

# Method statement for labour based construction of:

## Bitumen stabilised materials with emulsion

### Definition

Bitumen stabilised materials with emulsion (BSM-E) consist of a mixture of slow set bitumen emulsion and graded crusher stone or natural gravel with the addition of cement and water.

### Application

The treatment of crushed stone or gravel with emulsion is ideal for constructing new base courses for surfaced roads. The component materials can be mixed using a concrete mixer and placed by hand. The construction of 100 mm thick BSM-E by hand is suitable for urban and rural roads carrying less than 500 vehicles per day. A layer thickness of 150mm BSM-E is recommended for more than traffic volumes of more than 500 vehicles per day. BSM-E is also suitable for backfilling when repairing potholes in bases.

### Material requirements

**Aggregates:** - Suitable granular material which meets the minimum requirements of a G5 classification can be used. For clayey gravel lime should be added to reduce the PI to below 7. If lime is used it may not necessary to add cement.

**Binder:** - Anionic stablemix grade bitumen 60% emulsion conforming to SANS 309 is recommended.

**Cement:** - Fresh Ordinary Portland cement must be used. The cement acts as a catalyst, promoting the breaking of the emulsion after compaction.

**Water:** - Potable water

### Plant and equipment requirements

Below is the typical plant requirement to mix and place 18 m<sup>3</sup> loose or 12 m<sup>3</sup> compacted BSM-E per day.

Item	Number of items
Concrete mixer (0.3 m <sup>3</sup> )	1

Wheel barrows	4
Shovels	8
Rakes	4
Large containers (25 litres)	5
Small container (1 & 5 litre)	1
Pedestrian double drum vibratory roller of weight 0.6 t or more	1
Watering cans	2
Steel shuttering (3 m lengths)	10
Screed	1
Steel gauges (3 m lengths)*	6

\* Required to contain the loose material before compaction

### Labour requirements

Below is the typical composition of a team necessary to mix and place 18 m<sup>3</sup> loose or 12 m<sup>3</sup> compacted BSM-E per day.

Activity	Number of workers
Loading of gravel	2
Operating concrete mixer	1
Pushing wheelbarrows	3
Loading emulsion, cement and water	2
Spreading material	3
Compacting layer	1
Traffic control	2

### Construction

#### Mixing

The mixing of the materials can be done by hand, but for improved efficiency and speed of application the use of a concrete mixer is recommended. Before mixing commences the proportions of the mix must be

established i.e. percentages of emulsion and cement or lime to be added to the gravel or crushed stone. Typical mix proportions are as follows:

Material	Percentage by mass	
	Crushed stone	Gravel
Bitumen emulsion	3	3
Cement or lime	1	2

For batching the following procedure is recommended. Firstly, the typical mass of gravel/crushed stone required to fill four 25 litre containers is determined. The mass of emulsion and cement or lime required based on the percentage of the aggregate mass is then calculated. For example: for 200 kg of gravel add 6 kg or 6 litres of emulsion and 2 kg or 3 litres of cement or lime.

The following mixing sequence is recommended to obtain a thoroughly mixed BSM-E:

- Step 1: Add the gravel/crushed stone into concrete mixer
- Step 2: Add the cement or lime into concrete mixer
- Step 3: Mix contents
- Step 4: Pour water into concrete mixer
- Step 5: Mix contents
- Step 6: Pour in emulsion
- Step 7: Mix contents

The amount of *liquid* in the BSM-E after mixing i.e. emulsion, in situ moisture of the gravel and added water must be 1 – 1.5 % above the optimum moisture content (OMC) for the Mod AASHTO density of the material being stabilised as determined in a soils laboratory. The quantity of water to be added will vary depending on the in situ moisture of the aggregate, the type of aggregate and prevailing air temperature. The mix should not be too dry or moist as it is unlikely that compaction will be achieved.

## Placing

The BSM-E material should be placed between the shutters and spread with rakes. In the case of a 150 mm layer, the material should be levelled off by scraping the screed over the top of the shuttering. The material placed should be compacted before placing the next layer. Before compacting the final layer the steel gauges should be placed on top of the shuttering to contain the loose material. A 100 mm layer can be placed and compacted in a single layer. The depth of the gauges is determined by the bulking factor of the material which is usually 1.5 for gravel.

Only sufficient material should be placed at a time as will allow proper compaction before the moisture content drops below OMC. The loose material is compacted using the pedestrian roller. Compaction should start against the shuttering on both sides before compacting the centre. The compacted layer should be checked for thickness and evenness. If the layer is to be opened to traffic before being surfaced, a diluted emulsion should be applied on the loose upper surface using a watering can before compaction. This will provide a tightly knit surface.

The BSM-E should be left to dry for at least two days to allow the emulsion to cure and set. It is not necessary to prime the new base if the surfacing is carried out immediately after the material has cured.

## **Quality control**

Before construction commences the appropriate mix proportions of emulsion and cement/lime should be established. A soils laboratory should be requested to test the parent material to determine the following properties:

- Grading and PI
- Bulking test
- Optimum moisture content

A dilution test - in which the emulsion is diluted 50:50 with water from the source in a glass container - should be carried out to check if the water and emulsion are compatible.

During mixing a quick test for moisture content of the material can be done by squeezing the stabilised material in the hand to ensure that there is no excess water or that it is not too dry before placing. The work completed should be measured on a daily basis and the proportions of emulsion and cement determined from actual quantities used and checked for correctness.