

**SEISMIC EARTH PRESSURES :** (Applies to Retaining Walls over 12ft)

Static Lateral Earth pressure:

$$P_a = \boxed{\frac{1}{2} K_a \gamma H^2} \quad (1)$$

where  $K_a = \tan^2(45 - \frac{\phi}{2})$

$H$  = Wall Height

$\gamma$  = Soil unit weight

$P_a$  = Static pressure

Seismic Lateral Earth pressure:

$$\Delta P_{ae} = \boxed{\frac{1}{2} \gamma H^2 * \frac{3}{4} K_h} \quad (2)$$

where  $K_h$  = Horiz. ground acceleration (in  $g$ )

Combined (Static + Seismic) earth pressure:

$$P_{ae} = \frac{1}{2} K_a \gamma H^2 + \Delta P_{ae}$$

$$= \frac{1}{2} K_a \gamma H^2 + \frac{1}{2} \gamma H^2 * \frac{3}{4} K_h$$

$$= \boxed{\frac{1}{2} \gamma H^2 \left( K_a + \frac{3}{4} K_h \right)} \quad (3)$$

### Example of Seismic earth Pressures on Retaining Walls:

The following calculation is for an active condition, and the retaining wall height is taken as H.

The image shows handwritten calculations on lined paper. At the top right, under the heading "Given", the following values are listed:  $K_h = 0.1g$ ,  $K_v = 0$ ,  $\phi = 30^\circ$ ,  $\gamma = 115 \text{ pcf}$ , and  $K_a = \tan^2(45 - \frac{\phi}{2}) = 0.33$ . On the left, a box labeled "Example" contains three numbered calculations. Calculation (1) finds the static earth pressure  $P_a = \frac{1}{2} K_a \gamma H^2 = \frac{1}{2} (0.33) 115 H^2 = 19.2 H^2$ , labeled "Static earth pressure". Calculation (2) finds the seismic component  $\Delta P_{ae} = \frac{1}{2} \gamma H^2 * \frac{3}{4} K_h = 0.5 (115) H^2 * 0.75 (0.1g) = 4.3 H^2$ , labeled "Seismic earth pressure". Calculation (3) finds the combined pressure  $P_{ae} = \frac{1}{2} \gamma H^2 (K_a + \frac{3}{4} K_h) = 0.5 (115) H^2 * (0.33 + 0.75 (0.1g)) = 23.3 H^2$ , labeled "Combined (Static + Seismic) earth pressure".

**Given**

$$K_h = 0.1g \quad K_v = 0$$
$$\phi = 30^\circ, \quad \gamma = 115 \text{ pcf}$$
$$K_a = \tan^2(45 - \frac{\phi}{2}) = 0.33$$

**Example**

(1)  $P_a = \frac{1}{2} K_a \gamma H^2$   
 $= \frac{1}{2} (0.33) 115 H^2$   
 $P_a = 19.2 H^2 \rightarrow \text{Static earth pressure}$

(2)  $\Delta P_{ae} = \frac{1}{2} \gamma H^2 * \frac{3}{4} K_h$   
 $= 0.5 (115) H^2 * 0.75 (0.1g)$   
 $= 4.3 H^2 \rightarrow \text{Seismic earth pressure}$

(3)  $P_{ae} = \frac{1}{2} \gamma H^2 (K_a + \frac{3}{4} K_h)$   
 $= 0.5 (115) H^2 * (0.33 + 0.75 (0.1g))$   
 $= 23.3 H^2 \rightarrow \text{Combined (Static + Seismic) earth pressure}$

If you have a basement wall (at rest condition) multiply the above values by 1.33

So, for instance, the seismic component of earth pressure, (2) above would be  $1.33 * 4.3 H = 5.7 H$