Chapter Forty

RAILROAD GRADE CROSSINGS

BUREAU OF LOCAL ROADS AND STREETS MANUAL

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As local highways are built and upgraded, it is inevitable that new railroad grade crossings will be required and that existing crossings will need to be modernized to meet current criteria. The geometric design of a railroad grade crossing requires consideration of the horizontal and vertical alignment, sight distance, and cross section of both the highway and the railroad. Other important design elements include the selection of an effective crossing surface that will permit smooth passage of vehicles across the tracks; the provision of signing and pavement marking to give adequate notice of the railroad crossing and visibility to motorists and train operators; and the selection of appropriate warning devices for the crossing environment.

40-1 DESIGN ELEMENTS

40-1.01 <u>Geometric Design</u>

40-1.01(a) General

Geometric design of a railroad grade crossing will generally be governed by the railroad profile and grade, which can be varied less easily than that of the roadway. The safety and function of the roadway, however, should not be compromised for the sake of accommodating a grade crossing in the shortest possible length or with the lowest cost. Avoid abrupt changes in roadway alignment and grade to meet the railroad. Design the grade crossing to provide as flat a roadway grade as practical through and at either side of the crossing to facilitate vehicle stops and starts if necessary.

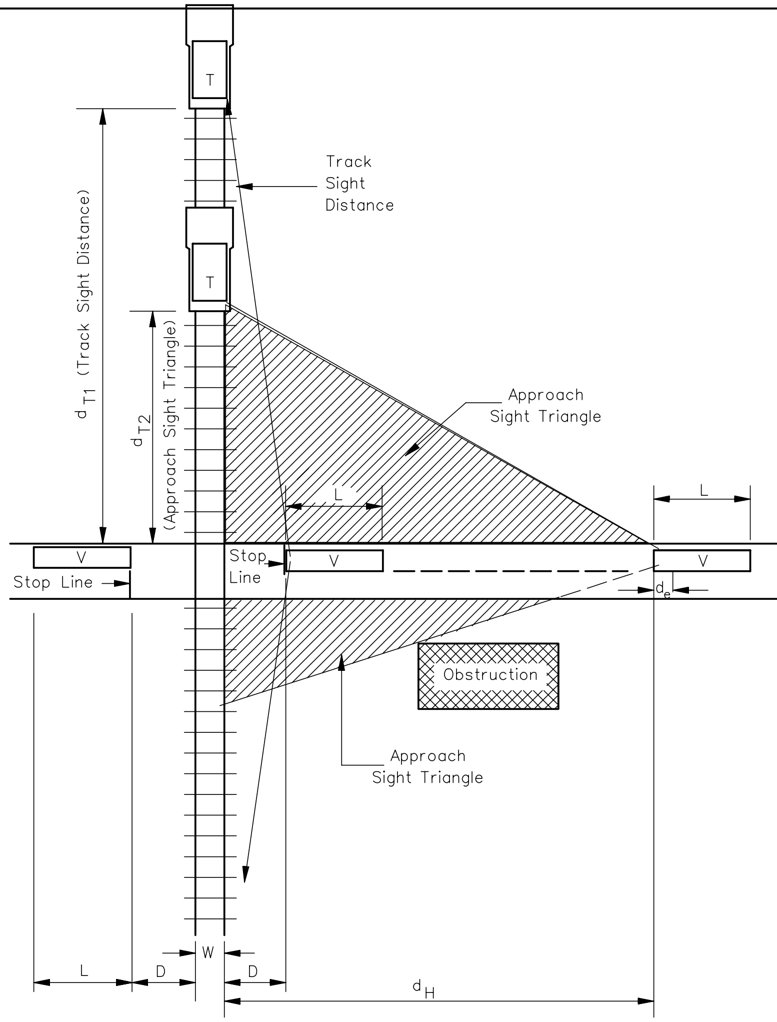
The general geometric design requirements for the design of grade crossings are the same as those for other intersections, as described in Chapter 34.

40-1.01(b) Sight Distance

Figures 40-1A and 40-1B provide the design criteria for sight distance at railroad crossings.

FHWA publication *Railroad-Highway Grade Crossing Handbook* contains guidance on sight distance evaluations for grade crossings, as does AASHTO's *A Policy on the Geometric Design of Highways and Streets*.

The number and nature of any obstructions lying within the sight triangles of drivers using a grade crossing will aid in determining the level of warning device required for the crossing (i.e., the more numerous and the more obstructive the objects, the greater the need for advance warning signs).



where:

d_H = sight distance leg along the highway allowing a vehicle to cross tracks safely even through a train is observed at a distance d_T from the crossing or to safely stop the vehicle without encroachment of the crossing area, ft (m)

d_{T1} = sight distance leg along the railroad tracks for stopped vehicle, ft (m)

d_{T2} = sight distance leg along the railroad tracks for approaching vehicle, ft (m)

D = distance from the stop line or front of the vehicle to the nearest rail (assumed to be 15 ft (4.5 m))

L = length of vehicle (assumed to be 65 ft (20 m))

W = distance between outer rails; for a single track, 5 ft (1.5 m)

De = distance from the driver to the front of the vehicle (assumed to be 10 ft (3.0 m))

See Figure 40-1B for values of d_H, d_{T1}, and d_{T2}.

MEASURING SIGHT DISTANCES AT RAILROAD CROSSINGS

Figure 40-1A

US Customary

Train Speed (mph)	d_{T1} (ft) Departure From Stop 0	d_{T2} (ft) Vehicle Speed (mph)					
		10	20	30	40	50	60
10	240	146	106	99	100	105	111
20	480	293	212	198	200	209	222
30	721	439	318	297	300	314	333
40	961	585	424	396	401	419	444
50	1201	732	530	494	501	524	555
60	1441	878	636	593	601	628	666
70	1681	1024	742	692	701	733	777
80	1921	1171	848	791	801	838	888
		Distance along highway from crossing, d_H (ft)					
		71	137	222	326	449	591

Metric

Train Speed (km/h)	d_{T1} (m) Departure From Stop 0	d_{T2} (m) Vehicle Speed (km/h)									
		10	20	30	40	50	60	70	80	90	100
10	45	39	24	21	19	19	19	19	20	21	21
20	91	77	49	41	38	38	38	39	40	41	43
30	136	116	73	62	57	56	57	58	60	62	64
40	181	154	98	82	77	75	76	77	80	83	86
50	227	193	122	103	96	94	95	97	100	103	107
60	272	232	147	123	115	113	113	116	120	124	129
70	317	270	171	144	134	131	132	135	140	145	150
80	362	309	196	164	153	150	151	155	160	165	172
90	408	347	220	185	172	169	170	174	179	186	193
100	453	386	245	206	192	188	189	193	199	207	215
110	498	425	269	226	211	207	208	213	219	227	236
120	544	463	294	247	230	225	227	232	239	248	258
130	589	502	318	267	249	244	246	251	259	269	279
		Distance along highway from crossing, d_H (m)									
		16	26	39	54	71	90	112	137	163	192

Note: Values are for a 65-ft (20-m) Truck Crossing a Single Set of Tracks at 90°.

SIGHT DISTANCE AT RAILROAD CROSSING

Figure 40-1B

The intersection angle of the grade crossing should be as close to a right angle as is practical for the location so that sight distances for both the road user and the train operator will be optimized. Where practical, avoid locating driveways and other road intersections within the sight triangle. Obstructions (e.g., trees, utility poles, signs) should be removed or located so that the visibility of warning and other informational signs is not diminished. Outside of municipalities, a minimum distance of 300 ft (100 m) along the highway on either side of a grade crossing should be kept clear of all removable obstructions (605 ILCS 5/9-112).

40-1.01(c) Horizontal Alignment

Avoid locating a grade crossing on a horizontal curve of either the highway or the railroad to reduce the tendency for the driver to be distracted by having to negotiate the curve. Intersecting curves with conflicting superelevations also present maintenance difficulties. It is often not practical to achieve the intersection of two tangents. Instead, consider other design elements that would compensate for the reduced visibility and maintenance difficulties (e.g., signing, pavement marking, other warning devices, appropriate types of crossing surfaces), as discussed in later Sections of this Chapter.

40-1.01(d) Vertical Alignment

Unless the Illinois Commerce Commission (ICC) otherwise specifically orders, at a minimum, the gradeline of highway approaches to grade crossings hereafter established or substantially reconstructed must be as follows:

- from the outer rail of the outermost track coincident with a tangent to the tops of the rails for about 24 in (600 mm), then, for a distance of 25 ft (7.5 m) ascending or descending at a grade cannot deviate more than 1% from the tangent, then to the right-of-way line (and as far beyond as the ICC's control may extend in any case) at a grade not to exceed 5.0%; and
- where superelevated track or tracks make strict compliance with this Section impractical, the grade of approaches shall be constructed so as to provide the best vertical alignment under the circumstances with due regard to surface regularity.

The width, transverse contour, type of surface or pavement, and other characteristics of each approach to a grade crossing must be suitable for the highway and shall, in every case, conform to the requirements of good practice.

When the approach grades are funded with Grade Crossing Protection Funds or other State or Federal funds, the vertical alignment shall be designed in accordance with Chapter 30. At locations where it is not feasible to improve the vertical profile according to criteria in Chapter 30, IDOT will consider granting a variance to the vertical alignment.

Vertical curves should be long enough to ensure an adequate view of the crossing and meet geometric requirements for the design speed of the roadway. In order to minimize pavement drainage problems, avoid locating crossings at or near the low point of sag vertical curves. Where grade crossings are located on a significant highway downgrade, consider ways to collect or divert the surface drainage in order to avoid excessive moisture infiltration into the railroad track ballast.

Ensure that the width, transverse contour, type of surface, and other characteristics of each approach to a grade crossing are suitable for the highway and conform to the requirements of good practice.

40-1.01(e) Cross Section

Design all new grade crossings to be at least as wide as the approach roadway, including shoulders. Provide a minimum width of 20 to 22 ft (6.0 m to 6.6 m); see criteria in Chapter 32.

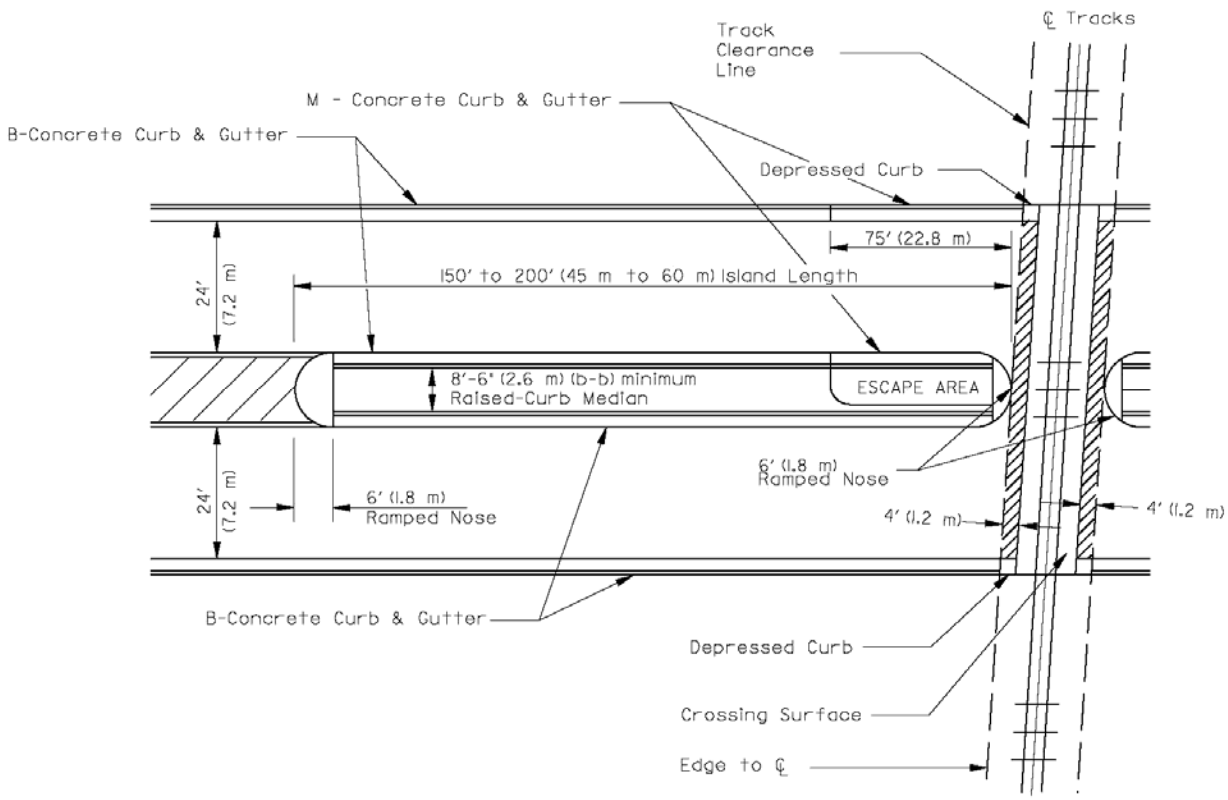
Where approach pavement to a single-track grade crossing features a barrier curb, extend the width of the grade crossing to the back of the curb. Additional width may be needed for sidewalks adjacent to the curb. Where two or more adjacent tracks are traversed by the grade crossing, extend the crossing width 3 ft (900 mm) outside the curb face.

Whatever the configuration of the pavement cross slope in the approaches to the grade crossing, the cross slope through the crossing plus 2 ft (600 mm) on either side should be as close to tangent as can reasonably be accommodated. A transversely sloping pavement surface intersecting with level railroad tracks will result in a rough crossing surface, which may divert driver attention from the safe negotiation of the crossing to finding the smoothest route through the crossing. The transition from the normal crown or superelevated pavement cross section to the level cross section should be accomplished far enough in advance that the transition is smooth, yet should be short enough to minimize the unfavorable drainage conditions created by the flat grade.

Coordinate the design of drainage features at the roadside adjacent to the grade crossing (e.g., ditches, curb inlets) with the railroad. Check that the internal drainage features of the railroad cross section as well as external drainage along the railroad right-of-way do not conflict with roadway drainage features.

40-1.01(f) Medians

Where median-mounted warning devices will be installed, and other than an earth median is adjacent to a grade crossing, the median should have a barrier curb with a minimum median width of 8.5 ft (2.6 m) [10 ft (3.0 m) desirable] back-to-back of curb. Depress all medians and curbs on approaches to the crossing to the level of the pavement edge or gutter flag within the track clearance line. The track clearance line runs parallel to the track at a distance of 8 ft (2.4 m) from the centerline of the nearest track; see Figure 40-1C.



Notes:

1. *Where a raised-curb, flush, or traversable type median is used on the roadway, provide B-6 or B-9 (B-15 or B-22) raised-curb median on crossing approaches and provide M-2 or M-4 (M-5 or M-10) raised-curb median on crossing departures adjacent to each side of the railroad track(s).*

2. *In addition to deterring vehicular movements over the track(s) in the median area, the raised-curb median provides a space for mounting railroad warning device units, if required.*

3. *If the railroad tracks are located close to a cross street and lie within the left-turn lane of the intersection, this situation will require a special design and the use of barrier type curb along the median adjacent to the turn lane.*

4. The median should have a minimum width of 8.5 ft (2.6 m) [10 ft (3.0 m) desirable] back-to-back of curb.

TYPICAL MID-BLOCK MEDIAN TREATMENT ADJACENT TO RAILROAD CROSSINGS
(Multilane Urban and Suburban Highways)

Figure 40-1C

In addition to deterring vehicular movements over the track(s) in the median area, the raised-curb median provides a location for mounting railroad warning device units, if required.

40-1.01(g) Sidewalk and Bicycle Grade Crossings

Sidewalks and bicycle crossings with the railroad are more sensitive to the skew angle than the main highway because of the possibility of bicycle or wheelchair wheels being trapped in the rail flangeway. See Section 42-3.04 for information on sidewalk and bicycle grade crossings.

40-1.01(h) Grade Separations

Determine whether existing or proposed grade crossings should be eliminated and/or replaced with a grade-separation structure using the following criteria:

- Provide grade separation when the expected crash frequency (ECF) for grade crossing gates exceeds 0.02 and the benefit-cost ratio exceeds 1.0. Section 40-2.03 of this Chapter provides the steps used to determine the benefit-cost ratio and ECF. The ECF must be computed for existing and future conditions to determine the benefit-cost.
- Provide grade separation where an expressway in a rural area is constructed or reconstructed across the railroad.

40-1.02 <u>Grade Crossing Surfaces</u>

40-1.02(a) Local Agency/Railroad Coordination

The local agency determines the alignment of the roadway portion of the crossing and determines acceptable crossing surface types when the highway authority is funding the crossing surface. The railroad must select from the IDOT-approved list of surfaces for the crossing and is responsible for maintenance of the crossing within railroad right-of-way.

For both upgrades to existing crossings and the construction of new crossings, contact the railroad early in the process of planning and design. Long approval times are typical for any work within railroad right-of-way.

40-1.02(b) Crossing Surface Types and Applications

Where a road improvement involves construction on one or both sides of an existing rail-highway grade crossing, or where the crossing is located beyond the limits of the improvement, but within the stopping sight distance for the highway design class, ensure the crossing is surfaced with material suitable for the highway traffic. Ensure the width of the crossing conforms to the traveled way surface width plus the usable shoulder. If the roadway approaches are widened, it may be necessary to relocate existing warning devices further away from the edge of roadway. Additionally, in these situations, it may be necessary to provide longer gate arm lengths.

The available grade crossing surfaces are shown in Figure 40-1D along with the relative durability of each type. The useful service life or durability for each type shown varies with the level of both vehicular traffic and railroad traffic, as well as with other factors (e.g., frequency of maintenance, number of parallel tracks in a crossing).

The perception of acceptable performance is likely to vary with several factors, including the level of service anticipated for a particular roadway (e.g., collector versus arterial); and the roadway design speed, which affects the speed at which vehicles approach and attempt to traverse the crossing.

40-1.02(c) Crossing Surface Selection Guidelines

The installation cost of the crossing surface types listed in Figure 40-1D tends to increase with increased durability. An additional economic consideration, however, is ease of maintenance. Several high-type crossing surfaces (e.g., rubber, steel, PC concrete) are available in prefabricated panels or sections, which are easily installed and which permit easy removal and replacement for track maintenance work. The ability to re-use existing materials may offset the higher initial costs for crossings that are expected to require frequent maintenance (e.g., high volume crossings). In general, grade crossings with high vehicular traffic and/or rail traffic justify crossing surfaces with a longer design life.

In general, the following is recommended:

- Where the roadway traffic equals or exceeds 1000 ADT, use prefabricated rubber or concrete surface materials.
- For ADT less than 1000, timber and/or asphalt crossings may be used.

A more detailed method to determine an appropriate crossing surface based on life-cycle cost analysis and rail and road traffic volumes is described in NCHRP 250*, Highway-Rail Grade Crossing Surfaces*.

In addition, the Railway Progress Institute has developed selection factors for acceptable grade crossing surfaces.

Crossing surfaces that are funded with State or Federal funds must be from IDOT’s approved crossing surface list. The most recently approved crossing surface list can be obtained by contacting the Central BLRS.

Crossing Surface	Durability	Primary Failure Mode(s)
Asphalt	Low	Poor impact performance, long-term settlement
Asphalt with Timber Flangeway Guard	Low	Wood abrasion, rot, settlement, poor asphalt impact performance
Asphalt with Rail Flangeway Guard	Low	Poor impact performance, long-term settlement
Timber Panels	Moderate	Wood abrasion, rot, fastenings loosen under impact
Rubber and Timber	Moderate	Wood rot
Metal Panels	High	Abrasion, brittle failure
Rubber: Longitudinal Shim	High	Shims splitting, snowplow damage, fastenings loosen under impact
Rubber: Lateral Shim	High	Shims splitting, snowplow damage, fastenings loosen under impact
Rubber: Full-depth	High	Abrasion, rubber separation
Concrete (cast-in-place and pre-cast)	High	Surface abrasion, cracking

GRADE CROSSING SURFACE TYPES

Figure 40-1D

40-1.02(d) Removing Bituminous Material and Foreign Objects from Rails

Where it is necessary to cross a railroad track while applying bituminous materials, ensure that bituminous material is not applied on the rails. If at all practical, notify the railroad company when the work is to be done in order to have a railroad representative present to inspect and, if necessary, assist in cleaning off the rails should some bituminous material be inadvertently sprayed on them.

Likewise, remove any road building material or objects that might drop onto the rails by the operation of road building equipment immediately from the flangeways to avoid a possible train derailment.

40-1.03 Signing and Pavement Markings

40-1.03(a) General

Advance warning signs and pavement markings should be provided by the local agency to meet the minimum requirements defined in the *ILMUTCD*.

40-1.03(b) Supplemental Signing and Pavement Markings

Supplemental signing and/or pavement markings is required where a railroad grade crossing is located less than 80 ft (25 m) before an intersection with a State or local road, as measured from the stop line at the intersection to the closest rail on the crossing. These situations are shown in the *ILMUTCD*.

40-1.03(c) Exempt Railroad Crossings

625 ILCS 5/11-1202 allows abandoned, industrial, or spur track railroad grade crossings to be designated as exempt by the Illinois Commerce Commission.

Exempt crossings must be signed according to the *ILMUTCD* before officially being considered exempt. Signs for exempt railroad crossings are intended to inform drivers of vehicles carrying passengers for hire, school buses carrying children, or vehicles carrying flammable or hazardous materials that a stop is not required at the designated grade crossing.

40-2 WARNING DEVICES

40-2.01 Protection of Railroad Crossings

Ensure that the type of protection provided at rail-highway grade crossings located within or adjacent to a highway improvement or beyond the limits of the improvement but within the stopping sight distance is placed according to the following guidelines:

1. Crossbuck Supports. The railroad will place the crossbucks' supports 8 ft-1 in (2.46 m) from the edge of the traveled surface where curb and gutter is not installed, and 4 ft-1 in (1.24 m) from the face of the curb where this type of construction is employed.

2. Railroad Crossing Signals. The railroad will install railroad crossing signals with the concrete bases essentially flush with the surface. Except where a barrier curb exists adjacent to the traveled way, the center of the signal mast must not be closer than 8 ft-1 in (2.46 m) from the edge of the final finished surface of the highway. Where a barrier curb is used, the center of the signal mast must not be closer than 4 ft-1 in (1.24 m) from the face of the curb.

40-2.02 Selection Guidelines

Warning devices are required at all highway-railroad crossings where grades are not separated. Select the type of warning device according to the following:

1. General. At a minimum, provide reflectorized crossbucks, pavement markings where possible, and advance warning signs as indicated in the *ILMUTCD* at all crossings.

2. Expected Crash Frequency. Use Equation 40-2.1 and the factors in Figure 40-2A to determine the expected crash frequency.

   $$ECF = A \times B \times T \qquad \text{(Equation 40-2.1)}$$

   Where:

   ECF = Expected Crash Frequency
   A = Traffic factor, see Figure 40-2A
   B = Component factor, see Figure 40-2A
   T = Current number of trains per day

A Factors

VEHICLES PER DAY (10-YR ADT)	FACTOR
250	0.000347
500	0.000694
1000	0.001377
2000	0.002627
3000	0.003981
4000	0.005208
5000	0.006516
6000	0.007720
7000	0.009005
8000	0.010278
9000	0.011435
10000	0.012674
12000	0.015012
14000	0.017315
16000	0.019549
18000	0.021736
20000	0.023877
25000	0.029051
30000	0.034757

B Factors — Basic Values for Railroad Protection Devices

Components	Basic Value Adjustments
Crossbucks, traffic volume less than 500 vehicles per day	3.89
Crossbucks, urban	3.06
Crossbucks, rural	3.08
Wigwags	0.61
Flashing lights, urban	0.23
Flashing lights, rural	0.93
Gates, urban	0.08
Gates, rural	0.19

CRASH FREQUENCY FACTORS
(Highway-Railroad Grade Crossings)

Figure 40-2A

* * * * * * * * * *

Example 40-2(1)

Given: Urban Area
Crossbuck Protection
Current ADT = 5000 Vehicles Per Day
Current Train Traffic = 5 Trains Per Day

Problem: Determine the appropriate warning devices that should be used at this crossing.

Solution: First determine the expected crash frequency of the existing crossbuck protection.

Expected Crash Frequency:

ECF = 0.006516 x 3.06 x 5 (Equation 40-2.1)
ECF = 0.10
ECF = 1 crash every ten years

Crash frequency is greater than 0.02 indicating the need for higher type device.

* * * * * * * * * *

3. Cantilevered Flashing Signals. Use cantilevered flashing signals, in addition to other warning devices, on multilane highways that qualify for active warning devices and where there is the possibility of a truck blocking the view of the roadside signals. Also, consider providing cantilever signals at high-frequency crash locations that possibly could be improved by more visible signals and to improve visibility for motorists due to certain geometric factors (e.g., crossings, horizontal curves, sag vertical curves). Cantilever signals may be considered where the vertical and/or horizontal alignment prevents the motorist from seeing the signals at an adequate distance.

4. Gates and Flashing Signals. Provide flashing signals and gates where one or more of the following conditions are met:

   multiple mainline railroad tracks;

   multiple tracks at or in the vicinity of the crossing, one of which may be occupied by a train or locomotive that obscures the movement of another train approaching the crossing from view;

   high-speed train operation combined with limited sight distance at either single or multiple track crossings;

   a combination of high speeds and moderately high volumes of highway and railroad traffic;

either a high volume of vehicular traffic, high number of train movements, substantial numbers of school buses or trucks carrying hazardous materials, unusually restricted sight distance, continuing crash occurrences, or any combination of these conditions;

the expected crash frequency for flashing lights exceeds 0.02 and the benefit-cost ratio equals or exceeds 1.0 (the method for determining the benefit-cost ratio is shown in Section 40-2.03); and/or

a diagnostic team recommends them.

Gates are not required in individual cases where a diagnostic team justifies that gates are not appropriate.

5. Higher-Type Warning Device. Provide a higher type of warning device than may be justified under any of the preceding criteria if there is continuing or potential crash occurrence due to:

unusual track or roadway geometrics;

restricted sight distance; and/or

other unusual conditions (e.g., where the potential exists for exceptional crash consequences to a large number of rail or highway passengers, or where there is the potential for a crash involving hazardous materials).

In other instances, a lower level device may be justified if concurred with by a diagnostic team.

Where the distance measured along the centerline of the highway between two regularly used adjacent tracks is less than 100 ft (30 m), consider the crossing as a multiple track crossing and install warning devices accordingly. Where the distance is 100 ft (30 m) or greater, consider each crossing as individual crossings and signalize each according to the preceding criteria.

40-2.03 Benefit-Cost Ratio Analysis

Use the following procedure to find the benefit-cost ratio for the installation of warning devices at railroad crossings:

Step 1. Calculate the Present ECF. Calculate the expected crash frequency for the current installation (see Equation 40-2.1).

Step 2: Calculate the Future ECF. Calculate the expected crash frequency for the proposed installation (see Equation 40-2.1).

Step 3: Calculate the Annual ECF Savings. Calculate the annual savings in the expected crash frequency by subtracting the future ECF from the present ECF (Step 1 - Step 2).

Step 4: Calculate the Benefit. Calculate the benefit by multiplying the annual savings by the cost of crash, Z, where Z equals the ratio of deaths and injuries per crash (average for latest 3 years in Illinois) x cost per crash (Z x Step 3). Use the National Safety Council crash cost data which are documented, periodically updated, and revised annually by BDE.

Step 5: Calculate the Annual Cost. Calculate the annual cost of the proposed installation by either of the following equations:

Annual Cost = U + V (Equation 40-2.2)

Where:

U = Cost of flashing lights divided by expected life (assume 20 to 30 years)
V = Yearly maintenance cost of flashing lights

or:

Annual Cost = Y + W (Equation 40-2.3)

Where:

Y = Cost of gates divided by expected life
W = Additional annual cost to maintain gates instead of flashing lights

or:

Annual Cost = L + M (Equation 40-2.4)

Where:

L = Cost of grade separation divided by expected life
M = Additional annual cost to maintain grade separation instead of gates

Step 6: Calculate the Benefit-Cost Ratio. Calculate the Benefit-Cost Ratio by dividing the benefit by the annual cost (Step 4 ⁄ Step 5).

40-2.04 Circuitry Devices

Refinements to activation circuitry should be recommended when the credibility of the warning devices could be beneficially increased. This includes developing the signal “lead time” based on train speeds or installing motion detectors, or constant warning time devices (predictors). These are described as follows:

1. Grade Crossing Predictors. Grade crossing predictors (GCP/constant warning time) circuitry should be considered for upgrade improvements to existing active warning devices and new installations when the train speed exceeds 10 mph (16 km/h) and:

   - there are switching moves on the approach circuits,
   - where trains operate at variable speeds on the line, or
   - there is an unusual track and crossing geometry.

   Grade crossing predictors also deal with trains stopping in the approach circuits and they provide uniform warning time for temporary reductions in train speed.

2. Motion Detectors. Consider motion detectors where:

   Gates. Where gates are present, provide motion detectors where there:

   - is stopping or other lengthy occupancy of the approach circuits,
   - are new gate installations,
   - is upgrading of crossings with flashing signals to gate installations, or
   - are major control circuitry changes required at existing installations.

   Flashing Signals. For flashing signals, provide motion detectors where there:

   - is stopping or other lengthy occupancy of the approach circuits,
   - are new flashing signal installations, or
   - are major control circuit changes required by changes in or additions to flashing signals.

Note that the cost differential between grade crossing predictors (GCP/constant warning time) and motion detector circuitry is minor in comparison to the total installation cost. In addition, grade crossing predictor (GCP/constant warning time) circuitry can be adjusted to a wider, more variable set of train traffic conditions. When contemplating circuitry improvements, it is best to contact the railroad to make an accurate assessment of train traffic and a more informed decision on circuitry improvements.

See Chapter 39 for information on coordinating railroad and highway traffic signals.

40-2.05 Barrier Systems

The following will apply to barrier systems around warning devices:

1. General. Do not provide barrier systems (e.g., guardrail, impact attenuators) at railroad grade crossings except in extraordinary circumstances. In most cases, the roadside barrier presents more of a hazard than the railroad warning device. Also, it may block a lateral escape route in advance of the signal. Extraordinary circumstances that may justify the use of a roadside barrier in the vicinity of a railroad crossing warning device include:
   - locations where the approach roadway is on a fill with side slopes steeper than 1V:3H and greater than 10 ft (3.0 m) in height,
   - locations with a high crash history involving a warning device where a benefit-cost analysis demonstrates a roadside barrier is warranted, and
   - locations where there will be a temporary delay in the relocation of warning devices for the widening of a highway.
2. Installation. See Chapter 35 of this *Manual* and the *IDOT Highway Standards* for the installation of guardrails at crossings.
3. Special Conditions. In industrial or other areas involving low-speed highway traffic and where warning devices are vulnerable to damage by turning truck traffic, ring-type guardrail may be installed to provide protection for warning devices. Substitute shielding devices (e.g., concrete, railroad ties, and railroad rails) are not permitted.
4. Signals. Do not use breakaway or frangible bases for cantilever signal supports.
5. Maintenance of Barriers. The local agency will maintain all longitudinal guardrail and impact attenuators. The railroad will be responsible for maintaining the ring-type guardrail.
6. Approval. Approval for the erection of any roadside barrier by the railroad must be obtained from the local agency having jurisdiction of the road.

40-3 REFERENCES

1. *A Policy on Geometric Design of Highways and Streets*, AASHTO, 2004.

2. *Railroad-Highway Grade Crossing Handbook*, *Second Edition*, FHWA, 1986.

3. NCHRP 250, *Highway-Rail Grade Crossing Surfaces*, Transportation Research Board, 1998.

4. *Bureau of Design and Environment Manual*, IDOT.

5. 92 *Illinois Administrative Code*, Part 1535.

6. *Illinois Manual on Uniform Traffic Control Devices,* IDOT.