

Effects of vegetation type on water infiltration in a three-layer cover system using recycled concrete

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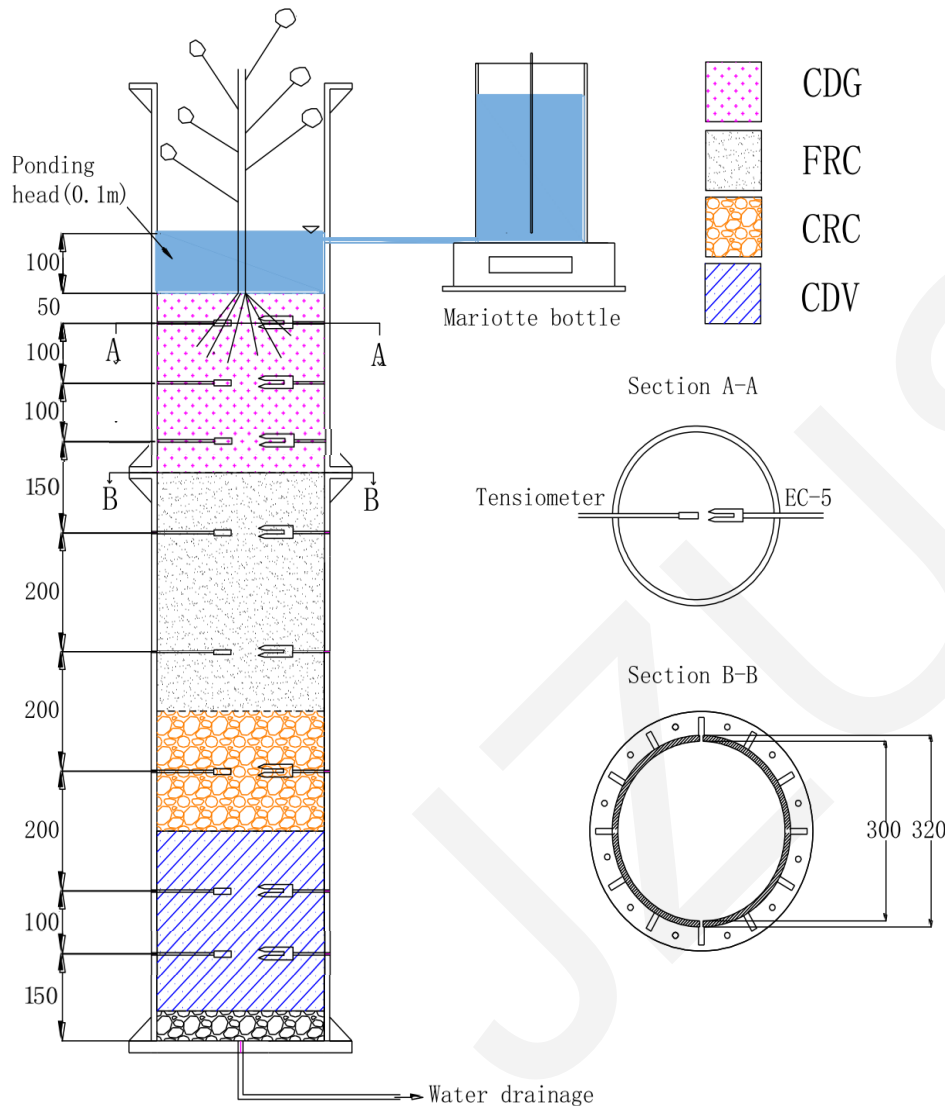
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Objectives

- To investigate the **effectiveness** of **sustainable materials** (i.e. **recycled concrete**) for forming the three-layer landfill cover system
- To investigate the **effects** of plant types on water infiltration in the **sustainable** three-layer landfill cover system

Experimental set-up



Height of column = 1.5 m

Inner diameter of each cylinder = 0.3 m

Soil thickness and DOC/RD:

-CDG=0.3m (95 DOC)

-FRC= 0.4m (95 DOC)

-CRC= 0.2m (80 RD)

-CDV= 0.3m (95 DOC)

Instrumentation:

-8 tensiometers

(Suction of 0 –80 kPa)

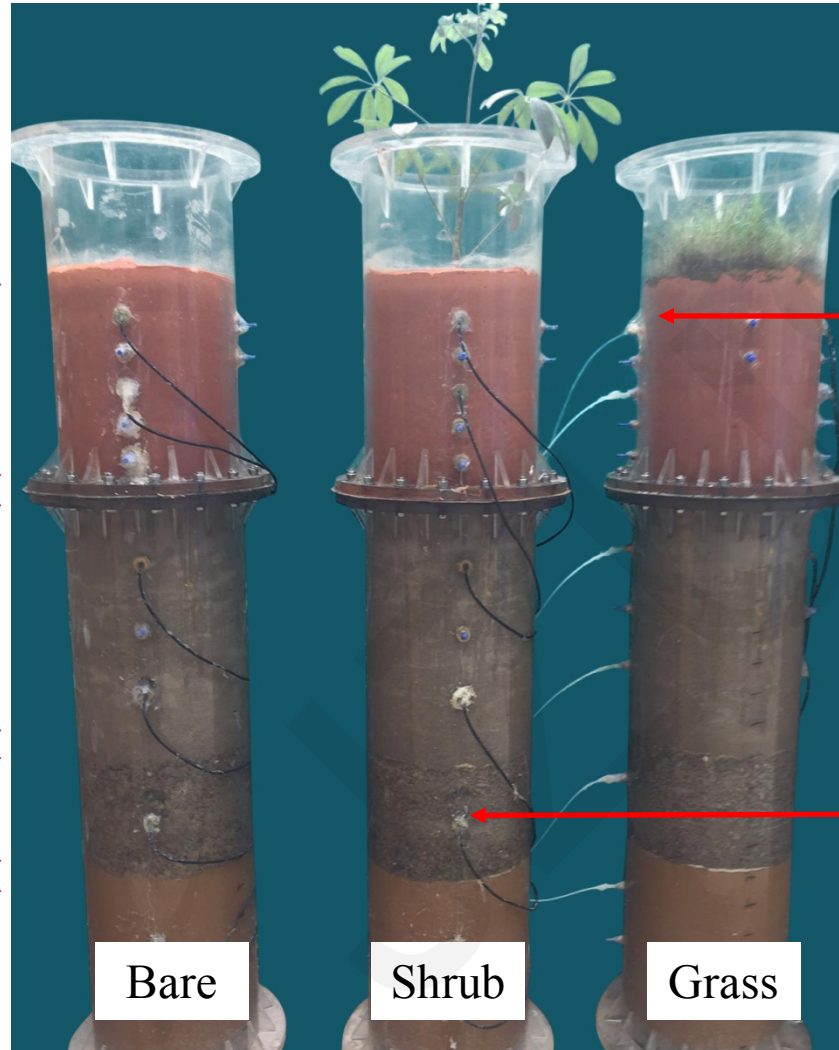
-8 EC-5

(Volumetric water content)

Upper boundary: 0.1 m Constant head

Lower boundary: Free drainage

Overview of soil columns



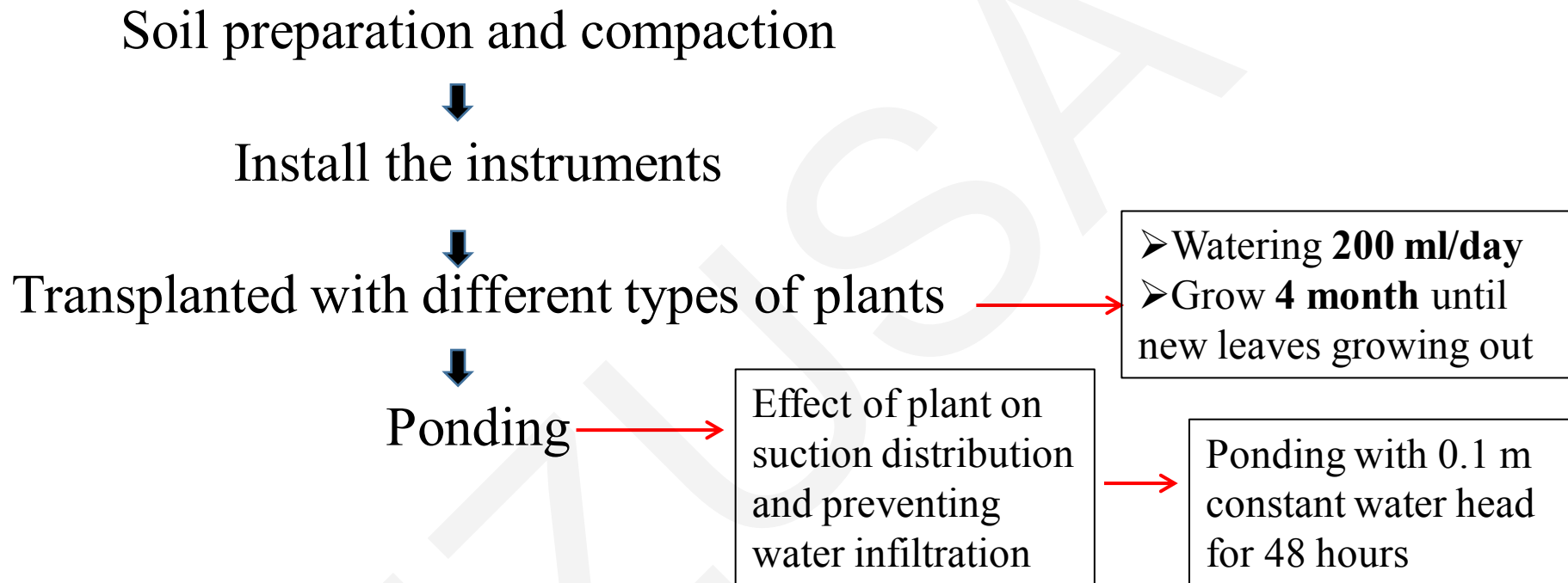
Tensiometer



EC-5

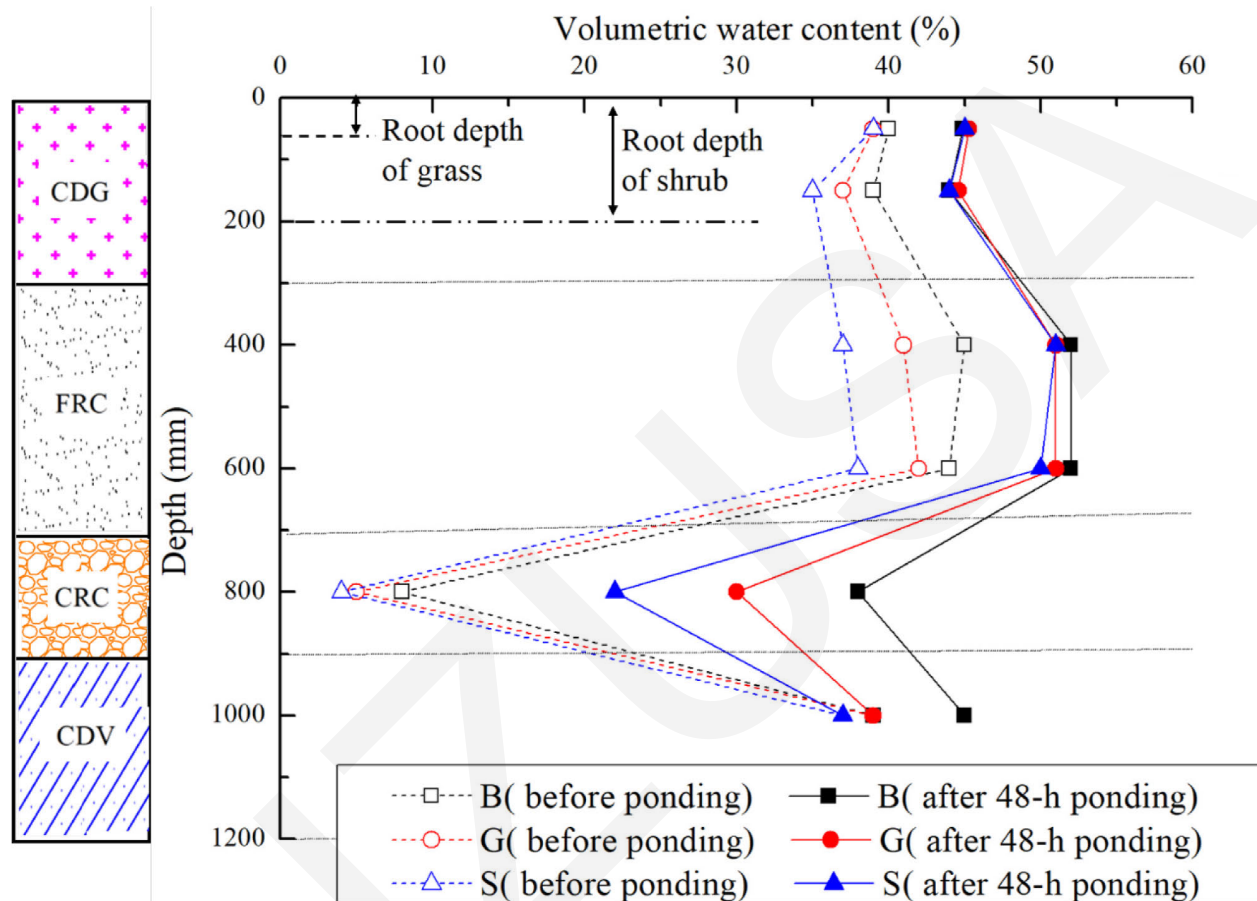


Test procedure



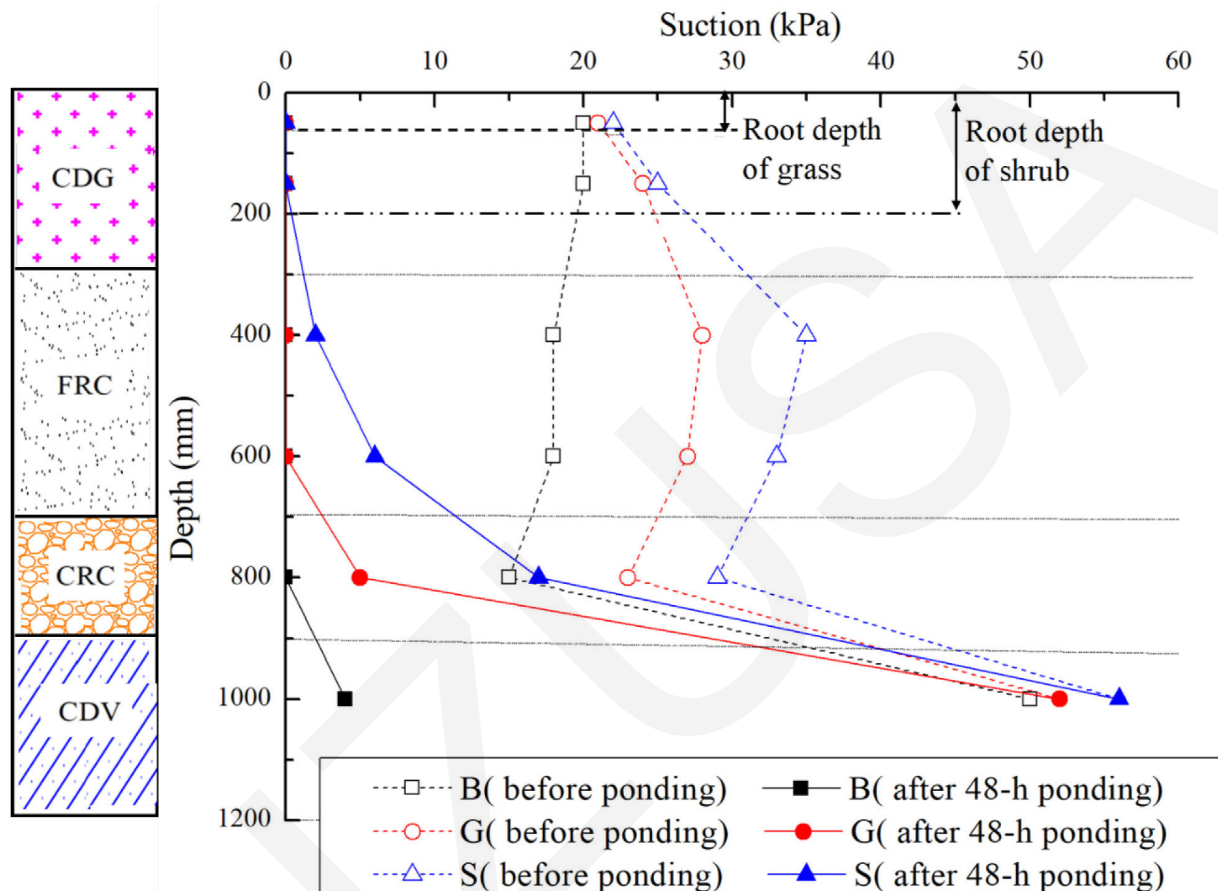
- Four months of growth were considered sufficient for root establishment with the surrounding soil (Ng et al. 2016).
- A constant ponding head of 100 mm for 48 hours is equivalent to more than 1000-year return period in Hong Kong, (Ng et al. 2016)
- All columns were placed in the Geotechnical laboratory of Harbin Institute of Technology, Shenzhen, China. The daily temperature and humidity in the room were maintained ~26 °C and ~55 %, respectively.

Effects of plant types on VWC distribution during ponding test



- During ET before ponding, the VWC in the fine recycled concrete layer of the vegetated three-layer system was generally lower than that of bare cover. Moreover, the water content under the shrub cover was even lower than that under the grass cover.
- After 48-hour ponding, VWCs in bottom layer of the planted soil column were lower than those of the bare soil column, which is consistent with the data of suctions.
- The presence of vegetation significantly enhances the effectiveness of the sustainable three-layer landfill cover system in preventing water infiltration.

Effects of plant types on suction distribution during ponding test



- After 48-hour ponding, the suctions retained in bottom layer in the vegetated soil column were significantly higher than those in the bare soil column.
- This is because shrubs have deeper roots and a larger zone of influence on root water uptake than grass species.

Main conclusions

1. During ET before ponding, the VWC in the fine recycled concrete layer of the vegetated three-layer system was generally lower than that of bare cover. Moreover, the water content under the shrub cover was even lower than that under the grass cover. This indicates that **ET effects: shrub > grass > bare**.
2. After ponding, **percolation was observed only under the bare cover**. For the vegetated cover systems, even though capillary effects in the upper two layers were not effective, higher suction was maintained in the bottom layer than in the bare covered column. As expected, **water permeability was lower in the vegetated columns and prevented percolation**.
3. Compared with the grassed cover, the cover with the shrub maintained a lower VWC and hence a higher suction in the layers. This implies that **shrubs are more effective in reducing water in-filtration in three-layer landfill covers in humid climates**.
4. During ponding, the CCBE layer lost the effectiveness, however no percolation was observed due to presence of low permeability layer at bottom in all three columns, which means that sustainable three-layer landfill cover system is a **promising sustainable** alternative landfill cover system for humid climates.