Analysis of the Causes of Reclamation Embankment Collapse after Final Closure

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INTRODUCTION

Along the West Coast of Korea, many reclamation projects are being carried out to expand the country's territory for various business developments. When creating new sites through reclamation projects, it is necessary to precede the work by blocking seawater. This closure work becomes the most difficult process involved in reclamation as the water velocity increases due to the narrowing gap at both ends. However, even after the completion of the final closure work, the embankment can be destroyed due to various factors such as the piping phenomenon resulting from the difference in water levels between the sea and landward side of the revetment or the occurrence of abnormally high tides and waves. This study analyzed the process and causes of the collapse of embankments after the final closure has been conducted.

FIELD INVESTIGATION

The target area is a reclamation project district located on the West Coast of Korea. After the final closure work, there was an occurrence of slope collapse on the backside of the embankment. The collapse of the embankment occurred in several places, and all were located on the backside slopes. The riprap (0.4 m³/ea) on the backside slope collapsed, exposing the filter mat and the underlying foundation stones (0.03 m³/ea). The section was temporarily reinforced using crushed stones for landfill before embankment. As shown in Figure 1, the collapsed embankment consists of core stones with 0.03 m³/ea and covering stones with a volume of 0.4 m³, with a non-woven filter mat installed.

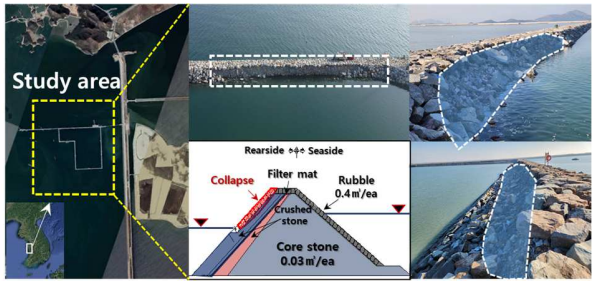

Figure 1 The Study Area and Damaged Seawall

PHYSICAL MODEL TEST

To reproduce the collapse phenomenon of the embankment section and analyze the cause of the collapse, a two-dimensional sectional hydraulic model test was conducted. The movement characteristics of the aggregate due to the difference in water levels inside and outside the embankment were examined using the observed tidal data at the time of collapse, and the change in water pressure within the stone structure was also examined. In addition, a PIV simulation was performed to evaluate the change in flow due to water level changes, and the hydraulic characteristics resulting from the change in the porosity of the filter mat were also measured simultaneously.

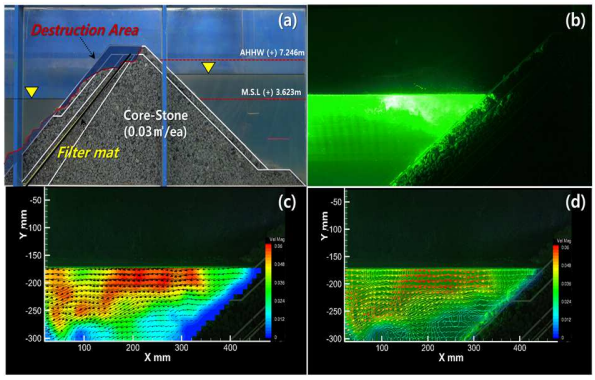

Figure 2 Results of Physical model Test (a) Stability test due to tide level change ; (b) Snap shot of PIV test; (c) & (d) Analysis results of Flow field

CONCLUSION

As a result of the analysis of the causes of the collapse, it was confirmed that the rapid fluctuation of the flow field due to the change in the difference between the internal and external water levels of the embankment caused the displacement of the riprap. The cause of the collapse was that the design of the embankment did not reflect the dynamic fluctuation of the flow field due to the water level difference. The sectional collapse phenomenon was influenced by the change in the difference in water levels as a major variable. It was deemed necessary to increase the weight of the riprap and install a filter mat with an appropriate permeability coefficient in preparation for reaching the critical water level, and guidelines for this were provided. It is found that an increase in the weight of the materials or a change in the permeability coefficient of the filter mat is necessary to enhance the stability of the section.

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