XBLOC-PLUS: THE INTERLOCKING, PATTERN PLACED & EFFICIENT ARMOUR UNIT

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INTRODUCTION

Most breakwaters are built with randomly placed single layer armour units as these are most cost-efficient. Most single layer blocks require random unit orientations, which requires the crane operator to assess the orientation of each individual unit during placement. DMC noticed the desire for an interlocking block which can be placed in a regular pattern as many crane operators find it easier to place units uniformly, which requires less intuition. Fifteen years after the introduction of Xbloc, DMC introduces a new interlocking breakwater armour unit called XblocPlus which is placed with uniform block orientations.

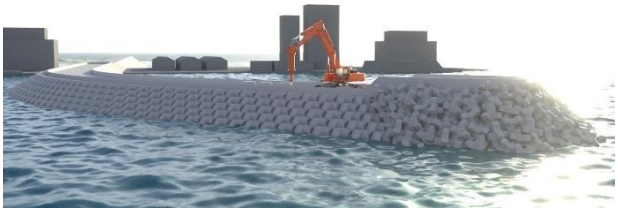

Figure 1: Aesthetic appearance of XblocPlus slope

OBJECTIVE BLOCK DEVELOPMENT

The development of the uniformly placed XblocPlus unit through numerous studies has focused on the following aspects:

1) Regular placement to enhance constructability;
2) High permeability to increase hydraulic stability and reduce concrete use
3) Strong interlocking and structural performance to ensure a robust single layer armour protection;
4) Flexibility of the unit to follow deformations in the under layer without loss of hydraulic stability.

HYDRAULIC STABILITY

In spite of the fact that the 2D and 3D scale model tests performed confirm a hydraulic stability equal to or better than Xbloc, DMC has chosen a design stability number of Hs/ΔDn=2.5 for XblocPlus. This choice results in intrinsic safety in a design with XblocPlus. Although the appearance of the Xblocplus armour slope is smoother a roughness coefficient, γ of 0.45 has been deduced, similar to that of the original Xbloc.

Figure 2: XblocPlus Shape

CONCRETE USE AND NUMBER OF BLOCKS

Due to the lower stability number chosen, an XblocPlus will be larger than an Xbloc or Accropode-II for the same design wave height. In spite of this, the concrete use with XblocPlus is equal to the concrete use with Xbloc, hence 10% lower than Accropode-II for a similar breakwater slope. 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.

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 3: Placement of 6.5ton XblocPlus

AFSLUITDIJK PROJECT

The paper will describe design and construction experiences within the first application of the block which is the Afsluitdijk Project where 75,000 units are being used to protect The Netherlands against rising sea levels and increased storms

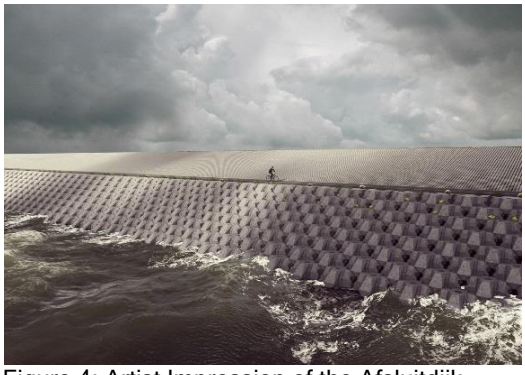

Figure 4: Artist Impression of the Afsluitdijk