Date 4th Oct 2020

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Aim →

To determine in-situ P-waves velocity of rock of layer for various rock excavation application by Seismic reflection technique.

Materials required →

- Data - logger
- Geophone
- Hammer
- Blasting cables
- Geodes (3-channel)

Theory →

Seismic refraction technique →

It is a geophysical method to determine the subsurface velocity of structure through an analysis of the seismic waves that return to the ground surface after refraction at the boundaries of subsurface layers with different seismic activities.

Types of seismic sources →

- Dynamite for deeper exploration
- Weight drops accelerated by rubber bands or vacuum and mini-vibrator

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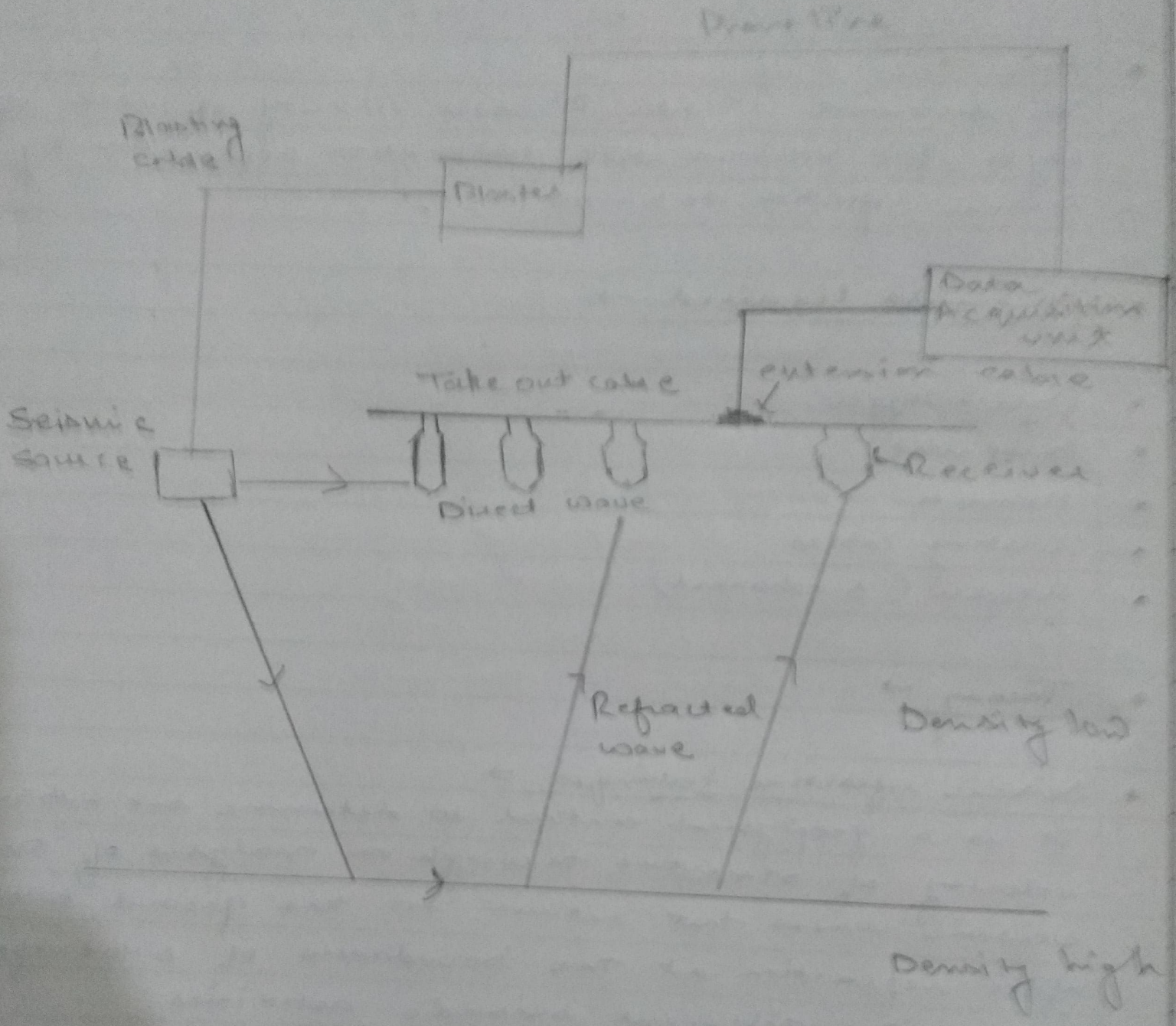

Schematic diagram of the seismic refraction meth

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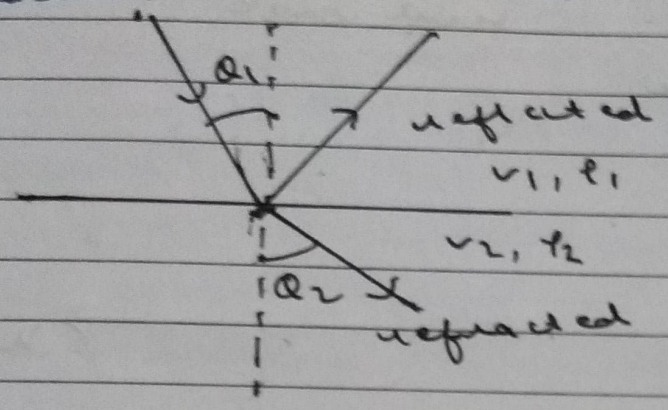
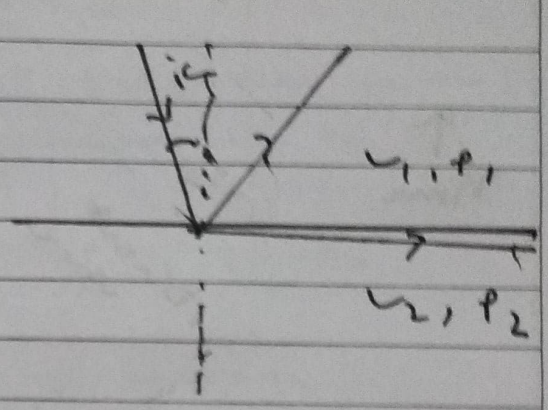
- Depth of Investigation is less than 20m, hammer and weight drop can be used
- Snell's law, critical angle ic and the condition for refraction.





$$\frac{\sin(\theta_1)}{v_1} = \frac{\sin(\theta_2)}{v_2} = \text{const} = p$$

p is called the 'ray parameter', as it characterizes the entire ray path.

- **Procedure →**

- Planning the survey
- Study of existing information
- Arrangement of the survey lines.
  - The survey line should be arranged perpendicular to the strike of the target geological structure and boundaries.
  - As a rule of thumb, the survey line is generally around 5–10 times of the depth of Investigation.

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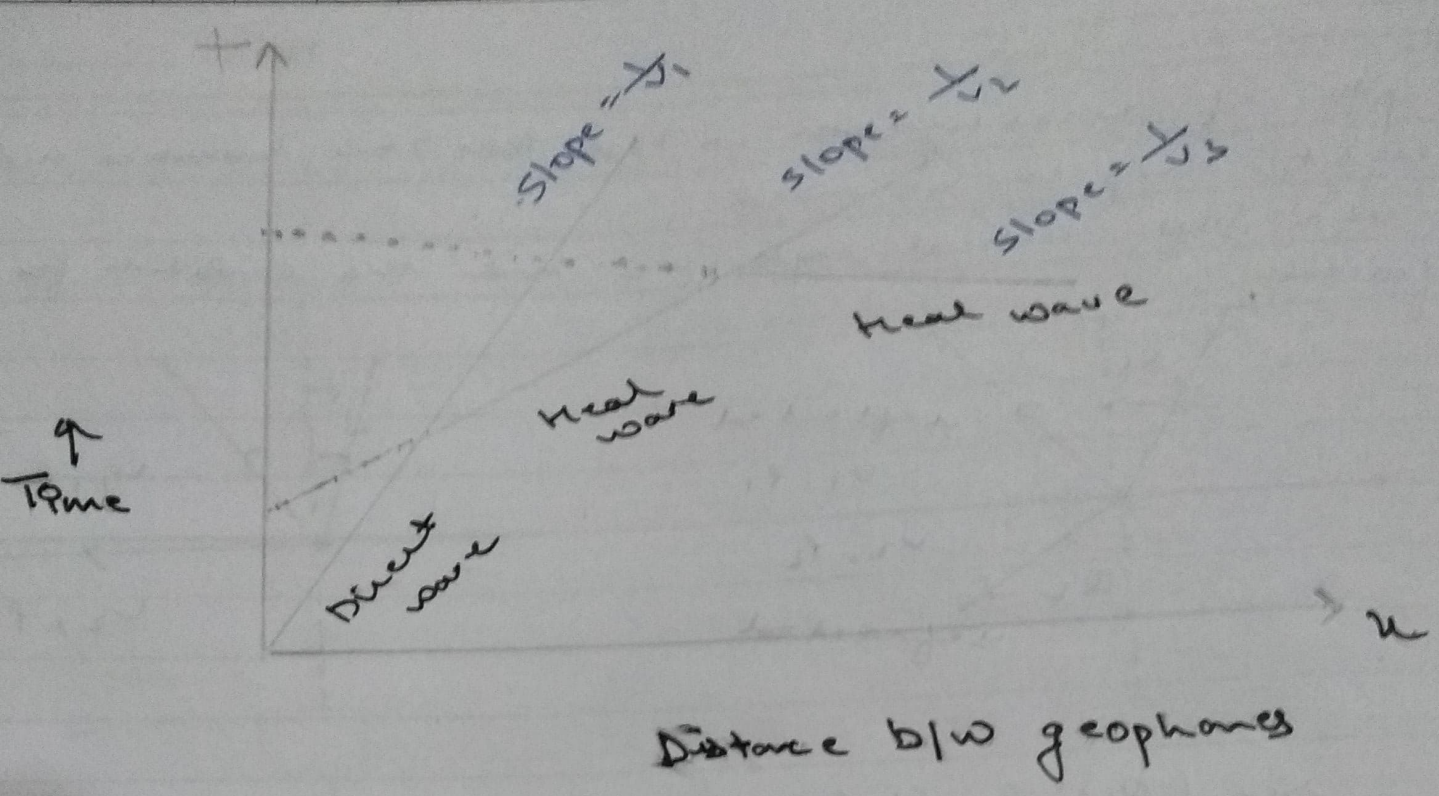
t
Slope = 1/V1
Slope = 1/V2
Slope = 1/V3
Head wave
Head wave
Direct wave
Time
x
Distance b/w geophones

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- Intervals of source and receiver point
  - 10 m geophone intervals are usually adequate but for shallower targets, the interval can be reduced to 5m or less
  - During the survey, the geophones will be arranged in spreads of typically 12 or 24 geophones
  - It is recommended source points should be at interval of 30-60 m.
  - Suitable seismic source is chosen

- **Applicability →**

- The seismic refraction method is applicable in situations where the P wave velocity increases with depth
- The method is widely used for site characterisation in road construction, dam construction and tunneling project.
- Provide us with information about
  - lithology
  - rock strength
  - crack density
  - degree of weathering
  - metamorphism
  - location of fault.

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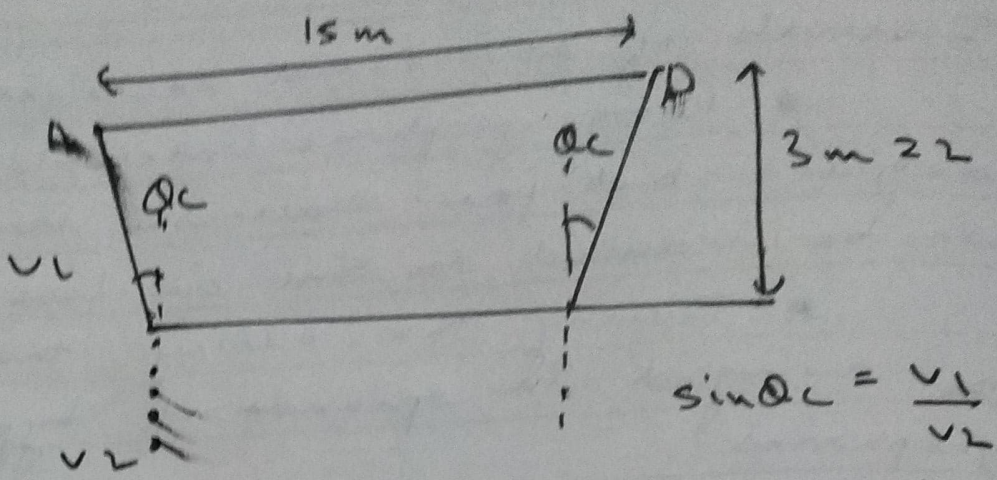

$$\sin\theta_c = \frac{v_1}{v_2}$$

$$= \frac{1}{\sqrt{2}}$$

• Problem →

Ans First arrival

Time taken by direct wave = $\frac{x}{v_1} = \frac{15m}{500 ms^{-1}}$

$t_{AB} = 0.030 sec$

Time taken by refracted wave = $t_{AB} + t_{BC} + t_{CD}$

$= \frac{2 sec\theta_c}{v_1} + \left(\frac{x - 2 tan\theta_c}{v_2}\right) + \frac{2 sec\theta_c}{v_1}$

$= 0.019 sec$

$t_{refracted} = 0.019 sec$

Since, $t_{refracted} < t_{direct}$, the refracted waves arrives first.

Arrival time = 0.019 second

Maximum distance

For direct waves reached first

$t_{direct} < t_{refracted}$

$\frac{x}{v_1} < \left(\frac{2 sec\theta_c}{v_1}\right) + \left(\frac{x - 2 tan\theta_c}{v_2}\right) + \left(\frac{2 sec\theta_c}{v_1}\right)$

$\Rightarrow \frac{x}{v_1} - \frac{x}{v_2} < 2x\left(\frac{sec\theta_c}{v_1} - \frac{tan\theta_c}{v_2}\right)$

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