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Development of landslide displacement detection sensor using optical fiber

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Development of the displacement detection sensor using their feature of the optical fiber has progressed. This paper describes the sensor using Rayleigh scattered light whose energy is decreased because of the micro bending generated on an optical fiber line.

This sensor is based on a principle which convert the landslide displacement to the micro bending and detect the displacement position by analyzing the loss of Rayleigh scattered light occurred with it. In this paper, this structure is called detectable part. The sensor is able to measure cover a wide area because some detectable parts is placed successively and connected each other by optical fiber line which is combined with tension line. In detectable part, the optical fiber line is coiled around a shaft, as shown in Fig.1. When the landslide displacement occurs, the tension between the two ground points affects optical fiber line which connects two parts and the radius of coiled fiber cable become smaller, which cause the micro bending at each corner of shaft. In detectable part, the loss of scattered light occurs due to micro bending, and we are able to know a position of displacement with measurement using OTDR (Optical Time Domain Reflectmeter). Figure 2 shows the example of relationship between loss of scattered light energy and displacement which is given to the sensor intentionally.

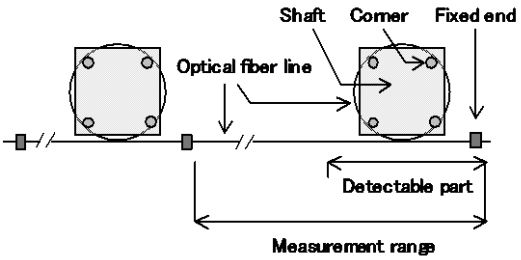

Fig.1 Structure of optical fiber sensor

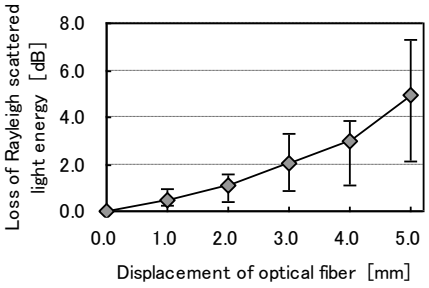

Fig.2 Relationship between loss of light energy and displacement

We performed an efficiency test under the condition of the various shape of shaft in detectable part. As a result, the following was clarified. The straight shape which has two corners is suitable for landslide which is expected to generate a large displacement. Meanwhile the triangular shape which has three corners is suitable for landslide which is expected to generate a small displacement. Figure 3 shows the straight shape and triangle shape of shaft. In the laboratory experiment, we also found that we could know where the landslide displacement occurs using this optical fiber sensor.

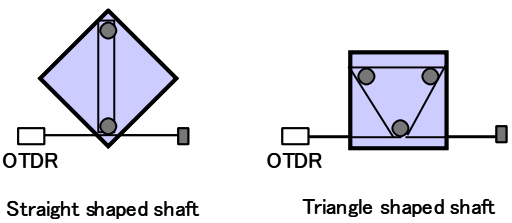

Fig.3 Shape of shaft