Non-Contact Ultrasound Scanner – New Nondestructive Technique for Testing Fiber Cement Boards – Description, Test Methodology, Application Example

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Abstract
This paper presents new nondestructive technique – non-contact ultrasound scanner – suitable for testing fibre cement boards. The capabilities of this technique for locating defects in usually unilaterally accessible fibre cement boards on its production process are described. An original test methodology developed for this purpose is included. The methodology was verified through laboratory tests on specimens and through on-site tests on a real production process. The suitability of this technique for testing fibre cement boards and its reliability have been confirmed.

Keywords: fibre cement boards, nondestructive testing, ultrasounds, non-contact ultrasound scanner

1. Introduction
In recent years increasingly more building facades have been made of fibre cement boards [1] as the latter became fashionable among architects.
This paper presents a new non-contact ultrasound method exploiting Lamb waves to check fibre cement boards for delaminations during production [2-4]. A non-contact ultrasound scanner based on Lamb waves, specially designed for the quality control of fibre cement boards is presented in this paper.

2. Non-contact ultrasound scanner
A specially designed and built measuring system in the form of a stationary non-contact ultrasound scanner was used to test fibre cement boards. The scanner operates by inducing an elastic wave in the tested member. The technique of a travelling Lamb wave introduced into the tested material via air without contact between the transmitting head (T), the receiving head (R) and the tested material is used here [5]. The two heads are located on the same side of the tested board on its opposite edges, covering the whole width of the board. Ultrasound heads (with the basic frequency of 100 kHz) for measurements in air, a system for positioning the heads (the scanner), an arbitrary signal generator with a two-channel oscilloscope sampling signals with a frequency of up to 10 MHz, a signal amplifier and a PC with dedicated software for measuring system control and data acquisition and analysis are used for the testing of the fibre cement boards.
3. Test methodology

The methodology is shown graphically in figure 1.

Figure 1. Methodology for nondestructive location of delaminations in fibre cement boards by means of non-contact ultrasound scanner.
4. Practical use of test methodology

The methodology of locating delaminations in fibre cement boards by means of the stationary non-contact ultrasound scanner was tested directly on the production line. Figure 2 shows the results, in the form of graph of Lamb wave amplitude versus distance from board edge with the average amplitude marked, for board in which a delamination was located by the non-contact ultrasound scanner.

![Graph of Lamb wave amplitude versus distance from board edge for board with delamination](image)

**Figure 2.** Graph of Lamb wave amplitude versus distance from board edge for board with delamination

5. Conclusion

A new methodology for the nondestructive location of delaminations in fibre cement boards by means of a non-contact ultrasound scanner, used for the quality control of such boards on the production line, was presented.

The aim of the ultrasound tests carried out using the specially designed non-contact ultrasound scanner based on Lamb waves was to locate delaminations which could have arisen in the production of fibre cement boards. The amplitude characteristics of the Lamb wave as a function of the place of signal registration, indicating the location of a delamination, were determined. The trials confirmed the suitability of the method and the methodology for the testing of boards being in motion in the production process.

References