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Stability Analysis of Concrete Seawalls against Earthquake Forces

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Abstract

Seawalls are commonly constructed to prevent landward erosion of shorelines and maintain configuration of the area behind them against wave action. Recently, rising of sea level particularly in the northern coastline of country, has caused special attention to design and construction of seawalls in that region. One of the important factors in design of seawalls and stability control of such structures is their safety factor (S.F.) against overturning. Present study considers all effective parameters on stability of seawalls; appropriate equations are presented for calculation of the safety factor against overturning. The equations are presented in such a way that designers can easily use them. Furthermore, different design curves are also obtained by sensitivity analysis of seawall stability. Using the presented equations can be a great help for optimum design of seawalls against different loads combination, particularly for earthquake forces. The results of present study clearly indicate that the optimum dimensions for a typical rectangular or trapezoidal concrete seawall, as far as the stability of such structure is concerned, highly depends on the slenderness of the wall (ratio of the wall height to wall width). Increasing this value from a critical range of 1.5 to 2 results in drastic drop of the safety factor against overturning. Also the presence of earthquake forces enhances this reduction leading to a narrow-bound confidence interval for the safety of concrete seawalls.

1-Introduction

Since Iran is almost bounded by water (in the North by Caspian Sea and South by Persian Gulf), major ports are the basic necessities for these areas. These necessities arise from several concerns. One of these concerns is the wave run up and water level changes, especially in northern shores, which calls for accurate studies of different beach protection methods.

One of the modes of seawalls failure is their overturning, due to applying different loads. Therefore, determination of Safety Factor (S.F.) of design is important. Main forces applying to seawalls include: wave's force, earthquake force, hydrostatic force, hydrodynamic force, soil pressure and vertical forces (inertia and uplift).

At first, important forces and their equations are presented. Safety Factor is calculated by defining rational and dimensionless parameters. The presented equations are absolutely useful for all design purposes, which can be a great time savers and lead to optimum designs.

2-Governing Equations

The proposed cross section of a gravity seawall is shown in figure 1.The seawall is subjected to an earthquake motion having peak ground acceleration of 0.3g for 50% probability of accidence.