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MODELLING OF STRESS-STRAIN STATE OF CONCRETE REINFORCEMENT WELDED JOINTS

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The main stage of the technological process during the construction of buildings and structures of precast or precast monolithic reinforced concrete structures is the placement of reinforcing mesh. Significant amount of effort in the process of production of such reinforcing mesh falls on welding operations. It is due to the high quality of welded joints in comparison with so-called un-welded methods with the use of "Lenton" type muffs or lapped with bonding method [1]. Reinforcement of A-III and A-IV type has been acquired widespread application during the erection of buildings and constructions by mean of monolithic-wireframe technology. Such type of reinforcement is supplied in hot-rolled or heat-strengthened state with the diameter of 8…16 mm made of steel grade A400, Fe360-B, Fe510-B, Fe490 and Fe510-C. Welding process of such reinforcement occurs using manual arc welding, machine welding and bath-arc welding [2].

The complex of experimental investigations of strength characteristics determination of lap and butt joints with strips of reinforcement bars made of electric arc welding has been carried out in the present work. It has been also modelled of stress-strain state of welded joints at the mechanical tensile test.

Welding process of lap joints of C_{23}-Pe type was carried out by mean of lengthy side-lap welds with one-sided and double-sided melting (Figure 1, a). Butt joints with double circular-shaped strips of C_{21}-Рн type were carried out in the same way as a previous one with one-sided, staggered and double-sided melting (Figure 1, b).

Mechanical tensile tests of samples of welded joins was carried out according to the *ISO 5178:2019*. As a result of mechanical tests it has been established that the lap and butt welded joints with one-sided melting do not provide high strength of welded joints. Fatigue limit of such samples do not exceed 192…321 MPa accordingly. Samples fracture constantly was carried out along the welded joint. Low strength of one-sided lap welded joints during the mechanical tensile tests is apparently caused by the combined stress that acquires in consequence of alignment error of load application. Such alignment error of load application leads to the occurrence of bending moment.

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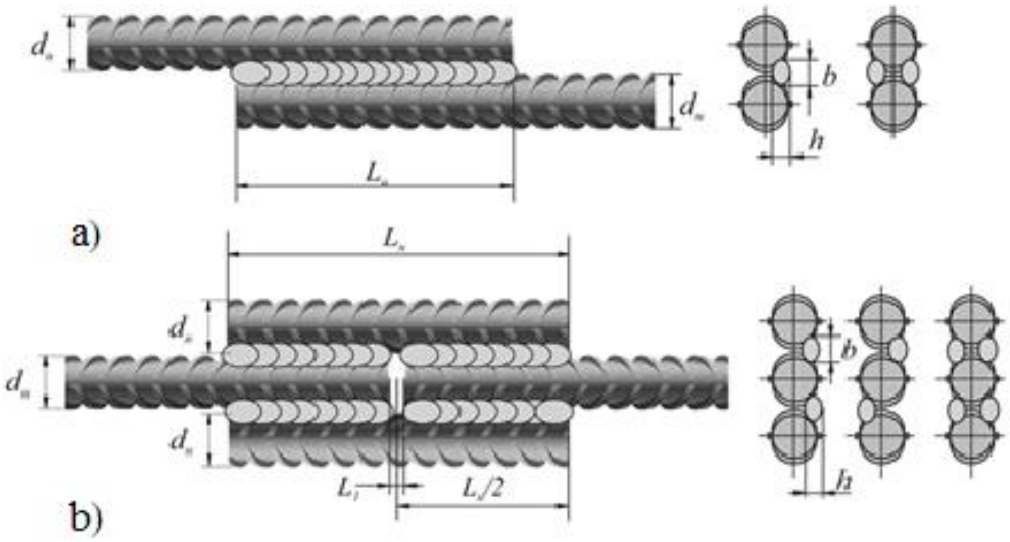


Figure 1. Welded joints of reinforcement realized by mean of manual arc welding: a) lap joints of C_{23}-Ре type; b) butt joints of C_{21}-Рн type

Reinforcement welding using staggered and double-sided welds slightly increased the ultimate strength of welds but do not allow to achieve its uniform strength. Thus, strength factors of lap and butt welded joints of reinforcement in our investigations were variable in the range of 411…578 MPa that is slightly less than the strength of base metal (600 MPa). Samples fracture constantly was carried out along the heat-affected zone and occurred brittle character (Figure 2).

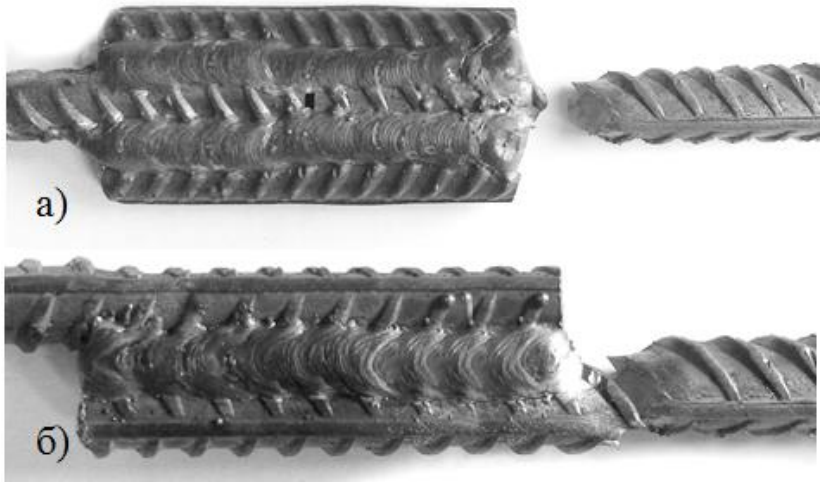
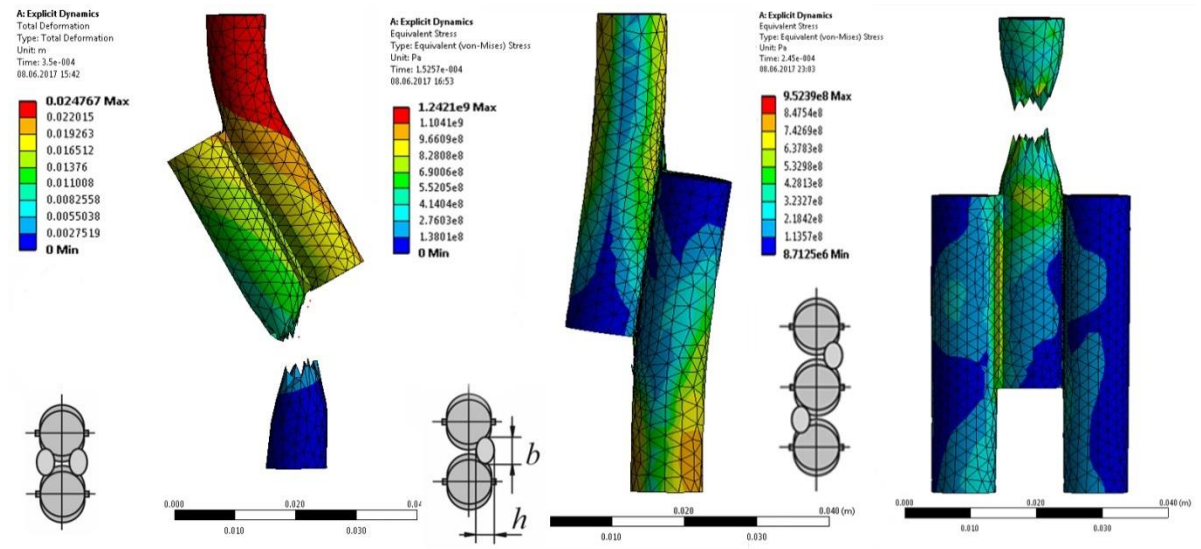


Figure 2. Samples of welded joints of reinforcement after full-scale tensile tests: a) butt welded joints with double strips; b) lap welded joints

Modern ways of mathematic modelling allow to forecast of mechanical behaviour of construction elements including nonlinear behaviour of materials. Load-carrying capability of concrete reinforcement welding joints have been investigated. To achieve this, finite-element model of concrete reinforcements has been designed. Modelling process was carried out using ANSYS Explicit Dynamics system. The results of modelling are demonstrated on the Figure 3.



a) b) c)

Figure 3. Modelling of stress-strain state of reinforcement welded joints: a) lap welded joints with double-sided welds; b) lap welded joints with one-sided melting; c) butt welded joints with double strips made of staggered welds

Analysis of modelling of stress-strain state of concrete reinforcements welded joints has been shown the correlation of calculated results with results after full-scale investigations.

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