International High-Occupancy Vehicle Facilities

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The use of high-occupancy vehicle (HOV) facilities in North America, especially those on freeways and separate rights-of-way, has been examined extensively over the past 20 years. However, little is known about the extent of and experience with similar facilities in other parts of the world. This shortcoming is addressed by providing an overview and description of HOV lanes in operation in non–North American countries. The results of initial review indicate that HOV facilities are being used extensively in many parts of the world. Exclusive HOV lanes, on either separate rights-of-way or freeways and arterial streets, are in operation in 16 metropolitan areas around the world. The largest number of international HOV projects fall into the general category of nonexclusive HOV lanes on arterial streets. These types of projects have been identified in at least 75 cities. A general description of these facilities is provided. The similarities and differences between HOV projects in North America and other parts of the world are highlighted. Finally, mechanisms for improving the future exchange of information on international HOV projects are presented.

High-occupancy vehicle (HOV) facilities are one technique being used in many metropolitan areas to address traffic congestion and air quality concerns. Many areas are pursuing a wide spectrum of possible solutions in response to the continued increase in traffic congestion, the projected growth in travel demand, and limited financial resources and right-of-way availability. The use of HOV facilities, which focus on increasing the person-movement efficiency of a roadway or travel corridor, is a viable alternative being considered and implemented in many areas.

Since the 1969 opening of the exclusive bus lanes on Shirley Highway in Washington, D.C., many metropolitan areas in North America have developed priority facilities for high-occupancy vehicles. A variety of HOV treatments are currently in operation, including busways on separate rights-of-way, HOV lanes on freeways, HOV bypass lanes at freeway ramp meters, arterial street HOV lanes, and transit malls. As of April 1990, a total of 40 HOV projects in 20 metropolitan areas, representing 332 mi of HOV lanes, were in operation on freeways or on separate rights-of-way in North America (*1*). Moreover, arterial street HOV facilities and other priority measures are being used in many metropolitan areas.

Although the use of HOV facilities in North America, primarily those on freeways and on separate rights-of-way, has been examined extensively over the past 20 years (*1–5*), little is known about the extent of and experience with similar applications in other parts of the world. An overview and description of HOV lanes in operation throughout the world are provided, and projects in the planning and design stages are identified. In addition, the similarities and differences between HOV applications in North America and other parts of the world are discussed.

The results of this preliminary examination indicate many similarities in the issues, problems, and operating experiences among all projects. However, differences also exist in the approaches and techniques used in different areas. Examination of these similarities and differences can enhance the overall understanding of the role HOV facilities can play as well as the advantages and disadvantages of different approaches. To help facilitate the further sharing of information, which would benefit all groups, areas for additional research and analysis are identified, along with suggested methods to encourage and promote future information exchanges.

METHODOLOGY

Two techniques were used to obtain the information on international HOV applications contained in this report. First, a literature review was conducted to identify existing sources of information. This review identified a few journal articles and listings of projects. However, the general lack of published information supports the previously noted conclusion that few comprehensive data are available on international HOV facilities.

To obtain more detailed information, individual letters were sent to representatives from agencies, transit operators, consulting firms, and university research groups throughout the world. The names of possible contacts were identified by members of TRB's HOV Systems Committee and other individuals, as well as references obtained through the literature review. Approximately 30 letters were initially sent requesting information. More letters were sent on the basis of suggestions received in response to the first mailing.

Response to the initial request was good. Data, including reports and memorandums, were provided on a variety of HOV projects in many parts of the world. However, as could be expected, not everyone contacted has responded. Thus, the information in this paper does not fully address all the HOV projects that are thought to be in operation. In addition, not provided in many instances were detailed operating characteristics such as the number of vehicles and passengers using the facilities. Complete data on some projects are missing, but the results of the literature search and individual correspondence provide a good overview of the types of HOV facilities in operation throughout the world. As such, this paper enhances the level of understanding of international HOV

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facilities and establishes a base for additional research and analysis.

DESCRIPTION OF INTERNATIONAL HOV FACILITIES

Overview

This section provides a summary of the HOV projects in operation in non–North American countries. The classification system used to describe the different types of HOV projects represents a slight departure from those used in recent documents on HOV facilities in North America (*1*,*6*). This modification was made to reflect more accurately the types of HOV projects in operation throughout the world. Three general categories are used to characterized international HOV projects. These are exclusive HOV facilities on separate rights-of-way, exclusive HOV facilities on freeways or arterial streets, and nonexclusive HOV lanes on arterial streets.

This research identified six exclusive HOV projects on separate rights-of-way. These projects include two guided busway systems and four busways. Like the busways in Ottawa, Ontario, and Pittsburgh, Pennsylvania, these facilities, with one exception, are open only to buses. Ten exclusive HOV projects were identified in operation on freeways, expressways, and major arterial streets. In all cases, these lanes are restricted to buses only. The largest number of international HOV projects fall into the general category of nonexclusive HOV lanes on arterial streets. Most of these applications are concurrent-flow HOV lanes in downtown areas. These types of applications were identified in 75 cities around the world. This figure probably understates the use of this type of treatment, almost exclusively restricted to buses, because many large and medium-sized cities in Great Britain and Europe use some type of priority lane for buses in congested areas.

The HOV facilities described in this section are oriented much more toward bus-only applications than those in North America, but in many other respects they represent a greater diversity of applications. The types of facility range from guided busways to short queue jumps on local streets. There are also examples of HOV lanes implemented as major components of the transportation infrastructure. These include the development of a new town in Great Britain around a busway and the use of HOV lanes in developing countries to provide a basic level of transportation to large numbers of people. Furthermore, examples exist of the use of both sophisticated advanced technologies to provide additional priorities to transit vehicles and very basic approaches using buses with trailer units and maxi-taxis to increase the capacity of the lanes.

Exclusive HOV Facilities, Separate Rights-of-Way

The six exclusive HOV facilities located on separate rights-of-way are briefly described in this section. Figure 1 shows the location of these facilities, and Table 1 provides a summary of the major characteristics of each. Maps of individual facilities are provided for a few projects.

Adelaide, Australia

A 7.5-mi guided bus system is in operation in Adelaide, Australia. Officially called the Northeast Busway, the facility is commonly referred to as the Adelaide O-Bahn. The system was developed by Mercedes-Benz and was opened in phases between 1986 and 1989. Figure 2 shows the location and general service design of the O-Bahn system. Buses using the facility are equipped with special lateral guidewheels. These allow the vehicles to operate in normal service on local streets and to access the O-Bahn system by connecting the protruding

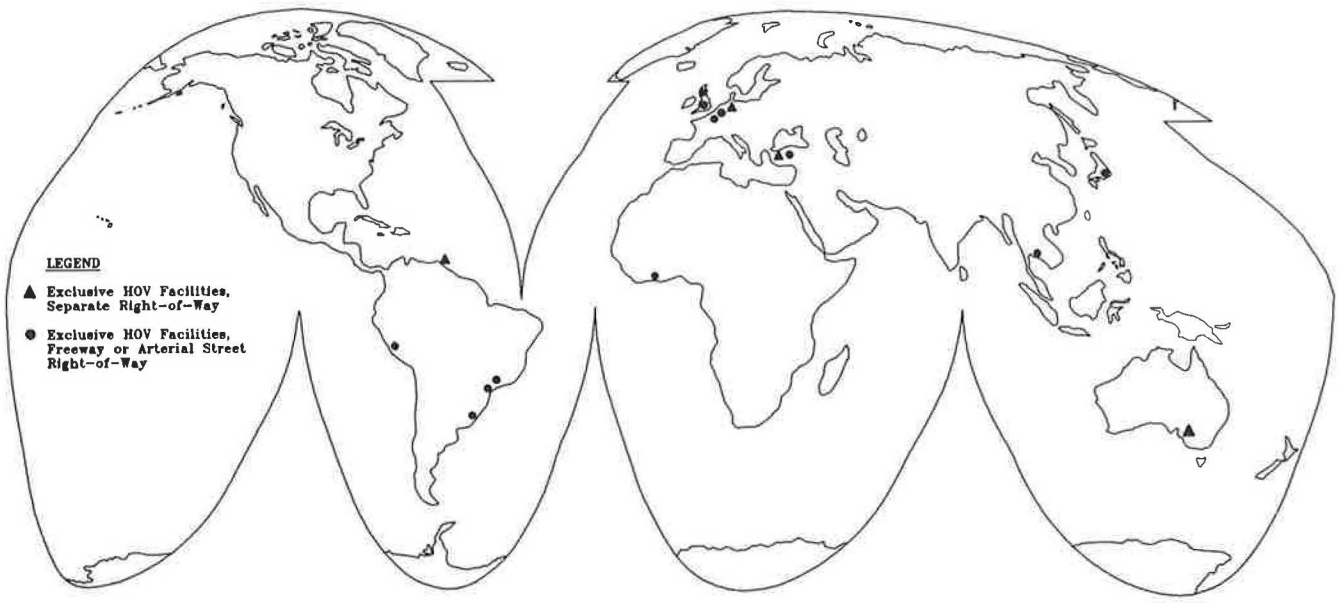

FIGURE 1 Non–North American exclusive HOV lanes.

TABLE 1 Summary of International HOV Projects—Exclusive Facilities on Separate Rights-of-Way (*7–9,11,15*)

Location	Description
Exclusive Facilities Separate Right-of-Way	
Adelaide, Australia	Northeast busway or O-Bahn system, as it is commonly referred to, is a 7.5 mile guided bus system in operation in Northeast Adelaide. Opened between 1986 and 1989, the system provides high speed bus operation on an exclusive guideway. Buses are equipped with special lateral guide wheels allowing operation on both local streets and the O-Bahn. Support services are provided.
Essen, Germany	A 4.5 mile guided busway is currently in operation. Opened in stages between 1980 and 1988 the system allows buses to operate on local streets and access the busway through the use of lateral guide wheels. Further testing of the use of dual-mode trolley bus/diesel buses is planned.
Istanbul, Turkey	A 4 mile two lane two-way bus-only street is in operation. Used by both public and private operators, the facility is located on the alignment of a proposed future rail line.
Redditch, Great Britain	Eight miles of exclusive busways are in operation in the city center and in areas connecting the different villages. The busway system was developed as one element of the overall transportation system designed in the Master Plan for the Redditch New Town.
Runcorn, Great Britain	New Town designed around a 13-mile 2-lane, 2-way busway. The system was developed to provide priority to public transit vehicles, control the use of automobiles and coordinate transportation and land use. The busway is 22 feet wide in most sections, with elevated sections in the city center. Signal preemption and supporting facilities and services are provided.
Port of Spain, Trinidad	Ten miles of a planned 15-mile busway are currently in operation. The busway, which is located in an railroad right-of-way, will link Port of Spain to Arima. Buses and privately owned and operated maxi-taxis are able to use the facility.
Exclusive HOV Facilities, Freeway or Arterial Street Right-of- Way	
Abidjan, Ivory Coast	Two busways are in operation parallel to arterial streets. Both are 2-lane, two-way busways, carrying approximately 150 buses in each direction during the peak-hours. One facility is 5.5 miles long and the other is slightly under 1 mile.
Ankara, Turkey	A 3.3 mile exclusive bus lane is in operation located adjacent to arterial street in major cross-city corridor.
Bangkok, Thailand	A total of 125 miles of bus lanes are in operation. These include both exclusive lanes next to arterial streets and concurrent flow lanes on arterial streets.
Curitiba, Brazil	35 miles of exclusive busways and bus lanes are in operation in four corridors. Daily ridership in all four corridors is approximately 340,000 passengers.
Liege, Belgium	A 6-mile 2-lane, two-way bus facility is located in the median of the Boulevard de la Sauveniere. In addition, 4 miles of non-separated bus lanes are in operation.
Lima, Peru	Exclusive 5-mile 2-lane, two-way busway located in median Paseo de la Republic Expressway. Opened in 1974, ridership levels average 5,000 passengers an hour in both directions.

(*continued on next page*)

TABLE 1 *(continued)*

Location	Description
Paris, France	Extensive 190 mile system of bus lanes, with some physically separated.
Porto Alegre, Brazil	A total of 18 miles of bus lanes are located in the median of carriageways in seven radial corridors. Using a system of platooning vehicles, volumes of up to 20,000 passengers per hour are carried.
Sao Paulo, Brazil	Physically separated and concurrent flow bus lanes are in operation in a number of corridors. Many of these are 2-lane, two-way facilities located in the median of the roadway. Platooning of buses is used to increase the capacity of the lanes.
Yokohama, Japan	Approximately 15 miles of exclusive busways, 20 miles of priority lanes, and a short segment of a contraflow lane are in operation. Other priority measures are also in use.

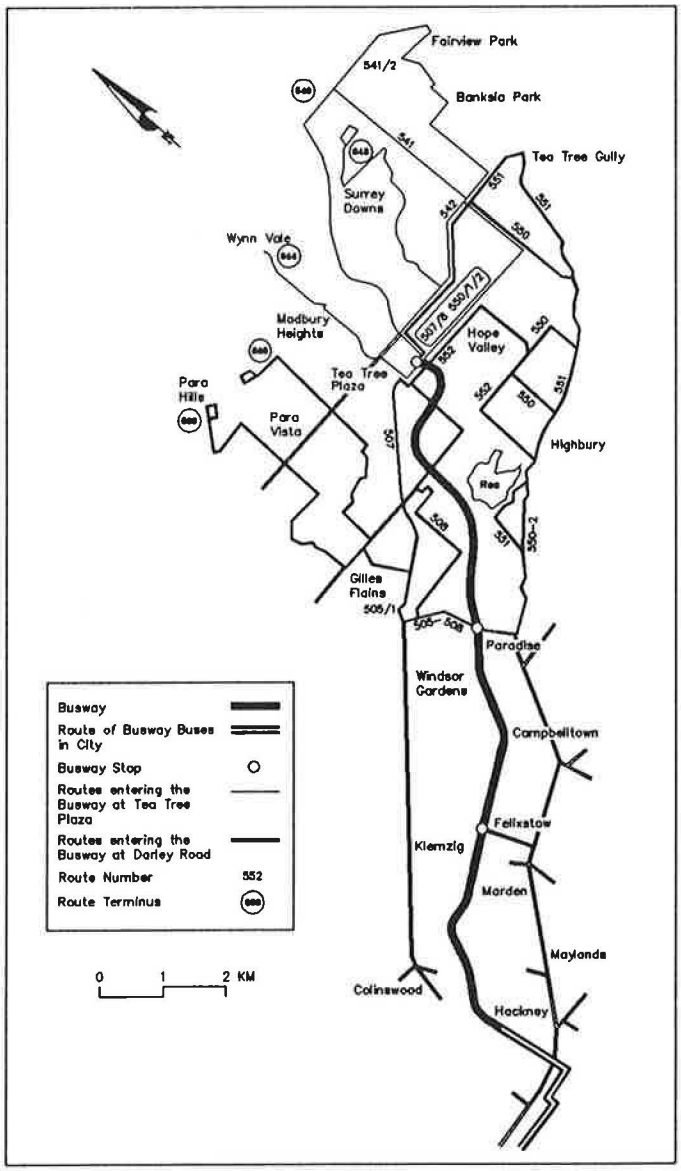

FIGURE 2 Adelaide O-Bahn.

guidewheels to the concrete track. The O-Bahn system allows buses to operate at speeds of up to 50 to 60 mph. The system is supported by park-and-ride lots, feeder buses, express buses operating only on the guideway, and routes that circulate in neighborhoods and then access the guideway (*7,8*).

Essen, Germany

A guided bus system is also in operation in Essen, Germany. Using funding from the Federal Ministry for Research and Technology, the local transit agency, and Daimler-Benz and MAN, a 4.5-mi guided bus system was implemented between 1980 and 1988. Like the system in Adelaide, buses can operate in regular service on local streets and then access the busway by engaging lateral guidewheels into the curbing on the concrete guideway. The next planned step in the project is to test the use of dual-mode trolleybus–diesel buses on the facility (*8*).

Istanbul, Turkey

A 4-mi two-lane, two-way bus-only road is in operation in Istanbul. The busway was developed on an alignment that may be converted to rail at some time. Both public and private buses are allowed to use the facility. Although no ridership levels are available, the facility is noted as being extensively used (*8*).

Port of Spain, Trinidad

Currently, 10 mi of a planned 15-mi busway are in operation in Port of Spain, Trinidad. As shown in Figure 3, when completed the busway will link Port of Spain to Arima. The two-way, two-lane busway was built on an abandoned railroad right-of-way. The facility is used by buses and privately owned and operated maxi-taxis. Ridership figures for 1987 indicated that some 55,000 passengers were being carried in buses; the maxi-taxis accounted for four times as many passengers. Maxi-taxis were prohibited from using the facility for a number of years because of concerns that they were taking potential passengers away from the public buses (*8*).

Redditch, England

Eight miles of exclusive busways were developed as part of the roadway system designed for the new town of Redditch in Great Britain. Located southeast of Birmingham, Redditch was designated as a new town in 1964 to help relieve overcrowding in the West Midlands conurbation. The Redditch master plan included both a roadway and a busway system. The busway system, which was completed in the late 1970s, includes exclusive rights-of-way in the city center and in areas connecting the different villages. Buses operate in the mixed-traffic lanes in other areas (*9–11*).

Runcorn, England

Runcorn, south of Liverpool, is another of the British new towns designated in 1964. In Runcorn, the busway concept was taken a step farther than the design used in Redditch. The master plan, and subsequent development of the new town, was designed around a 13-mi two-lane, two-way busway in the shape of a figure eight. As shown in Figure 4, the city center and shopping district is located at the center of the "eight," with residential, industrial, and smaller commercial

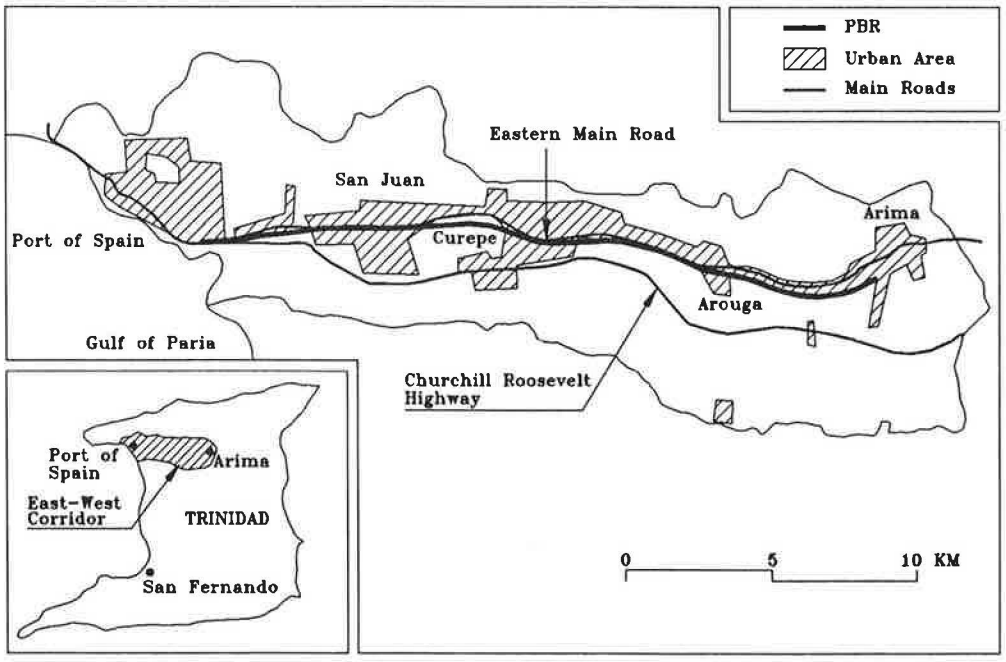

FIGURE 3 Port of Spain busway.

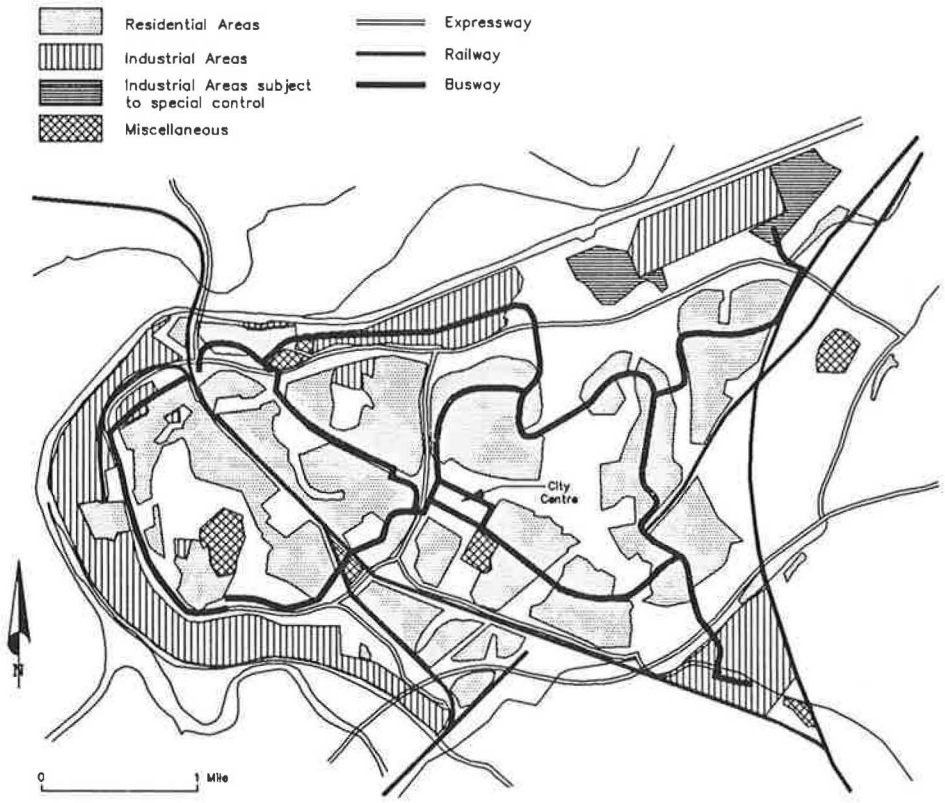

FIGURE 4 Runcorn busway.

areas located along the route. The busway concept was designed specifically to provide public transportation with an advantage, to control the use of the automobile for work trips, and to coordinate transportation and land use. The busway is 22 ft wide in most parts, with elevated sections in the city center. Traffic signal preemption is provided at most intersections to give buses priority. Bus headways range from 5 to 15 min depending on the time of day. Other support services and facilities are provided, and a variety of employer-coordinated programs have been used over the years (*9,12–15*).

Exclusive HOV Facilities, Freeway and Arterial Street Rights-of-Way

The 10 exclusive HOV facilities identified in operation on freeways, expressways, and major arterial streets are described in this section. Figure 1 illustrates the location of these projects, and Table 1 provides a summary of their major characteristics.

Abidjan, Ivory Coast

Two busways are in operation parallel to arterial streets in Abidjan. Both are two-lane, two-way facilities. One is 5.5 mi long and the other is slightly less than 1 mi. Both provide service in the heaviest travel corridors, averaging about 150 buses in each direction in the peak hours. Development of the busway and other transit facilities in Abidjan was financed by the World Bank (*8*).

Ankara, Turkey

A 3.3-mi exclusive bus lane is in operation adjacent to an arterial street in a major cross-city corridor in Ankara. Although no specific statistics are available, bus-rider volumes have been described as being very heavy during the peak periods (*8*).

Bangkok, Thailand

About 125 mi of bus lanes are in operation in Bangkok. These include both exclusive lanes next to arterial streets and concurrent-flow lanes on arterial streets. Both public transit vehicles and privately owned and operated minibuses are allowed to use the lanes (*8*).

Curitiba, Brazil

Approximately 35 mi of exclusive busways and bus lanes are in operation in Curitiba. This system was initiated in the 1970s as part of an integrated land use and transportation policy favoring public transit. Busways and bus lanes of 14, 7, 6, and 8 mi operate in four corridors. Total ridership in all four corridors averages 340,000 passengers a day. Development of the system was financed partially by the World Bank (*8*).

Liège, Belgium

A total of 10 mi of bus lanes are in operation in Liège, including 6 mi of physically separated lanes. The Boulevard de

la Sauveniere bus lane is located in the median of an arterial street. It is separated from the general-purpose traffic lanes by a planted curb barrier (*8*).

Lima, Peru

An exclusive bus lane, approximately 5 mi in length, operates in the median of the Paseo de la Republic Expressway in Lima. The two-lane, two-way facility was opened in 1974 on the alignment of a planned rail line. Ridership levels average 5,000 passengers an hour in each direction (*8*).

Paris, France

An extensive system of bus lanes, comprising approximately 190 mi, is in operation throughout Paris. The Ligne Pilote routes use an extensive system of bus lanes. The curb lane is used for much of this system, although only a small amount is actually physically separated from the mixed-traffic lanes. In addition, other preferential treatments, such as traffic signal preemption, are provided along these routes (*8,9*).

Porto Alegre, Brazil

Bus lanes are currently in operation in seven radial corridors in Port Alegre. Located in the center of the roadways, a total of 18 mi are in operation. A convoy system is used to maximize the movement of buses on the lanes. Buses are held back at entry points and travel in platoons, halting at stops in unison. This allows volumes of up to 20,000 passengers an hour at speeds of 12 mph. Buses with trailer units are used on some routes to increase further the capacity of the system (*8*).

São Paulo, Brazil

Physically separated and concurrent flow bus lanes are in operation in a number of corridors in São Paulo. The common design is to locate two-lane, two-way busways in the center of arterials or expressways. The platoon or convoy system noted previously is used in many of these facilities to increase their capacity. This has allowed up to 420 buses an hour to travel in some sections (*8*).

Yokohama, Japan

Approximately 15 mi of exclusive bus lanes, 20 mi of priority lanes, and a short segment of a contraflow bus lane are in operation in Yokohama. In addition, priority traffic signals and computer-controlled bus location devices are being used (*8*).

Nonexclusive HOV Facilities on Arterial Streets

A variety of nonexclusive HOV facilities are being used in cities throughout the world. With a few limited exceptions, these facilities are all oriented toward providing priority treatments for buses. Furthermore, many of these applications are in downtown areas, although projects are also found in other congested travel corridors. Nonphysically separated HOV lanes were identified in 75 cities. In many cases, multiple projects are in operation within a metropolitan area. Figure 5 shows the cities in which these types of projects are in operation, including 10 in England. As noted, this figure probably underrepresents the use of this type of treatment, which appears to be commonly used in many British and European communities.

Table 2 lists the cities identified with operating arterial-street HOV facilities, the total length of all projects in miles,

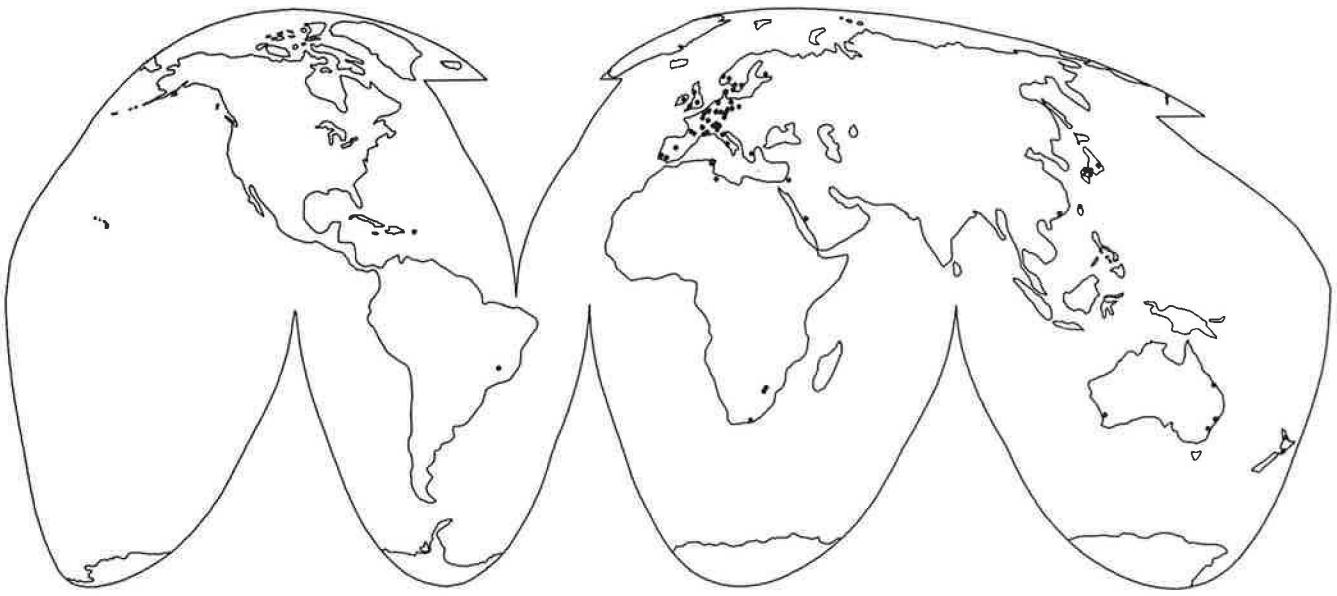

FIGURE 5 Non–North American arterial-street HOV lanes.

TABLE 2 Summary of International HOV Projects—Arterial Street Applications (*8,9*)

Location	Total Length of all Projects (miles)	Other Priority Measures
Australia		
Brisbane	2	X
Canberra	6.5	X
Perth	8.2	X
Sydney	N/A	X
Belgium		
Antwerp	2.0	
Brussels	3.5	
Brazil		
Belo Horizonte	N/A	
Denmark		
Copenhagen	3.2	
England		
Hull	N/A	X
Leeds-Bradford	9	
Leicester	2.2	
London	N/A	
Manchester	N/A	X
Nottingham	N/A	X
Oxford	21	
Reading	.6	
Southampton	1.2	X
Sheffield	2	
Finland		
Helsinki	20	
France		
Bordeaux	6.3	X
Lille	4.4	X
Lyon	31.3	
Marseille	1.5	
Nice	5.6	X
Paris	190	X
Strasbourg	3.5	
Toulouse	4.7	
Germany		
Aachen	3.5	X
Augsburg	1.2	
Berlin	6	
Bochum/Gelsenkirchen	7.5	
Hamburg	N/A	X
Hannover	N/A	
Weisbaden	1	
Wuppertal	3	
Greece		
Athens	1	
Hong Kong		
Kowloon	N/A	X
Ireland		
Dublin	9.1	X
Israel		
Jerusalem	2.4	
Italy		
Bologna	1.4	
Milan	.8	
Rome	1.2	

(*continued on next page*)

TABLE 2 (*continued*)

Location	Total Length of all Projects (miles)	Other Priority Measures
Japan		
Hiroshima	80	X
Kitakyushu	N/A	
Nagoya	6.4	
Okayama	4.8	
Osaka	56	X
Tokyo	145	X
Libya		
Tripoli	11.2	
Luxembourg		
Bouillon	.7	
Netherlands		
Amsterdam	21.5	X
New Zealand		
Auckland	N/A	
Wellington	N/A	X
Norway		
Bergen	5.6	X
Oslo	1.3	
Portugal		
Lisbon	13.4	
Puerto Rico		
San Juan	11.1	X
Saudi Arabia		
Jedda	1.9	
Scotland		
Edinburgh	6.2	
Singapore		
Singapore	43	X
South Africa		
Johannesburg	N/A	X
Port Elizabeth	N/A	X
Pretoria	4.7	
Spain		
Madrid	N/A	
Seville	2.3	
Sweden		
Göteborg	N/A	X
Stockholm	N/A	X
Switzerland		
Bern	0.8	
Lausanne	4.4	
Zurich	7.8	X
Taiwan		
Taipei	N/A	
Tunisia		
Tunis	6.2	
Wales		
Cardiff	1.2	

and an indication if other priority measures are used. The use of traffic signal preemption, giving priority to buses at controlled intersections, is the most common of these measures, but other techniques are also used. Since most of these applications focus on the use of concurrent-flow lanes for buses, the individual projects will not discussed. However, the one exception to this—the Onewa priority scheme in Auckland, New Zealand—is briefly described.

The Onewa priority scheme is the first use of an HOV facility open to buses and carpools in New Zealand. A 0.7-mi HOV lane currently operates in the a.m. peak period on Onewa Road in Auckland. The roadway, which provides access to the Harbour Bridge and Motorway, is severely congested in the morning peak period. Parking was restricted on a short segment of the roadway, and the previous one-lane facility was restriped for two lanes. The curb lane is restricted to buses and carpools, allowing them to bypass the major congestion point. The lane has been in operation since 1982, when it was initiated as a 6-month demonstration. Figures from 1989 indicate that approximately 1,680 vehicles and 4,070 passengers use the lane from 7:00 to 8:30 a.m. Enforcement of the lane occupancy requirements has been an issue, and regular enforcement is provided (W. R. Dragger, personal communication; *16*).

PROPOSED HOV PROJECTS

Two projects in the planning stage are worthy of note, because they both represent the use of HOV lanes on major freeways that would be open to carpools, vanpools, and buses. These projects are similar to many of the applications in operation in North America. One of the planned projects is in the Netherlands; the other is in Taiwan.

Amsterdam, the Netherlands

A tidal-flow carpool lane is in the planning stage on a section of A1 between Amsterdam and 't Gooi/Hengelo in the Netherlands. This facility would be located in the median of the freeway. Reserved right-of-way exists in the median to construct a one-lane facility with shoulders. The occupancy requirement, or demanded seat occupancy per vehicle, is still being determined. Construction on the facility is estimated to begin in 1991, with completion scheduled for 1993 (*17*).

Taipei, Taiwan

A 25-mi HOV lane is currently proposed on the Sun Yat-Sen Freeway in Taipei. This facility would connect Taipei with the CKS International Airport in Taoyuan. The proposal includes concurrent-flow lanes in each direction that would be reserved for carpools and buses. A feasibility study is currently in progress and is expected to be completed by spring 1992 (B. K. Kang, personal communication).

COMPARISONS WITH NORTH AMERICAN HOV FACILITIES

Similarities and differences exist between the international HOV projects examined in this paper and those in operation in North America. The projects identified in this paper were planned and designed to address the same types of problems as those in North America. Furthermore, many projects experience the same types of operating issues and concerns. However, differences also exist. Non–North American applications are more oriented toward bus-only facilities, whereas the use of facilities open to carpools and vanpools, as well as buses, is more prevalent in North America. Moreover, non–North American projects are noted for the use of other priority measures, such as traffic signal preemption, better integration of land use and public transportation, and more extensive use of arterial street HOV applications.

HOV projects in all parts of the world were developed to address common problems related to traffic congestion, environmental concerns, and improving the efficiency of public transportation. In most cases, the non–North American projects focus on providing priority treatment for buses, and those in North America also include carpools and vanpools. This difference may be partially due to the lower levels of automobile ownership in other parts of the world (*18*) For example, many of the HOV applications, especially those in developing countries, provide a basic level of mobility to individuals without other options. However, it is interesting that automobile ownership levels, gasoline consumption, and traffic congestion levels are increasing in many parts of the world (*18–20*). Information on the proposed projects in the Netherlands and Taiwan, as well as some existing projects, specifically note the need to control the increases in traffic congestion in an environmentally sound manner (*16,17*).

The need to coordinate the development and operation of HOV facilities with many agencies and groups was noted in a number of sources (*9,16*). This supports the general experience in North America, where the importance of multiagency coordination and cooperation on successful HOV projects has been noted (*21*). Enforcement of the lane operating requirements was not identified as a major problem with the bus-only facilities, but it was noted as a concern on the Auckland facility. Requests for use by other groups, such as taxis and commercial delivery vehicles, was also noted in Auckland (*16*). Both of these experiences are common with HOV projects in North America.

The introduction of new, expanded, and restructured bus service was noted as often accompanying the introduction of HOV lanes in non–North American cities (*8,9,15,16*). The introduction of services and other service changes often have accompanied many of the HOV projects in the United States and Canada.

The HOV projects in non–North American countries use more extensive priority measures and techniques to support the effectiveness of the facilities than the HOV projects in the United States. The use of traffic signal preemption devices and priority traffic signal timing are the two most common methods. However, the use of a variety of advanced technologies to provide real-time transit information as well as other priority treatments was also noted. The most widespread use of advanced technologies was noted in Europe, Great Britain, and Japan (*8,9,15*). It appears that projects in the United States could benefit from the experience with these types of applications.

The use of HOV facilities to assist in better integrating and coordinating land use and transportation also appears to be more successful outside the United States. The development

of the busways as part of Redditch and Runcorn are perhaps the best example of this, but even in other areas the integration of land use and public transportation appears to be more successful than in the United States. However, it is interesting that even in the best examples, many of the same problems currently encountered in the United States are evident. For example, although Runcorn was designed and developed around the busway, parking is free or relatively inexpensive at major employment locations and in the city center. It has been noted that this policy does not encourage use of the busway (*15*).

The widespread use of arterial street HOV lanes is another area in which North American cities could benefit from the experience in other parts of the world. The potential use of arterial street HOV lanes, both as stand-alone projects and as links in a regional HOV system, has generated a great deal of interest recently among transportation professionals. It appears that much could be learned about the design and operation of these types of facilities from the projects in other parts of the world.

CONCLUSION

An overview and description of HOV facilities throughout the world has been provided. A summary of exclusive HOV lanes operating in separate rights-of-way and on freeways, expressways, and major arterials has been presented. In addition, a listing of cities using arterial street HOV lanes was provided, along with a discussion of projects in the planning stage. Finally, a review of the similarities and differences with HOV project in North America was presented.

As noted previously, this paper represents the starting point for an enriched understanding of the application of HOV facilities throughout the world. Obviously, additional information is needed to understand fully the breadth and depth of HOV application outside North America as well as the issues, problems, and experiences associated with their use. It would be beneficial to continue to research the design aspects, operational characteristics, vehicle volumes and passenger levels, land use and transit integration, and potential future projects. It would be appropriate to request additional information through the World Bank, *Jane's Urban Transport Systems*, TRB, and other international transportation organizations.

In addition, transportation professionals and groups in all parts of the world would benefit from greater information sharing and the exchange of experiences and ideas. A variety of methods are appropriate to promote and encourage greater communication on HOV projects. First, the 1992 HOV Facilities Conference, which will be held in Ottawa, provides an excellent opportunity to encourage greater participation from non–North American representatives. The TRB Conference Planning Subcommittee should consider this possibility in developing the program for the 1992 conference. In addition, a session at the TRB Annual Meeting, which is attended by representative from countries throughout the world, may be appropriate. Such a session could be considered for the 1993 Annual Meeting.

The information presented in this paper has provided an initial indication of the scope of HOV applications throughout the world. It has further identified many areas in which additional research and information sharing would benefit transportation professional in all areas. The opportunity exists to build on this effort and to establish an ongoing coordinated approach to facilitate the collection of more detailed information and to share ideas among transportation professionals throughout the world.

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