GRASS SOD PULLING TESTS TO DETERMINE RESISTANCE AGAINST EROSION BY WAVE OVERTOPPING

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INTRODUCTION

From 2007 wave overtopping tests with the Wave Overtopping Simulator (Van der Meer et al, 2008) have been performed on real dikes in order to determine the strength of grass covers against loads from wave overtopping. Over 15 different locations and over 50 different test sections have been tested. Most of these large scale tests have been performed on grass covers on a clay subsoil. In 2020 and 2021 wave overtopping tests have been performed on grass covers on a sand / sandy subsoil, showing less strength than a clay subsoil, but still remaining significant strength. All wave overtopping tests have been performed on typical mixtures of grass species common in the Netherlands and Belgium. In 2019 also tests were performed on a Mock-up dike in Singapore on tropical grass species and different subsoils (Van der Meer, 2020).
As part of the tests since 2014, grass pull tests with a grass sod pulling device have been performed in order to estimate the critical velocity, the strength of the grass cover, on a specific subsoil with a small and easy to perform test. The critical velocity is derived from the critical normal stresses which are calculated from the force needed to pull out the grass sod and the dimensions of the pulled sod. The method of determining the critical velocity from grass pull tests has been validated with the results of tests with the Wave Overtopping Simulator. The practical, mobile and easy to perform grass pull tests can be used to evaluate the strength of grass covers over time after seeding and for an estimation of strength of existing grass covers on different subsoils.

GRASS SOD PULLING DEVICE

In 2019 an improved version of the prototype grass pulling device was designed and build. The device consists of a three legged frame with an electric motor and a frame with pins grabbing the grass sod of 20 cm by 20 cm, see Figure 1. The device pulls with a constant pull speed. Parallel force and position are measured and logged.

Figure 1 - Set-up of grass sod pulling tests

GRASS SOD PULLING TESTS

From all performed tests a database containing over 2,000 tests has been composed. The database will be analyzed to relate the derived critical normal stresses to the critical velocity as found from the wave overtopping tests. Bijlard et al. (2016) developed and validated a procedure based on tests on grass covers on a clay subsoil. This procedure has been followed again for specific cases like grass on sand subsoils, tropical grass species and different cover compositions of mixtures of grasses and herbs. Analysis is ongoing and first results have been derived.
First results show that when calculated with the procedure developed in 2016 the strength of a grass cover on a sand subsoil is underestimated compared to the critical velocity derived from wave overtopping tests. The reason for the underestimation may be found in the fact that the shape of the pulled sods on a sand subsoil differs from pulled sods on a clay subsoil. Also the root lengths on the pulled sods differ. The roots in a sand subsoil are pulled out of the underlayer as the roots on clay subsoil tend to break at the bottom of the pulled sod. Estimation of the strength of the grass sod based on grass sod pulling tests therefore needs to incorporate a factor for taking into account the subsoil.
New tests on grass covers with different ecological and biodiversity stimulating mixtures of flower rich herbs and grasses are scheduled for winter 2022/2023. Again results of the grass sod pulling tests will be validated with wave overtopping tests.

The paper describes the analysis and results of performed tests and verification of the results with results of wave overtopping tests. Guidance will be given to estimate strength of grass covers on dikes with different types of subsoil. Also a first estimation of strength derived from grass sod pulling tests 2022/2023 may be given for different mixtures of grasses and herbs.

REFERENCES

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