Beach Erosion Caused By Sand Dredging at Offshore Bar

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Introduction

Sand dredging at the offshore bar causes change in wave transformation followed by change of equilibrium beach profile and hence the shoreline. If the dredged area is close to the coastline sand may be transported from the upper portion of the beach into dredged area and erosion of the foreshore may occur. At Genkai Sea (Kojima, 1986), dredged holes located at the area where the water depth is less than 30m are found to be refilled with sand which would be mainly transported from the onshore side. In this study, the volume of sand dredging was taken into account to discuss the effect of offshore bar sand dredging on the intensity of beach erosion. The different volumes of sand were dredged at the offshore bar to clarify the relationship between the shoreline retreat and the volume of sand dredging.

Methodology

The beach profile and wave height were measured in 2D wave flume by a bottom profiler and wave gauges that were put on the trolley car (Figure1). In order to obtain the bar type profile from initial slope, regular bar type wave was generated (H=14cm, T=1s). Four cases of experiment were conducted with different volume of sand dredging (Table1). At the beginning of each experiment, bar type wave was generated for 1 hour from the initial uniform slope. After 1 hour of wave generation, a sand bar was formed. The crest of sand bar is located at 2.8m from the origin; width of sand bar is about 0.65m. Then, some amount of sand was dredged one time at the sand bar. After sand dredging, the wave was generated in the same condition for 4.5 hours. Beach profile and wave height were measured every 15, 30, 60 minutes in 1 hour after sand dredging.

Results and discussion

Even in the case without sand dredging (E1), the shoreline still gradually retreats after 60 minutes generation of bar type waves. Thus, we define the additional shoreline retreat caused by sand dredging as the difference from E1 case.

In the experiments E3D1-3, during 4.5 hours of wave generation after sand dredging, the sand bars were recovered by some amount of sand that was transported from the foreshore area and the shoreline retreat may result. Figure 2 shows the volume of sand dredging has significant effect on the beach erosion, the more volume of sand dredging the more shoreline retreats. The sand dredging causes quickly retreat of shoreline but the effect subsided in about 2 hours in all cases. In addition, at 4.5 hours of wave generation after sand dredging, wave breaking point of all experiments are primarily located at the same position and after breaking the wave height rapidly reduces in the sand bar area (Figure3); this means that the shoreline retreat in all cases is significantly reduced and stable after 2 hours.

Just after sand dredging, the position of wave breaking in all sand dredging cases moved onshore (Figure4). The wave breaking positions in experiments E3D1 and E3D2 are fairly close to each other and after breaking their wave height rapidly decreased in the sand dredging area, whereas in the experiment E3D3, the breaking wave position is further onshore and wave height significantly decreased at posterior location of sand dredging area. The decrease of energy flux in the experiments E3D1 and E3D2 in the sand dredging area expresses that the sand dredging area plays an important role in the wave energy dissipation. Therefore, the shoreline retreat is significantly increased in E3D3 case (Figure5). This explains that the difference of final shoreline retreat between experiments E3D3 and E3D2 is more than the difference between experiments E3D2 and E3D1 although the difference of sand dredging volume is equal.

In conclusion, volume of sand dredging is one of important factors for evaluating the effect of offshore bar sand dredging on shoreline retreat. The relationship between volume of sand dredging and shoreline retreat seems to have nonlinear property.

References

Kojima, H., Ijima, T. and Nakamuta, T. (1986), Impact of Offshore Dredging on Beaches, International Conference on Coastal Engineering , pp.1281-1295.

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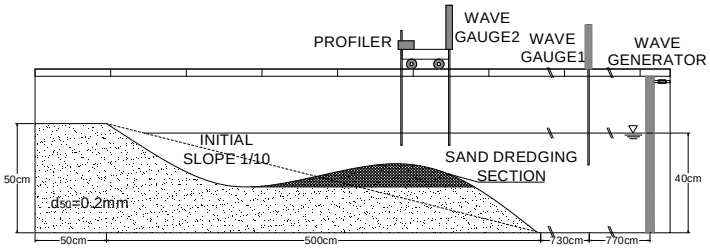

Figure 1 Experiment setup

Table 1 Experiment conditions

Case No.	Sand dredging	Wave condition	Dredging volume (m^3/m)
E1	Without dredging	Bar	0
E3D1	Dredging	Bar	0.02
E3D2	Dredging	Bar	0.04
E3D3	Dredging	Bar	0.06

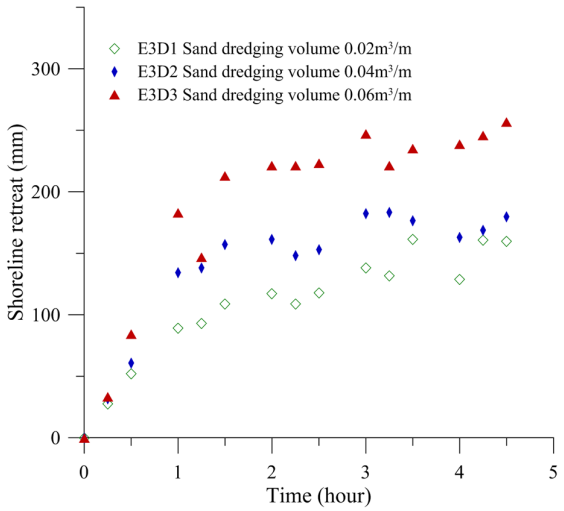

Figure 2 Shoreline retreat due to difference volume of fixed sand dredging E3

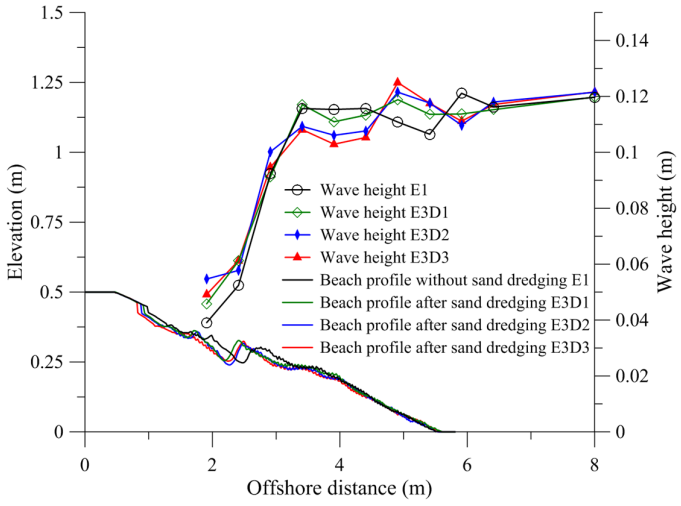

Figure 3 Beach profile and wave height distribution at 4.5 hours after sand dredging

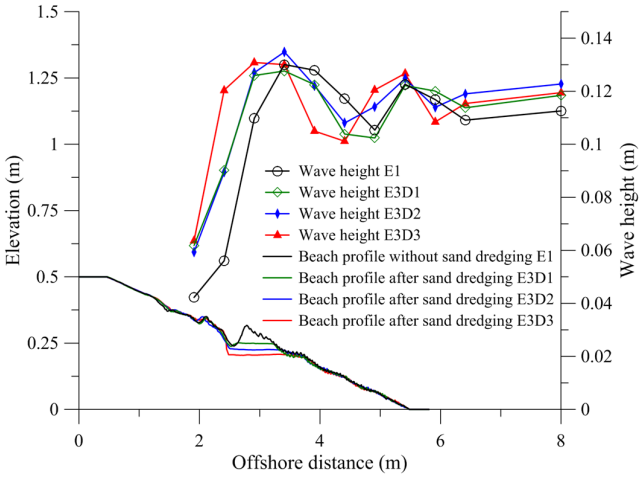

Figure 4 Beach profile and wave height distribution just after sand dredging

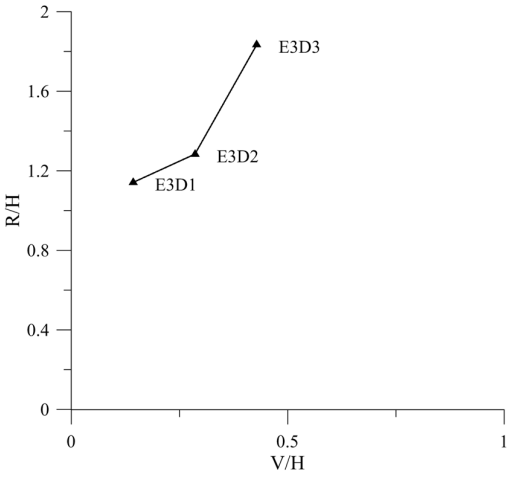

Figure 5 Shoreline retreat and volume of fixed sand dredging E3 after 4.5 hour in dimensionless (unit V: m^3/m)