Stability Analysis of Gravity Quay walls – Case Study, Teben Port

Samira Karimnader[1], Mir-Ahmad Lashte Neshaei[2], Mehran Karimpour-Fard[3]

1- Graduate Student, University of Guilan, samirakarimnader@yahoo.com
2- Associate Professor, University of Guilan, maln@guilan.ac.ir)
3- Assistant Professor, University of Guilan, mehran.karimpour@guilan.ac.ir

Abstract

Gravity quay walls are a common type of structures in construction of small ports. However these types of quay wall are relatively cost effective and easy to perform, but because of their considerable weight, there are some problems due to the stability of their foundation. In the region with high seismic activity, the problems due to stability of these types of quay wall will be pronounced, mainly because of enhancement in the soil lateral pressure behind walls as well as the effect of hydrodynamic forces. In this paper at first the design concepts of this type of quay walls will be reviewed and after that the constructed gravity quay wall in Teben Port in southern Iran will be introduced and discussed.

Keywords: Quay wall, Gravity, stability, lateral Pressure.

1. Introduction

Gravity quay walls are one of the most common port and harbor structures because of their applications (e.g., ship-loading, supporting facilities on their backfill, optimizing access to land, and navigable waters), durability, ease of construction, and the possibility of deep construction and reaching deep seabed elevations. However, because of the considerable weight of wall's sections, some issues existed regarding the stability of their foundations. During previous earthquakes, gravity quay walls have suffered significant damage as a result of their seaward movement and this has led to subsequent damage to the structures built on their backfill (International Navigation Association 2001).

According to Fig. 1, compared to a vertical-back wall, a landward-leaning wall has a smaller failure wedge and therefore a smaller lateral thrust to retain. Similarly, a larger failure wedge and lateral thrust develop behind a seaward (for quay walls) leaning wall. However, in comparison to the more common vertical-back walls, a large landward-leaning gravity wall would be considerably more expensive as it would require significant amounts of materials (e.g., concrete and steel reinforcement) to construct, may have soil bearing capacity problems attributable to its heavier weight, and because of its larger mass, greater inertial forces are applied on it during earthquakes.

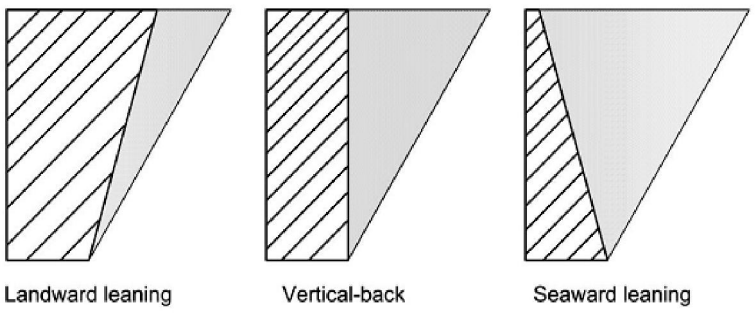

Figure 1. Types of wall rear-face shapes (hatched: wall; stippled: backfill soil failure wedge)

A remedy to these limitations, while taking advantage of the reduced lateral earth pressure on the landward-leaning rear face of the wall, is a broken-back wall (Figure 2). In a broken-back wall, increasing lateral earth pressures at deeper elevations of the wall are reduced by the landward-leaning rear face of the wall while the cost, weight, and mass of the wall are reduced by using a seaward leaning rear face at shallower elevations where lateral earth pressures are smaller (Sadrekarimi 2011).