combinations should be investigated to assess scour depth and toe stability – the worst case conditions may occur at a low water level even though wave heights may be lower. Consideration should also be given to the full life of the structure, ie to take account of natural foreshore changes and potentially increased wave activity at the end of the service period. For most coastal structures, wave forces (downrush and breaking) present the critical conditions when determining stability of the toe. However, currents can become important, particularly in deeper water or more sheltered sites where wave activity is restricted.

In summary the important considerations in establishing the nature of toe protection required are:

- location of the structure (scour is most severe near the wave-break point)
- form of structure (wave forces produced as a result of reflectivity or downrush)
- nature of the bed (resistance to erosion and grain size)
- nature of structure, revetment, breakwater etc.

As a general rule, scour potential is greatest where the water depth at the toe is less than twice the height of the maximum unbroken wave.

Special attention should also be given to areas where scour may be intensified, such as changes in alignment, structure roundheads, channels and downdrift of groynes etc.

Design methods for scour and toe protection are presented in Section 5.2.2.9.

Depth and form of toe detail

The basic principle of flexible toe protection is to provide an extension of the armour face such that the foundation material is kept in place beneath the structure to the bottom of the maximum depth of scour. Caution should be exercised if a non-flexible toe protection is to be adopted as this will not accommodate any change in profile if scour is to occur, which may lead to brittle failure.

When placing stones in a situation where the toe is below low water the construction aspects covered in Section 9.7.1.2 should be considered. The use of geotextiles should be carefully considered prior to their inclusion in a design with respect to installation, also covered in Section 9.7.1.2. Consultation with experienced installers and manufacturers should help assess the feasibility and cost benefits of using them. Consideration should be given to whether suitable granular underlayers and filters can be used instead.

A range of toe details are presented in Figures 6.57 to 6.64 for the following ground conditions.

1 Rock foreshore.

2 Impermeable layer near foreshore level.

3 Sand/gravel foreshore.

Different construction scenarios are discussed below. The list of examples is not exhaustive and there may be situations where a combination of the examples shown may be applicable.

The toe details shown in Figures 6.59–6.64 indicate that a geotextile may be necessary where construction is to take place on a granular material, to prevent loss of bed material through the structure. The designer should check whether a geotextile is required to ensure interface stability criteria between adjacent granular layers are met (see Section 5.4.3.6). This applies to the transition between the bed material and the placed layers (core or underlayer) and also between adjacent layers within the structure, for example between the underlayer and the core.