

FIRST APPLICATIONS OF XBLOCPLUS: EXPERIENCES FROM AFSLUITDIJK AND VISTULA SPIT PROJECTS

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INTRODUCTION

XblocPlus is a pattern placed single layer armour unit which was developed between 2015 and 2018 (Reedijk, 2018). The unit is applied on the Afsluitdijk Project in The Netherlands where 75,000 blocks are used. The second project followed at Vistula Spit in Poland. Valuable experiences were gained during the first practical application of the unit which are described in this paper.

AFSLUITDIJK

The Afsluitdijk is a 32 km enclosure dam which separates the Wadden sea and the Lake IJssel. The dam undergoes a major rehabilitation to meet future water safety requirements. Rijkswaterstaat (executive agency of the Dutch government) commissioned Levvel, a consortium of BAM, Van Oord, Invesis and Rebel, to prepare the design and carry out the reconstruction of the dam including sluices and highway as part of an DBFM contract. The project includes reinforcement of the armour layers and wave overtopping reduction.

Rijkswaterstaat gave ample room for the application of new innovations, stimulating the use of new materials and building methods resulting in improved sustainability and water safety.

The design of the XblocPlus armour layer was verified by large scale physical model tests (1:3) with focusing on the stability of the blocks and the overtopping of the structure (Ockeloen, 2020). Limits of placement tolerances were derived from the large scale model test.

Because of the large number of blocks, a fully automated casting factory was constructed to produce the blocks. The factory enabled the production of the large number of blocks in a relatively limited amount of time while securing the constant quality of the blocks. This circular factory will be dismantled after the project and can be used for future projects elsewhere in the world.



Figure 1 -Automated production of XblocPlus

Handling of the blocks occurs with a newly developed lifting device: "gripper". This gripper lifts the blocks by clamping into the circular hole in the middle of the XblocPlus. The gripper was tested in a placement trial and subsequently used for the whole project. The gripper enabled the operator to place the units at a high placement rate and improves the safety due to the lack of rigging personal needed.



Figure 2 - Gripper with XblocPlus

XblocPlus can be placed on gentle curves. For sharper curves a modified XblocPlus shape can be used, or the original Xbloc.

Depending on the applied number of rows of XblocPlus a minimum radius should be applied in order to maintain a correct placement pattern and interlocking.



Figure 3 - Curved section with XblocPlus

Part of the project is dedicated as trial area for research of various ecofriendly concrete mixtures with focus on

sustainability.

VISTULA SPIT

Work is in progress on the project “Construction of a waterway connecting the Vistula Lagoon with the Gulf of Gdańsk”. The Polish government commissioned the project to a joint venture of BESIX and NDI Group.

XblocPlus is used for the armour layer of the breakwaters sheltering the entrance channel of the waterway. The eastern breakwater follows a gentle curve resulting in placement of the blocks at both a concave and a convex curve at either side of the breakwater.

Placement is executed with assistance of divers for the underwater part of the armour layer who verify the interlocking of the blocks.



Figure 4 - Above water and under water placement of XblocPlus

Three sizes of XblocPlus are applied at the Vistula spit project (1 m^3 , 3 m^3 , & 4 m^3). Regular Xbloc (3 m^3 , & 5 m^3) is used at the head of the breakwaters due to the small radius of the head.

Transitions between XblocPlus sizes are made with a newly developed transition block. One of the sides of a transition block has the shape of a regular XblocPlus and connects with the surrounding XblocPlus units. The other side of the transition block has a flat corrugated surface that is either facing downwards or facing upwards. The two types of transition blocs are placed on top of each other. The flat surface creates a plane along the rows enabling the application of different block sizes at either side of the transition plan.

The transition block is applied for the first time at the Vistula Spit project after the stability of the transition was demonstrated during physical model tests.



Figure 5 -Transition between different sizes of XblocPlus

The head of the breakwater is constructed with regular Xbloc. At the intersection the regular Xblocs are placed on top of the XblocPlus.



Figure 4 - Transition between XblocPlus and Xbloc

- Reedijk, Eggeling, Bakker, Jacobs, Muttray (2018) Hydraulic stability and overtopping performance of a new type of regular placed armour unit, ICCE
- Ockeloen, Kuiper, Van den Steen, (2020) Large and small scale wave overtopping measurements for Afsluitdijk rehabilitation, Coastal Engineering Proceedings, (36v), structures.15.