

# Simulation of Earth Tunnel Excavation based on Trap Door Test by Distinct Element Method

## Concept

### Background

- Construction opportunity in the city tunnel for the purpose of the effective utilization of underground space increases from the shortage in development lot in the urban area recently.
- The design technique of the shallow-layer of large section tunnel is unsettled.

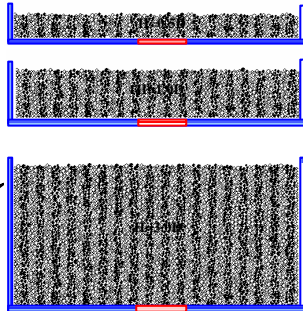
Therefore

### Purpose

- Trap door experiment is modeled using DEM.
- The behavior of the ground in the shallow-layer tunneling is visualized.

## Analytical model

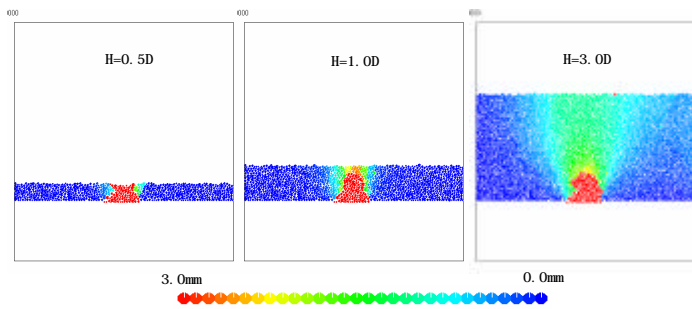
Input parameter	Numerical value		
	H=0.5D	H=1.0D	H=3.0D
Total particles : pieces	712	1435	4161
Normal stiffness : N/m	$0.5 \times 10^6$	$1.3 \times 10^6$	$2.0 \times 10^6$
Shear stiffness : N/m	$0.5 \times 10^6$	$1.3 \times 10^6$	$2.0 \times 10^6$
Diameter of particle : mm	1.4 ~ 3.3		
Friction coefficient	0.5	0.5	0.5
Viscosity coefficient	30	30	30
Density of particle : g/cm <sup>3</sup>	1.8	1.8	1.8



- immobility wall
- trap door
- Trap door is fallen to 5mm

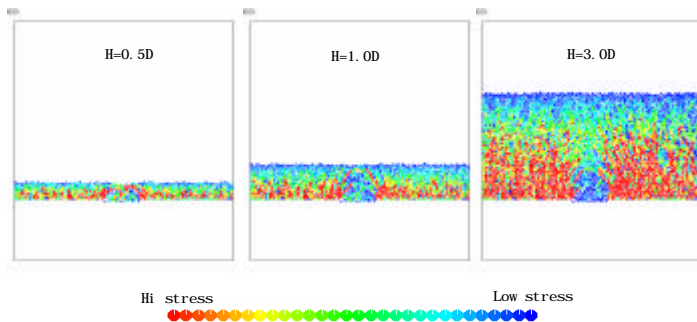
## Distribution of the displacement

Trap door drops by 5mm



## Internal stress

Trap door drops by 5mm



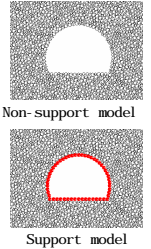
## Tunneling simulation

### Outline

- The simple tunneling model is made.
- We compare non-support with support on ground subsidence and internal stress.

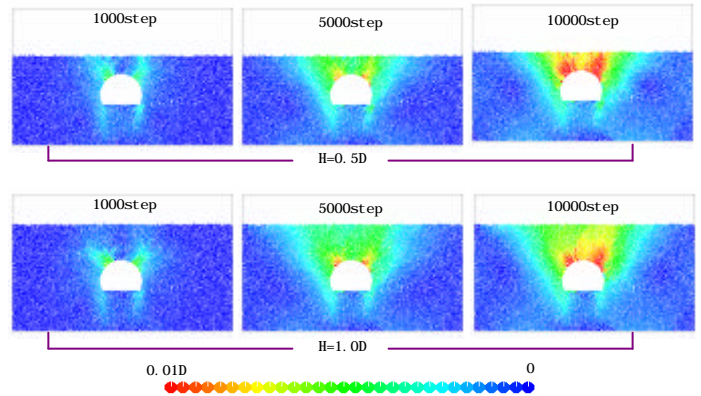
### Input parameter

- The correlation got in trap door simulation is used.

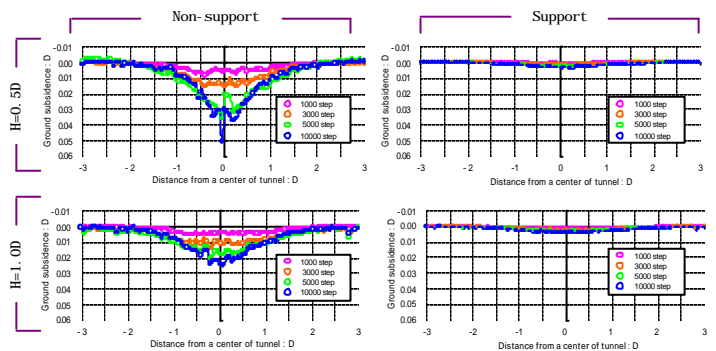


## Distribution of the displacement

non-supporting



## Ground subsidence



## Internal stress

H=1.0D

