MEASUREMENT OF RESIDUAL STRESSES IN WELDED ELEMENTS AND STRUCTURES BY ULTRASONIC METHOD

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ABSTRACT
The application of an ultrasonic non-destructive method for residual stress measurements has shown that, in many cases, this technique is very efficient and allows measuring the residual stresses both in laboratory conditions and in real structures for a wide range of materials. The ultrasonic method and results of residual stress measurement in large scale welded specimens and structures are discussed in this paper.

Keywords: residual stresses, ultrasonic method, welded elements.

INTRODUCTION
Although certain progress has been achieved in the development of different experimental techniques, a considerable effort is still required to develop efficient and cost-effective methods of residual stresses (RS) analysis (Kudryavtsev, 2008). The application of an ultrasonic method for residual stress measurements had shown that, in many cases, this technique is very efficient and allows measuring the RS both in laboratory conditions and in real structures for a wide range of materials (Kudryavtsev, 1985, 2013).

RESULTS AND CONCLUSIONS
The RS were measured in a number of welded specimens and real structures. The process of RS measurement in a large scale welded specimen by the UltraMARS® system is presented in Figure 1.

Fig. 1 - The process of residual stress measurement in welded specimen
Figure 2 shows the distribution of RS in as-welded condition along the weld and in direction transverse to the weld in 6061-T6 MIG-Pulse welded plate. The length of the weld (also width of the sample) was 200 mm, thickness of plate - 6mm (Klochkov, 2011). The averaged through thickness residual stresses were studied. Size of ultrasonic gage was 7x7mm. Figure 2a also shows the distribution of RS after fatigue loading of the welded sample. The sample was loaded at the following conditions: stress range 72MPa, stress ratio 0.1 and number of cycles 1000. After RS measurement the welded samples were further fatigue tested until complete failure and the results of RS measurements were compared with the fatigue life of welded elements.

The developed ultrasonic method was successfully applied for RS measurement in construction industry, shipbuilding, railway and highway bridges, nuclear reactors, aerospace industry, oil and gas engineering and in other areas during manufacturing, in service inspection and repair of welded elements and structures.

REFERENCES


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