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PROJECTION MECHANIZED WELDING OF 3 STEEL BAR WIRE NETS

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Abstract: The fabrication by projection welding of wire nets from three overlapped steel bars implies a mechanized line which has to assure the following operations: the drawing, straightening, cutting and welding of bars. The quality of the nets depends on the technology used to implement each module, but their resistance is imposed by the equipment, which realizes the last stage of the cycle, namely the simultaneous welding of ten points.

1. WELDING CYCLE

The fabrication by projection welding of wire nets from three overlapped steel bars implies a mechanized line which has to assure the following operations: the drawing, straightening, cutting and welding of bars. The quality of the nets depends on the technology used to implement each module, but their resistance is imposed by the equipment, which realizes the last stage of the cycle, namely the simultaneous welding of ten points. The welding cycle is ensured by a programmable device that has the form illustrated in figure 1, assuring: the feeding with cross bars, the step by step movement of the net and the execution of the welds.

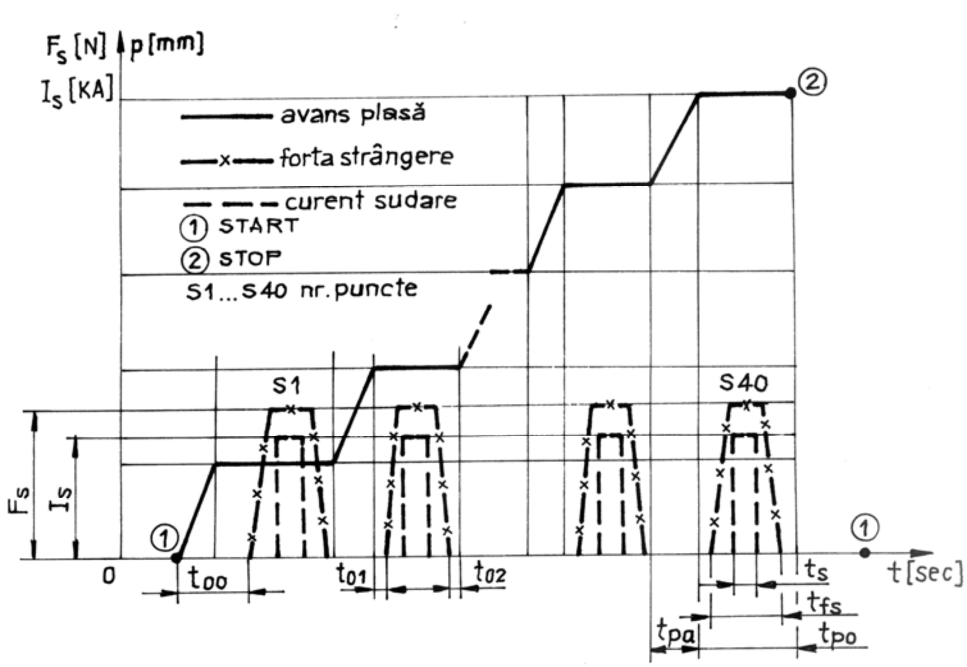

Figure 1. The working cycle of the net welding equipment

This paper presents the results of experimental testing only on the final unit "SPECIALIZED EQUIPMENT FOR PROJECTION WELDING" in a limited number of products, as well as several conclusions regarding the whole nets fabrication line.

2. THE WIRE NET

The wire nets have a special form and well-established dimensions, as in figure 2.

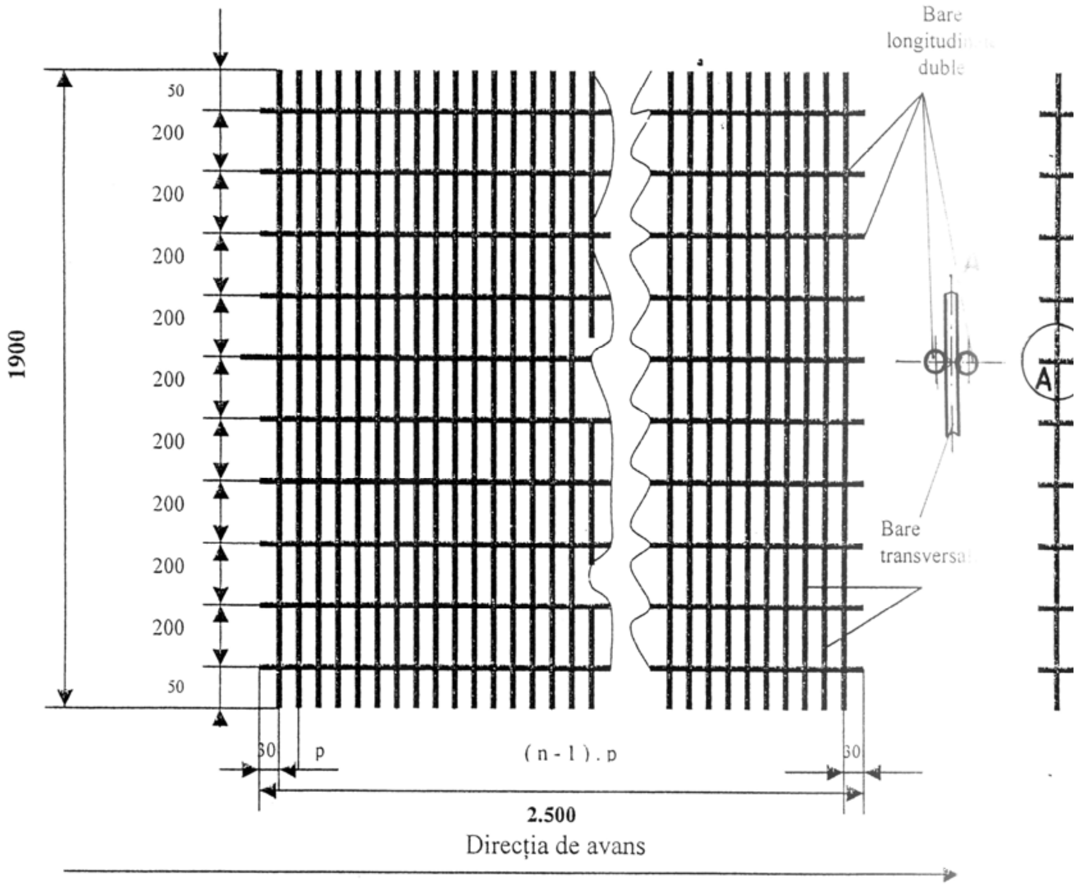

Figure 2. The wire net with three overlapped bars (drawing)

This type of nets have a precise destination, so a certain geometry and mechanical as well as anticorrosion resistance are needed, being used to protect highways.
The more special form of the net is given by the positioning of the cross bar between two longitudinal bars, detail A in figure 2.
The geometric characteristics of the net, limit linear deviations are presented in table 1 and correspond to the indications given in SR EN 10223/4/2000.

Table 1. The main characteristics of the welded net

Size / Parameters	Length [mm]	Width [mm]	Step between longitudinal bars [mm]	Step between cross bars [mm]	Free end [mm]	Bar diameter [mm]
0	1	2	3	4	5	6
Dimension	2500	1900	200	50÷200	30	4.5÷5.0
Deviations	± 5.0	± 5.0	± 2.5	± 1.5	± 1	± 0.5
Dimension of the net	2500 x 1900					

The basic material is a coil of wire SAE 1008 BUZAU, from which cross and longitudinal rods are made according to table 1, cut at a tolerance of ± 2.0 mm.

The selection of the basic material was made depending on the following criteria: the importance and destination of the product, reliability and not in the least the possibility to be drawn, straightened and cut the nets at the desired dimensions.

3. THE SELECTION OF THE WELDING PROCESS

The fabrication by welding of steel wire nets requires not only the quality and uniformity of welded joints, but also a certain degree of productivity and respectively the possibility to adapt the technology to other types and shapes of nets.

In this respect, considering all these objectives, the most indicated process is: the RESISTANCE PROJECTION WELDING, whose principle scheme is presented in figure 3.

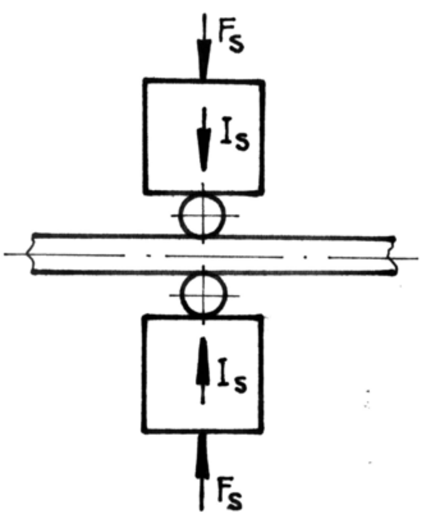

Figure 3. The principle of projection welding with round projections

The energy necessary for welding is supplied by the Joule-Lenz effect of intense current, of short duration, which passes across the electric resistance of the three bars volume, being in contact.

The welding parameters are appreciated initially, by empiric relations, table 2, and then measured, recorded, adjusted and omologated following the testing and experimental determinations: welding current *Is*, welding time *ts*, clamping force *Fs*.

Table 2. The main projection welding parameters

Parameters	Is [KA]	ts [sec]	Fs [N]	ρ [bar]	D_{NT} [mm]	Scs [%]
0	1	2	3	4	5	6
Calculus relations	$\rho \frac{\pi D \rho^2}{4}$	(0.1÷ 0.2)·s (1) (0.8÷ 1.0)·s (2)	$\rho \frac{\pi D \rho^2}{4}$	3 ÷ 8	(1.5 ÷ 2.8) D_8	(7 ÷ 12)

D ρ – diameter of the product
D_{NT} – diameter of the melted nucleus
Scs – shortening when welding – discharge under pressure
(1)– hard regime
(2) – soft regime

4. WELDING EQUIPMENT

The wire steel nets made of overlapped bars are welded in 10 points simultaneously, on a specialized equipment presented in figure 4.

Figure 4. Equipment for welding wire nets

Figure 5. Assembly of inferior-superior electrodes

The main parts of the equipment are: the basement in welded construction of specialized shape, 10 welding posts, the assembly of the inferior electrodes and superior backing electrodes, numeric controlled pneumatic cylinder that allows the programming and continuous adjusting of the longitudinal step between 50÷250 mm, cycle programmer with microprocessor, force electric installation and cooling circuits of the Cu-Cr electrodes.

Each welding post is endowed with an assembly of cubic electrodes, as in figure 5.

The geometric shape of the electrodes is motivated and technologically sustained by the possibility to use them again on all the 6 faces. The feeding with cross bars -40 in number- and with longitudinal bars, 2 x 10 is manually done by two supports: the first one, figure 6, also has a rolling plate of the cross bars, which advances mechanically to the welding posts.

Figure 6. The feeding with cross bars

Figure 7. The positioning of longitudinal bars

The feeding/supplying with cross bars (2500 mm length) is realized manually, too, as in figure 7, but their driving after the last welded point is a mechanized one, step by step, by means of the numeric controlled pneumatic cylinder.

The main characteristics of the projection welding equipment are presented in table 3.

Table 3. The main characteristics of the equipment

Parameters	ρ_n 50% [KVA]	N_{TS}	Nρs	Fs [N]	ρ [bar]	Productivity [m/min]
0	1	2	3	4	5	6
Characteristics	100	3	10	2400 ÷ 6300	3 ÷8	min 1.0

5. EXPERIMENTAL TESTING

The tests were made on the specialized equipment for welding steel wire nets, considering the following: establishment of the optimal welding parameters, adjusting of the net geometry and of the meshes, according to SR EN 10223/4/2000.

5.1. The verification of the net geometry

The verification of the net geometry was made by measuring the dimensions: length, width and the diagonal, figure 8. Results are presented in table 4.

Figure 8. The verification of diagonals

Table 4. Results of dimensional determinations

No. net	Length [mm]		Width [mm]	Diagonals [mm]		Length deviation [mm]	Diagonal deviation [mm]		Obs.
	Right	Left		D1	D2		Nets	SR EN	
0	1	2	3	4	5	6	7	8	9
1.	2442	2439	Constant	3034	3022	± 3	± 12	± 5 mm /1 m	Admitted
2.	2442	2439	Constant	3035	3022	± 3	± 13		Admitted
3.	2448	2434	Constant	3031	3026	±14	± 5		Admitted
4.	2433	2442	Constant	3030	3020	± 9	± 10		Admitted
5.	2442	2443	Constant	3035	3023	± 1	± 22		Admitted
6.	2435	2438	Constant	3028	3019	± 3	± 9		admitted

5.2. Visual examination

The visual examination evinces the fact that after welding there results flat fence panels fit to the proposed purpose, figure 8.

Figure 9. Assembly of welded net

5.3. Measurement of welding parameters

The measurement of welding parameters stipulated in table 2, was made with a Miyachi apparatus on each working post, figure 10, but under the same conditions for all working posts. The obtained values are presented in table 5.

a *b*

Figure 10. Measurement and recording of welding parameters: a – placing modulus "torr"; b – frontal panel Miyachi

Table 5. Welding parameters

Parameters	I_s [KA]	t_s [perioade]	F_s [N]	Scurtare [mm]	Productivity [m/min]	Obs.
0	1	2	3	4	5	6
Sizes	4.8 ÷ 5.0	[80]	500	1.5	1.2	Wire diameter 4.8 mm

5.4. Share testing

The share testing was made by means of a special device, figure 9; the results in table 6 were obtained.

Table 6. Share testing

Test	I_s [KA]	t_s [perioade]	F_s [N]	Shorting [mm]	Productivity [m/min]	Obs.
0	1	2	3	4	5	6
Fracture force	880	430	855	920	880	Fractured in the weld

According to SR EN 10233/4/2000, point 6.5 stipulates that welds are tested according to annex A, the average value of the share force should not be less than + 5% from the fracture force of the drawn wire, which was about 1031 daN.

6. CONCLUSIONS

The measurements and experimental determinations regarding the mechanized welding of steel wire nets with the diameter of the wire 4.8 mm evinced the following:

- the linear dimensions (longitudinal and on diagonals) frame in the limits stipulated by SR EN 10233/4/2000;
- the dimensions of cross and longitudinal meshes measured individually and cumulated are also in the limits of the standard;
- the free end must be cut after welding at the quota indicated in the standards;
- welding parameters remain constant after 20 welded nets, and then the electrodes must be cleaned.

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