

# Making an Accessible Light Rail System More Accessible Under the Americans with Disabilities Act

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The Sacramento Regional Transit District (RT) light rail stations were built in 1987 to be accessible to persons with disabilities, but they do not necessarily include all of the features required by the Americans with Disabilities Act of 1990 (ADA). Accessibility to all trains via minihigh platforms has encouraged patronage by persons with disabilities; currently, wheelchair user boardings average 40 per weekday. State building code and then-current federal accessibility standards were followed in the design of the system, resulting in many user-friendly elements for passengers with disabilities. U.S. Department of Transportation ADA regulations require that transit systems retrofit "key" existing stations to meet the ADA guidelines. RT's key station plan to ensure compliance includes modifications to the following existing RT light rail station elements at nine key stations: detectable warning strips, signage, Braille or raised print information, parking, handrails, curb ramps, lighting, level track crossings, and elevator communications. In February 1995 RT entered a voluntary compliance agreement with the Federal Transit Administration to set deadlines for modifications that had not already been completed. Several questions remain as to what some of the final modifications will be, especially for detectable warnings. RT is also looking to the future with a study of whether the existing design should be continued when the system is expanded, or whether alternative vehicle (low-floor, revised seating, etc.) or station designs will be re-

quired to continue the high level of accessibility enjoyed by Sacramento light rail riders.

**T**he Americans with Disabilities Act of 1990 (ADA) requires that new or altered rail transit stations be accessible to and usable by persons with disabilities, including wheelchair users. These stations must meet Architectural and Transportation Barriers Compliance Board (access board) guidelines contained in the U.S. Department of Transportation (DOT) regulation implementing the ADA. In addition, existing stations considered to be critical to the use of the system must be designated as "key" and modified to meet certain access board guidelines. Key stations that were built in compliance with federal accessibility standards in effect at the time of construction are not required to be completely retrofitted, except for ADA-mandated items not included in the earlier standards. (For example, detectable warnings were not required by the pre-ADA accessibility regulations and therefore must be added to all key stations.)

## SACRAMENTO LIGHT RAIL

The Sacramento Regional Transit District (RT) operates a 30-km (18-mi) light rail system with 30 stations.

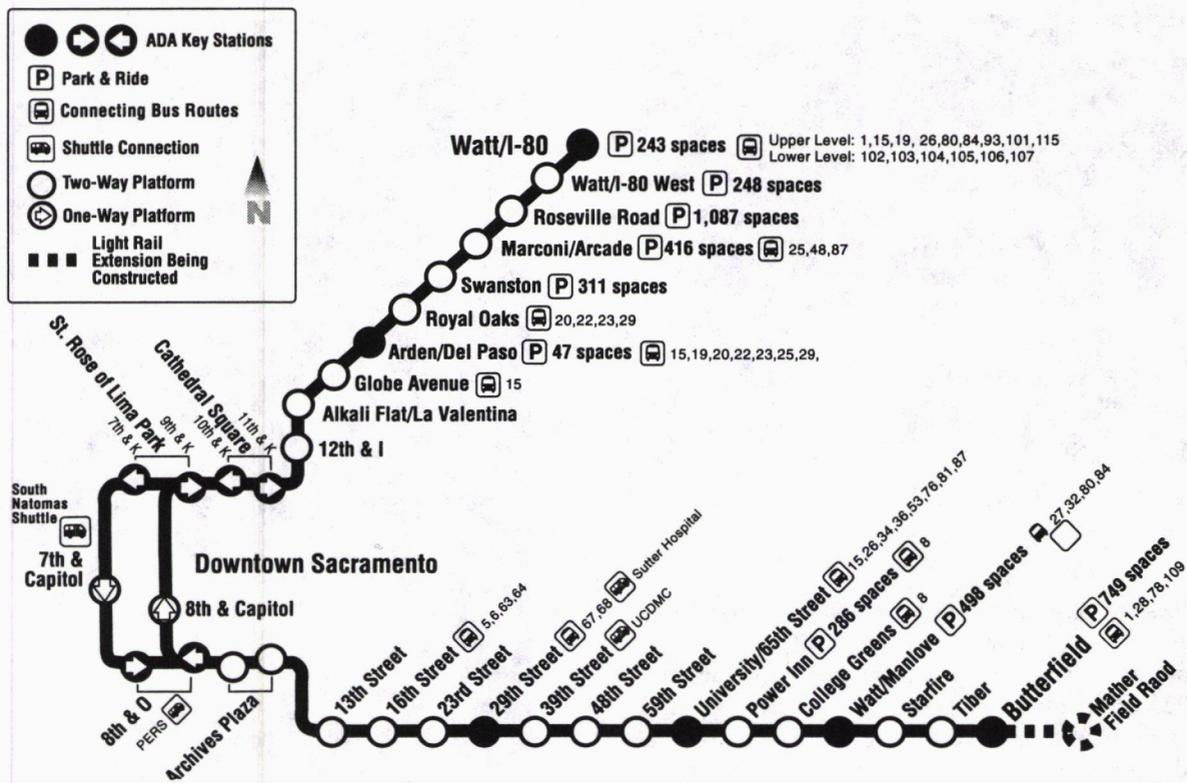


FIGURE 1 Sacramento Regional Transit light rail system.

Opened for service in 1987, the line serves two major travel corridors in the greater Sacramento area. The system operates on a combination of private and shared-street rights of way. Automated grade crossing signals and gates separate the operation from other vehicular traffic in all areas but the central business district, where it runs in streetcar fashion. Figure 1 contains a map of the RT light rail system. Timed-transfer connections to the RT bus system are available at nine stations. Park-and-ride lots accommodating between 40 and 1,100 cars are located at nine stations at the outer ends of the system. The light rail system is scheduled for a one-station (3.7-km/2.3-mi) extension in 1996 and possible extensions of 8 km (5 mi) and 14.5 km (9 mi) on the existing corridors when funding becomes available. Expansion into a new corridor (south area) has recently received approval for preliminary engineering and environmental work; implementation is contingent on future funding availability.

Stations on the light rail lines are of open-air design and feature automated fare vending machines (FVMs) that dispense tickets or passes used in an honor system for payment with random inspection. The stations were built to be accessible to persons with disabilities, including those using wheelchairs. The design and construction of the stations met state of California acces-

sibility standards in effect at the time and were also carried out in close consultation with local persons and groups representing a cross section of disability interests.

The resulting stations feature minihigh platforms with ramps (Figure 2) or wayside lifts (Figure 3). The platforms combine with bridge plates on the rail cars that operators deploy manually to afford walk- or roll-



FIGURE 2 Minihigh platform with ramp.

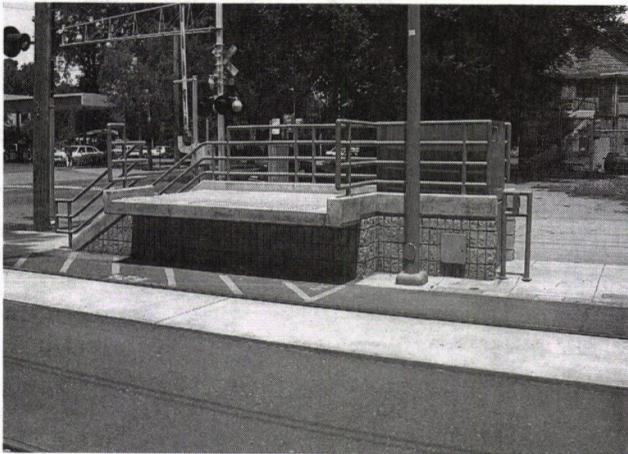


FIGURE 3 Wayside lift.

on access to passengers with mobility restrictions (Figures 4 and 5). Color-contrasting resilient-overlay detectable warning strips of a truncated-dome design are installed at all platform and boarding area edges. The FVM's have been adapted for use by blind patrons with the addition of instructions in Braille. Other station accessibility features include parking for persons with disabilities, curb ramps, accessible paths to platforms and boarding areas, and elevators at a two-story station.

Two stations were added to the system in 1994. These stations were designed and built to meet ADA accessibility standards as well as California Building Code (Title 24) accessibility requirements. Improvements over older stations were as follows:

- Consistent ADA-standard detectable warning strips 61 cm (24 in.) deep on low boarding areas as well as minihigh platforms,
- Roof canopy structures and seating on minihigh platforms,
- Light rail vehicle (LRV) door locator texture behind detectable warning strips,
- FVMs with integrated Braille or raised print instructions,
- FVMs consistently placed in center of shelters,
- Directional surfaces leading to FVMs (experimental), and
- Detectable warning strips at tops of stairs (experimental).

#### KEY STATION PLANS: ADA STANDARDS COMPLICATE ACCESSIBILITY COMPLIANCE

The standards required at key stations are contained in the *ADA Accessibility Guidelines for Buildings and Fa-*

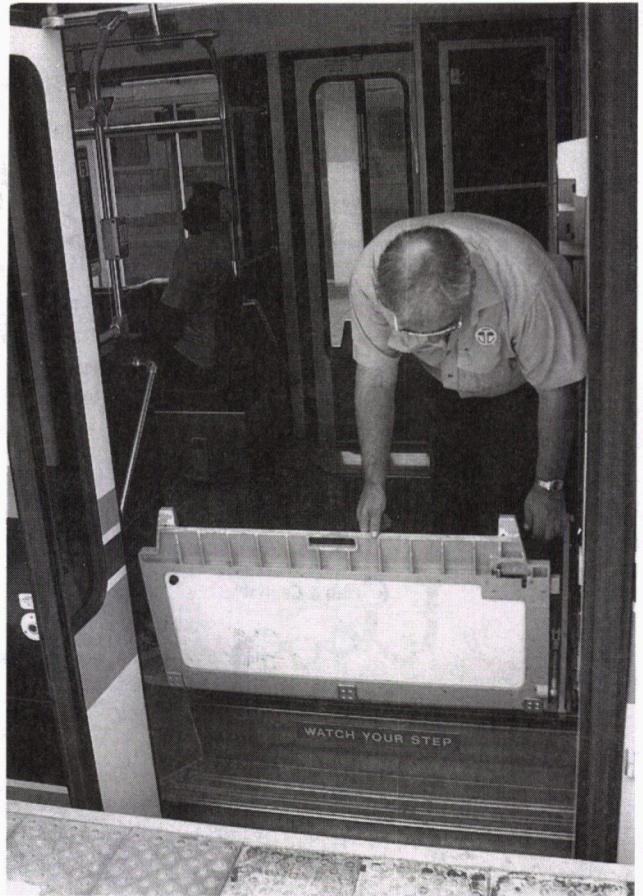


FIGURE 4 Operator manually deploying bridge plate.

*ilities* (ADAAG, or access board guidelines). Two alternatives to complying with the full ADAAG standards are given in limited circumstances: the application of "grandfathering" items that met prior federal accessibility standards when originally built or installed, and the concept of equivalent facilitation.

#### Grandfathering

For rail facilities already accessible before passage of the ADA, DOT allows items that met federal accessibility standards in effect at the time of construction or modification to be considered accessible under the ADA. To qualify for this grandfather clause, existing modifications must conform to the Uniform Federal Accessibility Standards (UFAS), which was a precursor to the ADAAG and was the standard to which all federally funded projects were subject before passage of the ADA.

However, this clause is limited to UFAS individual elements that were superseded by more stringent versions of the same standards in the ADA. New ADA



FIGURE 5 Bridge plate in position.

items that were not covered in UFAS must be retrofitted in existing key stations. For example, UFAS did not contain any standards for detectable warnings on walking surfaces or transit platforms. This means that even though the RT stations went beyond the UFAS in providing them, the existing platform detectable warnings, which do not meet ADA guidelines, could not be grandfathered.

### Equivalent Facilitation

Departures from particular technical and scoping requirements of the ADAAG by using other designs and technologies are permitted when the alternatives will provide equivalent or greater access to and usability of the facility. The DOT regulation specifies a procedure for using alternative methods of compliance. This procedure includes making a request to the Federal Transit Administration (FTA) that states the reason for not complying with ADA, what the alternative method is, and how it provides equivalent accessibility; it also outlines public participation in the process.

### RT Light Rail Compliance

The following are general descriptions of ADA-required items to the extent that they were applicable to the RT light rail system and were found to require significant changes. Applicable items were identified as to their compliance throughout the system. Site reviews were conducted to assess compliance at individual key stations, the results of which were included in a compliance plan for making the needed modifications.

#### *Station Identification Signs*

Signs identifying stations must meet minimum graphic standards and be visible on both sides of rail vehicles. Some RT stations had these signs on only one side. Signs on the other side were added at these locations, to the extent practicable. The graphic standards for character height and proportion, as well as finish and contrast, were met substantially by the existing signs. However, these signs were not as readable as they could have been, especially for low-vision patrons. Since the related destination signs were not compliant, RT decided to replace all of the station identification signs at the same time in a consistent graphic style. The ADAAG requirement for a totally nonglare eggshell finish was problematic because of the need to be able to remove graffiti. RT settled on a low-gloss paint combined with antigraffiti coating.

#### *Station Information*

Lists of stations, routes, or destinations served by the station must meet minimum graphic standards. At least one Braille and raised print sign identifying each station must be placed at uniform locations throughout the system. The RT destination signs ("To Butterfield," etc.) did not fully comply with the graphics standards and were targeted for replacement. Braille and raised print signs identifying each station had been planned and were already contained in a capital grant project intended to improve the existing Braille information on FVMs at each station.

The Braille and raised print signs posed some unique challenges to RT. First, the FVMs did not have enough space for both Braille and minimum 16-mm ( $5/8$ -in.) raised print information. And, in open-air stations, there are limited opportunities for consistent placement of signs to be easily located by patrons. This problem was exacerbated because RT stations varied greatly in their layout, including the location of shelters and FVMs. Ultimately, the railings of minihigh platforms were chosen as the best, most uniform location. Exposure to direct sunlight on Sacramento's 36°C (100°F) summer days precluded the metal signs that some other

systems have developed as durable solutions—reading transit information is difficult when fingertips are being seared.

Searching for a tough yet cool material led RT to test signs made of Coryon, a high-density polymer that is sandblasted to create raised print characters. Braille is produced by sandblasting or by using inset beads (Figure 6). A prototype 6.4 mm (¼ in.) thick was broken by vandals, which led to further testing of 12.7-mm (½-in.) material and the use of an aluminum frame. RT expects either of these versions to last several years in the field.

### *Fare Vending Machines*

FVMs are required to be physically accessible, and instructions and information for use must be accessible to and independently usable by persons with vision impairments. RT's fare machines satisfy the requirements for maximum and minimum physical reach. However, the ADAAG does not specify standards for making instructions on fare machines (vis-a-vis the automated teller machine requirements) usable for those with vision impairments.

RT fare machines are equipped with a notice on the front of the machine in Braille, directing the user to a panel in Braille on the side of the machine explaining the front panel buttons and instructions. In addition to this inconvenient arrangement, the present Braille information is out of date and no longer accurate. RT had provided in its capital budget to replace the Braille information with a current version and add station identification, as part of the previously mentioned Braille sign project.

RT had the opportunity to test integral, “dedicated” Braille and raised print instructions on new FVMs pur-

chased for the stations opened in 1994. With substantial input from blind advocates, including members of RT's disabled advisory committee, a successful prototype was developed for these machines that will also be the basis of machines replacing RT's original stock over the next few years. An interim retrofit of the existing machines was also developed in the form of a new faceplate incorporating integral Braille and raised print instructions. The existing mechanical and electrical components would require minimal modifications to accept the revised faceplate, and this approach may be used on some machines that are to be replaced late in the procurement cycle.

### *Detectable Warnings*

Station platform edges must have color-contrasting detectable warning strips of a truncated-dome design at least 61 cm (24 in.) deep. This standard is duplicated by California Title 24, with the addition that it must have resiliency or sound-on-cane-contact difference in outdoor, as well as indoor (which ADAAG requires) applications. Title 24 also requires the color to be safety yellow. RT station platform edge warnings have the required design and yellow color, but they are generally 61 cm (24 in.) deep only on the minihigh platforms. The regular boarding areas have warning strips 30.5 or 45.7 cm (12 or 18 in.) deep.

RT was one of the first systems in the United States to install what later became ADA-standard detectable warning material. The original 1-ft<sup>2</sup> rubber overlay “tiles” were installed using construction-grade mastic. The combination of Sacramento's summer heat and the tendency of the material to stretch over time resulted in the closing of the original gaps between squares. The tiles then butted up against each other, causing some to pop up and curl (Figure 7). This created a tripping hazard for pedestrians, which resulted in a few injuries and in the need for RT to pull up curled tiles and replace them sooner than anticipated. On the other hand, RT has not had any major incidents or accidents in which visually impaired passengers or pedestrians have unknowingly walked in front of approaching trains in station areas. Whether this would have been different if the detectable warnings were not in place is uncertain.

Several manufactured materials were tested by RT for installation characteristics, durability, and detectability by consumers during 1993 and 1994. The long-term experience with the rubber overlay material led RT to seek a more durable solution, preferably one that could be inset in a grout bed while still meeting desired detectability requirements. The city of Sacramento also had concerns about the aesthetic qualities of these materials on its revitalized downtown pedestrian mall. Failing to find an acceptable product offered by man-

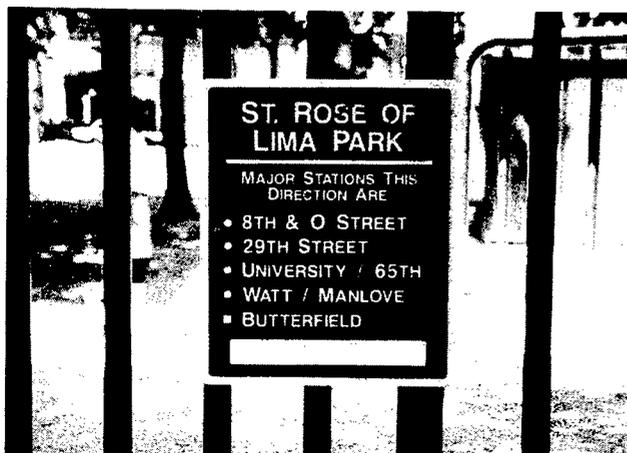


FIGURE 6 Destination sign with raised print and Braille (in white panel at bottom).

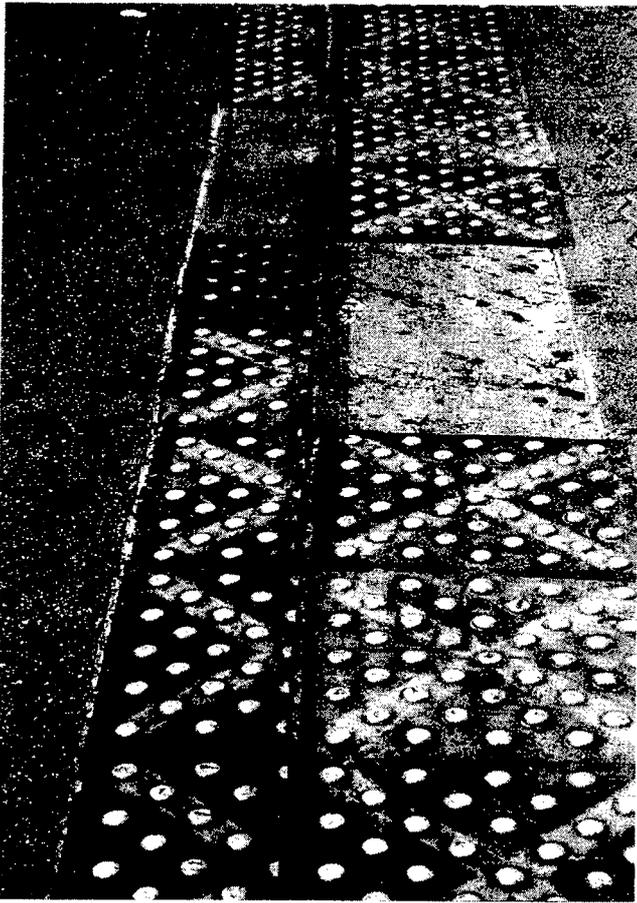


FIGURE 7 Rubber overlay tiles with truncated-dome detectable warning material.

ufacturers, RT decided to develop a prototype specification and find a manufacturer willing to experiment with it. A few manufactured products that may be suitable began appearing in the spring of 1995, about the same time that RT began to develop its test specifications.

A new situation arose while the key station voluntary compliance agreement (VCA) was being negotiated with FTA in February 1995. RT had planned on the need for “hazardous vehicular area” detectable warnings 91.5 cm (36 in.) deep only at crosswalks for side streets crossing the downtown K Street pedestrian mall. Since the RT boarding platforms are all designed for boarding along their entire length, and no vehicles other than the rail cars themselves use them, the RT stations were considered platforms subject to the 61-cm (24-in.) warning depth requirement. This includes both downtown malls and most of the other key stations where the boarding area is flush and the pedestrian circulation area coincides or overlaps with the rail area.

The ADA requirement for 91.5-cm (36-in.) warnings applies only where pedestrian walkways cross or adjoin

a vehicular way, without demarcation by curbs, railings, or other elements detectable by visually impaired pedestrians. This requirement was explained in detail in RT’s key station plan, which was adopted using extensive public participation by interested advocates and consumers with disabilities.

Upon negotiating the VCA, FTA decided to delete the detectable warnings, as it was now considering RT’s flush boarding areas to be “hazardous vehicular areas” (the minihigh platforms already had 61-cm warnings). The regulation for the 91.5-cm (36-in.) detectable warnings at hazardous vehicular areas was suspended by the access board pending further research and therefore could not be applied in the VCA. RT agreed to execute the agreement but also offered to help FTA reevaluate its new interpretation, which could result in confusion between pedestrian mall boarding areas and adjacent motor traffic. Consistency in the treatment of transit boarding areas, as couched in ADA mission statements, would be better served by keeping transit boarding areas differentiated from cross streets.

### *Illumination Levels*

Lighting in areas where signage is located must be uniform and must minimize glare on signs. Lighting along pedestrian circulation routes must provide uniform illumination. The lighting at some RT stations was inadequate, especially on stairways and adjacent areas at the two-story Watt/I-80 station, and at several stations where the lights did not shine down directly on the station identification signs. A project to rectify lighting deficiencies should be completed by mid-1995.

### *Track Crossings*

Where it is necessary to cross tracks to reach boarding platforms, the route surface must be level and flush with the rail top, except for a maximum 6.4-cm (2.5-in.) gap on the inner edge of each rail. Track crossings over what constitute hazardous vehicular ways must have detectable warnings as described earlier and must be 91.5 cm (36 in.) deep. The light rail tracks at RT stations were generally in compliance with this requirement. A few stations, however, feature pedestrian access over the tracks of a freight rail spur line. The infrequent use of these tracks by trains made it difficult to determine whether they constituted a hazard. Erring on the side of caution, RT decided to install the 91.5-cm (36-in.) warning strips on pedestrian approaches to the platforms that cross these tracks. This installation is now on hold because of the regulatory suspension by the access board described earlier. In addition, the pavement across the freight tracks was not level in some places and is being repaired.

## *Elevators*

Elevators at stations must have glazed or transparent panels to allow an unobstructed view both into and out of the car; they must also meet standards for accessibility of signals, controls, and other operating features. The elevators at RT's Watt/I-80 station were built to comply with Title 24 of the California Building Code and complied with UFAS. Most of the features of the elevators also meet the ADA standards. The elevators have transparent panels that allow visibility into and out of the sides of the car. However, the design of the station includes a solid wall on the lower level that does not allow visibility to these clear elevator panels from the platform itself.

Since the elevators substantially conformed to UFAS at the time of construction, RT considered them to be grandfathered under the provisions of the DOT rule for the transparent panel requirement. Not eligible for grandfathering, however, was the requirement that the emergency intercommunication system not be dependent solely on voice communication. RT investigated the installation of an alternative device to augment the existing telephone/intercom system, but it may instead replace the elevator control system entirely to deal with this and continuing damage to the controls by vandals. If the new design is successful, the elevator cars will automatically move up or down to the other level when passengers enter, obviating passenger-operated selections. Sensors would alert RT personnel of any malfunctions, alleviating the need for intercoms or alarms.

## **Cost Estimates and Budget Impacts**

The total estimated cost for required key station improvements, including new station identification and destination signs as well as Braille information at all (key and nonkey) stations was approximately \$700,000. Another \$630,000 would be required to upgrade the remaining nonkey stations to ADA standards. Both of these figures are likely to increase significantly if RT chooses an inset, as opposed to overlay, type of detectable warning material. The key station project was budgeted by RT using 80 percent federal capital funds. In the interest of systemwide consistency, nonkey stations will be completed over the next few years in stages, as funds become available.

RT annually budgets a separate amount for miscellaneous ADA accessibility facility and equipment upgrades (including bus system items), which will eventually cover the modifications to nonkey stations. These costs may appear modest when compared with those needed by older systems with center platforms and multilevel stations. However, they may be considered sig-

nificant for a recently opened system that placed accessibility high among its original design criteria and that has attracted and served passengers with disabilities for several years without major problems.

A third item budgeted is the rebuilding of the only station in the system that does not provide disabled boarding in both directions. The tracks here are in a downtown roadway, and the inbound boarding area requires passengers to cross the outbound tracks. It will cost about \$750,000 to move the tracks and sidewalk. This project is also contingent on taking several feet of private right of way, which will not be practical until the property is redeveloped. The city of Sacramento's rezoning for the proposed development requires the developer to contribute \$250,000 toward the cost of moving the station.

## **VEHICLE LOADING AND RAMPS VERSUS WAYSIDE LIFTS FOR ACCESS**

RT's design using minihigh platforms has been almost universally hailed in the community as an unqualified success. An average of 40 patrons using mobility aids (wheelchairs, scooters, etc.) board light rail on weekdays, and approximately 250 passengers who do not use wheelchairs board using the minihigh platforms. These include people using canes or crutches, people whose condition makes it difficult to climb the vehicle steps, and patrons with baby strollers or shopping carts. The latter category was encouraged for inclusion by RT's disabled advisory committee after the system opened with usage restricted to passengers with disabilities only. The philosophy that accessibility improvements should benefit and be used by anyone who can use them was the basis of this decision. Mainstreaming, as later forwarded by the ADA, is not accomplished as readily when facilities or programs for customers with disabilities are kept exclusive.

The ease of use of RT's design has created a two-edged sword: the system is so popular that it is beginning to turn away disabled passengers because of overcrowding. The current average is five to seven "pass-bys" per month, or about 0.6 percent of all boardings by mobility aid users. There are two reasons for this. First, the three wheelchair positions are sometimes occupied, especially during peak periods, by mobility aid users. Second, passengers not using mobility aids sometimes refuse to move for disabled patrons. RT operators are trained to ask such passengers to vacate the positions when needed, but once patrons have taken a seat, it is sometimes hard to budge them. Single-track staging on the system makes prolonged dwells for supervisory intervention in these cases highly undesirable. Educating riders on this and other accessibility issues is

a priority in RT's upcoming marketing program. System procedure for all pass-bys is to alert the next train (most on 15-min headways, equivalent to the most frequent bus services) to make sure the passenger is able to board. To deal with the crowding issue, RT is considering requiring that all baby strollers be folded upon boarding, which should alleviate crowding of the wheelchair positions as well as regular seating areas.

Most of the minihigh platforms are accessed by ramps with rises of 1 in 12, which meets the ADA standard. User acceptance of the ramps is high, partly because transit-riding mobility aid users tend to have powered wheelchairs or enough upper body strength to use ramps without problems. Three of RT's platforms (out of 60 one-way boarding areas) have wayside lifts, which are the source of problems for passengers with arm or hand movement limitations.

Unlike the wayside lifts on some other U.S. systems, Sacramento's were designed to be operated by the passenger without assistance from LRV operators (Figure 8; note passenger using foot to hold door open). Riders are required to be on the platform when the train arrives. Operators sometimes provide assistance if their schedules allow, but several users have complained about difficulty in opening the manually operated doors to the lift car or operating the control switches. RT plans to retrofit the controls with larger, paddle-type switches. Another possibility, for which technical solutions are not yet final, may be to convert the doors to open automatically and close when the up or down controls are activated.

The wayside lifts originally were used in places where platform or sidewalk clearance would not allow a ramp. RT's informal policy is to replace the wayside lifts if possible, depending on negotiations for space with the city and adjacent property owners. All new

stations are designed to allow for ramps in conjunction with the minihigh platforms. New platform ramps are also designed with a rise of 1 in 14 where space is sufficient for the longer runs required.

## LIGHT RAIL ACCESSIBILITY STUDY

The loading problems result in part from the RT system having consistent 15-min headways throughout the day, including peak periods. Capacity for peak loads is provided through the use of three- and four-car consists. Only the leading car of multiple-car trains is accessible via the minihigh platforms. The ADA standard for a minimum of two wheelchair locations per car would result in the need for up to eight locations at each end of every car, since the cars are double-ended and are operated in both directions. The size of the Siemens LRVs, combined with space limitations on RT's right of way, preclude the use of turn-around loops for single-ended LRVs.

To gauge whether the existing system features will provide enough accessibility to disabled passengers and adequate boarding for all passengers when future system extensions are built, RT has initiated a study to determine which direction will best address Sacramento's needs. The study is being conducted by a consultant team consisting of several firms with experience in rail planning and accessibility issues. Currently under evaluation are five alternatives for improved accessibility:

1. Double-stop trains at minihigh platforms:
  - Time constraints would result from operator assistance required, and
  - City street traffic would be blocked at certain times and locations.
2. Switch to low-floor LRVs:
  - Entire fleet would have to be replaced, with mixing of modes necessary until changeover is completed;
  - Station boarding areas would have to be reconstructed with 25.4- to 30.5-cm (10- to 12-in.) raised platforms, which would harm usability and aesthetics of downtown pedestrian mall; and
  - Minihigh platforms would be removed (after phase in is completed).
3. Lengthen each LRV with a low-floor middle section:
  - Stations would require raised platforms similar to full low-floor alternative,
  - Fleet capacity could be increased without adding new LRVs, and
  - Wheelchair access would be restricted to center sections of cars only or could be augmented by



FIGURE 8 Wayside lift operated by passenger.

leaving existing minihigh platform access for leading cars

4. Increase number of wheelchair spaces in a car:
  - Modifying existing cars could be the lowest-cost option,
  - Would not require new LRVs or station modifications,
  - Existing method of seating at both ends would significantly reduce overall seating, and
  - Single-ended cars would limit operational flexibility in assembling trains.
5. Implement high-level loading at all stations:
  - Would increase service speed with decreased boarding times;
  - Would require major rebuilding of all stations at significant, unplanned expense;
  - Would also require significant modification of existing LRV doors, steps, and suspension; and
  - High platforms on downtown pedestrian malls face strong opposition from community.

## ORGANIZATIONAL ISSUES

The various projects have involved the significant expense of time and effort by many of RT's operational, planning, and management departments:

- Chief Operating Officer,
- Civil and Track Design,
- Customer Relations (marketing and graphic design),
- Facilities Maintenance,
- Finance,
- General Manager,
- Legal,
- Light Rail,
- Planning,
- Program Control and Procurement,
- Safety,
- Systems Design, and
- Systems Development Director.

General planning and coordination of involvement by these departments in rail accessibility issues are handled by RT's accessible services staff. Operating under the assistant to the general manager, this function is staffed by a full-time administrator, a student intern, and a part-time secretary. The accessible services staff are also responsible for RT's bus service and facility accessibility, paratransit planning and contract management, and support to the Disabled and Elderly Committee for Accessible Transportation. Rail accessibility is a regular item on the advisory committee's monthly agenda, which has resulted in good communication between disabled customers and advocates, and the RT staff and board of directors.

## CONCLUSIONS

The public transportation system in Sacramento affords a very high level of accessibility to passengers with disabilities. The fully accessible light rail system coordinates with a bus system equipped with wheelchair lifts on 97 percent of all trips and a paratransit system providing more than 1,000 trips per average weekday. The RT system had a head start on meeting the requirements of the ADA by being designed to forward-looking state guidelines for disabled accessibility. Most of the improvements mandated for retrofitting will result in better access and usability by disabled, as well as nondisabled, patrons of the RT system. However, since the system was essentially already accessible, it is doubtful that these minor improvements will cause patronage by disabled people to rise perceptibly. Some doubt remains about how certain items required by the ADA, such as detectable warnings, can best be accommodated. Future system design to allow for needed accessibility is also not fully determined, with some of the more "pure" solutions posing issues of cost or streetscape disruption. The ultimate decisions in dealing with these concerns will inevitably build on Sacramento RT's strong history of accessibility as well as continued dialogue with disabled transit riders and advocates.