PARTICULAR SPECIFICATION

APPENDIX BM

SPECIFICATION FOR THE USE OF GRANITE FINES IN STRUCTUAL CONCRETE

Definition

1. Granite fines, also known as crushed rock sand, stone fines or quarry dust, etc. shall refer to any product obtained by processing granite coarse aggregates. The geometrical, physical and chemical properties of granite fines shall be subject to routine quality control and laboratory testing to ensure compliance with the requirements in SS EN 12620: Specification for Aggregates for Concrete.

Maximum Percentage Replacement and Allowable Fines Content

2. The Contractor may use granite fines in combination with natural sand as fine aggregates in structural concrete, subject to the requirements described as follows:

    a) For concrete up to Grade 60, granite fines may be used to replace natural sand at any percentage, up to 100%;
    b) For concrete with higher than 50% (by weight) replacement of natural sand with granite fines, the Contractor/RMC producer shall conduct additional tests under trial mixes as shown in **Table 1.**
    c) Fines is defined in SS EN 12620 as particle size fraction of aggregate which passes the 0.063mm sieve. The maximum allowable fines content of the granite fines shall be 12% by weight of granite fines.

Performance Requirements	**Test Standard**	**Minimum Number of Specimens**	**Performance Specifications**
Tensile Splitting Strength at 28 days	BS EN 12390-6	3 specimens per concrete mix design, with 1 specimen from each batch of trial mixes	The average strength of the 3 specimens shall be at least $1.1 \times f_{ctm}$, where f_{ctm} is the mean value of axial tensile strength of the concrete calculated based on SS EN 1992-1-1 Table 3.1

Table 1: Tests Requirements for Concrete with >50% Replacement of Natural Sand with Granite Fines

3. For concrete higher than Grade 60, the use of granites fines in structural concrete may be allowed by the Engineer on a case-by-case basis, provided that comprehensive tests as shown in **Table 2** have been conducted to demonstrate that the concrete properties are comparable with those of the concrete using 100% natural sand and comply with the requirements in the Materials & Workmanship Specification for Civil & Structural Works.

Category	Performance Requirements	Test Standard	Minimum Number of Specimens
Workability	Slump	BS EN 12350-2	3 specimens per test
	Slump flow (for self-compacting concrete only)	BS EN 12350-8	
	Bleeding	BS EN 480-4	
	Setting time	ASTM C403	
Strengths	Compressive	BS EN 12390-3	
	Flexure	BS EN 12390-5	
	Tensile splitting	BS EN 12390-6	
Deformation characteristics	Creep	BS ISO 1920-9	
	Drying shrinkage	BS ISO 1920-8	
Durability	Water penetration	BS EN 12390-8	
	Rapid chloride penetration	ASTM C1202	

Table 2: Tests Requirements for Concrete Deviating from the Guidelines in Clause 2

Quality Assurance and Quality Control Requirements for Granite Fines and Concrete Containing Granite Fines

4. The Contractor/RMC producer shall take note and comply with Building Construction Authority's (BCA) testing requirements for imported coarse and fine aggregates.

5. The Contractor/RMC producer shall also conduct tests on granite fines at the source/country of origin and on samples collected from local storage as stated in **Table 3**. This shall be in addition to the routine tests on fine aggregates in accordance with SS EN 12620.

6. The Engineer reserves the right to ask for further tests on granite fines as listed in **Table 3** and in SS EN 12620 when he deems required.

7. The Contractor/RMC producer shall undertake routine control and laboratory testing to ensure that the concrete containing granite fines complies with SS EN 206: Concrete - Specification Performance, Production and Conformity; and LTA M&W Specification for Civil & Structural Works.

8. The Contractor shall include the following information in the concrete mix design report for the Engineer's acceptance:
   a) Source/country of origin of granite fines
   b) Delivery and storage of granite fines
   c) Percentage replacement
   d) Test results of granite fines based on SS EN 12620 and **Table 3**

No.	Performance Requirements	Test Standard	Frequency of Tests		Performance Specifications
			At source /country of origin	Samples collected from local storage (tests by SAC-SINGLAS accredited laboratory)	
1	Grading for particle size distribution & fines content	BS EN 933-1	One per source of supply	1 per week	Fines content ≤12%
2	Fines quality (Methylene Blue Test)	BS EN 933-9		1 per week	≤1.4g/kg
3	Water absorption & particle density	BS EN 1097-6		1 per month	Uniformity check on declared value

Table 3: Additional Test Requirements on Granite Fines