

### 8.2.10 Maintenance issues that influence design

Chapter 10 examines maintenance in detail. However, it is important to consider in the early stages of design how and when maintenance will take place, in particular with reference to the flood season. Maintenance should also be considered when selecting the appropriate type of cross-section for river training structures. It is also vital to determine who will be responsible and what equipment will be available for maintenance activities. Issues to consider in the various design stages in respect of river training works include:

- **durability** of the protection system, including the accepted reduction in stone size and acceptable damage during service, and the capacity of the owner to maintain the structure
- **size of stones** in view of manual or equipment handling
- **availability of local material** for repair and possibility to create stockpile of material for maintenance purposes
- **provision of a berm** to allow maintenance of the lower part of the revetment
- **wide crest**, eg of spur-dike, to allow access for large trucks.

An effectively designed structure should withstand the loads imposed by the river, but other causes of damage should also be considered in the design. Table 8.3, adapted from PIANC (1987b), gives an *aide-memoire* of design measures that can help to overcome or address causes of damage. The aim of these measures is to avoid degradation or to make maintenance easier.

**Table 8.3** Causes of damage to bank protection (after PIANC, 1987b)

Feature	Cause	Effect	Design measure
Abrasion	Ice floes and debris floating in the waterway	<ul style="list-style-type: none"> <li>● impact near waterline</li> <li>● displacement of armourstones</li> <li>● puncturing of membranes</li> </ul>	<ul style="list-style-type: none"> <li>● design for resistance to impact</li> <li>● allow for easy repair</li> <li>● deflect water flow, eg by groynes</li> </ul>
	Abrasive sediment in high velocity flow, such as sand, gravels, cobbles, boulders	Grinding action at toe wearing through exposed fabrics, gabion baskets	<ul style="list-style-type: none"> <li>● incorporate a sacrificial layer of armour</li> <li>● avoid use of gabions in cases of extreme abrasion</li> </ul>
	Pack ice	Shearing force on cover layer due to ice-sheets riding up the revetment	Provide cover layer able to withstand load, design procedures are available CRREL (1980) and see Section 5.2.4)
Biological	Livestock	Grazing and trampling leading to destruction of vegetative protection	<ul style="list-style-type: none"> <li>● fence-off revetment</li> <li>● use non-degradable reinforcement to soil</li> </ul>
	Vermin	Burrowing into bank Gnawing through geotextiles or cables	Pest control Provide an impenetrable top layer
	Plant growth	Roots alter geometry of top layer	Vegetation control if necessary
	Seaweed and algae	Surface damage to asphaltic top layers	Bituminous sprays
	Microbes	Attack some natural fibres	Use resistant materials unless degradation is a specific requirement
Chemical	Oils and hydro-carbons	Attack bituminous systems	Avoid contact
	Sulphates	Attack concrete	Use sulphate resisting cement
	Other aggressive salts	Corrosion of steel wire, cables, connections	<ul style="list-style-type: none"> <li>● protect by galvanising and/or pvc coating</li> <li>● use heavier wires and cables, or suitable stainless steel wires and cables</li> </ul>