Reduction of dike revetment fatigue by sand bodies

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1. INTRODUCTION

In this abstract, we will emphasize on the relation between the presence of a sand body in front of a sea dike and the failure behavior of dike revetments. The presence of a sand body in front of a dike not only reduces the impact of the incoming waves, but also shortens the duration of the wave load on the revetment of the sea dike. Since failure of a dike revetment, composed of stone, asphalt, concrete or grass, happens by revetment fatigue, the benefits of the presence of the sand body are a combination of the reduction of the magnitude of the wave impacts and the reduction of the number of wave load cycles.

2. OBJECTIVE OF THE STUDY

The reduction of revetment fatigue depends on the volume and the initial shape of the sand body in front of the dike. In our study we investigate the effectiveness of a sand body for the following scenarios (Figure 1):

1. Sea dike only: This reference scenario considers a sea dike without any reduction of the wave load due to the presence of a sand body.
2. Foreshore: A foreshore in front of the sea dike reduces the wave load due to wave breaking. Since the foreshore is always submersed, there is no reduction of the duration of the wave load.
3. Beach: A beach in front of the dike reduces the wave impact on the revetment, and it reduces the duration of the wave load for the lower part of the revetment.
4. Dune: A dune in front of the dike reduces the wave impact on the revetment, and it reduces the duration of the wave load for the entire revetment.

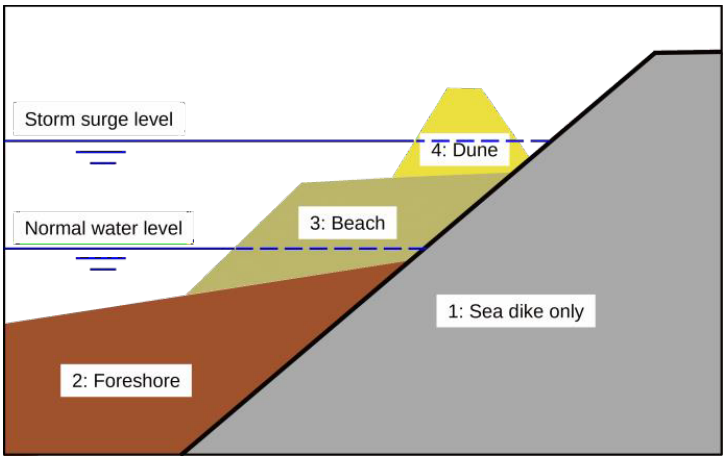

Figure 1: Definition of scenarios

In our study, we consider both stationary and time-varying hydraulic conditions. The stationary conditions give good insight into the protection mechanisms of a sandy body, while time-varying conditions better represent the real conditions during a storm.

3. CALCULATIONS OF REVETMENT FATIGUE REDUCTION BY SAND BODIES

The study involves the following calculations:

- Calculation of the erosion of a sand body during a storm
- Calculation of the wave impact on a revetment during a storm
- Calculation of the damage number of the revetment during a storm

The calculation of the erosion and the wave impact are carried out with the help of Xbeach (Roelvink *et al.* 2009). Figure 2 shows an example for a sea dike protected by a dune.

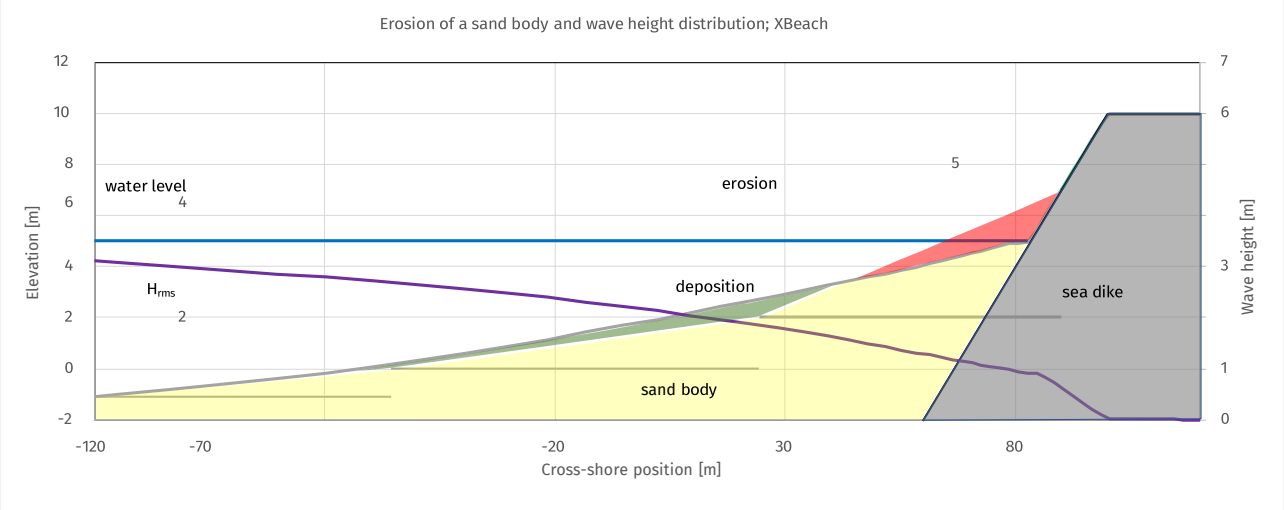

Figure 2: Calculation of erosion and wave impact with XBeach

The damage number of the revetment is defined by Miner's law. In our study we consider a revetment composed of asphalt, although revetment fatigue also happens for the other types of revetment. The calculations are carried out with the help of DiKErnel, the future software application for the assessment and design of revetments for The Netherlands. This model calculates asphalt revetment fatigue according to De Looff *et al.* 2006. Figure 3 shows the calculation of the damage number along an asphalt revetment during a storm surge, without the presence of a sand body.

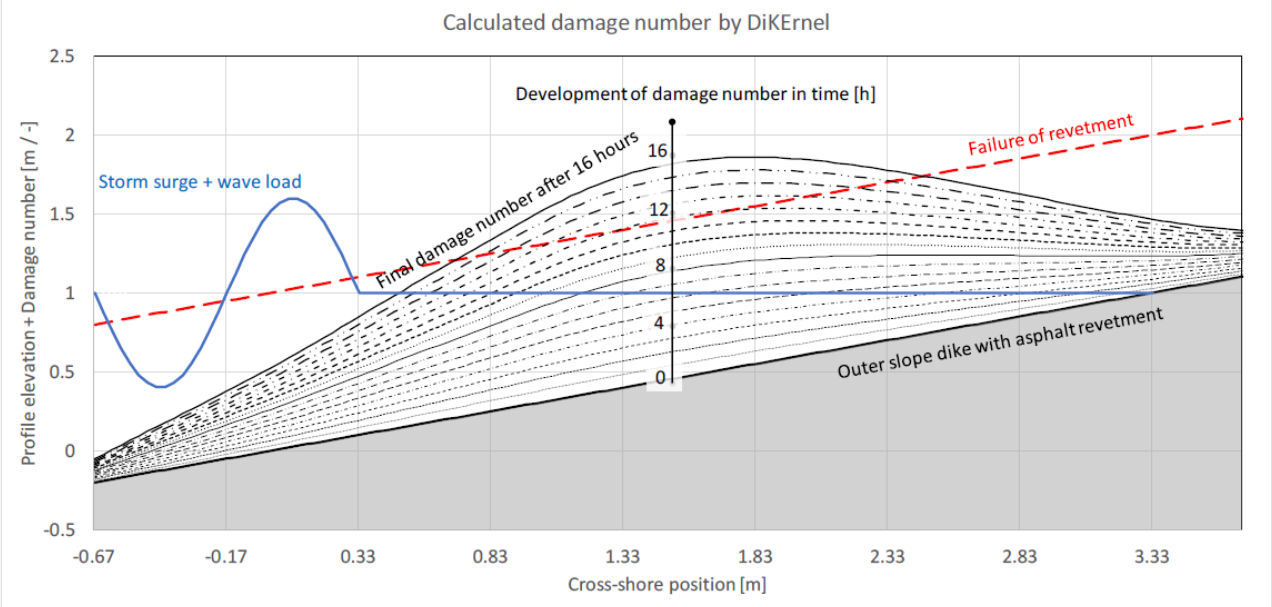

Figure 3: Calculation asphalt revetment fatigue with DiKErnel

4. ACKNOWLEDGEMENTS

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5. REFERENCES

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