C-01: Investigation into the causes of failure of asphalt concrete road surfaces in Colombo Municipal Council area

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It was observed that large amounts of movements and formation of corrugations have taken place in the asphalt concrete (A/C) road pavements in 1989/90 in Colombo Municipal Council area where the traffic density is high. Investigations were carried out on the road surfaces to determine the causes of failure that had taken place on these pavements. A few sections of failed surfaces and satisfactory surfaces of roads within the limits of Colombo Municipal Council were selected for the study. This paper deals with the above investigation and the determination of the causes of failure without taking into consideration the conditions of the underlying layers of subgrades and subbases.

Cores of asphalt concrete were collected both from the left hand side (LHS) and right hand side (RHS) of the road and these locations, are given in *Table 1*.

The bulk densities, percentages of binder and grading of the aggregate of each core were determined by carrying out extraction tests according to American Society for Testing Materials, (ASTM).

The percentage of binder and percentage of fine aggregate passing 75μm sieve size of each core sample were compared with the laboratory mix design values, carried out according to ASTM D3515 of 1990.

The grading of the aggregate of each core was compared with that given in the standard specifications for construction and maintenance of roads and bridges (SSCM) of Road Development Authority (RDA), for wearing course Type I, for asphaltic concrete surfacing.

Location No.	*Description*	*Condition of the surface*	
		LHS	*RHS*
01	Thotalanga Junction Colombo 14	Serious corrugations on the busbay	Apparently uniform
02	Prince of Wales Avenue Mahawatta Junction, Colombo 14	Good condition	
03	Ingurukade Junction (Roundabout) Colombo 14	Few shallow corrugations around the roundabout	
04	Sri Sangaraja Mawatha, Colombo 14 In front of Building Materials Corporation	Good condition	
05	In front of Police Station, Colpetty, Colombo 3.	Corrugations closer to the bus stop on the outer lane	Almost * uniform
06	In front of St. Peters College Colombo 6	Severe corrugations	Almost * uniform

* Few places with excess bitumen.

When the percentage of fine aggregate passing 75μm sieve is high (close to or above the upper limit of the grading band of SSCM) and when the percentage of binder in the mix is high, such locations are highly corrugated. In such locations, the fine aggregate has separated from the asphalt concrete surfacing material and formed a mastic with bitumen causing movement of the material due to instability of the mix.

Low voids content in the A/C mix may also result in instability or flushing of the pavement after it has been exposed to traffic for a period of time because of reorientation of particles and further reduction of voids due to additional compaction.

Table 2.

TABLE 2 : RESULTS OF THE ABOVE STUDY

Parameters							
	1 With respect to designed value	2	3	4	5	6	7 Average Value
Category of Surface							
1.Normal road surfaces (Location 2 & RHS of locations 1,5, & 6)	Approximately equal	Closer to the lower limit	Low	6-15	2-4	4.3-5.3	12
2.Normal road surfaces with slight excess of bitumen (RHS of locations 5* & 6*	Higher	Around the median	higher than category 1	6-10	0-2	5.3-6.0	13
3. Surfaces full of corrugations (LHS of locations 1,5,&6)	Much higher	Closer to the upper limit	higher than category/ 2	3-5	0	>6	14

Test parameters:

1. Percentage of binder for the coresponding percentage of fine aggregate 75μm sieve size
2. Percentage of fine aggregate 75μm sieve size with the specification limits given in SSCM for wearing course 1
3. bulk Density of the A/C cores
4. The ratio R = $\frac{\text{Percentage of fine aggregate between 2.36mm and 75}\mu\text{m sieves}}{\text{Percentage of aggregate passing 75}\mu\text{m sieve}}$
5. Voids contents of the A/C mix on road surface
6. Percentage of bitumen in A/C mix on road surfaces
7. Voids in mineral aggregate.

The research indicates that the causes of failure are due to the high percentages of binder and material passing 75μm sieve in the aggregate of mix and the low voids content for asphaltic concrete overlays.

The failures tend to occur on the lanes where the traffic is high during the afternoons when the overlay is hot. Bus bays and signal junctions have also not performed well due to heavy traffic braking and accelerating at these locations.

In future, adequate quality control measures and amending of the grading band for aggregates for mix should be adopted if asphaltic concrete overlays are to be constructed satisfactorily on roads with heavy traffic.