



BSI Standards Publication

**Hydraulically bound materials for civil  
engineering purposes – Specification  
for production and installation  
in pavements**

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### Summary of pages

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# Foreword

## Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 November 2019. It was prepared by Subcommittee B/510/4, *Cementitious bound materials, unbound granular materials, waste materials and marginal materials*, under the authority of Technical Committee B/510, *Road materials*. A list of organizations represented on these committees can be obtained on request to their secretary.

## Relationship with other publications

This British Standard gives non-contradictory and complementary information for the use in the UK of [BS EN 14227](#), the European Standard that defines and specifies hydraulically bound granular materials (HBGM) and hydraulically stabilized soils (HSS), known generically as hydraulically bound mixtures in [BS EN 14227](#) and as hydraulically bound materials (HBM) in this British Standard. These terms are used interchangeably but mean the same thing.

This British Standard has been produced in parallel to the 2018 revisions of [BS 1924-1](#) and [BS 1924-2](#). These British Standards detail sampling, sample manufacture and test standards; either in full or by reference to the relevant BS EN standard.

## Information about this document

[BS EN 14227](#) provides requirements for the constituents, composition and laboratory performance classification of HBGM and HSS, but not requirements for construction. This British Standard satisfies that need and for completeness also covers roller compacted concrete (RCC). This is a new standard and introduces the following:

- production, transport and installation requirements for RCC, HBGM and HSS; and
- testing and conformity requirements for RCC, HBGM and HSS.

This British Standard is appropriate for all types of UK works that incorporate HBM (the term HBM is taken to mean HBGM, HSS and RCC), whether produced by the ex-situ or in-situ method of production. This standard supports the appropriate investigation, specification and application of HBM in pavements whether for roads, of all types and classification, ports, airfields, heavy industrial areas, narrow widening/repairs, trench reinstatement and other applications.

This publication can be withdrawn, revised, partially superseded or superseded. Information regarding the status of this publication can be found in the Standards Catalogue on the BSI website at [bsigroup.com/standards](https://bsigroup.com/standards), or by contacting the Customer Services team.

Where websites and webpages have been cited, they are provided for ease of reference and are correct at the time of publication. The location of a webpage or website, or its contents, cannot be guaranteed.

## Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

**Presentational conventions**

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

*Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.*

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. “organization” rather than “organisation”).

**Contractual and legal considerations**

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with a British Standard cannot confer immunity from legal obligations.**

## 1 Scope

This British Standard specifies requirements for the production, installation, testing and conformity of hydraulically bound materials (HBM) conforming to [BS EN 14227](#) for pavement applications, whether constructed by the ex-situ or in-situ methods. It also includes requirements for preliminary work at the laying site, needed to ensure that the substrate is fit to receive the HBM.

*NOTE 1 The term “hydraulically bound materials” (HBM) used in this British Standard is the generic term to describe the wide range of materials comprising aggregates or soil, hydraulic binders and water; including roller compacted concrete (RCC), hydraulically bound granular material (HBGM) and hydraulically stabilized soils (HSS), which are available for use in the construction and the maintenance of roads and other paved areas.*

*NOTE 2 This British Standard does not include a framework for investigating and assessing existing pavements to be recycled to produce HBM.*

This British Standard relates to HBM for use in pavements, including the pavement foundation. Applications related to earthworks or other uses of HBM are not covered within this British Standard.

*NOTE 3 The annexes of this British Standard are informative only and do not contain provisions.*

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions of this document.<sup>1</sup> For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[BS 1924-1](#), *Hydraulically bound and stabilized materials for civil engineering purposes – Part 1: Sampling, sample preparation and testing of materials before treatment*

[BS 1924-2:2018](#), *Hydraulically bound and stabilized materials for civil engineering purposes – Part 2: Sample preparation and testing of materials during and after treatment*<sup>2</sup>

[BS 594987](#), *Asphalt for roads and other paved areas – Specification for transport, laying, compaction and product type testing protocols*

[BS EN 13242](#), *Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction*<sup>3</sup>

[BS EN 13286-41](#), *Unbound and hydraulically bound mixtures – Part 41: Test method for the determination of the compressive strength of hydraulically bound mixtures*

[BS EN 13286-42](#), *Unbound and hydraulically bound mixtures – Part 42: Test method for the determination of the indirect tensile strength of hydraulically bound mixtures*

[BS EN 13286-45](#), *Unbound and hydraulically bound mixtures – Part 45: Test method for the determination of the workability period of hydraulically bound mixtures*<sup>4</sup>

[BS EN 13808:2013](#), *Bitumen and bituminous binders – Framework for specifying cationic bituminous emulsions*

[BS EN 14227-1](#), *Hydraulically bound mixtures – Specifications – Part 1: Cement bound granular mixtures*

[BS EN 14227-2](#), *Hydraulically bound mixtures – Specifications – Part 2: Slag bound granular mixtures*

<sup>1</sup> Documents that are referred to solely in an informative manner are listed in the Bibliography.

<sup>2</sup> This British Standard also gives informative references to BS 1924-2.

<sup>3</sup> This British Standard also gives informative references to BS EN 13242:2013.

<sup>4</sup> This British Standard also gives informative references to BS EN 13286-45:2003.

BS EN 14227-3, *Hydraulically bound mixtures – Specifications – Part 3: Fly ash bound granular mixtures*

BS EN 14227-4, *Hydraulically bound mixtures – Specifications – Part 4: Fly ash for hydraulically bound mixtures*

BS EN 14227-5, *Hydraulically bound mixtures – Specifications – Part 5: Hydraulic road binder bound mixtures*

BS EN 14227-15, *Hydraulically bound mixtures – Specifications – Part 15: Hydraulically stabilized soils*

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### 3 Terms, definitions, symbols and abbreviations

#### 3.1 Terms and definitions

For the purposes of this British Standard, the terms and definitions in [BS EN 14227](#), BS 1924 (both parts) and the following apply.

##### 3.1.1 aggregate

granular material of natural, manufactured or recycled origin used in construction

[SOURCE: BS EN 13242:2013, 3.1]

##### 3.1.2 base

main structural element of a pavement

##### 3.1.3 cement

finely ground inorganic material which, when mixed with water, forms a paste that sets and hardens by means of hydration and which, after hardening, retains its strength and stability

*NOTE* See [BS EN 14227](#) for further information.

##### 3.1.4 course

element of a pavement constructed with a single HBM type

##### 3.1.5 ex-situ method

method where constituents are proportioned and mixed in a stationery plant for delivery to the point of installation

##### 3.1.6 fine milling

process of removing at least part of the surface of a paved area when the spacing between the cutting tools is 8 mm or less

##### 3.1.7 formation

surface of subgrade in its final shape after completion of earthwork

##### 3.1.8 fresh HBM

HBM within its workability period

##### 3.1.9 grading

particle size distribution expressed as the percentages by mass passing a specified set of sieves

*NOTE 1* See [BS EN 933-1](#) for further information.

*NOTE 2* Unless stated otherwise, for the purposes of this British Standard, the term relates to the total HBM, not just the aggregate or soil that is being treated.

**3.1.10 hydraulically bound granular material 1 (HBGM 1)**

grouping of HBGM including CBGM 1 (BS EN 14227-1), SBGM 1 (BS EN 14227-2), FABGM 1 (BS EN 14227-3) and HRBGM 1 (BS EN 14227-5)

**3.1.11 hydraulically bound granular material 2 (HBGM 2)**

grouping of HBGM including CBGM 2 (BS EN 14227-1), SBGM 2 (BS EN 14227-2), FABGM 2 (BS EN 14227-3) and HRBGM 2 (BS EN 14227-5)

**3.1.12 hydraulically bound granular material 3 (HBGM 3)**

grouping of HBGM including CBGM 3 (BS EN 14227-1), SBGM 3 (BS EN 14227-2), FABGM 3 (BS EN 14227-3) and HRBGM 3 (BS EN 14227-5)

**3.1.13 hydraulically bound granular material 4 (HBGM 4)**

grouping of HBGM including CBGM 4 (BS EN 14227-1), SBGM 4 (BS EN 14227-2), FABGM 4 (BS EN 14227-3) and HRBGM 4 (BS EN 14227-5)

**3.1.14 hydraulically bound granular material 5 (HBGM 5)**

grouping of HBGM including CBGM 5 (BS EN 14227-1), SBGM 5 (BS EN 14227-2), FABGM 5 (BS EN 14227-3) and HRBGM 5 (BS EN 14227-5)

**3.1.15 in-situ method**

method where constituents are proportioned and mixed in-situ, usually at the position of final use

**3.1.16 induced cracking**

lines of weakness formed in the uncompacted layer, immediately before rolling to control spacing, location and width of cracks

*NOTE This is also known as pre-cracking.*

**3.1.17 layer**

element of a pavement laid in a single operation

**3.1.18 lime**

quick lime [calcium oxide ( $\text{CaO}$ )] or hydrated lime [calcium hydroxide ( $\text{Ca}(\text{OH})_2$ )]

*NOTE Hydrated lime is also known in the UK as slaked lime. Lime referred to in this British Standard does not include agricultural lime (ground  $\text{CaCO}_3$ ), which is inert.*

**3.1.19 multi-layer work**

HBM constructed in two or more layers

**3.1.20 pozzolan**

material that, when mixed with lime or a source of lime and water, sets and hardens

**3.1.21 roller compacted concrete (RCC)**

high strength HBM

*NOTE In the case of RCC, strengths typically commence at  $R_{\text{c}} 35 \text{ N/mm}^2$ .*

**3.1.22 soundness**

physical and/or chemical stability of a constituent or mixture

**3.1.23 subbase**

one or more layers of material placed immediately above the road formation

**3.1.24 subgrade**

upper part of the soil, natural or constructed, that supports the loads transmitted by the overlaying structure of a road

**3.1.25 workability period**

duration of time counted from the end of mixing, during which the binder setting remains nil or very low

[SOURCE: BS EN 13286-45:2003, 3.1]

**3.2 Symbols**

For the purpose of this British Standard, the following symbols apply.

|          |                                  |
|----------|----------------------------------|
| $E_c$    | Elastic modulus in compression   |
| $P$      | Degree of pulverization category |
| $R_c$    | Compressive strength             |
| $R_{it}$ | Indirect tensile strength        |
| $R_t$    | Resistance in direct tension     |
| $S$      | Total sulfur                     |
| $T$      | Temperature in °C                |
| $t$      | Time in hours                    |
| $W$      | Water content category           |

**3.3 Abbreviations**

For the purpose of this British Standard, the following abbreviations apply.

|       |                                                                                                              |
|-------|--------------------------------------------------------------------------------------------------------------|
| ABS   | Air-cooled blast furnace slag                                                                                |
| AS    | Acid soluble sulfate                                                                                         |
| ASS   | Air-cooled steel slag                                                                                        |
| CaFA  | Calcareous fly ash (fly ash resulting from the combustion of high sulfate coals in energy generating plants) |
| CBGM  | Cement bound granular material                                                                               |
| CBR   | California bearing ratio                                                                                     |
| FA    | Fly ash from coal-fired energy production<br>[also known in the UK as pulverized fuel ash (PFA)]             |
| FABGM | Fly ash bound granular material                                                                              |
| GBS   | Granulated blast furnace slag                                                                                |
| GGBS  | Ground granulated blast furnace slag                                                                         |
| HBGM  | Hydraulically bound granular material                                                                        |

|        |                                                                                                         |
|--------|---------------------------------------------------------------------------------------------------------|
| HBM    | Hydraulically bound material                                                                            |
| HRB    | Hydraulic road binder                                                                                   |
| HRBBGM | Hydraulic road binder bound granular material                                                           |
| HSS    | Hydraulically stabilized soil                                                                           |
| IBI    | Immediate bearing index                                                                                 |
| LA     | Los Angeles coefficient                                                                                 |
| LWD    | Light weight deflectometer                                                                              |
| MCV    | Moisture condition value                                                                                |
| N/A    | Not applicable                                                                                          |
| OWC    | Optimum water content                                                                                   |
| PGBS   | Partially ground granulated blast furnace slag                                                          |
| PTR    | Pneumatic tyre roller                                                                                   |
| RCC    | Roller compacted concrete                                                                               |
| SBGM   | Slag bound granular material                                                                            |
| SiFA   | Siliceous fly ash (fly ash resulting from the burning of low sulfate coals in energy generating plants) |

#### 4 HBM

HBM shall conform to [BS EN 14227](#) and the requirements of this British Standard.

*NOTE* Guidance on investigation for use and application of these HBM is presented in [Annex A](#), [Annex B](#) and [Annex C](#).

#### 5 Mixture design

The composition of the HBM shall be determined from a laboratory mixture design procedure intended to ensure the HBM has properties conforming to the project specification. The procedure shall include requirements for strength, volume stability by determination of strength after immersion in water and, where appropriate/specified:

- immediate stability by determination of IBI; and
- resistance to frost heave.

HBM shall be deemed to be resistant to frost heave where the compressive strength class is  $C_{2/2.5}$  or greater, or  $R_{it}$  is greater than 0.25 MPa.

*NOTE 1* In this context, “frost resistance” refers to resistance to frost when in the completed pavement. It does not refer to resistance to surface scaling when directly exposed to frost before overlaying.

A mixture design shall be provided prior to the commencement of works.

A new mixture design shall be required if any of the following are amended:

- a) the source of a constituent;
- b) the target proportion of a constituent; and/or
- c) the target mechanical performance.

A new mixture design shall not be required for adjustments to added water according to water content of aggregate at the time of production.

*NOTE 2 Guidance on mixture design for HBGM, RCC and HSS is presented in [Annex D](#), [Annex E](#) and [Annex F](#) respectively.*

## 6 Preparatory works at the site

### 6.1 Preparatory works for ex-situ method

The receiving surface shall not be frozen. The surface to receive the HBM shall be free from loose materials and foreign matter (including standing water, mud, slurry or other deleterious material).

Prior to commencement of placing the ex-situ HBM, the profile and stability of the receiving surface shall be prepared to produce a substrate suitable for compaction of the HBM.

Any protection layer on the surface to receive the HBM shall be removed and any soft or damaged areas shall be rectified by excavating them and replacing with acceptable material having the same characteristics, including drainage and strength, as the surrounding material.

The sum of the deviations in the level of different pavement layers shall not result in a reduction of the specified nominal target surface course thickness.

Unless otherwise specified, the permitted deviation of the level of the prepared surface shall not be greater than the following values:

- a) formation to receive HBM:  $\begin{matrix} +20 \\ -30 \end{matrix}$  mm;
- b) subbase to receive HBM base:  $\begin{matrix} +10 \\ -20 \end{matrix}$  mm.

Unless otherwise specified, the surface to receive the HBM shall have the same longitudinal gradient, cross fall and surface level tolerances as the HBM.

### 6.2 Preparatory works for in-situ method

The surface profile shall be compacted, shaped and trimmed to enable uniform in-situ mixing and minimize subsequent re-profiling operations of the layer prior to final compaction of the HBM. It shall be free from standing water.

*NOTE When in-situ mixing is carried out above a substrate that contains materials that might affect the setting, hardening, strength or stability of the HBM, special attention should be given to the mixing depth in relation to the proximity of the substrate.*

## 7 Production

### COMMENTARY ON CLAUSE 7

*Production and installation can be carried out employing either:*

- a) *the ex-situ method of production, which employs a stationary pug-mill/paddle mixer followed by haulage and installation on site. Installation can be either by discharging into a paver or tipping on the ground to then be spread by grader, dozer or similar; or*
- b) *the in-situ method of production and installation, which employs purpose-made spreaders and rotovator/pulverizer mixers to incorporate/mix the previously spread treating agent with the underlying in-situ soil or previously placed soil or aggregate; or*
- c) *the in-situ method used in ex-situ mode where the in-situ mixed HBM is "picked-up" for haulage to the point of installation.*

HBM shall be produced and installed in accordance with a quality plan that incorporates:

- a) the job specification;
- b) the requirements of this British Standard; and
- c) the requirements for production control in [BS EN 14227](#).

The quality plan shall include:

- 1) sourcing, processing and storage of constituents;
- 2) description of the production and installation plant to be used, preferably including a flow diagram;
- 3) in the case of the ex-situ method of production, the location of the mixing plant, details of transportation and the expected average time between mixing and laying, details of the plant to be used for HBM installation capable of laying evenly, to the required depth, without significant segregation;
- 4) in the case of in-situ method, details of the method of spreading the treatment agents, the pattern of pulverization where required, the mixing procedure to ensure consistency and levelling;
- 5) calibration and inspection schedules for all parts of the process;  
*NOTE 1 Calibration records should accompany these schedules.*
- 6) measures to deal with hard edges and obstructions;
- 7) the methods employed for the forming of longitudinal, transverse and where applicable, horizontal joints in multi-layer work whether with or without bond;
- 8) measures to be taken in extreme weather;
- 9) site trial and, where applicable, a site trafficking trial to demonstrate stability for immediate trafficking or overlay;
- 10) demonstration of performance properties; and
- 11) sealing and protection of the resulting HBM.

*NOTE 2 Lime, cement, GGBS, HRB and dry fly ash should be stored in silos or similar storage.*

*NOTE 3 Conditioned (wet) fly ash should have no agglomerations greater than 10 mm size. It should be stored under cover for at least 72 h, at a minimum water content of 10%, prior to production.*

*NOTE 4 All constituents should be protected from freezing to ensure suitability for use.*

*NOTE 5 For the ex-situ method, aggregates should be stored on a firm and clean substrate avoiding contamination with other constituents for at least 24 h prior to production.*

*NOTE 6 GBS and ASS can be stored as aggregates and should be used within 3 months of delivery.*

---

## 8 Transport and delivery

### COMMENTARY ON CLAUSE 8

*This clause only applies to HBM transported to the point of use.*

*Adjustment to the water content might be required to account for materials, transportation time and weather. Adjustments to added water during production does not require a new mixture design (see [Clause 5](#)).*

Loading, transport and delivery shall be carried out such that segregation is minimized. Segregated areas shall be identified from visual examination. Segregated material shall either be removed and replaced with fresh material to full depth or re-mixed if possible to rectify the affected area.

The number of delivery vehicles shall be such that a constant supply is available to enable continuous installation.

HBM shall be transported directly to the point where it is to be placed in the permanent works and protected from drying and weather during transit and whilst tipping as appropriate.

Deliveries to the site shall be planned to avoid delays to the placing process. If an extended delay is predicted beyond the workability period, then a Type 2 joint (see 9.2) shall be formed within the workability period.

---

## 9 Installation

### 9.1 Laying and compaction

*NOTE 1 Laying and compaction requires suitable control to achieve level control, surface regularity and to meet the requirements in [Clause 10](#).*

When using a paver, the paver shall not be allowed to fully discharge between loads.

Laying and compaction of HBM, including any reworking and reuse, shall be carried out without segregation or drying out, and shall be completed within the HBM workability period as determined by BS EN 13286-45 or the default periods as defined in [Table 1](#) and [Table 2](#).

Where rectification of installed HBM is not completed within the HBM workability period, the defective area shall be removed to the full thickness of the layer, and new HBM placed and compacted.

*NOTE 2 The only exception to this is that fine milling of hardened HBM is permitted to rectify surface tolerance if it is demonstrated to avoid damage to the remainder of the layer. Damage to the underlying layer during early life fine milling can take the form of near surface cracking and/or loosening of material. The potential for this can be assessed by visual assessment of the surface and coring after fine milling. The likelihood of this is linked to the curing, age and specific constituents of the installed HBM.*

In the in-situ method, mixing shall produce a minimum horizontal overlap of 200 mm with previously mixed material.

When applicable, if a subsequent layer of HBM is placed on a layer previously stabilized, the tines or blades of the in-situ pulverizing-mixing machine shall be set so that they cut into the previously stabilized layer below by at least 20 mm.

Unless otherwise specified, the minimum nominal layer thickness shall be 150 mm.

The workability period, in degree hours, shall be the summation of the products of the average air temperature above 3 °C ( $T$  °C) and time for each period ( $t$  hours): i.e. workability period limit =  $\Sigma(T.t)$ . If the air temperature during the interval,  $t$ , fluctuates by more than 4 °C, then the remaining workability period shall be calculated.

*NOTE 3 Default workability periods are given in [Table 1](#) and [Table 2](#).*

**Table 1** — Default workability period for HBM when one or more binder(s) are added at the same time

| Binder constituents                                                 | Workability period (°C hours)<br>[Default maximum workability period where precise data unavailable]                                                               |
|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CEM1 alone, CEM1 with SiFA, CEM1 with GGBS                          | 35 (30 for RCC using CEM1 only)                                                                                                                                    |
| Lime with GGBS                                                      | 200                                                                                                                                                                |
| Lime with SiFA (SiFA both as a binder constituent and as aggregate) | 850                                                                                                                                                                |
| Lime alone                                                          | 1 700                                                                                                                                                              |
| GBS alone, ASS alone, GBS + ASS                                     | 3 000                                                                                                                                                              |
| Other constituents, combinations, possibilities not listed above    | Producer determined in accordance with the mixture design procedure guidance given in <a href="#">Annex D</a> , <a href="#">Annex E</a> or <a href="#">Annex F</a> |

**Table 2** — Default workability period for HBM when individual binder constituents are added at different times

| Binder constituents                                              | Workability period (°C hours)<br>[Default maximum workability period where precise data unavailable]                          |
|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| SiFA followed by cement                                          | 35 after cement addition                                                                                                      |
| GGBS followed by cement                                          | 35 after cement addition but within 850 of GGBS addition                                                                      |
| Lime followed by cement                                          | 35 after cement addition but within 1 700 of lime addition                                                                    |
| Lime followed by GGBS                                            | 200 after GGBS addition but within 1 700 of lime addition                                                                     |
| Lime followed by SiFA                                            | 850 after SiFA addition but within 1 700 of lime addition                                                                     |
| GBS + ASS                                                        | 3 000 after first addition                                                                                                    |
| Other constituents, combinations, possibilities not listed above | Producer determined in accordance with the guidance given in <a href="#">D.2.3</a> for HBGM and <a href="#">E.2.3</a> for HSS |

Making-up of level with the same material after initial compaction shall not be permitted for single layer working.

The edge of previously compacted material shall be vertical and straight before fresh HBM is placed against it.

Compaction shall be carried out in accordance with the density requirements in [Clause 10](#).

*NOTE 4* [Clause 10](#) deals with end product compaction. Compaction to a method specification might be appropriate for some schemes.

Only PTR compaction with a wheel loading of not less than 30 kN shall be applied to FABGM 6 from BS EN 14227-3.

On completion of compaction the HBM surface shall be closed, free from ridges, cracks, loose material, visible voids, ruts, shear planes and other defects.

## 9.2 Joints

Joints shall be classified as either:

- type 1 joint: fresh HBM against fresh HBM uncompacted; or
- type 2 joint: fresh HBM against vertical face of compacted HBM or other material.

For type 1 joints, the materials either side of the joint, while within their respective workability periods, shall be compacted at the same time such that there is a marrying-in/continuity of material across the joint during compaction (this is classified as a type 1 joint).

Where the previously laid material is outside its workability period, it shall:

- 1) be cut back to form a vertical face of fully compacted material with the required depth (this is classified as a type 2 joint);
- 2) be protected in accordance with [9.5](#); and
- 3) not be rolled during compaction of material laid against it.

Type 2 transverse joints on each side of a longitudinal joint shall be in line with each other.

All longitudinal joints in HBM base layers and RCC shall be outside any defined wheel track zone.

Where HBM is laid in more than one layer and where bond and monolithic behaviour is not required, longitudinal joints shall be staggered so that they are not coincident, with an off set of at least 300 mm.

### 9.3 Induced cracking

Where specified, induced cracking shall be undertaken.

Where induced cracking is formed by grooving the fresh HBM prior to final compaction, bitumen emulsion shall be poured or sprayed into the grooves, without flooding, to form a separation membrane. The grooving and bitumen emulsion mechanisms shall be set such that the depth of bitumen in the compacted mixture shall be a minimum of one quarter of the full depth of the layer. The bitumen emulsion shall conform to Class C40B4, in accordance with BS EN 13808:2013. Final compaction of the HBM shall fully close the surface of the groove throughout its full length.

Unless specified elsewhere, saw cutting of the hardened HBM as an alternative to induced cracking shall not be permitted.

### 9.4 Adverse weather conditions

The temperature of the HBM shall not be less than 5 °C at the time of production and compaction.

Where HBM is transported, it shall not be placed or installed on a frozen surface.

Installation shall cease when the air temperature falls below 3 °C and shall not be resumed until the air temperature is 1 °C on a rising thermometer.

For HBM that requires a curing period (see [9.5](#)) before trafficking, an extra day shall be added to the curing period before allowing trafficking, for each day the temperature falls below 1 °C during the curing period.

In the case of inclement weather, production shall cease, and any placed HBM shall be compacted immediately.

### 9.5 Curing and opening to trafficking

#### 9.5.1 General

On completion of compaction, the layer shall be cured to prevent loss of moisture, unless the layer is overlaid immediately.

Curing shall be achieved by either of the following procedures.

- a) Application of a bitumen emulsion spray in accordance with BS EN 13808:2013, Class C40B4 or C60B4 to produce an even and complete coverage of at least 0.2 kg/m<sup>2</sup> of residual bitumen. The machine (spraying equipment) spread rate shall be calibrated in accordance with the method in [BS 594987](#). Before spraying commences, the surface shall be free of all loose material and standing water. Application of the curing compound shall be by metered mechanical spraying equipment, spray tanker or spraying device such that there is a consistent and adequate cover

rate. The curing membrane shall be protected from any damage until construction of the overlaying layer. The spraying equipment used shall not cause deformation in the surface. If fine milling of hardened HBM or regrading of HBM within its workability period is undertaken to rectify surface tolerance, then the curing compound shall be reapplied.

*NOTE For small or inaccessible areas, application may be by hand held sprayer.*

- b) Application of a mist/fog/light spray of water, sufficient to keep the surface continuously wet until the specified strength of the HBM has developed or the layer is overlaid.

To protect RCC surface courses a colourless protection compound shall be applied at the manufacturer's recommended rate.

For a course constructed in more than one layer, the surface of the lower layer shall be protected with a mist/fog/light spray of water until overlaid.

### 9.5.2 Trafficking

Direct trafficking of the surface of HBM layers shall be in accordance with the requirements given in [Table 3](#). If a layer exhibits signs of damage, trafficking shall cease immediately and shall only be resumed once the layer has gained sufficient stability to resist damage.

*NOTE Trafficking includes site traffic prior to overlay and/or construction of the overlying layer(s). Further guidance on this can be found in the Britpave publication, The immediate trafficking of cement bound materials [1].*

**Table 3** — Trafficking of HBM

| HBM type                             | Direct trafficking of the surface of HBM                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RCC                                  | The layer shall not be trafficked until: <ul style="list-style-type: none"> <li>– test specimens made at the time of construction and cured under the same conditions as the layer achieve a minimum of 20 N/mm<sup>2</sup>; or</li> <li>– the layer is cured for 7 days.</li> </ul>                                                                                     |
| CBGM 1 and 2                         | The layer shall not be trafficked until: <ul style="list-style-type: none"> <li>– test specimens made at the time of construction and cured under the same conditions as the layer achieve a minimum of 4 N/mm<sup>2</sup>; or</li> <li>– the layer is cured for 7 days.</li> </ul>                                                                                      |
| HBGM 1 and 2 other than CBGM 1 and 2 | Not restricted provided either: <ul style="list-style-type: none"> <li>– the aggregate in the HBGM conforms to Category C50/30 for crushed or broken particles in BS EN 12620;</li> <li>– the HBGM achieves IBI category IPI<sub>50</sub>; or</li> <li>– in-situ performance is demonstrated by use of LWD in accordance with <a href="#">BS 1924-2:2018</a>.</li> </ul> |
| HBGM 3, 4 and 5                      | Not restricted provided either: <ul style="list-style-type: none"> <li>– the HBGM achieves IBI category IPI<sub>50</sub> (IPI<sub>40</sub> for HBGM 3); or</li> <li>– in-situ performance is demonstrated by use of LWD in accordance with <a href="#">BS 1924-2:2018</a>.</li> </ul>                                                                                    |
| FABGM 6                              | Not permitted. Installation of the overlying layer shall be carried out within the workability period of the FABGM 6 and without direct trafficking the FABGM 6 surface.                                                                                                                                                                                                 |