

## Detailed GPR survey for delineating boulders buried in a roadbed of a highway under construction

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We conducted a detailed GPR survey on a highway under construction to detect and map boulders in a roadbed buried against regulations on embankment materials. Buried boulders in roadbeds should be eliminated because they might cause surface pavement undulation and would deteriorate drivability. A 540 m long, 20 m wide zone was covered within three days by two parties, each composed of two of us, by means of two sets of high-precision GPR tools with the aid of VRS RTK-GNSS positioning systems. Soon after the primary field survey, we quickly processed the acquired data within two days, and extracted a total of 148 anomalies in the zone. We then conducted the secondary survey uninterruptedly to precisely locate the points where anomalies were identified. The located points were immediately dug with a backhoe to certify whether boulders had been buried or not. It took only one and half day for the secondary field survey. As a result, boulders of 20 cm to 100 cm in size were actually excavated from 146 points of the located 148 anomaly points. This extremely high hitting ratio was mainly supported by the precise positioning system which enabled us to locate back to the anomaly position within 2 cm. In addition, we made a criterion to discriminate the anomalies generated from buried boulders based on GPR diffraction patterns. The criterion was quite helpful to identify anomalies from buried boulders not from other objects such as metal fragments. Owing to the high performance GPR survey within a total of 6.5 days from the primary survey to the excavation of identified boulders, we successfully contributed to minimize the delay in embankment works of the highway under construction.

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