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EFFECT OF APPLIED SURCHARGE LENGTH ON SEISMIC BEHAVIOR OF BROKEN-BACK WALL

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Quay walls as the retaining structures of harbours are commonly subjected to large overburden loads. Changing the magnitude and length of these loads can affect wall movement mode including its horizontal and vertical displacements. In this study, the seismic behaviour of block-type quay walls rested on dense foundations are numerically investigated in four different conditions (*Cases* 1-4). As it is demonstrated in Figure 1, the surcharge load is applied on both the wall and the backfill in *Case* 1. Afterwards, the surcharge load is just applied on the backfill in *Case* 2. The surcharge loads are started from the hunched point and outside the failure surface in *Cases* 3 and 4, respectively. To this end, a numerical model is developed and validated against the experimental observations (Sadrekarimi et al., 2008).

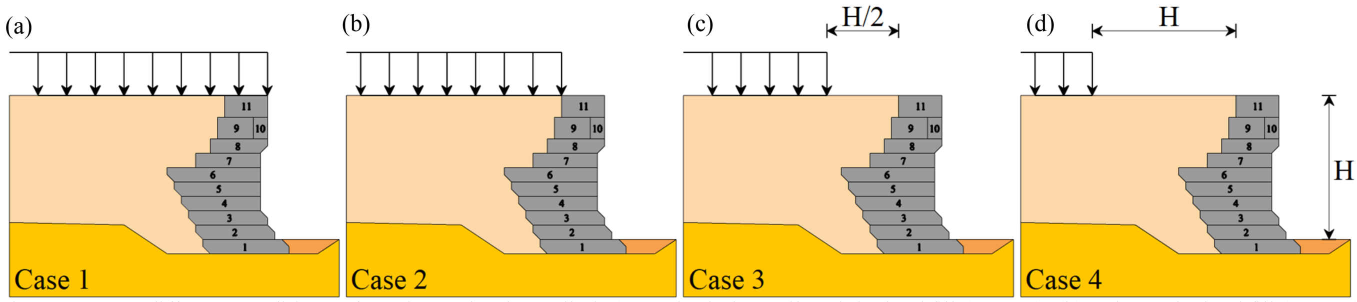


Figure 1. Four different conditions of surcharge loads applied: (a) on both the wall and the backfill (Case 1), (b) only on the backfill (Case 2), (c) in an area started from the hunched point (Case 3), and (d) in an area started from the outside of failure surface (Case 4).

Numerical modelling is performed based on explicit finite difference method incorporating hysteretic Mohr-Coulomb constitutive model to explain the stress-strain response of soil and the Rayleigh damping to increase the level of hysteretic damping in the model (Itasca, 2016). The geometry of model is illustrated in Figure 2. Concrete blocks are modelled by linear elastic material. Interactions between the blocks and also between the blocks and soil are simulated by special interface elements allowing for slipping and gapping through the Coulomb frictional law. The finite difference mesh size is selected small enough to allow the seismic wave propagation throughout the numerical model. The sea water is modelled through the hydrostatic pressures applied to the front side of the wall. In dynamic analyses, the free-field condition is applied to the lateral boundaries eliminating the wave reflection into the model (Ebrahimian, 2013). The bottom boundary of numerical model is assumed to be rigid and acceleration time histories are applied to the base of numerical models. According to Figure 3, overall agreement is obtained between the predicted and measured accelerations and displacements. Additionally, the acceleration magnitudes at top of the wall increase in comparison with those of wall toe.

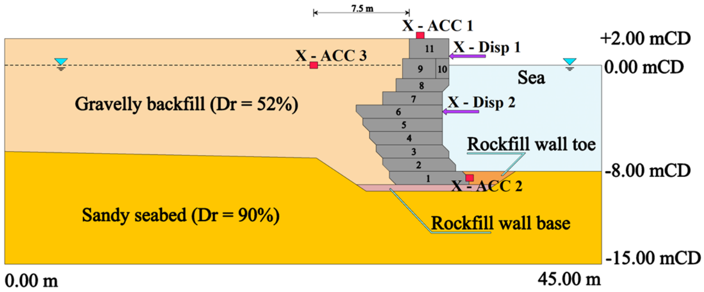
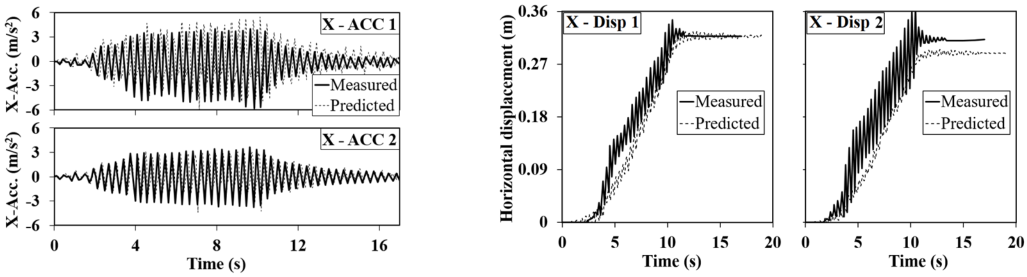


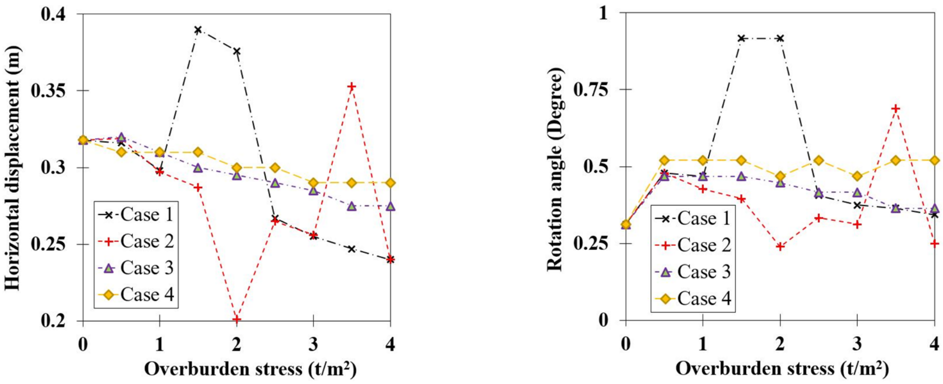
Figure 2. Geometry of numerical model.



(a) (b)

Figure 3. Comparison between predicted and measured results: (a) acceleration, and (b) displacement.

The wall movement deceases when the surcharge load is applied directly on both the wall and the backfill (*Case* 1). However, this leads to relocating the wall center of gravity and increasing the probability of wall overturning. Generally, the horizontal displacement of the wall decreases when the surcharge is simultaneously applied on both the wall and the backfill. Since, applying the surcharge on the wall leads to upward movement of wall's center of gravity. Subsequently, the probability of wall overturning increases. Thus, the rotation and movement of the wall are maximum in *Case* 1 when the surcharge is lower than 2 ton/m (Figure 4), while we have an opposite trend in *Case* 2. This implies that the rotation and movement of the wall in *Case* 2 are minimum at those surcharges which are lower than 2 ton/m. On the other hand the wall rotation and movement are decreased as the distance between the surcharge and wall head increases. This results show the influence of the length of surcharge loading on wall deformation.



(a) (b)

Figure 4. Variation of: (a) wall horizontal displacement, and (b) wall rotation against surcharge loading at different conditions of surcharge loads applied.

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