U.S. Department
of Transportation

Federal Railroad Administration

Office of Civil Rights

REPORT TO THE HOUSE AND SENATE AUTHORIZING COMMITTEES:

STUDY OF METHODS TO IMPROVE OR CORRECT STATION PLATORM GAPS

OCTOBER 2010

[This page intentionally blank]

Contents

[This page intentionally blank]

Executive Summary

Section 404 of the Railroad Safety Improvement Act of 2008 (RSIA) requires that the U.S. Department of Transportation complete a study to determine, " . . . the most safe, efficient, and cost-effective way to improve the safety of rail passenger station platforms gaps in order to increase compliance with the requirements under the Americans with Disabilities Act, including regulations issued pursuant to section 504 of such Act and to minimize the safety risks associated with such gaps for railroad passengers and employees." In addition to a fatal accident in 2006, a 2009 analysis of injuries arising from platform-train gaps on a single commuter railroad found that for the period 2005 to 2008, there were 179 gap injuries, which accounted for 25 percent of passenger injuries on that railroad. The researchers concluded that the 30 percent reduction in the final two years of their study might be attributed to the railroad's gap awareness campaign. It is important to note the two forces driving this report, increased safety for passengers navigating the gap and achieving compliance with the Americans with Disabilities Act.

The Americans with Disabilities Act of 1990 (ADA) is a wide-ranging civil rights law that prohibits discrimination based on disability. The current ADA regulatory requirements concerning gap management require, with some exceptions, coordination of car floors with platforms so that the horizontal gap between a car and the platform is no more than 3 inches and the height of the car floor be within plus or minus 5/8 inch of the platform height. The goal is unassisted boarding for disabled passengers for all cars accessible to other passengers boarding from the same platform. However, a number of engineering and operational conditions preclude achieving and maintaining the desired ADA gaps between rail cars and platforms at locations where level boarding exists in environments where freight and heavy passenger rail share track. These standards can and often are met in light and rapid rail operations.

Why Passenger Car/Platform Gap Cannot Conform to Existing ADA Regulations

The desired ADA gap requirements cannot be met due to a number of factors. Routine train operations cause ongoing variation of vehicle to platform gaps, both horizontally and vertically. Variables associated with routine wear, the general physics associated with train movement and accepted engineering parameters for railroads all contribute to a variance up to 8 ¾ inches horizontally and 5 ½ inches vertically. Additional variation occurs due to track class, curvature, super-elevation and the different suspension designs between freight and passenger equipment.

On average, passenger cars are 8 inches narrower than freight cars (10'0" versus 10'8"). This is necessary to allow passenger cars to navigate turns within a desirable distance of the track centerline. Passenger equipment must be equipped with a relatively soft suspension for rider comfort. This alone can result in a roll angle of nearly 8 degrees, which will cause a passenger car to move sideways 6 inches or more at 48 inches above top of rail (ATR). Shorter, wider freight cars require greater offset of the platform from the centerline in order to clear a station than passenger cars.

Although there are some generalities that can be made regarding platform and equipment floor heights in the East and West, passenger cars are in service in the United States with floor heights of 15, 24, 25, 44 and 48 inches ATR. Amtrak's Superliner equipment at 15" ATR is the general

specification west of the Mississippi while 48” ATR is the common floor height found in the Northeast. Safety concerns dictate that passengers should never have to step down into a passenger car, so floor heights must be at or above platform heights for safe operations.

Another factor is consideration of over dimensional (OD) loads. Freight shipments occasionally involve movement of over-sized loads in terms of weight and dimension, requiring greater offset of platforms from the track centerline, ultimately resulting in wider platform gaps. The Department of Defense (DoD) also moves OD loads. The State Departments of Transportation, American Association of Railroads (AAR), Surface Transportation Board (STB), American Railway Engineering and Maintenance-of-Way Association (AREMA), Railway Industrial Clearance Association, FRA and railroad companies work to ensure that military clearances are maintained. FRA staff have determined that OD loads do not conflict with platforms at 15” to 17” above top of rail (ATR).

Passenger Operation Survey

As of November 2009, there were 27 passenger railroads operating in the United States. The Volpe National Transportation Systems Center (Volpe) conducted a survey of a representative sample consisting of nine passenger railroads and Amtrak. The railroads surveyed reported that the desired ADA gap has proved difficult to achieve in operation. The norm in the field today appears to be at least a 6” or 7” gap, even with such aids as vehicle mounted platform extenders or sacrificial platform mounted extenders. Interviewees indicated that in negotiating operating rights with private freight railroads, the freight operators expressed concern that there should be no physical interference with OD loads. Some interviewees remarked, however, that freight railroads derive welcome benefits from new passenger rail starts, especially in improved track and grade crossings using public funds. Passenger operators also reported that utilizing existing station or on-board personnel to call attention to and provide assistance with negotiating unusually wide gaps appears to be an effective approach.

Comments from Disability Rights Advocates and Other Stakeholders

The Department of Transportation published a Notice of Proposed Rulemaking (NPRM) in early 2006 seeking comments on its proposal to amend its ADA and Section 504 regulations to, among other items, update requirements concerning rail station platforms. The Department of Transportation strongly believes that, in choosing accessibility solutions, it is important that service be provided “in the most integrated setting that is reasonably achievable.” The implication of this principle in the rail station context is that the accessibility solution that provides service in the most integrated setting should be chosen. Many organizations provided comments touching on level boarding issues, such as the National Disability Rights Network, AARP and Equip for Equality, as well as many others. A review of these comments was conducted for purposes of this study, and the overwhelming position of the organizations representing the disabled community calls for service in the most integrated setting with a preference for full length level boarding, affording unassisted access to all cars available for boarding to other passengers. Comments from the railroads disagreed with this position.

Potential Mitigation Measures

A study conducted for a commuter railroad suggested three main components to a gap injury mitigation strategy: modifications to the platform and cars, providing information to passengers and training for train crews and platform personnel. For the platform and train, suggestions included using reflective markings at train door thresholds and at locations of the platform with large gaps, use of contrasting color to bring attention to existing train hand rails and reduction of large gaps where feasible. For passengers, the study called for additional platform personnel during peak periods and at stations with high gap injury rates and use of pre-recorded messages to "Watch the Gap." Suggested training included providing data on the railroad's gap injury rates with a goal for reducing these injuries and alerting train crews to the passenger types and stations where assistance may be needed.

Track may be added to move OD loads away from platforms. Gauntlet track, for example, is an arrangement in which railway tracks run parallel on a single track bed and are interlaced such that only one pair of rails may be used at a time. This method shifts the OD load away from the station far enough for safe clearance. Another alternative is a bypass track to completely separate freight and passenger trains near the platform.

Because of the significantly larger gaps encountered when platforms are located on curves, one of the most effective actions that can be taken is to move the platform from a curve to a tangent. However, this situation typically is encountered at existing platforms in difficult terrain or heavily urbanized areas where older configurations were built long before accessibility was a consideration and relocation of the platform is not readily achievable. In these locations other mitigating techniques must be employed.

Mechanical car-borne gap extenders are used with some equipment and considered reliable as long as a manual override feature is included. Car-borne gap fillers may still leave a significant space that will require a bridge plate for passengers using assistive devices for mobility. However, by partially closing the gap it improves safety for all passengers. Fixed car-borne extenders are installed below the threshold to extend the train's width at platform level thereby lessening the gap. At this time, the Long Island Rail Road is installing such devices under its M7 passenger cars.

Platform modifications may also be used to narrow the gap. Platform mounted movable extenders are used to achieve a smaller gap and are currently available in both mechanically and manually operated configurations. Such extenders are generally used in corridors where there are higher mixtures of passenger and freight movements on the same track. They require considerable maintenance, especially in northern climates. A failure to operate properly could have ramifications on safety, clearances and schedules that could impact the entire operation.

In the case of railroads that rarely make OD freight movements, special retractable extenders can be attached to the platform. Personnel on the OD movement can manually push the flaps up to allow clearance and then return them to their normal down position afterwards. This option is labor intensive, but may be a more feasible option in accommodating infrequent OD cargo.

Wooden platform extenders are sometimes employed to mitigate gaps. While easy to install and adjust, wood has the potential to splinter and become airborne when impacted, causing safety hazards for passengers and railroad workers. Sacrificial edges using polymer or fiber reinforced plastic polymer edge boards have been installed in some locations.

Bridge plates are used to bridge vehicle-platform gaps and are manually deployed by station or train crew. They are found on platforms or in stations, usually under lock and key or may be carried in the passenger car. Based on interviews with railroad operators, manually deployed bridge plates are the most commonly used mitigation measure. The conductor or other on board staff can readily lift and deploy the bridge plate.

The NJ Transit Rail study showed positive results in gap related injuries that were likely influenced by information and awareness strategies. The key to a successful public relations campaign is through common trademarks, formats, use of international symbols and the coordination of all of the elements, including schedule cards, station descriptions, websites and the physical attributes at the station including platform markings, signs, shelter, ticketing access, and consistency of location to support the message.

Relative Cost of Mitigation Strategies

The following table is a recap of the mitigation strategies discussed. The chart includes relative cost rankings. The cost rankings are presented to illustrate the range of costs that different mitigation strategies may involve. Life cycle costs are estimated, so while a technique may be more expensive at the outset, it might be less expensive in the long run and vice versa. Costs can be operational such as using train staff to deploy an assistive aid or capital intensive, such as the cost of installation and maintenance of a movable platform. Some mitigation strategies are a composite of the two. Effectiveness is ranked based on utility and satisfaction. Rankings are based on 10 for the highest, 1 for the lowest.

Mitigation Strategy	Cost Ranking	Life Cycle Cost	Effectiveness
Gauntlet track	10	8	9
Bypass track	10	8	9
Platform extenders	8	5	7
Platform edge modifications	5	4	7
Car borne bridge plates	1	1	8
Platform bridge plates	1	1	4
Station aids	2	1	4
Internet outreach	1	1	3

Access for Persons with Mobility Impairments at Locations without Full-Length Level Boarding

Many platforms in service in the United States do not have level boarding. At these locations the platform-vehicle gap is not the primary issue for mobility impaired passengers; rather, access to the train becomes the primary issue. Several methods are currently employed to facilitate access.

At many locations, wayside or car-borne wheelchair lifts are used. Manually operated lifts are generally locked in their own enclosure on the platform. The use of wayside lifts has similar drawbacks as brigdge plates or ramps kept at stations. Bad weather can affect the mechanisms or prevent access to the lift, keys can be lost, or theft or vandalism can occur. In addition, it can be very time consuming to find, move the lift to the desired railcar door, deploy and lift a passenger into the railcar. This results in longer dwell times and the funnelling of passengers with mobility impairments to the cars closest to the wayside lift's enclosure. Wayside lifts are the least favored means of access.

Car-borne lifts located on each car of a consist are operated by the train crew and have an override mechanism in the event of mechanical failure. Car-borne lifts do not have the drawbacks of lifts kept at stations. Moreover, they can be deployed more quickly from every car of the railcar and do not have the effect of forcing mobility impaired passengers to use the rail car door closest to the lift.

Many stations use mini-high platforms as a means of access for passengers with disabilities. Mini-high platforms are disfavored because they often do not provide unassisted access to all cars available to passengers. A major safety issue of concern in the design of mini-high station platforms is the issue of entrapment, where an area between the ramp and mini-high and platform edge could result in a user being trapped between the ramp and a passing train.

Conclusion

While there are a number of gap mitigation techniques available and in use in the United States, there is room for improvement in gap safety awareness and opportunities for an improved system-wide safety approach. With reference to disabled access, a number of engineering and operational conditions preclude achieving and maintaining the desired ADA gaps between rail cars and platforms at locations where level boarding exists. Disabled access to the intercity rail system is improving but is still far short of the vision contained in the ADA.

[This page intentionally blank]

REPORT TO HOUSE AND SENATE

SEC. 404. STUDY OF METHODS TO IMPROVE OR CORRECT STATION PLATFORM GAPS.

Not later than 2 years after the enactment of this Act, the Secretary shall complete a study to determine the most safe, efficient, and cost-effective way to improve the safety of rail passenger station platforms gaps in order to increase compliance with the requirements under the Americans with Disabilities Act (42 U.S.C. 12101 et seq.), including regulations issued pursuant to section 504 of such Act (42 U.S.C. 12204) and to minimize the safety risks associated with such gaps for railroad passengers and employees.

On August 5, 2006, an18-year-old female passenger exiting a Long Island Rail Road (LIRR) commuter train at Woodside Station in Queens, New York, fell through a 7 7/8-inch horizontal gap between the rail car and the station platform. After falling through the gap to the track level beneath the platform, she did not follow instructions from the train conductor and her friends to be still and wait for rescue, but instead crawled under the platform and into the path of an oncoming passenger train. She sustained fatal injuries. (National Transportation Safety Board (NTSB) Accident Report DCA-06-FR-009, Adopted March 13, 2009.) While fatalities are rare, this tragic accident highlights the safety issues involved with platform gaps.

An analysis of injuries arising from platform-train gaps was completed in July 2009 as part of a study focused on customer behavior relative to the gap on New Jersey Transit Rail. That study found that for the period 2005 to 2008, gap injuries accounted for 25 percent of passenger injuries on NJ Transit Rail. There were 38 gap injuries in 2005, 75 in 2006, 83 in 2007 and 58 in 2008. The researchers concluded that the 30 percent reduction in the final two years might be attributed to NJ Transit Rail's efforts to alert passengers to the gap as part of an awareness campaign. (Customer Behavior Relative to Gap between Platform and Train, Final Report, Janice R. Daniel and Naomi G. Rotter, New Jersey Institute of Technology, July 2009).

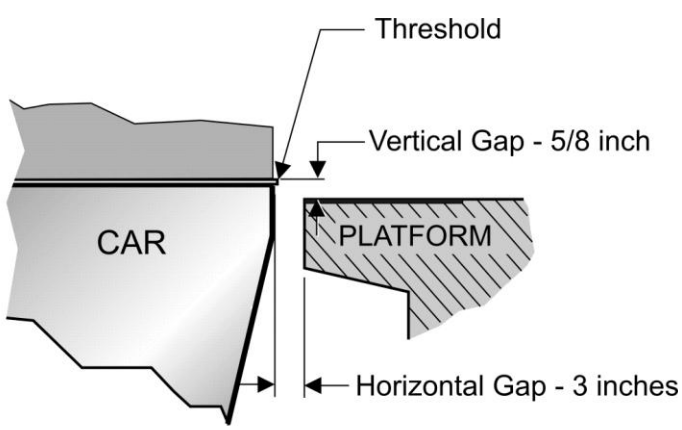
Section 404 of the Railroad Safety Improvement Act of 2008 (RSIA) requires that the U.S. Department of Transportation complete a study to determine the safest, most efficient, and cost effective ways to improve the safety of rail passenger station platform gaps and to minimize the safety risks associated with such gaps. Prior to the enactment of RSIA, the Federal Railroad Administration published the "FRA Approach to Managing Gap Safety" (Gap Safety Report) in December 2007. (*See* Appendix A.) The Gap Safety Report anticipated many of the requirements found in Section 404 of RSIA but was focused on a process to evaluate platform sites and employ a systematic approach to gap mitigation. The methodology suggested in the Gap Report is useful in comparing solutions using a risk management approach, in this case to evaluate and develop risk mitigation strategies to reduce platform-vehicle gaps to acceptable and safe levels. The Gap Safety Report did not address issues of cost efficiency or compliance with the Americans with Disabilities Act.

The Americans with Disabilities Act of 1990 (ADA) is a wide-ranging civil rights law that prohibits discrimination based on disability. Intercity and commuter rail transportation access is addressed generally at 42 U.S.C. §12161 *et seq*. The current applicable regulatory requirements concerning gap management are found at 49 CFR § 38.113(d), which states:

> (d) Coordination with boarding platforms--(1) Requirements. Cars which provide level-boarding in stations with high platforms shall be coordinated with the boarding platform or mini-high platform design such that the horizontal gap between a car at rest and the platform shall be no greater than 3 inches and the height of the car floor shall be within plus or minus 5/8 inch of the platform height. Vertical alignment may be accomplished by car air suspension, platform lifts or other devices, or any combination.
> (2) Exception. New cars operating in existing stations may have a floor height within plus or minus 1 ½ inches of the platform height.
> (3) Exception. Where platform set-backs do not allow the horizontal gap or vertical alignment specified in paragraph (d) (1) or (2), platform or portable lifts complying with Sec. 38.125(b) of this part, or car or platform bridge plates, complying with Sec. 38.125(c) of this part, may be provided.
> (4) Exception. Retrofitted vehicles shall be coordinated with the platform in existing stations such that the horizontal gap shall be no greater than 4 inches and the height of the vehicle floor, under 50% passenger load, shall be within plus or minus 2 inches of the platform height.

Figure 1 is an excerpt from the Gap Safety Report that illustrates the ADA gap requirements.

Figure 1. Cross section of Car and Platform Showing 3” Width Gap and 5/8” Height Differential



EXISTING GAP SITUATION

Unassisted boarding to all cars on a train for individuals using wheelchairs for mobility requires full length level boarding with minimum vertical and horizontal gaps. A mobility impaired passenger using a wheelchair should be able to access to any car accessible to other passengers boarding from the same platform. “Level boarding” means that there is coordination between the platform height and the vehicle floor. However, a number of engineering and operational conditions preclude achieving and maintaining the desired ADA gaps between rail cars and platforms at locations where level boarding exists and where freight and heavy passenger equipment share track. Light and rapid rail can and often do meet the ADA gap requirements.

Why Passenger Car/Platform Gap Cannot Conform to Existing ADA Regulations

The Department of Transportation has a proposed rule to update its ADA regulations for requirements for railroad platforms, Docket Number OST-2006-23985. The docket is closed to comments at the time of this report; however the final rule has not yet been published. The FRA released a document entitled "Factors Associated with Railroad Passenger Car Clearances to High Platforms for Intercity and Commuter Rail Systems." (FRA Factors Paper) dated March 7, 2006), (*See* Appendix B). The FRA Factors Paper concludes that the current ADA gap requirements cannot be met due to a number of factors. A paper presented at the 2003 Annual Meeting of the Transportation Research Board examined issues related to access for mobility impaired passengers and reached the same conclusion regarding high level platforms. (Resolving Conflict Between Mobility-Impaired Passenger Requirements and Freight Service in Mixed High and Low-Platform U.S. Railroad Lines, Transportation Research Record 1848, p.70, Edward K. Morlok, November 2002).

Routine train operations cause ongoing variation of vehicle to platform gaps, both horizontally and vertically. The FRA Factors Paper contains two tables, reproduced below as Tables 1 and 2, that show the variables associated with routine wear, general physics associated with train movement and accepted engineering parameters. These factors do not negate the existing regulations calling for level boarding or the Department's level-boarding guidance; rather they are factors that exist and require great attention in terms of detection, maintenance and prevention. In the event that all variables stack up, the variance is significant; up to 8 ¾ inches horizontally and 5 ½ inches vertically. This only provides for basic forces and does not account for additional variation due to track class, curvature, super-elevation and the different suspension designs between freight and passenger equipment, all of which can introduce even greater variation.

Table 1. Sources of Horizontal Range of Variation.

Source	Variation
Track Gauge (FRA Class 4 Regs.)	1 ½ inches
Flange Wear	¾ inch
Wheel Axle Mounting	3/8 inch
Misc. Truck Suspension, Center Plate, etc., wear	½ inch
Platform Construction Tolerance	¼ inch
Track Alignment (FRA Class Four Regulations)	3 inches
SUBTOTAL	6 3/8 inches
Passenger Car 7.3° Roll at 48" ATR	6 1/8 inches
TOTAL	12 ½ inches
Passenger Car 7.3° Roll at 18" ATR	2 3/8 inches
TOTAL	8 ¾ inches

Source: Factors Associated with Railroad Passenger Car Clearances to High Platforms for Intercity and Commuter Rail Systems, FRA, 2006.

Table 2. Sources of Vertical Range of Variation.

Source	Variation
Multiple Wear, Wheels	2 ½ inches
Spring set, Center Plate wear, air, springs*, etc.	½ inch
Platform Construction Tolerance	½ inch
Vertical Track Profile (FRA Class 4 Regs.)	2 inches
TOTAL	5 ½ inches

*Does not include deflated air springs

Source: Factors Associated with Railroad Passenger Car Clearances to High Platforms for Intercity and Commuter Rail Systems, FRA, 2006.

Passenger Cars Differ from Freight Cars

The dimensions, suspension and placement of trucks under rail cars have a direct impact on the gap. Freight cars are fairly standardized and fall into well-defined categories. The American Association of Railroads (AAR) maintains a series of diagrams illustrating railcar dimensions in detail, referred to as "Plates." There are a variety of sizes designated as "Standard," Plates B through H. Plate C is probably the most frequently encountered dimensionally, as it describes, "Unrestricted [movement and inter-changeability] except on certain [restricted] roads…." The restriction includes a maximum weight of 265,750 pounds. Freight cars generally have a stiff suspension when compared with passenger cars.

On average, passenger cars are 8 inches narrower (10'0" versus 10'8") than freight cars. This is necessary to allow the passenger cars to navigate turns with the length of the car within a desirable distance of the track centerline. Passenger comfort parameters dictate that rail passenger equipment must be equipped with a relatively soft suspension. According to the Factors Associated with Railroad Passenger Car Clearances, this can result in a roll angle of nearly 8 degrees, which will cause a passenger car to move sideways 6 inches or more at 48 inches above top of rail (ATR). Shorter, wider freight cars require greater offset of the platform from the centerline in order to clear a station than passenger cars.

Variability in Floor Heights

Level boarding is not possible with all vehicle types. Although there are some generalities that can be made regarding platform heights in the East-West divide, the same cannot be said for the varieties of rail vehicles that exhibit variance in threshold heights and vertical gaps. Passenger cars are in service in the United States with floor heights of 15, 24, 25, 44 and 48 inches ATR. Amtrak's Superliner equipment at 15" ATR is the general specification to meet west of the Mississippi while 48" ATR is the common floor height found in the Northeast. Safety concerns dictate that passengers should never have to step down into a passenger car, so floor heights must be at or above platform heights for safe operations.

Passenger-Only Systems

Passenger-only systems may be built to tighter tolerances, thus reducing the vertical and horizontal gaps. However, even with passenger-only systems, there is a likelihood of through-train movements without stopping at a given station. In such cases sway remains an impediment to narrowing the platform to vehicle gap to the degree called for in the existing ADA regulations.

Impact of Curvature

Track curvature has an extreme impact on platform clearances. Stations located on a curve require more clearance between the rail car and the platform edge than stations on tangent (straight) track because stations on curved track must compensate for car overhang on the ends. The width of the gap depends on the sharpness of the curve, the length of the rail car, the truck spacing, location of doors relative to the trucks, and whether the platform is on the inside or outside of the curve. Depending on the dimensions of the car and location of the trucks (wheel assemblies) on the car, some doors might be closer to the platform while vehicle to platform gaps elsewhere in the same car or train might be much wider. In the case of the Syosset Station on the Port Jefferson Branch of the Long Island Railroad, illustrated in Photo 1, a much wider gap than usual is the result, ranging from 10" to 15".

Photo 1. Syosset Station, LIRR Port Jefferson Branch (LIRR).

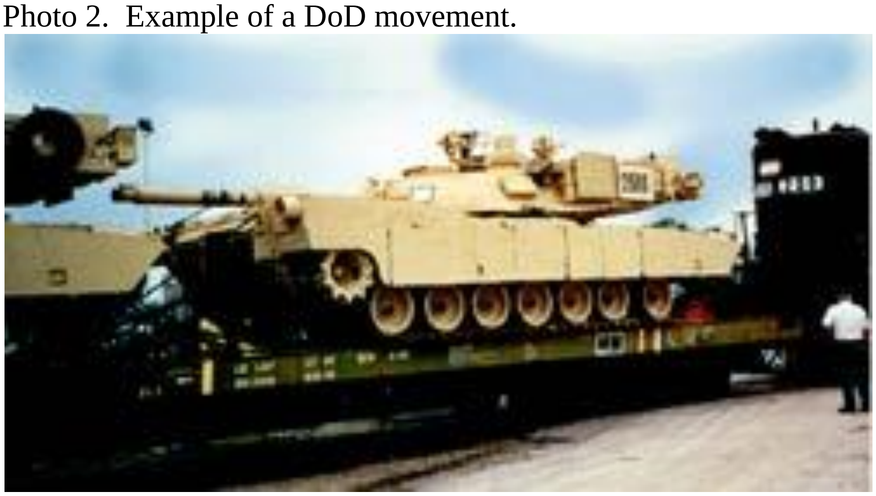
Stations should be located on tangent track and not curves whenever possible. However, in the case of certain right of way alignments, especially older ones, correcting this problem would be very difficult because of dense urbanization or topography around the station. In the larger established railroads in the Northeast where ridership is very high, there are short time intervals between trains and the infrastructure is so tightly woven into the urban fabric, it is likely infeasible to change platform locations. This is one of the reasons the original ADA Accessibility Guidelines for Buildings and Facilities (ADAAG) included language pertaining to the structural or operational infeasibility of meeting the gap requirements.

Over Dimensional (OD) Loads

Civilian freight occasionally involves movement of over-sized loads in terms of weight and dimension, requiring greater offset of platforms from the track centerline, ultimately resulting in wider platform gaps. The Railway Industrial Clearance Association (RICA) works closely with the American Railway Engineering Maintenance of Way Association's (AREMA) Committee 28—Clearances, to ensure that these large movements can be accommodated. Carrying OD loads is one reason that track-owning freight railroads insist that platforms be limited to 8" ATR. FRA staff have determined that platforms located at 15" to 17" ATR do not interfere with any existing OD equipment.

The Department of Defense (DoD) could be required to deploy heavy and/or OD cargo (such as tanks) on short notice by rail. The Strategic Rail Corridor Network (STRACNET) coordinates line designations and agreements with the civil sector, in conjunction with Railroads for National Defense (RND). RND, in turn, works in conjunction with FRA to ensure military clearances are always possible on the designated routes. FRA has defined a core system known as "Principle Rail Lines" that have Amtrak service, are defense essential and carry annual freight volume of 20 million gross tons per mile (MGTM/M). The State Departments of Transportation, American Association of Railroads (AAR), Surface Transportation Board (STB), AREMA, Railway Industrial Clearance Association, FRA and railroad companies work to ensure that military clearances are maintained.

Photo 2. Example of a DoD movement.



Except for very special movements that need to be vetted in advance, the STRACNET specifications are similar to the AAR freight plates. Care must be taken as the OD loads may overhang the edge of the waiting area of low level platforms. Photo 2 is an example of an OD DoD movement.

INTERVIEW OF REPRESENTATIVE PASSENGER OPERATORS

As of November 2009, there were 27 passenger railroads operating in the United States. (*See* Appendix C). In order to collect more detailed information for this report about the current passenger railroad platform environment nationwide and discover potential best practice gap mitigation methods, the Volpe conducted a survey of a representative sample consisting of nine passenger railroads and Amtrak. The representative sample is listed in Table 4. The first step in Volpe's survey was to delineate operations geographically using the Mississippi River as the dividing line between East and West. This is because platform height conventions (with the exception of Chicago's Metra Electric District), are markedly different, with 48" ATR platforms in the Northeast versus 8" ATR in the West.

Categories of Platform Heights – the East/West Conceptual Divide

- 8" ATR refers to low-level platforms. Some systems like the Diesel Districts in Chicago are entirely 8" ATR throughout. Eight inch ATR is also found at some platforms in the West that possess 8" ATR for the entire station length, except that the platform is equipped with 25" ATR mini-high platforms or rely on platform located lifts for boarding passengers who use wheelchairs or otherwise need level boarding.

- 45" to 50" ATR inch full length platform height is found in older systems in the Northeast and on Chicago Metra's Electric District.

- Mixed Configurations. Some railroad stations have a mixture of platform heights; combining 45-50" ATR, or 45-50" ATR mini-high platforms, at a station that is otherwise configured at 8" ATR. For instance, full length high platforms are used in eastern terminals such as Boston, Philadelphia, New York, Baltimore, and Washington DC. However, outlying stations on the same lines may be configured at 8" ATR. The vehicles that operate on these lines are equipped with traps and floor plates in end vestibules that allow for level boarding at the high platform. Boarding at outlying, less used stations employ car-borne or platform wheelchair lifts. Some stations have mini-platforms installed at 20' or more length to provide partial level boarding with the assistance of bridge plates.

Table 3 is a summary of platform heights above the rail and the corresponding method of access for passengers in wheelchairs or who otherwise require level boarding.

Table 3. Railway Platform Categories.

Category	**Access Method**
8" ATR	Mini-High Platforms/Bridge Plate Bridge Plate Lift on Platform Lift on-board Car
15" ATR, Level Boarding	Bridge Plates
25 to 44" ATR, Level Boarding	Bridge Plates
45 to 50" ATR, Level Boarding	Bridge Plates

After applying the East/West delineation, the systems listed in Table 4 were selected according to climate and the other variables discussed above.

Table 4. Representative RRs for This Study: East/West Coast, North/South, Old/New

Operator	Name	Status	Climate
WEST			
CALTRAIN (San Francisco)	Peninsula Corridor Joint Powers Board	New	Temperate
Chicago Metra	N.E. IL Commuter Rail Corp	Established	Cold
Minneapolis/St. Paul	North Star Commuter Rail	New	Cold
Sea-Tac	Puget Sound RTA	New	Temperate
Utah Transit Authority	UTA Frontrunner	New	Cold
EAST			
Long Island RR, New York	LIRR	Established	Cold
Massachusetts Bay Transportation Authority	MBTA	Established	Cold
SE Pennsylvania TA	SEPTA	Established	Cold
South Florida RTA	TRI-RAIL/SFRTA	New	Warm

Volpe gathered preliminary information before interviews with passenger rail operators were conducted to learn about each system's stations, accessibility policies, degree of accessibility at stations, planned future extensions, operational policies, and other pertinent information.

Interview Instrument

A standard interview instrument was used. (*See* Appendix D). The questions gathered information about:

- Railroad characteristics, including the number of stations and data on platform configurations, such as platform heights and use of mini-high platforms.
- Accessibility measures used, including bridge plates, moveable platform edge, train-borne lifts, zoned stopping, station mounted lifts and other methods.
- Longer-term plans including new construction, retrofitting current configuration, vehicles, and extensions.
- Open-ended questions to capture additional and unanticipated, but useful, information of the overall program and if the interviewee had any materials to use or cite.

A copy of the interview form can be found at Appendix E.

Key Findings

A summary of Volpe's findings are summarized in table form in Appendix D. The desired ADA gap has proved difficult to achieve in operation, thus operators frequently invoked the exceptions listed in the rule. The norm in the field today appears to be at least a 6" or 7" gap, even with such aids as vehicle mounted platform extenders or sacrificial platform mounted extenders.

Sacrificial extenders are generally wood or composite strips attached to the edge of the platform that will compress or wear away if moving equipment comes into contact.

As the Hazard Analysis Approach described in the Gap Safety Report, there is no one-size-fits-all approach to mitigating the gap. For instance, due to the limited time between trains on the LIRR, platform mounted gap fillers were viewed as unadvisable due to the potential cascading effects that could be produced by a system failure, which could include delays and negatively impacting safety and operations. This also applies to platform extenders that cannot be readily be manually retracted in the case of mechanical failure. Based on interviews, passenger railroads prefer car-borne systems with manual backup capabilities to retract over platform-mounted ones because there is less chance of interrupting operations, signalization and greater likelihood of maintaining schedules, even in the event of failure.

Interviewees indicated that in negotiating operating rights with private freight railroads, there was a concern expressed by the freight operators that there should be no physical interference with OD loads. Some interviewees remarked, however, that freight railroads derive welcome benefits from new passenger rail starts, especially in improved track and grade crossings using public funds. Passenger operators can leverage these benefits to press for ADA compliance.

Passenger operators report that utilizing existing station or on-board personnel to call attention to and provide assistance with negotiating unusually wide gaps appears to be an effective approach. In many cases assistance to riders is a duty that can be easily added to an employee's other core duties without much alteration of contracts or collective bargaining agreements.

There are operational innovations and best practices occurring in the field, such as locating two adjacent vestibules to stop at the same mini-platform. Locating two adjacent vestibules at the same stop doubles the boarding capacity for passengers with mobility impairments and provides access to two coaches rather than just one. This in turn allows faster boarding overall, thereby reducing dwell times. The new Boston commuter rail mini-high platforms are built 40' in length rather than the more commonly reported 20' length. Since persons with disabilities should have access to all cars accessible to others without disabilities, double and triple stopping of the train may still be necessary as cars fill up or if cars dedicated to a specific purpose are in the consist (such as wi-fi and quiet cars). This is a significant shortcoming when relying on mini-highs to access accessibility.

COMMENTS FROM DISABILITY RIGHTS ADVOCATES AND OTHER STAKEHOLDERS

The Department of Transportation published a Notice of Proposed Rulemaking in early 2006 seeking comments on its proposal to amend its ADA and Section 504 regulations to, among other items, update requirements concerning rail station platforms. (Notice of Proposed Rulemaking, 71 F.R. 9761, Docket Number OST-2006-23985 February 27, 2006). The Department strongly believes that, in choosing accessibility solutions, it is important that service be provided "in the most integrated setting that is reasonably achievable." (*see* 49 CFR 27.7(b)(2)). The implication of this principle in the rail station context is that the accessibility solution that provides service in the most integrated setting should be chosen.

Over 400 comments were docketed; many from organizations serving constituencies that include persons with disabilities. Organizations such as the National Disability Rights Network, AARP and Equip for Equality, as well as many others, provided comments. A review of these comments was conducted for purposes of this study, and the overwhelming position of organizations representing the disabled community is a call for service in the most integrated setting with a preference for full length level boarding, affording access to all cars available for boarding.

POTENTIAL MITIGATION MEASURES

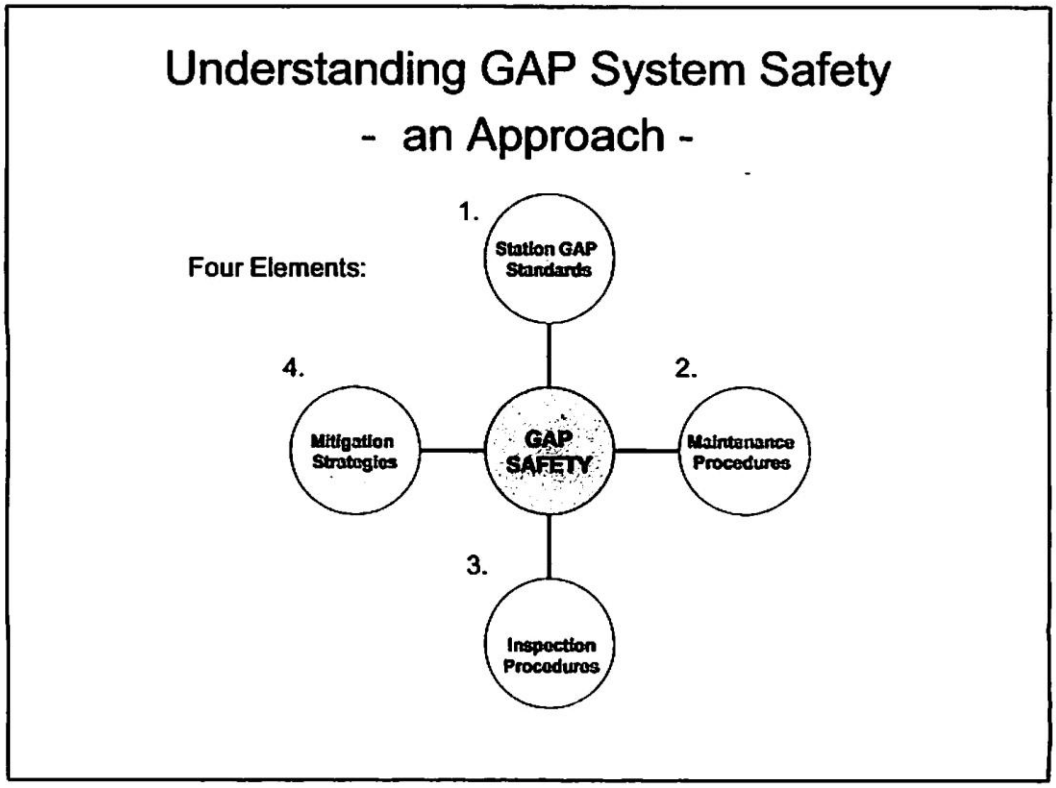
All Hazards Systems Approach to Any Gap Mitigation Measure

The all-system hazard approach to gap mitigation is outlined in the FRA's Gap Safety Report as a method to approach the problem. The all-system hazards approach applies a risk management model to evaluating and developing risk mitigation strategies to obtain safe and compliant risk levels. This approach is universally applicable to any sort of modification, methodology or enhancement considered; and it is an underlying guiding concept that runs throughout FRA's Gap Safety Report. Figure 2 illustrates the application of this method to gap safety.

No matter what approach, technology or process is considered, the hazard analysis approach is applicable to ensure optimized results and safety. It is also useful in comparing approaches in order to obtain optimal safety at an optimal cost.

The NJ Transit Rail study suggested three main components to a gap injury mitigation strategy: modifications to the platform and cars, providing information to passengers and training for train crews and platform personnel. For the platform and train, their suggestions include using reflective markings at train door thresholds and at locations of the platform with large gaps, use of color to bring attention to existing train hand rails and reduction of large gaps where feasible given train clearance requirements. For passengers, the study calls for additional platform personnel during peak periods and at stations with high gap injury rates and use of pre-recorded messages to "Watch the Gap." Suggested training providing data on the railroad's gap injury rates with a goal for reducing these injuries and alerting train crews to the passenger types and stations where assistance may be needed. (Customer Behavior Relative to Gap between Platform and Train, Final Report, Janice R. Daniel and Naomi G. Rotter, New Jersey Institute of Technology, July 2009).

Figure 2. The four elements of the all hazards approach to gap safety.

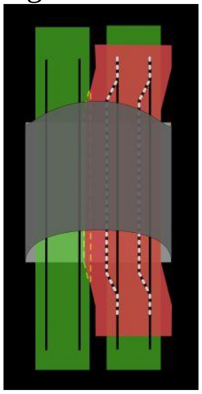


Relocate Track to Minimize Gap

Gauntlet Tracks

Gauntlet track is an arrangement in which railway tracks run parallel on a single track bed and are interlaced such that only one pair of rails may be used at a time. This method shifts the OD load away from the station far enough for safe clearance. Gauntlet tracks are an effective method for accommodating wide load movements while allowing for an optimal gap between passenger car and platform. When wide freight movements are frequent, once a day or more, a gauntlet track with interlocking signalization is generally advisable. When wide load situations are less frequent, monthly for example, then a gauntlet track with a hand thrown signal and switch could be appropriate.

Figure 3. Gauntlet Track, Dotted Line



Bypass Tracks

Another alternative is a separate bypass track for freight and passenger trains. While not a direct method of reducing gaps, this approach provides the opportunity to remove freight traffic from passenger traffic in the vicinity of the station so they do not interfere with each others' operations.

Photo 3. Bypass Track on Right.

Courtesy of Bernard Kennedy, Volpe Center.

Relocate Platform from Curve to Tangent

Because of the significantly larger gaps encountered when platforms are located on curves, one of the most effective actions that can be taken is to move the platform from a curve to a tangent. However, this exception typically occurs at existing platforms in difficult terrain or heavily urbanized areas where older configurations were built long before accessibility was a consideration and relocation of the platform is not readily achievable. In these locations other mitigating techniques must be employed.

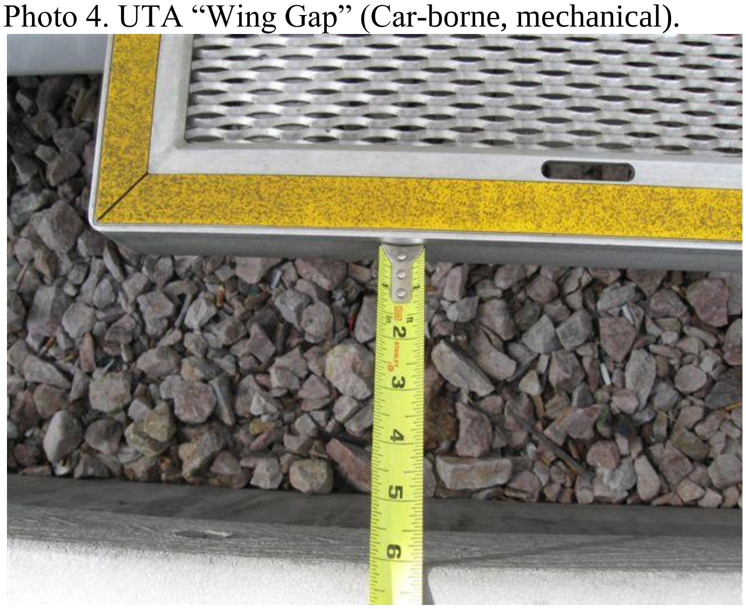
Mix of Platforms

Heavy rail commuter lines serving Philadelphia, Boston and Washington DC possess a mixture of equipment and platforms. Locations include full length level boarding, 8" ATR with platform or car-borne wheelchair lifts and mini high platforms of the 48"-50" inch convention. Where full length high platform boarding in used, consistently located bridge plate deployment areas, platform markings and signage as well as proper ADA placarded vehicles ensure that passengers know the location of boarding points where bridge plates are deployed. However, this method of funneling passengers with mobility impairments to specific cars does not meet the ADA requirement of access to all coaches accessible to others.

Car-borne Gap Extenders

Mechanical car-borne gap extenders are used with some equipment and considered reliable as long as a manual override feature is included. Note that in Photo 4, the car-borne gap filler still leaves a significant space and will require a bridge plate for passengers using assistive devices for mobility. However, by partially closing the gap it improves safety for all passengers.

Photo 4. UTA "Wing Gap" (Car-borne, mechanical).



Fixed car-borne extenders are installed below the threshold to extend the train's width at platform level thereby lessening the gap. At this time, the Long Island Rail Road is installing such devices under its M7 passenger cars.

Retractable Platform Extenders

Platform mounted movable extenders are used to achieve a smaller gap and are currently available in both mechanically and manually operated configurations. Photo 5 illustrates a moveable extender that can be retracted for OD loads while optimizing the gap for day-to-day passenger operations. Such extenders are generally used in corridors where there are higher mixtures of passenger and freight movements on the same track. They require considerable maintenance, especially in northern climates. A failure to operate could have ramifications on safety, clearances and schedules that could impact the entire operation.

Photo 5. Platform Mounted Mechanical Extender.

Source: www.nycsubway.org

In the case of railroads that rarely make wide freight movements, special retractable extenders can be attached to the platform. Personnel on the OD movement can manually push the flaps up to allow clearance and then return them to their normal down position afterwards. This option is labor intensive, but may be a more feasible option in accommodating infrequent OD cargo. Photo 6 shows a manually deployed moveable ledge mounted on the station platform. The train depicted is a passenger train, but with the flaps lifted, extra width is available for OD loads. This type of deployment is suited for rights of way when only infrequent OD freight movements require greater clearance.

Photo 6. Manually-Lifted Station-Mounted Movable Ledge.

Courtesy of Bernard Kennedy, Volpe Center

Full Length High Platforms

Where there is exceptionally heavy rail traffic, as is the case in the Northwest Corridor, Metro North and the Long Island Railroad, extensive full-length platform stations exist throughout the systems. These full length platforms benefit from the efficiencies in passenger boarding and alighting resulting in optimized dwell times and passenger operations. There is a confluence of operating efficiencies and ADA compliance at these locations. However, while these platforms meet the full length level boarding requirements of the ADA, the required gaps in the ADA regulations are still not achieved.

Platform Edge Modifications

Wooden platform extenders are sometimes employed to mitigate gaps by extending platforms horizontally. While easy to install and adjust, wood has the potential to splinter and become airborne when impacted, causing significant safety hazards for passengers and railroad workers. Sacrificial edges using polymer or fiber reinforced plastic polymer edge boards have been installed in some locations. The LIRR has extended station platform width, when possible, in 1/8 to 1/2 inch increments utilizing polymer platform edge strips. They are installed and shaved to fit where needed. The polymer material is considered safer than wood because it does not splinter and break when impacted. Photos 7, 8 and 9 illustrate platform extenders in use on the LIRR.

Photo 7. Example of Sacrificial Platform Edge and Retrofitted On-Borne Gap Extender (LIRR)

Photo 8. Extending Platform with Wood (LIRR)

Photo 9. Example of Wood Platform Extender (LIRR)

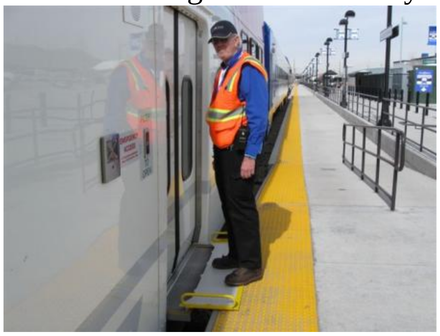
Bridge Plates

Bridge plates are used to bridge vehicle-platform gaps and are manually deployed by station or train crew. They are found on platforms or in stations, usually under lock and key or may be carried in the passenger car.

- Station Bound. Special or custom bridge plates are sometimes required due to the extra wide gaps caused by the platform being located on a curve. Under these circumstances the bridge plate is usually stored on the platform under lock and key. There are inherent problems with storing boarding equipment in remote, locked locations due to missing keys, insect infestation, weather and vandalism.

- Car-Borne. Based on interviews with railroad operators, manually deployed bridge plates are the most commonly used mitigation measure. They are generally stored adjacent to the threshold in the interior of the car in a special recessed storage niche. The conductor or other on board staff can readily lift and deploy the bridge plate. Photo 10 illustrates a manually deployed bridge plate. Note that the bridge plate is being used in conjunction with the fixed car-borne wing extender to bridge the gap.

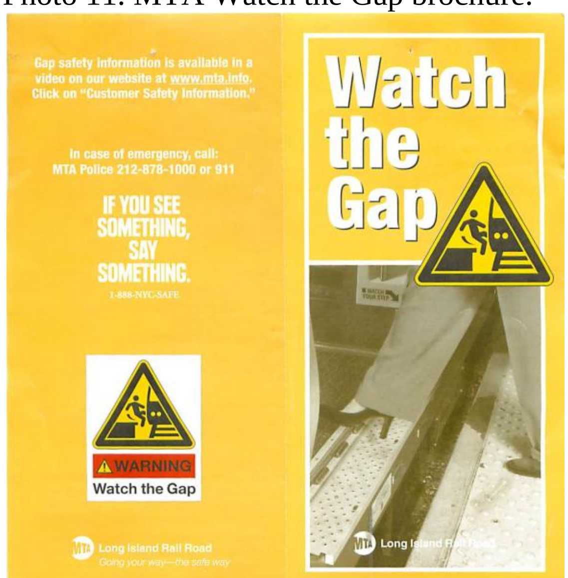
Photo 10. Bridge Plate Manually Deployed on Sound Transit



Enhanced Information Strategies

The NJ Transit Rail study showed positive results in gap related injuries that were likely influenced by information and awareness strategies. The key to a successful public relations campaign is through common trademarks, formats, use of international symbols and the coordination of all of the elements, including schedule cards, station descriptions, websites and the physical attributes at the station including platform markings, signs, shelter, ticketing access, and consistency of location to support the message. Photo 11 is an example of part of MTA's "Watch the Gap" program. To better inform all passengers and operators, the FRA Web Site could be augmented with information, links, contacts, webinars, discussion groups, and Web 2.0 social networks addressed to accessibility issues could be developed and maintained by the FRA Office of Civil Rights to keep passengers with disabilities and the operators who serve them informed.

Photo 11. MTA Watch the Gap brochure.



RELATIVE COSTS OF MITIGATION STRATEGIES

The following chart is a recap of the mitigation strategies discussed. The chart includes relative cost rankings. The cost rankings are presented to illustrate the range of costs that different mitigation strategies may involve. Life cycle costs are estimated, so while a technique may be more expensive at the outset, it might be less expensive in the long run and vice versa. Costs can be operational such as using train staff to deploy an assistive aid or capital intensive, such as the cost of installation and maintenance of a movable platform. Some mitigation strategies are a composite of the two. Effectiveness is ranked based on utility and satisfaction. Rankings are based on 10 for the highest, 1 for the lowest.

Table 8, Relative Cost Matrix

Mitigation Strategy	Cost Ranking	Life Cycle Cost	Effectiveness	Comments
Gauntlet track	10	8	9	
Bypass track	10	8	9	
Platform extenders	8	5	7	
Platform edge modifications	5	4	7	
Car borne bridge plates	1	1	8	
Platform bridge plates	1	1	4	Problems with keys.
Station aids	2	1	4	
Internet outreach	1	1	3	

ACCESS FOR PERSONS WITH MOBILITY IMPAIRMENTS AT LOCATIONS WITHOUT FULL-LENGTH LEVEL BOARDING

Many platforms in service in the United States do not have level boarding. At these locations the platform-vehicle gap is not the primary issue for mobility impaired passengers; rather, access to the train becomes the primary issue. Several methods are currently employed to facilitate access.

Wheelchair Lifts

Where platforms are not built for full length level boarding or equipped with a mini-high platform, wayside or car-borne wheelchair lifts can be used. Photo 12 illustrates a manually operated lift similar to the ones commonly used in the United States. The wayside lifts are generally locked in their own enclosure. The use of wayside lifts have similar drawbacks as brigdge plates or ramps kept at stations. Bad weather can affect the mechanisms or prevent access to the lift, keys can be lost, or theft or vandalism can occur. In addition, it can be very time consuming to find, move the lift to the desired railcar door, deploy and lift a passenger into the railcar. This results in longer dwell times and the funnelling of passengers with mobility impairments to the cars closest to the wayside lift's enclosure.

Car-borne lifts located on each car of a consist are operated by the train crew and have an override mechanism in the event of mechanical failure. Car-borne lifts do not have the drawbacks of lifts kept at stations. Moreover, they can be deployed more quickly from every car of the railcar and do not have the effect of forcing mobility impaired passengers to use the rail car door closest to the lift. Photo 13 illustrates a typical center door commuter car equipped with a lift.

Photo 12. Mechanical Wayside Lift

Caltrain

Photo 13. Metra Bi-Level Diesel District Center Entrance; Includes Car-Borne Wheelchair Lifts Manual Bypass Mechanism is Located to the Left of the Doorway.

15” Mini-High Platforms

Many stations use mini-high platforms as a means of access for passengers with disabilities. A major safety issue of concern in the design of mini-high station platforms is the issue of entrapment. Photo 14 shows a bridge plate in use at a mini-high platform on the Minneapolis Road Runner. Photo 15 shows an area to the left of the ramp that could result in a user being trapped between the ramp and a passing train. In any situation using a combination of high and low platforms, rail operators should not employ a solution that has the effect of channeling passengers into a narrow space between the face of the higher-level platform and the edge of the lower platform. Such a design is inherently unsafe. In fact, any obstructions on a platform (stairwells, elevator shafts, seats, etc.) should be set back at least 6 feet from the platform edge.

Photo 14. Manual Bridge Plate Deployed at a Mini-High

Photo 15. Tri-Rail Mini-High.

CONCLUSION

While there are a number of gap mitigation techniques available and in use in the United States, there is room for improvement in gap safety awareness and opportunities for an improved system-wide safety approach. With reference to disabled access, a number of real world conditions preclude achieving and maintaining the desired ADA gaps between rail cars and platforms at locations where level boarding exists. Disabled access to the intercity rail system is improving but is still far short of the vision contained in the ADA.

Appendix A

FRA Approach to Managing Gap Safety, December 2007

Federal Railroad Administration
Office of Safety

FRA Approach to
Managing Gap Safety

December 7, 2007

Revision 03

FRA Approach to Managing Gap Safety

1. Introduction:

The Federal Railroad Administration (FRA) is responsible for promoting the safety of the Nation's passenger and freight railroads. To address this responsibility, FRA develops programs that identify, monitor, and address railroad safety issues.

FRA is concerned about the risk of injury to passenger train users posed by the gap between railcars and high level station platforms. Although many gap accidents only result in minor injuries, they can initiate a chain of events that may lead to serious or fatal injuries. The FRA feels that an effective way to address the gap safety issue is for passenger train operators to develop a gap safety management program. The gap safety management program should:

- use engineering evaluation and analysis to establish gap standards for all high level stations, and
- apply mitigation strategies to further reduce the risk of gap accidents.

The passenger railroad gap safety management program should use hazard management techniques, such as hazard analysis, to identify appropriate hazard mitigation strategies. Hazard analysis is a process where hazards are identified and recorded and corresponding hazard mitigation strategies are identified, recorded and tracked to completion. The hazard mitigation strategies should be designed to eliminate, or control gap hazards and to lower the overall risk of injury to passengers. The hazard analysis and hazard mitigation process should recognize and include any existing strategies currently in place.

Hazard management is not a difficult process but it is designed to be both comprehensive and continuous. Passenger railroads must be prepared to develop and support a long term gap safety management program. A hazard management team made up of interdepartmental technical and safety experts from the railroad should be established to implement the gap safety management program. The hazard management team's primary role would be to identify the hazards and agree on the mitigation strategies. Hazard management is not a one time task but requires the passenger railroad go back and periodically reaffirm the gap safety management program. Review of the gap safety management program can be triggered by time, by a major event such as an accident, or by a change in the method of operations.

Some passenger railroads already have strong gap safety programs or appropriate hazard mitigation strategies in place. The gap hazard management program the FRA is suggesting is meant to enhance rather than replace the existing programs. The FRA gap hazard management program would compliment and formalize existing programs and document any existing mitigation strategies. The FRA gap safety management program can also confirm that all appropriate hazards have been identified and controlled or reveal hazards that were previously overlooked.

The gap, as discussed in this document, is defined as the horizontal space between the edge of the platform and the edge of the rail car door threshold plate, and the vertical difference from the top of the platform and the top of the rail car door threshold.

. **Figure 1** contains a diagram that illustrates the gap between the rail car and the platform.

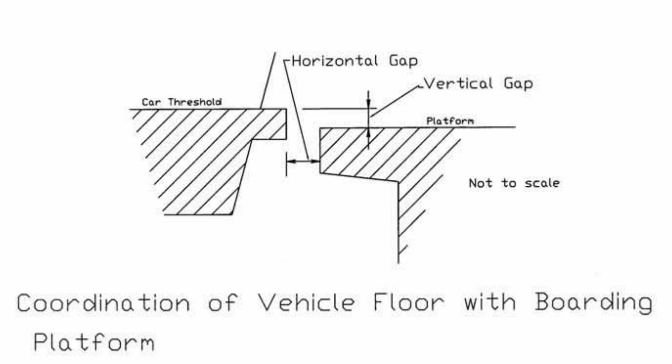


Figure 1. Horizontal and vertical gap between the railcar door threshold and the platform edge.

This document presents FRA's approach to managing gap safety. FRA considers the approach to be an effective method of managing safety hazards related to the gap at high level passenger platforms and a way to ensure minimum levels of safety for passengers.

The approach involves the following elements:

1. Station Gap Standards
2. Hazard Management
3. Maintenance Procedures
4. Inspection Procedures
5. Hazard Mitigation Strategies
6. Gap Safety Management Follow-up

Each step in the gap safety management process will be broken down and discussed in detail.

2. Station Gap Standards:

Passenger railroads should establish station gap standards for all high level platforms. The station gap standards should define the size of the gap between the door threshold and the platform by identifying critical dimensions that define the gap (such as the distance between the centerline of the track and the platform edge). These critical dimensions should include tolerances and be specified in the station gap standards. The standard gap that is determined at a particular station or stations is based on the geometries of the track, platform and the equipment that utilizes the station. Tolerances of the equipment, track and platforms will result in actual gap measurements which may vary from the standard gap.

Station gap standards may already exist in state regulations or the railroads own internal requirements. Some states, such as New York and Massachusetts, already have dimensional requirements for the location of high level platform edges with respect to the centerline of the track. Some of the state requirements were established to ensure proper clearance between railroad freight cars and the platform edges rather than maintain a safe gap for passenger boarding and alighting. In any case, passenger railroads should be aware of any state requirements and use those requirements as the starting point for establishing station gap standards.

Once the basic gap dimension requirements are established, passenger railroads should look for opportunities to reduce the gap. In some cases, rail traffic mix, method of operation, station configuration, or other factors will not support reducing the gap beyond the current requirements. If an engineering evaluation supports this conclusion, then maintaining the basic gap dimension is the appropriate action. However, larger gaps pose a greater risk for a passenger falling through the gap and may require specific mitigation strategies to control risk. Therefore, stations with larger gaps will likely need more hazard mitigations than stations with smaller gaps.

To determine if the gap dimension can be reduced, the railroad should review the current gap dimension requirements with respect to the operational environment. For example, the actual gap dimension may vary depending on the configuration of the station. Stations located on a curve will require more clearance between the rail car and the platform edge than stations on tangent track. Stations on curved track must compensate for car overhang on the ends.

As shown in **Figure 2**, the width of the gap depends on the sharpness of the curve, the length of the rail car, the truck spacing, the location of the doors relative to the trucks, and whether the platform is located on the inside or the outside of the curve.

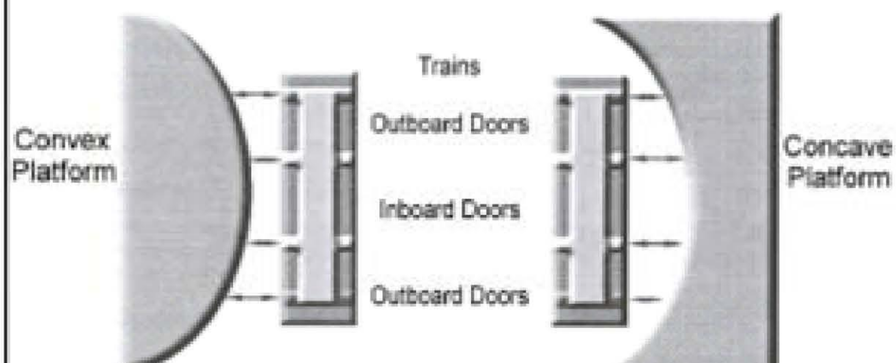


Figure 2

Figure 2. Illustration showing the relationship of the rail car doors and the platform edge on curved track.

Gap dimensions may also vary due to the type of rolling stock that uses the station. For example, some passenger railroads operate different widths of passenger equipment depending on the type and generation of the passenger car. Other railroads may operate identical passenger equipment but must accommodate commuter passenger equipment, long distance passenger equipment, freight equipment, or high and wide over dimension traffic at some or all of their stations. In other cases, stations or end terminals may be exclusively used by similar equipment and be able to tolerate a narrower gap. Still other stations may have to accommodate a subset of the types of trains described above.

Train speed is also a consideration when developing gap standards. Some passenger operations have rail traffic that passes high level platforms without stopping. In this situation, the dynamic characteristics of the passing trains must be considered and enough clearance provided between the train and the platform edge to prevent railroad equipment from striking the platform edge.

It is clear from this discussion that different gap standards may be appropriate for different stations and that gap dimensions maintained by the railroad may vary with the circumstances. A railroad with some tangent and some curved station platforms and a variety of equipment passing through stations will probably need more than one gap standard for its stations. In the extreme, each individual station may need to have its own gap standard due to the characteristics of the station and the type of traffic. Passenger railroads should consider all of the variations in operations that exist on their property as they develop station gap standards or attempt to further reduce the gap.

3. Hazard Management:

Once a passenger railroad has established gap standards for all of its high level stations, the hazard identification and hazard management process can begin. FRA suggests that the passenger railroad use a comprehensive hazard analysis as the core of the hazard management process. Passenger railroads should already have hazard analysis techniques identified as part of their system safety program plans. The techniques identified in the system safety program plan should be appropriate for conducting a hazard analysis on the gap safety issue. If the current hazard analysis techniques are not appropriate for analyzing the gap issue then the passenger railroad should develop a new hazard analysis approach.

Appendix A of this document contains guidelines for conducting a gap safety hazard analysis that can minimize risk to passengers. The hazard analysis guidelines are based on the United States Department of Defense 1993 document "System Safety Program Requirements," Mil-Std-882C and the hazard identification and resolution process described in APTA publication "Manual for the Development of System Safety Program Plans for Commuter Railroads." The APTA document and Mil-Std-882 are excellent methods for conducting hazard analyses in a disciplined, structured manner. A disciplined and structured approach is valuable because it allows hazards to be systematically identified, inventoried, analyzed, and addressed. The methodology ensures that all hazards and mitigation strategies are adequately reviewed. The process provides a permanent record of the hazard analysis and serves as a reference document to review and analyze future accidents or changes in system operations.

4. Maintenance Procedures:

Once gap standards are established and the gap is set within tolerances, maintenance procedures will be needed to service station platforms, track, and rolling stock because elements of these items can directly affect the gap. Comprehensive maintenance procedures are vital for keeping the gap within acceptable tolerances. Many of the maintenance procedures that affect gap safety may already be in place in the passenger railroad's maintenance plan.

For example, station maintenance can affect the gap and the overall risk to passengers boarding the train. Platform resurfacing and modifications should only be performed when their influence on the gap is understood. Extended edges also need to be maintained to preserve the established gap and ensure that firm footing is available at the edge of the platform. Damaged or broken edges should be repaired promptly and with adequate consideration for maintaining the correct gap.

Track maintenance is another area that can influence the gap. The relative position of the track with respect to a stationary platform edge essentially defines the gap. Track maintenance including track alignment, leveling, cross level and ballast cleaning may move the track laterally and horizontally and will directly affect the gap. Track class designations may also affect maintaining the gap because lower classes of track allow greater tolerances on vertical and horizontal alignment. A more extensive list of some of the elements that should be considered for managing the gap from a track and platform perspective appears in **Appendix B**.

Rolling stock maintenance involving the wheels, car suspension, or car leveling system can also influence the gap at a station platform. Worn wheels lower the car floor and can continuously impact the vertical gap over the life of the wheel set. Settling and wear in truck suspension components can affect the horizontal and the vertical gap. Worn truck components can allow excessive side to side clearance that can either close or open the horizontal gap depending on the vehicle dynamics as the rail car rolls to a stop at a station. Rail car pneumatic leveling systems that use air springs can also affect the vertical gap if they are not maintained or properly adjusted. Other rolling stock components that may potentially affect the gap are listed in **Appendix C**.

In a perfect world with unlimited resources and a perfect maintenance program, the influence of maintenance procedures on the gap would probably not be a consideration. However, passenger railroads sometimes have to make decisions on deferring or delaying maintenance on track and equipment that is in need of repair. The effect of deferred maintenance on gap safety should be considered in the discussion.

Finally, passenger railroads should have specific maintenance procedures in place to respond to gaps that are out of tolerance. When the gap is out of tolerance, there should be standard procedures used to systematically review the platform, track, and rolling stock to determine the cause and correct the out of tolerance condition.

5. Inspection Procedures:

Inspection procedures can provide the railroad with comprehensive information necessary to manage gap safety. Once a railroad establishes a gap standard and uses the standard to adjust station platform gaps, periodic inspection of the gap is necessary to monitor and maintain the gap within tolerances. Periodic inspections should be conducted often enough to detect any significant movement of the track with respect to the platform and confirm that the rolling stock is working satisfactorily within the system. The passenger railroads should determine appropriate inspection periods and procedures based on their gap standards and tolerances.

The inspection program may yield valuable information on how the gap varies from day to day - train to train – or car to car. The railroad should establish limits for the gap that trigger appropriate actions to determine the cause and to correct the gap. Correcting the gap may require maintenance on the track, the rolling stock, the station platform or a combination thereof.

The passenger railroad's inspection procedures may require measuring the distance between the centerline of the track and the platform edge or measuring the actual gap between the door threshold and the platform edge. Measuring the actual gap, however, only indicates that the gap is within or outside tolerances. Measuring the actual gap does not indicate the contribution of the station platform, track, or rail car to the overall gap dimension. The contribution of other components can only be determined through additional inspections of the platform, track, and rail cars that make up the system. Procedures should be established to decide what action to take if the actual gap dimension is out of tolerance.

In support of hazard management, it is important that the gap be inspected periodically based on a specific time interval – not just after an accident or incident.

6. Hazard Mitigation Strategies:

After the passenger railroad has established gap standards and reviewed or modified the maintenance and inspection criteria to maintain the gap, the railroad is still left with a hazard. The gap dimension and tolerances may be well established and understood but the remaining gap still poses a risk to passengers.

System safety and hazard management techniques are used to identify additional steps necessary to further reduce the risk to passengers. FRA believes that using a hazard analysis approach to identify and mitigate hazards as described in Section 3 of this document is an appropriate way to proceed. Using a hazard analysis approach documents the hazard and – just as important – documents the hazard mitigation. Only when you have a complete hazard list with corresponding hazard mitigation strategies are you actually performing hazard management.

Larger gaps pose a greater risk for a passenger falling through the gap and may require specific mitigation strategies. If a railroad decides to follow the basic gap dimension requirements specified by the state or other regulatory entities, then the railroad should be prepared to identify and institute additional mitigation strategies to reduce the risks to all passengers – including those with disabilities, the aged, or the very young. Some suggestions of items to be considered when identifying mitigation strategies for high level platforms appear in **Appendix D**. Several types of hazard mitigation strategies are available to manage gap hazards. These include:

- Hardware and Technology
- Policies and Procedures
- Employee Training
- Passenger Outreach
- Passenger Behavior

6.1 Hardware and Technology:

Hardware and technology solutions can offer effective hazard mitigation and should be carefully considered. Engineered systems are especially useful because many are not dependent on the human being to follow a procedure or take an action. There are many examples of hardware and technology used in the passenger railroad industry used to reduce the gap or to assist passengers to safely board or alight from trains. The passenger railroads should carefully evaluate any proposed technology or hardware solutions because they may create other safety hazards.

Moveable platforms have been applied to some stations and are designed to close the gap after the train arrives. The moveable platform is especially appropriate for reducing the gap at stations located on curved track. **Figure 3** shows an application of an extendable platform on New York City Transit. Pictures of platform edge extenders used at a station on a curved track are shown in **Figure 4**. Other stations use platforms with fold up edges that provide comfortable boarding for commuter trains but can be folded out of the way to allow high and wide freight or military trains to pass.

- The NYCT has three locations where gaps are significant, Times Square Station, 14th Street Station and South Ferry (See Figures 21 and 22). Because these stations are located in enclosed environments where the elements (snow, ice, rain, etc.) have little if any effect, movable platforms that extend to the edge of the trains have been installed to minimize the gap.

Figures 21 and 22 - Gap fillers

Figure 3. Photograph of the extendable platform used on New York City Transit indoor platforms.

Figure 4. Moveable platform edge

Gauntlet tracks that provide increased clearance between the rolling stock and the platform edge are used at some stations to route freight trains and excess dimension equipment past station platforms. Passenger trains are routed on a second track located to maintain an appropriate gap for passenger boarding and alighting.

One manufacturer has developed a rubber platform edge with fingers that extend towards the door threshold to serve as a gap filler. The fingers provide fall through protection and also bend out of the way if struck by a passing trains. The configuration of the rubber platform edge is shown in **Figure 5**.

Figure 5. Extended rubber fingers on platform edge gap filler.

The resulting gap can also be mitigated by adding extended threshold plates to the passenger car. The threshold extender can close the gap to make boarding or alighting safer. A gap filler used on the Washington METRO is shown in **Figure 6**.

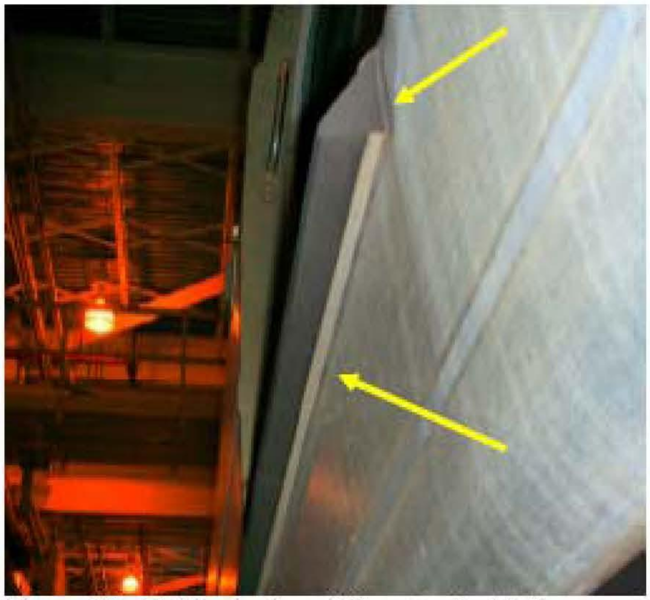


Figure 23 – Rubberized gap filler attached below threshold on WMATA car (as seen from below)

Figure 6. Rubberized gap filler attached below threshold on WMATA car (shown from below).

Some commuter railroads use lighting at edge of the platform and door threshold interface to accentuate the gap and warn passengers of the danger. Gap safety lighting can either be mounted under the platform or under the door threshold.

Another method to reduce the gap is to use power bridge plates that extend the door threshold towards the platform edge or bridge the gap completely. A power bridge plate or door threshold can be helpful to disabled passengers when boarding and alighting from the train.

Other hardware and technology solutions exist that can be effectively used to mitigate gap hazards.

6.2 Policies and Procedures:

A passenger railroad may need to develop new policies or procedures that serve as hazard mitigation strategies. Policies and procedures can be an important component of safe operation. The passenger railroad should use the hazard analysis to identify the specific types of policies and procedures that are needed. The hazard analysis may show that the railroad already has all the necessary policies and procedures in place. However, sometimes the analysis will indicate the need for new or modified policies and procedures to support the gap safety program.

For example, some railroads restrict the number of doors that can be opened on certain curved platforms. Restricting door openings to those with the smallest gap on a curved platform can mitigate some of the safety risk for passengers boarding or alighting from the train. This procedure serves as an important hazard mitigation strategy.

Other passenger railroads have special procedures to observe doors as they close or as the train leaves the platform. Door operations are not directly related to gap safety, door operations are certainly part of the station system, and observing the train during loading, unloading, and door closure can assist in detecting a gap accident and preventing a train from leaving a station with someone trapped in the gap or on the tracks.

At some stations or under some operating conditions, it may be necessary to post a station attendant on the station platform to monitor and assist passengers during boarding and alighting. Special policies and procedures that specify when and where a station attendant should be used may need to be developed as a hazard mitigation strategy. For example, platform crowding during special events may become an issue. Crowding on platforms may result in additional gap incidents – even on platforms with minimal, well controlled gaps. When excessive platform crowding is expected, platform monitors or other special processes or procedures may be appropriate.

6.3 Passenger Outreach:

A comprehensive passenger outreach program can serve as an effective method to enlist the help and cooperation of the passengers in gap safety. The program should utilize a variety of media to effectively present the information. The media may include:

- On Board Announcements
- Signage
- Posters
- Brochures
- Seat Drops
- Videos

Onboard announcements can be used to address gap safety. Amtrak and some other railroads operating in the northeast include "watch the gap" in the conductor's station announcements.

Signage instructing passengers to "watch the gap" in the area of the vestibule or on the station platform may also be appropriate. However, it is important not to provide so much signage in the vestibule area as to become ineffective or to detract from other important signage in the area.

Posters with gap safety themes can be mounted on advertising racks throughout the train. Gap safety (or general safety) brochures can be located in racks next to train timetables or incorporated in public timetables distributed to passengers. Additional information can be included on tickets or monthly passes.

On some railroads, seat drops may be appropriate. Seat drops are brochures, letters, or pamphlets left on every passenger seat at the beginning of service. Each passenger would have to pick up the material before sitting.

Videos are another important tool – especially on commuter railroads that have advertising or information monitors on their trains or platforms.

If a commuter railroad has access to celebrities, then a taped celebrity announcement may be helpful. The Las Vegas airport uses celebrity announcements to provide safety and security information to patrons. For example, Don Rickles instructs airport patrons to hold children's hands when using the escalator. A similar automatic celebrity announcement may be appropriate for some trains or station platforms.

Passenger outreach announcements and materials should be clear and concise but detailed enough to define the gap and the related safety issues. The message should be targeted at all passengers – both regular customers and one time users – so that everyone will fully understand the gap issue and act accordingly.

6.4 Employee Training:

New policies or procedures developed as gap safety hazard mitigation strategies should be addressed in training programs as necessary. The training should be focused on the particular groups that are responsible for carrying out the new policies and procedures such as:

- Train crews,
- Maintenance staff,
- Station personnel,
- Station supervision,
- Station security, and
- Railroad police

Training should also be developed for others who deal directly with gap issues.

The type of training that is provided will vary depending on the requirements for hazard mitigation. Trainmen and conductors may need training in such areas as:

- Look back procedures

- Monitoring door openings and closings
- Assisting special needs passengers on and off the train
- Platform monitoring

Track, car, and platform maintenance workers may require training in:

- Critical maintenance procedures that affect the gap
- Approved inspection procedures for monitoring the gap
- Quality control during and after maintenance procedures that affect the gap

Training is essential for establishing and maintaining employee involvement in mitigation strategies designed to minimize the risk posed by the gap.

6.5 Passenger Behavior:

Passenger behavior is often random and hard to control. Train crews are hard pressed to reliably predict what a passenger may do next. However, there are steps that can be taken to influence or respond to undesired passenger behavior – especially behavior that may lead to unsafe acts during boarding and alighting from trains.

To analyze gap hazards related to passenger behavior, the passenger railroad should first identify the situations or types of behavior present on the railroad that can lead to gap safety hazards. For example, the passenger railroad may be concerned with the following types of behavior:

- Disorderly Conduct or Disruptive/Unsafe Behavior
- Unmonitored children

Disorderly Conduct or Disruptive/Unsafe Behavior can lead to gap safety hazards – especially if taking place when the individuals are boarding or alighting from the train. Unmonitored children pose a risk to themselves and others when they run down the platform to board a train. Even a small gap can pose a hazard to an unsuspecting child that is not properly supervised.

The key to responding to these types of behavior is to have policies and procedures in place to address the issues as they occur. The responsibility for developing the policies and procedures belongs to the passenger railroads but the responsibility for addressing the behavior rests primarily with the on board crew. Passenger railroads should establish passenger behavior policies and insist that their crews enforce those policies. The railroads should determine if there are adequate existing policies in place to address the types of behavior that lead to gap safety issues. For example:

Does the railroad have policies that:

- Address issues of disorderly passengers or those displaying disruptive and/or unsafe behavior on the station platforms or trains including denying boarding or putting individuals off the train?
- Require train crews to address issues with unmonitored children on trains or on station platforms?

Passengers may need to be reminded of the responsibilities of the conductor and his right to address passenger behavior issues. For example, a commuter railroad could provide a flyer that states the conductor's authority and responsibility to remove disorderly passengers or those displaying disruptive and/or unsafe behavior from the train.

Passenger behavior issues are delicate issues but they must be addressed in a consistent and responsible manner. The railroad must provide their onboard crews with the tools that they need to control the situation. This includes the policy, appropriate training, and support when the policy is applied. If a passenger railroad uses new or existing policies as a hazard mitigation strategy, then the policies must be enforced. The passenger railroad should use efficiency testing or observations to ensure that crews consistently follow the policies.

Other types of passenger behavior can be broken down in a similar way. Using a hazard management team to explore passenger behavior issues by asking questions and reviewing policies can lead to identifying appropriate mitigation strategies to address the behavior.

7. Gap Safety Management Follow Up

The passenger railroad gap safety management plan is an ongoing activity that will require regular follow up. Periodic review of the hazard management plan and the hazard analysis should be conducted to ensure that mitigation strategies remain fully implemented and that all hazards are satisfactorily closed out.

The hazard management program described in this document and captured in the hazard analysis should also be reviewed as changes occur in the configuration or the operation of the passenger rail system or as the external environment changes. The hazard analysis worksheets should be revisited and updated whenever changes occur. Changes that can affect the hazard analysis include:

- new or expanded passenger service,
- revised operations procedures,
- use of new or modified equipment
- changes to existing stations or building new stations

It is important to make the hazard analysis a living document that can be modified and updated as new information is collected about the gap safety issue. The hazard analysis work sheet should also be reviewed after each serious gap accident or incident to determine if the hazard analysis and the mitigation strategies are valid or need to be updated. The review of the hazard analysis is conducted to confirm that all hazards are identified and that the frequency and severity classifications for specific hazards remain accurate.

8. Summary:

FRA encourages passenger rail operators to examine the risk posed by the gap between the rail car door threshold and high level station platforms and recommends that all passenger rail operators establish gap safety management programs to establish and consistently maintain a uniform gap and uniform boarding and alighting conditions at each station. The gap safety management program should:

- use engineering evaluation and analysis to establish gap standards for all high level stations, and
- apply mitigation strategies to further reduce the risk of gap accidents.

Recognizing that passenger railroads typically operate over the rights-of-way of freight railroads, FRA recommends that, in developing and implementing gap safety management programs, passenger rail operators coordinate with the freight railroads which host their operations or which operate over passenger railroad owned lines, and that the freight railroads assist in their efforts to promote platform gap safety. Using this approach, FRA hopes to achieve improvements in passenger rail platform safety.

The hazard analysis approach outlined in Appendix A of this document represents one method to conduct hazard analysis. However, there are many other methods and techniques for managing hazards. Additional information on how to apply hazard management techniques to railroad operations exists in a variety of documents. The documents listed in the bibliography section represent a small sample of the type of information available.

9. Bibliography

U.S. Department of Defense. 1993. "Military Standard, System Safety Program Requirements." Mil-Std-882C. Washington, DC: U.S. Department of Defense.

American Public Transportation Association. 2000. "Manual for the Development of System Safety Program Plans for Commuter Railroads." Washington, DC: American Public Transportation Association.

U.S. Department of Transportation Federal Transit Administration. 2000. "Hazard Analysis Guidelines for Transit Projects." Washington, DC: U.S. Department of Transportation.

Bahr, Nicholas J. 1997. *System Safety Engineering and Risk Assessment: A Practical Approach*. New York, NY: Taylor and Francis.

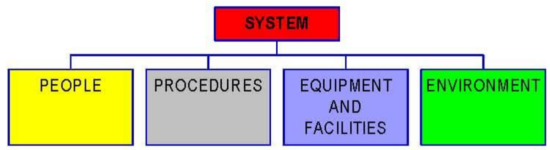
APPENDIX A

HAZARD ANALYSIS PROCESS

1. Hazard Management System Safety Approach

The system safety approach is a holistic process for hazard analysis because it considers the overall passenger railroad system. A passenger railroad system is made up of the following elements:

- People
- Procedures
- Equipment & Facilities
- Operating environment



These elements need to interact and integrate with each other in order for the system to function. Changes to one element or part of an element may have a profound effect on the other element of the system, and thus, affect the safety of the system.

2. Hazard Analysis as a Tool

Hazard analysis is a tool used in the system safety process to allow a passenger railroad to evaluate hazards in the various modes of operation. This process should start in the design phase (include any system extensions, modifications, or vehicle purchases) and continue until the system is retired; the hazard analysis is a continuous process.

Hazard analysis is defined as an analysis performed to identify hazardous conditions for the purpose of their elimination or control. The purpose of hazard analysis is to:

- Identify safety hazards and their causes
- Determine hazard severities/probabilities
- Recommend corrective action to correct procedures and resolve design problems
- Provide documented evidence of compliance with design, code, or specification requirements to management

2.1 Identifying Hazards

The passenger railroad hazard management team must have a working knowledge and understanding of how the individual system elements (people procedures, facilities & equipment and the environment) interface with each other. When identifying safety hazards present in a system, every effort should be made to identify and catalog all potential hazards. For the purpose of this project we will limit ourselves to platform gap safety. However, if in the process of identifying hazards, other non related hazards are identified, then they should also be captured and analyzed.

There are many techniques for identifying hazards. Basic methods to help identify hazards may include:

- Data from previous accidents or operating experience or case studies.
- Scenario development (what if) and judgment of knowledgeable individuals (hazard management team members)
- Development of Generic hazard checklists.
- Development of specific hazard checklists pertinent to the operating railroad
- Pictures
- System tours
- Formal hazard analysis techniques
- Design data and drawings
- Analysis and compare similar systems
- Identify codes standards and regulations that may affect the system (highway codes regarding grade crossing)

3. Hazard Analysis and Resolution Process

There are five main steps in performing the hazard analysis process. They are:

1. System Definition
2. Hazard Identification
3. Hazard Assessment
4. Hazard Resolution
5. Follow Up

The five steps are shown schematically in **Figure A1**. Each step of the process will be explained in detail in the following sections.

3.1 Step 1 – System Definition

The first step of the hazard analysis identification and resolution process is to define the system under consideration. A good system definition is important to understand the environment and interfaces that occur during operation of passenger trains – especially those elements that may positively or negatively affect safety. The system definition is best accomplished by individuals who are intimately familiar with the passenger rail operation.

The system definition should be a narrative statement that fully describes, at a minimum, train operations, the rolling stock, track configuration, infrastructure, and environment.

This guideline will limit the system to the station platform of the passenger railroad. Here are a few examples that may help to define the system. (These examples will vary with each railroad).

- Location of station tangent track and curved track
- How many passengers utilize station the every day
- How many and what type of stations make up the system

Federal Railroad Administration

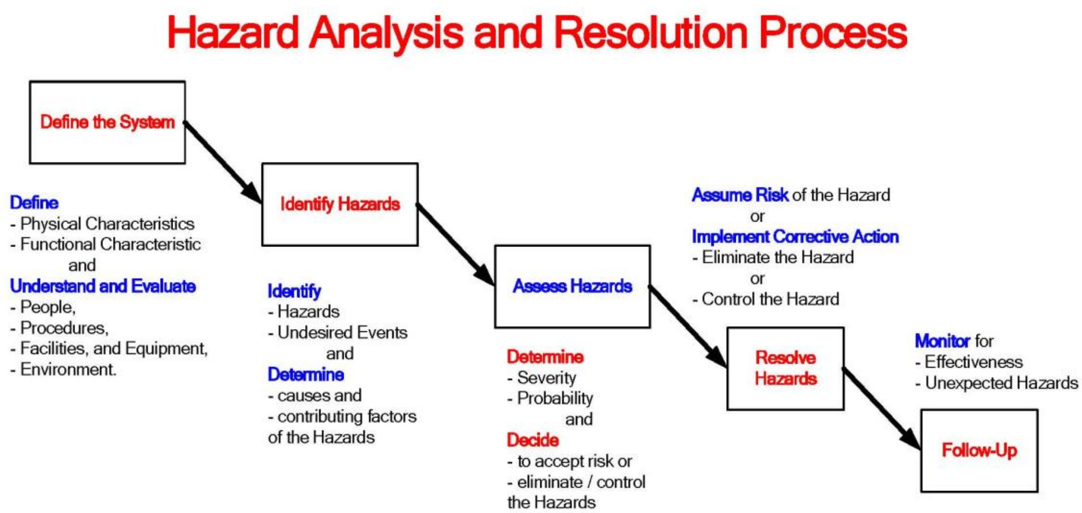


Figure A1. Schematic diagram of the Hazard Analysis and Resolution Process.

Revision 03 21 December 7, 2007

passenger dynamics and associated safety issues because the results of each type of incident or issue may be quite different.

The hazard analysis process should also consider different locations and configurations of platforms on the system that may be critical in escalating an incident. When performing hazard analyses, consider locations at stations that could potentially cause, contribute to, or escalate an incident.

3.4 Step 4 – Hazard Resolution

3.4.1 Developing a Mitigation Approach

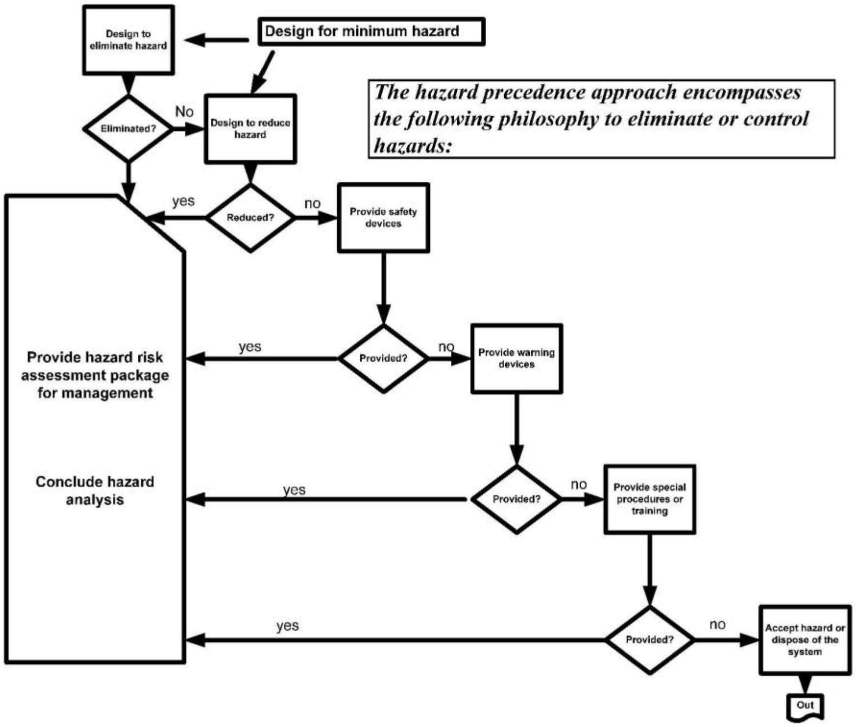
The right side of the worksheet includes information on the mitigation approach – the strategy adopted to reduce the severity or the frequency of the hazard. Once a mitigation approach is determined, the effect of the mitigation strategy on the severity and the probability or frequency of the hazard is estimated and the revised risk matrix figure is recorded on the worksheet. In this manner, hazards that require mitigation can be moved to a lower criticality and/or frequency category where the risk may be more acceptable to the passenger railroad operator. As mitigation actions are implemented, the status of the hazard will change from open to closed. The last column should include references to the dates and documents that establish the closure action.

Some hazards will require more than one mitigation strategy. For example, a passenger railroad may decide to place personnel on station platforms with excessive gaps as a way of reducing the risk of passenger injury. This would be a valid short term strategy but may not be appropriate in the long term. A longer term strategy, however, may be to realign and re-tamp the track to the established track centerline to platform edge Improvements in rolling stock suspension along with track improvements may represent a valid method to reduce platform gap dimensions. Therefore, the mitigation strategies or actions should be categorized as short term, medium term, or long term actions.

3.4.2 Hazard Precedence

The hazard precedence approach is a technique for controlling hazards during different phases of the system life cycle. Keep the hazard precedence approach to hazard mitigation in mind when developing mitigation strategies. The approach is most often used on new systems because many hazards can be eliminated during the design stage - before the system is initiated and put in service. The hazard precedence approach, however, is also useful when assessing existing systems although changes to the design become retrofits and are generally far more expensive.

Federal Railroad Administration



Revision 03 29 December 7, 2007

SAMPLE
PLATFORM GAP HAZARD ANALYSIS
WORKSHEET

HAZARD IDENTIFICATION						MITIGATION APPROACH					
Hazard Number	Hazard Description	Cause	Effects	S	P	Mitigation Strategy	Rev. S	Rev. P	Status	Responsibility	Comments
1	Platform Slippery weather condition	Weather Condition Rain, platform surface too smooth, standing water.	Boarding or alighting train passenger could slip and fall into the gap.	2	A	Establish new maintenance policy to include platform drainage inspection Passenger announcement policy includes warning about slippery conditions during rain or snow events Passenger announcement policy includes watch the gap announcement at all stations Follow existing maintenance and inspection plan to verify proper track alignment to platform Change specification for platform painting to include abrasives to improve footing	3	B	Open	Operations, maintenance and track maintenance	This is a system wide hazard during inclement weather. Review platform maintenance contract to assure platform drain cleaning is part of the contract and timely response to platform maintenance issues is addressed. Station personnel and crews are required to make announcements to watch the gap per SOP P-1 and identify and report hazardous conditions to maintenance control. Maintenance control will immediately dispatch personnel to the affected platform The safety department will add this item as an attribute to audit for compliance every quarter. The safety department will also verify quarterly that track alignment to platform maintenance is being performed in accordance with Track Procedure TA-5.

APPENDIX C

Rail Car Components

Recommendations for Equipment Design, Inspection, Testing and Maintenance for Passenger Equipment Operated in High Level Platform Territory

A. New Equipment

1. The following parameters should be specified in the procurement documents:
   a. Allowable car width with tolerances over the side door threshold plates.
   b. The finished car floor height with tolerance.
   c. The allowable wheel wear.
   d. The car body dynamic outline; including the limits of motion for the side door thresholds.
   e. The passenger side door locations.

2. The passenger side door location specification should consider minimizing gaps between floor and the platforms on curved track locations that are present on the carrier's right of way.

3. The procurement document should include the requirement for a dimensional analysis to be performed and documented by the builder to identify the expected car motions which will affect the vertical and horizontal gap between the car and the platform. This analysis shall include as a minimum: identification of critical components that affect the horizontal and vertical gap and, the dimensions and tolerances of such critical components. The dimensions and tolerances of these key components shall be agreed upon by the car builder and carrier, considering the goal of reducing the gap when possible.

4. The maintenance instructions should identify all items that affect the gap and their associated pass/fail criteria to ensure that the resultant car body to track motion is within the level agreed to between the car builder and the carrier.

B. Existing Equipment

1. Review the existing maintenance instructions to identify all components that affect the gap. Evaluate the parameters for possible gap reduction. Make revisions as necessary.

2. Inspection, Testing, Maintenance (Below are general recommendations. Other property or equipment specific procedures can be developed using the same principle).

   a. Daily inspection: (Add the following if not already included.)

1). Inspect suspension system as follows:
(a) Ensure that outer coils springs are not broken.
(b) Ensure that air springs are operating as intended.

2). Ensure gap signage is in place and legible. Ensure passenger announcement system (if equipped) is in proper working condition.

3). Inspect lighting near door way.

4). Ensure that passageways and side door threshold plates are free of oil, grease or any obstruction which would create a slipping or tripping hazard

b. Periodic Inspection: (Add the following if not already included.

For the identified components, (ref. Item B.1.)

1). Ensure air pressure gages and instruments used for adjusting the car body height are properly calibrated.

2). Check car body height. Adjust car body height as necessary according to established procedures.

3). Truck periodic inspection:
(a). Primary Suspension Inspection:

- Inspect journal box suspension system (i.e. springs, dampers) for excessive wear, cracks or deterioration to ensure system integrity and proper adjustment.

(b). Secondary Suspension Inspection:

- Inspect secondary suspension assembly for excessive wear, cracks or deterioration to ensure secure installation and proper adjustment.
- Items to be inspected include: springs, rubber spring seats and shims, bushings, rubbers, etc., if so equipped.
- Inspect all dampers for excessive leaks, excessive wear, and mounting deterioration.
- Inspect air springs for deterioration, damage, or air leaks.
- Inspect lateral damper system for excessive leaks, damage, excessive wear, and secure installation.
- Inspect lateral bumper assemblies/parts for excessive wear, damage, and missing components.
- Inspect leveling valves for fluid leaks, proper installation, and proper function.
- Inspect steering rods for excessive wear, damage, secure installation, and proper function.
- Ensure air bag height or pressure is within the specified range.

- Inspect air spring system, including reservoirs, piping, valves, hoses, fittings, and clamps, for dents, cracks, wear, leakage, or undue stress. Ensure system integrity and proper function.

(c). Truck Frame Periodic Inspection:

- Inspect truck frame for wear, cracks, and proper clearances.

(d). Wheel Periodic Inspection:

- Inspect wheels for excessive wear (i.e. flange and tread thickness).

c. Unscheduled Maintenance

After any car maintenance that may affect the body height (e.g. truck replacement, air bag replacement, wheel set replacement), check the car body height.

Adjust car body height as necessary according to established procedures

APPENDIX D

Station Considerations

Gap Safety recommendations, in High Level Platform Territory:

A) Train Door Operating Procedures:
Train Door Operating Procedures are, important to ensure safety, at high level platforms. Some of the safety considerations, for door operations, in high platform territory are:

- Ensure that the engineer and the train door operator coordinate to hold the doors closed until the train is completely on the full platform;
- Ensure that train crew holds doors not fully aligned with the platform in the closed position;
- Ensure there are appropriate on-board announcements for passengers. i.e. ("mind-the-Gap" and "to hold the hand of small children");
- Ensure that all crew members are positioned at their assigned locations;
- Ensure safety notices are distributed to train crews alerting them to hazards at stations with "wide-gaps";
- Ensure procedures, for train crew members to view the entire platform, to observe conditions before closing train doors are in place and enforced;
- Establish procedures, where practical, to close train doors from the last open car and observe platform as the train begins to move;
- When it is not practical to close the train doors from the rear car, there should be look back procedures for the train door operator and the engineer to observe the platform, immediately after the doors are closed, to ensure the doors are clear of all persons attempting to board or de-board.

B) Platform Guidelines:

To enhance the safety of passengers, at high level platforms, where practical, there should be audible & visual safety mitigation strategies, in place to:

- Alert passengers on the platform to "mind-the-Gap between the platform and the train door threshold;
- Alert passengers with children, to hold the child's, hand, while on the platform and while boarding and alighting;
- Alert passengers to stand clear of approaching trains;

Appendix B

Factors Associated with Railroad Passenger Car Clearances to High Platforms for Intercity and Commuter Rail Systems, March 2006.

FEDERAL RAILROAD ADMINISTRATION
March 7, 2006

FACTORS ASSOCIATED WITH RAILROAD PASSENGER CAR CLEARANCES TO HIGH PLATFORMS FOR INTERCITY AND COMMUTER RAIL SYSTEMS

SUMMARY:

1. It is highly desirable for commuter rail lines and federally designated high-speed corridors to provide for level boarding of rail passenger cars. However, a series of real world conditions preclude achieving and maintaining the desired ADA gaps between rail cars and platforms. Bridge plates will be required to achieve level boarding compliance with ADA regulations.

2. High-level platform heights have been standard at 48-inches ATR in the northeast for nearly a century. A new “mid-level” platform height for low entry-level cars needs to be standardized. Passenger car doors should be flush with the outside wall of the car, not recessed in such a way as to increase the gap between the platform and the car floor.

3. Routes that have historically moved OD freight loads must be provided: with either a track without a platform, a platform edge that can be moved to provide extra clearances, or a gauntlet track at the platform. Hand operated gauntlet tracks through a 1000-foot long platform typically cost in the range of $500,000, while fully interlocked remotely controlled gauntlet tracks with appropriate signaling would cost $1.5 -$2.0 million.

4. It is recommended that the ADA regulations read as follows: “Cars which provide level boarding with station platforms shall be coordinated with the boarding platform design such that the horizontal gap between a car at rest and the platform shall be no greater than 10 inches on tangent track and 13 inches on curves and the height of the car floor shall be within plus % inch to plus 5% inches of the boarding platform.”

5. Level boarding platforms should: be located on tangent track or mild curves not exceeding I” 40’ (radius of 3438 feet) with little or no superelevation, be free of obstructions within 6 feet of the platform edge adjacent to the track, not have any turnouts or crossovers along the platform length and not have any pedestrian crossings across tracks except, if necessary, beyond the platform ends with train activated warning systems.

INTRODUCTION:

The Americans with Disabilities Act (ADA) requires that any new or remanufactured intercity or commuter rail cars be readily accessible and useable by individuals with disabilities, including individuals who use wheelchairs. See 42 U.S.C. $12162. To that end the Federal Railroad Administration (FRA) has taken the view that full train length level boarding systems should be installed at all new and rebuilt stations along the federally designated high speed rail corridors, and the Federal Transit Administration (FTA) has taken the position that all new commuter rail systems and new or rebuilt stations on existing commuter rail systems should provide full train length level boarding platforms for all train doors. For the reasons set forth below, the FRA considers it infeasible to obtain full train length level boarding at all intercity stations, many of which are used by only one or two trains a day.

BACKGR0UND:

The concept of level boarding for both the disabled community as well as the general public is well founded. Observations with a stop watch in Chicago before the existence of the ADA repeatedly showed loading or unloading trains in good weather was 3 times faster when using level boarding compared to steps with low platforms. Subsequent stop watch observations of manual crank wheelchair lifts compared to bridge plate use likewise showed at least a factor of 3 in favor of level boarding. Unfortunately, since high platforms cost more than low platforms, their use prior to ADA has historically been restricted to high-density commuter or corridor routes, where boarding time became a critical factor in railroad operations

Regulations promulgated by the United States Department of Transportation (DOT) to implement the ADA for intercity and commuter railroads require that “[cars which provide level boarding in stations with high platforms shall be coordinated with the boarding platform or mini-high platform design such that the horizontal gap between a car at rest and the platform shall be no greater than three inches and the height of the car floor shall be within plus or minus 5/8 inch of the platform height.” 49 C.F.R. $38.1 13 (d)(l); see also 49 C.F.R. $38.93 (d)(l) (regulation applying to commuter rail). Exceptions are authorized for new cars in existing stations, retrofitted vehicles and where platform setbacks do not allow the specified gaps to be met. See49 C.F.R. $38.113(d)(2)-(4).

The DOT regulations describing a requirement for “high” platforms must first be understood to apply to any platform that is above the traditional low-level platform, whose surface is typically eight inches above the top of the rail (ATR). It should also be understood that historically each state was responsible for prescribing clearances around railroad tracks. Each state enacted statutes defining up to forty-one different clearances 3that railroads are required to use within that state. These clearances typically included dimensions for low and high-level platforms and varied slightly among the states. While the fixed facilities were regulated by the individual states, the railroad industry itself set the clearance standards for rolling stock. Nevertheless, the ADA and its promulgating regulations require that the clearance standards for rolling stock and fixed plant be fully coordinated.

The Association of American Railroads (AAR) has over the years issued a series of what are called “Plates” describing the maximum static dimensions of freight and passenger cars used in interchange service between the various rail carriers. However, each rail carrier is also free to carry “Over Dimensional” (OD) loads along various routes in special train movements with numerous operating restrictions being followed. Typically, these OD shipments are moved at slow speeds during times when other rail traffic is at a minimum (typically at night), because adjacent tracks are frequently blocked by these very wide loads. In many cases, these OD movements involve military shipments of the Department of Defense (DOD), which keeps a master map of all OD routes in the U.S. and the individual route clearances. The FRA has taken the position that the necessary clearances required for moving OD loads during the last ten years will be preserved as well as any DOD clearances. OD clearances used more than ten years ago would require further justification in order to be retained.

REQUIREMENT INFEASIBILITY:

Conventional high-level platforms used in the northeast have a height of approximately 48-inches ATR and are 5 feet 7 inches from track center line on a tangent track. The typical floor height of a passenger car with new multiple wear wheels is slightly more than 51 inches. However, clearance widths and heights do not stay fixed over time. As to vertical height, each new multiple wear wheel can have about 2.5 inches of steel removed from the radius of its tread by wear or wheel truing machines before it is condemned for scrap. Moreover, truck center plate wear, permanent set in the car springs after long use, and general wear on other truck components can collectively reduce the car floor height ATR by another 1/2 inch or so. The FRA has issued regulations limiting the height of drawbars (couplers) to a range of 31.5- 34.5 inches ATR. Typically, new wheels will raise the height of the drawbar to just below 34.5 inches, while well worn multiple wear wheels will be just above the 31.5 inch minimum. Shims may be used to insure that the drawbar height does not go below 3 1.5 inches.

The real wild card in the vertical height control question of conventionally ballasted track occurs during the periodic resurfacing and lining operation where some of the ballast is “tamped” under the ties. This “tamping” effectively raises the track relative to a platform. Collectively, then, when comparing new to well worn conditions, the vertical height difference between the passenger car floor height and the platform height can vary between 3 and 5 inches, which is far beyond the plus or minus 5/8 inch required by the regulations. This is not intended to say that all dimensions will stack up in the worst way; indeed, it is highly unlikely that all of these elements will line up in the most restrictive manner. However, realistically, a variation of 2-5 inches will exist between the car floor height ATR and the platform height. See Table A.

For completeness of this discussion, it should also be noted that a typical railroad passenger car will cause the ballast to compress approximately 1/2 inch from its unloaded position. Therefore, the platform height ATR without a train present should be 1/2 inch less than the computed dimension to adjust for the rail position when a train is present. Likewise, if old rail is replaced with new rail of a heavier design, the track through the station platform must be under-cut and lowered in order to compensate for the higher new rail and tie plates. If 115 lb. rail is replaced with 140 lb. rail the track would have to be lowered by just over 1 inch or the platform surface raised by a similar amount.

The horizontal clearance between standard rolling stock and the conventional northeast high-level platform is likewise made up of a number of variables. Metal is worn off both the wheel flange and rail head, as well as various truck components. Alignment of the track and face of the high-level platform will be subject to the normal construction and maintenance tolerances. Standard vehicle construction tolerances will add to the equation. The above items can collectively account for lateral movement of 2 to 3 inches in either direction.

The most overlooked element in horizontal clearance analysis is the bouncing and swaying of rolling stock (freight and passenger) not stopping at the station. This dynamic clearance envelope is significant. Human comfort criteria dictates that railway passenger cars must be equipped with a relatively soft suspension; however, this soft suspension can result in a roll angle of nearly 8 degrees. An 8 degree roll angle will cause a passenger car at high-level platform height to move sideways over 6 inches. Quality track maintenance can typically cut the roll displacement in half; but 3 inches of roll and 3 inches of other tolerances described in the previous paragraph will still move a 10 foot wide passenger car very close to the platform. In any case, for these reasons, the 3-inch horizontal gap required by the ADA regulations are probably impossible to meet, even where only passenger trains are operated. See Table B below.

While the above discussion has been based on high platforms situated on tangent track, high platforms can be placed on mild curves of up to 1-degree 40 minutes with little (1 inch) or no superelevation without serious impacts on the traveling public. As a “rule of thumb”, each degree of curvature will increase the gap between the car and the platform by approximately 1 inch. If the curve is superelevated, the gap between the car and the platform will increase by 1 inch for every inch of superelevation. Thus a 2- degree curve with 3 inches of superelevation would add 5 inches to the gap between the car and a platform.

The discussion has so far been limited to conventional northeastern 48 inch high-level platforms. Many relatively new bi-level rail passenger cars have low floor levels. The Amtrak superliner cars have floors 17.5 inches ATR; while the California cars are 17.5 inches ATR, the Sounder cars are 25 inches ATR and the Talgo cars are also 25 inches ATR. Making these cars available for level boarding will require constructing "high" platforms at heights that have never been discussed and standardized before. Historically, railroad passenger car designers have opposed any circumstance where a passenger would have to step down into a rail car; it was felt that a slight step up was preferred. A problem will arise where Amtrak Superliners and certain commuter cars must use the same platform. Additionally, these "mid-level" platforms would be at an elevation ATR where the AAR plate diagrams are on a slope (not vertical) and where OD clearances have not historically been discussed with passenger operators. It is known that the lateral allowance for wheel flange and rail head wear in conjunction with track alignment tolerances would be the same as previously discussed, while the carbody roll clearance would be 35-55 percent of a northeastern high-level platform.[1]

The ADA regulations on level boarding presume that the passenger car doorway has a floor that extends at least to the edge of the carbody if not a little beyond. The passenger cars purchased for the Sound Transit System in Seattle, Washington, and some other commuter systems actually have the door step recessed 6 inches behind the edge of the carbody, thus adding to whatever gap that may exist between the platform and the carbody.[2]

RAILROAD WORKERS RIDING ON FREIGHT CARS:

In order to provide for a safe means for railroad workers to ride on freight cars, FRA Regulation 49 CFR part 23 1.1[(d)(3)(iii)] requires sill steps on all four corners of a freight car "preferably flush with side of car" and "tread shall be not more than 24, preferably not more than 22, inches above the top of rail." These still step clearances are included within the normal AAR plate diagrams. However, a railroad worker riding on one of these sill steps is not included in any clearance plate.

If a worker is standing on a sill step, the worker's shoes (boots) will stick down below the sill step by an inch or two and the rear portion of his foot will project away from the sill step by 6-10 inches. The normal riding position of the worker would result in the back of the legs and body projecting out away from the car much further. Since the FRA regulations for maximum distance ATR would apply to a newly built and empty freight car, a fully loaded car with worn wheels and suspension system could have the still steps 4 inches or so lower or in the vicinity of 18 inches ATR.

---

[1] However, before any decision is made on the height and location from track center line for a "mid-level'' platform, it would be advisable to consult with the AAR, the American Railway Engineering and Maintenance of Way Association (AREMA) and the American Public Transportation Association (APTA). The National Railroad Passenger Corporation (Amtrak) would also have a vested interest in the topic.

[2] A regulatory fix may be needed to prohibit such recessed doors.

Railroads using standard 48-inch high level platforms prohibit employees from riding the side of a freight car in the vicinity of the high platforms, as there is simply no clearance. A mid-level platform 15-17 inches ATR would appear to provide sufficient clearance to allow workers to ride past a platform on a freight car. Any mid-level platform in the vicinity of 25 inches ATR would probably require prohibiting workers from riding on the side of freight cars.

OVER DIMENSIONAL LOADS AND NEED FOR GAUNTLET TRACK:

All AAR plates for freight cars, except Plate H, have a maximum width of 10 feet 8 inches (5 feet 4 inches from track center line) at platform height of 48-inches ATR. While the lateral movement due to worn wheels, worn rails and track alignment deviations is similar to passenger cars, the horizontal swaying of freight cars is much less than passenger cars due to a much stiffer suspension system. Freight car roll is approximately half of a passenger roll or about 4 degrees, which results in a lateral movement of only 3 inches at 48-inch platform level. If we again assume higher quality track work in the vicinity of station platforms, the horizontal roll of a typical freight car would be in the vicinity of 1 to 1 1/2 inches. The lower roll angle and quality trackwork have permitted standard freight cars to operate past high-level platforms for nearly a century, when built to various AAR plate specifications.

However, as previously noted, some freight cars and freight car loads exceed the AAR plate clearances by significant amounts (typically 18-24 inches). The height ATR of these OD loads can vary widely depending on the type of freight car being used. Conventional flat car floors range from 43-56 inches ATR when empty; fully loaded they would be 2-3 inches lower due to spring compression. The official railway equipment register, under heavy capacity and special type flat cars, lists a number of depressed center flat car floors at 24 inches and a few at 23 inches ATR when empty. A wide load placed on a depressed center flat car would be expected to foul any platform built above a height of 19-20 inches ATR unless a gauntlet track, a bypass track or moveable platform edge was provided. How to handle these OD loads becomes a route specific/site specific decision. Where the OD movements are not frequent (perhaps several times a year to once a week), a hand operated gauntlet track, which moves the OD shipment away from the high platform, a moveable platform edge or a separate track without a platform is probably the most economical solution. When OD shipments become frequent (daily to several times a week), a fully signaled remotely controlled gauntlet track or platform bypass track becomes the preferred alternative

PROPOSED RAIL CAR -PLATFORM GAP REQUIREMENTS:

Of necessity the previous discussion of platform setback from track center line has focused on the dynamic clearance requirements of both freight and passenger cars moving past a standard 48-inch high platform. Nearly a century of operations has verified the feasibility of operating freight and passenger cars past high-level platforms built 5 feet 7 inches from track center line. In theory this would result in a 7-inch static gap for a standard 10-foot wide passenger car (5 feet either side of the track center line). However, it needs to be understood that rail cars normally do not come to a stop exactly centered on the track center line, and thus may leave a gap that is either less than or greater than the 7 inch nominal clearance. Our only interest here is what the maximum static gap might be for passengers.

The passenger car roll displacement shown in Table B can be eliminated from this discussion. Gauge face rail head wear on tangent track would be essentially negligible, but could be significant on a curve and be part of the rail gauge limits imposed by FRA regulations. Flange wear, wheel axle mounting and various truck suspension wear limits as well as basic track alignment and platform construction tolerances can and will be allow a passenger car to stop with a gap greater than 7-inches. A realistic combination of these elements could add or subtract 3-inches to/from the basic 7-inch gap, thus yielding 10-inches as the maximum gap for tangent track. Since high platforms have been successfully used on mild curves (1 213 degrees), it would be reasonable to allow for an additional 2-3 inches for curve and superelevation adjustments for curved platforms.

The vertical height difference between the car floor and the platform caused by multiple wear wheels, center plate wear, spring set, etc. is going to be limited by FFL4 regulations for drawbars to a total range of 3 inches. If one assumes no tolerance for platform or track construction and a standard car floor height of 5 1%-inches, then the minimum car floor height of 48%-inches would be %-inch above the 48-inch high platform and preserve the desire that no one should ever step down into a car. In reality track is raised by tamping and construction tolerances over the length of a platform (500-1200 feet) will exist. With a 3-inch variation dictated by FRA drawbar regulations, we must now decide how much tamping and construction tolerance to allow before it becomes necessary to lower the track or raise the surface of the platform. For this discussion it is proposed that 2 inches be allowed for a combination of tamping and initial construction tolerance of track and platform. The total vertical allowance between a passenger car floor and a platform would be 5 inches.

PEDESTRIAN CROSSING AT STATION PLATFORMS

It has become acceptable practice over the years to provide level at grade crossings across station tracks when low level (8 inch ATR) platforms are used. These crossings may be 10-15 feet wide at the crossing point, but 30 or more feet wide when ramps to the 8 inch ATR platform are included. Since step stools have historically been used to assist passengers in boarding trains from low platforms, the 8 extra inches or a step stool on a small ramp have not been a problem, when a car door stops at the pedestrian crossing. For traditional 48-inch high platforms pedestrian at grade crossings have been prohibited or in some cases placed at the end of the platform.

Since the basic objective of 15 or 48-inch ATR platforms is to provide level boarding to all accessible rail passenger cars, at grade pedestrian crossings should be prohibited or in rare circumstances placed at the end of a platform with the appropriate ramps and automatic train activated barriers with visual and audible warning systems.

TURNOUTS OR CROSSOVERS ADJACENT TO PLATFORM

The ends of any rail vehicle passing through a curve will extend significantly beyond the normal static position of the vehicle towards the outside of the curve. The typical 85 foot long passenger car has 60 foot truck centers; thus, the ends of the car are approximately 12 feet beyond the truck center pin. Furthermore, the centrifugal force caused by the curve will cause the car wheel flanges to make firm contact with the outer rail and cause the car body to sway or roll towards the outside of the curve. This action typically results in the need to increase horizontal clearances by approximately 1 inch per degree of curvature before considering any superelevation.

Turnouts (switches) by themselves or as part of a crossover between two parallel tracks have internal curves that are inversely proportional to their size. A number 8 turnout (used in congested terminal designs) has nearly a 12-degree (488 foot radius) curve, while a number 20 turnout (main line 45 mph crossover) has only 1"45' (3290 foot radius) curve. Placing a turnout adjacent to a high level platform would require a curved "notch" in the platform to allow for the passenger car overhang as it transits the turnout curve, which could significantly increase the gap between the platform and a car operating on the tangent side of the turnover. Since this "notch" would effectively negate the whole reason for a high platform in the first place, turnouts adjacent to a high platform are not allowed, unless there is no other feasible alternative and the movement allowed by the turnout is essential to railroad operations.

TABLE A

Vertical Variations between Passenger Car Floor Heights and Passenger Boarding Platforms

Multiple Wear Wheels	2 ½ inches
Spring Set, Center Plate Wear, Air Springs', etc.	½ inch
Platform Construction tolerance	½ inch
Vertical Track Profile (FRA Class 4 Regs.)	2 inches
Total	**5 ½ inches**

1 Does not include deflated air springs

TABLE B

HORIZONTAL VARIATIONS BETWEEN PASSENGER CAR SIDE WALL AT FLOOR HEIGHT AND PASSENGER BOARDING PLATFORMS

Track Gauge (FRA Class 4 Regs.)	1 ½ inches
Flange Wear	¾ inch
Wheel Axle Mounting	3/8 inch
Misc. Truck Suspension, Center Plate, Etc. Wear	½ inch
Platform Construction Tolerance	¾ inch
Track Alignment (FRA Class 4 Regs.)	3 inches
Subtotal	**6 3/8 inches**
Passenger Car 7.3 Roll at 48-inches ATR	6 1/8 inches
Total	**12 ½ inches**
Passenger Car 7.3" Roll at 18 inches ATR	2 3/8 inches
Total	**8 ¾ inches**

Summary:

1. It is highly desirable for commuter rail lines and federally designed high speed corridors to provide for level boarding of rail passenger cars.

2. High level platform heights have been standards at 48-inches ATR in the northeast for nearly a century. A new “mid-level” platform height for low entry level cars needs to be standardized.

3. Routes that have historically moved OD freight loads must be provided with either a track without a platform, a gauntlet track at the platform, or a platform edge that can be moved to provide extra clearance.

4. A series of real world conditions preclude achieving and maintaining the desired ADA gaps between rail cars and platforms. Bridge plates will be required for wheelchairs to achieve level boarding compliance with ADA regulations.

5. Passenger car doors should be flush with the outside wall of the car, not recessed in such a way as to increase the gap between the platform and the car floor.

6. At grade pedestrian crossings, if absolutely necessary, should be placed at the ends of a high platform and be provided with automatic train activated barriers with visual and audible warning systems.

7. Turnouts adjacent to a high platform are not allowed, unless there is no other feasible alternative and the movement allowed by the turnout is essential to railroad operations.

Appendix C

List of Passenger Railroads Operating in the United States, August 2010.

Railroad	Major Metropolitan Area Served
Altamont Commuter Express (ACE)	Stockton, CA - San Jose, CA
Connecticut Department of Transportation (Shore Line East) (CDOT)	New London, CT - New Haven, CT
Hawkeye Express	Iowa City, IA
Long Island Rail Road (LIRR)	New York, NY
Maryland Area Regional Commuter Train Service (MARC)	Washington, DC - Baltimore, MD
Massachusetts Bay Transportation Authority (MBTA)	Boston, MA - Providence, RI
Metro North Railroad (MNR)	New York, NY - Hoboken, NJ - New Haven, CT
Minnesota North Star	Minneapolis, MN
New Jersey Transit Railroad (NJT)	New York, NY - Hoboken, NJ - Trenton, NJ - Philadelphia, PA
New Mexico Rail Runner Express	Albuquerque, NM - Santa Fe, NM
North County Transit District (Coaster)	San Diego, CA - Oceanside, CA
Northeast Illinois Regional Commuter Rail Corporation (METRA)	Chicago, IL - Joliet, IL - Aurora, IL - Kenosha, WI
Northern Indiana Commuter Transportation District (NICTD)	Chicago, IL - South Bend, IN
Peninsula Corridor Joint Powers Board (CALTRAIN)	San Francisco, CA - San Jose, CA
Piedmont Commuter Railroad	Raleigh, NC - Winston-Salem, NC
Port Authority Trans Hudson Railroad (PATH)	New York, NY - Hoboken, NJ - Newark, NJ
Puget Sound Regional Transit Authority (Sounder)	Seattle, WA - Tacoma, WA
RTA Music City Star	Nashville, TN
Southeast Florida Regional Transportation Authority (TriRail) (SFRTA)	Miami, FL - West Palm Beach, FL
Southeast Pennsylvania Transit Authority (SEPTA)	Philadelphia, PA - Newark, DE - Trenton, NJ
Southern California Regional Rail Authority (Metro Link) (SCRRA)	Los Angeles, CA - Santa Barbara, CA - Oceanside, CA
Tri Met Westside Express Service (WES)	Wilsonville, OR - Beaverton, OR
Trinity Railway Express (TRE)	Dallas, TX - Fort Worth, TX
UTA Front Runner	Salt Lake City, UT
Virginia Railway Express (VRE)	Washington, DC - Manassas VA - Fredericksburg, VA
Amtrak - Passenger Railroad	Nationwide
Alaska Railroad - Passenger Railroad	Fairbanks, AK - Anchorage, AK

The 27 passenger railroads (commuter/ intercity) as of November 2009; does not include tourist or scenic passenger railroads.

Courtesy: FRA Office of Safety

Appendix D

Survey Questionnaire

RITA John A. Volpe National Transportation Systems Center
U.S. Department of Transportation

STUDY OF METHODS TO IMPROVE OR CORRECT STATION GAPS—INTERVIEW INSTRUMENT

Your agency was selected as a representative system, along with nine (9) others that incorporate the range of constraints, operating environments, station configurations, climate that the 26 commuter rails systems and AMTRAK face each day.

In 2007 the FRA produced a report, Federal Railroad Administration Office of Safety, FRA Approach to Managing Gap Safety which described a hazard analysis methodology to indentify and mitigate gap safety issues.

This follow-on report is in regards to the Rail Safety Improvement Act, specifying a report "Conduct Study of Method to Improve or Correct Passenger Station Platform Gaps with a specific emphasis on ADA compliance, the bottom line being the achievement of 3" gaps platform/vehicle gaps and 5/8" height gaps.

Note that an FRA report entitled, "Factors Associated with Railroad Passenger Car Clearances to High Platforms for Intercity and Commuter Rail Operations," observes a current practice of 7" to 10" gaps.

We are searching for current practices, as well as ideas that have been under consideration and any longer term incremental approach you a taking to facilitate wheelchair and physically challenged passenger movement. The findings will be shared with Congress and industry in October 2010.

The systems are:

- East Coast: Long Island Railroad, Southeastern Pennsylvania Transit Authority (SEPTA), Tri-Rail Southeaster Florida Regional Transit Authority, Massachusetts Bay Transportation Authority
- West Coast: Chicago METRA, Utah Transit Authority Frontrunner, CALTRAIN (San Francisco Bay Area, Sounder Transit (Tacoma/Washington), and Minnesota North Star.

John A. Volpe National Transportation Systems Center
U.S. Department of Transportation

Interview Form

Interviewer:
____

Operator: ____
- **Number of Stations:____**
- **Number of Stations breakout with the following characteristic**
  - **Level Platforms: 8" ATR; 15"ATR; 48-50" ATR:____**
  - **Partial Platform (mini platform, usually ~20 feet/reached via ramp/set back where freight train movements are anticipated/requiring bridge plates: ____**
  - **Ground Level Platform____**

Temporary or near-term ADA requirements fulfillment
- **How done:**
  - **Bridge plates ___**
  - **Moveable platform edges ___**
  - **Rubber finger gaps on platform ___**
  - **Rubber gap fillers on-vehicle __**
  - **Edge boards __**
  - **Powered bridge plates ___**
  - **Threshold plates ___**
  - **"Watch the Gap" and other visual aids sign or platform aids ___**
  - **Zoning cars (multiple stops, opening only certain doors) ___**
  - **Gauntlet track for freight to not affect platform width ___**
  - **Widening car bodies ___**
  - **Sacrificial edge ___**
  - **Retractable high level platform ___**
  - **Automatic car leveling ____**

Longer-term plans/New construction, plans for ADA compliance, improvement____

Other questions:
- **Other technologies looked at to fill the gaps: __________________________________**
- **Statistics? (If available): ____**

Open Ended Discussion Questions:
- **Open Q&A Time: Wish List, the perfect scenario, ideas____**
- **Pictures of disabled using aids____**

Not Part of Interview (Background Web Site review):
- **Web Search of above railroads and remaining 16 that are not part of the sample.**

Appendix E

Summary Results of Survey

System	Name	Location	Status
WEST			
California Department of Transportation	CALTRAIN	SW	Established
Northeast Illinois Regional Commuter (NIRC)	Metra	NW	Established
Metro Transit of Minneapolis St. Paul	Northstar Commuter Rail	NW	New
Puget Sound Regional Transit Authority	Sounder Commuter Rail	NW	New
Utah Transit Authority	Frontrunner	NW	New
EAST			
NY Metro Transportation Authority	Long Island Railroad	NE	Established
Massachusetts Bay Transportation Authority	Purple Line Commuter Rail	NE	Established
Southeastern Pennsylvania Transportation Authority	SEPTA	NE	Established
South Florida Regional Transportation System	Tri-Rail	SE	New
New Jersey Transit	River Line	NE	New

System	Number of Stations	Accessible Stations
WEST		
California Department of Transportation	32	26
Northeast Illinois Regional Commuter (NIRC)	239	188
Metro Transit of Minneapolis St. Paul	6	6
Puget Sound Regional Transit Authority	10	10
Utah Transit Authority	8	8
EAST		
NY Metro Transportation Authority	124	120
Massachusetts Bay Transportation Authority	132	95
Southeastern Pennsylvania Transportation Authority	154	107
South Florida Regional Transportation System	18	18
New Jersey Transit	20	20

System	Number of Vehicles	Platform ATR
WEST		
California Department of Transportation	No response	15" mini-high
Northeast Illinois Regional Commuter (NIRC)	841 diesel district; 171 electric district	8" diesel district; 50" electric district
Metro Transit of Minneapolis St. Paul	18	25" mini-high
Puget Sound Regional Transit Authority	58	25" mini-high
Utah Transit Authority	35	8", 24" mini-high
EAST		
NY Metro Transportation Authority	1000	50"
Massachusetts Bay Transportation Authority	410	8"
Southeastern Pennsylvania Transportation Authority	357	48", 48" mini-high
South Florida Regional Transportation System	26 Gallery, 6 DMUs	25" mini-high
New Jersey Transit	20	21"

System	Platform Types
WEST	
California Department of Transportation	20' mini-highs
Northeast Illinois Regional Commuter (NIRC)	8" diesel district; 50" Electric full length level
Metro Transit of Minneapolis St. Paul	20' mini-highs
Puget Sound Regional Transit Authority	20' mini-highs
Utah Transit Authority	Mini-high platforms can accommodate 3 cars at once and serve both types of cars on system
EAST	
NY Metro Transportation Authority	Most platforms full length level for 8 cars, except for several which accommodate only 6 cars.
Massachusetts Bay Transportation Authority	45' mini-highs that accommodate 2 cars; terminals and several key stations have full length level platforms
Southeastern Pennsylvania Transportation Authority	18 stations full length level, 26 stations with minis-high platforms, 107 low level
South Florida Regional Transportation System	20' mini-high platforms, remainder of stations low level
New Jersey Transit	Full length level serving two car trainsets

System	Access Method
WEST	
California Department of Transportation	Mini-high bridge plates, stored on train; station side lift is used at some locations
Northeast Illinois Regional Commuter (NIRC)	Diesel line uses on board mounted lifts; always one car in the consist located at the non-downtown end of the platform; at terminals with full platforms, attendants assist; Electric line, vehicle borne bridge plates
Metro Transit of Minneapolis St. Paul	Bridge plate on mini-high platforms. Some 3' to 4' gaps on the system. Vehicle mounted rotating lifts for 8" ATR portion of system
Puget Sound Regional Transit Authority	15" mini-high developed with citizen groups testing mockup
Utah Transit Authority	Bridge plates
EAST	
NY Metro Transportation Authority	Threshold plates/vehicle borne bridge plates; modified platforms where possible using sacrificial edges 1/2 to1/8 inch polymer extending material; call ahead for some stations(phone listed on fare card) Syosset (extra wide gap), Jamaica & Flatbush Avenue stations have dedicated staff due to high volume
Massachusetts Bay Transportation Authority	On board bridge plates except Readville, where platform stored bridge plate is supplied to service the extra wide gaps required in the rail yard
Southeastern Pennsylvania Transportation Authority	Bridge plates at high level and mini-highs; plates located and locked at the mini-high; one bridge plate available for full platform locations
South Florida Regional Transportation System	On board bridge plates, DMU's have on board lifts which can deploy on any platform in system
New Jersey Transit	No assistive devices needed on high platforms

BIBLIOGRAPHY

Analysis of Passenger Gap Injuries at Train Stations, submitted to the Transportation Research Board, Janice R. Daniel and Naomi G. Rotter, New Jersey Institute of Technology, November 15, 2009.

Customer Behavior Relative to Gap between Platform and Train, Final Report, Janice R. Daniel and Naomi G. Rotter, New Jersey Institute of Technology, July 2009.

Factors Associated with Railroad Passenger Car Clearances to High Platforms for Intercity and Commuter Rail Stations, Federal Railroad Administration, March 7, 2006.

FRA Approach in Managing Gap Safety, Federal Railroad Administration, Office of Safety, December 7, 2007.

Full-Length, Level Boarding Platforms in New Commuter and Intercity Rail Stations, Department of Transportation, September 1, 2005.

National Transportation Safety Board (NTSB) Accident Report DCA-06-FR-009, Adopted March 13, 2009.

Resolving Conflict Between Mobility-Impaired Passenger Requirements and Freight Service in Mixed High and Low-Platform U.S. Railroad Lines, Edward K. Morlok, Transportation Research Board Paper Number 03-3232, 2003.

Standard for Rail Car Gap Safety and Accessibility Management during Passenger Boarding and Alighting, American Public Transportation Association, APTA UAP-ST-001-07, November 12, 2007.