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Non-contact Imaging for Micro Crack in Shallow Layer of Concrete Using Very High-intensity Aerial Ultrasonic Wave

超高強度超音波によるコンクリート浅層の微小き裂の
非接触イメージング

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1. Introduction

A detection method for an invisible crack of concrete has been reported hammering method, an infrared method, it has already been established the methods as a detection technique. However, there is a no reported case that the noncontact and non destructive method for the crack in shallow layer of concrete. To rapidly assess wide areas of concrete for defect, a nondestructive inspection technique is needed.

Recently, a noncontact and nondestructive method of inspection has been developed for cases where aerial ultrasonic waves cannot be used. We have developed the noncontact and nondestructive method that used high-intensity aerial ultrasonic waves and optical equipment. In a fundamental study, we have previously studied the forced excitation method for detecting a defect in the shallow layer in solid materials. [1]

In this report, we investigate to detect the crack in shallow layer of concrete by a proposed method which use a high-intensity aerial ultrasonic wave and optical equipment.

2. Experimental set up and method

Fig.1 shows a schematic view of measurement principle. In figure, it is expected a vibration of the surface on the concrete has a crack in shallow layer is larger than that of the surface on the concrete without crack when it is excited the surface on the concrete. Therefore, it is possible to detect the crack area in shallow layer of concrete.

Fig.2 shows a schematic view of experimental device. The experimental device is consist of the point converged ultrasonic sound source [2] and optical equipment (LDV). In the experiment, the measurement point on the surface of the sample is set to coincide with the convergence point O of the radiated ultrasonic waves on the x-axis. Under ultrasonic irradiation, the vibration velocity on the sample surface is measured with the LDV. In the addition, the laser

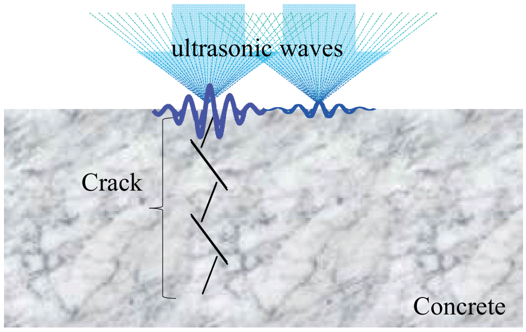

Fig.1 Measurement principle.

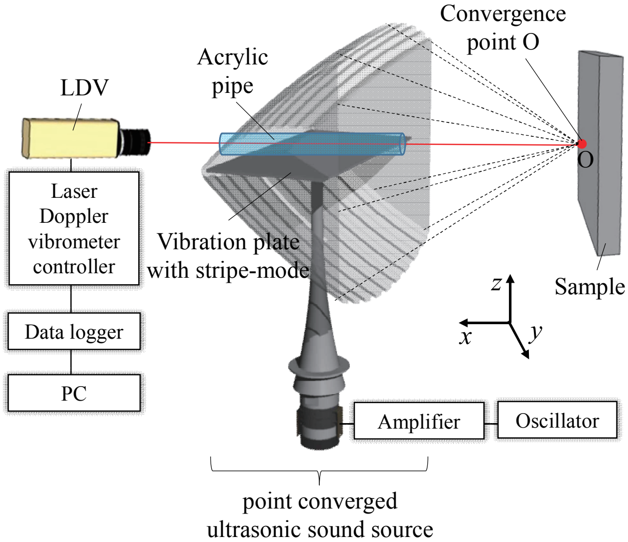

Fig.2 Experimental device.

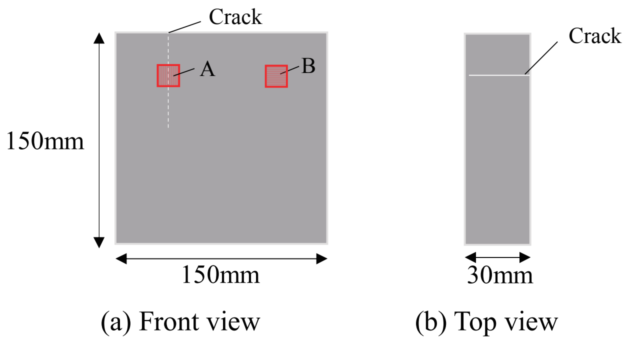

Fig.3 Sample detail.

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beam from the LDV is passed through an acrylic pipe in the experimental device because sound waves from the vibration plate could affect the beam (see Fig. 2). The ultrasonic waves converge to a small circular region around point O. The ultrasonic waves generated by this acoustic source converge to a 10mm diameter spot 326 mm from the opening of the acoustic source. In addition, aerial ultrasonic wave intensity is about 6 kPa at an input power of 15 W.

Fig. 3 shows the 30-mm-thick mortal has dimensions of 150 × 150 mm^2. In this basic experiment, we used the sample is mortal. We prepared the mortal has a micro crack by boring line of 1 mm in width into its rear face as air gap in fig.3. In addition, its depth is 1 mm from the sample surface. Measurement area is area A (crack area) and B (normal area) that have dimensions of 2.5×2.5 mm. In this experiment, the input power was held constant at 5 W, measured at 1 mm intervals.

3. Result and discussion

Fig. 4 and **5** show the measurement result. Fig. 4 is the result of area A, and Fig. 5 is the result of area B.

In fig. 4, the vibration velocity distribution around the crack line is larger than that at the other area. Specially, the vibration velocity in left side in figure is gradually decrease and the vibration velocity in right side in figure is rapidly decrease.

Fig. 6 shows vibration velocity distribution on the dotted line in Fig.4 and 5.

In figure, the vibration velocity distribution around the crack line became widely large. In addition, the vibration velocity at point P is obviously larger than that at point Q.

Above the result, it was confirmed to detect the crack in shallow layer of mortal by the proposed method.

4. Conclusion

We investigate to detect the crack in shallow layer of concrete by the proposed method.

As a result, t was confirmed to detect the micro crack that is 1 mm in width and 1 mm in depth from the sample surface.

Acknowledgment

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References

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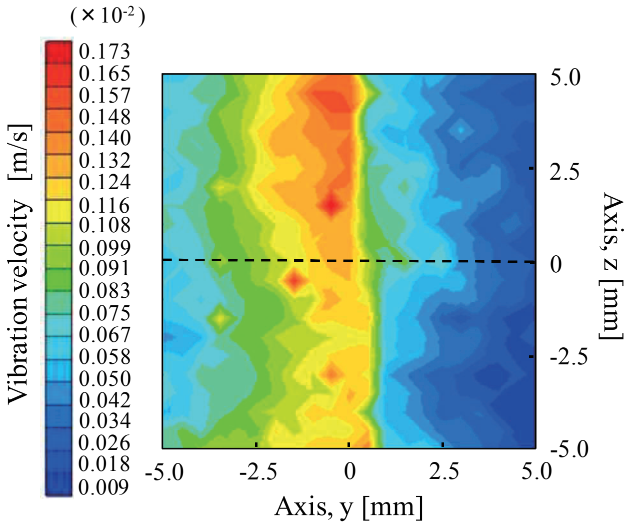

Fig.4 Vibration velocity distribution on the area A.

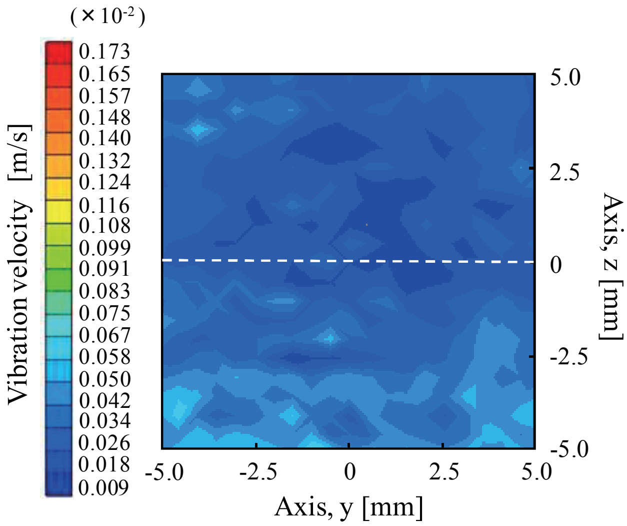

Fig.5 Vibration velocity distribution on the area B.

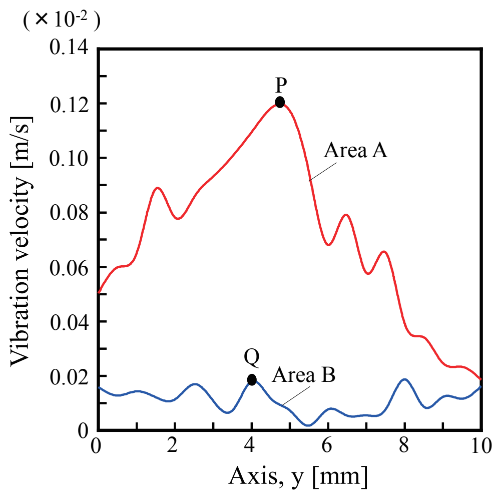

Fig.6 Vibration velocity distribution along the axis-y.