Transportation Planning and Management in Small Towns in a Developing Country: Case Study for Sri Lanka

S. C. WIRASINGHE, J. F. MORRALL, AND L. L. RATNAYAKE

The underlying reasons for the poor state of the transportation systems in small towns (also known as urban councils) in Sri Lanka are identified. Two major reasons are the lack of coordination among the various agencies responsible for different aspects of the system, and the absence of transportation planning. The lack of coordination and transportation planning can be addressed by establishing the post of "transportation planning engineer" in large urban councils. The duties and responsibilities of the proposed post and the required qualifications are outlined. Technical problems associated with road cross sections, the vehicle-transport network, pedestrian facilities, parking, and traffic control are discussed and some remedies suggested. The importance of considering the mobility of all people, as opposed to those using automobiles, is emphasized. Novel approaches to the provision of public transportation services, such as joint urban council–private sector "tram" systems are proposed.

The transportation systems in most small towns (also known as urban councils) in Sri Lanka are in a state of chaos today, mainly because of poor management, lack of financial resources, inadequate maintenance of the existing transportation system, and the low capacity of the public (bus and van) transportation systems. A small town is defined as one with a population range of 5,000 to 50,000. The lack of formal coordination among the various agencies [e.g., Roads Development Authority, Urban Council, Police, Regional (Bus) Transport Board, Private Bus Operators Council] contributes to the general disarray. Furthermore, some important users of the transportation system such as pedestrians and cyclists are not formally under the purview of any particular agency.

Besides the problem of coordination, some of the other problems associated with transportation system planning and management in small towns and possible remedies are also discussed.

TRANSPORTATION NETWORK

The transportation network in a urban council essentially consists of nodes [trip generators and attractors such as shopping areas, bus terminals, railway stations, weekend markets (pola), schools, hospitals, and industrial parks] and transportation links that connect the nodes to residential areas, to each other, and to intercity routes. In addition to roads (with sidewalks) the network includes foot and bicycle paths. The roads on the network should be classified as intercity arterials (primary), secondary, tertiary, and feeder. The classification of a particular road will depend on functions and volume.

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Intercity

Most small towns are on a Class A or B intercity route. The major function of an intercity route is the movement of traffic through the small town. Consequently, the link should have a minimum of two clear vehicular lanes that are not obstructed by parked vehicles. On-street parking during periods of light traffic can be allowed only if four lanes are available. An intercity route could also consist of two one-way links with one lane and one parking lane, each forming a complete system. Raised and fenced sidewalks of a minimum 1-m height should be provided for pedestrians. Ideally, adjacent parallel one-way service roads should be provided with adequate parking, and parking should not be allowed on the intercity link. A good example is the Colombo-Galle Road through the Kalutara urban councils shown in Figure 1.

Bypasses take business away from small towns. Consequently, bypasses should be considered only if space is unavailable for adequate traffic movement within small towns.

Primary Arterial

An arterial street services major intraurban council movements of traffic as its major function. If an arterial link coincides with an intercity link it should be configured as an intercity link. Otherwise, it should have a minimum of two lanes. One or two parking lanes could be provided if space is available. Off-street parking lots should be considered if space is not available for on-street parking lanes. An arterial could also consist of two one-way links with one-vehicular lane each and, if space is available, one parking lane each. Raised and fenced sidewalks should be provided for pedestrians in central business district (CBD) regions. In other parts of the urban council, at-grade, stabilized, compacted, drained, graveled sidewalks are sufficient. A good example is the Colombo Airport access road.

FIGURE 1 Widened section of the Colombo-Galle Road, Kalutara; note that cross section includes sidewalks, service roads, and main highway.

Secondary Arterial

A secondary arterial such as a shopping street caters mainly to people who have shopping destinations on that street. Ideally, it should have wide sidewalks for pedestrians, two parking lanes, and two lanes. However, a one-way street with only one lane and two parking lanes is acceptable. Additional off-street parking should be provided where necessary. In extreme cases, shopping streets can be converted to pedestrian-only malls with parking near the extremities of the mall and on adjacent streets.

Collectors (Tertiary)

Collectors are mixed use side streets that service local destinations as well as feed arterials with traffic. Two lanes with two at-grade graveled sidewalks are generally adequate, with parking bays provided in areas with shops, schools, temples, and such. One-way collectors should have at least one lane and one sidewalk.

Feeders

Feeder streets are side streets connected to collectors or arterials that service areas of mainly residences and an occasional boutique. Ideally, two lanes should be provided on these low-volume, low-speed roads. However, one wide lane on which two vehicles can pass slowly while moving in opposite directions is sufficient. At least one sidewalk should be provided.

Industrial Streets

Industrial streets are collectors that serve industrial regions or parks within the urban council. They should have two wide lanes that can accommodate trucks and wide sidewalks, plus bicycle lanes and sidewalks for the workers.

ROAD CROSS SECTIONS

The delays experienced by private motorized vehicles (subsequently referred to as vehicles) is perceived by most decision makers and influential citizens (all of whom are regular users of automobiles) to be a major problem. Although this is true to some extent, it is important to consider all modes of transportation (vehicles, pedestrians, buses, bicycles, carts) when establishing the cross sections for the roads in a town. In particular, it is important to consider formally pedestrian and bicycle trips since they are the most attractive from the economic, public health, and environmental points of view. It is noted that the term "cross section" includes both lanes and shoulders. Figure 2 shows a section of highway with no shoulder provision for pedestrians. In contrast, Figure 3 shows a cross section with adequate shoulders for pedestrians. Increased capacity for vehicles should not be given at the expense of the pedestrians. At the same time, lanes demarcated for use by vehicles (hereforth called lanes) should be free of pedestrians (except at crosswalks), and shoulders assigned to pedestrians should be kept free of parked vehicles.

All roads should consist of at least one lane with shoulders adequate for pedestrians. Each lane of a two-lane, two-way or one-lane, one-way road should be wide enough (usually 5 m) for a van to pass a load-carrying bicycle, with the cross section of each lane consisting of a 3.7-m vehicle lane and a 1.3-m bicycle lane. The cross section should be wider if Regional Transport Board (RTB) buses are allowed. If parking is allowed, sufficient width should be available for a parking lane and the shoulder should be physically separated. This will help prevent motorists from parking on areas designated for pedestrians.

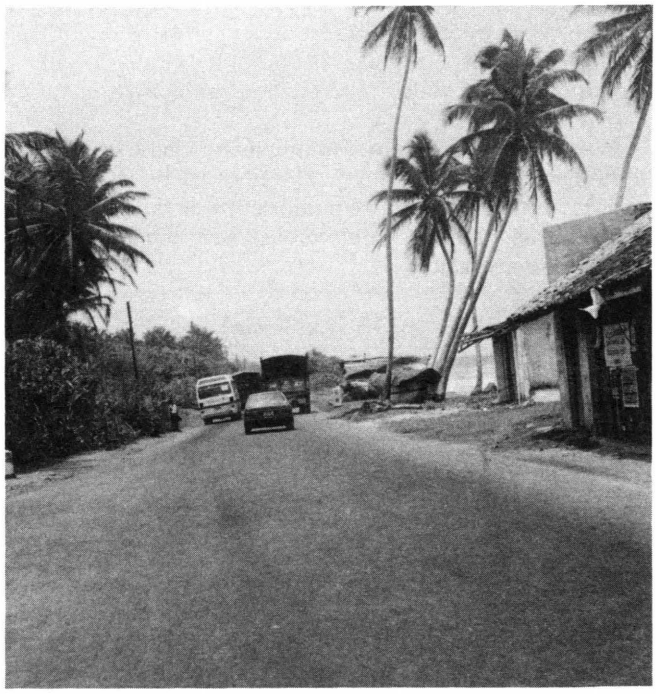

FIGURE 2 Section of Galle Road near Galle; inadequate shoulders for pedestrians.

FIGURE 3 Kandy Road; recently reconstructed with adequate lane and shoulder width.

FIGURE 4 Parked vehicles force pedestrians to walk on street in Welimada urban council.

In heavy pedestrian sections (more than 600 pedestrians per meter per hour), the lanes and adjacent sidewalks should be separated by welded steel-pipe fences with concrete foundations (*1–3*). This will prevent pedestrians from walking on lanes and vehicles from being parked on the sidewalk. In medium pedestrian sections the sidewalk should be raised, and in light pedestrian sections the road should be protected by a curb between the lane and a leveled gravel sidewalk. Figure 4 depicts the problem in which parked vehicles force pedestrians to walk on the roadway.

The available roadway width and land use should dictate the number of lanes and whether parking is allowed. For example, shopping streets should have at least one parking lane 3 m wide, and priority should be given to extra lanes over parking lanes in streets with heavy through traffic. On arterial roadways the cross section should be wide enough to accommodate a median of variable width (usually a minimum of 1 m wide). The median can consist of raised curbs.

Bus bays should be provided (minimum length of 36 m for three buses) near bus stops in the town center. Transit operators at bus stops should not interfere with the pedestrians. Cantilevered structures in place of present rectangular ones should be constructed.

CHANNELIZATION AND SIGNS

Intersections should be channelized for turning movements and traffic circles when necessary. Further, all intersections within town limits except those between local streets should be controlled with Stop and Yield signs. Occasionally, an intersection may have to be signalized.

The centerline of a two-way street should be marked with a solid yellow line. The edges of outside lanes should be marked with solid white lines. The space on the left side of the solid white line is for bicycles. A further solid white line will demarcate the separation (if any) between the bicycle lane and the parking lane. A broken white line will denote the separation between same-direction lanes.

Local directional, parking, and traffic control signs are the responsibility of the urban council, and intercity directional signs are the responsibility of the Roads Development Authority (RDA). However, a manual on uniform traffic central devices for Sri Lanka should guide both groups.

PARKING

Traveling by private automobile is not cost-effective from a social point of view when the costs of providing extra lanes, parking facilities, policing, environmental pollution, and health care are considered. Ideally, most intraurban councils' trips should be undertaken by public transportation, cycling, or walking. A good intraurban council bus service should be subsidized (when necessary) by using funds generated by parking fees, provincial and national subsidies, and other sources.

At present, the parking fee is from no charge to 1 rupee in most urban councils, irrespective of the time and the duration. A significant amount should be charged for all vehicles, including official vehicles, to park—say, 5.00 rupees per hour with a minimum of 2.50 rupees. Higher amounts should be charged during periods and at locations where parking is in short supply. Thus, parking near the market on weekends should be more expensive than parking at the edge of the town center during off-peak periods. The main idea is to discourage personal automobile use and consequently to reduce congestion caused in part by circulating vehicles. However, it is essential to provide a good alternative public transportation system.

A significant amount of employment could be generated locally by hiring parking ticket issuers such as the traffic wardens of Colombo. However, it may be more cost-effective to install locally designed parking meters. Again, a national competition could be organized for a parking meter suitable for local weather conditions and resistant to local forms of vandalization.

Double parking and parking on the sidewalk (along or across) should be prohibited. Parking lanes should be wide enough to allow angle parking by passenger vans.

PEDESTRIAN FACILITIES

The highest priority should be given to pedestrian facilities such as sidewalks, footpaths, pedestrian precincts (malls), and crosswalks. All streets should have dedicated exclusive-pedestrian sidewalks of appropriate width. The sidewalks should be raised and fenced in very heavy pedestrian corridors or in locations where parking lanes are adjacent. Parking on the sidewalks should not be allowed under any conditions.

The sidewalks should be designed with adequate space for utility posts, garbage containers, and bus stops so that a minimum width is available for walking. In particular, urban council bylaws should be strictly enforced to prevent the dumping of garbage, new construction materials, and construction debris on the sidewalks. The use of movable containers for construction debris should be encouraged. It is common for sidewalks to be blocked by raw garbage, garbage containers, and trucks loading or unloading goods. Whenever possible, back streets (unpaved service streets running behind shops) should be used for this purpose. Alternatively, the storage and collection of garbage and the loading and unloading of goods should be strictly controlled with respect to time and location.

Sidewalk vendors and stalls provide a service to pedestrians that is governed by market forces. Forcible evacuation of vendors to distant "markets" rarely solves the problem. However, priority space is for the pedestrian flow and not for vendor stalls. Streets with heavy pedestrian flows and many sidewalk vendors are prime targets for conversion to malls.

Grade-separated pedestrian crossings (tunnels and bridges) are expensive and usually unattractive, unsafe, and rarely used to their potential. Well-marked at-grade crosswalks that are policed frequently and equipped with traffic lights where necessary are usually sufficient.

Besides providing exclusive sidewalks along all streets, serious attention should be given to providing a network of pedestrian facilities such as footpaths and pedestrian malls that connect major nodes with the nearest bus terminal or bus stop, rail station, and parking lot. The essential ideas behind such a network are to provide a safe walking environment and to minimize walking distance. The footpaths should be leveled, compacted, stabilized, and well lit. Crossings of footpaths and streets should be carefully controlled with signs and signal lights where necessary. The pedestrian network should be designed to encourage the circulation of people walking and of public transportation as opposed to the circulation of vehicles seeking nearby parking. Schools and playgrounds should be connected to nearby residential areas by footpaths and sidewalks. Pedestrian crossings near schools should be located and operated with special care. Above- and below-grade crossings should be used only if absolutely necessary for capacity or safety purposes such as a crossing of an intercity route with heavy traffic by a pedestrian route. The use of the facility should be encouraged by providing well-designed, attractive structures with in-place vendor stalls if possible. It is recommended that two national competitions for type plans for at- and below-grade crossings be held.

At present, the police control crosswalks used by pedestrians. However, they should also ensure that pedestrians do not walk along the vehicular rights of way and enforce appropriate laws.

BICYCLES AND OTHER NONMOTORIZED TRANSPORTATION

Previous large-scale urban transportation studies in Sri Lanka have neglected the importance and opportunities offered by nonmotorized transportation modes such as bicycles and pedal-powered trishaws. In fact nonmotorized modes are often cited as one of the causes of traffic congestion and safety problems on urban streets. This view of nonmotorized transportation has resulted in transportation system management schemes directed mainly to the automobile, bus, and truck at the expense of nonmotorized transportation. Part of the problem as well is the view that nonmotorized transportation is associated with a backward technological society. Also part of the problem is that bicycle technology in Sri Lanka is antiquated—for example, single gearing on pedal trishaws.

Pedal Cycles

Thirty years ago, the percentage of cycle riders in small towns was much higher than it is today. Even though cycling should be encouraged in Sri Lanka for shorter-distance traveling (because fossil fuel is not available), neither government nor planners have taken any measures to encourage this mode. The sharp drop in cycling is mainly due to safety reasons. Police accident statistics clearly show that a large number of pedal cyclists have had accidents in the recent past in small towns and other places and that many of these accidents are fatal. It is proposed that roads in towns should be planned to ensure the safety of pedal cyclists as well to encourage school children and others to use this mode more frequently.

Possible solutions concerning bicycles and other slow-moving nonmotorized transportation include the separation of traffic streams into fast and slow lanes. Bicyclists may have to share the same facilities as pedestrians on narrow cross sections such as bridges. The minimum lane width for a bicycle with a carrier basket (the type typically used in Colombo) is 1.2 m, and the desirable width for a two-way cycle path is 2.0 m. In rural areas bicycles can share the shoulder with other slow-moving vehicles such as animal-drawn traffic.

To improve safety for slow vehicles, traffic regulations (such as the provision of lights or reflectors) and transportation systems management that recognize the importance of nonmotorized transportation both need to be marked.

The potential, however, for nonmotorized transportation in Sri Lanka will not be fully realized until modern technology such as multiple gearing and improved braking are used. Modern bicycle technology coupled with planning and traffic engineering that provide for slow-moving vehicles will help establish nonmotorized transportation as socially acceptable and practicable in Sri Lanka.

Draught cattle have been used in many South Asian countries for a very long time. Sri Lanka has a relatively higher per-capita vehicle ownership (about 2 percent) among South Asian countries. In the capital, Colombo district per-capita vehicle ownership is about 10 percent. However, even today nonmotorized transport is a major mode of transportation, even in Colombo.

Cycling and walking are the major nonmotorized modes of passenger transport in small towns, especially for shorter and

medium-distance travel up to 6 to 10 km. Bullock and hand carts are the two major modes of nonmotorized goods transport.

Bullock Carts

Many aspects of bullock cart operations and costing remain imperfectly known—their type and design, the number of improved versions, their daily use, cost of operation, pattern of ownership, life span, and the exact nature of freight carried. There are an estimated 44,000 bullock carts in Sri Lanka.

Most bullock carts have steel-rimmed wooden-spoked wheels attached to a wooden axle. All rely on wooden superstructures with roofs made from either coconut leaves or, less commonly, corrugated iron. In the far north and east of the country, open-sided bullock carts are more common. In Sri Lanka the average load carried by a bullock cart is about 400 kg (*4*).

In congested small towns in which there are narrow roads with many bends, the bullock carts delay motorized traffic because the roads are not planned to handle such mixed traffic. This has resulted in planners' giving low priority to this mode, even though many people use bullock carts to transport goods. The passenger-car equivalent of a bullock cart is estimated to be 6 to 8 units, and the average speed of a laden bullock cart is estimated to be 3.7 km/h. The average haul generally lasts 1 to 2 hr.

The major commodity carried by bullock carts and hand carts in urban council areas is building materials (bricks, cement bags, sand, metal, iron reinforcements, roof tiles, timber, etc.). The hiring charge for a cart is about half that of a truck for up to about 13 km. Hence, a majority of people living in urban areas hire carts to transport goods that need no careful handling.

TRAFFIC AND PEDESTRIAN CONTROL

Unless vehicle ownership is low, traffic congestion cannot really be eliminated. There is no city in the world that has both high automobile ownership and low traffic congestion. Traffic will increase to fill available capacity.

It is relatively easy to control traffic on a well-planned, well-designed transportation network. In addition to enforcing the Motor Vehicles Act on automobiles and other vehicles, the police should also actively control pedestrians who cross illegally and walk along the vehicular lanes. Bicycles should also be checked for safety features and lights.

Traffic control is needed mainly at intersections where the road space is shared by intersecting streams of traffic and pedestrians. Control options include noncontrol, traffic control signs, traffic circles, and traffic signals. If the presence of police is required at a traffic circle, then it is either poorly designed or unable to handle the existing flows.

When pedestrian traffic is low, it is counterproductive for police to stop vehicles at marked pedestrians crossings (with no signals) to let pedestrians cross. This leads the drivers to believe that they need not stop unless signaled by a policeman. Instead, the police should charge those who do not stop for pedestrians at crosswalks. If pedestrian traffic is so high that motor traffic can be severely obstructed at a crosswalk by regularly crossing pedestrians, pedestrian signals that work on, say, 1-min cycles should be installed. Grade-separated crossings should be considered as the last step. If funds are not available to install pedestrian signals, the police could control pedestrian crossings.

The philosophy behind urban traffic management is to get pedestrians and vehicles to remain in their own rights-of-way and to interact only at specific locations under controlled conditions.

PUBLIC TRANSPORTATION

The mobility of a majority of people depends on the provision of reasonable public transportation and pedestrian facilities; this includes non-automobile-owners, senior citizens, children, and many females. The urban council could negotiate with the local RTB depot and the Private Omnibus Association (POA) regarding the provision of intraurban council bus services connecting residential areas to major nodes such as shopping centers, markets, government offices, hospitals, major office buildings, industrial parks, railway stations, and main bus terminals. Routes, stop locations, bus types, timetables, and terminal locations should be discussed and negotiated. On low-demand routes the RTB and POA can be subsidized for providing minimum services.

Currently available van services to schools are disasters waiting to happen because of overloading, lack of safety measures, and poor pick-up/drop-off locations and practices. Most such services provide transportation to far-off schools outside urban council boundaries. Van service to local schools from within the urban council should be encouraged by providing good off-street parking facilities in or near schools and suggesting appropriate routes and safety features in conjunction with parent-teacher associations and school administrations. These services could be funded on a user-pay basis.

Priority should be given to bus stops over parking lanes. Bus stops should be provided in parallel bus bays only if one lane is available for through traffic. Otherwise, buses should be allowed to stop on the left lane.

An accessible, reliable, fast, safe, and inexpensive public transportation system is the key to urban transportation management. A scheme that gives priority to public transportation and pedestrians can succeed only if the public transportation system functions.

Mitric has suggested that developing countries could draw several lessons from the successful French experience in providing public transportation service in urban areas (*5*). He argues that the French system is successful because of the following:

- Existence of a coherent national policy on urban public transportation.
- Use of clear contractual arrangements among various levels of government and public transportation authorities that have been set up by groups of urban councils. The contracts "clarify relationships and mutual responsibilities; establish measurable goals; and stress partnership and negotiation."
- Maintenance of competition between various private operators as well as private and public operators.
- Decentralization, which resulted in experimentation and variety in technical matters, organizational, and tariff policies as well as in amounts of investment in public transit per capita.

- Creative funding of public transportation including local taxes and subsidies from the federal government.

The urban councils transport planning engineer, representing the public (the demand side) should negotiate with the RTB and POA (the supply side) regarding intraurban councils routes, bus stops, and frequencies. Otherwise, the public may be at the mercy of an oligopoly in which certain areas are not served. Some routes may have to be subsidized.

In fact, urban councils have the power under Sections 57 and 59 of the Urban Council Act of 1988, individually or in association with nearby urban councils, to construct and operate "tram" systems (streetcars or light rail transit systems) and all other public transportation systems (*6*). Under Section 58, they have the power to form agreements with private sector operators to undertake such transport functions. Such services should be supported by the national and provincial governments as well as through special urban council taxes on properties and vehicles as allowed under Section 162(1) of the Urban Council Act of 1988.

Shanmugalingam has given a legal opinion to the effect that "the draft proposals (in this report) are not in any way ultra vires to the provisions of the 13th Amendment" (personal communication, 1991).

COORDINATION

The responsibility for various aspects of the transportation system in an urban council falls on several different agencies and officials. A major cause of the mismanagement of the system is the splitting of responsibility among many agencies and officials. One possible solution would be for the urban councils to take over responsibility for most aspects of the transportation system. However, this is not viable from an economic point of view given the low tax base of many urban councils. It is also an inefficient way of using resources such as highway maintenance equipment. On the other hand, some urban council administrations appear to be satisfied in not having much responsibility since transportation woes can be blamed on others.

In the following it is argued that the transportation system performance in small towns can be improved substantially by creating the post of transportation planning engineer. This engineer would be responsible for all transportation planning and management activities falling under the control of an urban council. Typically, one transportation planning engineer would be responsible for each large urban council. For small urban councils within an urban conurbation, an associate transportation planner (not necessarily an engineer) would be responsible for the day-to-day planning for each urban council and the transportation planning engineer would have overall responsibility for all urban councils within the conurbation. Among other responsibilities, the transportation planning engineer would chair a transportation coordinating committee consisting of persons from various public and private agencies responsible for various sectors of the transportation system.

Urban Council Transportation Planning Engineer

At a minimum, an urban council should be responsible for planning the transportation system within its area, to the extent possible under the Urban Council Act of 1988. It is vitally important for a transportation planning engineer to be available in-house and to be responsible to the urban councils' politicians and hence to the people. Some of the major functions of the proposed urban council transportation planning engineer are

- Planning and operating the urban council road network;
- Designating arterials, collectors, local roads, and so on;
- Designating parking lanes and off-street parking lots;
- Enforcing parking and collecting parking fees;
- Designating truck routes, loading zones, and times;
- Providing traffic signs;
- Situating bus stops, bus terminals, and bus routes (in consultation with RTB and POA);
- Providing bicycle facilities; and
- Providing pedestrian facilities.

A major function of the transportation planning engineer would be the chairing of an urban council transport coordination committee consisting of the following officials:

- Urban council transportation planning engineer (chair);
- Inspector of Police (traffic), Sri Lanka Police (local station);
- RDA executive engineer;
- RTB depot superintendent;
- POA secretary;
- Merchants association president; and
- Sri Lanka Railway station master.

This group should meet at least four times a year and whenever necessary to discuss problems, solutions, and any possible changes to the transportation system. Each official would have legal authority over various aspects, but he or she would be expected to consider the viewpoints of the others and to attempt to accommodate their concerns. At the least, all issues and concerns would be on the table and would receive a full airing of views.

Further, the transportation planning engineer would chair an honorary advisory committee of citizens consisting (at a minimum) of

- A local school principal,
- A local merchant,
- Two householders from the urban council, and
- A senior citizen from the urban council.

Input would be requested from this committee regarding any changes to the transportation system.

The transportation planning engineer and the works engineer would coordinate excavations for utilities (water, sewerage, electricity, telephone) to minimize disruptions. Essentially, no major excavations should be permitted on the road system without the prior consent of the transportation planning engineer.

Qualifications and Training

The transportation planning engineer would be a qualified civil engineering graduate who has taken courses in transportation planning and engineering and preferably a course

in urban planning. In the long term transportation planning engineers should be required to hold a postgraduate diploma in transportation planning and management. This type of diploma is planned to be offered by the University of Moratuwa beginning in 1992. Professional registration (C.Eng.) would be required.

The associate transportation planner would be any degree holder qualified in at least two of the following subjects: physics, mathematics, geography, economics, sociology, and computer science. The associate planners could be further trained by means of a series of short courses, seminars, and workshops in transportation planning and management.

SMALL TOWN CASE STUDIES

Two small towns have been selected for case studies: Nugegoda and Maharagama on Route A4. Both towns are within what may be considered the greater Colombo area. The traffic and transportation problems of each town are discussed briefly, and preliminary planning studies are recommended. These studies are currently under way by final-year civil engineering students at the University of Moratuwa.

Nugegoda

Nugegoda is on Highway A4 approximately 10 km southeast of the Colombo CBD.

Road Network

The main shopping area is on a secondary road connecting with the main highway, Route A4. The two main intersections are uncontrolled with operations at times similar to a four-way stop. There is little or no channelization. All road links are nominally two-lane facilities. Pavement surface is considered good, but excavations have not been resurfaced and many manhole covers are missing, as shown in Figure 5. The uncovered manholes pose a danger for pedestrians, cyclists, and vehicles.

Public Transportation

Public transportation facilities consist of an off-street terminal for public and private buses that is adjacent to the Nugegoda rail station. The rail line is currently underused in terms of its potential capacity, although the three trains per day are operating with high load factors. In June 1990, a total of 3,022 passengers passed through the Nugegoda rail station. The rail line has a right-of-way adequate for upgrading to light rail transit. Of grave concern is the encroachment on the rail right-of-way by small shops and squatters, as shown in Figure 6. Measures should be taken immediately to protect all transportation corridors from illegal development. Without a transportation corridor, introduction of upgraded rail or transitway systems will be difficult, if not impossible, to construct.

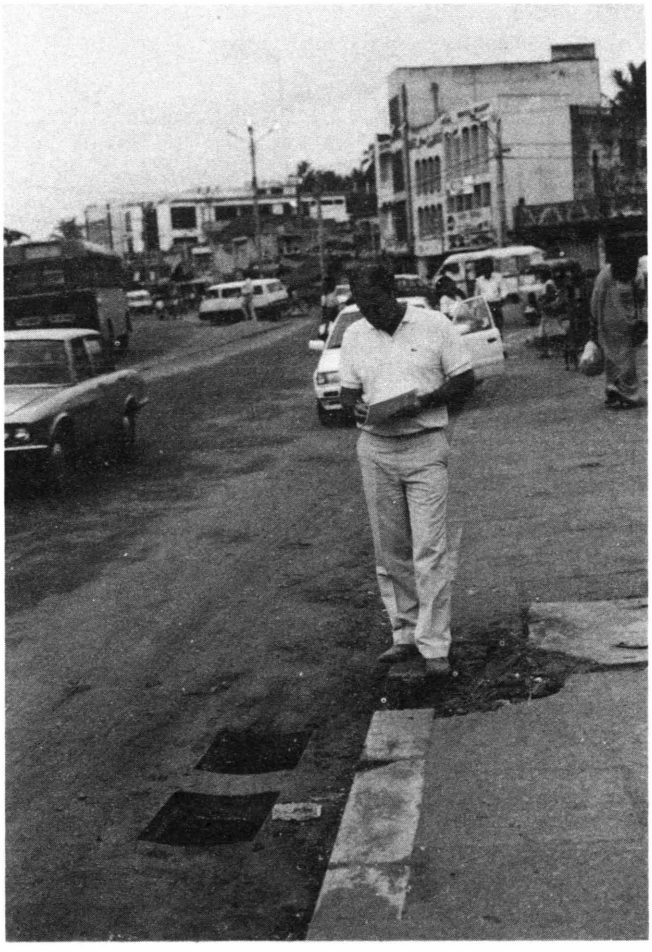

FIGURE 5 Missing manhole covers on main shopping street in Nugegoda.

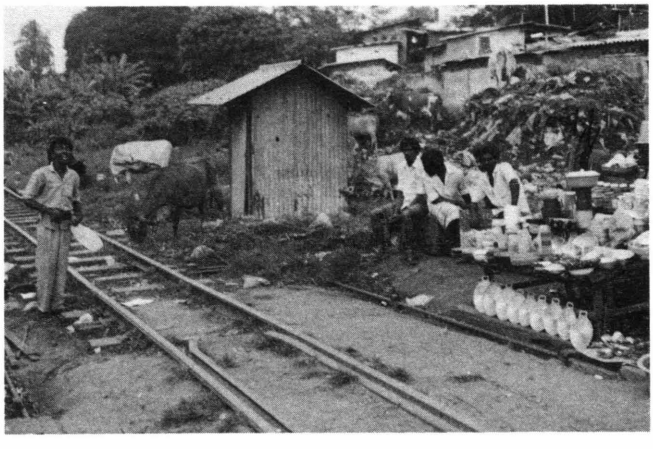

FIGURE 6 Example of encroachment on K.V. rail line right-of-way in Nugegoda.

Pedestrian Facilities

Although wide sidewalks exist in certain areas, many sections have broken pavements, forcing pedestrians to use the road. In those areas with no sidewalks, pedestrians are forced to walk on the road. Pedestrian crosswalks are in need of repainting. The open market provides a pedestrian mall free of vehicles. Pedestrians are sometimes forced to use the road if sidewalks are used for displays by shop owners, as shown in Figure 7.

It is recognized that a lack of pedestrian data has been a constraint in defining the pedestrian problem and evaluating alternative solutions. Recent techniques, however, have been developed to minimize the errors resulting from short-term counts with large variances (*1*). Using such techniques would help expand the pedestrian data base of small towns and introduce new planning techniques to the transportation planning engineer.

Parking

Off-street parking is provided at the shopping center, and parallel parking is permitted on the main shopping street west of the open market. A limited amount of parking in front of shops, although illegal, is tolerated by the police because of the problems of enforcement. Illegally parked cars, however, force pedestrians to walk on the road. Traffic wardens were observed on duty, and their efforts were diligently performed and effective. Parking for taxis is provided at the shopping center, which is adjacent to the bus and rail terminal.

Recommended Studies

1. Conduct a traffic circulation analysis.
2. Analyze two main intersections to determine if signals are warranted and their cost.
3. Review public transportation facilities including the bus and rail terminals.

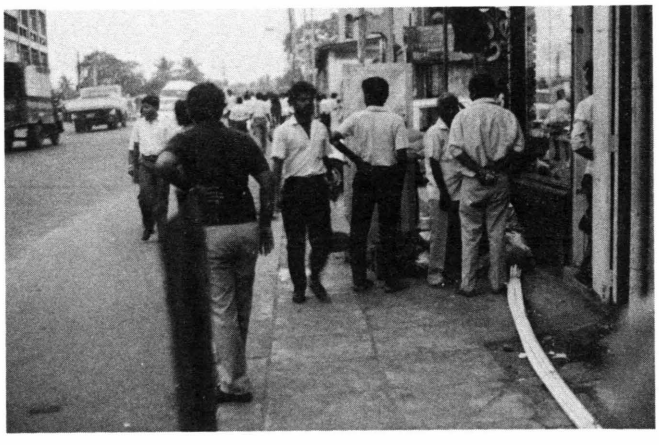

FIGURE 7 Pedestrians forced to use road where sidewalks are used by shop owners.

4. Develop an overall plan to improve pedestrian facilities. Special attention should be paid to the separation of pedestrians and vehicles, crosswalks, and adequate pedestrian walkways.
5. Develop a parking plan for Nugegoda town. The plan should show the location and number of parking stalls and where parking is restricted.

Maharagama

Maharagama is also on the main road A4, but it is several kilometers southeast of Nugegoda. Maharagama differs from Nugegoda in that the main shopping activity is on the main road and that the potential for a fully integrated transportation system is not as great.

Road Network

The main shopping activity lies on the Route A4, which also serves through traffic. The old highway parallels part of the new highway and offers some potential for a bus terminal off of the main route. The main problem with traffic circulation appears to be that the main route must serve all trip purposes and all modes, including its use as a bus terminal.

Public Transportation

The main problem is that the bus terminal lies along Route A4, resulting in buses interfering with through and local traffic as well as pedestrians.

Pedestrian Facilities

Along the main route, pedestrian facilities are very poor. However, the market area provides shopping in a mall atmosphere.

Parking

A limited amount of off-street parking is provided in Maharagama; however, many vehicles were observed parking on curbs and sidewalks.

Recommended Studies

1. Examine the possibility of separating through and local traffic.
2. Determine the potential of using the old road as an off-street bus terminal. Because this offers the greatest potential for improvement in Maharagama, a detailed public transit circulation and terminal plan should be developed. Also, as part of this project, the potential of linking the bus and rail station should be investigated.
3. Develop a plan for upgrading pedestrian facilities throughout Maharagama town center.

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