Development of a new nondestructive inspection method for concrete bridges

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Aging transportation infrastructures has become a social issue. Almost 50 years have passed since many road bridges and railroad bridges were constructed during the high economic growth period in Japan, while 50 years is said to be the expected lifetime of bridges. Some prestressed concrete bridges built during that time have deterioration in steel inside concrete due to insufficient grout filling and salt damage. However, it is not possible to degrade the internal steel by the usual visual inspection

We have developed a nondestructive inspection method that can detect the breakage of internal steel as one of the means to grasp the deterioration condition of a prestressed concrete bridge. By detecting internal steel breakage, it is possible to improve the quality of the prestressed concrete bridge's inspection, and we believe that this can lead to diagnosis of residual performance.

We named the developed method "Magnetic Stream Method". In this method, a special magnet is applied to the internal steel material from the outside of concrete, and a magnetic field is run from one direction, thereby capturing the sudden attenuation phenomenon of the magnetic field due to breakage. If there is no breakage in the internal steel, the magnetic force flows in a fixed direction while gradually weakening in proportion to the distance, so the magnetic force detected by the sensors also gradually decreases, but if there is a breakage, the flow of the magnetic force is stopped because of being divided, the magnetic force drops sharply at the divided portion.

Here is an experiment of measurement results using a post tension method prestressed concrete bridge model installed in our laboratory. The steel material to be measured is a standard type sheath tube with an inner diameter of 45 mm and a thickness of 0.27 mm, and a PC steel material (1S28.6) consisting of 19 strands with a diameter of 28.6 mm. As shown in Figure 1, when a two-component model in which sound steels and broken steels are arranged 20 cm apart is installed and measured, the sensor immediately above the broken steels can catch the rapid damping of the magnetic force as shown in Figure. 2.

Currently, the technology to analyze the data of "Magnetic Stream Method" on the cloud has been improved, and while conducting demonstration experiments with stakeholders and inspections on actual bridges, we always confirm customer value and usage scenes, and we are developing this technology as a nondestructive inspection solution combining magnetic sensing and IoT.

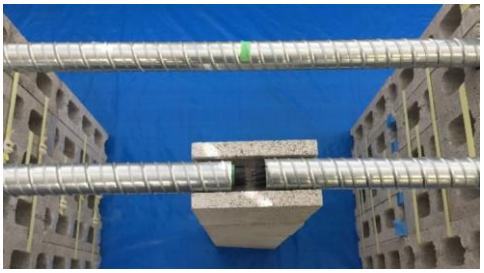

Figure 1 Model for experiment

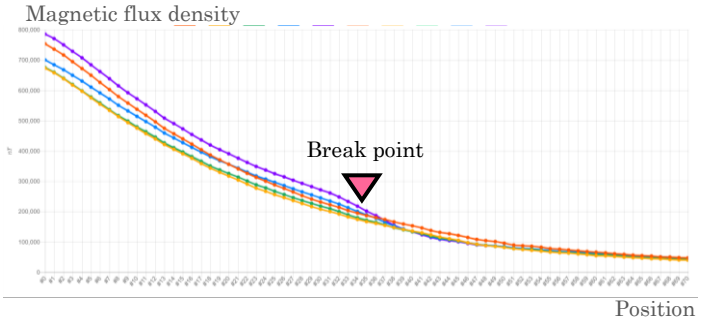

Figure 2 Experiment result