

EPSc 353: EARTH FORCES  
**Refraction Seismology Experiment**

**Objective:** To explore the shallow subsurface using a small-scale seismic refraction experiment, and to familiarize students with simple seismic data acquisition and interpretation.

**Procedure:**

1. Lay out experiment with a long measuring tape extending in the direction of the geophone spread. Place the striker plate near the start of the measuring tape. Uncoil spread cable and extend along the tape, with take-outs spaced with the desired geophone interval. The strike plate will be at meter 0, the first geophone should be at 1.5 meters distance. Space the geophones at 1.5 meter spacing up through 18 meters distance, and then 4 meter spacing after that (total length should be 66 m). Connect the geophones to the take-outs by matching the wide clip to the wide gap in the take-out. Put the geophones firmly into the ground (step on them). Be sure the geophones go vertically into the ground and do not touch the measuring tape.
2. Be sure to record important data such as the position of the line (GPS location), the orientation of the line, and geophone spacing and shotpoint locations relative to the geophones.
3. Connect the spread cable, hammer switch, power supply, and laptop computer to the seismograph. Its operation will be demonstrated in the lab. After connecting all the geophones, we will check the noise monitor to make sure all the geophones are operating. At this point somebody should check to make sure all the geophone positions are correct.
4. One person wearing the ear protectors will strike the sledge hammer against the striker plate. The waveforms from each geophone will be displayed on the laptop screen. If the signals are not clean (for example, if the hammer strike was not good or if a gust of wind causes a lot of noise on the record) the signal can be erased. Noise will be minimized by "stacking", or adding the signals of several hammer blows, which generally causes random noise to cancel out but enhances the true signal. If the record is good it will be added into memory. After enough good hammer blows are added, the data is complete, and will be stored in the computer.
5. Now repeat the procedure for the reverse profile. Repeat steps 3-5 from the other end of the geophone line (27 m point), and from 51 meter point.
6. Now pick up the spread cable and move it so that the first geophone is at 26 meters. Repeat steps 3-5 from the 66 meter point and the 0 meter point. Refer to the geophone position diagram again. You will be given plots of all the data produced, and the data will be on some of the computers in the lab if you want to do more detailed picks.

**Data Analysis:**

1) Produce a model for the shallow structure of the study area based on the data you have obtained. You should be able to distinguish and determine the seismic velocity of 3 layers. Since the layers are nearly horizontal you can use the equations for horizontal layers.

2) Estimate the maximum possible dip of the first interface by trying to make the downdip and updip velocities as different as you can:

$$\Theta = 0.5(\sin^{-1}(V_1/V_{2d}) - \sin^{-1}(V_1/V_{2u}))$$

3) What material do you think makes up the three layers?

**Hand in:**

1) Copies of seismic records with the direct and refracted arrivals marked, as well as the air wave and surface waves.

2) Complete analysis procedure, including graphs.