AUTOMATED HIGH LEVEL PLATFORM RETRACTABLE EDGE FEASIBILITY TO ACCOMMODATE WIDE LOAD PASSENGER FREIGHT MANUAL ON HIGH SPEED PASSENGER RAIL LINES

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ABSTRACT
Throughout the country freight and passenger rail traffic frequently operate on the same tracks, creating challenges to meet the needs of both operations. One major challenge facing many carriers and authorities today is bringing passenger stations into compliance with the Americans with Disabilities Act (ADA). The most effective and efficient way to meet the ADA requirements is through the provision of full-length level boarding platforms. Unfortunately, high level platforms create a physical conflict with wide-load freight movements in areas where freight and passenger rail operate over the same right of way. Over the years, multiple options to alleviate the conflict while meeting the requirements of ADA have been developed, including freight by-pass tracks, gauntlet tracks, mini-high level boarding platforms and varying versions of manual flip-up platform edges. The manual flip-up edges have been chosen to reduce the gap between passenger cars and platform edges, while being able to be manipulated to provide increased freight clearances. Although the various designed movable edges provide a level of solution, the industry is looking for a safe, heavy duty, standardized, fully automated edge that can be controlled by off-site supervision.

As part of PennDOT’s Keystone Corridor Improvement Program, several projects involved wide-load clearance envelopes requiring a solution that will meet the needs of the freight operators, while addressing PennDOT’s goals of ADA compliance and reducing platform dwell time. To address these issues, PennDOT conducted a study to identify and evaluate the feasibility of alternatives to traditional manual flip-up edge installations. This paper will present the results of this study, including the planned implementation for platform alternatives on the Keystone Corridor.

INTRODUCTION
One of the major challenges facing passenger rail organizations today is the upgrading and rebuilding of passenger stations, particularly passenger platforms. The design considerations relating to passenger boarding are level boarding to reduce dwell time and for compliance with the Americans with Disabilities Act (ADA). One of the ways in which this is regularly being accomplished is through the construction of full-length high-level platforms at stations. At many stations, high-level platforms have replaced traditional low-level or ground-level passenger platforms because high-level platforms provide direct boarding for large numbers of passengers along with easy, unrestricted access to trains for people with physical disabilities.

Throughout the country, the common passenger rail right of way is typically either a shared passenger/freight corridor or a freight right of way with passenger service being
hosted by the owner. This creates inherent challenges in meeting the needs of both operations, especially when ADA compliance and high-level platforms are part of the system. Where freight and passenger service operate together, high-level platforms create physical conflicts in the dynamic operating envelope of freight railroads that have wide load freight movements.

Over the years, multiple options to alleviate the conflict while attempting to provide level boarding for passenger access and the requirements of ADA have been developed. These options include freight by-pass tracks, gauntlet tracks, and manual flip-up platform edges.

While flip-up edges are the most cost-effective of the three solutions, they frequently present significant problems with their use, such as the requirement for worker manipulation to retract and deploy the edges and the need for the platform edge sections to be durable enough to survive in the rail environment. The system must operate in all types weather environments. The system needs to be validated in both the fully retracted and deployed positions for positive clearance indication to the operations center and locomotive engineers. This often leads to the installation of less effective and less desired solutions for both moving freight and passenger boarding while providing ADA compliance at passenger stations.

As part of the Pennsylvania Department of Transportation's (PennDOT) ongoing Keystone Corridor Improvement Program, several station projects involving wide-load clearance envelopes need solutions that met the clearances of the freight operators, and PennDOT's goals of continuing to increase ridership, reducing travel time and for ADA compliance. To address these issues, PennDOT conducted a study to identify and
evaluate the feasibility of alternatives to traditional manual flip-up edge installations. Through this study, several creative and technologically advanced were identified that eliminate many of the issues present in high platform and freight movement conflicts. The preliminary set of alternative approaches were as follows:

1. Powered Lifted Edge
2. Manual Lifted Edge
3. Vertical Rail Traverse
4. Accordion Fold Platform
5. Telescoping Edge
6. Flip-Down Edge
7. Drum and Spring Conveyor
8. Mini High Platform
9. Swing-Out Cam Follower
10. Mini High Scissor Lift

Of the 10 options listed above, seven options were dismissed due to their inability to perform in all weather environments. There were three options that remained for further evaluation. These options were the lift edge, lowered edge and telescoping edge. These options were ranked as follows:

- Lift edge – most durable and safety advantages
- Lowered edge – less reliable and no safety edge
- Telescoping edge – extensive platform modifications, not durable in harsh weather, poor safety features

CLEARANCE STUDY

The initial step to determine the requirements of any design alternative that meets the needs of the operating railroads is to examine the clearance requirements of the railroads and related agencies. Therefore, a review of the horizontal clearance requirements of various railroad and regulatory entities has taken place to determine appropriate horizontal clearances. The list of entities reviewed included American Railway Engineering and Maintenance-of-Way Association (AREMA), Association of American Railroads (AAR), AMTRAK, Pennsylvania Public Utilities Commission (PUC), Department of Defense Strategic Rail Corridor Network (STRACNET), the review of freight railroad clearance requirements (CSX and Norfolk Southern). Preserving and protecting the ability for freight trains to carry high and wide loads is to be considered in determining the horizontal clearance needs to be met by any design alternative. The results of the agency clearance review are presented below in Table 1.
Preserving the ability for freight trains to carry high and wide loads is a requirement in determining the horizontal clearance that needs to be met by a proposed retractable platform edge. Based on the clearance review and subsequent discussions with the various railroads, it was determined that a 14-foot wide dynamic clearance envelope would be provided. Clearance from the centerline of the track would then be seven feet. Ultimately, the prototype lift edge was to be designed to provide a horizontal clearance of 7 feet – 2 inches. Based on the clearance review, this would provide more than the required 6 feet horizontal clearance from the centerline of the track at a region 3 feet 9 inches above top of rails for STRACNET.
Horizontal clearances for AAR, PUC, and Amtrak would all be met by the proposed configuration of the platform lift edge in both the up and down positions.
CODE REVIEW AND DESIGN PARAMETERS
The successful design of a retractable platform edge must go through an initial code review and the design parameters of the system must be defined. The following topics were considered for the determination of the design parameters:

Temperature
Bearings and lift mechanism must operate in all weather environments and sustain expansion, contraction and influence from solar gain, and extreme low temperature environments. As the design advances, specific temperature limits will be identified.

Ice
System should be designed to shed water and not provide an environment for ice build-up. However, the system should be able to endure reliable operation with a reasonable amount of ice buildup.

De-icing chemicals
System components should withstand exposure to de-icing chemicals over a prolonged period of time. Design should incorporate water and de-icing drainage exposure.

Collision Impact - Impact Loading
The platform edge must have a sacrificial plate system on the lead edge as required by AMTRAK. The edge must be able to accept glancing impact without damage to the lift system or platform mounting face. The System should be of modular construction such that extreme collision damage of any one lift section would permit removal and replacement of the element without limitations to the remainder of the lift system. The element should be able to be removed and the system programmed to accept modification to accommodate operation during repair time periods.

Platform loads – Design Loading
The platform edge will be designed to support passenger assembly crush loads and self-weight. The prototype design “self weight” is unknown at this time, the recommended personnel loading is 150lbs. per Sq.Ft. as an initial design parameter. During design of the lift edge, every attempt should be made to make the system as light as practical. The ability to remove and replace individual sections of lift edge should also be considered. Appropriate platform live loading and snow loading will be determined as the design advances.

Platform lifting section surface profile
The platform is to incorporate the ADA required tactile warning surface and slip resistance.
Platform structure
The load path shall be designed to manage full function without load being transferred onto mechanical lift system. The lift edge in operating position will bear on the mounting structure components.

Sliding surfaces
All sliding surfaces are to function during icing periods. Frozen bonds between plates must be addressed when lift edge is to be moved.

Indication of clearance
Each section will provide a fully functional or fully stowed position indication. The indication is to be fed into a verification system to provide positive indication to the transportation dispatching authority to allow traffic through increased clearance locations.

System Reliability
The system design is required to provide continual performance in harsh weather environments with a high degree of system reliability and positive indication of functionality to be reported to the rail control center.

DESIGN OF LIFT EDGE SYSTEM - Utilizing the required design parameters the lift edge individual components will be designed and a prototype will be constructed. The lift edge prototype will be provided for either manufacturer in-house testing or lab review for verification of performance through all test procedures. Upon successful completion of all test procedures the prototype will be produced and installed in a test platform location for monitoring and evaluation during revenue service.

STANDARD PLATFORM DESIGN FOR ACCEPTANCE OF MODULAR COMPONENT INSTALLATION
The platform system design will include the precast platform sections that will be the base platform deck for the station. These platform sections will provide a continuous anchorage and mounting system for the movable platform sections provided as the mechanized portion of the lift system. In addition to the movable lift sections, there will be power provided to the lift sections, either hydraulic or electrical, along with validation sensors for positive indication of position (stowed or deployed). The system will be managed by a control system that will provide the following management needs:
• Remote control capability – back to operations control center
• Power to the individual lift sections
• Validation of lift edge position
• Positive indication back to the control cabinet and operations control center
• Trouble codes for system malfunction and problems with system
OPERATIONAL PARAMETERS

The following stages of operation were also considered. The stages of operation are:

**Standard Operation Position** – this position is the functional fully extended position. The lift edge structure will be supported by the platform support to upper bearing connection. The lower portion of the platform will bear on a vertical bearing block that will support the lift frame in a horizontal position.

**Pre-activation Validation** – the system will be queried for trouble codes and the platform will be visually inspected by the control center operator using platform closed circuit television cameras (CCTV). Upon positive verification of the safety of passengers on the platform and the positive indication from the controller, the system can be activated.

**Passenger Warning Notification** – there will be audio-visual warning notification to anyone in the vicinity of the lift edge. The notice will continue until the deployment is completed.

**Retraction** - The system will be signaled to engage the retraction phase. It will go through the cycle time for the retraction phase and provide indication of full retraction of all lift edge elements. Upon positive verification of the lift edge elements, the ROW can be released to high and wide traffic.

**Pre-activation validation** - the system will be queried for trouble codes and the platform will be visually inspected by the control center operator using CCTV. Upon positive verification of the safety of passengers on the platform and the positive indication from the controller, the system can be activated.

**Passenger Warning Notification** – there will be audio-visual warning notification to anyone in the vicinity of the lift edge. The notice will continue until the deployment is completed.

**Return to Standard Operating Position** - The system will be signaled to engage the extension phase. It will go through the cycle time for the extension phase and provide indication of full extension of all lift edge elements. Upon positive verification of the lift edge elements, the ROW can be released to passenger service.

**Prototype Monitoring:**
The system will undergo an initial full system inspection for compliance with all design parameters. The documentation will be preserved for final evaluation of performance. The system will be inspected on a quarterly basis to evaluate full operational safety, structural integrity, and full function of mechanical elements. At the conclusion of the evaluation phase, the system will be inspected and evaluated to determine durability and system reliability.
CONCLUSIONS
Based on the essential requirement for shared passenger and freight operations there is a definite need for a solution to the longstanding clearance problems in this combined environment. Passenger access, level boarding, ADA compliance and access for increased clearance consists have generated the need for this study. The pursuit of a safe reliable solution that can accommodate both passenger and freight operations will benefit the rail and transit industry. This selected alternative intends to address these needs and provide the solution being sought. The final determination of acceptance of the system will be addressed upon review of the performance data with the FRA, passenger rail operators and effected freight carriers.
Prototype - Power Life Edge for High Speed Rail Platforms

Pursing an automated solution to a long standing challenge

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Overview

1. Research Overview
2. Automated Life Edge Study Results
3. Scaled Demonstration
4. Next Steps
5. Questions / Recap / Next Steps

Background

PennDOT funded upgrade to Amtrak Keystone Corridor:
- Funded by FRA, FTA, and PennDOT
- Grade Crossing Eliminations, Interlocking Reconstructions, & Station Upgrades to meet ADA & improve operations

Norfolk Southern maintains track usage rights:
- Need to maintain wide clearance envelope at stations
- Specifically at planned new High Level Platforms for Coatesville & Middletown Stations

Background

1. GAUNTLET TRACK AT STATION SWITCHING OUTSIDE OF PLATFORM LIMITS.
   - 5,500 ft. new track w/ 2 electric switches & high level platforms
   - Total Est. Construction Cost: $6.3 M
   - 25 Year Life Cycle Cost: $4.7 M

   PROS:
   - Standard, ADA compliant platforms
   - Increased clearance envelope for freight traffic
   - Standard platform maintenance

   CONS:
   - Freight speed restrictions at Gauntlet
   - Significant additional infrastructure
   - High cost & work Class III

Options to Maintain Wide Load Clearance At High Level Platforms

2. GAUNTLET TRACK WITH MANUAL SWITCHES
   - 700 ft. new gauntlet track w/ 2 manual switches & high level platforms
   - Total Est. Construction Cost: $3.4 M
   - 25 Year Life Cycle Cost: $1.8 M

   PROS:
   - ADA compliant platforms with no modifications
   - Freight trains shifted to Gauntlet track will provide larger buffer from platforms
   - Standard platform maintenance

   CONS:
   - Major construction operation which would take place within rail bed
   - Additional track maintenance
   - Manual switch operation

Options to Maintain Wide Load Clearance At High Level Platforms

3. MINI-HIGH LEVEL PLATFORM - SETBACK
   - 75 ft high-level platform
   - 425 ft low-level platform
   - Switchback ramps w/ bridge plate
   - Total Est. Construction Cost: $1.5 M
   - 25 Year Life Cycle Cost: $0.125 M

   PROS:
   - ADA compliant platforms with no modifications
   - No track modifications
   - Standard platform maintenance
   - Low cost

   CONS:
   - Small ADA accessible boarding area
   - No level boarding for non-ADA passengers
   - Requires manual bridge plate operation

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Options to Maintain Wide Load Clearance At High Level Platforms

4. HIGH LEVEL PLATFORM W/ FLIP-UP EDGE
   - 500 ft. new high-level platform
   - 500 ft. manual flip up edge
   - Total Est. Construction Cost: $2.25 M
   - 25 Year Life Cycle Cost: $2.8 M

   PROS:
   - Allows continued use of freight trains on shared use track – no track modifications
   - Constructed from weather resistant common materials
   - Full length high-level ADA compliant platform

   CONS:
   - May feel unfamiliar and therefore unsafe to passengers, especially to those in wheelchairs
   - Manual moving parts will require regular maintenance
   - Requires railroad personnel for manual operation of retraction and deployment.

PennDOT Automated Lift Edge Study

- 10 options identified, studied, & ranked
- 11th option – Composite Breakaway also evaluated

Ranked Options
1. Powered Lift Edge
2. Manual Lift Edge
3. Vertical Rail Traverse
4. Accordion Fold Platform
5. Telescoping Edge
6. Flip-Down Edge
7. Drum and Spring conveyor
8. Mini High Platform
9. Swing-Out Cam Follower
10. Mini High Scissor Lift

Power Lift Edge: Performance Characteristics

- Hydraulically actuated raised edge:
  - Power lift edge components
  - Design will address:
    - Full ADA compliance
    - Passenger loads
    - Temperature changes
    - Ice on the platforms & de-icing chemicals
    - Collision impact

Power Lift Edge: Operations

- Pre-activation / audio visual alarm for passenger protection
- CCTV verification of operation
- In operating position, lift edge bears on structure locked hydraulically
- In stowed position, lift edge locked hydraulically and acts as passenger barrier

Power Lift Edge: Safety

- The platform in the stowed position provides the additional required clearance and acts as a safety barrier for passengers on the platform.
Power Lift Edge: 3D Model

Power Lift Edge Maintenance and Reliability

• System designed for all weather performance
• Hydraulic system chosen for durability & reliability
• Low pressure system using environmentally friendly fluids
• Harsh environment hardware
• Control system utilizes proven mechanical technology and sensor systems (ex., elevators, people movers, forklifts, hydraulic construction equipment …)
• Periodic inspections at prescribed intervals
• Maintenance program will follow industry protocols

Power Lift Edge: Cost

• Estimated Construction Cost:
  • $1.5M - $2.0M per station (assumes 2 – 500 ft. platforms)
  • Approx. $250K - $500K more than 1 full length platform with manual flip up edge
• Estimated Maintenance Cost:
  • $1.0M - $1.4M 25 year life cycle cost (2 full length platforms)

Prototype Automated Life Edge Study

Next Steps:
• Meet with Passenger and Freight Carriers for further review.
• Design standard movable hydraulic platform edge: design & specification, operating procedures, inspection program, and maintenance protocol

Timeframe: Fall/Winter - 2014
• Determine future action based on outcomes of research and response from carriers.

Questions / Discussion / Re-cap