



#### Notes

$F_s$  is the shape factor, see Section 3.4.2

$n_{RRD}$  is the uniformity coefficient of the size distribution curve, Section 3.4.3.3

**Figure 3.53** Illustration of theoretical scenarios for an aggregates blast and an armourstone blast applied to the same rock mass. IBSD and BBSD are represented by Rosin-Rammler curves

### 3.9.3.4

#### Suggestions for Improving the yields of armourstone

Generally, the proportion of armour stones in the blast increases with increasing tensile strength, increasing Young's Modulus and increasing discontinuity spacing. Normal blasting practice (eg for aggregates and ores) aims to achieve high-fragmentation blasts. By contrast, greater percentages of armour stones can be achieved by adjusting common practice through consideration of the following (see Figure 3.55 for definition of blasting terminology).

- 1 A low **specific charge**. Generally, a specific charge as low as 0.11–0.25 kg/m<sup>3</sup> can be used. If possible, the explosive used should have lower velocity of detonation,  $VOD$  (m/s). For such low specific charges, maintaining high drilling accuracy is critical to avoid insufficient rock break-out.
- 2 The **spacing-to-burden ratio** should generally be less than or equal to 1, with burden larger than the discontinuity spacing in a jointed rock mass.
- 3 If the **bench** is either too high or too low, armourstone production will be poor. For an initial estimate, bench height could be selected as two to three times the burden. In planning bench levels, the rock mass from which most armourstones might be produced, such as thickly bedded layers, should be located nearly at the top of the bench alongside the stemming section of the holes.
- 4 A large **stemming length**, larger than the burden, is usually recommended.
- 5 A small **blasthole diameter**. A diameter of less than 100 mm is recommended.
- 6 One row of holes is found to be better than multiple rows. If permitted, holes should be fired instantaneously rather than using inter-hole delaying (this may cause high ground vibration).
- 7 A **bottom charge** of high energy concentration is needed for the bottom to break clean away.
- 8 A **decoupled column charge** of ANFO (ammonium nitrate/fuel oil) packed in plastic sausages is effective when a 300–3000 kg range is recommended – the explosives are evenly distributed, giving quite even fragmentation.
- 9 A **decked charge**, to break up the continuity of explosives, will be necessary in most situations when armourstone greater than 3 t is recommended. The material for decking can be either air or aggregates.