Basalton Quattroblock vs Armourstone

How engineered products allow reduction in the environmental footprint

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Introduction

The industry is responsible for the increase of greenhouse gas emissions with climate change as a result. Lowering the environmental footprint of the construction industry is becoming increasingly more important. One of the possibilities to reduce this footprint is via smart engineering: selecting the right solution for each specific use-case. In this abstract, a comparative analysis for a fictive coastal protection project located in Sylt, Germany is made to determine how smart engineered concrete products, in this case the Holcim Basalton Quattroblock, could outperform regular sand, gravel and armourstone (rip-rap) when it comes to the environmental footprint over its lifetime.

Goal and procedure

The goal of the environmental data generated is to provide a reliable and fair comparison with regards to use of different products within coastal protection projects. To achieve this goal, the following procedure is used: The Dutch MKI or ECI (Environmental Cost Indicator) is determined which bundles a total of 11 environmental profiles, under which CO_2, into 1 monetary value which expresses the compensation that should be made for the environmental harm. As the carbon footprint is often used for comparisons, the CO_2 footprint is also computed in this comparison. To do this, the latest version of the Environmental Performance Assessment Method for Construction Works is used and meets all criteria[1]. This comparison is a partial LCA, including life cycle categories A1-A3, C2-C4 and D and default processes are used. The results are only indicative.

Situation sketch

The situation from Figure 1 below is compared in this analysis

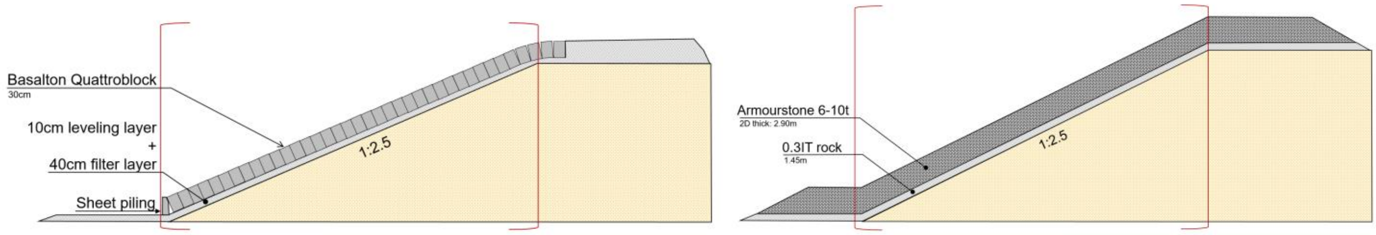

Figure 1 – Basalton Quattroblock revetment (left) and Armour stone revetment (right)

Both situations have reference unit "*1 running meter of dike profile for a revetment with life cycle lifespan of 100 years*". The armourstone situation uses a 2D thick armourstone 6-10t layer and a 0.3-1t rock filter layer below this armourstone layer. Both materials commonly originate from Norway. In the case of the Basalton Quattroblocks: these are produced in Heide, Germany. Below the Basalton Quattroblocks, a 10cm leveling layer and 40cm filter layer is applied. This results in the following material inventory:

Table 1 – Composition of identified variants, expressed per running meter of dike

Material	Unit	Armourstone	Quattroblock CEM I	Quattroblock CEM III
Armourstone 6-10t	Ton	65.8	-	-
0.3-1T rock fill layer	Ton	32.9	-	-
Leveling layer Quattroblock	Ton	-	2.27	2.27
Fill layer Quattroblock	Ton	-	10.75	10.75
Quattroblocks 30cm	m^2	-	13.5	13.5
Sheet piling	m^2	-	0.105	0.105

[1] – Dutch methodology meets the requirements from: NEN-EN-ISO14040, NEN-EN-ISO 14044, ISO21930, ISO/TR14025, EN15804+A2.

Results

The carbon footprint comparison can be found in Figure 2 below.

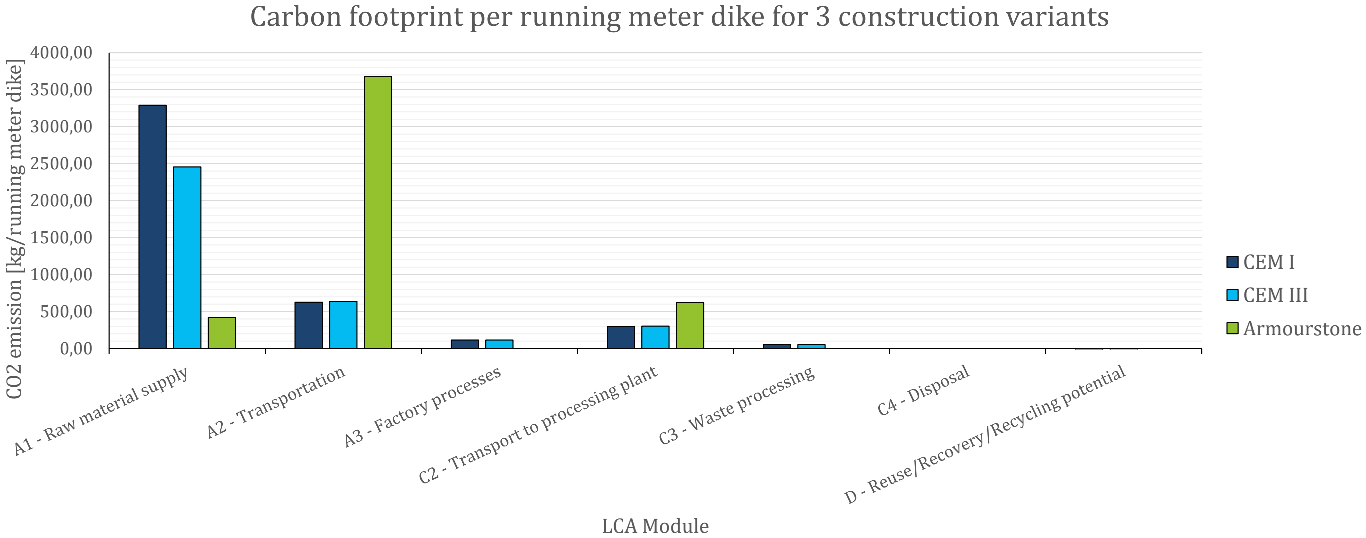

Figure 2 – Carbon footprint comparison of three dike construction variants

In the case Holcim Basalton Quattroblocks are used, most carbon is emitted during production of the cement. For the armourstone, the large transportation distance from Norway to Germany results in large carbon emissions. When using CEM I instead of armourstone, a reduction of **9.5%** in carbon footprint is possible[2]. If CEM III is substituted, this reduction increases to **26.5%.**

The environmental cost indicator comparison can be found in Figure 3 below.

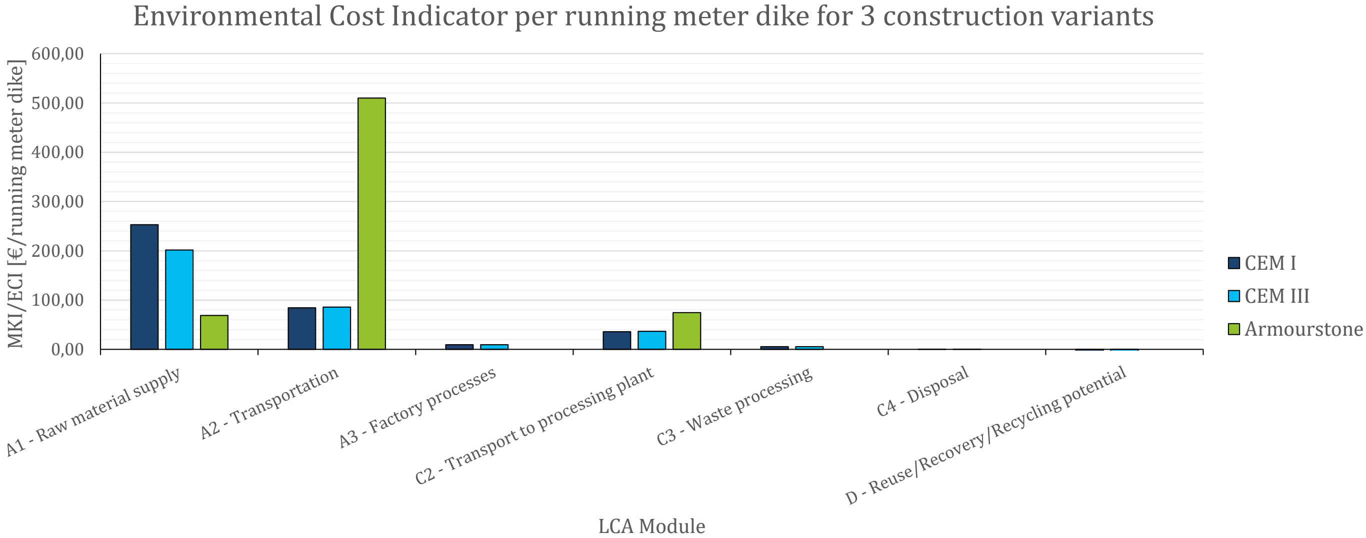

Figure 3 – Environmental cost indicator comparison of three dike construction variants

Once again most of the environmental footprint originates from the production of cement for the Holcim Basalton Quattroblocks. For the armourstone the transportation of the stones is once again responsible for most emissions. When using CEM I, the environmental cost indicator can be reduced by **42.7%** relative to armourstone[2]. If CEM III is substituted, this reduction increases to **50.1%.**

Smart engineering with Holcim Basalton Quattroblocks allows for large carbon savings on large construction projects, outperforming sand, gravel and rock. However, it should be noted that this is subject to location as armourstone is commonly imported and transported over large distances. When this is the case, the Holcim Basalton Quattroblock can be a sustainable alternative to traditional armourstone. Accelerating green growth, Holcim.

[2] – The calculations excludes equipment for placement and maintenance. The Holcim Basalton Quattroblocks require less equipment and maintenance compared to Amourstone, increasing the difference in carbon footprint even more.