The current researchquantifies the influence of beach slope and tidal conditions on saltwater dynamics in single and multilayered porous media.

Pumping patterns, beach slope, tidal dynamics, and sea-level rise influence the saltwater-freshwater interface.

Density-driven flow in porous media remains one of the challenging problemsowing to its inherent non-linearity and limited availability of analytical solutions or availability of standard or field data set.

Two-dimensional (2D) Sand Box Models was utilized for the current study over three-dimensional (3D) model considering the ease in a) instrumentation (Non intrusive measurement) and b) visualization.

Experimental quantification of the beach slope effect was evaluated.

The convective fingering effect is another phenomenon not observed in the previous vertical boundary studies.

To develop an image analysis technique to quantify the concentration gradient in porous media.

The experimental instrumentation can be divided into five parts/ units a) SandBox Model, b) Tidal Mechanism, c) Pressure Transducer, d) Data Acquisition System, and e) Digital Camera. Moreover, Peristaltic Pump and Conductivity Temperature, and Depth (CTD) Diver were also utilized for the experiments.

The tidal mechanism was designed to impose a periodic head boundary condition at the left side of the Sand Box Model. It has four sub-units i) Water Column, ii) Flexible Pipe Connector, iii) Rotodyne DC Motor, iv) Control System.

This forward-backward (direction) motion of Rotodyne DC motor and its duration are automatically controlled by the Control System.

**Pore water pressured was captured by Super TJE ultra-precision pressure transducers (STJE AP111) from Honeywell.**

The Digital Single Lens Reflex (DSLR) camera Nikon d5100 was utilized for capturing time-varying experimental saltwater-fresh water interface movement.

Electrolab India make Peristaltic pumps of Model:PP-50VX were used. The pumps were individually calibrated to obtain the relationship between rotational speed and flow rate.

The CTD Diver Model: DI272 (Make: Schlumberger Water Services, Delft, Netherlands) measures absolute pressure, temperature, and conductivity of the water.sampling was performed at an interval of 15 milliseconds for 10-12 hours.

Scanning Electron Microscope (SEM) Micrograph and Energy-dispersive X-ray (EDX) spectrum of Clean Sand, Grade-I IS Sand, and Bentonite were shown.

However, repeatability of the experimental results could be ensured with

The tracer should be i) soluble in an aqueous solution, ii) nonreactive (low absorption), and ii) non-diffusive.standard material. Diffused reflectance absorption spectra (DRS) [with OR-3100 spectrophotometer (ORLAB)] were recorded to check the absorption characteristics. The change in absorbance (with and without

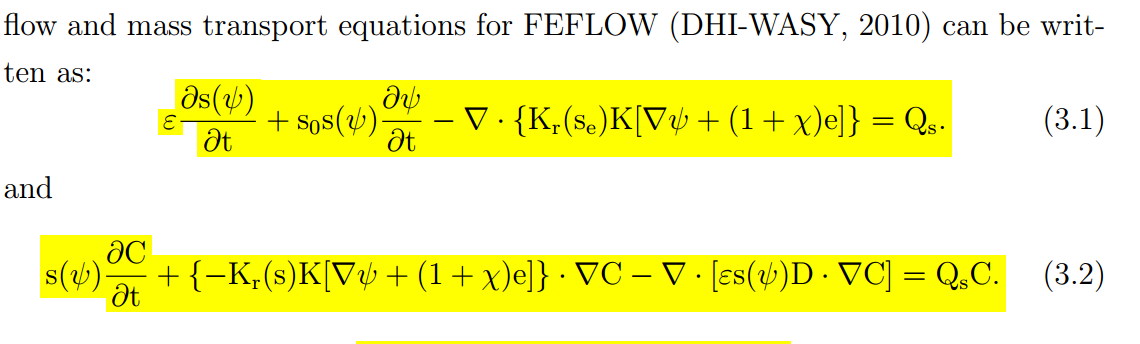
Sand) of the dye solution was used to calculate the dye concentration in solution. Rhodamine-B was identified as the most suitable dye considering the better visualization effect.

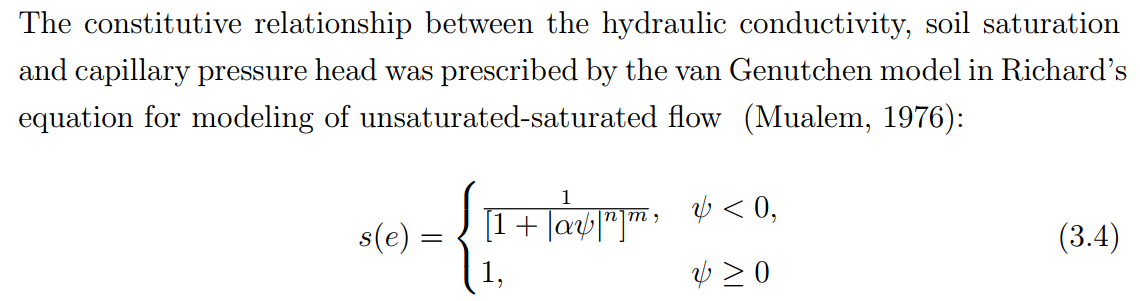
**Chapter 3:** The present work considers both confined and unconfined configurations of porous media under sloping beach face conditions.

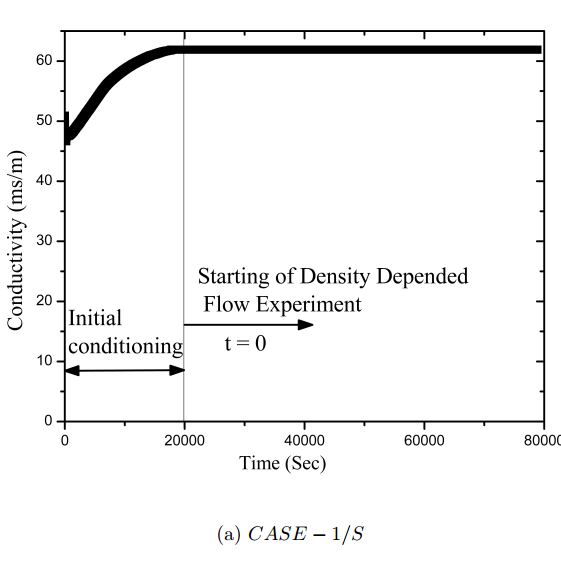
In the present study, six pressure transducers (STJE from Honeywell; PS1 to PS6) were placed in a horizontal line 0:57 m above the floor.

A wet packing method similar to Ataie-Ashtiani et al. (1999) was adapted to obtain uniform sand packing with minimum entrapped air to satisfy a homogeneous isotropic condition.

Initially, physical system got stabilized under freshwater flow conditions. The measurements for density-dependent flow experiments were taken only after stabilization of the density measurements.



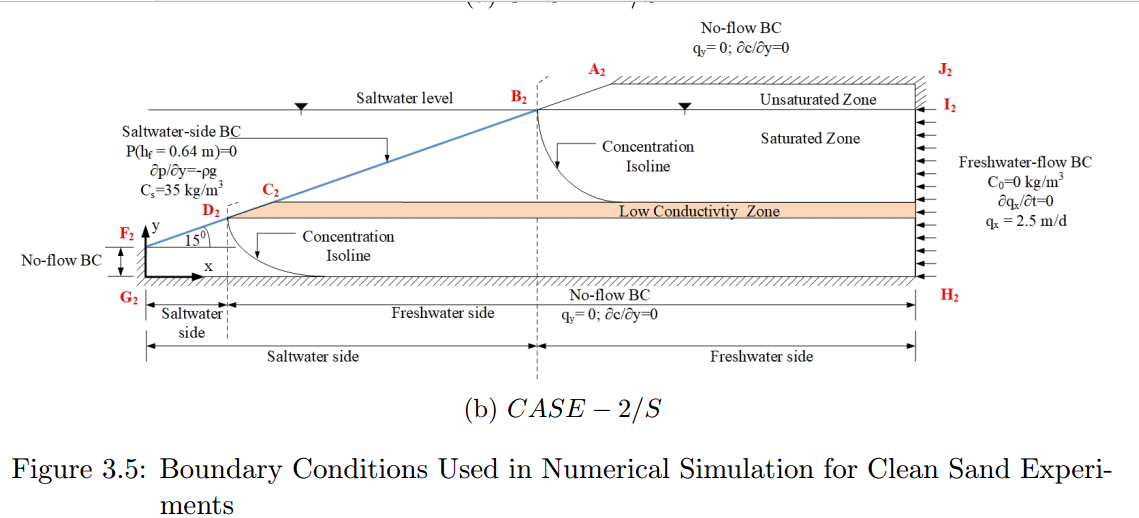




The water retention curves of the Clean Sand and Grade-I IS Sand were determined in the laboratory.

Initial conditions for CASE −1=S and CASE −2=S were specified in terms ofhead and concentration values. At the beginning, the domain was saturated with freshwater at constant flux from the right side (freshwater concentration).

Along the saltwater-side boundary (B1 − C1 in CASE − 1=S andB2 − F2 in CASE −2=S) equivalent static freshwater head condition was applied.



The peristaltic pump was used for creating the freshwater flux boundary condition.

An optimal element size of 0:004 m was obtained from the mesh convergence study.

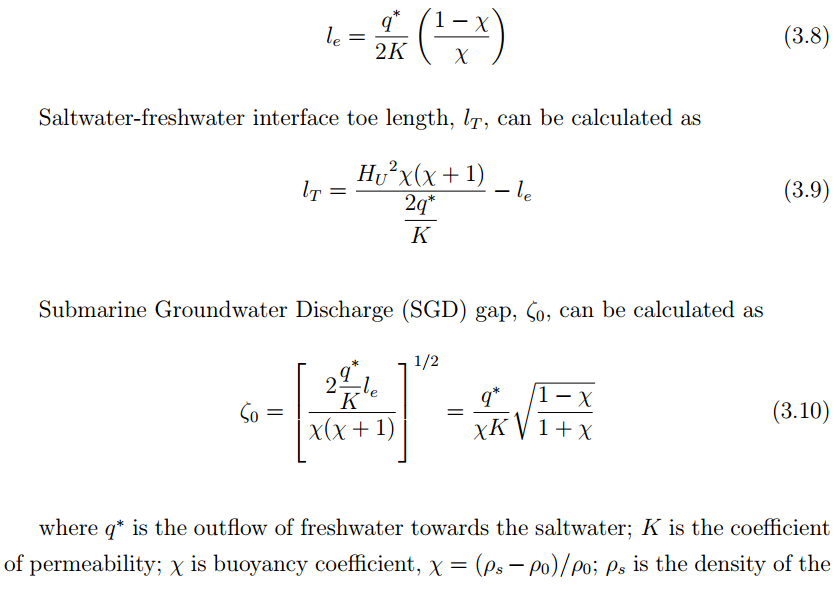
A rectangular grid (0:10 m × 0:05 m) was marked on the frontal glass surface of the Sand Box Model. During the image acquisition process, points placed at four corners of the ZoneB (rectangular) were utilized as static control points. These static control points were used to define the scale and orientation of the all-digital images under a unique reference frame. In Sand Box Model light source cannot be placed at the backside due to the opaque nature of the material. Thus two Halogen Lights were provided from the front side.

Image (ImRaw) stores colour (R-G-B) information in pixels. It is convenient to represent image as a multidimensional digital array (py × px × 3).

The raw images were aligned and corrected with respect to the static control points. The cropped images corresponding to the test section were utilized for the next level of analysis. These images provide scattered/noisy information about the color distribution. Thus neighborhood averaged images were used for further analysis. Resulting images provided usable tracer movement information for comparison with physical and numerical results.

**Analytical solution:**  Van der Veer (1977) provided a more robust solution. The main focus of this analysis is to quantify SGD gap through which the freshwater discharge occurs. In the present study Van der Veer (1977) solution was utilized with no recharge from the top.

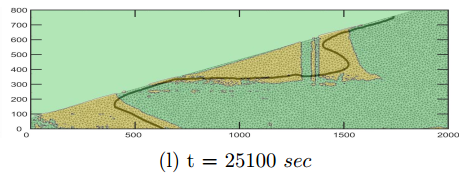
The horizontal distance between the extended point of saltwater-freshwater interface and sloping beach face, le, can be calculated as



The analytical solution was also utilized for comparison of experimental and numerical values of Toe Length and Submarine Groundwater Discharge Gap.

The numerical simulation results over-predicted the interface movement in vertical direction.Overprediction is due to the fact that convective instabilities occur during the travel of a heavier fluid (saline water) in the presence of a lighter fluid (freshwater) flow and under the perturbations of the natural medium.

The numerical simulation failed to capture the local fingering effect visible in experiments during the initial period.



In the presence of the confining layer.

Numerically simulated pressure head and experimental hydraulic head valueswere plotted to check the consistency of the obtained results. Averaging was performed on the porewater pressure data (acquired at 20 Hz frequency) to remove noise.

**1966\_Pulse-Testing: A New Method for Describing**

**Reservoir Flow Properties Between Wells**

Pulse-testing utilizes a sensitive diferentiaipressure gauge at a responding well to measure and recordthe response generated by a series of ffo w rate changes (pulses) at an adjacent or pulsing well.

pulses obey unsteady-state, compressible-j?ow \*heory and thus provide a measure of both transmissibility (kb/ p) and storage (~ch).

**1981\_Determinationof Hydrogeological ParametersUsingSinusoidal PressureTests: A TheoreticalAppraisal**

A methodfor determiningthehydrogeological parametersof formationsof interestbasedon a sinusoidal pressurefluctuationin an excitationboreholeisproposed.Equationsarederivedwhichdescribethe

dependenceof pressuresand phaselagsoutsidethe excitationboreholeon distance,signal frequency,specificstorage, hydraulicconductivity, andflowrates.Thesecovertwo distinctconfigurations: that of apointsourcedeepwithin a water-saturatedelasticformationandthatof a line sourcetotally penetrating a confinedaquifer.

Having excited the formationwith a wave of a particularamplitudeand frequency, wouldtherebea measurable signal at a useful distance,and would this be suitablydependenton a limited number of hydraulic parameter

Thesinusoidal pressure test,wherea sinusoidal variation of

pressure is induced in a source wellandthesignal ismeasured

in an observationwell,

The propertymeasuredis hydraulic diffusivity:a combined functionof hydraulicconductivityand specificstorage rather than the two separately.

.The diagnostic measurementsare phase shift and amplitude, so the

start time for the test is irrelevant,