Section 3.4.3.9). The *simple* non-standard grading approach is usually sufficient, however, for specific requirements a detailed approach may be used.

Attention should be paid to durability of the armourstone used (see Section 3.6), notably with reference to weathering processes such as freeze and thaw (see Section 3.8.6).

Box 8.3 *Design of a revetment cover layer against current attack*

The reader should note that design equations are sensitive to the choice of input parameters. In particular, the depth-averaged velocity should be used for Pilarczyk's and Maynord's approaches while the near-bed velocity is to be used for Escarameia and May's approach. Standard values of the other input parameters are given in Section 5.2.3.1, however, more detailed values may be relevant. When using Pilarczyk's approach, the reader should refer to:

- Section 5.2.1.3 to determine the turbulence factor k_t. At a site where fairly high but not excessive turbulence is expected, a value of r = 0.20 may be used (see Section 4.3.2.5).
- Section 5.2.1.8 to determine the depth factor Λ_h required to determine the velocity profile factor k_h.

When using Escarameia and May's approach, the reader should refer to Section 4.3.2.5 to determine the turbulence intensity required for calculation of the turbulence coefficient C_T.

The result is expressed as an armourstone size required for stability, including a safety coefficient for Maynord's approach. The reader should note that both Pilarczyk's and Escarameia and May's approaches provide a median size D_{n50} that can be easily converted into M_{50} and allow selection of a standard grading (see Step 3). However, Maynord's equation provides a median sieve size D_{50} with $D_{n50} \cong 0.84\ D_{50}$ (see Section 3.4.2 for further discussion on the relation between D_n and D).

A standard double layer thickness is $2k_t\ D_{n50}$ (see Section 3.5.1 for values of the layer thickness coefficient, k_t (-)). When small armourstone is required for weak currents, it may be practical to use a thicker layer to sink a geotextile and a fascine mattress. Conversely, assuming a minimum thickness of 0.5 m is required for construction purposes, ie D_{n50} = 0.203 m, the hydraulic stability for this armourstone size may be checked to confirm if sufficient.

Step 4: Design of the filter system and sublayer

In principle, a granular filter could be used between the subsoil and the cover layer. In practice, geotextiles are increasingly used for this purpose. The filter criteria for both granular and geotextile filters are given in Section 5.4.3.6. Three different criteria should be satisfied by the filter system:

- functional requirement, ie meeting filter rule requirements
- construction requirement, notably when placing geotextile or granular filter underwater
- durability requirement, ie sufficient resistance during construction and the structure lifetime.

The option of a full multi-layered granular filter, placed in thin layers on a slope underwater, is rarely practicable in river engineering works, except for very large structures. A composite filter, consisting of a geotextile and a granular layer is more common. Often it is appropriate to place the armour layer directly onto a geotextile (without sublayer), or onto a gravel underlayer without geotextile.

In Box 8.4, the functional requirements are discussed for the specific case of a geotextile filter. These functional requirements concern the interface stability of the base soil with the geotextile filter fabric and the filter permeability. When the cover layer is directly applied onto the geotextile filter, specific attention should be paid to ensuring it is not damaged during construction (see Section 9.7.1).