High-compactability concrete: Concrete that enables economic construction of high-quality lining

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Construction of tunnel lining requires placing and compaction of concrete in an enclosed space, and involves risks of material separation and filling defects.
High-compactability concrete is a type of concrete that has the same unit water content and cement content as conventional concrete (15cm slump), but boasts superior fluidity, material segregation resistance, and filling capacity (Photo 1). Figure 1 is a conceptual diagram of the ratio of ingredients.
High compactability concrete has the following characteristics.

(1) The water content and cement content are the same as those in conventional concrete, so there is no increase in material costs and it is possible to prevent the occurrence of shrinkage cracks after hardening.
(2) Coarse aggregate with a maximum size of 40 mm is used, so the lateral pressure on the tunnel lining form is equivalent to the lateral pressure when conventional concrete is used, and there is no need for reinforcement of facilities.
(3) The concrete has high fluidity (21 cm slump) and filling capacity (over 28 cm filling height), so it easily flows and fills up the form to full capacity through light compaction even in crown sections.
(4) By using fly ash (powdery substance, powder-based high compactability concrete) and water reducing admixture (thickener, thickener-based high compactability concrete) that contains thickening ingredients, it is possible to prevent occurrence of back side cavities and clogging during pressure-feeding caused by material segregation.

Currently, high compactability concrete has been applied to tunnel lining construction on the Hokuriku Shinkansen Line.

Photo 1 External view of high compactability concrete

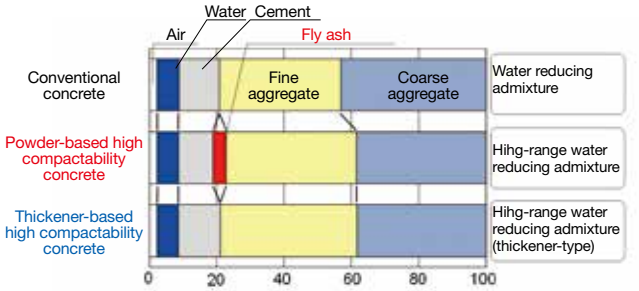

Fig. 1 Conceptual diagram of the ratio of ingredients of various types of concrete