V = volume of the (concrete) armour unit (m^3)

D_n = nominal diameter of the armour unit (m), $D_n = (k_s)^{1/3}D$, where k_s is shape coefficient and D is characteristic dimension of the concrete armour unit, ie block height (see Section 3.12 for data).

The permeability of the structure is not defined in the standard way, as using Darcy's law (see Section 5.4.4.4), but is rather given as a notional index that represents the global permeability of the structure, or as a ratio of stone sizes. It is an important parameter with respect to the stability of armour layers under wave attack. The permeability depends on the size of the filter layers and core and can for example be given by a *notional permeability* factor, P. Examples of P are shown in Figure 5.39 in Section 5.2.2.2, based on the work of Van der Meer (1988b). A simpler approach to account for the influence of the permeability on the stability of rock-armoured slopes under wave or current attack uses the ratio of diameters of core material and armour material.

A practical measure for the permeability of dams (referring to the structure rather than the materials) under current attack is the ratio between armourstone size, D_{n50} (m), and dam height, d (m). This ratio, D_{n50}/d (-), sometimes also called "dam porosity", may be interpreted as a measure for the voids in the rockfill.

The **packing density** is a parameter directly related to the placement pattern of the armour layer. It is a term mainly applied to blocks in armour layers; the influence of the placement pattern on the stability of the structure is discussed in Section 5.2.2.3. Equation 5.99 gives the expression for the estimate of the number of armour units per unit area, N ($1/m^2$), as used in Sections 3.5.1 and 3.12.

$$N = \frac{t_a(1-n_v)}{V} = \frac{nk_t(1-n_v)}{D_{n50}^2} \quad (5.99)$$

where:

N = N_a/A ($1/m^2$), where N_a is the number of armour units in the area concerned (-); A is the surface area of the armour layer parallel to the local slope (m^2); N is sometimes called *packing density*

t_a = armour layer thickness (m), defined by $t_a = nk_tD_{n50}$ (see also Section 3.5)

V = armour unit volume (m^3).

NOTE: The packing density of concrete armour layers is the same as defined above in Equation 5.99, but then with D_n instead of D_{n50}. The packing density is then $N = \phi/D_n^2$, where ϕ is the **packing density coefficient** (-), see also Section 3.12.

The term *packing density* is rather widely used in literature, denoted as ϕ, when actually the packing density coefficient, defined in Equation 5.99, is meant.

Parameters related to the response of the structure

The behaviour of the structure can be described by a number of parameters, depending on the type of structure. **Statically stable structures** are described by the number of displaced units or by the development of damage, ie differences in the cross-section before and after storms.

The damage to the rock armour layer can be given as a percentage of displaced stones related to a certain area, eg the entire layer or part of it. The **damage percentage**, D (%), has originally been defined in the *Shore protection manual* (CERC, 1984) as:

The normalised eroded volume in the active zone, from the middle of the crest down to 1H_s below still water level (SWL).