Geophysical Research Abstracts
Vol. 15, EGU2013-8048, 2013
EGU General Assembly 2013

Coastal protection using topological interlocking blocks

Elena Pasternak (1), Arcady Dyskin (1), Charitha Pattiaratchi (1), and Efim Pelinovsky (2)

(1) University of Western Australia, Crawley, Australia, (2) Department of Nonlinear Geophysical Processes, Institute of Applied Physics, Nizhny Novgorod, Russia

The coastal protection systems mainly rely on the self-weight of armour blocks to ensure its stability. We propose a system of interlocking armour blocks, which form plate-shape assemblies. The shape and the position of the blocks are chosen in such a way as to impose kinematic constraints that prevent the blocks from being removed from the assembly. The topological interlocking shapes include simple convex blocks such as platonic solids, the most practical being tetrahedra, cubes and octahedra. Another class of topological interlocking blocks is so-called osteomorphic blocks, which form plate-like assemblies tolerant to random block removal (almost 25% of blocks need to be removed for the assembly to loose integrity). Both classes require peripheral constraint, which can be provided either by the weight of the blocks or post-tensioned internal cables.

The interlocking assemblies provide increased stability because lifting one block involves lifting (and bending) the whole assembly. We model the effect of interlocking by introducing an equivalent additional self-weight of the armour blocks. This additional self-weight is proportional to the critical pressure needed to cause bending of the interlocking assembly when it loses stability. Using beam approximation we find an equivalent stability coefficient for interlocking. It is found to be greater than the stability coefficient of a structure with similar blocks without interlocking. In the case when the peripheral constraint is provided by the weight of the blocks and for the slope angle of 45^o, the effective stability coefficient for a structure of 100 blocks is 33% higher than the one for a similar structure without interlocking. Further increase in the stability coefficient can be reached by a specially constructed peripheral constraint system, for instance by using post-tension cables.