



CONSTRUCTION
INDUSTRY COUNCIL
建造業議會

Reference Material



Model Specification for Self-compacting Backfill Material

First published, June 2023

FOREWORD

This report belongs to a series of Reference Materials on Sample Specification/Sample Clauses produced by the Construction Industry Council (CIC) under the theme of Model Specifications for Use of Innovative Technology. Previous Sample Specification/Clauses issued by the CIC can be found from the following link: https://www.cic.hk/eng/main/aboutcic/publications/reference_materials/.

In the backfilling of pits and trenches around manholes and for footpath/roads, soil-based backfill materials are used. Use of the soil-based backfill materials requires compaction, and on-site tests to verify the in-situ density achieved. Placing and compaction of the soil-based backfill materials in congested pits/trenches are particularly difficult, and there is no guarantee that voids in the backfilled materials are all removed in the end. This is undesirable as presence of voids in the backfilled materials could lead to soil settlement, and hence footpath/road subsidence and damage. A new self-compacting backfill material has been developed by Nano and Advanced Materials Institute Limited (NAMI) (Nissinen & Sham, 2021). In addition to the self-compacting nature and easy excavatability, the material also exhibits good thermal performance which allows the heat generated from the power cables underneath footpath/roads to be carried away effectively to avoid overheating, and hence damages to the cables.

This reference material presents the model specification clauses for the new self-compacting backfill material developed.

This reference was prepared by Dr Thomas Lam based primarily on the information given in the particular specification for self-compacting backfill material for backfilling of pits and trenches prepared by the Highways Department (HyD)¹. Comments from the Development Bureau, Architectural Services Department, Buildings Department, Civil Engineering and Development Department, Highways Department, Housing Department and Urban Redevelopment Authority have been obtained in the preparation of this reference material. These contributions are gratefully acknowledged.

Practitioners are encouraged to comment at any time to the CIC on the contents of this reference material, so that improvements can be made to future editions.

Industry Development
Construction Industry Council

¹ See the memo issued by DDHy of ref. (B2BH) in HyD TR/10-3-/14 dated 31.1.2022 on Self-compacting Backfill Material (SCM) for Backfilling Utility Trenches and Voids – Particular Specification.

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PREFACE

The Construction Industry Council (CIC) is committed to seeking continuous improvement in all aspects of the construction industry in Hong Kong. To achieve this aim, the CIC forms Committees, Task Forces and other forums to review specific areas of work with the intention of producing Alerts, Reference Materials, Guidelines and Codes of Conduct to assist participants in the industry to strive for excellence.

The CIC appreciates that some improvements and practices can be implemented immediately whilst others may take more time for implementation. It is for this reason that four separate categories of publication have been adopted, the purposes of which are as follows:

- | | |
|---------------------|--|
| Alerts | The Alerts are reminders in form of brief leaflets produced quickly to draw the immediate attention of relevant stakeholders to the need to follow some good practices or to implement some preventive measures in relation to the construction industry. |
| Reference Materials | The Reference Materials provide standards or methodologies generally adopted and regarded by the industry as good practices. The CIC recommends the adoption of the standards or methodologies given in the Reference Materials by industry stakeholders where appropriate. |
| Guidelines | The Guidelines provide information and guidance on particular topics relevant to the construction industry. The CIC expects all industry stakeholders to adopt the recommendations set out in the Guidelines where applicable. |
| Codes of Conduct | The Codes of Conduct set out the principles that all relevant industry participants should follow. Under the Construction Industry Council Ordinance (Cap. 587), the CIC is tasked to formulate codes of conduct and enforce such codes. The CIC may take necessary actions to ensure compliance with the codes. |

To allow us to further enhance this publication, we encourage you to share your feedback with us after you have read this publication. Please take a moment to fill out the Feedback Form attached to this publication and send it back to us. With our joint efforts, we believe our construction industry will develop further and continue to prosper in the years to come.

ABBREVIATIONS

HyD	Highways Department
PFA	Pulverized Fuel Ash
SCM	Self-compacting Backfill Material
UU	Utility Undertaker

1. MODEL SPECIFICATION FOR SELF-COMPACTING BACKFILL MATERIAL

1.010 Preamble

- 1.011 General Requirements
- (1) The Contractor shall use a self-compacting backfill material (SCM) for
 - (a) backfilling of pits, trenches, etc.; or
 - (b) filling of voids in between pile caps, manholes, gully pit, gully sumps, drainage chambers, etc., and temporary lateral supports for the specified area in the project.
 - (2) The SCM shall be a self-levelling, free flowing, soil-like backfill material which can be pumped into the required areas without the need for layer-by-layer compaction. The mixing of the product can be carried out either on-site or off-site.
 - (3) The Contractor shall seek consent from the concerned utility undertaker (UU) if the SCM is to be used in areas where there are underground utilities and these underground utilities will be embedded by the SCM.
 - (4) The Contractor shall seek comments from the concerned maintenance department if the SCM is proposed to be used. Particularly, the Contractor shall seek comments from the Regional Offices of the Highways Department (HyD) if the SCM is to be used under the public roads maintained by HyD. The Contractor shall provide record photographs, test certificate/report and as-built plan where the SCM is used (including area, length, width, depth, etc.) to the maintenance department, upon completion of the backfilling works.
 - (5) The SCM shall be a backfill material composing of the following:
 - (a) Cementitious material. Either Portland Cement (PC) or Pulverized Fuel Ash (PFA) complying with BS EN 197-1:2011 or BS EN 450-1:2012 respectively shall be used.
 - (b) Fine aggregate. The fine aggregate used shall be clean and hard complying with the Construction Standard CS3:2013 (HKSAR, 2013).
 - (c) Pulverized material. Clean sedimentary rock material complying with the following requirements shall be used:
 - (i) grain size of not more than 100 µm as determined in accordance with Test Method 8.5 of Geospec 3 (GEO, 2017) or equivalent;
 - (ii) clay content not exceeding 1.50 g/100 g as determined by the methylene blue test in accordance with CS3:2013; and
 - (iii) calcium carbonate (CaCO₃) content exceeding at least 75% by mass as calculated from the calcium oxide content in accordance with BS EN 196-2:2013.
 - (d) Water. Clean fresh water taken from the public supply shall be used.
 - (e) Admixtures. The pigment admixtures used shall comply with BS EN 12878:2014 and the accelerating admixtures, retarding admixtures,

water-reducing admixtures and superplasticising admixtures shall comply with BS EN 934-2:2009+A1:2012.

- (6) The Contractor shall submit the following to the *Engineer*# for approval at least 14 day before the SCM is placed:
- (a) name of the SCM suppliers (Notes: A list of the SCM suppliers on the CITF's list is given in Appendix A.);
 - (b) planned areas of application in the project (Notes: A location plan showing the area of the SCM application shall be provided.);
 - (c) particulars of the materials used (see Clause 1.020);
 - (d) method statement (see Clause 1.030);
 - (e) name of the engineer responsible for the operation and supervision of the planned application (the Responsible Engineer); and
 - (f) name of the supervision personnel assigned by the Responsible Engineer to carry out the supervision of the operation.

Notes: #The term Engineer may be changed to Supervising Officer, Contract Manager, Appointing Party, etc., to suit the project situation.

1.020 Particulars of Materials

1.021
Cementitious
Material, Fine
Aggregate and
Pulverized
Material

- (1) The following particulars of the proposed cementitious material, fine aggregate and pulverized material shall be submitted:
- (a) certificate issued within 6 months for each type of the cement or PFA used showing the manufacturer's name, date and place of manufacture and compliance with the requirements, including the results of tests for composition;
 - (b) certificates/documents issued within 6 months for the fine aggregate used in accordance with Clause 6.2.2(2) of CS3:2013 showing compliance with the requirements; and
 - (c) certificates/documents issued within 6 months for the pulverized material used showing compliance with the requirements, including the results of tests for grain size, methylene blue value and CaCO₃ content.

1.022
Admixtures

- (1) The following particulars of the proposed admixtures shall be submitted:
- (a) manufacturers' literature, description of physical state, colour and composition, recommended storage conditions and shelf life;
 - (b) method of adding the admixtures to the SCM mix, recommended dosage, effects of under-dosage and over-dosage; and
 - (c) certificates issued within 6 months for each type of the admixture used showing the manufacturer's name, date and place of manufacture and compliance of the admixtures with the requirements.

- 1.023 Self-compacting Backfill Material Mix
- (1) The following particulars of each proposed designed SCM mix shall be submitted:
 - (a) grading of fine aggregates;
 - (b) method of placing the SCM;
 - (c) hardening time of the SCM; and
 - (d) source, formulation, test data for the designed SCM mix produced in the plant or plants, and results of the site trial tests carried out for the designed SCM mix, including those given in Clause 1.035, to demonstrate the appropriateness and SCM formulation and the compliance of the mix with the criteria.

1.030 Method Statement

- 1.031 General
- (1) The following shall be included in the method statement:
 - (a) batching and mixing;
 - (b) transportation;
 - (c) fence off plan for the backfill area;
 - (d) placing;
 - (e) testing and sampling (and compliance criteria); and
 - (f) forms for record keeping.
- 1.032 Batching and Mixing of Self-compacting Backfill Material
- (1) For the SCM produced off-site (i.e. ready-mixed SCM), location of the plant from which the SCM is to be obtained shall be provided. The batching and mixing shall comply with Clauses 16.37 and 16.38 of the General Specification for Civil Engineering Works (2020 Edition) (HKSAR, 2020).
 - (2) For the SCM produced on-site, details of the proposed plant to be used, including a layout plan and output of the plant, and method of batching and mixing the SCM, including the measures to maintain the quality of the SCM produced shall be provided.
- 1.033 Transportation of Self-compacting Backfill Material
- (1) SCM shall not be transported in a manner that will result in contamination, segregation, and loss of constituents.
 - (2) Ready-mixed SCM shall be transported to the site in purpose-made agitators operating continuously or in truck mixers. The truck mixers used shall be thoroughly cleaned before loading and transporting the fresh SCM.
- 1.034 Placing of Self-compacting Backfill Material
- (1) The permission of the *Engineer* shall be obtained before SCM is placed in any part of the permanent works. If placing of SCM is not started within 24 hours after the permission has been given, permission shall be obtained again from the *Engineer*. The Contractor shall inform the *Engineer* before starting the placing operation and shall give the *Engineer* sufficient time to inspect the works that are to be covered up.

- (2) Fresh SCM shall be placed in its final position within 2½ hours of the introduction of water to the SCM mix.
- (3) Additional protective sheets shall be used around the discharging area to avoid splashing of SCM. Trunking or chutes, if used, shall be clean and used to avoid segregation and loss of constituents of the SCM.
- (4) SCM can be placed with concrete pumps, which shall be operated and maintained in accordance with the supplier's recommendations. The pumps and pipelines shall be maintained in a clean condition. Joints in the pipelines shall be tightly fixed to prevent grout loss.
- (5) SCM shall not be placed under submerged conditions.

1.035 Testing and Sampling

- (1) Samples of the fresh SCM shall be collected from the first batch and subsequent batches for every discharge of 25 m³ or less.
- (2) Two samples shall be collected from each batch for density test according to Section 5 of the Construction Standard CS1:2010 (HKSAR, 2010).
- (3) Two samples shall be collected from each batch for flowability test according to ASTM D6103-17 or equivalent.
- (4) Two samples shall be collected from each batch for determination of 28-day compressive strength, where a pair of test cubes shall be made from each sample. The size of the test cube shall be 100 mm and the method of making the test cubes and the method of testing shall follow those given in CS1.
- (5) The number of tests for density, flowability and compressive strength may be reduced if in the opinion of the *Engineer* the standard of quality control is satisfactory.
- (6) The load placement capability of the SCM surface shall be tested according to ASTM D6024 or equivalent prior to further backfilling or conducting other works over the SCM backfilled area. The *Engineer* shall assign a testing location for performance of the load placement test. The test shall be conducted 5 consecutive times for every 20 m² of the in-place SCM or part thereof.
- (7) The thermal conductivity of the SCM shall be tested according to ASTM D5334 or equivalent when the SCM is used for backfilling utility trenches with power cables. The *Engineer* shall assign no less than 5 locations within the backfilled area for every 20 m² of the in-place SCM or part thereof for performance of the thermal conductivity test.

1.036
Compliance
Criteria and
Non-compliance

(1) The acceptance criteria for SCM is given in Table 1.

Table 1 – Technical Requirements for SCM

Property	Range	Standard
Density	1900 to 2100 kg/m ³	CS1:2010 (Section 5)
Flowability	Slump flow spread (without segregation) ≥ 200 mm	ASTM D6103
28-day compressive strength (Note 1)	Not less than 0.3 MPa and not more than 1 MPa (for utility trench backfilling) or 2 MPa (for other void backfilling)	CS1:2010 (Section 12)
Load placement capability	The hardened SCM is ready for load application when there is no surface water and no indentation with a diameter larger than 75 mm after the ball-drop test	ASTM D6024
Thermal conductivity (Note 2)	>1.1 W/mK when moisture content >10%	ASTM D5334
Hardening time (Note 3)	8 to 24 hrs (from completion of mixing to reach penetration resistance with a final set of 3.5 N/mm ²)	CS1:2010 (Section 3)


Notes:

1. Due to the low compressive strength of SCM, the loading rate of the compressive strength testing machine shall be adjusted to suit.
 2. Thermal conductivity tests shall be carried out only when the SCM is used for backfilling utility trenches with power cables.
 3. The tests are not needed for this specification. However, the test results shall be provided by the material supplier to demonstrate that the proposed SCM meets the setting time requirement.
- (2) If the result of either the density or flowability test carried out on a sample taken from the first vehicle of the batch does not comply with the specified requirements, the SCM in that vehicle shall not be placed. Another sample from the subsequent vehicle of the same batch shall be collected for testing until the requirements are met.
 - (3) If the 28-day compressive strength of the SCM does not comply with the specified requirements, the Contractor shall be required to propose rectification measures to the satisfaction of the *Engineer*.
 - (4) If the indentation diameter after the measurement of the load placement capability test does not meet the acceptance criteria, an additional load placement test in the vicinity of the non-compliant testing location shall be conducted at appropriate intervals, such as hourly, until the acceptance criteria are met, such that the works over the backfilled area can be resumed.
 - (5) If any of the five measurements of the thermal conductivity test does not comply with the specified requirements, the Contractor shall remove the hardened non-compliant SCM, backfill the trench and reinstate the pavement above with appropriate method agreed with the *Engineer*.

1.037 Forms for Record Keeping

- (1) For ready-mix SCM, a delivery note for each delivery to the site shall be provided. The delivery notes shall be kept on the site and made available for inspection by the *Engineer* at all times. The details required in a delivery note are given in Table 2.
- (2) For SCM produced on-site, the Contractor shall submit a proposed list of particulars about the SCM to be produced to the *Engineer* for approval at least 14 days before the SCM is placed. Details of the particulars shall be kept on the site and made available for inspection by the *Engineer* at all times.
- (3) The SCM placement record shall be kept by the Contractor on the site and made available for inspection by the *Engineer* at all times. The details required for the SCM placement record are given in Table 3.
- (4) The certificates/documents issued within 6 months showing the sources of the cementitious material and fine aggregate (see Table 2) shall be kept by the Contractor on the site and made available for inspection by the *Engineer* at all times.

Table 2 – SCM Delivery Note

DELIVERY NOTE 送貨單					
XYZ Company					 <small>0 36000 29145 2</small>
<i>Delivery Note No.:</i>			<i>Date:</i>		
PLANT					
<i>Name:</i>			<i>Location:</i>		
SITE					
<i>Name:</i>			<i>Location:</i>		
TRUCK					
<i>Truck No.:</i>	<i>Arrival Time:</i>	<i>Unloading Started:</i>	<i>Quantity (m³):</i>		
<i>Slump/ Flow (mm):</i>	<i>Time Water Added:</i>	<i>Unloading Completed:</i>	<i>Cumulative Quantity (m³):</i>		
SCM Mix					
<i>Mix ID:</i>		<i>Proprietor:</i>			
<i>Formulation:</i>		<i>Source:</i>			
CEMENTITIOUS MATERIAL					
<i>Type:</i>		<i>Source:</i>			
FINE AGGREGATE					
<i>Type:</i>		<i>Source:</i>			
ADMIXTURES					
<i>Type:</i>		<i>Source:</i>			
<i>Remark:</i>					
<i>Operator:</i>		<i>Received by:</i>			
<i>Purchaser:</i>					

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APPENDIX A – SELF-COMPACTING BACKFILL MATERIAL ON THE CITF’S PRE-APPROVED LIST



(a) Self-Compacting Backfill Material System (CITF No. PA21-015)
Golik Concrete Limited / Minji Limited / Vast Hill Development Limited
Tel: 2634 1818 / 9144 3497 / 6377 1213

Feedback Form

Model Specification for Self-compacting Backfill Material (June 2023)

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(Please put a “ ✓ ” in the appropriate box)

1. As a whole, I feel that this publication is:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
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Comprehensive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Useful	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Practical	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Does this publication give you useful information on the specification clauses for self-compacting backfill material?	Yes	No	No Comment		
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4. To what extent have you applied the specification clauses made in this publication to your work?	Most	Some	None		
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
5. Overall, how would you rate this publication?	Excellent	Very Good	Satisfactory	Fair	Poor
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Other comments and suggestions (please specify and use separate sheets if necessary).					
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