Influence of Seasonal Changes on Shear Wave Velocity in Compacted Soils

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ABSTRACT

Shear wave velocity, is used in classifying the soil into seismic site classes based on the expected seismic behavior during ground motion. Changes in shear wave velocity due to seasonal changes in moisture content from dry to wet could lead to poor performance or failures of structures. In recent years season to season events have become more extreme, hence it is important to examine the impacts on measured shear wave velocities and seismic site classification.

Research described here involved laboratory testing to examine changes in shear wave velocity with changes in soil moisture content and suction and how this impacts seismic site classification.

Source: https://www.researchgate.net

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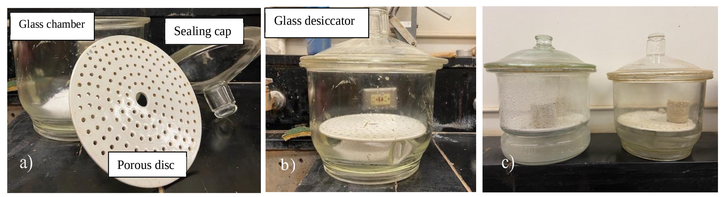
BACKGROUND: OBJECTIVES AND SCOPE OF WORK

- Identify the major factors influencing the shear wave velocity during seasonal changes.
- Measure changes in shear wave velocity as water content, suction, percent of fines, and density changes
- Investigate the impact of seasonal changes on seismic site class

METHODS I: LABORATORY TESTING

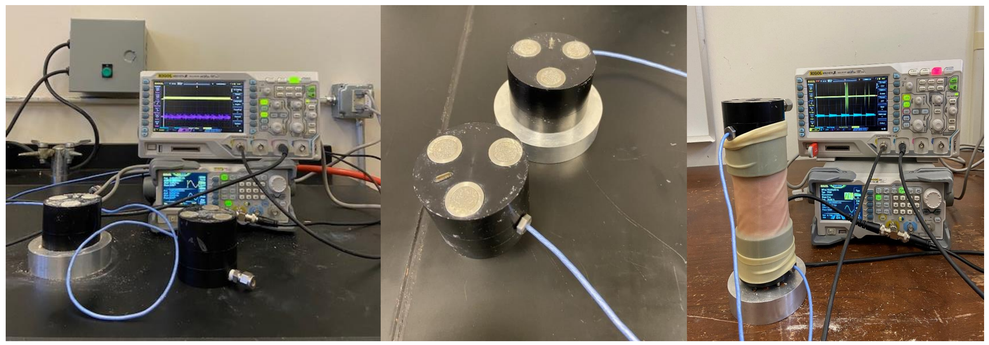
Three main laboratory tests were conducted:

1) Vapor equilibrium suction control chambers were set up to control the wetting and drying of tested samples. The chemical solution used in the closed glass chamber creates an atmosphere where water in the air and the soil sample reach energy equilibrium. This exchange causes a change in the soil water content and suction.



2) The WP4_T chilled mirror hygrometer was used to measure the total suction of the soil specimens using a sacrificial companion specimen. Readings were taken at various water contents to examine the changes in suction while drying/wetting.

3) Bender elements were used to measure shear wave velocity of the test samples at various water contents. The system consists of sending and receiving bender elements, a function generator, and an oscilloscope.



METHODS II: Soil Mixtures

Three soil mixtures were used during testing by mixing kaolin and fine sand as follows:

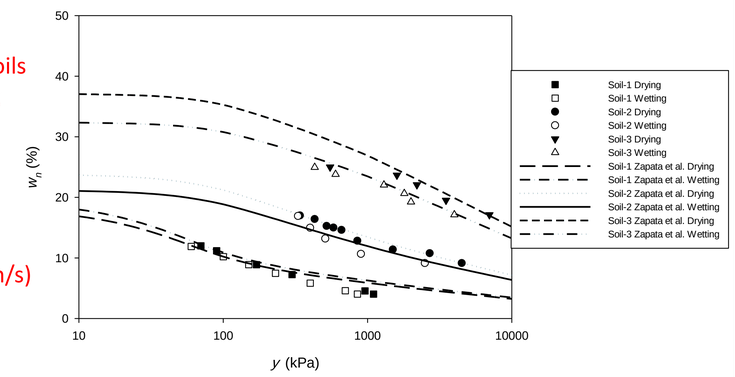
1) Soil-1: 90% sand and 10% kaolin
2) Soil-2: 50% sand and 50% kaolin
3) Soil-3: 10% sand and 90% kaolin

For each soil, samples were mixed to the desired water content and compacted in a 2.5” diameter x 2.8” height mold. Samples were then extruded and trimmed to give a 1:1 diameter to height ratio.

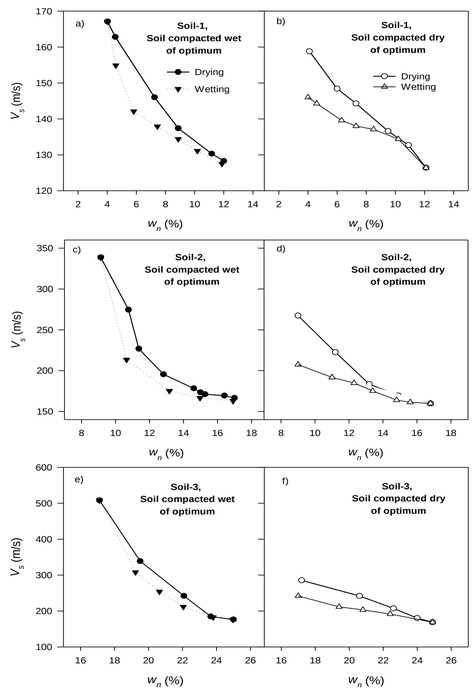
RESULTS I: SOIL WATER CHARACTERISTIC CURVES

Soil Water Characteristic Curves were plotted for soils 1, 2 & 3 along the wetting and drying paths.

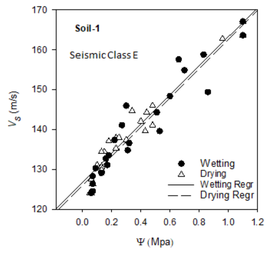
Symbols:
w_n- water content (%)
ψ- total suction (kPa)
V_s- shear wave velocity (m/s)

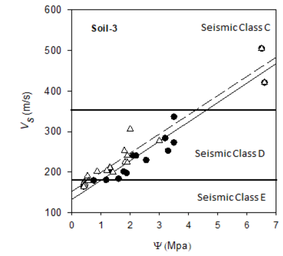


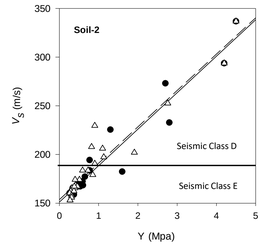
RESULTS II: SHEAR WAVE VELOCITY VERSUS WATER CONTENT



IMPLEMENTATION: SHEAR WAVE VELOCITY VERSUS SUCTION and IMPACT ON SEISMIC SITE CLASS







- Results show that V_s is strongly influenced by the following factors:

1) Water content and suction
2) Wetting and drying paths
3) Initial soil structure

- Changes in water content impacts the seismic site class of the soil which is important to consider during the earthquake resistance design.

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