3.4.2 HIGHWAY/RAILROAD AT-GRADE CROSSINGS

3.4.2.1 General

Highway/railroad at-grade crossings are locations where highways and rail lines cross each other at the same grade. Grade Crossing locations may present safety, design, cost and operational issues that must be considered when planning improvements to a route that hosts commuter and/or intercity passenger trains. At at-grade crossings, vehicles intersect and conflict with the normal path of train operations. As such, the probability of safety and operational issues at these locations is potentially higher than any other location along the railroad corridor. Potential issues must be reviewed and mitigated when designing and/or upgrading a highway/railroad at-grade crossing. These issues include (but are not limited to):

- Long term maintenance cost of the at-grade crossing track structure and highway surface
- Illegal moves by drivers around safety warning devices to foul the path of the train
- Delays to train operations and increased infrastructure costs resulting from incidents and damage to railway grade crossing appliances
- Delays to train operations resulting from damage to and/or malfunction of active warning devices
- Level access to the rail corridor for trespassers.
- Accommodations for pedestrians to crossing the rail corridor.

Consideration of the requirements for the construction, operations and maintenance of grade crossings must all be included early in the planning and design processes. Criteria for Class 5 track and below are provided for in the AREMA Manual Chapter 5 – Track, Part 8, Highway/Railway Grade Crossings. Criteria for Class 6 track and above provided for in the AREMA Manual Chapter 17, Part 3.4.2 Grade Crossings (USA).

Other useful references include:

- Railroad-Highway Grade Crossing Handbook https://www.fra.dot.gov/Elib/Details/L02829.
- The Manual of Uniform Traffic Control Devices (MUTCD), Chapter 8 for warning devices
- FRA High Speed Passenger Rail Safety Strategy (NOV 2009)
- Current Edition of Manual of Uniform Traffic Control Devices for Canada, Transportation Association of Canada (TAC).
- Current Edition of Grade Crossing – Handbook, Transport Canada, Ottawa, Ontario.
- Current Edition of Consolidation Grade Crossing Regulations, Canada Minister of Justice.
- Current Edition of Grade Crossing Standards, Transport Canada, Ottawa, Ontario.

A list of similar references can be found in AREMA Chapter 5 Bibliography.

3.4.2.2 Planning

When planning an improvement to an existing passenger rail corridor or developing a new corridor, special consideration should be given to reducing the number of at-grade public and private crossings to a practical and manageable amount. In new corridors with high speed passenger rail operations, serious consideration should be given to grade separating all highway/rail crossings. In most states railroad-highway grade crossings are regulated by a state agency. These agencies should be contacted early in the planning stage of the railway to ascertain if grade crossings will be allowed and the current regulations for them. In all cases a complete analysis of a proposed grade crossing or grade crossing elimination must be prepared with involvement by all stakeholders. In accordance with

the location of the crossing, the analysis should be done to FHWA, Transport Canada, and/or Manual on Uniform Traffic Control Devices (MUTCD) standards and include the overall crossing, highway approaches, railroad approaches and the environment.

3.4.2.3 Design

At a minimum, the designer should consider equipping all public at-grade crossings in a passenger rail corridor with active warning devices including flashing lights and gates and/or cantilevers obstructing the flow vehicular traffic. Active warning devices and other safety factors will be discussed amongst the diagnostic team consisting of the railroad and/or transit authority and appropriate state agency. The agency/authority has the ultimate decision regarding the decision to install active or passive warning devices. Enhanced safety appliance designs may include but are not limited to:

- Four-quadrant gate systems to block all lanes (these may include vehicle presence detection for dynamic exit gate operation to prevent vehicles from becoming trapped between the gates)
- Medians along the roadway to prevent gate run-arounds
- Pre-empted traffic signals to control traffic across the crossing and at adjacent intersections
- Queue cutter traffic signals to minimize cueing on railroad tracks (as well as near-side traffic signal heads to encourage vehicles to stop prior to the crossing)
- Pavement markings where warranted to guide motorists through the crossing (including "Do Not Stop on Tracks" signs and markings to discourage motorists from fouling the crossing)
- Fencing to limit access to the corridor from the roadway
- Flashing Lights & Gates

All these enhancements should be considered on a crossing by crossing basis. Active warning devices provide an alert to vehicular operations at the crossing. But as is the case with many roadway traffic control features, compliance is dependent on the vehicle operator. A driver can deliberately, or accidentally, make an illegal move to foul the path of an oncoming train. Additionally, active warning devices are complex electronic systems and may be connected to traffic signal systems. Any malfunction of the system in the safe mode can significantly impact train and vehicular operations.

The highway profile at a grade crossing is of particular concern. It should be designed to ensure passage of trucks with low ground clearances, so they do not become stranded.

Consideration must be given to the height of overhead contact wires at grade crossings. See Chapter 17 Part 3.4.2.3(d).

Special consideration should be given to at-grade crossings in proximity to passenger station stops. The following issues should be considered for these crossings:

- Grade crossings immediately downstream from the station will likely activate upon approach of the train even though the train would stop short of the crossings. This is due to the station stop being present within the grade crossing approach. In this case crossing gates will raise after a time then reactivate when the train departs. Multiple gate activations can have negative impacts to highway traffic operations.
- Trains approaching crossings after stopping at stations adjacent to crossings must comply with FRA and the owning and operating railroad's gate down times. A train's failure to comply with operating rules may affect proper operation of the signal system and any pre-empted traffic signals and can extend train schedules.
- Consideration should be given to providing key down systems controlled from the operator's cab

to provide an early actuation of grade crossing devices prior to departure from a station. The use of these systems at crossings near station stops can prevent extremely slow station departures and resulting delays and reduce the possibility of trains entering crossings prior to minimum regulatory and railroad gate down times.

Private at-grade highway crossings are typically covered by an agreement between the crossing owner and the railroad and/or transit authority. At minimum, per the requirements of the MUTCD these crossings should be equipped with passive warning devices such as crossbucks or other appropriate signage. Safety at these crossings can be enhanced by locked gate access or active warning devices. Alternate access may also be considered to the property to address concerns associated with the at-grade crossing. Costs for the design, installation and maintenance of private grade crossings are born by the private client.

The track stiffness transition that typically exists at a grade crossing should be addressed during design. This may be accomplished through use of varying tie spacing within the approach, use of ties with increasing length, track underlayment below the crossing surface or other methods approved by the railroad. The length of the transition should be determined by the maximum authorized speed for that track segment.

Surfacing materials for grade crossings should be specified which cannot be lifted or displaced by the wind created by high speed trains. Ballast is of particular concern and should be capped or eliminated for distances from the grade crossing which preclude damage from stones lifted by trains. Where ballast is used it should be properly regulated for at least 200 feet from either end of the crossing. Cast-in-place or precast concrete slabs, rubber or metal surfacing may be used where appropriate as determined during the diagnostic review.

If the cost benefit is justified, the preferred solution for providing access across a passenger rail corridor is a grade separation. Information on the design of grade separation structures can be found in Volume 2 of this manual. A grade separation, or a bridge over or under the railroad, provides unobstructed access for both vehicles and trains, improving traffic flow for each and eliminating the possibility for train-vehicle collisions and other related incidents. While the design and capital costs of a grade separation are likely higher than construction of a crossing at-grade, the ongoing maintenance costs, improvements to traffic flow, safety benefits, and elimination of potential incidents can outweigh those costs. The public cost benefits should be calculated as part of the justification for grade separation. Treatment of crossings should be a key cost component in the development of the capital and maintenance budget for a passenger rail project. Generally, the construction of a grade separated, elevated vehicular road is less expensive than depressing the roadway underneath the railroad. Although less expensive, the overhead road crossing causes more disruption to the railroad and may generate much opposition from the local community due to the aesthetics of an elevated road crossing a railroad.

3.4.2.4 Operations

FRA Track Safety Standards 49 CFR 213.365, 367 and 369 specify the minimum nature and frequency of visual inspections, special inspections and inspection records legally required for high speed rail track. In view of the significant risks at grade crossings, these inspections and records should include grade crossings and all the devices at or related to them.

FRA Track Safety Standards 49 CFR 234 specifies the minimum reporting, maintenance, inspection and testing legally required for all grade crossing signal systems. Consideration should be given by the railroad owner/maintainer to the provision of more frequent inspection and testing cycles to provide an additional level of safety beyond the legal minimum.

FRA Track Safety Standards 49 CFR 234 and 236 specify the signal safety standards regarding cab signaling and Positive Train Control (PTC).

In addition to the mandated inspection cycles, where reasonably possible the grade crossing protection and warning devices may include automatic diagnostic tests with reporting to the railroad operations control center and to trains approaching the crossing. When a malfunction is detected the appropriate maintenance team should be notified immediately.

3.4.2.5 Maintenance

A proactive maintenance cycle for all grade crossings and the associated safety devices should be planned and documented as part of the planning, design and construction process. Proactive maintenance activities include surfacing and regulating of the track on either side of the grade crossing, as well as maintenance of the roadway surface, the traffic control devices and pavement markings. Proactive maintenance includes actions necessary to ensure proper drainage. The maintenance program for a particular crossing depends on the property owner and operating railroads.

Proactive maintenance for grade crossings should include records of the date, time, location and nature of all inspection and maintenance activities. The records should identify the need for procurement of additional spare parts and materials and where they should be stored. Changes which may be required in staffing and/or training and qualifications should be noted. Planning for future maintenance activities must be documented and brought to the attention of management for budgeting.

FRA maintains an inventory of railroad grade crossings. Railroads are required to submit information to the National Highway-Rail Crossing Inventory about the crossings through which they operate. Highway-rail grade crossing accident/incidents must be reported to the FRA.

The maintenance plan should include an option for third party independent verification of maintenance activities for grade crossings.