News Release
Railway Technical Research Institute
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RTRI Develops Presstressd Concrete Girder Crack Detection System with Conductive Coating Material

RTRI developed **Presstressd Concrete** (PC) **Girder Crack Detection System with Conductive Coating Material** enabling early detection of the cracks and their location on PC girders.

【Overview】

- Fine cracks occurring on PC girders are important clues to assess the performance of the girders but difficult to detect because they are generated only when trains are passing. This system is able to find such fine cracks by measuring the changes in electric circuit resistance caused by the damage of the conductive coating material applied onto the undersurface of the girders.(Fig.1)
- The measured resistance can be checked at a distant places via internet.(Fig.2)

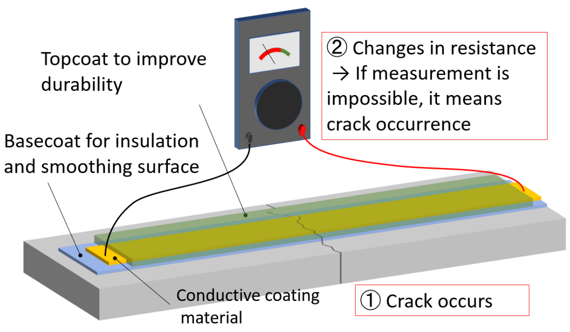

Fig.1 Crack detection with conducting coating material

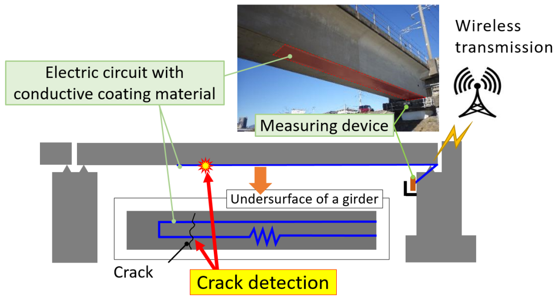

Fig.2 Crack detection system applied onto PC girders

【Advantages of this system】

This system will enable early detection of the occurrence and locations of the cracks that are generated on the undersurface of PC girders and are difficult to find by visual inspections. With this system, railway operators will be able to find such fine cracks by measuring the changes in electric circuit resistance caused by the damage of the conductive coating material applied onto the undersurface of the girders. It leads to more effective repair and reinforcement of the girders and maintenance schedule.

【Background】

The PC girders that have been used for 20 to 50-meter length bridge girders are using PC steel bars. A tensile force applied to the PC steel bars beforehand generates, as a reactive force, a compressive force acting in the longitudinal direction of rails, and it prevents crack generation even under the impacts of train passing. However, the compressive force is diminished if the PC steel is ruptured due to corrosion and other reasons and cracks might be generated on the undersurface of the girders.

At the initial stage, only a small number of PC steel bars have ruptures and cracks occur only when train passes. But the cracks start to occur constantly with the increase as the number of ruptured bars increase, the cracks occur constantly, and PC girders might have seriously damage. Although it is effective for PC girder maintenance to detect the cracks at the initial stage, they are difficult to detect in visual inspections.

【Details of this system】

In this system, electric circuits are built on the undersurface of the PC girders by spraying the conductive coating material. If the surface coated with the material is disrupted by cracks, the circuits are cut off and cracks can be detected.

The circuits consists of a crack detecting section and conducting section. The concrete of the crack detecting section is directly coated with the conducting material in order to detect the number and locations of cracks. On the conducting section, elastic urethane tapes are placed and the tapes are coated with the conducting coating material. Therefore this section is less likely to be cut off even if cracks occur. (Fig.3) If the occurrence of cracks need to be identified in a certain area of the girder, the detecting section is placed and for other areas, the conducting section. By arranging both types of sections like this, multiple cracks and their locations can be detected as is shown in Fig.4. In addition, by analyzing the relationships between the numbers and locations of cracks and the bearing force of the PC girders, it will be possible to estimate the remaining bearing force at the time of crack occurrence.

The measuring device of this system runs on electric batteries for more than 1 year. Since the data of circuit resistance measured 50 times per second can be recorded onto SD cards or other media and is electronically transmitted, it is possible to confirm the data quickly via internet at distant places (Fig.2)

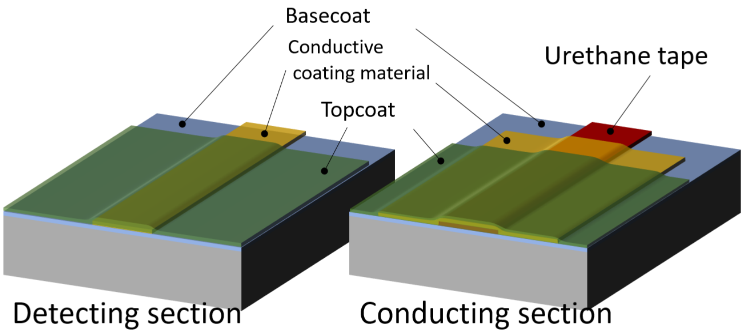

Fig.3 Detecting section and conducting section

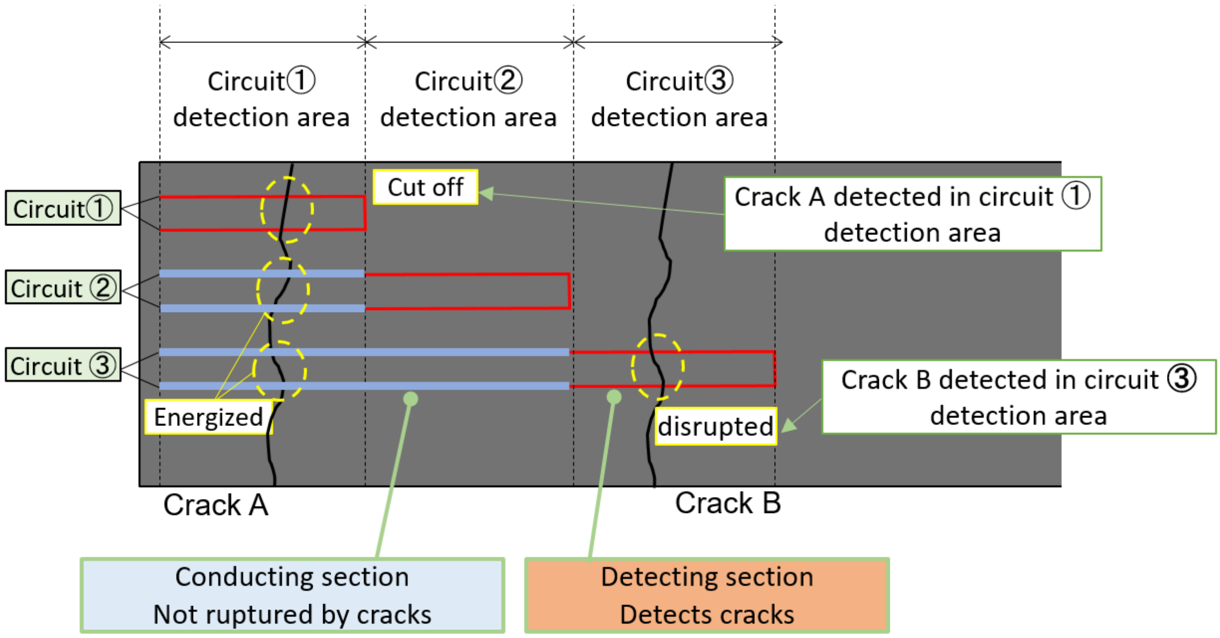

Fig.4 Circuit configuration on the undersurface of a PC girder

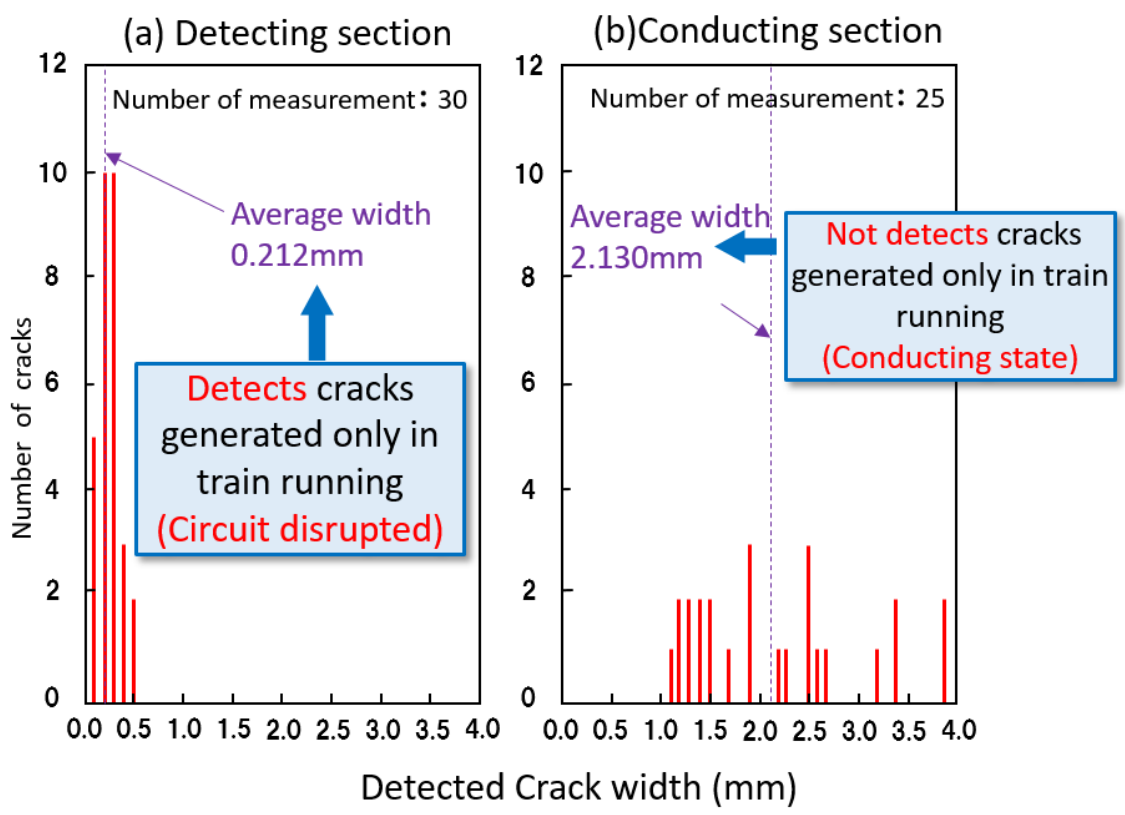

Fig.5 Feature of cracks generated on the coating material applied to detecting section and conducting section

With indoor testing, it has been confirmed that the conducting section circuit is not cut off even if 1mm-wide cracks occur, while the detecting section circuit is cut off by 0.2 mm-wide cracks. (Fig. 5)

Crack generating tests have been conducted on the bridge-model test specimen and it has been confirmed that, when cracks that occur only under train running are generated, only the detecting section circuit is cut off but the conducting section circuit is not and thus the cracks can be detected.

【Test operation on commercial lines】

This system has already been installed to a conventional line facility for a test purpose. It has been more than 3 years since it was applied to the outside facility in December 2016 but the system has been working without any troubles nor maintenance work except battery replacement.

Part of this research has been implemented with the railway technical development grant by the Ministry of Land, Infrastructure, Transport and Tourism.