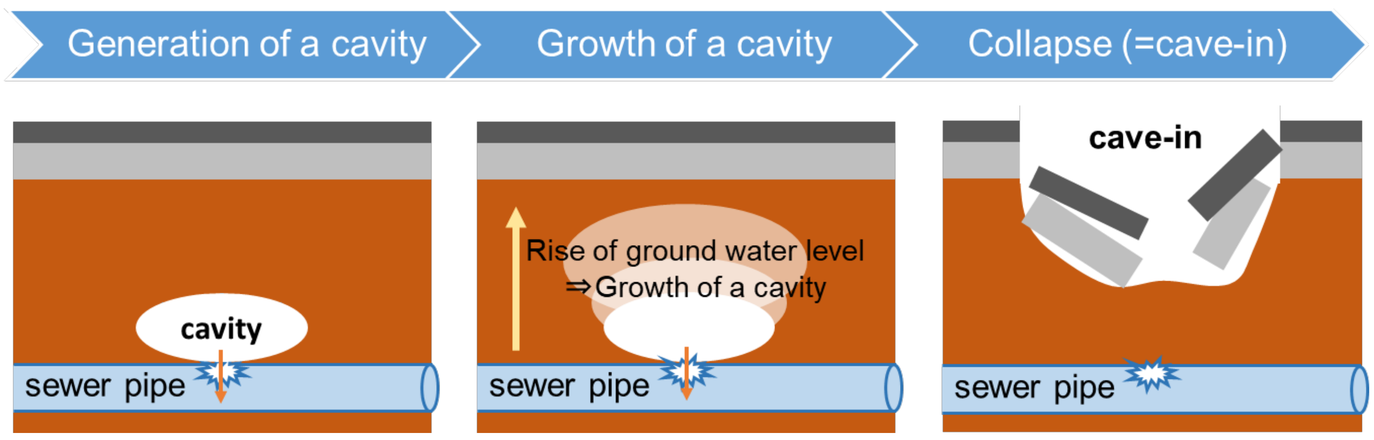
Investigation of Initial and Collapsing Subsurface Cavity with Model Tests

初期から崩壊に至る地盤内空洞の進展プロセス

A road cave-in is one of serious problems in the management and maintenance of road. In this study, series of model tests simulating cave-in formation were conducted to investigate its mechanism.

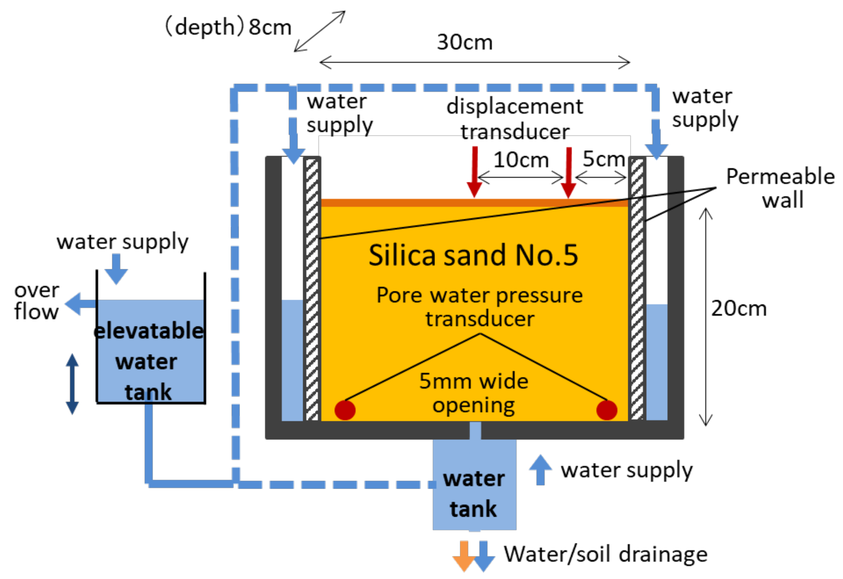
道路陥没は道路保全の観点で重要な問題であり、道路の効率的な維持管理のために路面下空洞の生成・拡大メカニズムの解明が求められています。本研究では、模型実験により地盤陥没の生成過程メカニズム、および陥没危険度評価についての考察を行っています。

Road cave in caused by a subsurface cavity



- Ground cave-ins are initiated by cavities in the ground.
- One of typical causes for the formation of cavities in urban area is old sewer pipes.
- In rural area, underground cavities may be formed by the underground water pathway.
- Rise of ground water level seems to be one of important factors of the growth of cavities.

Model test apparatus and test procedure

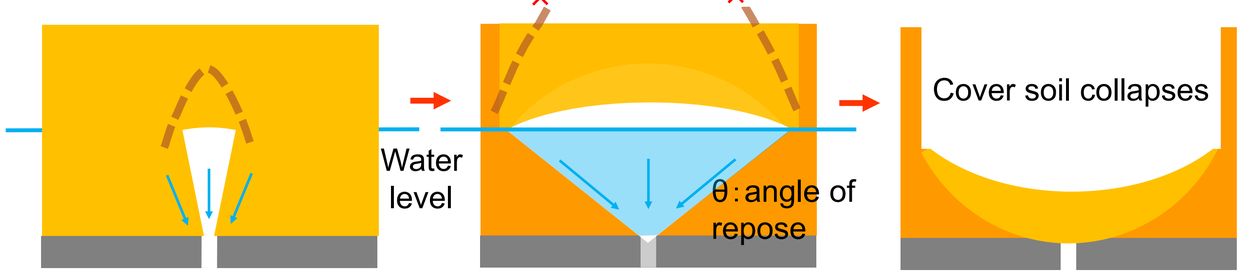


1. Model ground was made in the soil chamber using uniform sand.
2. Water was supplied through side walls or bottom.
3. A plug at the bottom opening was taken out. Water with soil around the opening was drained and a cavity was formed.

Process of cavity formation/expansion

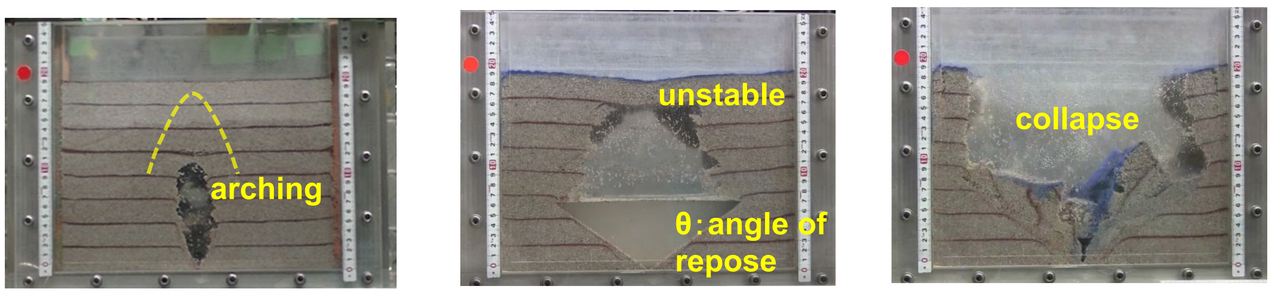
When a narrow cavity is formed deep in the ground, the arch action works

When a wide cavity developed in shallow ground, there is no room for the arch action



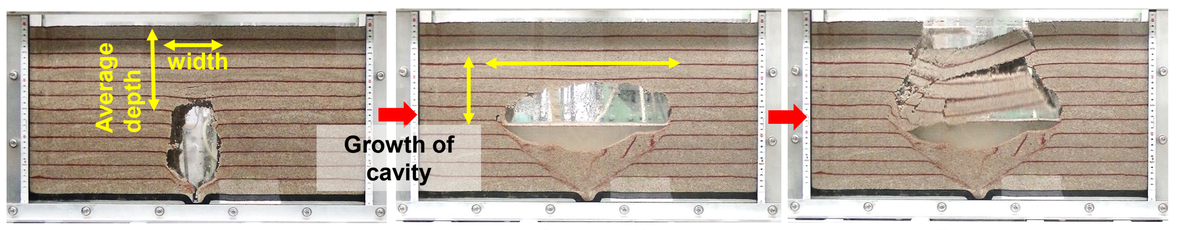
When water drains quickly, a chimney-like narrow cavity forms

When water stays in the cavity, fan-shape cavity develops

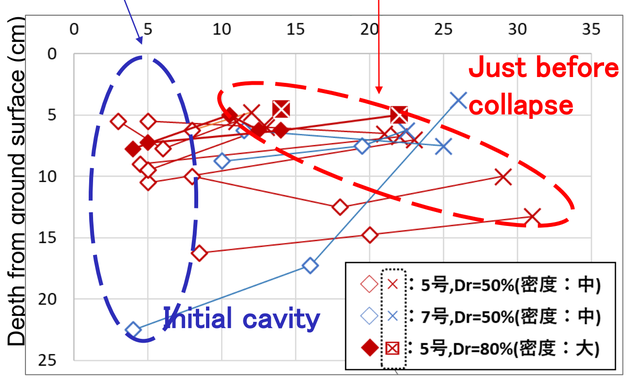


Change of water level, or high water level are one of main factors for cavity expansion

From initial cavity to collapsing cavity



Initial chimney-like cavity | Just before collapsing | collapsing



Chimney-like vertically elongated initial cavity

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Width of cavity under the groundwater increase

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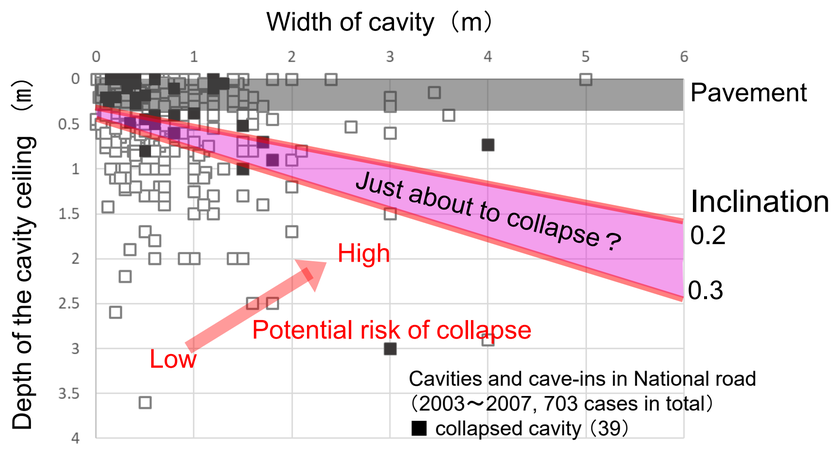
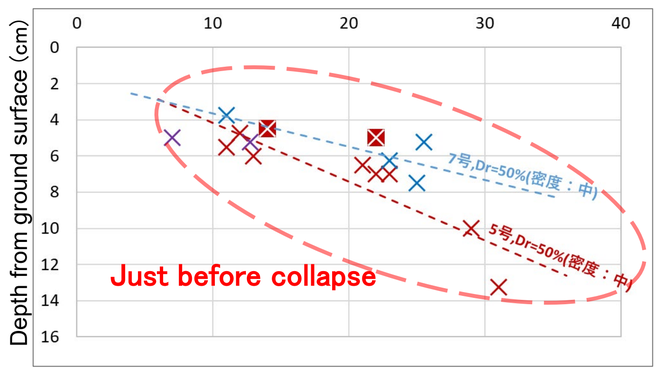
Soil above the cavity collapses

When the thickness of covering soil is large enough compared to the width of cavity, a cavity is stable as the ground arching and apparent cohesion seems to work.

Potential risk of road cave-in

Cases of real cavity and collapse in roads





Wet uniform sand above a cavity collapses due to its self weight, when the ratio of average depth and cavity width becomes below 0.2 to 0.3.

Potential risk of collapse can be evaluated by width and depth of the cavity

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