Study on Seismic Behaviour of Gravity Retaining Wall

Kuldeep sharma[1] Dr. S.M.Ali Jawaid[2]
[1]Research Scholar [2]Professor
[1,2]Department of Civil Engineering
[1,2]Madan Mohan Malviya University of Technology Gorakhpur, India

Abstract— In this paper discuss the calculating factor of safety. The strategy of gravity retaining walls in an earthquake-prone environment is generally constructed upon still analysis using an equal seismic coefficient. This can be a suitable approach, provided that the seismic coefficient is strong-minded from a rational analysis of real dynamic behavior. The report discusses the seismic strategy of gravity walls retaining rough backfill with no hole water. The general features of behavior are exemplified by field skills, outcomes from workroom model tests and from theoretical analyses. Both the conventional technique of design and the Richards-Elms (1969) method, based upon a similarity to a sliding block, are reread. An inadequacy of the sliding block similarity is discoursed, and corrections obtained using a two-block model are presented. Numerous birthplaces of uncertainty are examined in feature. The random nature of ground motions, uncertainty in resistance factors, and prototypical mistakes, including the important effect of deformability in the backfill. All of these results are then joint to improvement a probabilistic course of action for estimate seismically induced displacements of ramparts and an improved version of the Richards-Elms procedure of design. The risk that walls planned by the conventional method might experience unnecessary displacements is analyzed. Creator supplied keywords include: Retaining walls--design and assembly (LC); Richards Elms retaining wall design method (WES).

Key words: F.O.S. (Factor of safety), Richards Elms Method, retaining Wall

I. Introduction

In the seismic zones, the retaining walls are exposed to lively earth pressure, the magnitude of which is more than the stationary earth pressure due to ground motion. Since a dynamic load is repetitive in nature, there is anessential to determine the movement of the wall due to earthquakes and their damage potential. The design of gravity type retaining walls for trembling induced loads is normally skillful by using the Richards and Elms (1979) limited movement design technique. Gravity type retaining walls are those that stem their solidity from their weight and these can comprise automatically stabilized earth structures. Whitman and Liao (1985) projectedanalteration to the Richards and Elms method to account for the uncertainty in the determination of soil properties, doubt in the modeling assumptions, and uncertainty in the nature of the predictable ground motions. Both of these design methods are assessed herein using data from current earthquakes (Loma Pietà, Northridge, Kobe) and the consequences and their implications upon current design practice are discussed. Retaining walls are designed to withstand stresses produced by lateral earth pressure. The magnitude of this pressure is a purpose of the soil properties, the wall and the concentration of static and dynamic loads.

The inclination of a wall plays a main role in the reduction or development in lateral earth pressure. Arise in the inclination angle from the perpendicular state declines lateral earth pressure. Theories to calculate static and seismic Pressures on retaining walls are typicallyindividual for vertical conditions; applied pressure on inclined retaining walls has rarely been a matter of concern.

II. Literature review

Newmark (1965) proposed a basic procedure for evaluating the potential deformation that would be experienced by an embankment dam surprised by an earthquake by seeing the sliding block-on-a-plane mode as shown in fig. (1a)in this important development, it was envisaged that slope failure would be initiated and movements would be to occur if the inertial forces on the potential sliding mass were reversed. Thus by computing, an acceleration at which the inertial forces become sufficiently high to cause yielding to begin, and integrating the effective acceleration on the sliding mass in excess of this yielding acceleration as a function of time fig.(1c), velocities and ultimately the displacements of the sliding mass could be assessed.

This analysis is based essentially upon the rigid plastic behavior of materials fig. (1b) though this method was developed for a sliding analysis of an earth dam, it has been used by Richard and Elms (1979) to compute the displacements of retaining walls. They have proposed a method for design of gravity retaining wall based on limiting displacement considering the wall inertia effect. The procedure developed by them is described below.

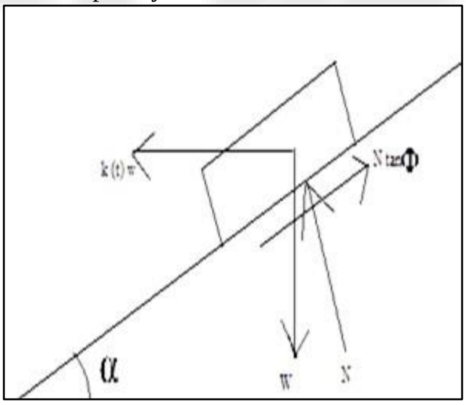

Fig. 1(a): Forces on sliding block

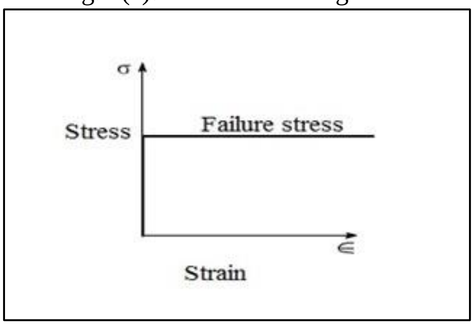

Fig. 1(b): rigid plastics stress strain behaviour of a material

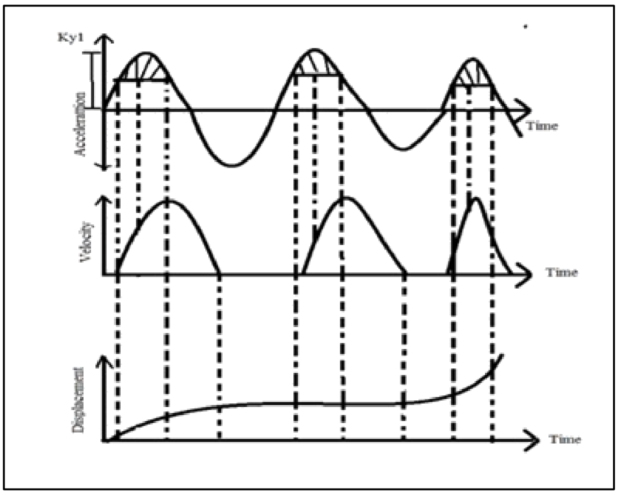

Fig. 1(c): Integration of effective acceleration time history to determine velocities and displacement

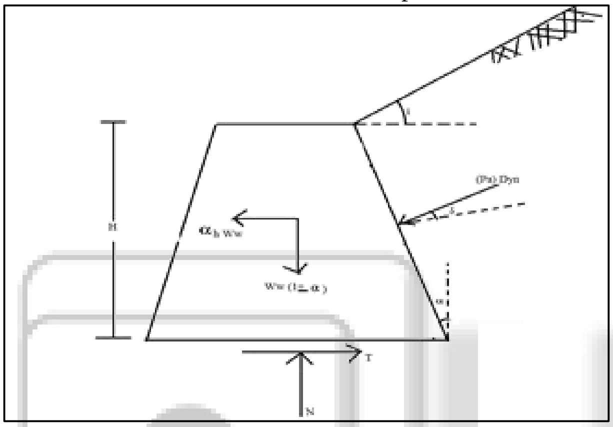

Fig. 1(d): Forces on a gravity wall

III. ESSENTIAL STEPS OF ANALYSIS

A gravity retaining wall is shown in fig. (1d), along with the forces acting on it during his fig an earthquake. In this fig. various terms used are:

W_w= Weight of the retaining wall

α_h , α_v = Horizontal and vertical seismic coefficient

$(P_A)_{dyn}$= Dynamic active earth pressure,

α = Inclination of wall face with vertical

δ = Angle of wall friction

φ_b = Soil-wall friction angle at the base of the wall

N = Vertical component of the reaction at the base of the wall

T = Horizontal constituent of the reaction at the base of the wall

Summing the forces in the vertical and horizontal directions, we get

$$N = W_w \pm \alpha_v W_w + (P_A)_{dyn} \sin(\alpha + \delta) \quad (1)$$

$$T = \alpha_h W_w + (P_A)_{dyn} \cos(\alpha + \delta) \quad (2)$$

$$T = N \tan \emptyset_b \quad (3)$$

Solving eqs. (1), (2) and (3), we get

$$W_w = \frac{(P_A)_{dyn} \cos(\alpha+\delta) - \sin(\alpha+\delta).\tan \emptyset_b}{(1\pm\alpha_v) \tan \emptyset_b - \alpha_h} \quad (4)$$

Pitting $(P_A)_{dyn} = \frac{1}{2} \gamma H^2 (K_A)_{dyn}$ *and* $\alpha_h = (1 \pm \alpha_v) \tan \varphi$, the eq. (4) can be written as

$$W_w = \frac{1}{2}\gamma H^2 (K_A)_{dyn} . C_{IE} \quad (5)$$

Where

$$C_{IE} = \frac{\cos(\alpha+\delta) - \sin(\alpha+\delta).\tan \emptyset_b}{(1\pm\alpha_v)\,(\tan \emptyset_b - \tan \varphi)} \quad (6)$$

For static condition, the weight of wall W is given by:

$$W_w = \frac{1}{2}\gamma H^2 K_A . C_I \quad (7)$$

Where

$$C_I = \frac{\cos(\alpha+\delta) - \sin(\alpha+\delta).\tan \emptyset_b}{\tan \emptyset_b} \quad (8)$$

Therefore

$$\frac{W_w}{W} = \frac{(K_A)_{dyn}}{K_A} . \frac{\tan \emptyset_b}{(1\pm\alpha_v)\,(\tan \emptyset_b - \tan \varphi)} \quad (9)$$

F_T = Ratio of earth pressure coefficients in dynamic and static cases

$$F_T = \frac{(K_A)_{dyn}}{K_A} \quad (10)$$

$$F_I = \text{Wall inertia factor} = \frac{\tan \emptyset_b}{(1\pm\alpha_v)\,(\tan \emptyset_b - \tan \varphi)} \quad (11)$$

In Eq. (9)

$$\frac{W_w}{W} = F_T F_I = F_w \quad (12)$$

F_T = ratio of earth pressure coefficients in dynamic and statics cases

F_w= Factor of safety

F_I = Wall inertia element

F_w is factor of safety applied to the weight of the wall to take into account the effect of soil pressure and wall inertia.

IV. CONCLUSION AND DISCUSSION

In this paper are calculate factor of safety by using the Richards and Elms (1969). By the fig. shows a plot of FT, FI, and Fw for various values of α_h. From this figure for FT = 1.0 and Fw=1.5, the value α_h works out to be 0.18. However, if the measured inertial factor of wall, the critical horizontal acceleration corresponding to Fw=1.5 is equal to 0.105.Therefore, if a wall is designed such that W_w=1.5 W , the wall will start to move laterally at a value ofα_h=0.105. Hence for no lateral drive, the mass of the wall has to be increased by a considerable amount over the static disorder, which may prove to be inefficient. Keeping this in view, the actual design is carried for some lateral displacement of wall. Richards - Elms (1969) have given a dign process dazed on a limited permissible wall movement, rather than on the assumption that the wall not move at all,

- Decide upon the acceptable maximum displacement, d
- Determine the design value of $\alpha_{hd} = \alpha_h \left(\frac{5\alpha_h}{d}\right)^{\frac{1}{4}}$

Where

α_h=Acceleration coefficient from earthquake

d_{max} = Maximum displacement in mm

Using α_{hd}, determine the required wall weight, W_w by substituting it in eq.(4). The value of α_{vd} may be taken as $\frac{\alpha_{hd}}{2}$.

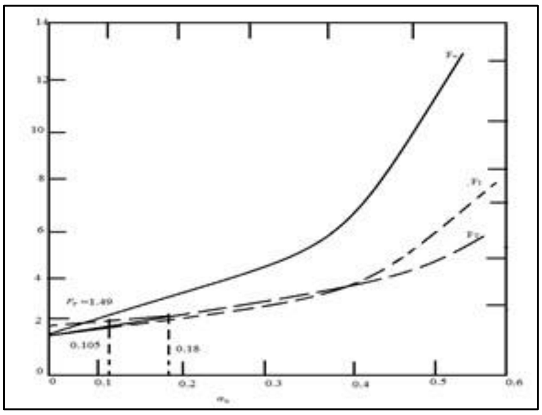

Fig. 2: variation of FT, FI, and Fwwith α_h (Richards and elms,1979)

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