آزمایش های ژئوفیزیکی

در مهندسی ژئوتکنیک

درس شناسایی های ژئوتکنیکی زمین

علی فاخر

روش های لرزه ای

seismic

Seismic methods

1. Refraction
2. High-resolution reflection
3. Vibration
4. Uphole, down-hole, and cross-hole surveys

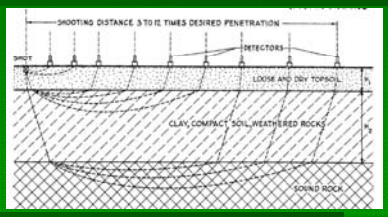
درس شناسایی های ژئوتکنیکی زمین

علی فاخر

روش های لرزه ای

seismic

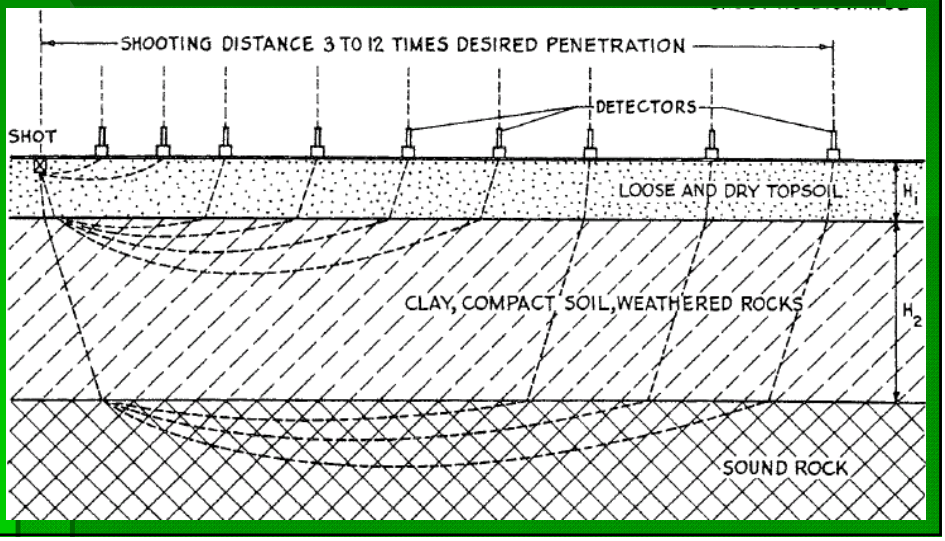
seismic refraction method.



placing a series of geophones in a line on the ground surface

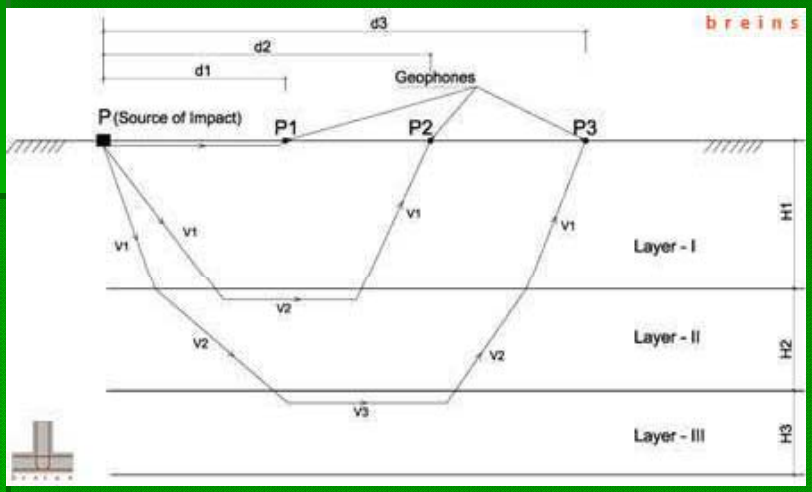
Producing a shock wave (or shot) by striking a metal platewith a sledgehammer

seismic refraction method.



seismic refraction test

seismic refraction test



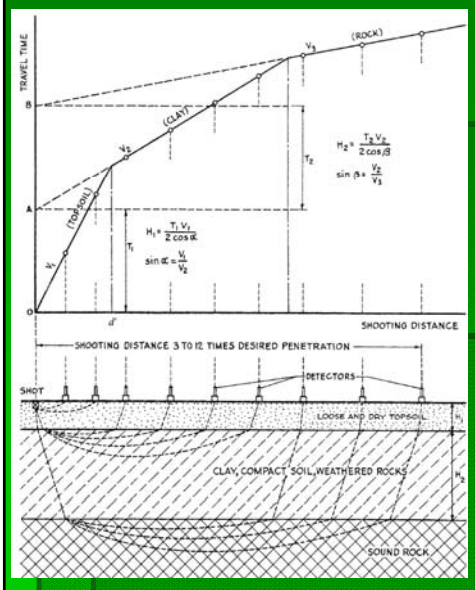
geophone

geophone

درس شناسایی های ژئوتکنیکی زمین

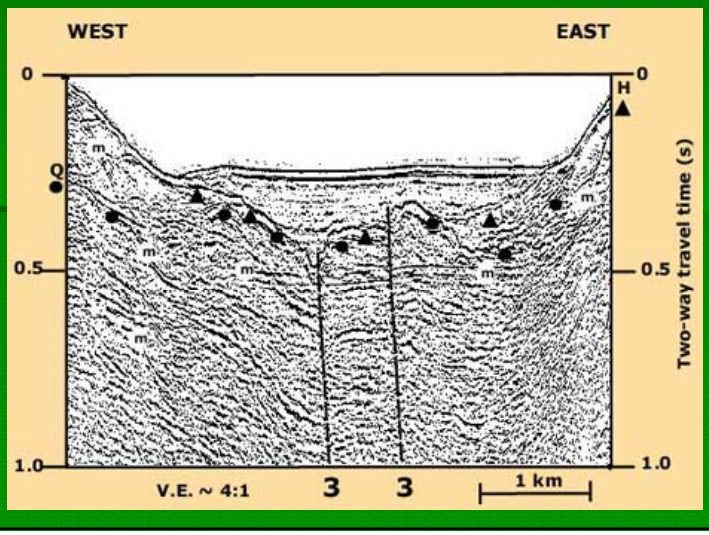
علی فاخر

A shooter awaits word from the observer at the laptop to give the plate a good blow. Each shotpoint is run three times and the results stacked for cleaner data.



This figure presents an example of a time-distance plot obtained from a seismic refraction survey to determine the thickness of the layers.

high-resolution seismic reflection



مثال

The Kansas Geological Survey used high-resolution seismic reflection for the KDOT subsidence investigations.

Seismic signals are induced by a vibration truck that delivers three 10-second sweeps that cover the 25 to 250 Hz range.

Four 60-channel seismographs are networked to simultaneously record 240 channels of input.

Geophones are spaced every 8 feet; two geophones are used at each location for redundancy and signal strength.

The vibration truck conducts sweeps along the geophone line at 16-foot intervals, making this a time-consuming process.

With this setup, the geophysicists can interpret seismic reflections from beds 1000 feet below the surface.

مثال

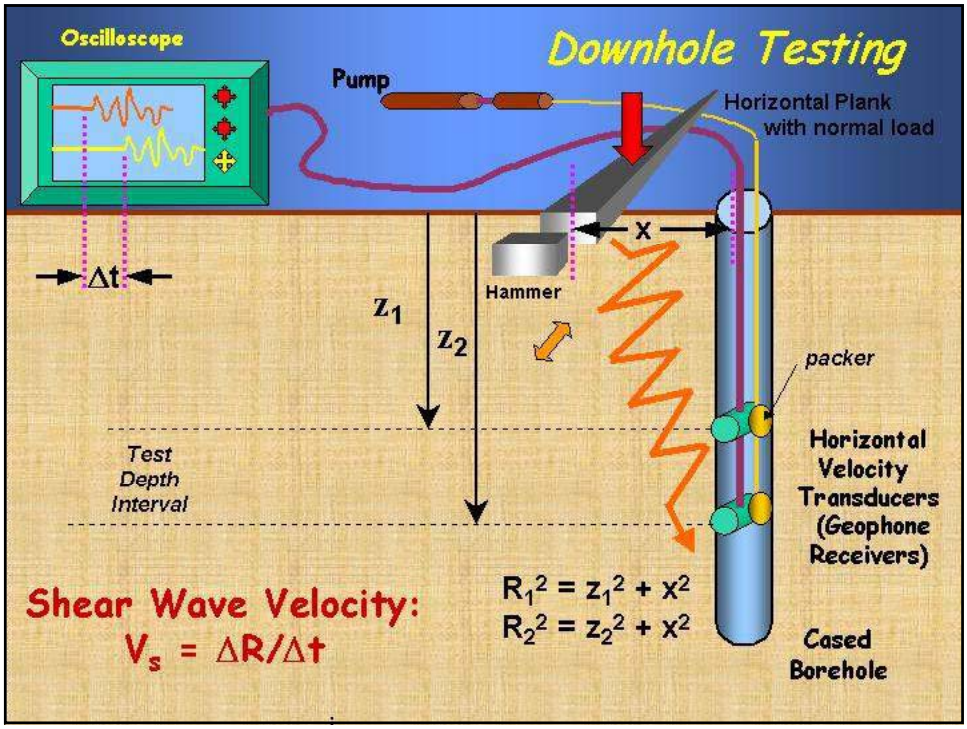


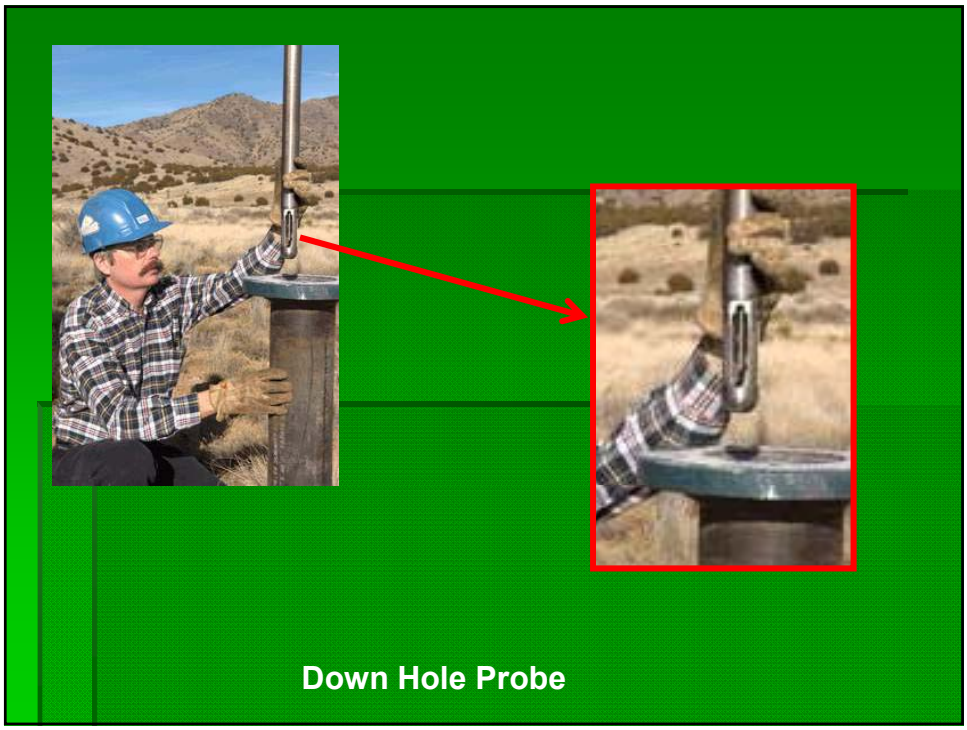

مقایسه

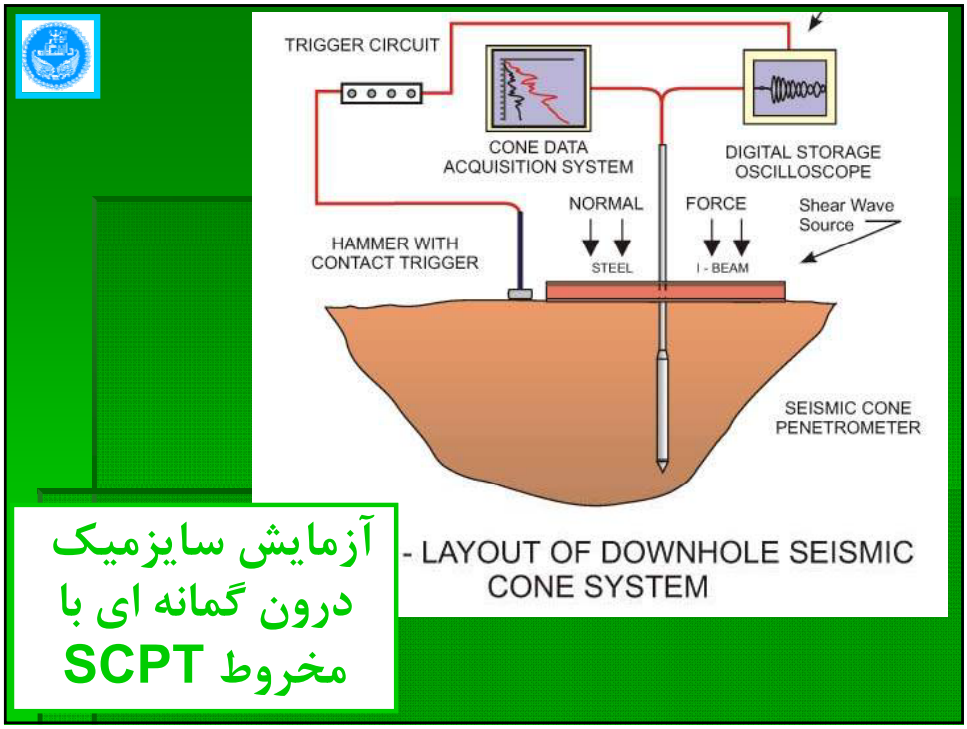
درس شناسایی های ژئوتکنیکی زمین
علی فاخر

Refraction seismic profiling
-depth to water table
-depth to Devonian

Reflection seismic profiling
-deep Pleistocene channels
-basal zone stratigraphy
-depth to Devonian
-Devonian stratigraphy


Oscilloscope
Downhole Testing
Pump
Horizontal Plank with normal load
X
Δt
Hammer
z1
z2
packer
Test Depth Interval
Horizontal Velocity Transducers (Geophone Receivers)
Shear Wave Velocity:
Vs = ΔR/Δt
R1² = z1² + x²
R2² = z2² + x²
Cased Borehole

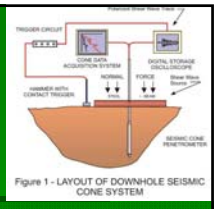

Down Hole Probe



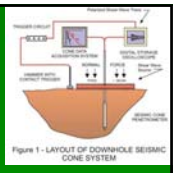
آزمایش سایزمیک درون گمانه ای با مخروط SCPT

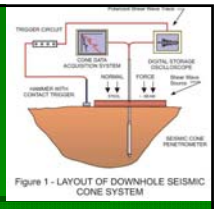
- LAYOUT OF DOWNHOLE SEISMIC CONE SYSTEM

آماده سازی چوب برشی قبل از آزمایش سایزمیک پیزوکن



چکش ، چوب برشی و مخروط مخصوص آزمایش لرزه ای

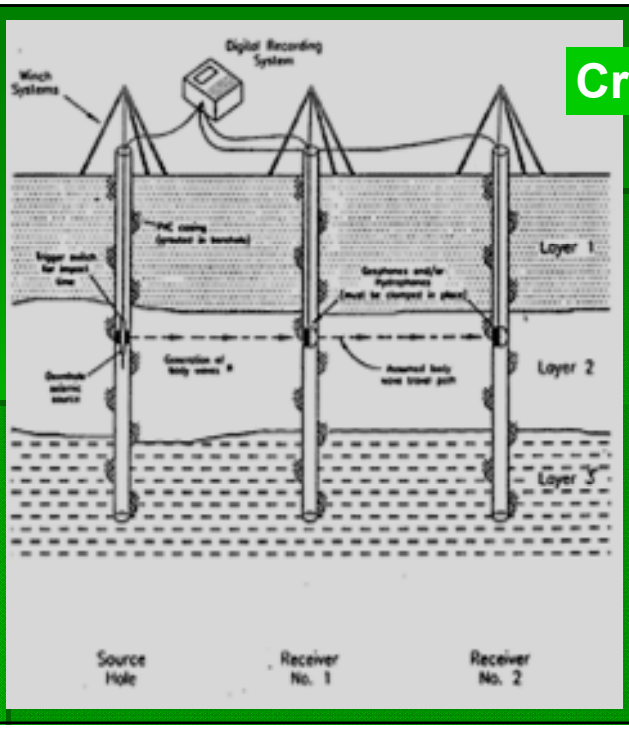




نحوه انجام آزمایش

نحوه انجام آزمایش سایزمیک درون گمانه ای با مخروط SCPT

Cross Hole



Cross Hole

Name of method	Procedure or principle utilized
Seismic methods 1. Refraction	Based on time required for seismic waves to travel from source of energy to points on ground surface, as measured by geophones spaced at intervals on a line at the surface. Refraction of seismic waves at the interface between different strata gives a pattern of arrival times at the geophones versus distance to the source of seismic waves. Seismic velocity can be obtained from a single geophone and recorder with the impact of a sledge hammer on a steel plate as a source of seismic waves.
2. High-resolution reflection	Geophones record travel time for the arrival of seismic waves reflected from the interface of adjoining strata.
3. Vibration	The travel time of transverse or shear waves generated by a mechanical vibrator consisting of a pair of eccentrically weighted disks is recorded by seismic detectors placed at specific distances from the vibrator.
4. Uphole, downhole, and crosshole surveys	(*a*) Uphole or downhole: Geophones on surface, energy source in borehole at various locations starting from hole bottom. Procedure can be revised with energy source on surface, detectors moved up or down the hole. (*b*) Downhole: Energy source at the surface (e.g., wooden plank struck by hammer), geophone probe in borehole. (*c*) Crosshole: Energy source in central hole, detectors in surrounding holes.

Name of method	Applicability and limitations
Seismic methods 1. Refraction	Utilized for preliminary site investigation to determine rippability, faulting, and depth to rock or other lower stratum substantially different in wave velocity than the overlying material. Generally limited to depths up to 30 m (100 ft) of a single stratum. Used only where wave velocity in successive layers becomes greater with depth.
2. High-resolution reflection	Suitable for determining depths to deep rock strata. Generally applies to depths of a few thousand feet. Without special signal enhancement techniques, reflected impulses are weak and easily obscured by the direct surface and shallow refraction impulses. Method is useful for locating groundwater.
3. Vibration	Velocity of wave travel and natural period of vibration gives some indication of soil type. Travel time plotted as a function of distance indicates depths or thickness of a surface strata. Useful in determining dynamic modulus of subgrade reaction and obtaining information on the natural period of vibration for the design of foundations of vibrating structures.
4. Uphole, down hole, and cross-hole surveys	Obtain dynamic soil properties at very small strains, rock mass quality, and cavity detection. Unreliable for irregular strata or soft strata with large gravel content. Also unreliable for velocities decreasing with depth. Crosshole measurements best suited for in situ modulus determinations.

درس شناسایی های ژئوتکنیکی زمین

علی فاخر

روش های الکتریکی

electrical

Electrical methods

1. Resistivity
2. Drop in potential
3. E-logs

روش های الکتریکی

electrical

Electrical Earth Resistivity

مقایسه روش های الکتریکی

Electrical methods 1. Resistivity	Based on the difference in electrical conductivity or resistivity of strata. Resistivity is correlated to material type.
2. Drop in potential	Based on the determination of the drop in electrical potential.
3. E-logs	Based on differences in resistivity and conductivity measured in borings as the probe is lowered or raised.

درس شناسایی های ژئوتکنیکی زمین
علی فاخر

روش های مغناطیسی

magnetic

درس شناسایی های ژئوتکنیکی زمین
علی فاخر

روش های مغناطیسی

magnetic

Highly sensitive proton magnetometer is used to measure the Earth's magnetic field at closely spaced stations along a traverse

درس شناسایی های ژئوتکنیکی زمین
علی فاخر

محدودیت روش های مغناطیسی

magnetic

Difficult to interpret in quantitative terms but indicates the outline of faults, bedrock, buried utilities, or metallic trash in fills.

درس شناسایی های ژئوتکنیکی زمین
علی فاخر

ثقل سنجی

Gravity measurement

درس شناسایی های ژئوتکنیکی زمین
علی فاخر

روش
ثقل سنجی
Gravity measurement

Based on differences in density of subsurface materials which affects the gravitational field at the various points being investigated.

معایب و مزایای روش
ثقل سنجی
Gravity measurement

Useful in tracing boundaries of steeply inclined subsurface irregularities such as faults, intrusions, or domes. Methods not suitable for shallow depth determination but useful in regional studies. Some application in locating limestone caverns.

Taking a gravity measurement on the Law Dome ice cap

Gravity measurement in HongKong


درس شناسایی های ژئوتکنیکی زمین
موفق باشید
علی فاخر