.04 each.
4) Option for rezisteanta shock will be chosen by the beneficiary, as mentioned in the order. Material with which concrete is done to catch chose himself to be made of steel S235J0/SR EN 10025 / 2004, hereinafter called the motherboard.

Oţelurile carbon steels with low alloy steel materials are commonly used in welded steel construction. They represent more than 90% of the total production of steel and carbon steel is used in industrial production more than all other materials combined. Behaviour of welded carbon steel is determined primarily by the carbon content. It is estimated that if the C content is less than 0.25% (C <0.25%) carbon steels have a good behavior in welding, which implies that welding can be done without taking additional measures to prevent technological trend Hardening embrittlement of the base metal, namely to avoid cracking. If the carbon content exceeds 0.25% (C> 0.25%), to avoid the danger of brittle fracture and have taken some additional technological measures as follows: preheating, high linear energy welding, filing a material with high plasticity . Given the situation discussed, welding technology must meet a set of rules such as:

1) To reduce the participation of the base metal, welding procedure must provide for the use of electrodes with diameters as lower minimum values of current and high welding speeds. Welding must be running the thread-like layers.

2) 2) Since the contact between two dissimilar metals is most sensitive to cracking, in terms of their construction to avoid any sudden transitions from one thickness to another and any irregularities that could lead to stress concentration. In particular, must avoided by the notch effect is that one can remain at the root unsearchable joints between two cylindrical pieces of thick plate with small diameter. These unsearchable can cause cracks that can extend the basic seam or metal.
3) 3) The breaking strength of the stitching should not be less than less metal resistance as a participant at the joint.
4) 4) Because the different metal welding is a high risk of failure, the preferred use of electrodes and flows with basic character.
5) 5) The joints of different steels, welding conditions release, in general, steel with difficult weldability.
   In the case of dissimilar joints, internal tensions can not be completely removed in a heat treatment. Residual stresses disappear when heated, but during cooling, due to special physical properties of both metals in November tensions, different from the original. In general, heat treatment applied to their joints heterogeneous structure aims to remove fragile areas. Apply heat treatment indicated for difficult weldable steels. Welded joints between the rail and support plate has the following main characteristics: asymmetric impenetrable corner merge by overlapping, 7mm thick weld weld length 120mm respectively, the number of identical welds welds 124x2 = 248, type application - shear-horizontal position welding, operating temperature> 20C-, welding-sided access to unlimited, on-site welding and place at ground level, homogeneity DISSIMILAR merge-category - basic metals chemically different metallographic structure that close. Joint presentation is made in Figures 3 and 4.

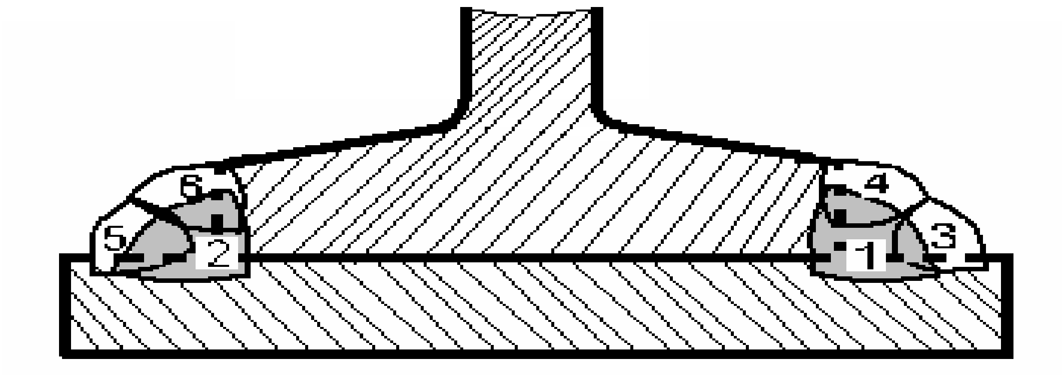


Figure 4. Rail joint detail – foot

In general, the choice of welding process is performed in two stages: • selection of welding processes that enable technological problems technically; • choice of welding processes that determine the previously established maximum economic efficiency. Choice of welding process for joining heterogeneous base rails of the type CF40 and motherboard support is primarily based on the conditions for carrying out the work ie welding is done on site wind conditions that increased temperature and humidity relatively low <10C, specific climatic conditions of November. Based on the above considerations were proposed following welding processes: manual welding electrode and welding wire wrapped tubular SE Self-ST. For objective reasons, related to the costs of any investment, we opted for performing welding operations process SE.Cel second ST welding process should not be precluded from carrying out such work having regard to the great advantage of welding productivity compared with the process is similar in terms of quality, even in difficult conditions on site implementation. The order of deposition of layers is presented in fig.4 and fig.5

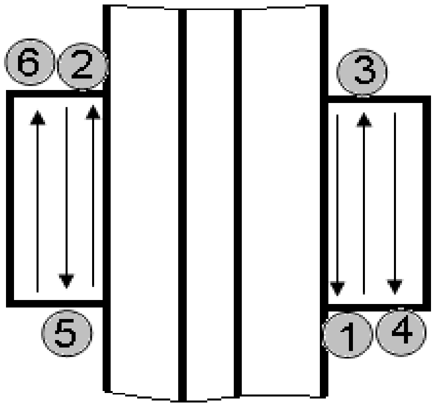


Figure 5. Deposit welding direction crossing

Form is the weld joint in the table, which quotas are submitted and its preparation. Table 2

4 .. Calculation of a welding process parameters.

Nature and the polarity of the current CC (base coat)

2. Is welding current

$$I_s = (20 + 6d_e).d_e \quad (A)$$

$$I_s = (160 – 190) \Rightarrow I_s = 170 \pm 5 \text{ A}$$

3. Arc voltage Ua:

$U_a = 16 + 0.05 * I_s = 16 + 0.05*170 = 24.5$ V = 24 – 25V

2. Vs. welding speed:

$$V_s = \frac{10}{6} * \frac{\alpha_d * I_s}{\rho * A_t}$$

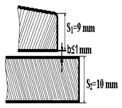
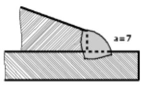
$$V_s = \frac{10}{6} * \frac{0.85 * 9.3 * 170}{7.85 * 21} = 13,58 \text{ cm/min} \quad V_s = 13 - 14 \text{ cm/min}$$

5. E_l linear energy:

$$E_l = \frac{U_a * I_s}{V_s} * 60$$

$$E_{lr} = \frac{25 * 170}{14} * 60 = 18214 J/cm = 18.000 \text{J/cm}$$

Table 3. Choice of standard shape and dimensions of joints joint

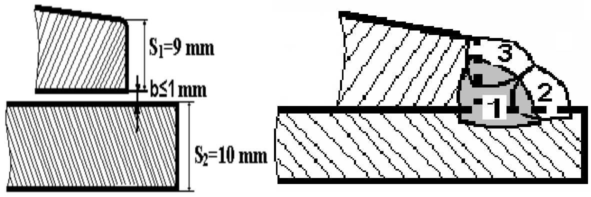
Nr. crt.	Notare îmbinare	Procedeul de sudare	Nr. STAS Rost	Simbol îmbinare	Grosimea îmbinării	Forma rostului	Forma îmbinării	Dimensiunile rostului				Justificare Observaţii
								s [mm]	α (β) (^{0})	b [mm]	c [mm]	
1	S_1	SE	**SR EN 29692/94**		7			10/9	--	0...1	--	Lap-joint in the corner asymmetric inscrutable, horizontal welding position and access unilaterally.

Based on recommendations on welding behavior of the two materials examined scap.1.3 conditions for implementation of the joint on that site heterogeneity of the weld seam is proposed to be made with preheating to avoid the danger of brittle fracturing and cold welds. Preheat temperature is recommended in the literature of 150-200 0C, see escape. 1.3. Provisional attachment welds is recommended temperature of 200C, while the actual welding temperature of 150C. Temperature between passes should not fall below 200C. Confirmation of the results of the qualification of welding technology are included in the minutes of welding procedure qualification (WPAR).

Fig.6. Macroscopic appearance of the weld

PRELIMINARY SPECIFICATION FOR WELDING PROCEDURE (pWPS) City: TIMISOARA Examiner or verification body: no. Welding procedure reference - producer: - The method of preparation and cleaning of the joint: Producer: STU Department of flexible wire brush welder Name: Cristian Belu base metal specification: The process of welding: 111 - SR EN ISO 4063 / 2000 S 235J0 - SR EN 10025/2-2004 merge type: FW - P SR EN

287-1 + A1/1997 Sina heavy rail type 40 - STAS 1900-80 Welding Position: DB - ISO 6947 / 94 thickness base material (mm): S1 = 9 mm, S2 = 10 mm outer diameter (mm): - Details of joint training:

Joint training scheme (joint shape and size, shape and arrangement of joint crossings)	**The sequence of welding operations**
	1 Point components b ≤ 1 mm 2. Provisional catching 3. Checking the positioning rail 4.Makingpreheating 5.Welding 1 line 6. Cleanup and visual inspection of lines 2 and 3 7.Making visually after each pass 8. Checking

Welding details:

Line	Welding process	diameter electrode (wire) (mm)	Welding current (A)	Arc voltage (V) of the	Nature of current / current polarity	Wire speed (m / min))	welding speed (cm / min)	linear energy (kJ / cm) (kJ/cm)
1	111	4.0	170±5	24-25	CC^+	14	-	18,0
2	111	4.0	170±5	24-25	CC^+	14	-	18,0
3	111	4.0	170±5	24-25	CC^+	14	-	18,0

Filler metal, coding and marking information (for ex.): Manufacturing: 1125/2-81 E51.5.B.120.2.0.H5/STAS Swing (width max. The row (mm): ... NO (SUPERBAZ) special requirements for drying in the oven Oscillation (amplitude, frequency, timing): T = 250-300 □ C, t = 2h

3. Seam welding cost
   Calculul steps:
   A. Cost of a calculation CMA1 welding weld metal filler material MD1
   m_{D1}=Ac*ϕ*10^{-3} (Kg/m)
   m_{D1}=60*7,85*0,001=0,471 Kg/m
   2 Calculation mA1
   $\mathrm{mA1} = \frac{mD1}{GMA}$= 0,471/ 0,65 = 0,720 kg/m, unde GMA=65% pentru SE
   3 Deposit required material cost price mA1
   C_{MA1}=m_{A1}*p_{el} = 0,72 * 5,33 = 3,83 lei/m
   welding electrode SUPERBAZ C: d = 4 mm,
   price=1.25 euro
   1,25x4.27=5.33 eur

   B. FO CMO1 labor cost PMO SE = 25% = 6.81 Euro / h (labor price welder)
   C_{MO1}= T1 * p_{MO} = 1,42 * 6,81= 9,67lei/m
   $\mathrm{T1} = \frac{ts1}{60*FO}$ = 21,4/(60x0,25) = 1,42 h/m

t_{s1}=3x (100/v_s) =21,4min/m

FO= 25% for manual welding

p_{MO} = 6,81 lei/h (lab)or price

C. Energy Cost CW1

C_{W1}=w1*pw= 167*0,35 = 0,58 lei/m

$$W_1 = \frac{1}{0.9} * \frac{I_s U_a T_S}{60000} = \frac{1}{0.9} * \frac{170*25*21,4}{60000} = 1,67 kWh/m$$

D. Overhead cost CRe1

C_{Re1}=R_{R1}*T_1=10,21*1,42 = 14,49lei/m

R_{R1}=(1…2)P_{MO}=1,5*6,81=10,21 lei/m

E. The total unit cost

Ct1 =C_{MA1}+C_{MO}1+C_{W1}+C_{RR1}= 3,83+9,67+0,58+ 14,49= 28,57 lei/m

F.Welding total cost

C = C_{t1}*L_s= 28,57x 0,12 = 3,42 lei

G.Total rail welding:

C_{total} = Cxn_s = 3,42x248 = 848,16lei

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28. *** - Cataloage şi produse ale principalelor firme de echipamente pentru sudare, EWM, Closs, Esab, Miller, Rehm, Telco, Lincoln, G-Tech, Tehnisud, etc.