

Major breakage refers to breakage of individual armour stones along pre-existing defects, as shown in Figure 3.10 for armourstone with different geological origins. Any defects are controlled by the geology of the rock source and the production technique. For example, sedimentary rocks may contain bedding planes, stylolites, calcite veins or shaly partings, while igneous rocks may contain mineral veins, contacts between distinct petrographic units or cooling cracks. In addition, macro-flaws may be induced by blasting or fragmentation of the rock mass during extraction. If these defects propagate, a proportion of stones will be transformed into large fragments. If major breakage takes place on a significant number of stones, this may significantly affect the mass distribution of the armourstone and consequently the value of design parameters such as M_{50} or D_{n50} (see Section 3.6.6). Resistance to major breakage is known as **integrity**.

Minor breakage refers to breakages of asperities. This often occurs when stone edges or corners are knocked off during routine handling, by the traffic of heavy plant during construction, or during initial settlement of the structure (see Figure 3.11). This phenomenon takes place along new fractures created through the mineral fabric of the stone. It is often associated with bruising and crushing, and generally creates fragments of limited size (up to a few tens of kilogrammes) depending on the armourstone grading. This phenomenon has a limited impact on the mass distribution and the M_{50} value (see Section 3.6.6), but can contribute to edge rounding. Many strength tests exist for measuring the resistance of mineral fabric to breakage and are discussed in Section 3.8.5 but they do not correlate with armourstone integrity tests (Perrier *et al*, 2004).

In simple terms, **armourstone integrity** is the ability of armourstone pieces to withstand excessive breakage during their life cycle. It should not be confused with resistance to breakage through the mineral fabric, ie resistance to minor breakage that might be tested on small laboratory specimens or aggregates. From a survey of feedback from 200 professionals, including designers, contractors, quarry companies, port and waterways authorities, armourstone integrity was identified as an **essential property** (Dupray, 2002). Two aspects of integrity should be distinguished.

- 1 The integrity of armourstone as an individual piece is its ability not to display excessive breakage. The threshold for excessive breakage is discussed in Section 3.8.5.
- 2 The integrity of armourstone as a granular material is the ability of a consignment not to display excessive changes of mass distribution and especially of its characteristic masses.

Integrity is a property of heavy and light armourstone, among others such as shape characteristics, that may be evaluated by initial type tests, ie one-off tests giving information about an armourstone source to promote design optimisation. Such initial type testing is distinct from routine testing of the quality of consignments in association with factory production control.

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