3.5.1 Rigid Wall

The pressure distributions on a smooth perfectly rigid wall from horizontal inertia loads in the soil were shown in Figure 2.2. An approximate linear pressure distribution suitable for design purposes is given in Figure 3.3 (Matthewson et al, 1980). The increment of earthquake force is given approximately by:

$$\Delta P_E = C(0)\gamma H^2 \qquad (3\text{-}1)$$

The point of application of the earthquake force increment is at approximately 0.6 H above the base.

The earthquake induced pressures and forces are dependent on the soil Poisson's ratio but are not very sensitive over the normal range of values for typical soils (see Figure 2.3). The pressures are also insensitive to the wall roughness. For design purposes, the earthquake pressure distribution and force on a rigid wall can be assumed to be independent of the backface condition and soil elastic constants. The pressure distribution given in Figure 3.3 may therefore be used for soils with both cohesion and frictional properties.

For the case of a rigid wall with sloping backfill, the earthquake forces may be obtained from the finite element solutions for an elastic soil shown in Figure 3.6. For comparison, the MO solution for a soil with a friction angle, $\phi = 35°$ is also plotted. The increase in force produced by the sloping backfill is of comparable magnitude for both the rigid wall and MO assumptions. The ratio of the force increase between horizontal and sloping backfills can therefore be used for all walls, including walls intermediate between rigid and those sufficiently flexible to meet the MO assumptions.

In the rigid wall analysis, the height of the centre of pressure was found to increase by about 10% for the backfill slope increasing from horizontal to 20°. For design purposes, the shape of the pressure distribution for sloping backfills may be assumed to be the same as for the horizontal case.

For backfill slopes greater than 25° more detailed analyses should be undertaken. Slope stability may also be critical on steep backfills.

3.5.2 Stiff Wall

A stiff wall is defined here as a wall that moves outward at the top between 0 to 0.2% of the height, H, under combined gravity and earthquake pressures. An approximation for the increment of earthquake pressure on a wall that displaces 0.2% at the top is shown in Figure 3.4. The increment of earthquake force for 0.2% top displacement may be taken as:

$$\Delta P_E = 0.75\ C(0)\gamma H^2 \qquad (3\text{-}2)$$

The point of application of the earthquake force may be taken as 0.5 H from the base.

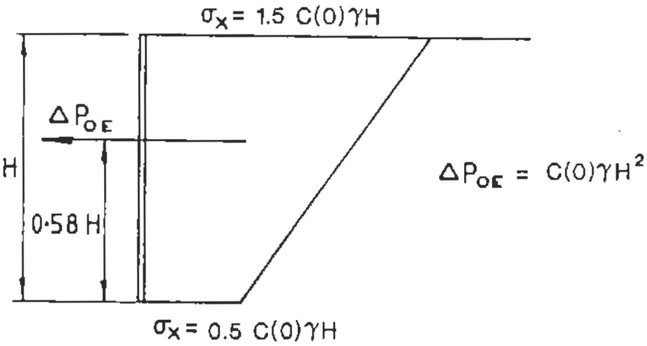

FIG. 3.3 EQ PRESSURE INCREMENT ON RIGID WALL

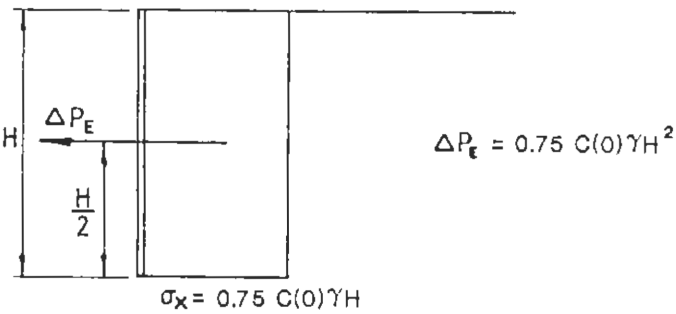

FIG. 3.4 EQ PRESSURE INCREMENT ON STIFF WALL

Pressures and forces on walls that displace less than 0.2% at the top may be obtained by linear interpolation between the stiff and rigid wall pressures and forces.

The earthquake pressures on a stiff wall are more sensitive to the soil properties than for the rigid wall case. If soil stiffness properties are known, then a more detailed analysis can be carried out by evaluating the force ratio parameter P_r and using Figures 2.12, 2.13, 2.15 and 2.17 to obtain pressure distributions and earthquake forces.

The effect of sloping backfill can be obtained by increasing the earthquake component of wall force by the ratio between the horizontal and sloping backfill forces for the rigid wall solution given in Figure 3.6.

3.5.3 Flexible Wall

Where the outward movement of the top of the wall under gravity and earthquake pressures exceeds 0.5% of H, an active pressure state may be assumed and the pressures obtained from the Coulomb sliding wedge theory or the MO equations.

The MO equations cover both passive and active stress states and include effects from both vertical and horizontal earthquake accelerations. Vertical accelerations produce relatively small increases in the horizontal pressures and may be neglected for design purposes.