ENVIRONMENTAL EFFECTS AND THE PLANNING OF URBAN TRANSPORTATION SYSTEMS

by N.N. PATRICIOS
University of the Witwatersrand

INTRODUCTION
The main elements of an urban transportation system which can have significant environmental impacts are urban freeways, surface railways and elevated mass transit facilities such as the monorail. These all have similar effects on the urban environment although they vary in their actual impact. To illustrate these effects it is intended to concentrate on urban freeways only in this paper as these are causing the greatest concern.

This paper will first review the concept of urban freeways, then attempt to identify the reason for the growing opposition to this form of highway. This is followed by an analysis of the deleterious effects of urban freeways. In conclusion the environmental approach to planning and designing freeways in urban areas is described.

THE URBAN FREEWAY CONCEPT
It is now widely accepted that the urban freeway concept can be defined as follows:

A high capacity road which is situated in a built-up area, with separated carriageways for the opposing streams of traffic, reserved for the sole use of certain prescribed classes of motor vehicles, with complete control of access at specially designed junctions, with grade separated intersections throughout and usually fenced off from its surroundings.

There is a certain amount of confusion surrounding the meanings of the terms freeways, motorways and expressways. The general international definitions are:

Freeways: an originally North American term for the type of road defined above
Motorway: an originally British term for the same type of road.
Expressway: a high capacity road, with limited access and with partial or no grade separated intersections.

In South Africa both ‘freeways’ and ‘motorways’, which mean the same thing, are used but it would seem that the term freeway predominates.

THE GROWING OPPOSITION TO URBAN FREEWAYS
During the 1960s while Europe and other countries were still planning and constructing urban freeways, strong opposition developed in the USA to the construction of additional freeways. This reaction still continues today and in cities such as San Francisco, Philadelphia, Boston, Memphis, San Antonio, Washington, Cleveland and Baltimore new highway construction is being resisted, mainly on the grounds of the costs of tackling the resulting traffic pollution and congestion.

By the end of the 1960s the opposition to urban freeways had spread to other countries. In Britain there have been anti-freeway movements in London, Bristol, Bath, Newcastle, York and Glasgow. South Africa has not escaped this reaction either.

There are no generally agreed reasons for this growing opposition to urban freeways in the various countries. Besides costs, other reasons would appear to be community disruption and the social and psychological impacts caused by freeways (Fig 1).

At the International Road Federation’s Sixth World Highway Conference, held in Montreal in 1970, the encroachment of motor vehicles on amenity, their visual intrusion, the noise and pollution they generate, and the potential disturbances of social conditions by new roads (urban freeways in particular were considered as among the worst offenders) were stressed. The dominant theme at the conference was the need to recognize the ecological, environmental and sociological responsibilities of all those concerned with transportation. This is a convenient point at which to look at the environmental effects of urban freeways in more detail.

ENVIRONMENTAL IMPACT OF URBAN FREEWAYS
The anti-freeway movement is directed mainly at proposals for urban freeways through the inner or central areas of cities. The three major grounds of objection appear to be:

- Unacceptable environmental impact
- High financial and social costs
- Doubtful efficacy as a transportation solution

The strength of any one of these three objections would vary depending on local circumstances. Of course there are many urban freeways which have been built, or are proposed, where there have been or there are no objections raised but this should not lead us to a

Dr. N.N. PATRICIOS was born in Johannesburg in 1938. He obtained his Bachelor of Architecture degree from the University of the Witwatersrand in 1962 and in 1965 he was awarded the Diploma in Town and Country Planning (with distinction) from the University of Manchester. In that year he was also awarded the Heywood Medal for the student achieving the highest academic standard in both practical work and written examinations in the Department of Town and Country Planning.

In 1970 he attained his PhD from the University of London. He is an Associate Member of the Town Planning Institute (UK). Dr. Patricios worked as an architect-planner with various County Councils in Britain between 1963 and July 1970 when he was appointed as a Lecturer in the Department of Town and Regional Planning Witwatersrand University. In July 1971 he was promoted to a Senior Lectureship and in 1973 he served as Chairman of the Governing Committee and Acting Head of the Department of Town and Regional Planning.
complacent attitude. Growing awareness and concern by the public and various authorities as to the deleterious effects of freeways means that any decision to build an urban freeway must be shown to pass a stringent evaluation test.

The results of this test would have to show that any proposal is acceptable and satisfactory in terms of no or minimal environmental impact, that it involves a reasonable financial cost and minimal social cost, and it is an efficient solution to the particular problem, which results from the evaluation of alternative transportation solutions. In fact the Federal Highway Administrator in the USA has extended the criteria for assessing highway proposals from those concerned only with mobility and efficiency, to include the compatibility of any proposal with its environment in social, physical and aesthetic terms. This takes into account the fact that highways do not exist in isolation, but must be considered as one component amongst others in the total urban environment.

This paper will be concerned solely with the environmental impact of urban freeways. This does not mean that cost and efficacy are not equally important.

The potential impact of urban freeways on local communities is derived from two sources:
1. Traffic movement associated with freeways
2. The physical aspects of freeways (width, elevation, form and construction, spacing and type of intersections, and off and on ramps)

As environmental effects from these two sources have now been quite comprehensively examined, a summary of our present knowledge will be presented below in a simplified and non-technical manner. It is most important to remember, however, that any investigations into environmental impacts must include both the freeway corridor itself and the surroundings of the secondary road network feeding the freeway.

**Deleterious effects derived from traffic movement**

*Noise.* Traffic noise is probably the major environmental impact caused by urban freeways. The subject has been extensively researched and one important finding is that there is a direct relationship between traffic volumes and noise levels on urban freeways. That is, as the number of vehicles on the highway increases there is a corresponding increase in noise levels which can be calculated from specially prepared graphs.

*Pollution.* There is no general agreement as to whether vehicle fumes contribute significantly to the urban pollution problem. This is due to the variations in local climatic and other environmental conditions. However, it has been estimated that motor vehicles in the USA contribute on average up to 60 per cent of the total amount of air pollution, while in the city of Los Angeles this figure rises to 85 per cent.

*Vibration.* Ground-borne vibration is not normally a problem except where special buildings such as hospitals, auditoria and research laboratories are placed close to the freeway. On the other hand air-borne sound waves — although inaudible — can cause nausea and headaches.

**Deleterious effects derived from the physical aspects of urban freeways.**

**Displacement of people, buildings and activities.** The construction of a freeway in a densely built up urban area can lead to the large scale displacement of buildings and land uses. This in turn can lead to the disruption of established existing communities and the creation of social and economic problems. The extent of the impact and consequent displacements varies; firstly depending on which areas of the city the freeway is taken through and secondly on the form of the freeway — whether it is elevated above ground, is at ground level, is depressed below ground level in 'cut' or is actually underground in a tunnel. An additional problem is that in virtually all countries in the world there are no provisions for compensating people living adjacent to a freeway corridor for the problems of noise, visual impact or other environmental effects and the blighting nature on property values.

**Severance of existing communities.** Where a freeway is taken through an established residential area two severance problems can arise. The freeway can sever a socially cohesive community and disrupt friendships and other patterns. It can also sever access to a particular activity or facility by creating a barrier to such destinations as shops, schools, parks and so on. The seriousness of the severance in both cases depends on the extent to which the freeway disrupts or obstructs existing patterns of movement; it also depends on people's attitude to and perception of the freeway, its height above ground level and the provision of convenient access across it.

**Visual problems.** Most visual problems arise from
elevated freeways which are conspicuous and can constitute an intrusive element in the townscape unless very carefully designed. The problems include disturbing views of the freeway, the obstruction of established views and the conflict between the large scale of the freeway and the close grain of buildings and open spaces.

**Loss of privacy, sunlight and daylight.** These are not usually a major problem but should be on any checklist. Where problems do arise they are due mainly to elevated freeways placed too close to occupied properties.

**Measurement of environmental impact**

Present work on the environmental effects of urban freeways is directed at establishing the precise criteria for environmental quality against which the nuisance value of the effects described above can be measured. Environmental quality is that which is determined by what people believe they see, hear, feel or think and not by any 'objective measure'.

This author believes that an essentially behavioural approach to the problem of environmental impact will provide a sound and unified basis for measurement and assessment of effects. The adoption of this approach will bring about the need to recognize that the perception of problems and solutions as seen by professionals and the public can differ quite widely. It is therefore necessary to include in the planning process any population affected by urban freeway proposals.

**THE ENVIRONMENTAL APPROACH TO THE PLANNING AND DESIGNING OF URBAN FREEWAYS**

It is now clear that urban freeway proposals must be justified on the grounds of environmental acceptability and financial and social costs, and as efficient transportation solutions. Assuming that the latter two grounds are satisfactorily justified what then is the environmental approach to the planning and designing of urban freeways?

First of all, urban freeways must be considered as an integral part of the urban structure and form part of an overall transportation-land use policy. In this approach the transportation goal of maintaining mobility must be consistent with social goals and the quality of the built environment. An urban freeway route needs to be selected very carefully, the likely environmental impact investigated most thoroughly, and alleviating measures introduced to eliminate or reduce any deleterious effects.

Secondly, a comprehensive approach is also essential at the local level if freeways are to be successfully integrated into the urban fabric in a visually and socially acceptable manner (Fig 2).

In certain circumstances urban freeways can bring benefits in the form of faster and more reliable journey times, relief of congestion on existing roads, environmental improvements, fewer accidents and more efficient bus services. But to prevent uncontrolled traffic generation, they must be accompanied by firm traffic restraint, simultaneous improvement in the quality of public transport facilities and the creation of environmental areas protected from traffic nuisance by modern techniques of environmental management.

Within an inter-disciplinary team the urban designer's role in the process of deciding on a proposal and the planning and designing of the freeway, once it is fully justified on transportation grounds, is as follows:

1. The measurement and evaluation of:
   a. an environmentally acceptable route
   b. an environmentally acceptable form of the freeway (i.e. whether a freeway at grade, elevated or depressed)

2. The examination of the probable success of measures in ameliorating deleterious environmental effects.

3. The selection of a route and form of freeway with no or minimal environmental impact.

The main measures of countering the deleterious effects of freeways in urban areas include noise screens, insulation of adjacent buildings and specially designed buildings to form 'barrier blocks' (Fig 3) in addition to the development of the air space above a freeway, the use of regained land below elevated freeways, the provision of pedestrian underpasses or bridges, and the sensitive design of freeway structures, street furniture and landscaping.

Comprehensive redevelopment has been strongly advocated as a method of dealing with all environmental impacts simultaneously. By redeveloping the land within a freeway corridor, at the same time as the highway itself is being constructed, it is possible to establish environmental standards and what is publicly acceptable, thus reconciling the additional land take and costs for comprehensive redevelopment.
Extensive redevelopment however is a method which has to be applied with considerable discretion to avoid even worse environmental, social and economic consequences. In addition, comprehensive redevelopment of freeway corridors is not possible within the framework of existing legislation and procedures in virtually all countries in the world. To carry out these ameliorating measures and increased compensation payments could result in adding 15 to 20 per cent to the cost of freeway building. This is the figure arrived at by the Urban Motorways Committee set up by the British Government in 1969 and which reported in 1972.

This additional expenditure to meet the full environmental costs of new freeways, will force authorities to consider most carefully all the alternative solutions to a transportation problem before proposing urban freeways. Most city and metropolitan areas cannot afford these costs on their own and central government assistance would seem to be essential if urban freeways are to be built.

H. MARTENS was born in Greytown, Natal, in 1922 and received his education at the Greytown Intermediate School and the University of the Witwatersrand. Thereafter he was attached to various Government Departments in the Republic and in what was then Southern Rhodesia, where he was concerned with the Kariba hydro-electric project on the Zambezi River. At present Mr. Martens holds the post of Assistant Chief Engineer with the Department of Transport, and is a member of the design team concerned with the planning of freeways in the Republic of Southern Africa.

NIKO STUTTERHEIM is gebore in 1915 te Bethal, Transvaal. In 1933 matrile was hy by Huiske der Hoerskool in Johannesburg en in 1937, na 'n studie van chemiese ingenieurswese aan die Universiteit van die Witwatersrand, houer hy met BSc(Eng). Sy eerste posisie is daarna as Senior Navoringsbeampte en Hoof Navoringsbeampte en in 1955 as Direkteur van die Nasionale Bouwverenigingsinstituut WNNR. In hierdie jaar is hy ook Sekretaris van die CCTA Inter-Afrikaanse Behuisingskomitee vir die Kommissie vir Tegnieke Samewerking in Afrika besoedeling. In 1959 word hy Vise-Generaal van die WNNR en in 1967 Adjunks-Generaal. Daarna is hy Mede-Besturende Direkteur, Noristan Beperk, en Besturende Direkteur Norchem (Edm's) Bpk en Noriscel (Edm's) Bpk.