QUANTIFYING THERMAL IMAGING DATA FOR PIPING DETECTION

ANALYZING THE FLOW RATE AND THE SIZE OF THE TEMPERATURE SPOTS IN THERMAL IMAGES OF SEEPAGE AT DYKES

The failure mechanism piping is a significant problem for the safety of river and sea dykes located in delta areas. This is the case in large parts of the Netherlands. Piping is a process that can reach an advanced stage before any sign is remarkably visible. Therefore, it is important to monitor the dykes during high water events to have insight in the actual conditions with respect to piping. The measurement of temperature is proven to be an effective tool for the detection of seepage spots which are possible piping locations in dykes. With the use of a camera with infra-red sensors, the surface temperature of structures can be measured, resulting in a thermal image. With thermal imaging, potential problematic seepage locations can be mapped very fast and efficiently since seepage often has a different temperature than its surrounding (see Figure 1).

The quantification of thermal imaging data for piping detection is a subject that needs to be investigated. In this study, the sizes of the seepage spots in the thermal images and the relation between these spots and the flow rate through the sand boils is quantified. The aim is to determine to what extent thermal imaging can be used to make a flow rate prediction of a seepage spot.

To determine to what extent thermal imaging can be used to make a flow rate prediction of a seepage spot, three main steps are taken. Firstly, a data analysis method is developed to quantify the sizes of the areas of the found seepage spots in the thermal images. An example of such a thermal image can be seen in Figure 2. Secondly, a correlation analysis is performed to find out if there is a relation between the areas of the seepage spots in the thermal images and the flow rate of the seepage through the sand boils. Lastly, a regression analysis is performed to develop a practical tool to enable flow rate prediction based on the size of the seepage spot in the thermal images.

In conclusion, the results show that thermal imaging can be used to make a prediction of the flow rate of a seepage spot under certain circumstances. It is a very promising method to be used as a complementary tool to enhance the quality of the dyke assessment, but additional validation in field conditions is required. It can make human observations more accurate, supports the interpretation of what is seen and can find critical seepage locations which human observations can miss.

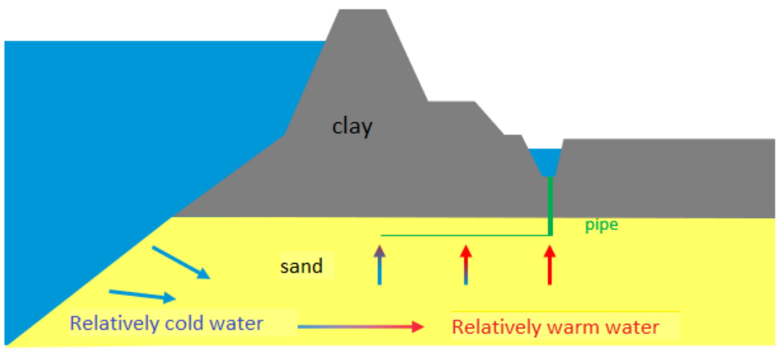

Figure 1: Illustration of the change of the temperature of seepage water underneath a dyke. The process can occur from relatively warm to relatively cold water as well.

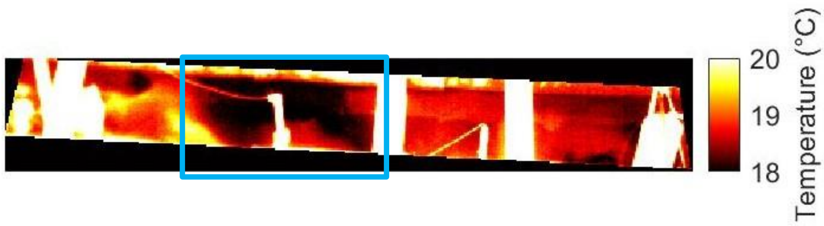

Figure 2: Example of a thermal image of the ditch in the case study of the research. Inside the blue square, a seepage spot can be seen with a lower temperature than the surrounding ditch water temperature. In white, some obstacles in front of the ditch can be seen which are taken out of the region of interest.

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