

# An experimental study of heat and moisture transfer in unsaturated sands

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Zones of unsaturated soil extend above the groundwater table and exhibit characteristic profiles of suction and degree of saturation as a consequence of capillary actions and of environmental conditions. However, very few studies have been made regarding the performance of water content and suction in beaches of granular soils that are exposed to complex hydro-environment loading such as tides, waves, precipitation and solar radiation (Fig. 1). In moist soil, temperature changes may induce water transfer and then influence the state of suction in the soil deposit concerned. This work is aimed to investigate interactions between heat transfer and moisture transfer in unsaturated sand, with the state of suction being a major factor of discussion.

Also, we attempt to extend an analysis procedure (Sassa, Li and Sekiguchi; 2004) so as to incorporate heat transfer, with the aim of facilitating a coherent description of energy transfer, pore fluid flows and cyclic plasticity. The present experimental work will provide a dataset against which an integrated analysis procedure may be closely examined.

A typical cross section of test set-up in our experimental program is shown in Fig. 2. An expanded Polystyrene (EPS) box was used for heat isolation purposes. Unsaturated conditions were controlled with consideration of capillary actions. A deposit of unsaturated sand was subjected to heating by a heat lamp overhead. Thermistors, soil moisture sensors (ADR), tensiometers (SK-5500-M6) were installed to continuously measure changes of soil temperatures, volumetric water contents and matric suctions. Fig. 3 typifies measured soil temperature changes in the course of heating and cooling.

The experimental program is in progress and will be detailed on the occasion of the presentation.

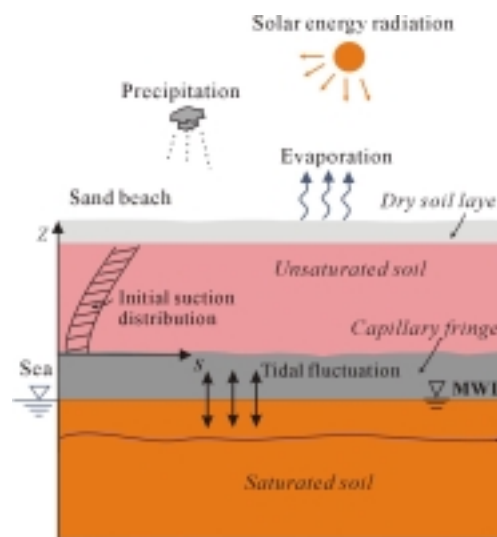


Fig.1 Environmental conditions leading to “initial” suction profile in sand beach

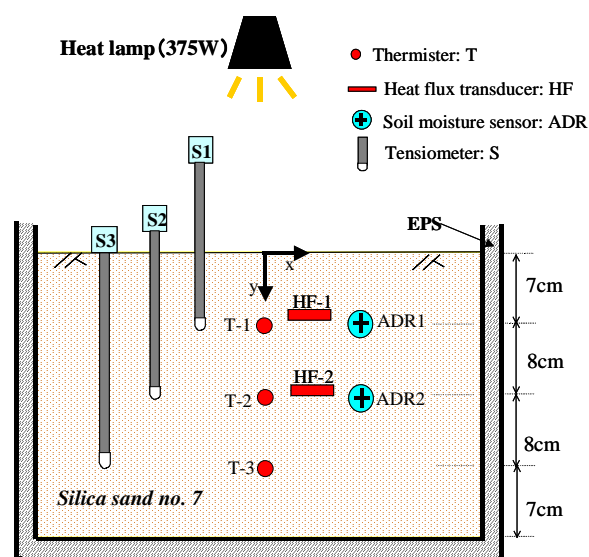


Fig.2 Set-up for laboratory experiment

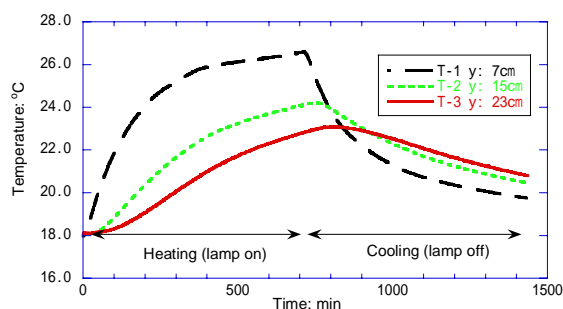


Fig.3 Evolution of soil temperatures