The stability of the armourstone on the front slope of a low-crested emergent structure can be related to the stability of a non-overtopped structure. This can be achieved by first calculating the required nominal diameter of the armour unit with one of the design formulae presented in Section 5.2.2.2 for rock armour layers and then applying a reduction factor on this nominal diameter, D_{n50}. It is, however, advised to take great care when reducing the armour size of a low-crested breakwater.

This approach has been adopted by Van der Meer (1990a). He suggested that the armourstone cover layer stability formulae (Van der Meer, 1988b) (see Section 5.2.2.2) can be used with D_{n50} replaced by $r_D D_{n50}$. The reduction factor, r_D (-), on the stone size required, is given as Equation 5.164:

$$r_D = \left(1.25 - 4.8 \frac{R_c}{H_s} \sqrt{\frac{s_{op}}{2\pi}} \right)^{-1} \tag{5.164}$$

where R_c is the crest freeboard (m), and s_{op} the fictitious wave steepness (-), based on the peak wave period, T_p (s).

NOTE: The factor $R_c/H_s \cdot \sqrt{(s_{op}/2\pi)}$ is equal to Owen's dimensionless freeboard, R^* (see Section 5.1.1.3, Equation 5.28).

Design curves are given in Box 5.20. The limits of Equation 5.164 are given by Equation 5.165 as:

$$0 < \frac{R_c}{H_s} \sqrt{\frac{s_{op}}{2\pi}} < 0.052 \tag{5.165}$$

NOTE: Equation 5.164 gives an estimate for the required stone diameter on the front slope. For the crest and the rear side a similar size of material or larger material may be required.

Rule of thumb for emergent structures

As a rule of thumb Equation 5.166 can be used to obtain a first estimate of the stone size, D_{n50} (m), in a conceptual design phase for **emergent structures** (Kramer and Burcharth, 2004) in **depth-limited wave conditions**, ie with breaking waves on the foreshore.

$$D_{n50} \geq 0.3h \quad \text{for} \frac{H_s}{h} = 0.6,\ \cot\alpha_s \geq 100 \ \text{and} \ \Delta \cong 1.6 \tag{5.166}$$

where H_s is the significant wave height at the toe of the structure (m); h is the water depth at the toe of the structure (m); α_s is the slope angle of the foreshore (°).

NOTE: Other values for H_s/h, $\cot\alpha_s$ and Δ might lead to very different values for the stone size required.