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Nihon Suido Consultants Co., Ltd.
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News Release

Nihon Suido Consultants Participates in Joint Development of Road Cave-in Precursor Detection System

Nihon Suido Consultants Co., Ltd. (Head Office: Shinjuku-ku, Tokyo; Representative Director and President: NAKANISHI Shinji) and Campbell Scientific Japan, K.K. (Head Office: Toda City, Saitama; Representative Director and President: SUGIYAMA Kiyoaki; “CSJ”) have jointly developed a Road Cave-in Precursor Detection System that uses sensor data to detect the formation and growth of voids caused by sewer conduits that could potentially lead to road cave-ins. Nihon Suido Consultants and CSJ have also filed a joint patent application for a Road Cave-in Precursor Detection System and Method for Manufacturing the Same relating to this system (Japanese Patent Application No. 2026-039634).

1. Development background

The road cave-in accident that occurred in the City of Yashio, Saitama, in January 2025 highlighted the prevention of road cave-ins caused by sewer conduits as an important social issue. A special-priority nationwide inspection led by the Ministry of Land, Infrastructure, Transport and Tourism in response to the accident identified numerous locations classified as Urgency Level I (measures required within one year) or Urgency Level II (measures required within five years). However, sewer conduit rehabilitation takes time, requiring investigation and design, budget allocation, procurement, and other processes. In some cases, this makes it difficult to take the action required by the national government for locations classified as Urgency Level I, creating a need for interim measures to maintain safety until rehabilitation work is completed.

(1) Roles in development

Nihon Suido Consultants:

Selecting measurement locations based on the mechanisms that cause road cave-ins; studying sensor installation and construction methods; conducting soil-box experiments using experimental soil layers; and developing the cloud-based monitoring system

CSJ:

Providing vibrating-wire sensors and converters using proprietary signal conversion technology; developing the measurement and communication system; and developing on-site data collection and communication equipment

2. System overview

For sewer conduit buried deep underground beyond the reach of radar waves, this system uses pressure sensors installed in the ground near the conduit to measure changes in earth pressure and pore water pressure. It detects the formation and growth of voids that could lead to road cave-ins by identifying the pressure

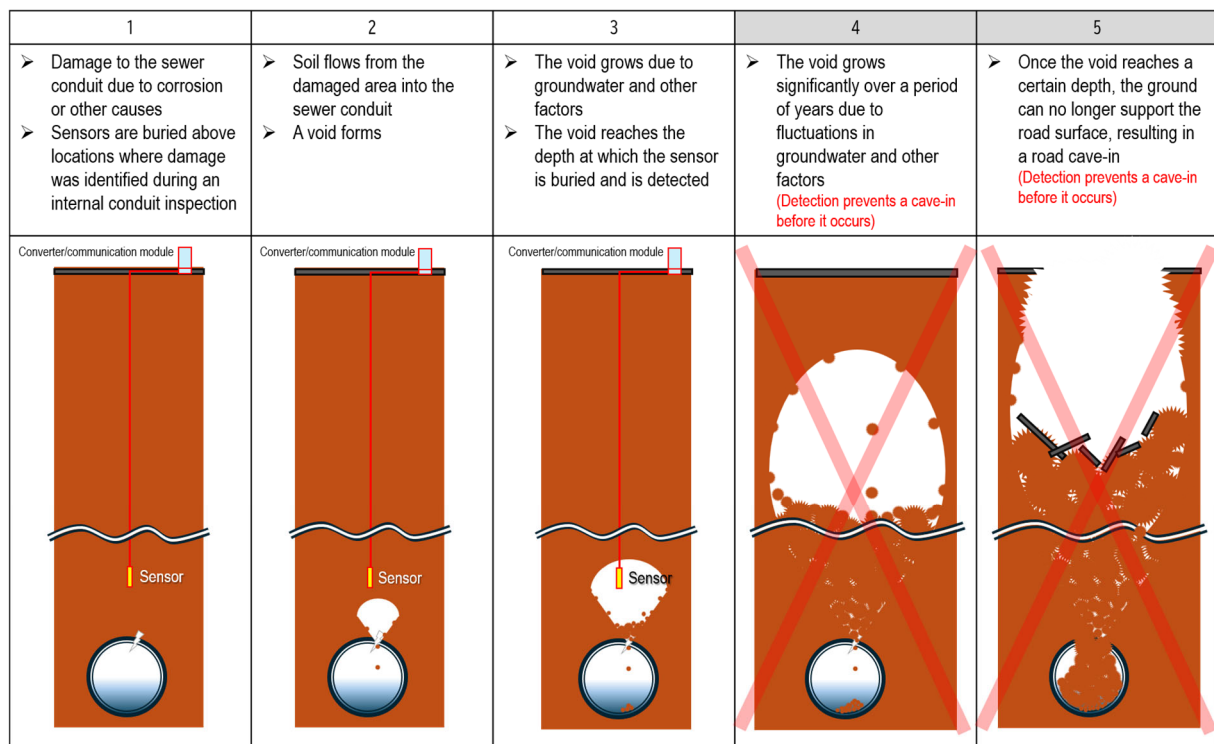
changes that occur when a void reaches the sensor location.

(1) Void detection method

At locations where localized damage to a sewer conduit has been identified, sensors are installed approximately 1 to 2 meters above the conduit to detect voids that expand and move upward toward the ground surface as soil flows into the conduit. Depending on the sensor location, the depth of the conduit, and the extent of the damage, the system can detect a void before it develops into a cave-in at the road surface.

* In this system, “precursor detection” means detecting that a void forming and growing around a sewer conduit has reached the sensor location before the road surface caves in.

* The “Report of the Committee to Investigate the Cause of the Road Cave-in Accident in the City of Yashio” (Committee to Investigate the Cause of the Road Cave-in Accident in the City of Yashio, February 19, 2026) indicates that several years may have elapsed between the formation of the void and the eventual cave-in at the ground surface.



Conceptual illustration from void formation to ground-surface cave-in

(2) System features

Measurement of earth pressure and pore water pressure deep underground

Pressure sensors installed in boreholes near the sewer conduit measure changes in earth pressure and pore water pressure deep underground. Even at depths that are difficult to investigate from the ground surface, the system detects the arrival of a void by capturing the pressure changes that occur when it reaches the sensor location.

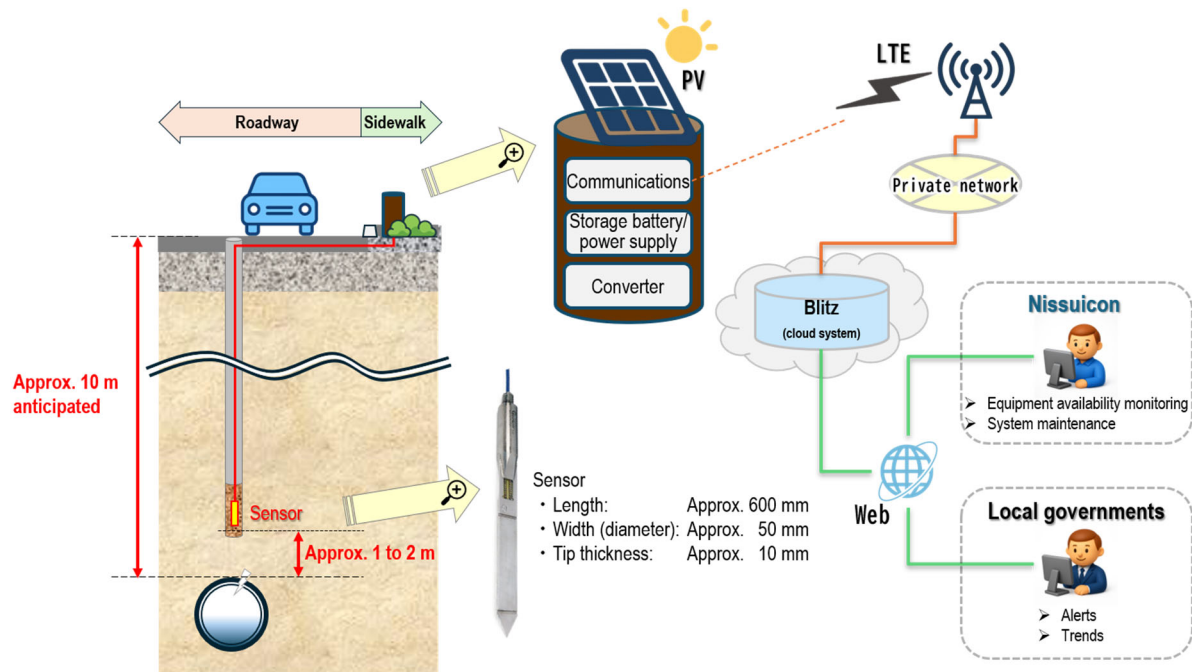
Measurement using long-distance cables

The system uses pressure sensors based on the noise-resistant vibrating wire method, which measures changes in vibration frequency caused by changes in wire tension, enabling measurements even when the sensor element and converter are separated by a long distance.

Remote monitoring via LTE communications and independent power supply

The system wirelessly transmits measurement data to the cloud via LTE through converters and communications equipment installed above ground, for example on sidewalks. The equipment operates on

an independent power supply combining solar power generation with storage batteries. The cloud-based system enables remote management of precursor detection alerts, measurement trends, equipment availability monitoring, and other functions.



Conceptual illustration of the system

*Role of the system

The system provides supplementary monitoring during the period before sewer conduit rehabilitation and does not definitively predict or prevent road cave-ins. Road and sewer system administrators will determine whether inspections, traffic restrictions, or other measures are necessary based on the measurement results and conditions at each site.

*Soil-layer testing at the Public Works Research Institute

Tests carried out independently by Nihon Suido Consultants at the Institute's facilities using an experimental soil layer recreated the formation and growth of a void and confirmed that sensors could measure the pressure changes associated with its growth.



3. Future development

Going forward, we will conduct field demonstrations on actual roads based on the results obtained from the experimental soil layer to verify sensor behavior during groundwater fluctuations and earthquakes. We will also evaluate construction methods that could further reduce installation costs, including the use of penetration testing during void investigations.

We will continue to work to reduce damage caused by road cave-ins while helping realize safer, more secure communities through the development of this system and look forward to helping build a prosperous and sustainable future society.

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