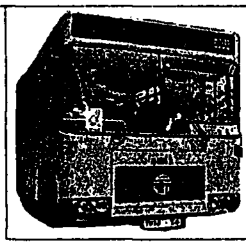
Need for Effective Highway Construction and Maintenance Procedures for Sri Lanka



The highway network is a significant component of the transportation infrastructure in any country. Every aspect of the economy can be directly tied to highways. That includes the movement of freight and finished goods and the movement of personnel to and from work, shopping and recreational locations. Given the dominance of the highway transport mode it is necessary to achieve two goals:

1. Provision of high level of service (minimize travel time and delays).
2. Provision of high level of safety.

The above goals are sometimes contradictory, but must be achieved in the context of ever changing constraints. These constraints can be broadly classified as economic and environmental. Since highway pavements constantly deteriorate due to traffic and the weather, each year a relatively significant portion of the national budget must be expended for satisfactory maintenance of the road network.

However, developing countries like Sri Lanka often encounter serious limitations in resources for pavement construction and maintenance, generating a vital need for efficient management tools that would optimize the capital and recurrent investment on pavements.

Present Scenario

Sri Lanka has over 90,000 kilometres of roads, out of which about 11,400 km are classified as national roads managed by the Road Development Authority. The national roads are classified into two groups as A and B. Provincial Councils or local government bodies such as Municipal Councils, Urban Councils, Divisional Councils or some government departments manage the balance. Some of the roads that do not fall into the category of national roads are classified as C, D and E class roads and others are not classified.

The entire road network in the country can be classified into nine groups as follows in the descending order based on the cost of construction and maintenance and the level of service:

1. Concrete paved roads
2. Asphalt concrete paved roads
3. Bituminous surface paved roads
4. Bitumen penetration macadam roads
5. Bitumen primed gravely soil roads.
6. Gravel surfaced roads
7. Earth roads
8. Tracks (Seasonal roads)
9. Trails & paths only suitable for two-wheeled traffic or pedestrian and animal traffic.

Majority of the National roads fall into the categories 1-4. Some of the other roads belong to categories 4-6. There are many kilometers of roads in categories 7-9 and there is a severe pressure on politicians, leaders and developers to upgrade them to categories 4-6, usually to category 4. The level of service provided by the road categories 4-6 for rural traffic is similar, but the cost of construction and maintenance would be different by many proportions.

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An accurate account of the extent of road length according to the road classification is not available. **Table 1** gives an estimate of the road length distribution based on the information available at the Road Development Authority and the University of Moratuwa.

Table 1: Distribution of National Roads by Road Classification

Province	Class A	Class B	% Class A	% Class B	Total
Western	356	1127	24%	76%	1483
Central	432	1226	26%	74%	1658
Southern	355	856	30%	70%	1211
North-Western	333	817	29%	71%	1150
North-Central	538	522	51%	49%	1060
Uva	414	791	35%	65%	1205
Sabaragamuwa	434	668	40%	60%	1102
North					1300
North-East					1200
TOTAL			33%	67%	11369

(Source: The University of Moratuwa (1997) & RDA)

Data shows that approximately one third of the national roads fall into the category of Class A. However, it can be observed that the percentage of Class A roads is relative small in the provinces where the total length of national roads is high.

There is no relationship between the class of the road and the road width or surface type. Even for a particular road, road widths vary depending on the location. Except for the road inventory database prepared by the University of Moratuwa no other comprehensive road inventory is available to study the present road geometries. This database also has to be updated for the present condition.

The distribution of national roads on provincial basis according to the surface type is given in **Table 2.**

During the last 15 years, only about 2000 out of 11400 km have been improved. Hence 9400 km are yet to be improved which is 4/5 of the National Roads. At this rate, assuming that nothing is to be done on the improved roads, it will take another 50-60 years to improve the balance length. As life cycle of asphalt-overlaid roads is approximately 15 years there will be a need to attend to already improved roads before improving the balance. The slow progress in road rehabilitation work is mainly due to the lack of funds. The road improvement projects that have been completed have used donor-funding form institutions such as ADB, World Bank, OECF etc. One cannot expect to receive donor funding for all road rehabilitation works. Under these circumstances there is no prospect for road improvements within a reasonable time frame unless a different strategy is adopted.

Another significant problem encountered in highway development is the relatively shorter life span of road pavements. In many situations roads have shown signs of deterioration earlier than the expected design life. Poor maintenance practices, inappropriate geometric standards, inadequate quality of the construction materials, drawbacks in construction techniques, uncontrolled traffic loads, adverse environmental conditions such as high temperatures and high intensity rainfall and unexpected increase in traffic loads are some of the reasons for premature failure of roads.

Possible Solutions

It is an acceptable fact that road maintenance should be carried out according to the available specifications in order to reduce the rate of de-

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terioration and keep the roads at an acceptable condition. For this funds should be allocated for the maintenance activities on the basis of existing road inventory and their condition. If this can be implemented we would have a road network with a reasonable standard. However, due to lack of financial resources road authorities are unable to adhere to the maintenance work as specified. The solution is to adopt a suitable management mechanism to maximize the utilization of the available funds. One of the problems of using established pavement management system (PMS) is the data-intensive nature of the decision making model. A management program for the RDA controlled road network has been successfully developed

(SLPMS, 2001) based on a decision making model that utilizes a rapid and less expensive visual pavement evaluation scheme. It is expected to introduce this program to the Provincial Councils and other local statutory bodies that manage paved highways.

More research and investigations are required to use the limited amount of pavement condition data that would be available at Provincial Council & Pradeshiya Saba level. In addition, investigations should be done for extending the currently developed management techniques to unpaved gravel road as well. Findings from recent efforts between the University of Moratuwa and RDA *(Amarasekera and Bandara, 2001)* can be utilized

It is also necessary to formulate systematic guidelines for planning and construction of new roads and rehabilitation of existing roads in Sri Lanka. This could be best achieved by first scrutinizing such existing guidelines elsewhere. Secondly, collaborative efforts between road authorities and research organizations can lead to the development of compatible procedures and streamlining of construction procedures to improve cost-efficiency.

Establishment of relationships to understand the variations in level of service and vehicle operating costs in relation to the traffic flow, traffic composition, surface condition and other geometric parameters, would be useful to achieve the above task. These relationships could be used to determine the traffic levels at which geometric or structural changes should be incorporated. For examples one could determine when a single lane road to be converted to intermediate lane roads, intermediate to two lane undivided standard, gravel to metaled and tarred roads and metaled and tarred roads to asphalt overlay roads or bitumen treatment surfaced (DBST/SBST) roads etc. This could be useful to minimize unnecessary expenditure in road development & rehabilitation.

It has been observed that gravel roads can easily carry traffic up to about 200 vehicles per day at a very much lower investment than paved roads. A recent survey has revealed that around 75% of the rural roads carry traffic loads less than 150 vehicles per day (vpd) and nearly 45% of the roads carry even less than 50 vpd. It is also observed that the percentage of commercial vehicles that can cause significant damage to road pavements is less than 10% of the total traffic flow. Nearly 85% of the vehicles falls into the category of very light vehicles such as bicycles, motorcycles and three wheelers *(Amarasekera & Bandara 2001)*. Due to the relatively light traffic load experienced in rural areas well designed and carefully constructed gravel roads could be used as a step in stage construction of paved roads, thereby making use of much needed funds in an efficient manner. Also certain locations such as, sacred places, national wildlife parks, archeological sites, warrant only unpaved roads due to environmental considerations.

It has become a practice to use typical (standard) designs for bridges and other structure in order to cut down on time for planning and design. However, site-specific designs for bridges and other structures could be used to cut down the costs associated with the use of typical designs at all locations. Further, site-specific designs will definitely be more environment friendly as compared to typical designs. Implementation of a design audit procedure would be useful in this regard. Maintaining inventories of bridges and other structures at National and Provincial level along with inspection and maintenance records could be employed to minimize the costs associated with maintenance of road structures.

Research work on effective and economic rehabilitation techniques and selection of materials need to be carried out. It is necessary to review existing techniques used for rehabilitation of Asphalt Concrete, DBST, SBST and gravel roads and explore possible improvements in terms of durability within cost efficiency. Also one could expand the scope of current research in exploring more appropriate material for rehabilitation and construction of paved as well as gravel roads *(Judith et. al, 2001)*. Investigating the possibility of developing of low cost structures for roads is another approach that can be taken to save money for much needed road improvements *(Sumanaratne & Kulathilake, 2001)*.

Steps should to be taken to transfer of new technologies in road construction and design from foreign and established local road contractors to other local contractors and road authorities. Establishment of a resource center (i) to maintain a library of literature related to new developments in road design, construction and maintenance, (ii) to provide training to people involved in road construction and maintenance at the grass root level and (iii) to provide forums to share the experience of local contractors and road authorities would be very useful in the future to achieve the goal of having improved road network.

Table 2: Distribution of National Roads by Surface Type

Province	Asphalt Concrete	BDST & SBST	Metal & Tarred	Primed	Total
Western	397	286	800	-	1483
Central	100	13	1545	-	1658
Southern	101	176	934	-	1211
North-Western	178	134	838	-	1150
North-Central	74	59	927	-	1060
Uva	-	52	1038	115	1205
Sabaragamuwa	136	106	860	-	1102
North	-	25	1275	-	1300
North-East	-	30	1170	-	1200
Total	986	881	9387	115	11369

(Source: University of Moratuwa (1997) & RDA)

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