

香港特別行政區政府
The Government of the Hong Kong Special Administrative Region

政府總部
發展局
工務科
香港添馬添美道 2 號
政府總部西翼 18 樓



Works Branch
Development Bureau
Government Secretariat
18/F, West Wing,
Central Government Offices,
2 Tim Mei Avenue, Tamar, Hong Kong

Ref : DEVB(W) 810/17/02

Group : 5, 7

5 September 2018

Development Bureau
Technical Circular (Works) No. 8/2018

Use of Manufactured Sand in Public Works Contracts

Scope

This Circular promulgates the policy of adopting manufactured sand for local production of cement mortar to be used in plastering, rendering and floor screeding works of all public works contracts.

Effective Date

2. This Circular shall take immediate effect.

Effect on Existing Circulars and Circular Memoranda

3. This Circular has no effect on existing circulars and circular memoranda.

Background

4. River sand used in Hong Kong is mainly imported from the Guangdong Province. To stay in line with the National Policy of protecting natural resources, the Mainland Government announced in 2009 to gradually reduce the annual export quota of river sand to Hong Kong and other places.

5. In view of the above, the Construction Industry Council has conducted a study¹ and recommended the adoption of manufactured sand (M-sand), which is defined as fine aggregates with improved particle shape and grading processed from crushed rock or gravel, as a river sand substitute for production of cement mortar. Trials completed by the Architectural Services Department and the Housing Department in 2017 and 2018 confirmed that with compliance of specified technical requirements, M-sand could replace river sand for cement mortar production to be used in plastering, rendering and floor screeding works with no major technical issues.

6. To cope with the dwindling import quota of river sand and assist in establishing a steady local supply of river sand substitutes, the Works Policies Coordination Committee, in its meeting on 26 April 2018, endorsed to mandate the adoption of M-sand for local production of cement mortar to be used in plastering, rendering and floor screeding works of all public works contracts.

Policy

7. All public works contracts, including design and build contracts and term contracts, the tender invitations of which are issued **on or after 1 October 2018**, shall adopt M-sand for local production of cement mortar to be used in plastering, rendering and floor screeding works through incorporation of the Particular Specification at **Appendices A and B**.

8. Should there be any genuine difficulties (e.g. supply shortage) in complying with the mandatory requirement, approval for exemption should be obtained from the subject D2 or above officer of the relevant works departments. Works departments shall keep the Development Bureau informed of details and reasons of any exemptions granted.

¹ The Construction Industry Council's study entitled "River Sand Substitutes for Concrete Production and Cement Sand Mortar Production" was completed in 2016.

9. The policy is not applicable to “pre-mixed plaster” which is factory-produced in Mainland or other countries by weighted combination of plaster raw materials and chemicals, and is supplied to construction sites in bags.

10. Further, works departments are recommended to explore the feasibility of adopting M-sand in other types of works with a view to further reducing the consumption of river sand in public works contracts. The increased use of M-sand in public works contracts could facilitate the development of a supply chain of M-sand in Hong Kong, which would make our industry more resilient against possible shortage of river sand.

Enquiries

11. Enquiries on this Circular should be addressed to Chief Assistant Secretary (Works)⁵.

(C K HON)

Permanent Secretary for Development (Works)

**PARTICULAR SPECIFICATION FOR
MANUFACTURED SAND FOR LOCAL PRODUCTION OF CEMENT MORTAR
IN PLASTERING, RENDERING AND FLOOR SCREEDING WORKS**

(For Civil Engineering Contracts)

SECTION 24

BUILDING WORKS

PART 5: PLASTERWORK AND OTHER FINISHES

MATERIALS

- Cement, water and manufactured sand*** 24.65A GS Clause 24.65 does not apply to production of cement mortar to be used in plasterwork and other finishes, and is replaced by the following:
- (1) Cement for plasterwork and other finishes shall be PC complying with BS EN 197-1.
 - (2) Water for plasterwork and other finishes shall be stated as in Clause 16.09.
 - (3)(a) Sand for mixes for plasterwork and other finishes shall be manufactured sand which is defined as crushed fine aggregates processed to improve the particle shape and grading for enhancing the performance of the material. The processing applied to the crushed fine aggregate may include grinding, screening and cleaning.
 - (b) Recycled aggregates may be used for production of manufactured sand subject to the prior agreement of the Engineer. Aggregates from marine source and all-in aggregates shall not be used.
 - (c) This PS covers aggregates having an oven-dried particle density not less than 2,000 kg/m³, and does not cover lightweight aggregates and heavyweight aggregates.
 - (d) In the event that difficulties are encountered (such as supply shortage) for procurement of manufactured sand, approval from the Engineer should be sought for exemption provided with justifications. If the Engineer is satisfied that there is genuine difficulty in procuring manufactured sand, clean natural sand complying with the technical specifications and other associated requirements specified in Part 5: Plasterwork and other Finishes under Section 24 – Building Works of GS may be used in some or all of the work under

this part. The following clauses in regard to the use of manufactured sand shall not be adopted.

(4) The chloride content of manufactured sand or crushed rock shall not exceed 0.03 % by mass when determined in accordance with CS3: 2013.

(5) When manufactured sand is used for production of cement mortar in plasterwork and other finishes, the constituents shall be mixed in the cement: manufactured sand ratio of 1:3 by volume except for the uses specified in Clauses 24.98A, 24.109A and 24.113A.

(6) Cement mortar shall be mixed by addition of minimum amount of water necessary for achievement of the required workability. The water: cement ratio should be not more than 3:5.

***Premixed
plaster***

24.66A The following is added after GS Clause 24.66(5):

(6) Locally manufactured pre-mixed plaster used in the Contract should be made with manufactured sand.

SUBMISSIONS

***Particulars of
plasterwork and
other finishes***

24.86A GS Clause 24.86 is deleted and replaced by the following:

(1) The following particulars of the proposed materials for plasterwork and other finishes shall be submitted to the Engineer:

- (a) A certificate for cement, gypsum plaster and lime showing the manufacturer's name, the date and place of manufacture and the material's compliance with the requirements stated in the Contract;
- (b) A certificate for stone chippings and each type of aggregate showing the source of the material and the material's compliance with the requirements stated in the Contract, and including results of tests as appropriate, for
 - Grading
 - Silt content
- (c) Test certificates for manufactured sand showing the source of the material and giving the results of tests for the geometrical, physical and chemical properties as specified in **Annex** to this PS shall be submitted together with the material submission and when required by the Engineer; and
- (d) Manufacturer's literature and a certificate for each type of tile and fittings showing the manufacturer's name, the date and place of manufacture and the tiles' compliance

with the requirements stated in the Contract.

(2) The particulars, including certificates, shall be submitted to the Engineer at least 14 days before the first delivery of the material to the Site. Certificates shall be submitted for each batch of the material delivered to the Site.

(3) For quality control and monitoring, test certificates for manufactured sand giving the results of tests for the physical and chemical properties as set out at **Annex** to this PS shall be submitted every three months unless agreed otherwise by the Engineer.

(4) The issue date of the test certificates for manufactured sand giving the results of tests required shall be within (i) three months for grading; and (ii) six months for other properties counting from the date of submission.

Samples of materials

24.88A GS Clause 24.88 is deleted and replaced by the following:

(1) Samples of the following proposed materials shall be submitted to the Engineer at the same time as particulars of the materials are submitted:

(a) Stone chippings and aggregates;

(b) Tiles and fittings; and

(c) Tile adhesives and tile grout.

(2) Samples of manufactured sand shall be taken in accordance with the procedures described in Section 8 of CS3:2013 or as agreed with the Engineer.

PLASTERING AND RENDERING

Applying spatterdash to new concrete

24.98A GS Clause 24.98 (2) is deleted and replaced by the following:

(2) Spatterdash shall consist of cement and coarse manufactured sand or granite fines in the proportions 1:2 by volume mixed with the minimum amount of water necessary to achieve the consistency of a thick slurry. Spatterdash shall be thrown with a hand trowel onto the surface to a thickness not exceeding 6 mm and shall cover at least 60% of the area that is to be plastered or rendered. Spatterdash shall be wetted one hour after application and shall be allowed to cure and harden before undercoats are applied.

Mixing plaster and render

24.105A GS Clause 24.105 is deleted and replaced by the following:

(1) Mixing plaster and render shall be in accordance with

BS 8000: Part 10: 1995. Too strong or too wet render mix that will increase the render drying shrinkage should be avoided. Plaster and render shall be mixed using the minimum amount of water necessary to achieve the required consistency and shall be used within one hour after mixing. The mixed materials shall not be reconstituted and shall not be used after the initial set has taken place. Unless otherwise permitted by the Engineer, the materials shall be mixed by mechanical methods.

(2) Renders containing plasticizers shall not be over-mixed and the constituents shall be dried before mixing with lime putty or water.

(3) Admixtures should not be used for mixing gypsum plasters.

Cement render 24.107A GS Clause 24.107 is deleted and replaced by the following:

(1) Cement render shall consist of cement and manufactured sand or granite fines in the proportions 1:3 by volume.

(2) Cement render with a specified finished thickness of 10 mm or less shall be applied in one layer. Cement render with a specified finished thickness exceeding 10 mm but not exceeding 20 mm shall be applied in two layers of equal thickness.

Gypsum plaster 24.108A GS Clause 24.108 is deleted and replaced by the following:

(1) Gypsum plaster shall be applied in two coats on solid backgrounds. The first coat shall consist of Browning plaster and manufactured sand in the proportions 1:2 by volume and the finishing coat shall consist of neat finish plaster to give a total thickness not exceeding 10 mm.

(2) Gypsum plaster shall be applied in three coats on metal lathing. The first coat shall consist of metal lathing plaster and manufactured sand in the proportions 1:1½ by volume. The second coat and the finishing coat shall be as stated in Clause 24.108A(1) for the first coat and the finishing coat respectively. The total thickness shall not exceed 13 mm measured from the outer face of the metal lathing.

Lime plaster 24.109A GS Clause 24.109 is deleted and replaced by the following:

(1) Apply internal lime plaster in two coats on solid backgrounds as follows:

(a) The proportions of cement: manufactured sand mix for the undercoat shall be 1:3 by volume;

(b) Finishing coats shall use lime plaster (with cement: lime: manufactured sand in the proportions 1:2:6 by volume) gauged with not more than 25% by volume of lime putty;

- (c) Thickness of undercoat shall not exceed 10 mm to walls and 5 mm to soffits;
- (d) Thickness of finishing coat to walls and soffits shall be at least 3 mm;
- (e) Allow three days for the undercoats to dry out thoroughly before applying the next coat. Cross scratch undercoats to provide key for the next coat; and
- (f) Total thickness of plaster shall not exceed 15 mm to walls and 10 mm to soffits.

(2) Lime plaster for internal use shall be applied in three coats on metal lathing. The first coat and the second coat shall consist of cement, lime and manufactured sand in the proportions 1:2:6 by volume. The finishing coat shall consist of cement, lime and manufactured sand in the proportions 1:2:6 by volume and shall be 5 mm thick. The total thickness shall not exceed 13 mm measured from the outer face of the metal lathing.

**Shanghai
plaster**

24.110A GS Clause 24.110 is deleted and replaced by the following:

(1) Shanghai plaster shall be applied in two coats, each 10 mm thick. The base coat shall consist of cement and manufactured sand in the proportions 1:3 by volume. The finishing coat shall consist of cement and stone chippings or marble chippings in the proportions 1:1 by volume. The chippings shall be mixed in one of the proportions stated in Table 24.6.

(2) After the finishing coat has set, the surface shall be scrubbed to expose the aggregate.

Table 24.6: Proportions of chippings in Shanghai plaster

Colour of Shanghai Plaster	Cement	Proportions of chippings by mass (%)				
		Stone chippings			Marble chippings	
		Dark grey	Light grey	White	Black	White
Dark	Ordinary	70	-	20	10	-
Medium	White	60	20	20	-	-
Light	White	5	75	-	-	20
White	White	-	-	-	-	100

SCREEDS, TERRAZZO AND GRANOLITHIC CONCRETE

Screeds

24.113A GS Clause 24.113 is deleted and replaced by the following:

- (1) Floor screeds exceeding 40 mm thick shall consist of cement, manufactured sand or granite fines and coarse aggregate in the proportions 1:1½:3 by volume. The coarse aggregate shall be graded such that 100% passes a 10 mm BS test sieve and 75% is retained on a 5 mm BS test sieve.
- (2) Lightweight screeds shall consist of cement and lightweight aggregate in the proportions 1:8 by volume for roofs and 1:6 by volume for floors unless otherwise approved by the Engineer. The screed shall be finished with cement and manufactured sand or granite fines in the proportions 1:4 by volume.
- (3) Other screeds shall consist of cement and manufactured sand or granite fines in the proportions 1:3 by volume.
- (4) Wall screeds shall be at least 10 mm thick. The surface shall be lightly scratched to form a key.
- (5) Floor screeds that are to be laid monolithically with the base shall be at least 15 mm thick and shall be applied within 3 hours after laying the base. Floor screeds that are to be bonded to a hardened concrete base shall be at least 20 mm thick.
- (6) Lightweight screeds shall be at least 50 mm thick excluding the topping. The topping shall be at least 15 mm thick and shall be laid monolithically with the screed.
- (7) Vapour barriers for lightweight roof screeds shall be laid flat without creases. Laps shall be at least 150 mm.
- (8) Screeds shall be laid between timber battens and in bays not exceeding 15 m². The length of each bay shall not exceed 1½ times the width of the bay and the top surface of the batten shall be set to the required level. Screeds shall be compacted to a uniform density throughout.
- (9) Screeds shall be completed with one of the following surface finishes as stated in the Contract:
 - (a) A smooth untextured finish using a steel trowel or power float;
 - (b) An even textured finish using a wood float; or
 - (c) A slightly roughened textured finish using a stiff brush.

Terrazzo

24.114A GS Clause 24.114 is deleted and replaced by the following:

- (1) Terrazzo shall be applied in two coats. The minimum thickness of each coat shall be as stated in Table 24.7. The first coat shall consist of cement and manufactured sand or granite fines in the proportions 1:3 by volume. The finishing coat shall consist of white or coloured cement and marble aggregate in the proportions 1:3 by volume. The finishing coat shall be applied before the first coat has set.
- (2) Terrazzo shall be laid in bays not exceeding 1 m². The length of each bay shall not exceed 1½ times the width of the bay. Bays shall be laid in a chequer board pattern and 24 hours shall be allowed between laying adjacent bays. Bays shall be separated from other bays and from adjacent finishes to the complete depth of both coats by 3 mm thick brass strips. Terrazzo shall be compacted to a uniform density throughout.
- (3) After curing has been completed as stated in Clause 24.119, the surface of terrazzo shall be ground to a smooth finish and to expose the aggregate. Voids in the surface shall be filled with matching cement.
- (4) One coat of wax polish shall be applied to the surface of wall finishes. Floor finishes shall not be highly polished or wax polished.

Table 24.7: Thickness of finish of Terrazzo

Location	First coat	Finishing coat
Floors	10mm	15mm
Walls and dadoes	10mm	10mm
Treads	-	20mm
Risers	-	15mm

TILING

Floor tiles

24.116A GS Clause 24.116 is deleted and replaced by the following:

- (1) Floor tiles on concrete bases shall be laid by the semi-dry method as stated in Clauses 24.116A(2) to (4).
- (2) The tiles shall be laid on a bed of cement and manufactured sand in the proportions 1:3 by volume. The bed shall be mixed semi-dry and shall be at least 20mm thick. The concrete base that is to receive the tiles and the bed shall be prepared and cleaned as stated in Clause 24.111.
- (3) The tiles shall be immersed in water for 30 minutes and shall be allowed to drain immediately before laying. The cement and manufactured sand bed shall be compacted and finished to the required level. A slurry of cement and manufactured sand in the proportions 1:1 by volume shall be mixed with the minimum amount of water necessary to achieve a creamy consistency and shall be spread and trowelled over the bed to a nominal thickness of 3 mm. The tiles shall be firmly bedded into the slurry to leave straight and even joints. Tiles with minor variation in colour shall be placed at random locations.
- (4) After the bed has set, the tiles shall be grouted with a mix of cement and manufactured sand in the proportions 1:1 by volume together with the minimum amount of water necessary to achieve the required workability. Surplus grout shall be cleaned from the face of tiles as work proceeds.
- (5) Floor tiles on floor screeds shall be laid by the thick bed method as stated in Clauses 24.116A(6) to (8).
- (6) The tiles shall be laid on a bed of cement and manufactured sand or granite fines in the proportions 1:3 by volume. The bed shall be approximately 15 mm thick and shall not be thicker than the tiles. The screed shall be dampened with clean water to prevent water being absorbed from the bed.
- (7) Before laying, the tiles shall be immersed in water for 30 minutes and allowed to drain and the back of tiles shall be coated with a slurry of cement together with the minimum amount of water necessary to achieve a creamy consistency. The tiles shall be firmly tamped into the bed to leave straight and even joints. Tiles with minor variations in colour shall be placed at random locations.
- (8) After the bed has set, the tiles shall be grouted with a mix of cement and manufactured sand in the proportions 1:1 by volume together with the minimum amount of water necessary to achieve the required workability. Surplus grout shall be cleaned from the face of tiles as work proceeds.

(9) After laying floor tiles, no traffic shall be allowed on the floor for the first 4 days and after that only light traffic as approved by the Engineer is allowed for the next 10 days

Wall tiles

24.117A GS Clause 24.117 is deleted and replaced by the following:

(1) Wall tiles shall be fixed to wall screeds as stated in Clauses 24.116A(5) to (8) except as stated in Clauses 24.117A(2) to (9).

(2) Glazed wall tiles shall be laid on a bed of cement and manufactured sand or granite fines in the proportions 1:3 by volume. The bed shall be at least 5 mm, and shall not exceed 15 mm, thick. Mosaic tiles shall be laid on a bed of cement and manufactured sand or granite fines in the proportions 1:3 by volume. The bed shall be 10 mm thick. Plain or coloured cement and water shall be mixed to a creamy consistency and white cement shall not be used except otherwise stated. Tiles with minor variations in colour shall be placed at random locations.

(3) Glazed wall tiles shall be soaked in clean water for at least 30 minutes and stacked to drain and fix as soon as the surface water has drained from them. Mosaic tiles shall not be soaked but the wall render shall be dampened with clean water sufficiently to prevent the mosaic tiles absorbing water from the bedding mortar.

(4) The backs of glazed wall tiles shall be coated with a mortar of cement and manufactured sand or granite fines in the proportions 1:3 by volume. The glazed wall tiles shall be tamped firmly into position so that the bed is uniformly spread throughout to a minimum thickness of 3 mm and not more than 6 mm at localised areas for rectification of slight variations in the trueness of the render background. The tiles and joints shall be cleaned before the bedding hardens.

(5) The backs of sheets of mosaic tiles shall be coated with a slurry of cement of the same colour as the final grout. The backing paper of mosaic tiles shall be removed and final straightening of the tiles shall be carried out as the sheets are fixed firmly into position. The surface shall be rubbed with grout and coloured, as required, to fill the joints and clean any surplus from the face of the tiles as the work proceeds.

(6) Glazed wall tiles and mosaic tiles shall be grouted with a final grout of white cement and powdered limestone in the proportions 1:3 by volume.

(7) When cement-based adhesive bedding method is used to fix wall tiles, the tiling work shall be carried out in accordance with BS 5385: Part 1: 2018 and the following:

(a) Site demonstration is to be carried out by the adhesive supplier on the whole application procedures before

commencing the tiling works;

- (b) Tiles shall be cleaned free of dust and loose powder and left thoroughly dry before immediate application;
- (c) Tiles shall not be wetted when fixing with tile adhesive unless stated in the manufacturer's recommendations;
- (d) Tile adhesive shall be prepared and mixed in strict accordance with the manufacturer's recommendations;
- (e) The adhesive shall be applied by notched trowelling and buttering method; and
- (f) For fixing mosaic tiles with adhesive, in addition to (a) to (e) of this sub-clause, attention to BS 5385: Part 1: 2018 for internal walls and BS 5385: Part 2: 2015 for external walls are required. The joints shall be grouted with a proprietary grout applied in accordance with the grout manufacturer's recommendations.

Roof tiles

24.118A GS Clause 24.118 is deleted and replaced by the following:

- (1) Roof tiles shall be laid on a bed of cement and manufactured sand in the proportions 1:4 by volume.
- (2) Roof tiles shall be laid loose and hot bitumen shall be poured between the joints and pointed.
- (3) 25 mm wide joints shall be formed for each 3 m of roof tiles, and 75 mm wide joints shall be formed around the perimeter of roof tiles, to allow for expansion.

TESTING

Manufactured sand

24.121A The following is added as a new clause after GS Clause 24.121:

- (1) The quality tests and sampling for manufactured sand are specified in **Annex** to this PS.
- (2) When manufactured sand is used for plastering and rendering works, upon the request of the Engineer, pull-out tests shall be carried out at the age of 28 days after application of the plastering or rendering. The pull-out strength should be not less than 0.5 MPa measured in accordance with BS EN 1015-12.

**TECHNICAL SPECIFICATIONS AND ASSOICATED REQUIREMENTS FOR
USE OF MANUFACTURED SAND**

(For Civil Engineering Contracts)

***Terms and
definitions***

1. For the purpose of this Particular Specification, the following terms and definitions shall apply:

(a) Manufactured Sand

Manufactured sand is crushed fine aggregates processed to improve the particle shape and grading for enhancing the performance of the material. The processing applied to the crushed fine aggregate may include grinding, screening and cleaning.

(b) Aggregate

Granular material used in construction; it may be natural or recycled.

(i) Natural Aggregate

Aggregate from mineral sources subjected to nothing more than mechanical processing.

(ii) Recycled Aggregate

Aggregate resulting from the processing of old concrete.

(iii) Coarse Aggregate

Aggregate mainly retained on a 5 mm test sieve and contains no more finer material than is permitted.

(iv) Fine Aggregate

Aggregate mainly passing a 5 mm test sieve and contains no more coarser material than is permitted.

(v) Fines

Particle size fraction of an aggregate passing the 75 μm test sieve.

(vi) Grading

Particle size distribution expressed as the percentages by mass passing a specified set of test sieves.

(vii) Test Sieve

Test sieve of metal wire cloth complying with ISO 3310-1:2000 or of square-hole perforated metal plate complying with ISO 3310-2:1999.

(viii) Designations d/D

All aggregates shall be described in terms of aggregate sizes using the designations d/D , in which d is the lower sieve size and D is the upper sieve size. An aggregate of size d/D is an aggregate mainly retained on the d size test sieve and passing the D size test sieve.

(ix) Constant Dry Mass

A test portion or test specimen is regarded to have achieved constant dry mass after it has been heated in an oven at a temperature of $105 \pm 5^\circ\text{C}$ for at least 24 hours, or its change in mass is within 0.1% when weighed at an interval of 1 hour after heating at $105 \pm 5^\circ\text{C}$ for a minimum of 16 hours.

GEOMETRICAL PROPERTIES

**Aggregate
size**

2. Manufactured sand for cement mortar is limited to fine aggregates with an upper sieve size of not larger than 5.0 mm. Coarse aggregates shall not be used. Depending on the thickness of mortar application and the surface finish wanted, the upper sieve size of the aggregates may be selected between 5.0 mm and 2.36 mm.

Grading

3. (a) The grading of manufactured sand, i.e. C (coarse graded), M (medium graded) or F (fine graded) as determined in accordance with Section 10 of CS3:2013, shall be declared and documented by the manufactured sand producer or supplier. This grading shall comply with both the overall limits and the limits for the declared grading given in Table 1 and Table 2 below for fine aggregates of size 0/5.0 mm and 0/2.36 mm, respectively. In addition, not more than one in ten consecutive samples shall have a grading outside the limits for the declared grading.
- (b) Manufactured sand for cement mortar not incorporating lime shall conform to the grading limits set out in Table 1, whilst manufactured sand for cement mortar incorporating lime shall conform to the grading limits set out in Table 2. Lime shall be hydrated lime to BS EN 459-1, delivered in sealed bags bearing the manufacturer's name or brand.

- (c) Manufactured sand of grading C (coarse graded) shall not be used unless prior approval from the Engineer is obtained.

Table 1 - Grading test of manufactured sand of size 0/5.0 mm

Sieve size	Percentage by mass passing test sieves (%)			
	Overall limits	Limits for declared grading		
		C	M	F
10 mm	100	-	-	-
5 mm	89-100	-	-	-
2.36 mm	60-100	60-100	65-100	80-100
1.18mm	30-100	30-90	45-100	70-100
600 µm	15-100	15-54	25-80	55-100
300 µm	5-70	5-40	5-48	5-70
150 µm	0-20	-	-	-

Table 2 - Grading test of manufactured sand of size 0/2.36 mm

Sieve size	Percentage by mass passing test sieves (%)			
	Overall limits	Limits for declared grading		
		C	M	F
5 mm	100	-	-	-
2.36 mm	89-100	-	-	-
1.18mm	60-100	60-100	65-100	80-100
600 µm	30-100	30-90	45-100	70-100
300 µm	15-100	15-54	25-80	55-100
150 µm	5-70	5-40	5-48	5-70
75 µm	0-14	-	-	-

Fines content

4. The amount of material passing the 75 µm test sieve as determined in accordance with Section 10 of CS3:2013, shall not exceed the quantities given in Table 3.

Table 3 - Limit for fines content

Fines content class	Maximum percentage by mass passing 75 µm test sieve (%)
F5	5

Foreign materials content

5. The maximum content of foreign materials in the manufactured sand as determined by manual sorting shall not exceed the quantities given in Table 4.

Table 4 - Limits for foreign materials in the manufactured sand

Type of foreign materials	Maximum percentage by mass (%)
Wood and other material less dense than water	0.5
Other foreign materials (e.g. shell, metals, plastics, clay lumps, asphalt and tar etc.)	1.0

Angularity

6. The shape of manufactured sand shall be sub-angular, sub-rounded or rounded. Angular manufactured sand is unacceptable.

PHYSICAL PROPERTIES

Particle density

7. The oven-dried particle density of manufactured sand as determined in accordance with Section 17 of CS3:2013, shall not be less than 2,000 kg/m³.

Durability

8. (a) Drying Shrinkage

The drying shrinkage of the manufactured sand as determined in accordance with Section 20 of CS3:2013, shall not exceed 0.075%.

- (b) Alkali-silica Reactivity

- (i) The linear expansion of mortar-bars immersed in NaOH solution at elevated temperature as determined in accordance with Section 22 of CS1:2010, shall be evaluated using Equation 22-1 of CS1:2010.

The potential alkali-reactivity of manufactured sand can then be obtained from Table 10 of CS1:2010.

- (ii) Alternatively, the concrete prism test in accordance with Section 23 of CS1:2010 may also be used and the potential alkali-reactivity of manufactured sand can then be obtained from Table 13 of CS1:2010.
- (iii) Manufactured sands fall into the alkali “Reactive” category shall not be used unless prior approval of the Engineer is obtained.

CHEMICAL PROPERTIES

Chlorides

9. (a) Water-Soluble Chloride Ion Content

The water-soluble chloride ion content of natural aggregates of manufactured sand shall be determined in accordance with Clause 21.3 of Section 21 of CS3: 2013.

(b) Acid-Soluble Chloride Ion Content

The acid-soluble chloride ion content of recycled aggregates of manufactured sand shall be determined in accordance with Clause 21.4 of Section 21 of CS3: 2013.

(c) Chloride Ion Content

The total chloride ion contents of natural aggregates and recycled aggregates of manufactured sand shall not exceed 0.03% by mass.

10. (a) Acid-Soluble Sulphate Content

(i) The acid-soluble sulphate content of natural aggregates of manufactured sand as determined in accordance with Clause 21.5 of Section 21 of CS3:2013, shall not exceed 0.8% by mass.

(ii) The acid-soluble sulphate content of recycled aggregates of manufactured sand as determined in accordance with Clause 21.5 of Section 21 of CS3:2013, shall not exceed 1.0% by mass.

(b) The total sulphur content of the natural aggregate of manufactured sand, when determined in accordance with Clause 21.6 of Section 21 of CS3:2013, shall not exceed 1.0% by mass.

***Other
constituents***

11. (a) Manufactured sand shall be clean and free of organic substances. The manufactured sand producer or supplier shall demonstrate that the supplied manufactured sand is clean and free of organic substances or alternatively the presence of organic substances does not affect the stiffening or hardening of mortar.
- (b) The presence of organic substances in the form of humus shall be determined in accordance with Clause 21.7 of Section 21 of CS3:2013. Where the test result under Clause 21.7 is negative, the manufactured sand shall be considered to be free of organic substances. Otherwise, the manufactured sand shall be further tested in accordance with Section 22 of CS3:2013 to assess the effect of organic substances on the stiffening time and compressive strength of mortar. The organic substances shall be of such proportion that:
- (i) the stiffening time of mortar test specimens does not increase by more than 120 minutes; and
- (ii) the 28-day compressive strength of mortar test specimens does not decrease by more than 20%.

**PARTICULAR SPECIFICATION FOR
MANUFACTURED SAND FOR LOCAL PRODUCTION OF CEMENT MORTAR
IN PLASTERING, RENDERING, FLOOR SCREEDING WORKS**

(For Building Contracts)

1. General

1.1 Specifications and Standards

- (i) This Particular Specification is to be read in conjunction with the latest edition of the General Specification for Building (“the General Specification”) together with all current amendments thereto issued by the Architectural Services Department.
- (ii) All clauses and description in the General Specification are relevant to the Works and are to apply wherever applicable. This Particular Specification is an amplification of the General Specification and refers only to those clauses and items which are at variance with or are not specified in the General Specification.
- (iii) This Particular Specification also refers to the following standards issued by Civil Engineering and Development Department:
 - (a) Construction Standard CS1:2010 – Testing Concrete (“CS1:2010”)
 - (b) Construction Standard CS3:2013 – Aggregates for Concrete (“CS3:2013”)

- 1.2 In the event of any doubt or discrepancy, this Particular Specification shall prevail and the Supervising Officer’s attention shall be drawn to such discrepancy or lack of information as soon as possible in order that he may advise the Contractor the required Specification.

2. Terms and Definitions

- 2.1 For the purpose of this Particular Specification, the following terms and definitions shall apply:

- (i) **Manufactured Sand**

Manufactured sand is defined as a crushed fine aggregate which has been processed to improve the particle shape and grading for enhancing the performance of the crushed fine aggregate. The processing applied to the crushed fine aggregate may include grinding, screening and cleaning.

- (ii) **Aggregate**

Granular material used in construction; it may be natural or recycled.

- (iii) **Natural Aggregate**

Aggregate from mineral sources subjected to nothing more than mechanical processing. Natural sand shall not be used.

(iv) Recycled Aggregate

Aggregate resulting from the processing of old concrete.

(v) Coarse Aggregate

Aggregate mainly retained on a 5 mm test sieve and containing no more finer material than is permitted.

(vi) Fine Aggregate

Aggregate mainly passing a 5 mm test sieve and containing no more coarser material than is permitted.

(vii) Fines

Particle size fraction of an aggregate passing the 75 μm test sieve.

(viii) Grading

Particle size distribution expressed as the percentages by mass passing a specified set of test sieves.

(ix) Test Sieve

Test sieve of metal wire cloth complying with ISO 3310-1:2000 or of square-hole perforated metal plate complying with ISO 3310-2:1999.

(x) Designations d/D

All aggregates shall be described in terms of aggregate sizes using the designations d/D , in which d is the lower sieve size and D is the upper sieve size. An aggregate of size d/D is an aggregate mainly retained on the d size test sieve and passing the D size test sieve.

(xi) Constant Dry Mass

A test portion or test specimen is regarded to have achieved constant dry mass after it has been heated in an oven at a temperature of $105 \pm 5^\circ\text{C}$ for at least 24 hours, or its change in mass is within 0.1% when weighed at an interval of 1 hour after heating at $105 \pm 5^\circ\text{C}$ for a minimum of 16 hours.

3. **Scope**

3.1 This Particular Specification is applicable to manufactured sand made of natural aggregates and recycled aggregates only. It covers aggregates having an oven-dried particle density not less than $2,000 \text{ kg/m}^3$, and does not cover lightweight aggregates and heavyweight aggregates.

3.2 Manufactured sand shall be used in local production of cement mortar in plastering, rendering and floor screeding works.

- 3.3 Locally manufactured pre-mixed plaster used in the Contract should be made with manufactured sand.

4. **Geometrical Requirements**

4.1 Aggregate Size

Manufactured sand for cement mortar is limited to fine aggregates with an upper sieve size of not larger than 5.0 mm. Coarse aggregates shall not be used. Depending on the thickness of mortar application and the surface finish wanted, the upper sieve size of the aggregates may be selected between 5.0 mm and 2.36 mm.

4.2 Grading

- (i) The grading of manufactured sand i.e. C (coarse graded), M (medium graded) or F (fine graded) as determined in accordance with Section 10 of CS3:2013, shall be declared and documented by the manufactured sand producer or supplier. This grading shall comply with both the overall limits and the limits for the declared grading given in Tables 1 and 2 below for fine aggregates of size 0/5.0 mm and 0/2.36 mm, respectively. In addition, not more than one in ten consecutive samples shall have a grading outside the limits for the declared grading.

Table 1 - Grading test of manufactured sand of size 0/5.0 mm

Sieve size	Percentage by mass passing test sieves (%)			
	Overall limits	Limits for declared grading		
		C	M	F
10 mm	100	-	-	-
5 mm	89-100	-	-	-
2.36 mm	60-100	60-100	65-100	80-100
1.18mm	30-100	30-90	45-100	70-100
600 µm	15-100	15-54	25-80	55-100
300 µm	5-70	5-40	5-48	5-70
150 µm	0-20	-	-	-

Table 2 - Grading test of manufactured sand of size 0/2.36 mm

Sieve size	Percentage by mass passing test sieves (%)			
	Overall limits	Limits for declared grading		
		C	M	F
5 mm	100	-	-	-
2.36 mm	89-100	-	-	-
1.18mm	60-100	60-100	65-100	80-100
600 µm	30-100	30-90	45-100	70-100
300 µm	15-100	15-54	25-80	55-100
150 µm	5-70	5-40	5-48	5-70
75 µm	0-14	-	-	-

- (ii) Manufactured sand for cement mortar not incorporating lime shall conform to the grading limits set out in Table 1, whilst manufactured sand for cement mortar incorporating lime shall conform to the grading limits set out in Table 2. Lime shall be hydrated lime to BS EN 459-1, delivered in sealed bags bearing the manufacturer's name or brand.
- (iii) Manufactured sand of grading C (coarse graded) shall not be used unless prior approval from the Supervising Officer is obtained.

4.3 Fines Content

The amount of material passing the 75 µm test sieve as determined in accordance with Section 10 of CS3:2013, shall not exceed the quantities given in Table 3.

Table 3 - Limit for fines content

Fines content class	Maximum percentage by mass passing 75 µm test sieve (%)
F5	5

4.4 Foreign Materials Content

The maximum content of foreign materials in the manufactured sand as determined by manual sorting in accordance with BRE Digest 433, shall not exceed the quantities given in Table 4.

Table 4 - Limits for foreign materials in the manufactured sand

Type of foreign materials	Maximum percentage by mass (%)
Wood and other material less dense than water	0.5
Other foreign materials (e.g. shell, metals, plastics, clay lumps, asphalt and tar etc.)	1.0

4.5 Angularity

The shape of manufactured sand shall be sub-angular, sub-rounded or rounded. Angular manufactured sand is unacceptable.

5. **Physical Requirements**

5.1 Particle Density

The oven-dried particle density of manufactured sand as determined in accordance with Section 17 of CS3:2013, shall not be less than 2,000 kg/m³.

5.2 Durability

(i) Drying Shrinkage

The drying shrinkage of the manufactured sand as determined in accordance with Section 20 of CS3:2013, shall not exceed 0.075%.

(ii) Alkali-silica Reactivity

(a) The linear expansion of mortar-bars immersed in NaOH solution at elevated temperature as determined in accordance with Section 22 of CS1:2010, shall be evaluated using Equation 22-1 of CS1:2010. The potential alkali-reactivity of manufactured sand can then be obtained from Table 10 of CS1:2010.

(b) Alternatively, the concrete prism test in accordance with Section 23 of CS1 may also be used and the potential alkali-reactivity of manufactured sand can then be obtained from Table 13 of CS1:2010.

(c) Manufactured sands fall into the alkali “Reactive” category shall not be used unless prior approval of the Supervising Officer is obtained.

6. Chemical Requirements

6.1 Chlorides

(i) Water-Soluble Chloride Ion Content

The water-soluble chloride ion content of natural aggregates of manufactured sand shall be determined in accordance with Clause 21.3 of Section 21 of CS3: 2013.

(ii) Acid-Soluble Chloride Ion Content

The acid-soluble chloride ion content of recycled aggregates of manufactured sand shall be determined in accordance with Clause 21.4 of Section 21 of CS3: 2013.

(iii) Chloride Ion Content

The total chloride ion contents of natural aggregates and recycled aggregates of manufactured sand shall not exceed 0.03% by mass.

6.2 Sulphur Containing Compounds

(i) Acid-Soluble Sulphate Content

(a) The acid-soluble sulphate content of natural aggregates of manufactured sand as determined in accordance with Clause 21.5 of Section 21 of CS3:2013, shall not exceed 0.8% by mass.

(b) The acid-soluble sulphate content of recycled aggregates of manufactured sand as determined in accordance with Clause 21.5 of Section 21 of

CS3:2013, shall not exceed 1.0% by mass.

(ii) Total Sulphur Content

The total sulphur content of the natural aggregate of manufactured sand, when determined in accordance with Clause 21.6 of Section 21 of CS3: 2013, shall not exceed 1.0% by mass.

6.3 Other Constituents

- (i) Manufactured sand shall be clean and free of organic substances. The manufactured sand producer or supplier shall demonstrate that the supplied manufactured sand is clean and free of organic substances or alternatively the presence of organic substances does not affect the stiffening or hardening of mortar.
- (ii) The presence of organic substances in the form of humus shall be determined in accordance with Clause 21.7 of Section 21 of CS3:2013. Where the test result under Clause 21.7 is negative, the manufactured sand shall be considered to be free of organic substances. Otherwise, the manufactured sand shall be further tested in accordance with Section 22 of CS3:2013 to assess the effect of organic substances on the stiffening time and compressive strength of mortar. The organic substances shall be of such proportion that:
 - (a) the stiffening time of mortar test specimens does not increase by more than 120 minutes; and
 - (b) the 28-day compressive strength of mortar test specimens does not decrease by more than 20%.

7. Sampling

- 7.1 Samples shall be taken in accordance with the procedures described in Section 8 of CS3:2013 or as agreed with the Supervising Officer.
- 7.2 The test certificates giving the results of tests for the Geometrical Requirements, Physical Requirements and Chemical Requirements under Clauses 4, 5 and 6 respectively shall be submitted together with the material submission and when required by the Supervising Officer.
- 7.3 For quality control and monitoring, test certificates giving the results of tests for the Physical Requirements and Chemical Requirements under Clauses 5 and 6 respectively shall be submitted every three months unless agreed otherwise by the Supervising Officer.
- 7.4 The issue date of the test certificates giving the results of tests required shall be within (a) three months for grading; and (b) six months for other properties counting from the date of submission.

8. Source of Aggregates

- 8.1 Aggregates shall be clean, hard, durable and obtained from a source approved by the Supervising Officer.
- 8.2 Recycled Aggregates may be used subject to the prior agreement of the Supervising Officer.
- 8.3 Aggregates from marine source and all-in aggregates shall not be used.

9. Proportions

- 9.1 Mix the constituents according to the following proportions:
 - (i) Cement: manufactured sand ratio of 1:3 by volume except for the uses specified in the sub-clauses below;
 - (ii) For finishing coats of internal lime plastering on solid backgrounds, cement: lime: manufactured sand ratio of 1:2:6 by volume;
 - (iii) For undercoats and finishing coats of internal lime plastering on lathing, cement: lime: manufactured sand ratio of 1:2:6 by volume;
 - (iv) For floor screeds over 40 mm thick, cement: manufactured sand (or granite fines if approved by the Supervising Officer): coarse aggregate ratio of 1:1.5:3 by volume. The grading of coarse aggregates shall be within the appropriate limits given in Table 3.1 of CS3:2013;
 - (v) For topping of lightweight screeds, cement: manufactured sand (or granite fines if approved by the Supervising Officer) ratio of 1:4 by volume;
 - (vi) For laying floor tiles by semi-dry method direct to concrete base, cement: manufactured sand ratio of 1:4 by volume; and
 - (vii) For laying “Canton”, concrete or lightweight roof tiles, cement: manufactured sand ratio of 1:4 by volume.
- 9.2 Mix the cement mortar with the minimum amount of water necessary to achieve the required workability. The water: cement ratio should be not more than 3:5 by volume.

10. Pull-out Strength Requirements when used as Plastering and Rendering

- 10.1 Upon the request of the Supervisory Officer, carry out pull-out test for the plastering/rendering at the age of 28 days after application of the plastering or rendering, the pull-out strength should be not less than 0.5 MPa measured in accordance with BS EN 1015-12.