Recognition of Local Defects in Timber Constructions to Optimize Repair Work

Otto Kroggel[1], Andreas Hasenstab[2], Jan Lutz [3], Harald Garrecht[4]

Abstract The application of preferable shear wave ultrasound for the examination of timber structures is displayed. Great advantage can be taken from the experiences gathered from the inspection of concrete. Geometry and attenuation for sound are often similar. It was found, that it is helpful and promising not to relay on single path of ultrasound, but to put together a large number of single shots and by this to produce a sort of a two or even a three dimensional picture of the structure under examination. By doing this the interpretation of results is focused of the contrast between sound and damaged material. Natural but harmless imperfections and inhomogeneous areas often found in natural wood don't lead to misinterpretations. Examples of practical experiences and examinations are given.

Keywords ultrasound, ultrasonic, shear waves, non-destructive testing

1. INTRODUCTION

If wood is protected against improper environmental influences, its life cycle is very long. A special problem is interior rot, caused by humidity or insects, which is difficult to recognize and can cause the collapse of constructions. In order to detect these types of damage, a number of minor destructive and non destructive techniques are applicable.

Especially in the field of preservation of historic buildings there is a large demand in non-destructive inspection techniques in order to preserve as much of the precious old substance as possible. At the moment, the only non-destructive techniques in use for the investigation of wood are X-ray radiography and scanning by ultrasonic compressional waves. Scanning by ultrasonic compressional waves is an easy-to-handle method, but a very careful interpretation is essential. Shear waves offer additional sources of information and the speed of measurement is high because no coupling agent is needed. The results of a large number of single measurements in a line (so called B-pictures) are relatively easy to interpret and enable the localization of inhomogeneities. The methods under development lead to strategies to optimize repair work and to improve the safety of the structure. A proper localization of damaged areas allows for example to reduce the application of toxic insecticides and to minimize the repair work.

[1] Otto Kroggel, Department of Materials in Civil Engineering, Darmstadt University of Technology, Germany, kroggel@massivbau.tu-darmstadt.de
[2] Andreas Hasenstab, Ingenieurbüro Dr. Hasenstab, Augsburg, zfp@hasenstab.de
[3] Jan Lutz, Germany, janlutz@gmx.de
[4] Harald Garrecht, Department of Materials in Civil Engineering, Darmstadt University of Technology, Germany, garrecht@massivbau.tu-darmstadt.de

2. APPLICATION OF ULTRASOUND INSPECTION TO TIMBER CONSTRUCTIONAL ELEMENTS

For providing a sufficient amount of energy for sending and receiving a large number of single ultrasound transducers are combined to form an array. These arrays produce a plane wave instead of the spheric wave generated by a single transducer.
Assembling a realistic picture on the base of a large number of single measurements provides the chance to distinguish between natural irregularities and larger damages in the individual object under investigation. The interpretation of results now is based primarily on the contrast between undamaged and damaged areas. The type of wood, the actual moisture content etc. are of minor importance.

3. TYPICAL RESULTS

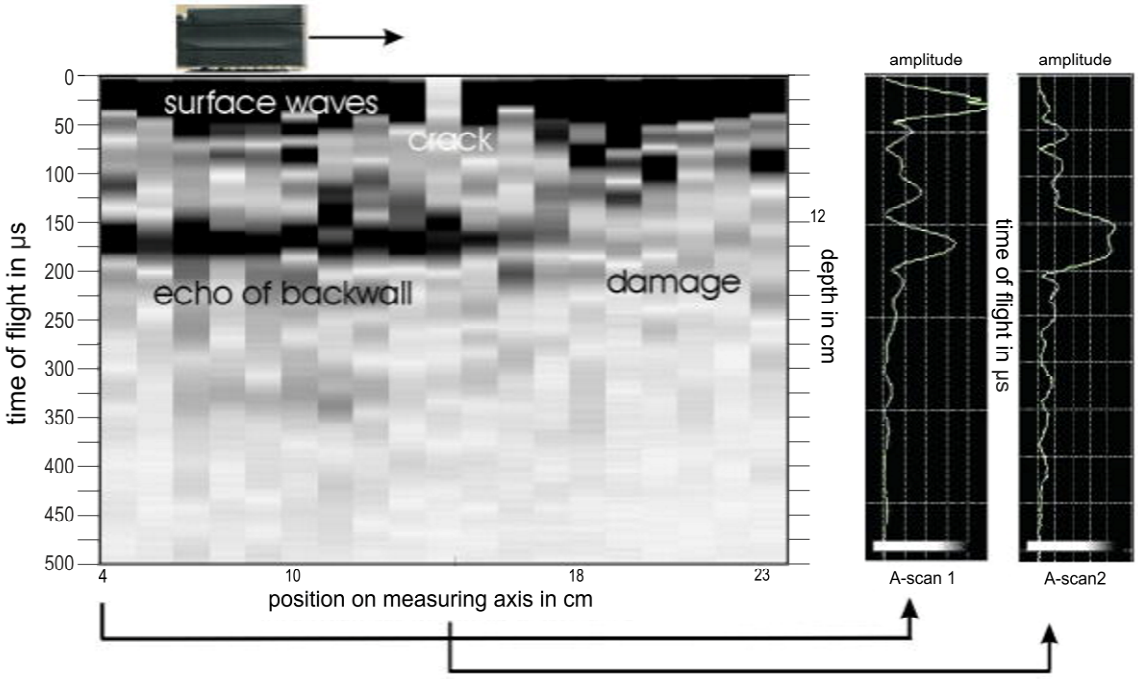

Figure 1 – B-picture of measurement with transverse waves of a damaged test specimen from the undamaged side, with an echo within the undamaged area, absence of the echo signal of the back wall in the damaged area, surface waves and the absence of the surface waves at the surface crack. Right: A-pictures of two positions of the B-picture.

4. CONCLUSIONS

The quality of results can be improved significantly as soon as a variety of transducers with different frequency ranges and sizes forming arrays are applied.

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