

XBLOC-PLUS - DEVELOPMENT OF A REGULAR PLACED INTERLOCKING ARMOUR UNIT

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INTRODUCTION

Randomly placed single layer interlocking concrete armor units are currently the most advanced and cost-efficient option for the protection of breakwaters. The key feature of these units is the random orientation of the units, which requires the crane operator to assess the orientation of each individual unit during block placement. DMC noticed the desire for a block which can be placed in a regular pattern as this will increase the placement rates. Apart of this, regular placement of armor units can also be preferred for aesthetical reasons (Figure 2).

Fifteen years after the introduction of Xbloc, DMC therefore introduces a new breakwater armour unit called XblocPlus which is placed with uniform block orientations.

OBJECTIVE BLOCK DEVELOPMENT

Randomly placed interlocking armor units can in principle be placed in a regular pattern. This is however not done in practice as regular placement leads to a higher packing density (and concrete consumption) and a reduced permeability.

- The development of the XblocPlus has focused on
- 1) regular placement to enhance construction speed;
 - 2) sufficient permeability to increase hydraulic stability and reduce concrete use;
 - 3) strong interlocking and
 - 4) flexibility to follow deformations in the under layer.

The result is the XblocPlus which is shown in Figure 1.



Figure 1: XblocPlus shape

HYDRAULIC STABILITY

Despite the fact that physical model tests confirm a hydraulic stability equal to or better than for Xbloc, DMC has chosen a design stability number of $H_s/\Delta D_n=2.5$ for XblocPlus. This choice results in intrinsic safety in a design with XblocPlus.

Due to the lower stability number chosen, an XblocPlus will be larger than an Xbloc or Accropode-II (a trademark of Artelia) for the same design wave height.



Figure 2: Aesthetic appearance of XblocPlus slope

CONCRETE USE AND NUMBER OF BLOCKS

In spite of this, the concrete use with XblocPlus is equal to the concrete use with Xbloc, hence 10% lower than for Accropode-II. Furthermore, due to the larger block size, the number of blocks is reduced by 25% compared to Xbloc and by 33% compared to Accropode-II.

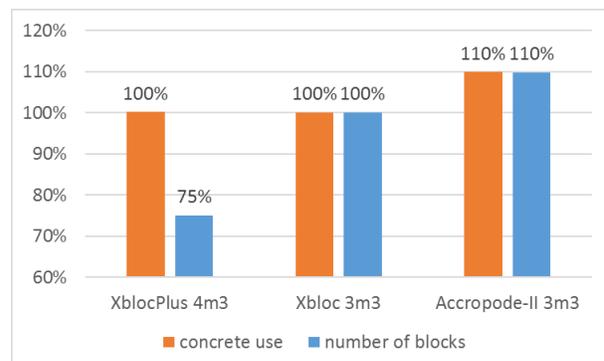


Figure 3: Comparison concrete use & number of blocks

PLACEMENT METHOD

The XblocPlus contains a hole in the main body which reduces wave pressure. This hole is used for fast and very efficient placement with a clamp. Placement rates with this method are significantly higher than conventional placement with a sling.



Figure 4: Placement of 6.5ton XblocPlus