Passenger Loading

Since double-ended vessels are selected primarily to hasten vehicle loading and unloading, passengers are normally a secondary concern. They are usually directed along separate ramps and bridges, or else they may use the same ramp space as the vehicles do. Most passenger-only vessels also use ramps or gangways.

The Vancouver SEABUS operation is the only sevice that effectively uses double-ended vessels for passenger loading and unloading. Passengers disembark from six doors located along the vessel's port or starboard side. Meanwhile, doors along the opposite side open soon after and allow passenger embarkation to occur. The separate, almost simultaneous loading and unloading of a total of 800 passengers occurs in 90 s.

PASSENGER AMENITIES

The facilities provided for passenger comfort, convenience, and overall ride enjoyment encompass (a) passenger storage facilities, including seating, standing room, and individualized cabins; (b) food and refreshment opportunities; (c) rest-room facilities; (d) scenic view; and (e) accessibility to the elderly and the handicapped. A wide variety of amenities are provided among ferry operations. Each selects appropriate facilities on the basis of such factors as expected ridership demand, ridership makeup, trip purposes served, and total route travel time. Some amenities, such as available window view and sun-deck space, are tied directly to the type of vessel used. Most passenger-related facilities, however, can be provided in various forms and arrangements on most vessel designs. Some of these facilities are discussed below.

Passenger Storage

Seating type and arrangement ranges from the transverse and longitudinal grouping of seats familiar to buses and subways, used on the Staten Island Ferry and Vancouver SEABUS, to the first-class airline-type seats and seating arrangements, used on the Golden Gate Ferry and available on other high-speed vessels including the Boeing Jetfoil and the Bell-Halter surface-effect ship. Unlike other vessels, the Staten Island Ferry vessels provide considerable standing room, with more than one-third of the passenger capacity estimated for standees.

Scenic View

Ferry systems that cater largely to social and recreational trips normally have considerable sun-deck space available; some have nearly two-thirds of their available seating in exterior locations. Among the smaller high-speed ships, on which sun-deck space is either limited (Golden Gate Ferry vessels) or not possible (hydrofoil), large viewing windows are often used to increase passenger enjoyment. However, even simple vessels of utilitarian design like the Vancouver SEABUS (Figure 1) can incorporate large viewing windows into basic vessel design.

IMPLICATIONS OF JONES ACT

The Merchant Marine Act of 1920, commonly referred to as the Jones Act, specifically forbids the operation of foreign-built vessels for domestic passenger and freight trade. In effect, this act forbids any domestic ferry systems from purchasing any foreign-built vessel, of which there are many among the slow- and high-speed variety. Obviously designed to protect and enhance the U.S. shipbuilding industry and labor force, the act has had the effect of limiting the choice of ferry-vessel design and construction to a relatively few U.S. firms. High vessel costs, long construction periods, and limited design options are the result. The availability of high-speed-vessel manufacturers is particularly limited.

Role of Waterborne Transportation in Urban Transit

ROGER P. ROESS

The initial findings of a three-year study to prepare a manual of planning guidelines for waterborne passenger transportation systems are reported. The various roles played by five major ferry systems in the United States and Canada are investigated to determine the range and flexibility of such services as they form an integral part of an urban or regional transportation network. The conclusion is that the considerable flexibility of the mode as well as the range of technology available provide a great potential for increased use of waterborne systems as a viable modal alternative in many areas, one that should receive greater attention from transportation planners.

Water was man's original form of vehicular transportation. There is historical evidence that crude barge-type vessels were used by early man to transport goods and individuals long before the wheel made overland vehicle-aided travel feasible. Throughout history, nations have developed near and along the world's navigable waterways, from ancient Egypt along the Nile to the original 13 American colonies, which developed as clusters around East Coast waterways.

Access to navigable waterways remains critical to the well-being of nations, and such major projects as the Panama and Suez Canals have literally allowed the economic survival of areas that may well have collapsed. In the United States, more than $1 billion in revenue is earned shipping grain, coal, steel, and chemicals over the nation's 25 000-mile inland waterway system.

Despite the historical significance of waterborne transportation to the affairs of man, a review of travel patterns in U.S. cities reveals that this mode has become the "forgotten man" of urban transportation systems. This is a fact even more incomprehensible in view of the number of large urban areas in the United States and elsewhere that are adjacent to navigable waterways.

Nevertheless, there are more than 600 ferry

operations in the United States and Canada today; they range from small private operators that pilot ferries that carry 8-16 cars across narrow waterways to massive public operations, such as those that exist in New York, Seattle, and Vancouver. Moreover, as the investment of resources in highway, rail, and even bus transportation escalates, expansion of the role of waterborne transportation in urban areas has become more attractive.

In March 1979, the Transportation Training and Research Center of the Polytechnic Institute of New York was awarded the first year of a three-year study to prepare a manual of guidelines for the planning of urban ferry systems. The purpose of the three-year effort is to compile relevant information and to develop planning methodologies specific to waterborne services.

The first-year effort, completed in May 1980, has concentrated on various aspects of functional design, including terminal layouts and vessel design. It also included a detailed consideration of the role or roles, both existing and potential, that ferries could conceivably play in urban transportation systems. It is this latter aspect that is treated in this paper.

IMPORTANCE OF ROLE

The question of role is critical to the planner considering any transportation alternative in that it defines how a particular route or service interacts with others to form an integrated transportation system. The question of role is really a composite of many more specific issues, among which are the following:

1. Who is served?
2. Is the service commuter-oriented?
3. What other trip purposes are served?
4. Is the service people- or vehicle-oriented?
5. How is the system viewed politically?
6. How is the system managed and financed?

The answers to these and similar questions define the role that a particular ferry service or system plays in the overall urban or regional transportation system. Understanding these roles is critical if the planner is to be able to consider waterborne transportation options in a rational fashion.

MAJOR FERRY SYSTEMS

One of the best methods of investigating the various roles that waterborne transportation may fill is to study a number of the large and more prominent ferry systems of North America. This paper summarizes the results of detailed analyses of five major systems--those of New York City, San Francisco, and Seattle, and two in Vancouver (the B.C. ferry and the SEABUS). These five were selected for detailed reporting because of the widely varying roles they play and because each illustrates a key or basic potential for waterborne services.

Although references are provided, the majority of the findings reported here are the results of on-site investigations and detailed discussions with the various system operators.

Staten Island Ferry (New York City)

The largest ferry system in the United States and Canada is the Staten Island Ferry, a service operated by the New York City Department of Marine and Aviation. The service carries more than 18 million passengers and 60 000 vehicles/year and is primarily a commuter service between suburban Staten Island and downtown Manhattan. For many years, the ferry was the only direct connection between Staten Island and the rest of New York City, and, despite the construction of the Verrazano Narrows Bridge and the initiation of competing express-bus service, it still carries large numbers of commuters. Ferry terminals at both ends are well served by local bus and rail transit systems (1).

Although the role of the Staten Island Ferry as a major commuter link that carries primarily walk-on passengers is clear, the development of that role has been more or less an accident of history. New York was at one time replete with ferry services: from Brooklyn to Manhattan, from Queens to Manhattan, from Manhattan to New Jersey, etc. One by one, numerous bridges replaced these services, which rapidly sank into bankruptcy and ceased operation. The Staten Island Ferry was the only service to survive as a monopoly into the 1960s, and it remains a considerably more direct and convenient mode to downtown Manhattan for many commuting trips.

It is clear that the Staten Island Ferry is primarily serving walk-on, journey-to-work commuters. The vehicle-carrying role of the ferry has declined since the opening of the Verrazano Narrows Bridge and should not be considered a major role of the service. In fact, two new ferries being purchased for the system will not accommodate vehicles at all and will carry only walk-on passengers.

Its role as a vital commuter link is strengthened by the dense public transit services that link up with the ferry--local buses and the Staten Island Rapid Transit line in Staten Island and the New York City subway in Manhattan. The physical locations of the Staten Island residential communities and the Wall Street central business district also contribute strongly.

The Staten Island Ferry, therefore, is very much a peak-period service; ridership falls drastically in off-peak hours. There is, however, a reasonable percentage of recreational travelers who also use the ferry.

Even more interesting than the Staten Island Ferry itself is the fact that it stands alone in New York as the only nonrecreational or nonsightseeing waterborne service in a city of five discontinuous boroughs largely surrounded by water. The opportunities for additional ferry service are great: from suburban Long Island (numerous points) to Manhattan, from other Staten Island locations to Manhattan, indeed from some of the historic locations in Brooklyn and Queens to Manhattan, and more. The impetus of clogged bridges and highways and capacity-strained rail transit systems has long suggested serious consideration of waterborne alternatives.

Although there has been little concerted effort to investigate new markets for ferry services in and around New York City, there have been some attempts:

1. During the 1964-1965 World's Fair, a hydrofoil service was initiated between Queens and Manhattan. It was, however, expensive and was discontinued after the fair.
2. Arrangements are currently being considered to demonstrate a high-speed surface-effect vessel between Manhattan and several points on Staten Island, but plans are being delayed due to legal and administrative problems.
3. A study sponsored by New York State is currently considering ferry service across Long Island Sound (between New York City and Connecticut) as an alternative to constructing a bridge.

Despite these efforts, however, there is little real momentum for additional services in the New York City area.

It is interesting to note that Long Island commuters took matters into their own hands during a recent railroad strike by hiring numerous fishing "party boats" to make their commute to Manhattan. This measure was technically illegal but served to heighten the importance and potential of the waterborne alternative in New York.

Golden Gate Ferry (San Francisco)

The San Francisco ferry system consists of two routes--from suburban Larkspur and Sausalito to downtown San Francisco. The system is unique in that it is new (initiated in 1977) and was planned, built, and operated with support from the Urban Mass Transportation Administration (UMTA) of the U.S. Department of Transportation (2,3).

The role of the system was clear and well defined in the planning process. The ferry system was and is an alternative to building an additional cross-bay bridge. The system carries about 2000 passengers/day on passenger-only vessels (an UMTA requirement for funding at the time). Vessels use gas-turbine engines for high speed, but correspondingly high fuel consumption and maintenance have been a problem with these engines.

The San Francisco ferries represent a unique experience in federal participation in the urban ferry mode and a unique experiment in using a ferry system as an alternative to bridge construction as a deliberate planning decision. The success of the service was severely hampered by a lengthy labor dispute during the summer of 1979, however, and it may well be several years before the service can be seriously evaluated on two key points: the ability to attract ridership to a new waterborne service and the ability to forestall the need for an additional bridge across San Francisco Bay.

It is interesting to note that the states of New York and Connecticut are making a similar study concerning a bridge across Long Island Sound, as was previously noted. In this case, the bridge plan is publicly unpopular, and a variety of ferry alternatives are under study.

The issue of federal participation in the Larkspur service is interesting in that it sets a precedent. UMTA provided 80 percent of the financing for the new terminal at Larkspur and for three new boats. These were the first such subsidies for waterborne services.

The case for federal support was made easier, since the service is of the high-speed passenger-only type. The suburban terminal is fed primarily by free park-and-ride facilities, although some feeder-bus service is also available. The clear-cut transitlike role of the San Francisco service was a most suitable one for UMTA support. It should be noted, however, that Washington State Ferries and other systems have also applied for similar capital assistance and have been denied. In these cases, however, the systems carry large numbers of vehicles as well as passengers.

Unlike the Staten Island Ferry, the San Francisco system is designed to be a premium service that has a high level of passenger amenities, including plush interior lounge areas and seating, bar service, etc., similar to express-bus and other systems that attempt to lure automobile users to a public mode.

Washington State Ferries (Seattle)

Washington State Ferries operates an extensive system of passenger and vehicle ferries in and around the Puget Sound area. The system includes 11 routes, 22 terminals, and 19 boats and services 17 million passengers and 7 million vehicles per year. The ferries service a variety of users from commuters to vacationers. Many of the islands on Puget Sound are not connected by highway to the mainland, and the ferry system provides a main transportation link among them and to the mainland (4,5).

The system is different from those in New York and San Francisco in two principal ways: (a) it is truly a "system" in that it has many differing routes and services, and (b) its primary users are those who bring vehicles aboard the ferry. Only about 36 percent of the system's passengers are "walk-ons".

The system is historically an old one, consolidated by the state's taking over a variety of private operators in 1951, and serves a dual role in Puget Sound's transportation network. First, the ferries are in a very real sense an extension of the highway system. Second, the system provides the only link to the mainland for numerous water-locked islands in the sound. The broad-based use and acceptance of a waterborne system as an integral and major part of a regional transportation network in Washington State are unique for the United States and again illustrates the waterborne mode's potential.

Washington State's ferry system graphically illustrates the importance and variety of roles that an extensive waterborne network can play in an urban region. The system services commuters and recreational travelers, vehicles and walk-on passengers, and regular and occasional users.

The Washington State ferry system, taken in total, is a regional rather than a strictly urban system, although several of its principal routes to downtown Seattle serve large numbers of regular commuters. It is different in character from the New York and San Francisco systems in that the carrying of vehicles is the primary service component. Further, there are points on the system at which it has a virtual monopoly, because no direct vehicular connections compete or the alternative vehicular routes take a much longer time and are farther than the ferry routes. The system contains commuter routes of 30 min to 1 h in travel time as well as the 3.5-h service to Vancouver Island, which is largely a recreational route.

The system receives no capital or operating subsidy from UMTA or any other federal agency. The state provides operating and capital subsidies of about $11 million/year from the state's motor-fuel tax. Fares are controlled by a public board and are generally set to return 75 percent of operating costs. The lack of federal funding, despite several applications, is generally thought to be due to two factors:

1. The system's emphasis on carrying vehicles rather than people and
2. The fact that a statewide funding mechanism is already in place and providing adequate support.

The first factor, however, fails to recognize the fact that vehicle-carrying ferries are a useful alternative to highway bridge and tunnel construction.

British Columbia Ferry (Victoria, B.C.)

The B.C. ferry system is a large one, which carries 10 400 000 passengers and 3 750 000 vehicles/year on 16 routes. The system, however, is not really urban in any way and services primarily noncommuter travel demands. Most routes run from the island of Vancouver to the British Columbia mainland (and islands in between), and the shortest scheduled run is about 1.75 h. Less than 5 percent of the passengers are

classified as walk-ons, and many trucks and buses are serviced (6,7).

The role of the B.C. system is clearly an extension of the highway system. None of the routes serve connections that can be made via bridges or tunnels. This role is reinforced by the way in which the system is financed. For each route operated, the B.C. ferry receives a subsidy equivalent to the estimated cost of amortizing the capital investment required to build the equivalent highway-bridge-tunnel link. This results in an extremely well-financed, highly subsidized system, in which operating funds are not a significant problem.

Although not an urban system, the B.C. ferry system is unique in the public support it receives and in the explicit recognition of its role as an alternative to bridge and tunnel construction. Further, the B.C. ferry system introduces an entirely new role--that of goods movement. Trucks are a major component of the B.C. ridership and provide the major means for transporting goods between Vancouver Island and the British Columbia mainland.

British Columbia Hydro Transportation (SEABUS)

The SEABUS operation in Vancouver, B.C., is unique in the industry in its physical design, concept, and role in the Vancouver urban transportation network.

It is made up of passenger-only service between Vancouver and a northern suburb and was from its inception planned and designed as an integral part of an urban transit system. The system's manager, who is also the developer of the service concept, has a background in the transit industry, not in the maritime industry. Several key elements make this system unique:

1. The intent of the service was to reduce the number of buses crossing the Lion's Gate Bridge, a three-lane facility that is greatly overloaded in peak periods; diversion of automobile users was not a major objective.
2. The docking system was designed specially for the service; boats enter a slip that surrounds the front and two sides of the vessel, with only 1 in of clearance on either side. Transit-type subway doors open on both sides of the ship and are placed about 10 ft apart; passengers exit on one side and enter on the other. The system reduces dock turnaround time to less than 3 min.
3. The vessel's control system features two sets of propellers--one propeller at each of the ship's catamaran corners. Propellers revolve 360°, which gives the vessel a highly responsive and finely tuned control system and allows the smooth docking procedure even though only 1 in of clearance is provided. With all propellers at full reverse, the ship can go from full speed ahead to stop within its own length (100 ft).
4. The North Vancouver terminal includes a bus-and-ride area, but no formal park-and-ride area has been set up. Ridership is high, however; 9500 passengers/weekday and 1250 passengers/weekend day. It is believed that enormous demand would arise if a park-and-ride area were provided, a demand that could not be handled by using only two boats. Additional boats and new routes are being contemplated.
5. The system is subsidized as a regular part of the transit system for 70 percent of its operating expenses.

The SEABUS is a uniquely planned and designed system that represents the state of the art in urban ferry services. The system's physical characteristics were cited as examples frequently in the course of this research. A key point for this discussion, however, is the unique role played by SEABUS as an extension of the transit system, i.e., as an alternative to bus transit. This approach is not only unique but dramatically places before the urban transportation planner greatly expanded horizons for the waterborne option.

CONCLUSIONS

There are many insights that can be drawn from the preceding discussion concerning the current role of ferry systems and, more important, the future potential of ferries in the United States:

1. The role of ferries as a primary form of river crossing has declined precipitously and will continue to decline. Bridges and tunnels are far more efficient in serving as crossings of narrow waterways, particularly where vehicles must cross those waterways.
2. Ferries are nevertheless becoming a more-frequently considered alternative to bridge and/or tunnel construction across more-expansive waterways, such as San Francisco Bay and Long Island Sound, where the cost of bridge or tunnel crossings is prohibitive. In existing services, B.C. ferries and the Staten Island Ferry clearly serve links that cannot be economically replaced by direct bridge and tunnel crossings; even the Verrazano Narrows Bridge is an indirect and time-consuming connection to Manhattan.
3. Ferries serve primarily two trip functions: commuting and recreation. Commuters are daily users and ridership is strongly peaked. The recreational users are occasional and dispersed. A potential exists to exploit the tourist trade (as many sightseeing services do) for additional income by providing special tour services as part of regular ferry service. Long-haul services are dominated by recreational uses.
4. The role of ferry services in maintaining links between islands and the mainland is a strong one in some existing systems, like B.C. ferries and Washington State Ferries. Many of these are monopolies and are required to maintain habitation of small islands. It is unlikely, however, that such services would be expanded to many island locations that are not now inhabited.
5. Services may be geared to the carrying of vehicles or walk-on passengers or both, depending on regional needs.
6. Ferry services may integrate to form links in a transit network (as in the New York City area and the Vancouver SEABUS) or may form an integral part of a highway system (as in the B.C. and Washington State ferries). They may also operate as relatively isolated services, such as that in San Francisco, which is essentially an isolated transit service, by using park-and-ride as a primary feeder. In some cases (the B.C. and Washington State ferries), the ferry system is in itself a regional network or coordinated system.
7. In long-haul situations, goods movement in trucks may become a significant function.
8. Public acceptance of existing and new systems is relatively high, and on a regional basis, governmental support in the form of subsidies is also strong. Subsidy measures may be either highway- or transit-oriented and generally are indicative of the functional role of the system.
9. Vessel technology (which is discussed in a paper in this Record by Bloch) allows for a wide variety of ships in terms of size, passenger and vehicle capacity, speed, propulsion system, hull design, etc. Essentially, a vessel can be built for virtually any need. The unique and creative use of

conventional technology in SEABUS stands as a tremendous example of the mode's potential in this regard.

Clearly, there is renewed interest in ferries as a viable transportation alternative in many areas. Just as clearly, there exists a potential for a growth of ferry services in many areas, both in terms of new service potentials and of ridership increases on existing services. The Staten Island Ferry, B.C. ferry, SEABUS, and others have experienced strong upward trends in ridership in recent years.

The logic for increased consideration of the waterborne mode is clear: The shortest distance between two points is a straight line. That line often goes over water. The technology has developed rapidly over the past several decades, and many nations have already put it to extensive use. As the resources available for massive land-based transportation systems decline, the water alternative becomes attractive, when available. After all, it is not necessary to construct the right-of-way.

The waterborne mode is not a solution to all our urban transportation problems. It is, however, a most flexible mode that can fulfill a variety of functions and roles. At the very least, it should be a more prominent option considered in situations in which it is available. Over the next two years of the current work, it is hoped that tools will be provided to aid the planner in this consideration.

The potential for waterborne transportation as a viable modal alternative has only been very lightly tapped. It is indeed ironic, but in the years to come, man may return to his original form of transportation to help alleviate the urban congestion being experienced in the more modern modes.

ACKNOWLEDGMENT

I would like to acknowledge meetings and interviews with Carl Berkowitz, executive director, New York City Bureau of Ferries; Stanley Kowleski, general manager, San Francisco Ferry Transit Division; Richard Berg, general manager, Washington State Ferries; and Charles Gallagher, general manager, British Columbia Ferry Corporation.

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Waterborne Access to Gateway National Recreation Area and Other Waterfront Recreation Areas by Passenger Barge-Tugboat Combinations

S. DAVID PHRANER

Examples of barge-tug operations are common on the waterways of America. Few (probably less than 20) exist in passenger-carrying forms. None exist that use a range of new technologies in barge-tug integrator systems for passengers. Approximately eight to ten of these barge-tug integrator systems now exist and are providing efficient movement of bulk goods. The basic feasibility of applying this technology to a unique passenger-transport need is addressed here—that of connecting large centers of population by using regional-scale waterfront recreation complexes. Gateway National Recreation Area, located in the New Jersey-New York region, is the second most visited National Park facility. Its access problems are unique and require innovative approaches. Barge-tug integrator systems exhibit characteristics that qualify them for consideration. It is estimated that modest but significant savings in capital and operating costs can be achieved by barge-tug integrator systems over conventional excursion vessels. In addition, the barge-tug combination provides some unique advantages in labor and vessel use, safety, joint use, and adaptability to purposes of recreational travel. Although barge-tug systems do have potential for application to recreation access, these advantages do not extend to use for the journey to work or for premium recreation.

The Tri-State Regional Planning Commission's involvement in water transit commenced with staff analysis of existing and past waterborne operations in the region. An analysis of the state of the art in waterborne modal technology was completed and used in an analysis of a ferry across Long Island Sound performed by Tri-State for Connecticut and New York. This study has recently been renewed. Most recent involvement is a demonstration of waterborne technology in several regional transportation applications. In addition, waterborne transportation is being considered for access by large numbers of seasonal vacationers to the Gateway National Recreation Area.

Regional, local, and federal agencies and other interested parties have cooperatively been treating the dilemma of providing efficient, enjoyable access to Gateway and other major recreation areas of the Tri-State Region. Access by waterborne transit has