SEATTLE, WASHINGTON

BRIEF: METRO BUS TRAVEL

Table of Contents

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METRO Bus Travel

SUMMARY

The 2.1-mile [1.3-kilometer] downtown bus tunnel, which opened in 1990 along Third Avenue and Pine Street, serves 23,000 passengers daily. Costs for the five-station tunnel were nearly $450 million, and operating expenses total $6 million annually. Average time savings for the dual-mode buses using the tunnel exceed 5 minutes per trip, and removing buses from city streets has also expedited general traffic flow there.

CITY CONTEXT

Seattle, with its steep hills, waterways, and snow-capped mountains is the hub of the picturesque Puget Sound region. The region encompasses over 1,750,000 people, of which more than 500,000 live in the city.

The central business district (CBD), located between Interstate 5 (I-5) and Elliott Bay, has an employment of over 115,000. This area is served by the Puget Sound ferries, the Seattle Center-CBD monorail, and an extensive system of diesel and trolley bus routes. Many lines use the downtown bus tunnel. Highway access is provided by Interstate 5 and the Alaskan Way Viaduct, which flank the CBD on the east and west.

Seattle is constrained by Elliott Bay and Lake Washington. This results in an "hourglass" shape that concentrates most travel in a north-south direction. Bus routes mainly access the long narrow central area on a handful of north-south streets. The heavy bus volumes and frequent conflicts with traffic led the city and region to search for off-street transit—the 2.1-mile [1.3-kilometer] Seattle bus tunnel is the result of this search.

The downtown bus tunnel helps transportation problems associated with population and employment growth in and around the Seattle central business district and King County. It is the United States' first transit facility designed for dual-power buses. It opened on September 15, 1990, to much national and international acclaim.

PLANNING AND IMPLEMENTATION BACKGROUND

At the time of the project planning, the federal government had a "no new rail starts" position. This forced King County METRO to study various bus alternatives (surface mall, twin-terminal intercept with mall, transit and non-transit vehicles, and a tunnel). Eventually, the tunnel option with five stations was picked and given top priority by the U.S. government for funding. METRO's decision to build a bus tunnel was made after the analysis of two tunnel and seven surface alternatives. All alternatives contained significant common improvements. These included a busway connection to the major interstate highways, an expanded surface trolley bus circulation system for downtown, and an increased number of CBD bypassed bus routes.

PROJECT DESCRIPTION

Starting at the north portal, as shown in Figure 1, the tunnel starts around Ninth and Pine Street where the open-air station is below the street level. Convention Place Station is a 4-acre site containing a bus-staging area. Going southbound, the tunnel continues down Pine Street and leads to Westlake Station, providing direct connections to the department stores in the area. This portion of the tunnel was created through cut and cover construction; contractors dug a 60-foot-deep trench and covered it with new roadway.

From here, the tunnel turns south down Third Avenue towards the south portal. Shield excavators created the Third Avenue section of the tunnel. The tunnel section between Westlake Station and the next stop, University Street Station, passes over the Burlington Northern train tunnel, which is the main north-south rail facility in the region. The University Street Station directly connects to Benaroya Concert Hall as well as the financial district. Five blocks further south is the Pioneer Square Station and the historic district. The final tunnel section is a curve-shaped portion leading to the south portal. This is the only part of the tunnel that is below sea level, and it passes merely 4 feet below the Burlington Northern Railroad tunnel. Since construction, this juncture has been stabilized with a chemical grout. The southern portal opens up to the open air International District Station. A concrete lidded area is just south of the station platform for bus staging.

In anticipation of light-rail vehicles for future use in the tunnel, rails were installed. In addition, all of the tunnel stations are accessible to people with disabilities. Most entrances have elevators.

STATIONS

There are three stations within the tunnel and one at each portal. Each station in the tunnel has a third lane that enables buses to pass disabled vehicles. (See Figure 2.) Each station has been purposefully designed to blend functional art and architecture. The lead artist worked with a lead architect to develop the distinctive art and architecture for each station. Stations feature colorful murals, clocks, electronic art, and etched tiles. A total of 21 artists were commissioned by METRO to create more than 30 pieces of artwork. Each of the station designs is a representative slice of the neighborhood it serves. Kiosks in city streets direct passengers to tunnel stations (Figure 3).

VEHICLES

In an effort to reduce noise and diesel fumes in the tunnel, METRO bought 236 special dual-powered buses (see Figure 4) manufactured by Breda Costruzioni Ferroviarie of Pistoia, Italy. All vehicles have wheelchair lifts in front and three wide doorways. The vehicle seats 64, including the driver and two wheelchair tie-downs. It is 60 feet long by 8.5 feet wide. When the vehicles arrive at the tunnel, the power is switched automatically from diesel to trolley power. Diesel is used when the vehicles are operating outside of the tunnel. In 1990, the vehicles' base price was $525,200.

The transition from electronic to diesel takes place at the Convention Center and International District Stations (see Figure 5). Storage areas for buses are also provided at those locations.

Safety and Security

Uniformed security personnel patrol the tunnel. METRO also monitors station and tunnel areas with a closed-circuit television system. The stations are designed without hiding areas or restrooms. Each station has information and emergency telephones tied directly to the METRO tunnel communications center. Computers monitor all tunnel systems and operations. The tunnel control center is staffed 24 hours a day, 7 days a week. Tunnel control booths are located at the north and south portals where controllers monitor the flow of tunnel buses into the tunnel system. The tunnel and stations have automatic fire-detection and suppression systems as well as being constructed with non-flammable materials. Emergency fan systems are in place for smoke evacuation, with emergency signage in tunnel sections and stations to direct the public to cross passages and exits.

Operations

The METRO bus tunnel is in operation between 5 am and 7 pm on weekdays and 10 am and 6 pm on Saturdays. The tunnel is closed on Sundays and holidays. When it is closed, routes operate in both directions along Third Avenue between Yessler Way and Olive Way. Southbound buses travel west along Stewart Street before turning south on Third Avenue. All stations are within the METRO designated "Ride Free Zone" (Figure 6). Bicycles are restricted and need to be unloaded at Convention Place Station from the north and International District Station from the south. Customer information telephones and signage are provided in all stations, with a full-service office at the Westlake Station.

Costs

The decision to build a bus tunnel should be viewed as an ambitious and costly effort to improve CBD bus operations and to reduce the number of buses operating on surface streets. Built in the late 1980s, the tunnel cost nearly $450 million. As of 1996, annual tunnel operating expenses added up to around 6 million dollars. Facility maintenance and power make up the largest portion of expenses, at $2.4 million. The next largest portion of expenses is vehicle maintenance, at $1.7 million. The figure for vehicle maintenance represents the marginal difference in maintaining tunnel buses versus other buses in the fleet.

Usage and Benefits

In 1996, the tunnel operated with up to 70 buses running per hour per direction, with the potential to accommodate up to 165 buses per hour per direction. King County METRO believes that 125 buses per hour per direction provide optimal levels of service without sacrificing quality. About 25 percent of all rush-hour bus trips through downtown Seattle use the tunnel. Currently about 23,000 people per day board one of the 26 routes provided by METRO and Sound Transit. Tunnel buses now go through the CBD considerably faster and more reliably than on-surface street buses. These routes take

about 10 minutes whereas similar surface routes take over 15 minutes, a time savings of 5 minutes or 2.5 minutes per mile.

As a result of removing buses from surface streets, general traffic flow has improved. Surface coach volumes decreased by 20 percent while passenger and vehicular accidents on tunnel routes were reduced by 40 percent compared with before.

Another benefit of the bus tunnel is the decreased surface noise, odor, and particulate pollution. The bus tunnel also extended and enhanced the regional high occupancy vehicle (HOV) system, increased off-street layover space for coaches, enhanced the CBD environment and aesthetics, and improved rider security in the CBD.

ASSESSMENT

The tunnel has the advantage of improved travel times, reliability, and identity, the three basic attributes of bus rapid transit. Greater benefits could arise if (1) the BRT service were extended via busways and reserved freeway bus lanes (e.g., I-5) or arterial streets, (2) the route structure was simplified to reduce the number of services provided and (3) hours of operation were extended beyond 7 pm.

The tunnel concept has potential application in downtown areas where congestion is frequent, bus volumes are high, and street space is limited—most likely in cities that already have rail transit (e.g., Boston).

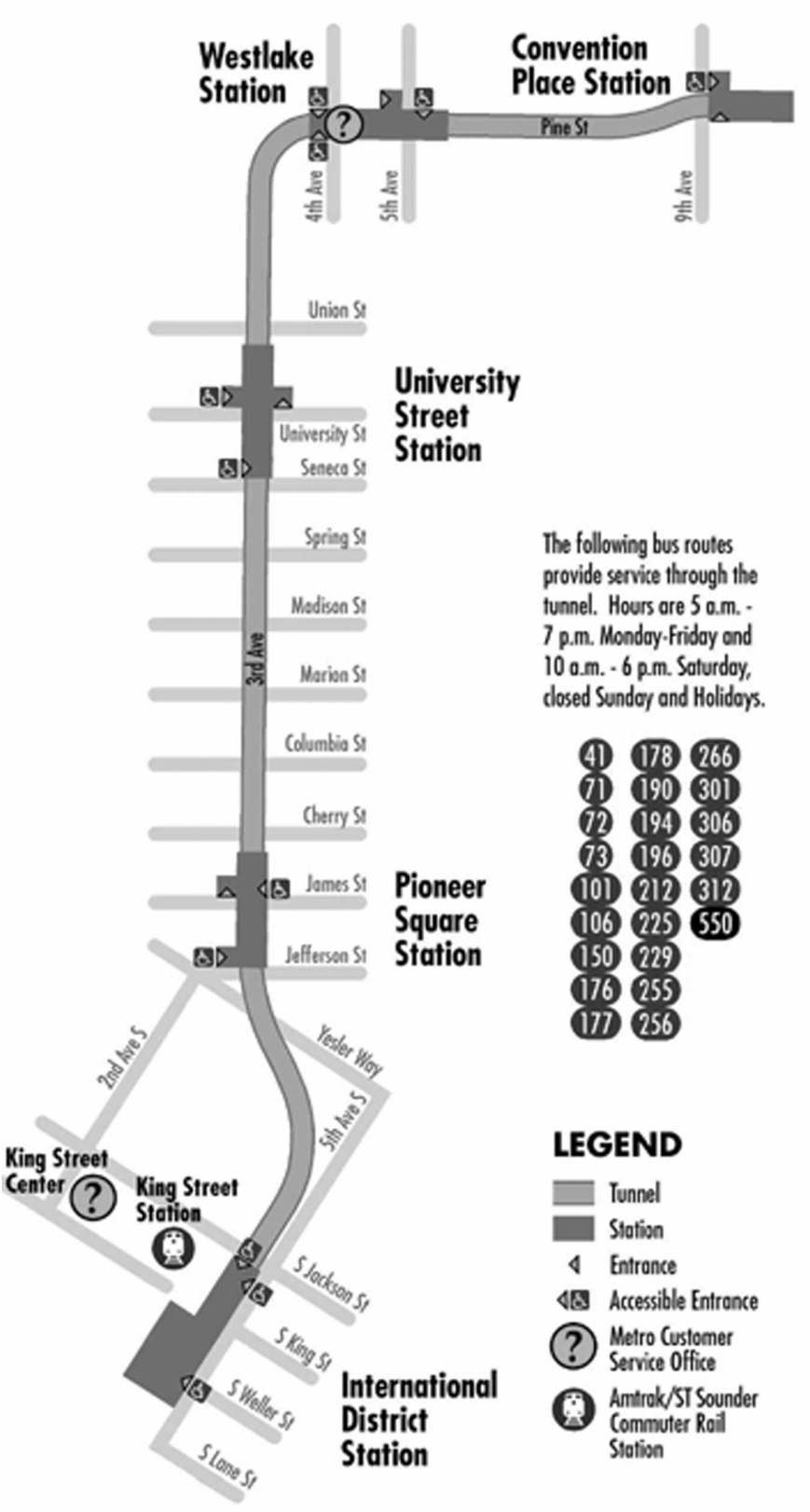

Figure 1: Seattle Tunnel Map

Figure 2: Tunnel Layout (Includes 3rd lane for Passing Buses)

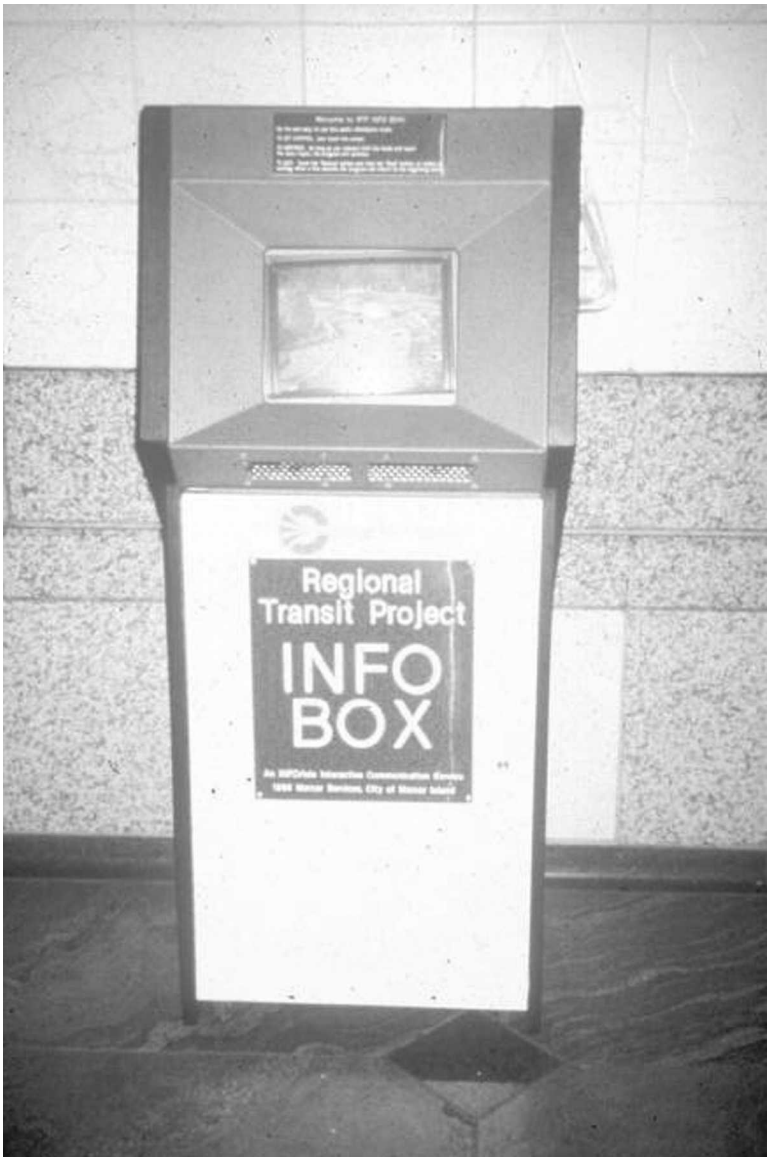

Figure 3: Typical Information Kiosk

Figure 4: Dual-powered Bus

Figure 5: Convention Place Station

Figure 6: Seattle "Ride Free" Zone