Road Transport: Meeting the Challenges

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Introduction

The road network is a significant component of the transportation infrastructure in any country. Every aspect of the economy can be directly tied to roads. That includes the movement of personnel to and from work, business, schools, shopping and recreational locations and the movement of freight, both raw material and finished goods. Given the dominance of the road transport mode it is expected to achieve the following 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 road pavements constantly deteriorate due to traffic and the weather, each year a relatively significant portion of money must be allocated for satisfactory maintenance of the road network.

History of Road Transport

Early roads have been used to transport goods using animals and humans. Subsequently animal drawn wheeled carts, chariots and wagons have been developed. There are evidences for paved roads as early as 4000 BC. Roads constructed using stones have been popularized during the Roman Empire period. New construction methods have been introduced during 18th & 19th centuries. Thomas Telford and John McAdam are considered as the pioneers in the above new construction methods.

Road transport in Lanka goes back to 1st century BC where Anuradhpura used to be the capital and were confined to the dry zone of the country. Roads in coastal areas and to up country were developed after the European occupation in coastal areas.

Function of Roads

Roads are needed to satisfy two basic requirements of any trip. They are accessibility and mobility. Accessibility is the ability to reach the destination location of any personal trip or goods movement, and can be considered as the end product of all travel needs. Travel need arises always to access a person, place or thing. Mobility refers to the ease of moving from one location (origin) to another (destination). Mobility can be considered as a function of speed, capacity, frequency, safety and cost.

Roads are used for many purposes other than for vehicle or pedestrian movement. They are, for parking, for recreational activities and for informal socio-economic activities. Hence there are a number of different categories of road users whose expectations are also to be met depending on the situation.

When considering the movement of vehicles, road pavements provide two basic functions. They are; to help guide the drivers, and support the vehicular loads. Road geometry and the pavement structure play vital roles in satisfying these two functions.

Classification of Roads

It is estimated that Sri Lanka road network consists of just over 100,000 km of roads of different kinds. Out of the above, nearly 12,400 km are considered as National roads (A and B Class), which are managed by the Central Government Road Development Authority. These roads generally connect provincial and district centers. Another 16,000 km of roads are categorized as C, D and E class Provincial roads, which are managed by the respective Provincial Councils.

The balance roads are owned by different organizations such as municipal and by urban councils, pradeshiya sabhas, Irrigation Department, Mahaweli Authority, Department of Wild Life Conservation and different plantations and estate companies.

Transport service by carts in the past

The above classification is mainly focused on administrative considerations. Generally the roads are classified according to their functions. Different countries use functional classification systems that are slightly different from one another. Here, the connectivity, the level of mobility and accessibility, and traffic volume are taken in to account for the classification. The following broad classification can be used in Sri Lanka if the roads are to be classified according to their functions. They are, Local Roads, Collector Roads, Arterial Roads and Expressways. It is possible to have sub classifications for each of the above categories depending on the need.

Future transport service

In any case, classification of roads is based on its pavement structure. Accordingly roads can be divided in to two basic categories, namely, flexible pavements and rigid pavements. Flexible pavements are those that consists of base course of suitable granular materials with or without bituminous binder and a bituminous surface course.

Rigid pavements are those constructed with Portland cement concrete.

There are two types of concrete roads presently used in Sri Lanka. They are reinforced or paver-laid main roads and hand or roller compacted rural roads.

The rest of road network in the country can be classified into eight groups in the descending order in terms of the cost of construction and maintenance, and the level of service. These are as follows:

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

Majority of the National roads come under categories 1-4. Major share of the other roads fall into categories 4-6. There are many kilometers of roads under categories 7-9, which are of under severe pressure on decision makers and developers for upgrading them to categories 4-6, and sometimes to category 1, 2 or roller compacted concrete roads. 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 higher many fold.

Major Development Stages

Development and operation of a road network goes through a number of important stages. They are; planning, feasibility study, geometric designing, pavement designing, construction, traffic operation and maintenance stages.

Proper planning is essential to develop an efficient road transport network. Understanding the present and future demand for transport, improving the connectivity of the exiting network, accommodating regional development needs, taking note of possible changes in vehicle fleet mix etc. are taken into account during the planning exercise.

Gravel surfaced roads

Projects identified as priorities during the planning stage need to go through the feasibility study stage that will investigate deep into economic, social, environmental and engineering feasibilities. All significant positive or negative impacts due to a proposed project are, identified during this process, and necessary remedial measures are proposed which would be included into the designs or accommodated during the construction stage. Benefit/Cost analysis, Environmental Impact Assessment, Social Impact Assessment, and Traffic Impact Assessment are some of the common tools used for the feasibility studies. In recent years, emphasis on road safety has increased, and road safety audits are also now encouraged during all stages of road development.

Geometric and pavement designs can be done in parallel after the planning exercise. Geometric design deals with the horizontal and vertical alignment of the road, width and other visible road furniture including signs, signals and markings. Road user convenience and safety are the main considerations during this stage. Limited availability of land may act as a constraint for proper geometric design.

Expressway

Bituminous surface paved roads

Asphalt concrete paved roads

The pavement and the shoulder are the most costly items of a given road. Pavement design deals with the structure of the road below the surface. Existing ground condition, expected traffic load and drainage are the main input parameters for pavement design.

Once the design and feasibility studies are completed the construction work starts. Quality of the workmanship and material used are the key parameters for a good road. Efficient use of material, equipment and labour is expected during this stage, and it is the responsibility of the engineers to ensure safety and the convenience of the general public, environment and the work force.

During the traffic operation stage traffic management plays a key role. Ensuring safety and minimizing delays will depend on the efficiency of traffic management. Today, traffic management focus is on movement of people and goods rather than on the movement of vehicles. For efficient traffic management proper road design, enforcement of law and user education are indispensable. During the operation stage roads tend to get deteriorated due to traffic load and other environmental conditions such as rain, wind, heat etc. It is an accepted fact that road maintenance should be carried out according to the available specifications in order to reduce the rate of deterioration and keep the roads in an acceptable condition. For maintenance, sufficient funds should be allocated on the basis of existing road inventory and their condition.

Challenges

Professionals involved in road transport have the responsibility of addressing the likely short and long term impacts of road projects on vehicular traffic, road users and non-road users. User related impacts are the travel cost, travel time, convenience and safety, where non users get impacted due to noise, air pollution, changes in land value and accidents.

In addition to the above responsibilities the professionals involved in road transport have to face many challenges. These challenges can be broadly identified as technological challenges and behavioural challenges. Challenges involving infrastructure, vehicle technologies and traffic operations are the technological challenges that one has to face. Continuous changes/improvements in the different transport modes, changes in general demographic trends, and user expectations relating to safety and comfort are the behavioural challenges that have to be overcome.

Cost of new road infrastructure is usually very high and engineers are faced with the problem of developing cost effective designs and construction techniques. Designs that use more sustainable materials are getting popular while construction methods that save time are preferred. Although the initial cost is a concern for many decision makers, today the professionals are more interested in the life cycle cost of the project as opposed to the initial cost because durability can not be compromised.

Road infrastructure gets deteriorated with time due to usage and environmental conditions. Adopting proper maintenance standards is a necessity to retain the required level of service. Repair cost and inconvenience to the roads users will increase if roads are not maintained systematically. Water is one of the main factors that contribute to road deterioration. Proper handling of drainage water is a major challenge for the road authorities.

Aging road infrastructure requires not only strength upgrading but also an increase in capacity and speed. Developing new techniques to economically combat aging infrastructure is a major challenge faced by the road engineers, as there could be constraints in land availability and environmental considerations.

Vehicle technologies keep changing with time due to technological advancements. More smaller and lighter passenger vehicles and bigger and larger freight vehicles are added to the exiting vehicle fleet. Fuel efficiency and safety standards continue to increase in the new vehicle fleet. Newer vehicles

have higher acceleration and deceleration capacities and user comfort, which demands roads that can accommodate higher speeds and capacities.

Managing ever increasing traffic volumes is another challenge that needs to be addressed. Road designs that accommodate both motor vehicles and pedestrians, intersection controls that accommodate more traffic, turning and parking restriction at appropriate places that facilitate the smooth flow of traffic, are some of the solutions for effective traffic management. It is necessary to develop innovative ways of road space utilization. Knowledge and application of latest developments in information and communication technologies can help in achieving this task to some extent.

When new transport modes are introduced to the system, especially in urban environs, travel patterns change significantly. Hence coordinated planning efforts are required to capture the future trends to systematically develop the road network. Making use of the capacities available in different transport modes, and using them in a complementory manner is now promoted, and this is sometimes termed as multi-modal travel. In order to achieve the expected results, networks and operation of different transport modes, such as bus routes, railway lines etc, need to be carefully coordinated.

Changes in general demographic trends due to economic or natural reasons contribute to an increase in demand for transport. Providing road infrastructure that accommodates these changes in land use is very essential to support the continuity of economic and social developments.

Assuring safety of road users and providing a reasonable level of service is one of the difficult challenges due to the contradictory nature of the expectations. However, this aspect cannot be ignored as the result will cause a significant increase in social cost.

Professionals involved in road transport in developing countries face many challenges in their attempts to improve the road systems in the respective countries. One dilemma is their inability to use the already developed transport theories or policies directly in a local context. The other is the un-affordability of technological advances available in the developed world to solve transport problems. Road engineers in developing countries always face the challenge of developing acceptable methodologies for prioritizing the use of resources that can be directed in achieving better, affordable and sustainable road transport systems that are subjected to continually increasing constraints.

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