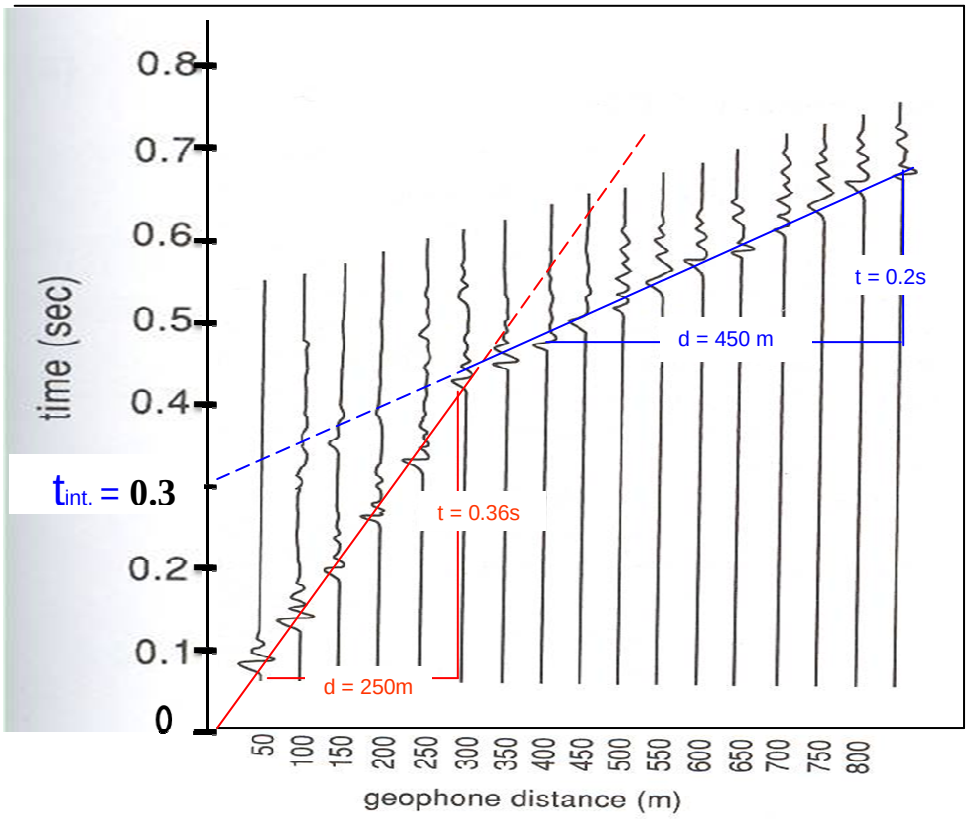
Memo for Practical 5
Seismic Survey

Schematic travel-time diagram of seismic refraction



a. Find the intercept time for the second geological layer. [1]
The time intercept for the forward ray is: $t_{int.}$ = 0.3 s

b. Find the number of geophones associated with the first layer. [1]
There are six geophones associated with the first layer.

c. How many geophones were used for the second layer? [1]
12 geophones were used during the survey for the second layer

d. By using the following travel-time curve, find the value of v_1 and v_2. [3]
To find the values of both v_1 and v_2, one must first calculate the slopes of both layer$_1$ and layer$_2$.

Slope$_1$ (m_1) of layer$_1$ = $(t_2 - t_1)/(d_2 - d_1)$
= (0.42 - 0.06)/(300 - 250)
= 0.36/250
= 0.00144
Thus $V_1 = 1/m_1$
= 1/0.00144
V_1 = 694.44 m.s^{-1}

Slope$_2$ (m_2) of layer$_2$ = $(t_2 - t_1)/(d_2 - d_1)$
= (0.68 – 0.58)/(850 – 400)
= 0.2/450
= 0.000444
Thus $V_2 = 1/m_2$
= 1/0.00044
V_2 = 2250 m.s^{-1}

e. Having determined the value of v_1 and v_2, use the formula given below to calculate the depth (h) to the second layer. [3]

$$t_{\text{int}} = 2h_1\sqrt{\frac{1}{v_1^2} - \frac{1}{v_2^2}}$$

$0.3 = 2h\sqrt{(1/(694.44)^2) - (1/(2250)^2}$

$0.3 = 2h\sqrt{(2.074*10^{-6}) - (1.97*10^{-7})}$

$0.3 = 2h\sqrt{1.88*10^{-6}}$

h = 0.3/.00274

h = 109.48 m

f. What are the physical meanings of *h, v_1* and *v_2*? [2]

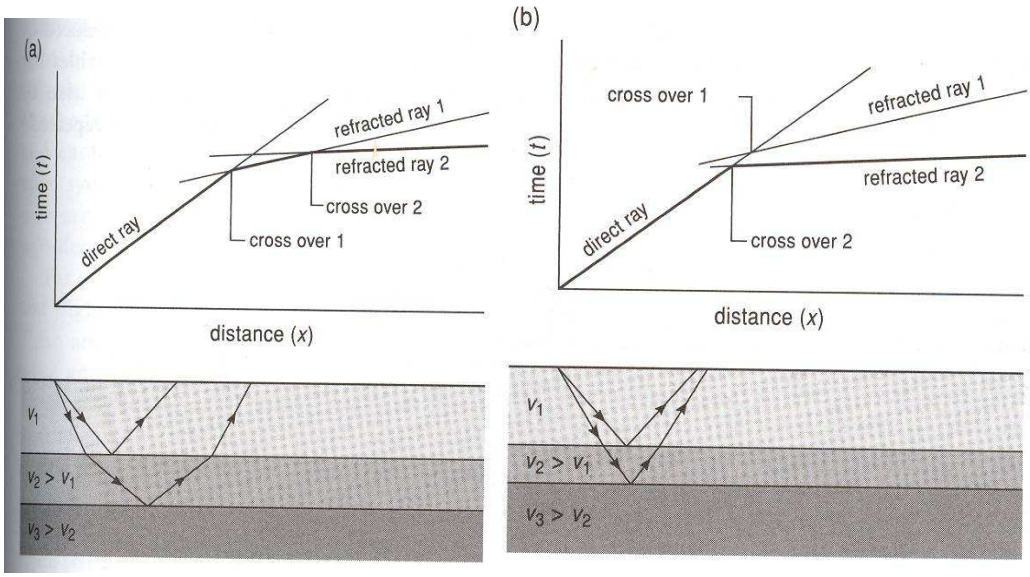
h = depth, v_1 and v_2 are velocities of the layer$_1$ and layer$_2$ respectively

g. "Hidden layer" concept. [4]

The seismic interface is not revealed by the t-x curves. There are two situations. Consider three layers.

i. *Layer$_2$ is revealed by short length of refracted ray$_1$. If layer$_2$ is thin enough, then the refracted head ray from layer$_3$ will arrive earlier pushing refracted ray$_2$ leftwards down, therefore no part of ray$_1$ will be the first arrival.*

ii. *Suppose the velocity of layer$_2$ decreased, that will displace crossover$_1$ to the right. If the velocity of layer$_3$ has increased, that will displace the crossover$_2$ to the left.*


(a)
time (t)
direct ray
refracted ray 1
refracted ray 2
cross over 2
cross over 1
distance (x)
v_1
$v_2 > v_1$
$v_3 > v_2$
(b)
time (t)
cross over 1
refracted ray 1
refracted ray 2
direct ray
cross over 2
distance (x)
v_1
$v_2 > v_1$
$v_3 > v_2$