LONG-TERM RESPONSE OF SHORELINE AND DEPTH-CONTOURS AFTER NEARSHORE SAND MINING BY EQUI-WAVE PHASE POTENTIAL CONCEPT

Jung-Lyul Lee, Sungkyunkwan University, jllee6359@hanmail.net

STUDY BACKGROUND

Shoreline changes as a result of increased anthropogenic activities in nearshore zones have caused unexpected damage to the hinterland. However, the current status of shoreline change prediction remains at a level where the basic concept is unestablished, and the existing method using the longshore sediment transport formula has uncertainties in the related coefficients and is limited in its scope of application.

This study aimed to characterize the ultimate shoreline change due to topographical alteration by applying the concept of Equi-Wave Phase Potential (EWPP) (Ria and Lee, 2023) and proposes a numerical methodology for converging to the new morphological equilibrium due to the change of wave phases after sand mining.

The reason why this study is urgent is that the issue of beach erosion is becoming an issue around the world due to the current trend of climate change, but at present, there is no proper way to do so, so it is expected that the supply of sand to the coast through sand mining will be unimaginably frequent.

EQUI-WAVE PHASE POTENTIAL CONCEPT

The EWPP concept is based on the fact that a contour line of the same depth, including the shoreline, in a beach composed of sand will ultimately correspond to the wave crest line. In other words, the concept is that the sand on the seafloor cannot withstand the wave-induced shear stress caused by the wave action, and is deformed like a fluid and placed in a state parallel to the wave crest line, which is a state in which the shear stress is free.

Here, EWPP differs from the wave crest line in that it means the potential that accumulates the wave phase so that the potential is high in the open sea and the lowest potential in the shoreline. In this study, the EWPP concept is used to quantify the extent of the eventual shoreline change due to anthropogenic terrain changes, such as those caused by sand extraction or submerged breakwater.

NUMERICAL APPROACH

The problem of erosion that occurs in the rear shoreline when the water depth rises due to sand mining is numerically investigated by extending Lee et al. (2022)'s approach. A parabolic wave deformation model is used as the wave deformation model to get the wave phase potential that reflects the wave refraction-diffraction combined effect.

In particular, in the numerical model, the wave angle effect from various directions was included so that the effect of the more substantial sand mining zone could be interpreted. With an increase in the longshore stretch of Sand Mining Zone (SMZ), the three-dimensional numerical results converge to an analytical solution with an infinite length.

CONCLUDING REMARK

The methodology introduced in this study provided quantitative results and dimensionless variables for beach management. These results will be an important guide to the scale of marine mining to protect beaches from erosion, depending on the incident wave environment, such as the annual mean wave period in the area where sand mining is performed, as shown in the case studies to previously accomplished sand mining projects.

REFERENCES

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