AREMA
American Railway Engineering and Maintenance-of-Way Association

# Part 8

# Highway/Railway Grade Crossings[1]

## — 2013 —

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[1] References, Vol. 51, 1950, pp. 200, 800; Vol. 54, 1953, pp. 487, 1306; Vol. 62, 1961, pp. 359, 904; Vol. 75, 1974, p. 2; Vol. 84, 1983, p. 94; Vol. 88, 1987, p. 78.

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## SECTION 8.1 GENERAL AND INTRODUCTION (2006)

### 8.1.0 SCOPE (2006)

The fact that design values and practices for new construction or for the reconstruction of highway/railway at-grade crossings are presented in this Part does not imply that existing non-conforming crossings are unsafe, nor does it mandate the initiation of improvement projects. For projects involving rehabilitation, restoration, replacement, renewal, resurfacing or maintenance of existing tracks though crossings, crossing surfaces or roadway approaches to crossings, where major revisions to alignment, elevation or profile are deemed impractical or beyond the reasonable scope of the work being undertaken, existing design values may be retained, particularly if a site investigation indicates the existing design features are performing in a satisfactory manner for the normally anticipated traffic exercising due care. Absent other compelling factors, the cost of full reconstruction of these facilities solely to conform to the recommended practices contained herein, particularly on lower volume roadways, will often not be justified.

### 8.1.1 DEFINITIONS (2006)

For purposes of this Part the following definitions shall apply:

The terms “construction” and “constructed” refer to newly created facilities or the relocation of existing facilities to a substantially altered location or alignment.

The terms “reconstruction” and “reconstructed” refer to improvements undertaken for the primary purpose of increasing roadway or railway system capacity, such as widening the roadway or adding additional lanes, or the laying of additional tracks.

The terms “rehabilitation”, “restoration”, “replacement”, “renewal”, “resurfacing” and “maintenance” all refer to lesser improvements; work undertaken for the purpose of system preservation; or to maintain or restore facilities or features to a prior status, capacity or utility; and include the replacement of components other than in-kind when comparable materials are considered functionally obsolete, are not readily available, or when necessary or desirable to comply with changes in the track owner’s or operating railroad’s standard practices or procedures applicable to such work.

The terms “highway”, “roadway” and “street” may be used interchangeably and are presumed to have the same meaning irrespective of ownership, maintenance responsibility, or governing authority.

# SECTION 8.2 GUIDELINES FOR THE DESIGN, CONSTRUCTION OR RECONSTRUCTION OF HIGHWAY/RAILWAY AT-GRADE CROSSINGS (2013)

## 8.2.0 DESIGN-GENERAL (2006)

The decision to construct a new roadway facility at-grade across an existing line of railroad, especially a main line, or a new rail facility across an existing roadway, should not be taken lightly. While acknowledging the motoring public frequently has real and legitimate needs to have access across rail lines, careful consideration should be given to balancing public necessity, public convenience and safety.

In urban areas, and even many rural areas, it is frequently not necessary, and seldom in the best interests of either the public or the railroad, for every roadway or street to extend across the railroad. Quite often, traffic on some number of roadways in relatively close proximity can be channeled to a single point of access across the railroad without unduly sacrificing convenience. This common point of access can then be engineered, or re-engineered, to improve operations and reduce potential conflicts for each respective mode. Whenever it is deemed necessary to establish a new crossing in an area where other crossings already exist, consideration should be given to closing one or more existing crossings.

While it is necessary for the design of highway/railway at-grade intersections to recognize and accommodate the unique characteristics of each traffic mode, many of the basic strategies and recommended practices for the design of the intersection and appurtenances are not unlike those traditionally employed in the practice of roadway/roadway intersection design.

Each intersection approach, including through and across the intersection itself, should be designed and constructed so as to comply, as near as practicable, with the generally accepted design criteria (such as typical section, grade, profile, structural integrity, etc.) for the speed, traffic density and intended function of the respective route (References 2, 5, 8); however, since railroad design criteria relative to horizontal and vertical curvature, gradient and superelevation tend to be more restrictive than the corresponding criteria for roadway pavements, it is typically necessary and generally more economical to first establish the governing track geometrics and then design or adjust the roadway geometrics accordingly.

To the extent that economics may be a factor in highway/railway intersection design, especially when deciding whether an existing or proposed intersection should be at-grade or grade separated, such analyses should not be based solely on initial construction costs, but should additionally consider life cycle costs associated with maintenance, delays to traffic and potential collisions (both train involved and non-train involved), irrespective of whether said costs may be incurred by the track owner and/or operating railroad, the roadway agency or the traveling public. Generally, whenever a new roadway is proposed to be constructed or an existing roadway reconstructed across a rail line, or a new rail line is to be constructed across a roadway, and absent other consideration of rail or roadway system design requirements and/or the presence of potentially favorable terrain, if the crossing exposure index (the product of the average daily number of train movements and the projected average daily number of roadway vehicles over the crossing) exceeds 70,000 in rural areas or 290,000 in urban areas, further analysis of the economic feasibility of grade separation is indicated (Reference 7).

## 8.2.1 ROADWAY DESIGN AND GEOMETRICS (2013)

### 8.2.1.1 Crossing Location

The roadway designer should ascertain the speed, frequency and nature of train operations at or in the vicinity of a proposed crossing and endeavor to avoid crossing tracks at-grade where the crossing would be frequently blocked by standing or slow moving trains. Such locations to avoid would include at or in the vicinity of rail yards and terminals, switching leads, tracks used for meeting or passing trains, where helper engines are often used, and areas where trains are frequently held short of

yards, terminals, interlockings or switch tracks specifically to avoid blocking other crossings. When it is necessary to cross tracks at such locations, grade separation of the roadway and railroad is highly recommended. Existing highway/railway at-grade crossings in such locations should be eliminated by closure or grade separation whenever possible. Care should also be taken to avoid crossing tracks at-grade wherever turnouts, crossovers, rail crossings or railroad bridges would fall within the limits of or in close proximity to the crossing. New highway/railway at-grade crossings should never be established across designated high-speed rail lines or tracks equipped with electrified "third rails". Other railway related factors which should be considered in selecting the location of an at-grade crossing are track curvature and superelevation, track gradient, number of tracks and others as may be relevant to the design of intersections and the selection of appropriate system(s) of highway traffic control devices at the crossing. (References 3, 4 & 5)

### 8.2.1.2 Roadway Alignment

To the extent practicable, the roadway alignment should be tangent in the immediate vicinity of the railroad and intersect the track(s) at or nearly at right angles. The number of traffic lanes and the width of the roadway section, including shoulders, should be uniform on both sides of the crossing and, preferably, for at least 100 feet on either side. Bi-directional center turn lanes should be eliminated in the immediate vicinity of any highway/railway at-grade crossing by installing a raised median instead, designating for use in one direction only, or striping out entirely. Additional shoulder or embankment width should be provided in the immediate vicinity of the crossing as/if required for proper placement of crossing traffic control devices per the *Manual on Uniform Traffic Control Devices* (MUTCD) (Reference 4). Parking lanes should be eliminated in the crossing vicinity as needed to preclude parked vehicles from blocking approaching motorists' view of the crossing traffic control devices and/or an approaching train. Curb cuts, driveways and other public access to the roadway within close proximity to the crossing should be restricted. Consideration should be given to pedestrians and bicyclists, where practical, and to persons with disabilities. The alignment of newly constructed or reconstructed sidewalks or paths should be adjusted to cross the track(s) as nearly at a right angle as possible to minimize the possibility of bicycle tires or the small wheels on the front of wheelchairs from becoming caught in the flangeway.

### 8.2.1.3 Roadway Approach Pavement

Any crown or superelevation in the roadway section should be eliminated at or tapered into the crossing to match the grade and profile of the railroad track. Portland cement concrete pavements should be terminated a sufficient distance from the outer edge of the crossing surface, giving due consideration to both future track and crossing surface maintenance as well as the type and width of equipment to be used to compact asphaltic concrete material in the resultant "gap" between the rigid pavement and the crossing surface (See Article 8.4.10 of this Chapter). Poured in place Portland cement concrete pavements should not be used between tracks where track centers are 25 feet or less. The use of under-pavement headers is not recommended; however, if the pavement design selected includes provision for headers, the headers should be constructed a sufficient distance from the ends of the track crossties so as not to interfere with future track and crossing surface maintenance and replacement operations.

### 8.2.1.4 Crossing Elevation

When constructing or reconstructing the roadway approaches to a highway/railway grade crossing, or the track through the crossing, the elevation of the crossing should be established by mutual agreement between both the roadway's and railroad's engineers, giving due consideration to any anticipated settlement of the track under traffic following any re-ballasting or surfacing. Where multiple tracks exist, the tops of rails of all tracks should be brought to the same plane where practicable.

### 8.2.1.5 Roadway Approach Grades

When constructing or reconstructing the roadway approaches to a highway/railway grade crossing, the roadway surface should be constructed to be level with said plane through the tops of rails for a distance of at least 24 inches (preferably 60 inches or more) beyond the outer rail of the outermost track in each direction. The top of rail plane should be connected to the grade line of the roadway in each direction by vertical curves of such length as is consistent with the design criteria normally applied to the functional classification of the roadway under consideration. (Reference 5) It is desirable that the surface of the roadway be not more than 3 inches above or 3 inches below the elevation of the top of rail plane, as extended, at a point 30 feet from the outermost rail, measured at right angles thereto. Particular care should be taken to provide a roadway profile that will allow

any reasonably anticipated low clearance vehicular traffic to traverse the crossing without hanging up on the crossing or rails. If such profile is not practicable or feasible, it is recommended the governing roadway authority restrict and sign the crossing and roadway accordingly. The profiles of newly constructed or reconstructed sidewalks shall comply with the Americans with Disabilities Act (ADA) guidelines, if practicable.

### 8.2.1.6 Traffic Control Devices

Allowing for and providing appropriate system(s) of highway traffic control devices at and in the vicinity of highway-rail grade crossings, in accordance with the provisions of the Manual on Uniform Highway Traffic Control Devices, (MUTCD) Reference 4, is an integral part of the design of new or reconstructed crossings. Active grade crossing warning devices shall comply with the applicable portions of the AREMA *Communications and Signals Manual of Recommended Practices* and *MUTCD*. Care must be taken to coordinate the design and operation of any highway traffic control devices at the highway-rail grade crossing with other traffic control devices or systems at nearby highway-highway intersections so as to avoid queuing vehicles on or afoul of the highway-rail crossing and to allow any such traffic to clear the crossing in the event of a train movement. It should be noted that changes to an adjacent highway-highway intersection such as the addition of lanes, installation of a traffic control signal or construction of a roundabout may affect driver behavior at the highway-rail grade crossing. (See also Sections 8.6 and 8.7 of this Chapter and section 8C.09 of *MUTCD*.) Designs for roadways carrying two-way traffic and having three (3) or more traffic lanes (including turn lanes) in the same direction across a highway-rail grade crossing should provide for non-mountable raised center medians extending at least 50 feet (200 feet preferred) on either side of the crossing and of sufficient width to allow for the placement of additional crossing traffic control devices in the median (see AREMA *Communications and Signals Manual of Recommended Practices* Part 3 and *MUTCD* for additional information on requirements for minimum clearances). All public highway-rail grade crossings should be additionally equipped with advance warning signs, and all paved approaches to public highway-rail grade crossings should have pavement markings installed, in accordance with the recommendations of the MUTCD. Typically, such advance warning signs and pavement markings are the responsibility of the roadway authority. (References 1, 3, 4, 6)

### 8.2.1.7 Drainage Ditches and Culverts

Railroad trackbeds are commonly designed with shallow side ditches primarily intended to drain the trackbed itself. Wherever a roadway approach to a highway/railway crossing conflicts with the trackside drainage, a culvert or other drainage structure of appropriate material and size (15-inch minimum diameter) should be installed under the roadway approach at an elevation which permits unrestricted flow. Such culverts should also be of sufficient length and/or equipped with flared ends or headwalls to preclude collapse of the roadway shoulder at or around the culvert ends, including provision for such additional shoulder width as may be required to properly place traffic control devices. It should be noted such trackside ditches were generally not designed as interceptors for area-wide drainage, thus should not be presumed to be an adequate outlet for the roadway drainage.

### 8.2.1.8 Track Structure Through Highway/Railway Crossings

The track structure through the limits of a new or reconstructed highway/railway grade crossing should be constructed or reconstructed in accordance with Section 8.4 of this Chapter.

### 8.2.1.9 General Safety Regulations, Insurance, Flagging and Right-of-Entry Permits

Whenever performing roadway work on railroad owned property or within 50 feet of an existing railroad track, the roadway authority and/or its contractor(s) should confer, in advance, with the operating railroad and/or track owner relative to the operating railroad's and/or track owner's respective requirements for safety, flagging, insurance, right-of-entry permits (if required) or other as may pertain to the performance of the proposed work, and should be prepared to comply with same.

## 8.2.2 RAILWAY DESIGN AND GEOMETRICS (2013)

### 8.2.2.1 Track Location

While the railroad engineer tends to have limited flexibility to adjust the design elements (alignment, grade and elevation) of a new or relocated track specifically to accommodate a highway/railway grade crossing, to the extent any such flexibility does exist, every reasonable effort should be made to accomplish a comparable result. (Refer to Article 8.2.0 of this Chapter.) If it is not feasible to alter the track layout to sufficiently mitigate any resulting undesirable crossing features, then, to the extent practical, consideration should be given to adjusting, relocating or possibly closing the road. Depending upon the type of rail facility being designed and the nature and volume of traffic on the roadway, number of lanes, etc., grade separation may be appropriate.

### 8.2.2.2 Crossing Location

To the extent practical, newly constructed or reconstructed tracks should be designed to intersect the roadway at or nearly at a right angle and, preferably, at a location where the roadway is tangent. The location(s) of any turnouts or crossovers should be adjusted to avoid falling within the limits of, or unduly close to, the roadway and to minimize the number of tracks in the crossing. If multiple tracks are to be constructed "side by side" within the limits of the roadway, the elevations of the tops of rails should all fall as nearly as practical in the same plane. Except where train-operating speeds will be relatively low, sharp curves in the track in close proximity to the crossing should be avoided where possible. To the extent practicable, efforts should be made to avoid a condition where any required track superelevation runs opposite the grade of the roadway. If the highway/railway crossing is to be in close proximity to a railroad bridge, the bridge should be of a ballast deck design to facilitate future adjustments, as may be required, to the elevation and profile of the tracks(s) through the limits of the highway/railway crossing.

### 8.2.2.3 Track Elevation

The elevation of newly constructed or reconstructed tracks through a highway/railway at-grade crossing should be established by mutual agreement by the railroad's and roadway's engineers and arrangements made to adjust, to the extent practical, the roadway approaches so as to conform with Articles 8.2.1.4 and 8.2.1.5 of this Chapter.

### 8.2.2.4 Traffic Control Devices

Where newly constructed or reconstructed tracks cross a public roadway at-grade, arrangements should be made to install appropriate system(s) of highway traffic control devices at and in the vicinity of the highway-rail grade crossing, in accordance with the provisions of the MUTCD and subject to any applicable State or local agency requirements and approvals. (See Article 8.2.1.6 of this Chapter).

### 8.2.2.5 Drainage

Where newly constructed or reconstructed tracks cross an existing roadway at-grade, care should be taken to avoid compromising the roadway drainage by placing culvert pipes or other appropriate drainage structures as/if needed in the roadway side ditches under the track. Any culvert pipes under the track(s) should conform to the requirements of Part 4 of Chapter 1 of this Manual as to material specifications and depth of cover.

### 8.2.2.6 Track Structure Through Highway/Railway Crossings

The track structure through the limits of a new or reconstructed highway/railway grade crossing should be constructed or reconstructed in accordance with Section 8.4 of this Chapter.

### 8.2.2.7 Highway Work Zone Traffic Control, Insurance, and Permits

Whenever performing track or crossing surface work through the limits of a public roadway, the operating railroad, track owner and/or railroad contractor should confer, in advance, with the roadway authority relative to their requirements for a

Temporary Traffic Control Plan or other work zone traffic control (see *MUTCD* Part 6 and Section 8A.08), insurance, permits (if required) or other as may pertain to the performance of the proposed work within the limits of the roadway, and should be prepared to comply with same (see Article 8.4.1 of this Chapter, however, relative to full roadway closure).

## SECTION 8.3 GUIDELINES FOR THE REHABILITATION OR MAINTENANCE OF HIGHWAY/RAILWAY AT-GRADE CROSSINGS (2013)

## 8.3.1 ROADWAY APPROACH REHABILITATION AND MAINTENANCE (2013)

### 8.3.1.1 General

Projects involving rehabilitation, restoration, replacement, renewal, resurfacing or maintenance of existing roadway approaches to a highway/railway grade crossing should be planned and executed, to the extent reasonably practicable, to conform to the provisions of Article 8.2.1 of this Chapter; however, whenever doing so would require revisions to the roadway alignment, elevation or profile which are deemed impractical or beyond the reasonable scope of the work being undertaken, such work should conform with the applicable standards and practices of the governing roadway authority and/or regulatory agency having jurisdiction for the scope of work being performed. Any such roadway approach work not being performed concurrent with the rehabilitation, restoration, replacement or renewal of the crossing surface should be planned and executed such that the resulting roadway surface conforms, as nearly as practical, to the elevation and profile of the existing track(s) and crossing surface(s).

### 8.3.1.2 Coordination with Railroad

Should projects involving rehabilitation, restoration, replacement, renewal, resurfacing or maintenance of existing roadway approaches to a highway/rail grade crossing require adjustments to the crossing surface (crossing width, track elevation, or other) or to other railroad owned or maintained facilities, it is incumbent upon the roadway engineer or roadway authority to communicate such plans to the respective railroad operating company or track owner sufficiently in advance of the work to allow for proper and timely coordination, including reaching a mutual agreement as to scope of work, materials to be used, work schedule(s) and division of costs.

When the nature of these adjustments impacts the compliance with *MUTCD*, State, local or railroad standards, corrective action should be taken. Where extensive corrective action is required, a diagnostic team may be convened to assure compliance with all applicable standards. Examples of adjustments requiring corrective action include:

a. Roadway geometric changes affecting width, crossing angle or elevation of the traveled way, such as:

   (1) Lateral clearances of traffic control devices including crossbuck assemblies or active warning devices

   (2) Vertical Clearances affecting overhead flashing light signals or height of gate arms

   (3) Modifications impacting the effectiveness of curbing

   (4) Modification or addition of lanes requiring changes or additions to traffic control devices

   (5) Modification or addition of shoulders requiring changes or additions to traffic control devices

   (6) Conversion of existing pavement width for alternative uses requiring changes or additions to traffic control devices

   (7) Changes to the width or crossing angle of the traveled way requiring adjustments to railroad signal circuits

b. Addition or modification of sidewalks or pathways

c. Addition or modification of guardrails or barriers

d. Improvements to roadways that affect the traffic volume or patterns

e. Addition or Modification of utilities in the vicinity of the crossing

#### 8.3.1.3 General Safety Regulations, Insurance, Flagging and Right-of-Entry Permits

Article 8.2.1.9 of this Chapter is incorporated herein by reference.

## 8.3.2 TRACK AND CROSSING SURFACE REHABILITATION AND MAINTENANCE (2006)

#### 8.3.2.1 General

Projects involving rehabilitation, restoration, replacement, renewal, resurfacing or maintenance of existing track(s) and/or crossing surface(s) through a highway/railway grade crossing should be planned and executed, to the extent reasonably practicable, to conform to the provisions of Article 8.2.2, Section 8.4 and Section 8.5 of this Chapter; however, whenever doing so would require revision(s) to the track alignment, track elevation and/or track profile which are deemed impractical or beyond the reasonable scope of the work being undertaken, such work should conform with the applicable standards and practices of the operating railroad, track owner and/or regulatory agency having jurisdiction for the scope of work being performed. Any such track or crossing surface work not being performed concurrent with the rehabilitation, restoration, replacement or renewal of the roadway approaches should be planned and executed such that the resulting crossing surface conforms, as nearly as practical, to the elevation of the existing roadway approaches or arrangements made to correspondingly adjust the roadway approaches. When such adjustment(s) consist of placing tapered overlays on the roadway approaches, such tapered overlays should typically extend, perpendicular to the railroad, at least 10-feet beyond the outside edge of the crossing surface or end of tie for each 1-inch of track raise above the pre-existing pavement elevation, or as otherwise deemed practical considering pre-existing conditions.

#### 8.3.2.2 Coordination with Roadway Authority

Should projects involving rehabilitation, restoration, replacement, renewal, resurfacing or maintenance of existing track(s) and/or crossing surface(s) through a highway/railway grade crossing require adjustments to the roadway approaches, it is incumbent upon the railroad engineer or person in charge of the work to communicate such plans to the respective roadway authority sufficiently in advance of the work to allow for proper and timely coordination, including reaching a mutual agreement as to scope of work, materials to be used, work schedule(s) and division of costs.

#### 8.3.2.3 Highway Work Zone Traffic Control, Insurance, and Permits

Article 8.2.2.7 of this Chapter is incorporated herein by reference.

# SECTION 8.4 THE TRACK STRUCTURE AS CROSSING FOUNDATION (2013)

## 8.4.1 GENERAL (2006)

Where roadways and railroad tracks intersect at grade, the track structure itself (ties, rail, ballast, etc.) serves as the foundation for the crossing surface which, in effect, is essentially an extension of the roadway surface across the tracks. Thus, in addition to its customary function of carrying and supporting rail traffic, it must also carry and support the roadway traffic. While the weight of roadway vehicles is often a fraction of the weight of rail vehicles, the impact effects of such roadway loading,

especially from heavy trucks, can be considerable. As such, the track through an at-grade crossing should be engineered and constructed with this additional loading in mind. Particularly on lighter density, low speed tracks, if extending the life of the crossing and/or reducing the need for maintenance is a concern, it is often advisable to construct the track through the limits of the crossing with heavier materials than may be specified for the remainder of the track.

It should also be recognized that conventionally constructed railroad trackage, particularly in North American freight service, by design, experiences considerably greater deflection under load than typical roadway pavements. Also, the differing level of live loads experienced by these respective structures often results in correspondingly different rates of subsidence. As such, where roadways and railways intersect at-grade, particular attention should be paid to the interface of the track and the roadway pavement along the vertical plane coincident with the ends of the track crossties.

Considering the current state of the practice relative to constructing, reconstructing, replacing, renewing and/or rehabilitating conventional railroad trackage, it should be recognized by rail and roadway personnel alike that attempts to do other than nominal highway/railway grade crossing maintenance within the limits of an existing roadway absent a full roadway closure are highly likely to result in less than satisfactory results requiring more frequent track and/or crossing maintenance and repeated roadway traffic disruptions. Thus, whenever such work is being undertaken, every effort should be made by the roadway authority to allow full closure of the roadway during the reasonable progress of such work.

## 8.4.2 DRAINAGE (2006)

In situations where the grade of the roadway approach descends toward the crossing, provisions shall be made to intercept surface and subsurface drainage and direct it laterally so that it will not be discharged on the track or pond adjacent to the track. Surface ditches shall be installed. All drainage areas should be cleaned and sloped away from the crossing in both directions along the track and the roadway. If required, subdrains with suitable inlets and the necessary provisions for clean-out shall be made to drain the subgrade thoroughly and prevent the formation of water pockets. This drainage shall be connected to a storm sewer system, if available; if not, suitable piping, geotechnical material and/or French drains shall be installed to carry the water a sufficient distance from the roadbed(s). Where gravity drainage is not available, a nearby sump may provide an economical outlet, or the crossing may be sealed and the roadbed stabilized by using asphalt sub-ballast or its equivalent.

## 8.4.3 SUBGRADE (2006)

The track subgrade should be cleaned of any old contaminated ballast and bladed to a uniform plane (with at least a ¼" per foot cross slope for drainage) a minimum of 12 inches below the bottom of tie, extending at least 20 feet beyond each end of the crossing and at least 1 foot (3 to 5 feet preferred) beyond the ends of the ties. In addition, it is recommended the subgrade be over-excavated to allow for a minimum of 6 inches of well compacted sub-ballast material to be installed below the ballast. A compacted layer of hot mix asphalt, typically 4 or more inches thick, may be substituted for the sub-ballast.

## 8.4.4 GEOTECHNICAL FABRIC (2006)

A geotechnical fabric may be used between the subgrade and ballast section. If used, it should extend at least 20 feet beyond the end of the crossing, and if a rail joint falls within these limits, at least 5 feet beyond the rail joint. If practical, the geotechnical fabric should extend under the roadway surface 10 feet or more each way from the centerline of track.

## 8.4.5 BALLAST (2012)

Clean ballast conforming to AREMA Chapter 1, of at least the same quality or better as that specified by the track owner or operating railroad for the track beyond the limits of the crossing, should be placed between, on the ends, and under the ties and sub-ballast.

### 8.4.6 TIES (2013)

New treated (nominal 7”x 9”) hardwood, concrete, steel, or composite ties, conforming to the specifications contained in Chapter 30 of this Manual for use in heavy haul freight service, should be used through the crossing and a minimum of 20 feet beyond each end of the crossing. Length, surface plane, spacing and type of ties should conform to the type of grade crossing surface materials being used and the respective surface material manufacturer’s recommendations. Ties must uniformly support the crossing surface material.

### 8.4.7 TIE PLATES, SPIKES, ANCHORS (2007)

All ties through the crossing and at least 20 feet beyond each end of the crossing should be fully plated with double shoulder tie plates. Unless an elastic fastener system is used, all ties should be spiked with at least 3 line-holding spikes (double spiked on gage side of rail) per tie plate and at least 2 plate holding spikes per tie plate and all ties through the crossing should be fully box anchored. Optional placement of tie pads is acceptable with cut spike fastener systems. It is recommended that elastic fasteners through rail crossings be treated with a corrosion resistant treatment.

### 8.4.8 RAIL (2006)

The rail section should, at a minimum, be 115 lb through the crossing area, and so laid to eliminate all joints within the crossing and for a distance of at least 1 foot for each MPH of maximum authorized train speed, but in no case less than 20 feet, beyond each end of the crossing. Where necessary, long rails shall be used or the rail ends welded to form continuous rail. If active grade crossing signals requiring an island circuit are present, there should be no joints within the island circuit. Any insulated joints required within the limits herein specified should be glued, bonded joints. The use of non-control cooled rail and rail sections known to have a higher tendency of developing head and web separation failures (e.g., 112 lb., 131 lb., etc.) should be avoided through highway/railway grade crossings. Similarly, the use of rails turned sideways (mudrails) or other rigid materials should not be used as flangeway fillers in highway/railway grade crossings as these also increase the likelihood of developing head and web separation failures in the running rails.

### 8.4.9 LINING AND SURFACING TRACK (2006)

Rails should be spiked to line and the track mechanically tamped and surfaced to grade and alignment as described in Articles 8.2.1.4, 8.2.1.5 and 8.2.2.3 of this Chapter.

### 8.4.10 REMOVING AND REPLACING TRACK (2006)

Where the track structure is to be constructed or replaced through the limits of an existing roadway, the pavement should be cleanly saw cut a minimum of 42 inches, and desirably 60 inches or more, from the outer ends of the ties, and the roadway pavement and base excavated to a depth consistent with the depth of ballast removal. Once the track panel has been placed, ballast section constructed and track surfaced and lined, a separation fabric may be placed to protect the ballast section. Appropriate roadway base stone should then be placed in lifts and firmly compacted with an appropriate roller or vibratory compactor prior to reestablishing the roadway pavement. This will aid in preventing the settlement which often occurs adjacent to the crossing surface.

## SECTION 8.5 CROSSING SURFACE MATERIAL SELECTION AND INSTALLATION (2006)

### 8.5.1 CROSSING SURFACE MATERIALS (2006)

Any crossing surface material may be used on any crossing at the discretion of the track owner or operating railroad, or as recommended by a diagnostic evaluation of the crossing, however, the use of unconsolidated crossing materials (ballast, dirt,

gravel) should generally be avoided at public crossings or on main tracks. Specifications and plans concerning the crossing surface material and usage should conform to the manufacturer's recommendations and/or the track owner's or operating railroad's specifications and plans and, where applicable, to the standards of the governing roadway authority. Manufactured crossing surface materials should be designed and fabricated to be substantially flush with the tops of rails when newly installed, giving due consideration to the rail height, tie plate thickness, fastening system, and anchor system and whether tie pads are to be used. Grade crossing surface systems, including any flangeway (gage or field side) filler material components, must be electrically non-conductive so as not to interfere with train control or crossing signals.

### 8.5.2 WIDTH OF CROSSING (2006)

The crossing shall be of such width as prescribed by law, but in no case shall the width be less than that of the adjacent traveled way plus 1 foot on each side as measured perpendicular to the roadway. Where sidewalks are present and the separation between the edge of the traveled way and near edge of the sidewalk is less than 8 feet, the sidewalk crossing surface shall be of the same type as the roadway crossing surface and shall be continuous to the back of the sidewalk.

### 8.5.3 FLANGEWAY WIDTH AND DEPTH (2006)

For newly constructed or newly reconstructed highway/railway crossings, flangeways not less than 3 inches in width should be provided. This width may be reduced at the discretion of the operating railroad if the track is used exclusively by transit or other captive (non-interchange) equipment. Flangeways shall be at least 2 inches in depth unless approved by the operating railroad.

## SECTION 8.6 LOCATION OF PARALLEL RAILWAYS AND HIGHWAYS (2013)

### 8.6.1 GENERAL (2009)

a. Instances occur where new highways may need to be constructed parallel to existing railroads, or new rail lines may need to be constructed parallel to existing highways. The closer such facilities are to each other, the greater the potential for highway-rail conflicts caused by either a desire for rail service by a user located on the other side of the highway, or property owners on the other side of the rail line desiring access to the highway. The former will result in rail spurs being constructed across the highway at-grade, the latter in perceived need for additional roadway crossings of the rail line at-grade.

b. To reduce conflicts and inconveniences, the following principles are recommended for the guidance of railroads, highway agencies, planners, and developers. These principles provide guidance for new or expanded road and rail facilities located and designed with proper attention to capacity, operations and safety. The purpose of these recommended practices is to reduce and minimize the construction of highways and railroads with less-than-desirable criteria or in close proximity to one another.

c. Even though there may be no immediate plans for land use changes in the area in question, but topographic or other factors do not preclude development, consideration should be given to factors which would affect or encourage future development. Adequate space for such activities should be reserved between the highway and the railroad to accommodate such uses.

d. It is also desirable to locate railroad tracks and parallel highways sufficiently distant from each other in the vicinity of highway-rail grade crossings to avoid negatively impacting grade crossing safety and operations. Allowances should be made for future grade separation of the highway-rail crossing, or, where such grade separation is not likely to be feasible or warranted, then as needed to address any anticipated present or future needs for highway storage distance, accommodation of traffic queues, and coordination of traffic control between the highway-rail crossing and any adjacent highway-highway intersections.

## 8.6.2 TRAFFIC IMPACT STUDIES (2009)

a. Railroad marketing and industrial development departments are often aware of present and future business potential on a site or sites which may be developed. Upon request, rail planning, operating and engineering personnel can work in partnership with community and regional transportation planners to define potential needs for rail access; room for switching operations; car loading and storage; and lead tracks or other rail improvements to accommodate present and future rail users on a site.

b. State Highway and Transportation agencies, and many local jurisdictions, require a site "traffic access and impact study" as a condition of issuing licenses or permits to developers who wish to add or remodel facilities which will have access from the street or highway system. This is a tool used to assess the effect a particular development or developments will have on the surrounding transportation network. It specifies what provisions are needed for safe and efficient highway access and smooth traffic flow. The product of the study is a report, prepared by and under the supervision of a registered Professional Engineer, which describes the type of access and the scope of required roadway improvements required to accommodate the development or developments on the site at "build-out". The report should be prepared in accordance with the latest edition of *Transportation Impact Analyses for Site Development* (ITE Journal February 2006), published by the Institute of Transportation Engineers (ITE); with the latest editions of *Trip Generation* (7th Edition, 2003) and *Trip Generation Handbook* (2nd Edition, 2004), published by the Institute of Transportation Engineers (References 10, 11 & 12) and with the specific requirements of the transportation or planning agency having jurisdiction. Such studies and reports should also consider the likely traffic impacts at nearby highway-rail grade crossings and any resultant needs for safety improvements or alterations thereat.

c. Where proposed land development will require additional public roadway access across an existing line of railroad to reach a parallel highway, any resultant impacts on existing and future railroad operations must be fully considered. Should creation of a new public highway-rail crossing be required, consideration should be given to grade separation, closing one or more nearby crossings, or locating the proposed development on an alternate site, as determined to be in the best interest of all concerned parties.

d. Where a community has developed along the main line of a railroad, and there are numerous street crossings of the tracks, the traffic access and impact study should expressly consider the consolidation of crossings and the use of the remaining streets to serve as outlets to the surrounding highway system. The concentration of traffic to a few desirable routes may permit physical improvements to intersections, traffic signalization, highway-rail grade separation, or other projects which may not otherwise be justified.

## 8.6.3 GENERAL DESIGN CRITERIA (2013)

a. The recommended practices for the design of the railroad facilities can be found in this Manual and the AREMA *Portfolio of Trackwork Plans*.

b. The criteria for the design of the highway facilities can be found in the publication, *A Policy for Geometric Design of Highways and Streets*, also called the "Green Book", published by the American Association of State Highway and Transportation Officials (AASHTO) (Reference 5); and state or local agency design directives and manuals. The chosen design should reflect the results of the access and impact study.

c. The requirements for highway traffic control devices approaching or at a public highway-rail or pathway-rail grade crossing can be found in the *Manual on Uniform Traffic Control Devices* (MUTCD) published by the Federal Highway Administration (FHWA)and the AREMA *Communications & Signals Manual of Recommended Practices*. (References 1 & 4)

d. Where the results of the traffic access and impact study indicate that traffic queues may extend from a signalized intersection to or across a highway-rail grade crossing, the traffic signals should be preempted by the grade crossing warning system in accordance with the MUTCD (see AREMA *Communications & Signals Manual of Recommended*

*Practices* Part 3 and the latest version of *Preemption of Traffic Signals near Railroad Crossings*, published by ITE (Reference 6)).

e. Highway traffic volumes and operations at non-signalized highway-highway intersections near the rail line should be reviewed for their effect on nearby highway-rail grade crossings and engineering improvements should be identified and considered.

f. Arterial highways parallel to the tracks and serving residential or commercial areas should be a sufficient distance from any highway-rail grade crossing, as established by the traffic access and impact study, to permit the queuing of traffic at a signalized highway-highway intersection between the railroad and the intersection without occupying the track.

g. Arterial highways parallel to the tracks should be a sufficient distance from any highway-rail grade crossing to permit grade separation of the highway-rail rade crossing in the future as may be required by additional development or future changes in highway and/or rail traffic.

h. The number of public highway-rail grade crossings of a main track within a given area should be minimized. It is desirable that such crossings be located no closer than ½ mile apart, measured along the tracks.

i. Highway-rail grade crossings with steep approach grades within the study area should be identified for potential elimination or correction. Care should be taken during highway or railroad construction or reconstruction that steep approach grades at crossings not be created or made worse.

j. Highway-rail grade crossings of main-line railroad tracks within industrial facilities are discouraged.

k. Where possible, industrial facilities, multimodal or bulk terminals, warehousing, or port operations should be located between the through highway and the railroad main line. This will permit the development of the property without having spur or service tracks cross the public highway or street.

l. Where service or spur tracks must cross a public highway at-grade, the crossing should be made as close to 90 degrees as practical, but not recommended less than 75 degrees. The installation of active traffic control devices and illumination should be considered. The highway-rail grade crossing should be located, or lead, storage or other tracks should be placed, so that switching or car spotting does not require that cars or locomotives be stopped on or near the crossing. The layout of the tracks or the rail operations should be so planned that industry or railroad employees are not required to be on the ground or exposed to traffic at or near the highway.

## 8.6.4 PHYSICALLY RESTRICTED AREAS (2009)

a. Where highways must be located adjacent to railroad tracks due to physical restrictions, they shall be designed and constructed so as to not interfere with the railroad roadbed or ballast section. Provision must be made for a subgrade cross section of the track or tracks adequate to encompass space for such items as the following:

(1) Railroad wayside signals, sign and appurtenances

(2) Crossing traffic control devices

(3) Railroad pole lines and catenary structures

(4) Buried facilities, such as fiber optics or other communications lines

(5) Drainage, including ditches and culverts

(6) Utilization of off-track equipment

(7) Signal cases or bungalows

(8) Railroad maintenance activities, such as tie and surface operations

b. Where it is possible that errant highway vehicles may intrude onto the track, barriers meeting the applicable criteria for strength and safety shall be placed to prevent highway vehicles from fouling the track or otherwise damaging railroad facilities or interfering with train operations. The design and placement of barriers must conform to the current edition of the *Roadside Design Guide,* 3rd Edition (2002), published by AASHTO. (Reference 9)

c. Provisions should be made for snow removal and/or storage, and ice control.

## 8.6.5 LIMITED ACCESS HIGHWAYS (2009)

a. A limited access highway may be defined generally as a highway especially designed for through traffic and to which abutting property owners have no right of access. Access may be had only at specified locations.

b. In some instances these access restrictions are modified to the extent that such access may be had by abutting owners as is reserved pursuant to the map and description of lands to be appropriated. Service highways, to provide access to and from areas adjacent to a limited access highway, may also be provided if they are deemed necessary in the public interest.

c. Any abutting property owner has an inherent right of entry to and from a public highway. In establishing limited access highways, this inherent right of abutting owners must be acquired from the owner by purchase, gift, agreement or condemnation. A railway as a property owner may therefore assert its right of access to a limited access highway that abuts its property, and seek a form of compensation for such loss of rights.

d. Highway-rail grade crossings are not permitted on highways designed for access control.

e. Where no usable property exists between the limited access highway and a parallel line of railroad, and no other reasonable means exists for the railroad to access its property for maintenance purposes, a locked gate access from the limited access highway may be appropriate.

f. Where usable property does exist between the limited access highway and a parallel line of railroad, the highway designer should endeavor to provide alternate access to the affected property which minimizes the need for at-grade highway-rail crossings.

# SECTION 8.7 LICENSE OR EASEMENT APPLICATIONS (HIGHWAY – STREET – ROADWAYS)[1] (2012)

## 8.7.0 DEFINITIONS (2012)

For purposes of this Part, terms are defined. These terms may apply to aerial, at-grade, or under grade activity.

The term “license or permit” means a written authorization, whereby a certain activity is granted. Usually a license / permit includes conditions and a fee, either a one-time payment or periodic. Licenses / permits may be cancelled by either party, sometimes on short notice, as defined in the license or permit.

[1] References, Vol. 56, 1955, pp. 378, 1045; Vol. 57, 1956, pp. 328, 953; Vol. 58, 1957, pp. 441, 1140; Vol. 63, 1962, pp. 185, 732. Reapproved without change 1962.

The term "easement" means an agreement whereby a property owner authorizes use of some or all of a property. An easement attaches a right of use to the property. Usually an easement includes conditions, fees, and is legally recorded. An easement may have a set time period.

The term "designer" means a party who is in charge of a project that proposes project work.

The term "owner" means a party who owns real property. The owner may be a railroad or other party.

The term "permittee" means a party who seeks or possesses authorization for activity on the real property of an owner.

The terms "engineering agreement" or "preliminary engineering agreement" are used to define an agreement between the railroad and an outside party for the design phase of a project whereby the railroad begins a financial account for its services. This agreement may include right of entry permission. The purpose is to identify how the proposed project affects railroad facilities (such as track, signaling, operations, and safety), identify design criteria (including clearances), and identify other project specific considerations.

The term "construction agreement" is used to define an agreement between the railroad and an outside party for the construction phase of a project whereby the railroad prepares a material and work force account estimate and a scope of work. Conditions set forth in a construction agreement usually identify construction activity; project duration; identification of construction forces, maintenance responsibilities, and flagging/safety requirements; insurance requirements; and may include negotiated agreements, licenses, and other permits.

## 8.7.1 PURPOSE (2012)

The purpose of this section is to notify the designer who proposes opening, closing, or modifying crossings (at grade or grade separated) that coordination may be necessary with several entities, including but not limited to the railroad, the state public agency in charge of regulating grade crossings, and utility companies. Depending on the nature of the proposed work, agreements, licenses, easements and/or other permits may be required.

Refer to AREMA Chapter 1, Part 5, Pipelines for additional information regarding crossings of pipelines.

## 8.7.2 GENERAL (2012)

a. The real estate department or the public projects department of the railroad is usually the contact point to begin the coordination process with the railroad. The railroad should be provided with a conceptual plan and anticipated project schedule as early as possible in the design process. It may be necessary for the owner and the permittee to enter into an engineering agreement.

b. Each state may have one or more agencies charged with regulation of public grade crossings. These agencies may be a utility commission, a commerce commission, department of transportation, or a local road authority. Federal requirements should also be considered.

c. Any entry onto railroad property will require permission of the railroad. Some owners may require right of entry permits that must be obtained prior to entry upon property. Some railroads require all who enter its property to complete railroad safety training.

d. Utility facilities may be present within the project limits. The designer should be aware that agreements may be in place between the utility company and other parties that include special considerations. The designer should contact the utility company early in the design process to make allowances for proper protection of those facilities.

e. Temporary use of property for construction purposes must be negotiated with the owner and operating railroad. Use of property for any purpose, including but not limited to, surveying, locating utilities, geotechnical activity, maintenance activities or any temporary or permanent construction, must be negotiated with the owner and operating railroad.

f. Upon approval of final plans and cost estimate, the appropriate license, easement, permit and/or a construction agreement will be prepared.

g. Upon regulatory agency approval and execution of the appropriate final agreements, construction can begin.

## 8.7.3 GENERAL PLANS & SPECIFICATIONS (2012)

### 8.7.3.1 Design

The designer should not overlook the railroad when gathering initial project information. Valuation mapping (right-of-way, track charts, station maps) and utility agreements from the railroad can provide useful information of property limits, property improvements, and utility locations. Most railroads have design criteria related to clearances, drainage and hydrology, pipe size and material, utility locations, grade crossing surface type and installation, and overpass/underpass structures including column thicknesses and crash walls.

The format and content of project documents will vary depending on the railroad and the public agency with jurisdiction. But, typically, information provided to the railroad for review should include the following:

a. Plans

(1) Information such as railroad property lines; property improvements such as tracks, signals, buildings, and pole lines; and utility locations and depths.

(2) USDOT/AAR grade crossing inventory number of each grade crossing within the project limits.

(3) Boundary of the property to be used by license, permit, or agreement.

(4) Distance to the nearest railroad milepost and milepost number and latitude and longitude coordinates, if available.

(5) Centerline of track or tracks.

(6) Current and proposed drainage structures.

(7) Proposed roadway improvements.

(8) Horizontal and vertical clearances from center of nearest track, top of rail (outside rail if track geometry is curved).

(9) Permanent and temporary traffic control devices and markings, including signals, foundations, cabinets, overhead wires, and underground conduits.

(10) Work zone traffic plans including detours, diversions, closures, flagging, and durations.

(11) Phased or staged construction.

(12) Location and boundaries of property to be used both temporary and permanent either by license, permit, or agreement. of any construction or temporary license, permit, or agreement areas.

b. Profiles

(1) Roadway centerline profile showing current and proposed grades.

(2) Roadway cross slope and transitions.

(3) Top of rail elevations of each track at road centerline and edges.

(4) Top of rail elevations within the project limits and at least 500 feet outside of project limits.

(5) Ditch elevations and grades.

c. Drainage

(1) Details and calculations of current and proposed drainage hydraulics and hydrology.

d. Sections

(1) Cross sections with currently existing ground and proposed track roadbed and ditches.

(2) Cross sections with currently existing ground and proposed roadway and ditches.

(3) Typical sections of proposed track, roadway, and ditches.

e. Property

(1) If requested, a plat, usually 8.5” x 14”, showing property to be used by license, permit, and or easement.

f. Contract Documents

(1) Supplemental special provisions for work on railroad property.

(2) Specifications for the portions of work that will affect or occupy railroad property.

g. Design and Construction Changes

(1) Work zone traffic plan changes

(2) Shoring plans

(3) Demolition plans and schedule

(4) Plan revisions or changes

(5) Other contract document changes

### 8.7.3.2 Submittals

The following is a typical sequence of submittals to the railroad, which should be submitted electronically, if possible:

a. Conceptual plan and project schedule.

b. License, permit, or agreements with applicable fees.

c. Initial plans, specifications, and calculations for railroad review.

d. Final plans, specifications, and calculations.

e. Final right of way or easement plats.

f. Design and construction changes submittals.

g. Construction agreement with insurance certificates and applicable fees.

h. Request for railroad flagging including dates and durations.

## SECTION 8.8 REFERENCES (2009)


1. Current Communications and Signals Manual of Recommended Practices, American Railway Engineering and Maintenance of Way Association (AREMA) Landover, MD.

2. Geometric Design Criteria for Highway-Rail Intersections (Grade Crossings), Institute of Transportation Engineers (ITE), Washington, D.C.: Publication No. IR-110, April, 2001.

3. Guidance on Traffic Control Devices at Highway Rail Grade Crossings, US Department of Transportation, Washington D.C. December,2002. Ayers, D.J., Unstable track formations respond to bituminous spray treatment, Railway Gazette International 128, n. 7, July 1972, p.263-264.

4. Manual of Uniform Traffic Control Devices, 2003 Edition, (FHWA), Washington, D.C.

5. A Policy on Geometric Design of Highways and Streets, American Association of State and Highway and Transportation Officials (AASHTO), Washington D.C.:2000 Edition.

6. Preemption of Traffic Signals near Railroad Crossings, Institute of Transportation Engineers (ITE). Washington D.C.: Recommended Practices, Item RP-025A (January 2006).

7. A Procedure for the Provision of Highway-Railroad Grade Separations, TransTech Group, Inc., G. Rex Nichelson, Jr. and George L. Reed, April 2001 (see Proceedings of the 2008 Rail Corridor Safety Conference, A Railroad Runs Through It, May 12-14, 2008). A link to download the full study is: www.TransTechGroupInc.com/paper.

8. Railroad-Highway Grade Crossing Handbook, 2nd Edition Revised (2007) Federal Highway Administration (FHWA), Washington D.C.: Publication No.FHWA-TS-86-215.

9. Roadside Design Guide, (2002) American Association of State and Highway and Transportation Officials (AASHTO), Washington D.C. 3rd Edition.

10. Transportation Impact Analyses for Site Development. Institute of Transportation Engineers, Washington D.C. (ITE) An ITE Proposed Recommended Practice. ITE Journal, (February, 2006).

11. Trip Generation, (2003) Institute of Transportation Engineers (ITE). Washington D.C. 7th. Edition.

12. Trip Generation Handbook, (2004), Institute of Transportation Engineers (ITE) Washington D.C. 2nd Edition.