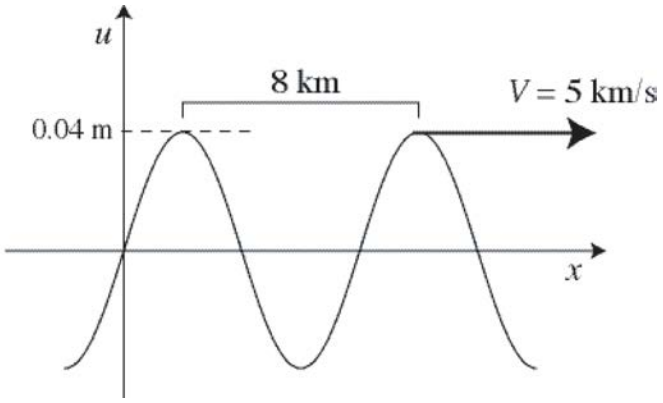
Introduction to seismology **Strain**

1. Assume two monochromatic plane waves propagating in x-direction: a) P.wave $u_x=A_x\sin(kx-wt)$ and b) S-wave $u_y=A_y\sin(kx-wt)$. Calculate in both cases the elements of strain tensors. Assume that it is possible to observe the vertical component of the curl. The rotation rate around a vertical component is given as the time derivative of the curl applied to the displacement field. How is the rotation rate related to the transverse acceleration (S-wave)? Would the P-wave contribute to the curl?

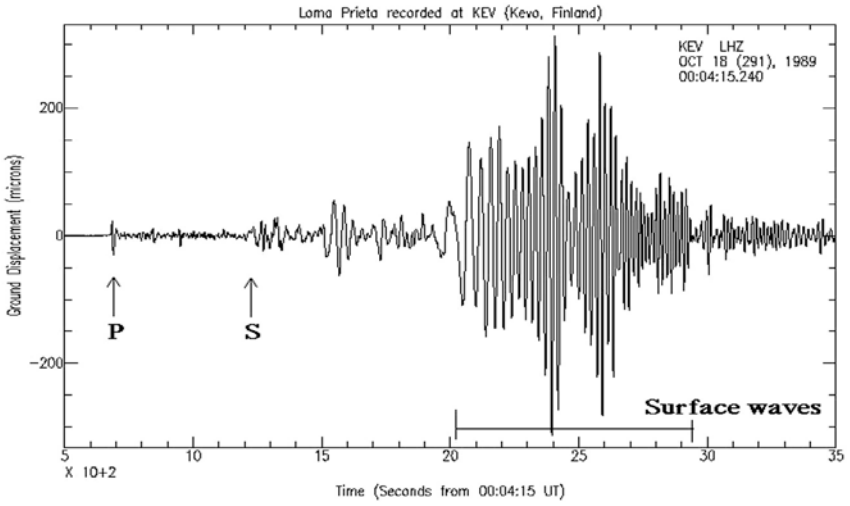
2. For the following harmonic plane wave at t = 0, traveling in the x direction at 5 km/s:



   Write down an equation for this wave that describes displacement, u, as a function of x and t. What is the maximum strain for this wave?

3. The 2003 Hokkaido earthquake (M8.1) lead to a maximum horizontal displacement of 1.5cm for Love waves of approximately 25 seconds period. Estimate the maximum dynamic strain induced by the passing wavefield for a horizontal phase velocity of 5km/s.

4. The figure below shows a vertical-component seismogram of the 1989 Loma Prieta earthquake recorded in Finland. Make an estimate of the maximum strain recorded at this site. Hints: 1 micron = 10^{-6} m, note that the time axis is in 100s of seconds, assume the Rayleigh surface wave phase velocity at the dominant period is 3.9 km/s, remember that strain is du_z/dx, Table 3.1 may be helpful.



5. The observed strain due to gravitational waves is on the order of 10^{-21}. The mean Earth-.Moon distance is 384000km. What is the corresponding change of length for such strains?