1.14.6. NON-DESTRUCTIVE INSPECTION OF REINFORCED CONCRETE STRUCTURES USING ULTRASONIC TOMOGRAPH A1040 MIRA

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There are lots of problems inside concrete structures that can significantly reduce the loading capacity of the object or its lifetime causing its damage; this can be corroded reinforcement or cracking of the beam or cavitities in the walls or similar. For in-time detection of such hidden defects the portable ultrasonic tomograph A1040 MIRA was developed, which is a helpful instruments for inspection due to its wide ranged functionality and applicability.

The operation of the tomograph is based on the method of synthesized aperture adopted from radar technique and combinational ultrasound sending-reception (SAFT-C), when reception of echo-signals for analysis is made not only by the sending elements of the array, but by all the elements available in the array.

The main part of the tomograph is its antenna array, built as a 40-element matrix array of DPC transducers with controller and data processor inside. The elements of the antenna array are the dry point contact transducers of shear waves with spring loading to the concrete surface. Also a PC laptop type is a data processing and imaging part of the tomograph.

The operation of the instrument is a step-by-step scanning of the object with the array along the pre-marked line, when the data in each position automatically saved in the memory of a 3D data massive as information about the reflective characteristics of the internal structure. Each section (B- or C- or D-scan) from the saved massive can be screened on the display, as well as a combined 3D image in general.

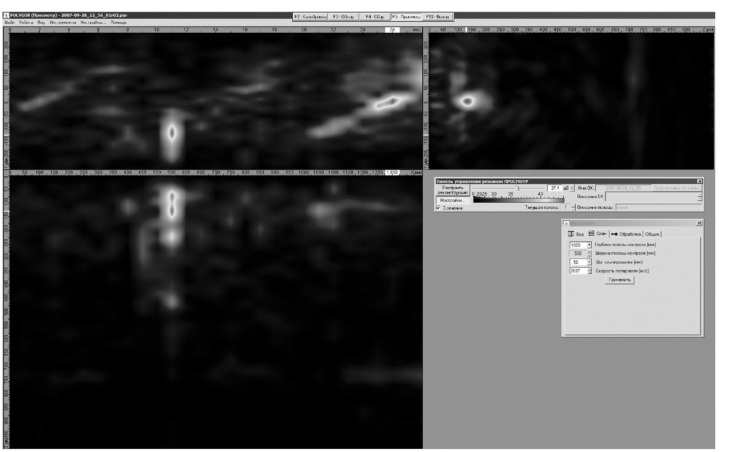

Fig. 1. Tomogram of reinforcement pillar of funicular road:
B-scan (top right); C-scan (top left) and D-scan (bottom left)

The analysis of the result image despite its visibility demands from operator experience and understanding of ultrasonic wave propagation and reflection laws, especially in regard to large-grained structures as reinforced concrete, which has its own specialties. In particular the analysis of relation between the first and second backwall signal allows evaluation of behind-the-wall area character and in some cases even the material contacting the backwall from other side. As to the sizes of the testing object and its internal parts such as reinforcement inside – this kind of information can be obtained from the tomograms.

The figure represents the processed resulted three intersectional images (scans) of the reinforced concrete pillar of funicular road. The C-scan image shows the top view (from the inspection side) on the pillar on the depth of 130 mm, where the reinforcements bars are located. One of the bars is heavily corroded, which is screened on the image as a bright red-green reflection in the right part of the image. The B-scan image (side view) shows exactly the section in the area of the corroded bar, giving a bright reflection too. On the D-scan (side-view) the crack is shown, which runs perpendicular to the pillar. The image received allows approximate evaluation of the crack length: from 50 to 250 mm. The crack image is also seen on the C-scan.

Slicing the received image in different directions (in length, in depth, along the scanning line) allows more detailed analysis and better understanding of the inspected object.