C-05: Rehabilitation of Kegalle - Bulathkohupitiya - Karawanella Road at Kegalle Junction by the construction of a cold mix surfacing

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The Kegalle-Bulathkohupitiya-Karawanella road with a cracked concrete pavement on a weak subgrade has been subjected to heavily loaded traffic along with inadequate drainage. Due to the poor condition, of road, repairs had to be carried out frequently for a period of several decades even after the construction of a concrete pavement in 1980.

In order to rehabilitate this road, a decision was taken in 1990 to construct a cold mix overlay using bitumen emulsion and 37.5 mm graded aggregate on the existing surface, for the first time in Sri Lanka, provide adequate drainage and study the behaviour and durability of such surfacing under the above conditions. This paper deals with the research on the techniques of construction to suit local conditions, problems encountered and the behaviour of the cold mix surfacing.

An investigation for pavement design was carried out by cutting cores in the existing concrete pavement and sinking auger holes in order to determine the properties of the underlying layers.

An overlay design for a flexible pavement was carried out based on the pavement investigation, a projected traffic count of about 3000 vehicles per day and a cumulative number of standard axles of 1.9×10^6 for a design life of 15 years. It was decided to construct a pavement of minimum thickness of 75 mm using cold mix in accordance with the pavement design, after constructing a correction course using the same material.

The following materials were used for the cold mix surfacing:-

Crushed stone aggregates conforming to the specification for grading of dense graded mixtures given in Asphalt Institute, USA Emulsion Manual (AIEM), 1984 and having strength characteristics conforming to Roads Development Authority (RDA) Standard Specifications for Construction and Maintenance of Roads and Bridges (SSCM) were used for the production of the cold mixes. Single sized aggregates of sizes 37.5, 19.0, 12.5 mm and crusher

fines were blended to obtain the required grading. The recommended grading band and the grading of the aggregate blend used are given in *Table 1*. The Aggregate Impact value and the Aggregate Crushing values varied from 21 to 25% and 19 to 25% respectively. The Los Angeles Abrasion value was 33%.

Table 1. Recommended aggregate grading band and aggregate blend for cold mix overlay

Sieve size		*Recommended grading band*	*Grading of Aggregate blend*
mm	μm	*% Passing*	*% Passing*
50		100	100
37.5		90 - 100	100
19.0		60 - 80	80
4.75		20 - 55	39
2.36		10 - 40	24
	300	02 - 16	08
	75	00 - 05	01

Cationic Slow Setting Bitumen Emulsion CSS-1 conforming to American Society for Testing Materials (ASTM) Specifications was used as the binder; the engineering properties are given in *Table 2*.

Table 2 Properties of css-1 bitumen emulsion

Properties	*Test Method*	*Test Result*
Viscosity Saybolt Furol at 50°C s	ASTM D 88 - 79	21
Storage stability 24 h %	ASTM D 244 - 77	0.7
Sieve test %	ASTM D 244 - 77	0.06
Oil distillate by volume of emulsion %	ASTM D 244 - 77	2
Residue %	ASTM D 244 - 77	63
Tests on residue from distillation test		
Penetration 25°C 100 g	ASTM D 78	110
Ductility 25°C 5 cm/min	ASTM D 79	68
Solubility in trichloroethylene %	ASTM D 76	99.6

Trial mixes were prepared using the above aggregate and emulsion as given in AIEM 1984 and the minimum percentages of premixing water and emulsion contents required to obtain satisfactory coating of the aggregate with workable consistency were determined and used for the production of cold mixes.

For the production of cold mixes 2 methods of mixing were employed: Three concrete mixers of capacity of 10 cu.ft. each were used. Cold mixes of workable consistency with good coating of particles were obtained, but the rate of production of the mix was slow and about 15 labourers had to be employed. When the wheel loader was used for production of cold mix, the rate of production was much higher and less labourers were required. The mix obtained was of good quality when visually observed.

Aggregates of the required sizes were mixed using a wheel loader with a bucket of known capacity and placed on a cleaned surface and the required quantity of water was added and mixed using the wheel loader bucket as a shovel. The mixed aggregate was spread to a uniform thickness of 200 to 300 mm. The required quantity of emulsion was measured from barrels into the loader bucket and poured on the surface of the aggregate. The materials were mixed thoroughtly using the wheel loader until all aggregate particles were well coated with emulsion.

A motor grader was used to spread and level the mix. The motor grader was less efficient than a paver that is normally used for this purpose, due to segregation of particles. In spite of this, the required cross fall and surface regularity for this work could be obtained.

Compaction of the surfacing was carried out using a 6 tonne vibratory roller and a 8-10 tonne smooth 3 wheeled roller that are easily available, in place of tandem and pneumatic tyred rollers that are used for compaction of hot mix.

To carry out this type of construction successfully cold mix of good quality should be produced. The materials should conform to specifications and the required proportions of the materials to produce cold mix of workable consistency with adequate coating of the aggregate, has to be determined. The requirement of efficient and experienced machine operators is also essential.

It has been observed that the cold mix surfacing using bitumen emulsions and 40 mm graded aggregate constructed for the first time in Sri Lanka in June 1990 has performed satisfactorily todate indicating that such cold mixes produced at site can be used as surfacing for roads with heavy slow moving traffic. This type of road construction may be used in the future for the production of bituminous mixtures when stationary mixing plants for hot mix hot laid bitumen bound materials are not available for such heavy duty surfacing.

The production of the cold mix and construction of the surfacing had to be carried out during the rainy season and it had not affected the quality and durability of the surfacing unlike hot mixed hot laid asphalt concrete and cut back asphalt mixes.