

A prototype of a new type of control drainage structure

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INTRODUCTION

The deepening water deficit in agriculture encourages to search for new solutions to mitigate this problem. The existing water management systems based on damming structures installed in ditches or drainage canals turn out to be impractical and ineffective today. Large-scale global research shows that a better solution is to control water directly in farmlands by using so-called controlled structures. The conducted research confirmed that using outflow regulators also significantly reduces the outflow of nitrates from the fields. Therefore, the use of such solutions has not only a local dimension but also brings measurable benefits to the environment.

THE PURPOSE AND SCOPE OF THE STUDY

Typical control structures are based on a stop-log system, where every single flashboard must be removed or added to change the water level. In a situation where it is necessary to fast outflow the water from the drains, usually in the pre-harvest period or at the beginning of the spring, removing several single flashboards wastes unnecessary time. The aim of the work was to modify the existing system, which would allow for quicker control of the water level in the soil. It is very important in a situation where we have to operate several such devices in the field. Such a solution just saves us time. The main scope of this work was to design and test two types of runners.



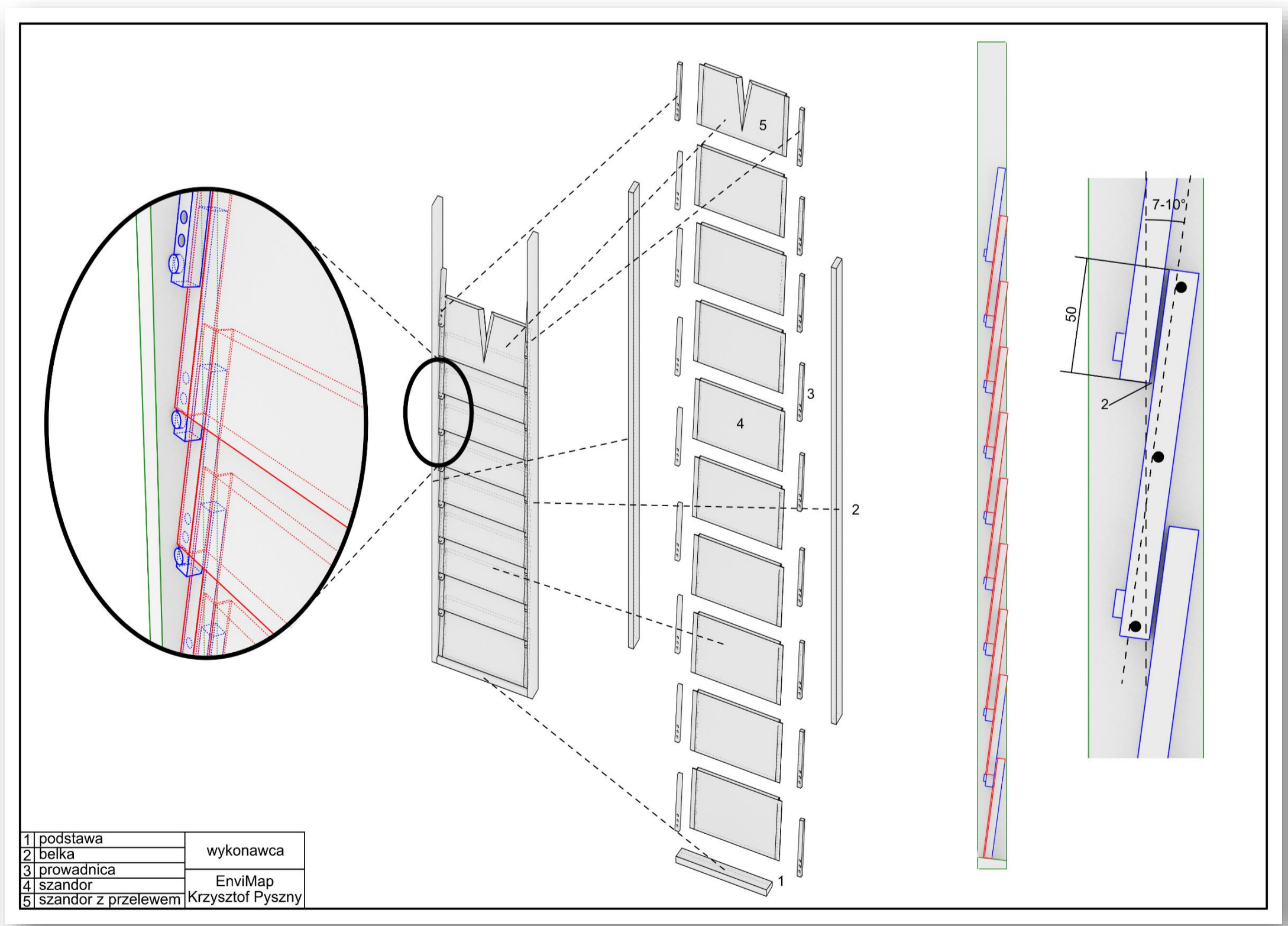
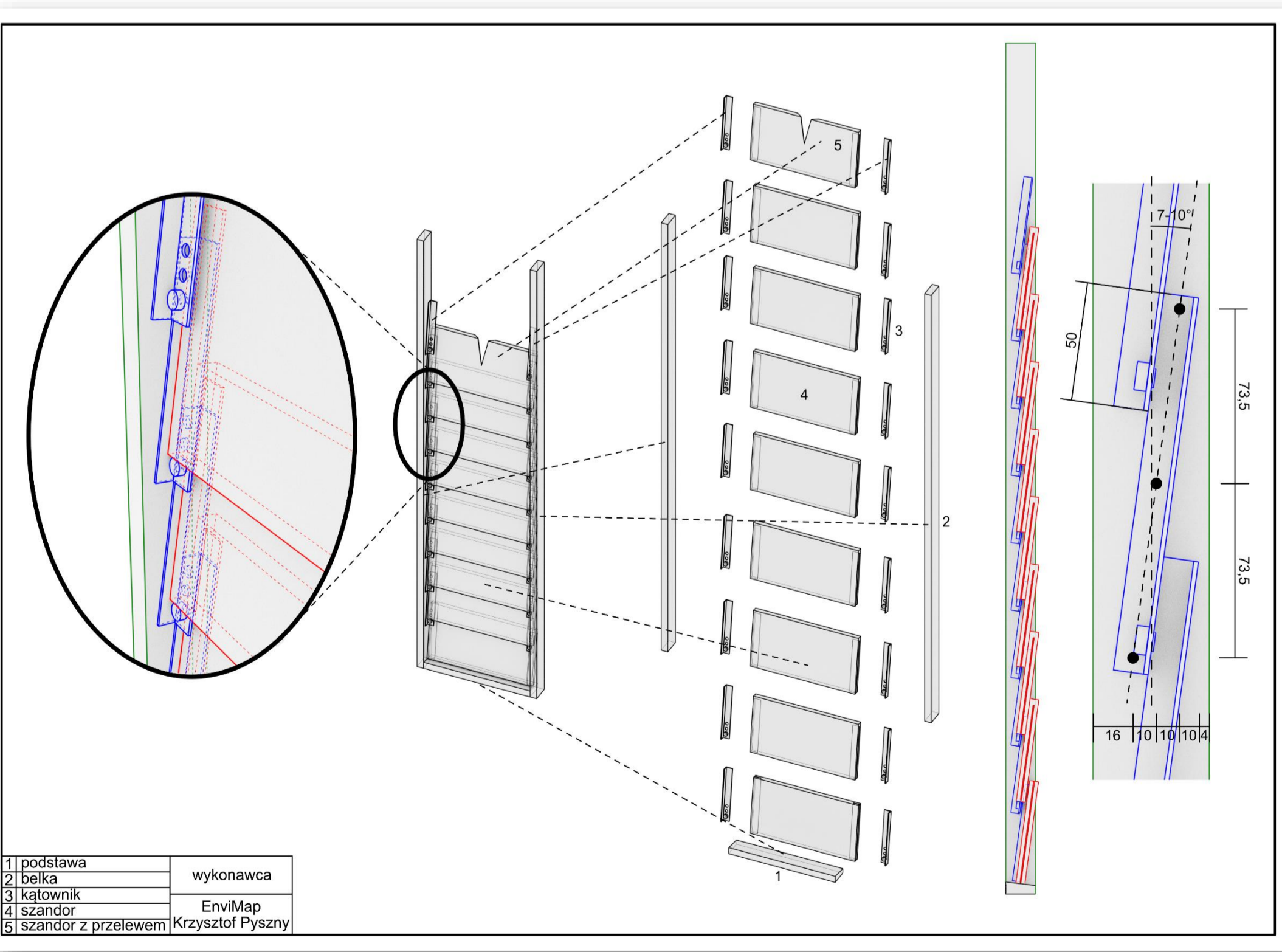
MATERIALS AND METHODS

Experiments were carried out in a laboratory flume with walls made of glass. The rectangular flume was 4,2 m long, 0.30 m wide, and 0.50 m deep. The purpose of these tests was to check whether the design assumptions about the new concept of control structure are met. Two types of materials to make flashboards were used in the tests: polyvinyl chloride (PVC) and polyethylene (PE). All works were conducted in the framework of the pre-implementation work carried out under the program of the Minister of Science and Higher Education entitled Innovation Incubator 2.0.

RESULTS

The solution of new control structure is based on the use of a new type of runner in the existing solutions, ensuring an individual method of mounting each stoplog (plate). Thanks to this, it is possible to freely change the height of water damming in the drainage ditch or directly in the field, on the drainage network, without having to remove all elements. Thanks to the applied modification, water management within the drained area is faster and more efficient, contributing to more effective management of a larger facility, with less work. The paper analyzes two types of solutions based on a new type of runner. In the case of the first solution, only the runner itself needs to be modified. It is possible to use previously used flashboards. The second solution is based on an additional modification of the stoplogs themselves, the connection of which acts as a tongue-and-groove connection. The additional result of the project was also the development of assembly technology and the examination of the properties of materials from which individual elements of controlled structure can be made.

The solution developed by Michał Napierała, Mariusz Sojka, and Rafał Wróżyński was granted a patent by the Patent Office of the Republic of Poland in 2022, no. 242565, under the name: „Diagonal flashboard regulator for waterdamming, in particular in a drainage network ”.



CONCLUSIONS

The research shows that in the case of two analyzed types of solutions, the best material for making stoplogs is PVC and PE. PVC saves his shape in spite of water loading. PE due to its sliding and adhesive properties is good for making slideways. However, In both cases, it is necessary to keep a tight fitting to provide leakproofness.