A Study on the Damage Inflicted on Small and Medium-Sized Fishery Ports Due to the Increase in Sea Level and Countermeasures for Port Tranquility

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INTRODUCTION

Problems caused by abnormal climate conditions are developing into major issues that are having adverse societal impacts. The rise in sea level, one of the representative problems associated with an abnormal climate, not only increases the reach and energy density of waves, but also negatively affects the stability of port facilities and the maintenance of tranquility. This study examines the increase in overtopping and the frequency of wave run-up occurring at small and medium-sized fishing ports due to the rise in sea level. In addition, wave overtopping and run-up are major factors that increase the fluctuation of the seawater surface at the port, and by analyzing the correlation between sea level rise, wave overtopping, and wave run-up, this study aims to prepare for any potential issues that may arise.

FIELD INVESTIGATION

Imwon Port, a small to medium-sized fishing port and located on the East Coast of Korea, suffered extensive damage from Typhoon Maysak in 2020. The tide level during the typhoon's impact was about 70 cm higher than the design water level, leading to collisions among moored vessels and the displacement of armor blocks.

Figure 1 Scene of Typhoon Attack in the Imwon port, Korea

PHYSICAL MODEL TEST

In Korea, there is an increasing number of old fishing port facilities, like Imwon Port, that have been continuously damaged by high waves or typhoons. Therefore, to examine the extent of damage occurring in small and medium-sized port facilities, and to establish countermeasures for wave overtopping and port tranquility, a three-dimensional hydraulic model test was conducted. Tidal levels were set up for the design tidal level (S.W.L +0m) at the time of the design of the port facility as a criterion. The tidal level (+0.7m) was reviewed as the recent damage caused by the typhoon occurred, along with the projected rise in sea level (+1.0, +1.3m). The experiment applied the wave height used at the time of the port's design and when the typhoon waves recently occurred. In addition, various measures to reduce the increased wave overtopping discharge and wave energy entering the port, such as raising the crest height, installing a low crest breakwater in front of the breakwater, and extending the length of the breakwater, were evaluated for optimal port tranquility.

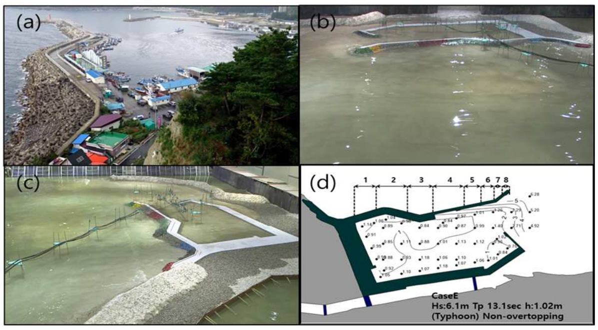

Figure 2 Test Scene (a) Breakwater in the Target Site; (b) & (c) Snap Shot of Wave Overtopping and Run-up Experiment; (d) Harbor Tranquility Result

CONCLUSION

The experimental results showed that the wave overtopping volume increased by about 80% compared to the design condition due to the rise in sea level caused by the typhoon's impact, and the wave height within the port rose by about 0.3m. Imwon Port, being a small to medium-sized fishing port, has an entrance width that is relatively greater than its length, and a shape that is prone to generating seiching within the port. Therefore, even if wave overtopping is effectively controlled, fluctuation of the seawater surface within the port will continue to occur. Hence, this study proposes measures to analyze tranquility within small and medium-sized fishing ports in the event of an amplified rise in sea level and wave magnitude.

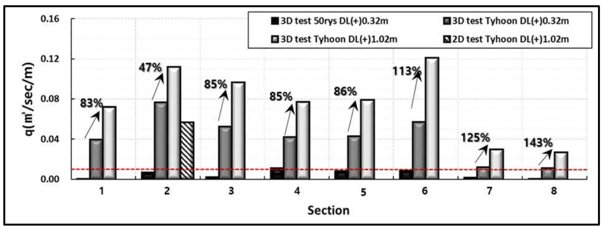

Figure 3 Variation of Wave Overtopping Discharge on each Section of the Breakwater

REFERENCES

Chini, N., Stansby, P.K. (2012): Extreme Values of Coastal Wave Overtopping Accounting for Climate Change and Sea Level Rise, Coastal Engineering, vol. 65(2012), pp. 27-37.