Geotechnical Earthquake Engineering

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Lecture # 10 (11/02/2013)

Example Problem :-

A seismograph which is located 1100 km away from an earthquake epincenter, records a maximum ground displacement of 14.7 mm for surface waves having a period of about 20 sec. Based on Gutenberg and Richter (1956) equation, calculate the surface wave magnitude of the earthquake. During this earthquake, the depth of the fault rupture is estimated as 12 km and the length of the surface faulting is determined as 750 km. Using the equation of Idriss (1985) for seismic moment and the equation of Hanks and Kanamori (1979) for moment magnitude, obtain the average slip along the fault. Use the correlation curve for magnitudes given by Heaton et al. (1982).

$$M_s = \log_{10} A + 1.66 \log_{10} \Delta + 2.0$$

A = max^{m} ground displ. (μm)

$A = 14.7$ mm $= 14.7 \times 10^3\ \mu$m

Δ = epicentral distance of seismograph (in deg.)

($360^\circ \equiv 40076$ km)

$$\Delta = \frac{1100}{40076} \times 360^\circ = 9.88^\circ$$

$$M_s = \log_{10}(14.7 \times 10^3) + 1.66 \log_{10}(9.88) + 2.0$$

$= 7.82$ Ans -- (a) < 8.3

For $M_s = 7.82$

$\Rightarrow M_w \simeq 8.0$

$M_w = -6.0 + 0.67 \log_{10} M_o$

or, $8.0 = -6.0 + 0.67 \log_{10} M_o$

$\Rightarrow M_o = 7.862 \times 10^{20}$ N.m

$M_o = \mu A D$ (N.m)

$\mu = 3 \times 10^{10}$ N/m^2 (shallow earthquake)

$A = (12 \times 1000) \times (750 \times 1000)$ m^2

$\therefore D = 2.912$ m Ans - - (b)