Chapter 13
MISCELLANEOUS TRAFFIC ITEMS

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13-1.01 Purpose

The purpose of this chapter is to present those traffic engineering functions which do not fall within material covered in other chapters.

13-1.02 SCOPE

This chapter includes review procedures, permits and guidelines for conducting specific studies and investigations. Other specialized subjects are also discussed.

13-1.03 CHAPTER ORGANIZATION

This chapter has four major sections; School Crossing Protection, Review and Permits, Route Numbering and Reference Point System and Special Investigations and Studies.

13-1.04 GLOSSARY

Ball Bank Indicator - An instrument used to determine the safe speed that a passenger vehicle can comfortably travel around a curved section of roadway. This instrument typically consists of a steel ball in a sealed curved glass tube filled with an alcohol solution.

Commissioner - "Commissioner" means the Commissioner of the Minnesota Department of Transportation.

County Highway Engineer- "County Highway Engineer" means a registered professional engineer employed as the County Highway Engineer or the Director of Public Works-County Highway Engineer of each county.

County State-Aid Highway - A county state-aid highway which:

1. is projected to carry a relatively heavy traffic volume or is functionally classified as collector or arterial as identified on the county's functional plans as approved by the county board;
2. connects towns, communities, shipping points, and markets within a county or in adjacent counties; or provides access to rural churches, schools, community meeting halls, industrial areas, state institutions, and recreational areas; or serves as a principal rural mail route and school bus route;
3. occurs at reasonable intervals consistent with the density of population;
4. provides an integrated and coordinated highway system affording within practical limits, a state-aid highway network consistent with projected traffic demands.

Department - "Department" means the Minnesota Department of Transportation.

District State-Aid Engineer - "District State-Aid Engineer" means a registered professional engineer employed as the District State-Aid Engineer.

Eighty-Fifth Percentile Speed - The speed at or below which 85 percent of the traffic is moving and normally used as a rule of thumb for establishing numerical speed limits. This can be determined directly from field sheets by counting from the top speed the number of vehicles equaling 15 percent of the total number of vehicles observed. The 85th percentile speed is usually within 2 mph of the upper limit of the pace.

Experimental Traffic Control Device - Any device which varies from the specifications set forth in the MN MUTCD.

Municipal State-Aid Street - A municipal state-aid street which:

1. is projected to carry a relatively heavier traffic volume or is functionally classified as collector or arterial as identified on the urban municipality's functional plan as approved by the urban municipality's governing body;
2. connects the points of major traffic interest within an urban municipality;
3. provides an integrated street system affording, within practical limits, a state-aid street network consistent with projected traffic demands.

Pace - The 10 mph range of speeds containing the largest number of observations. The pace can usually be determined by visual inspection of the vehicle speed data sheet. A normal speed distribution will contain approximately 70 percent of the sample within the pace with 15 percent above and 15 percent below the pace.

Railroad - "Railroad" means a common carrier by railroad as defined in United States Code, title 49, section 1, clause (3) of the Interstate Commerce Act.

Roadway - "Roadway" means that portion of a highway improved, designed, or ordinarily used for vehicular travel, exclusive of the sidewalk or shoulder. In the event a highway includes two or more separate roadways, the term "roadway" as used herein shall refer to any such roadway separately but not to all such roadways collectively.

Rumble Strips - A device used to alert the driver that there is a change of conditions ahead. It may consist of raised strips or sawed grooves in the pavement or some other means of creating a "rumble" effect.

Rural Section - "Rural section" is a highway design that has wide rights-of-way, open ditches for drainage, and a clearway of usually 30 feet from the edge of the outside lane.

Shoulder - "Shoulder" means that part of the roadway which is contiguous to the regularly traveled portion of the roadway and is on the same level as the roadway. The shoulder may be pavement, gravel, or earth.

Sidewalk - "Sidewalk" means that portion of a street between the curb lines, or the lateral lines of a roadway, and the adjacent property lines intended for the use of pedestrians.

State-Aid Engineer - "State-Aid Engineer" means a registered engineer employed as the State-Aid Engineer of the Minnesota Department of Transportation.

State Traffic Engineer- A registered professional engineer employed as the Director, of the Office of Traffic, Safety, and Technology (OTST) in the Policy Safety & Strategic Initiatives Division of the Minnesota Department of Transportation.

Street or Highway - "Street or highway" means the entire width between the boundary lines of any way or place when any part thereof is open to the use of the public, as a matter of right, for the purposes of vehicular traffic

Through Highway - "Through highway" means every highway or portion thereof at the entrances to which vehicular traffic from intersecting highways is required by law to stop before entering or crossing the same and when stop signs are erected.

Transportation District Engineer - "Transportation District Engineer" means a Transportation District Engineer of the Minnesota Department of Transportation.

Trunk Highway Turnback - "Trunk highway turnback" means a former trunk highway or portion of it that has reverted to a county or municipality in accordance with law.

Urban District - "Urban district" means the territory contiguous to and including any street which is built up with structures devoted to business, industry, or dwelling houses situated at intervals of less than 100 feet for a distance of one quarter mile or more. M.S. 169.01, Subd. 59.

Urban Section - "Urban section" means a roadway design used in urban districts where the right-of-way width is restricted. Because of the restricted right-of-way, there is not enough room for ditches, thus necessitating curbs and gutters.

Videologging - A permanent pictorial inventory providing instantaneous photographic references for the inspection of highways and roadside features.

13-2.00 SCHOOL CROSSING PROTECTION

13-2.01 Responsibility

The safety of school crossings is the joint responsibility of parents, school administrators, other public officials, and the general public. On Trunk Highways, the Department will install appropriate signs and markings at designated school crossings and may authorize local authorities to install additional devices conforming to approved standards in situations that meet reasonable warrants.

13-2.02 Guidelines

Information on school speed control is available in "A Guide to Establishing Speed Limits in School Zones," issued by the Department.

13-2.03 School Safety Patrols

School Safety Patrols are strongly recommended at all crossings used by grade school students. No other means of protection has been as effective as the School Patrol at crossings used by the younger pupils of the grade schools. However, these patrols have not proven effective for high school or junior high school students. Where a School Safety Patrol is functioning as recommended, normally the only necessary controls are the standard school crossing warning signs and markings.

13-2.04 Crossing Guards

Crossing Guards are effectively used at crossings where the use of a School Safety Patrol is considered impractical. Crossing guards are adults who operate in much the same manner as the school patrol in assisting school children to cross arterial streets safely.

13-2.05 School Speed Limits

School speed zoning will not automatically reduce crash frequency or severity. Improper zoning may actually create a situation favorable to crashes, by increasing the speed differential between vehicles and by causing pedestrians to rely on a posted limit which does not accurately reflect vehicular speeds. Thus, speed zoning must be done with great care. The legislation, MSA 169.14, Subd. 5a, granting local officials the authority to establish school zone speed limits was not intended as an endorsement of blanket zoning or maximum reductions. Mn/DOT practice is to use fluorescent yellow-green as the background color on the "SCHOOL" plaque (S4-3) and on the top portion of the "SCHOOL SPEED LIMIT" sign (S5-1).

Alternatives such as sidewalk construction, fencing, parking restrictions, crossing guard utilization, stop sign or signal placement, and pedestrian rerouting are virtually always more effective in reducing a pedestrian hazard. A traffic and engineering investigation must be undertaken before a speed zone is implemented and consists of two parts: (1) preparing a school route plan and (2) conducting a school zone hazard evaluation. See "A Guide to Establishing Speed Limits in School Zones".

1. **School Route Plan** - The main objective of a route plan is to minimize the number of streets crossed and to maximize the safety of crossings and routes used by school children. A school route plan for each school serving elementary and kindergarten students is useful in developing uniformity in the use of school area traffic controls. The plan, developed jointly by the school and traffic officials responsible for school pedestrian safety, consists of a map showing the street system, the school, existing traffic controls, established school routes and established school crossings.
2. **School Hazard Evaluation** - The hazard evaluation process determines those routes which can be made the most safe with the least cost and are most likely to be used by school children. The school route plan should be re-evaluated whenever changes in traffic or pedestrian patterns occur, when control devices change, or when the route's environment changes.

13-2.06 School Site Plan Review

It is the responsibility of the School District, when planning to build a new school facility or make major changes to an in place facility, to obtain all the necessary permits and approvals. The Minnesota Department of Education Planning Guide requires that the School District contact the District Traffic Engineer for guidance in planning for pedestrian and vehicle movements when Trunk Highways are involved. Other road authorities are to be contacted when their roadway is involved .

13-2.07 Rural School Bus Stops

When requested, the District Traffic Engineer shall review rural school bus stops in accordance with Section 7B-11 of the Minnesota Manual on Uniform Traffic Control Devices. This section establishes the warrants for placement of the "School Bus Stop Ahead" signs. A record should be kept in the District Traffic Office of the rural school bus stops which are so signed. As part of the record, the District Traffic Engineer should, at approximately two year intervals, check back with residents and/or bus operator that each stop is still being made.

When determining the need for the "School Bus Stop Ahead" (S3-1) warning sign where the school bus stop is located on or near a vertical curve with restricted sight distance, the height of eye of the driver is 350 feet and the height of object is 6 inches. Given this criteria, the sign is intended to be used where a school bus, when stopped to pick up or discharge passengers, on the roadway is not visible for a distance of 500 feet in advance of the stop. Where the driver can see the full outline of the bus at least 500 feet in advance of the stop, a sign is not required. At vertical curves, the flashing lights mounted at a height of 8 feet) will appear sooner to give the driver an added safety factor. However, advance warning distance may not be available where the school bus stop is located on or near a horizontal curve with a visibility restriction. The location of the sign should give the driver 9-10 seconds reaction/decision time from the sign to the bus stop location. On those highways, a distance of 850 feet to 1000 feet is advised, with the distance of 1000 feet recommended in the horizontal curve case due to greater difficulty for the driver to track the bus. The advance posting distance for lower speeds may be lower, but should not be less than 500 feet in any case. The 9-10 second reaction/decision time times the 85% speed in feet per second is recommended.

When requested, the District Traffic Engineer shall review rural school bus stops to determine if a stop qualifies to be signed "School Bus Loading Area". The following criteria must be satisfied prior to the establishment of a school bus loading area:

- Children will not cross the roadway, either to be picked up or after disembarking from the bus.
- Shoulders must be wide enough to accommodate full bus width, plus sufficient space for the passengers to safely stand during loading and unloading.
- No loading area should be established adjacent to an obstruction; such as guardrail, culvert, mail boxes, etc.
- No loading area shall be permitted in a turn lane.

Districts, at their discretion, may also require that the loading area be hard-surfaced, in order to prevent shoulder breakup and/or bus traction problems during periods when the ground is soft.

The sign "School Bus Stop Ahead" shall not be used in advance of a "School Bus Loading Area" stop.

Reference: Minnesota Statute 169.44, Subdivision 2(b)(1).

13-2.08 School Zone and Crossing Signs

The "School" sign (S1-1) may be used in advance of locations where school buildings or grounds are adjacent to the trunk highway. If there is a signed school crossing, the "School" sign shall be used in advance of each approach. The sign shall be a fluorescent yellow-green background color with black legend.

The School Crossing sign assembly shall consist of the "School" sign (S1-1) and a supplemental down arrow plaque (S2-P2) mounted directly below the "School" sign. The sign and plaque shall be fluorescent yellow-green background with black legend. The School Crossing sign assemblies shall be mounted as near as possible to the crosswalk.

See Figure 7.21 for pavement marking details. The assembly may be used at a signalized intersection with crosswalks but should not be used at "Stop" sign controlled intersections.

The mixing of standard yellow and fluorescent yellow-green signs of the same type, within a selected site area, shall be avoided. The preferred practice is not to use the speed advisory plaque with school signs. If a black/yellow speed advisory plaque is determined necessary for use with the "School" sign, then the sign and plaque shall be the yellow background color utilizing the wide angle prismatic retroreflective sheeting (commonly referred to as VIP-see Chapter 6 for specifications).

13-3.00 REVIEWS AND PERMITS

13-3.01 Geometric Reviews

Geometric design is concerned with the visible features of a highway such as pavement width, horizontal and vertical alignment, slopes, channelization, interchanges, etc. The design of these features can significantly affect traffic operation, safety and capacity. In fact, some of the traffic problems existing today are the result of geometric design features which could have been corrected during the design stages if the design had been reviewed from a Traffic Engineering point of view. It is essential to maintain regular and cooperative communication between Traffic and Design personnel. Each group needs and benefits from the knowledge and experience of the other.

13-3.02 Preliminary Layouts

The District Traffic Engineers should review all preliminary layouts to provide early input into the design process.

13-3.03 Evaluation of New Facilities

All newly constructed facilities should be evaluated on a systematic operation basis by District Traffic Engineers to assess their effectiveness in moving traffic safely and efficiently. If the improvement is not working as expected, it is imperative that an evaluation of the reasons for failure be made. Positive and negative feedback based on Traffic Engineering evaluations can be an important contribution toward upgrading design standards and criteria to meet changing conditions. A copy of comments should be sent to the State Traffic Engineer.

13-3.04 Entrance Permits (Minnesota Rules, Chapter 8110)

No entrance or driveway from a Trunk Highway to private property may be constructed without permission of the Department. Under normal conditions any necessary entrance facilities are provided by the Department when the highway is constructed or reconstructed. However, property and the type of land use are subject to change. Thus, existing access often must be revised. After a highway has been constructed, no additional entrances shall be constructed, nor shall an existing entrance be changed without the approval of the Transportation District Engineer. It is the responsibility of the Area Maintenance Engineer to investigate all requests for such permits and to recommend proper action to the Transportation District Engineer. Entrance permit application forms are discussed in the Maintenance Manual. Traffic Engineering principles should be applied in the investigation, and the District Traffic Engineer should have direct input.

A variance from the standards set forth in Chapter 8110 may be allowed by the Department when the variance will facilitate the safe, efficient use of the property for a lawful purpose and will not interfere with the construction, maintenance or safe and efficient use of the highway and its appurtenances by the public.

13-3.05 Transportation Permits

Permits for the movement of over-size or over-weight loads are issued on the authority of the Transportation District Engineer. This is primarily a maintenance function, but the District Traffic Engineer may assist as necessary. Transportation permit guidelines and forms are contained in the Maintenance Manual.

13-3.06 Use of Highway Right-of-Way for Special Events

Use of the trunk highway right-of-way for activities will not be allowed unless a legitimate public interest is to be served. Use of highway right-of-way not related to construction or maintenance requires that the requester contact the Mn/DOT District Office. Mn/DOT authorization will be granted, through the district permit process, if all pertinent criteria covered in these guidelines are satisfied.

The permit shall identify that the sponsor agrees to assume the entire responsibility and liability for all damages or injury to all persons, whether employees or otherwise and to all property, arising out of, resulting from or in any manner connected with the operation of the special event. The sponsor shall agree to defend and indemnify Mn/DOT, its agents and employees from all such claims including, without limiting the generality of the foregoing, claims for which Mn/DOT may be claimed to be liable and legal fees and disbursements paid or incurred to enforce the provisions of this paragraph, and the sponsor shall further agree and pay for such general liability coverage which protects the state as an additional named insured.

The permit shall also identify that the sponsor shall be responsible for any damage done to the highway property as a result of the special event, damages payable upon receipt of invoice.

If Mn/DOT provides assistance in the form of traffic control devices, signs and/or labor, the requester should be billed for the actual costs incurred by Mn/DOT.

For purposes of these guidelines, the use of highway right-of-way is split into four categories:

1. Use of Right-of-Way Involving Road Closure
2. Use of Right-of-Way Involving Traffic Restrictions
3. Use of Right-of-Way Not Involving Traffic Restrictions
4. Signs, Banners, and Decorations

Within each of these categories, the categories are subdivided as follows:

Freeways - Includes interchange areas on expressways

Expressways - Does not include interchange areas

High Speed, Two Lane, Two-Way Highways - Speed limit 45 miles per hour or greater: includes segments that may have additional lanes for passing, turning or bypassing and/or short segments of four or more lanes.

Low Speed Roads - Speed limit 40 miles per hour or less; generally includes those segments of trunk highways that pass through a city and/or serve a city street-type function and all frontage roads.

13-3.06.01Use of Right-of-Way Involving Road Closure

Examples of road closures include parades, races, filming, etc.

Freeways, Expressways and High Speed Two Lane Two-Way Highways - Closures should not be allowed.

Low Speed Roads - Closures may be allowed at the discretion of the District Office subject to the following criteria:

1. Closures shall not be allowed during peak traffic periods unless authorized by the District Traffic Engineer.
2. If the right-of-way is located within a city, requests shall be made through the offices of or by the city.
3. A plan for traffic control and documentation of the means to implement it should be submitted. An adequate detour route shall be provided. Motorists shall be guided through the detour by signs, traffic control personnel, law enforcement personnel or a combination of the three.

   Signs, if used, shall be in accordance with the Minnesota Manual on Uniform Traffic Control Devices (MN MUTCD).

   Detour signing, advance notices and publications are the responsibility of the requester. Mn/DOT should review, comment on, and approve the plan. Upon request, Mn/DOT may provide assistance in the form of traffic control devices, signs and/or labor. The requester should be billed for the actual costs incurred by Mn/DOT.
4. All road closures should be coordinated with the State Patrol and the local law enforcement agency.
5. Adequate traffic control and law enforcement personnel shall be arranged by the requester.
6. Festivals with a long history of occurrence and no traffic mobility or safety problems in the past should be allowed to continue. If a new traffic mobility or safety problem arises, it should immediately be brought to the attention of the event sponsor, local municipality, and enforcement agencies to be addressed. If no solution can be found, the organizations shall jointly agree to revise the location of the festival.
7. Denials of permits for road closures may be appealed to the Commissioner of Transportation by the requester.

13-3.06.02Use of Right-of-Way Involving Traffic Restrictions

Examples of this category include races, filming, etc.

Freeways - Use of the freeway mainline and the adjacent right-of-way should not be allowed. However, use of a local road overpass or underpass area may be allowed in those cases where there is no significant impact on freeway traffic, subject to the criteria covered under "High Speed Two Lane Two-Way Highways and Low Speed Roads," below.

Expressways - Use of right-of-way should not be allowed. However, use may be allowed in those cases where there is a limited impact on traffic, subject to the criteria covered under "High Speed Two Lane Two-Way Highways and Low Speed Roads," below.

High Speed Two Lane Two-Way Highways and Low Speed Roads - Use of right-of-way should not be allowed during peak traffic periods. Limited use is allowed subject to the following criteria:

1. The period of time for which a road is restricted for partial use should not exceed four hours.
2. If the right-of-way is located within a city, requests shall be made through the offices of or by the city.
3. The use of the right-of-way shall not interfere with motorists' safe operation of their vehicles.
4. The use of the right-of-way shall not obstruct sight distance and shall not detract from motorists' view of traffic control devices.
5. A plan for traffic control and documentation of the means to implement it should be submitted.
6. Adequate traffic control and law enforcement personnel shall be arranged by the requester.
7. All traffic restrictions should be coordinated with the State Patrol and the local law enforcement agency.

13-3.06.03Use of Right-of-way Not Involving Traffic Restrictions

Examples in this category are parking, booths, sales, etc.

Freeways - Use of the freeway mainline and the adjacent right-of-way should not be allowed. However, use of a local road overpass or underpass area may be allowed in those cases where there is no significant impact on freeway traffic, subject to the criteria covered under "Low Speed Roads" below.

Expressways and High Speed Two Lane Two-Way Highways - Use of right-of-way should not be allowed. However, use may be allowed in those cases where there is a limited impact on traffic, subject to the criteria covered under "Low Speed Roads" below.

Low Speed Roads - Use of right-of-way may be allowed subject to the following criteria:

1. If the right-of-way is located within a city, requests should be made through the offices of or by the city.
2. No advertisements should be permitted on the right-of-way.
3. The use of the right-of-way shall not interfere with motorists' safe operation of their vehicles.
4. The use of the right-of-way shall not obstruct sight distance and shall not detract from motorists' view of traffic control devices.
5. Adequate law enforcement personnel protection shall be arranged by the requester, as necessary.
6. Use of the right-of-way shall not exceed 30 days and similar use should not recur within ten months.

13-3.06.04Signs, Banners, and Decorations

Freeways - Signs, banners and decorations should not be allowed on the right-of-way.

Expressways, High Speed Two Lane, Two-Way Highways and Low Speed Roads - Directional signs may be allowed at the intersection of the local road leading to the event. Non-directional signs, banners and overhead decorations will be allowed only on low speed roads subject to the following criteria:

1. If the signs, banners or decorations are to be located within a city, the requests should be made through the offices of or by the city.
2. Signs, banners or decorations shall not be attached to any Mn/DOT structure (sign, signal, bridge, etc.).
3. Directional and non-directional signing are the responsibility of the requester. If, upon request, Mn/DOT provides assistance in the form of signs and labor, the requester should be billed for the actual costs to the Department.

4. The requester for directional signing will be advised that signing must conform to the MN MUTCD or as directed by the District Office.
5. Directional signing shall contain only directional information for the event.
6. Non-directional signs or banners shall not appear to represent or conflict with an official traffic control device in shape, form, color or legend. They should be of a neutral color.
7. Non-directional signs or banners should display only the name of the event and the scheduled time.
8. Signs, banners and decorations shall not obstruct sight distance or detract from motorists' view of traffic control devices.
9. No changeable message signs of the type used for temporary or permanent traffic control shall be permitted for event advertising purposes.
10. The minimum clearance for all signs, banners and decorations spanning a highway should be 22 feet above the roadway and shoulder.
11. Adequate traffic control shall be provided when overhead signs, banners, and decorations are being installed and removed.
12. Non-directional signs, banners, and decorations pertaining to an event shall not be in place longer than two weeks prior to the event and shall be removed within three days after the last day of the event.

13-4.00 ROUTE NUMBERING AND REFERENCE POINT SYSTEM

13-4.01 General

Each highway in Minnesota is part of a dual system of numbering. The first part of the system is a Constitutional or Legislative route number and the second part is a route signing number (i.e., U.S. route number, Interstate route number or a Minnesota Trunk Highway number). The total numbering system must be kept in logical order and great care must be exercised in changing or revising any portion of the system. There are certain rules which must be followed and certain committees, both locally and nationally, that must be involved to make the system workable.

13-4.02 Constitutional Routes

The Constitutional amendment adopted in 1920 establishing the Minnesota highway system listed 70 routes that by their very description connected various cities and areas in the state into a highway system. These first 70 routes are known as Constitutional Routes and are numbered 1-70. These routes are described in Minnesota Statutes 161.114 and, because of the constitutional nature of their establishment, should be considered unchangeable.

13-4.03 Legislative Routes

Since the original 70 routes were established, many additional routes have been added to the Trunk Highway system through action of the Legislature. These routes, currently numbering over three hundred, are known as Legislative Routes. These routes are modified, revised, changed and added to from time to time by the Legislature, usually on the recommendation of the Department. These routes are described in Minnesota Statutes 161.115. Any changes proposed by the district in these routes should be coordinated through the Department's Control Section and Route Numbering Committees as established by Department Directives 2-015A and 2-02A, respectively.

13-4.04 Names and Designation of Certain Highways

At various times the Legislature has named and designated portions of certain constitutional and legislative routes. Typical names are the "Capitol Highway," "Floyd B. Olson Memorial Highway," "Yellowstone Trail," etc. Named routes are listed in Minnesota Statutes 161.14 where the route itself is described and the special conditions for signing each route are set forth.

13-4.05 Interstate Routes

The National System of Interstate Highways was established in 1957 with a numbering system and distinctive markers designed by the American Association of State Highway and Transportation Officials (AASHTO). East-west routes have even numbers and north-south routes have odd numbers with the lowest number routes in the west and south. Major routes have one or two digit numbers, and the most important routes have numbers ending with 0 or 5. Special, related three-digit numbers are used to designate spurs and circumferential routes in urban areas. Any proposed revisions to this numbering system must be coordinated through the Route Numbering Committee since approval by a National Committee is required prior to any change in the system.

13-4.06 U.S. Highways

The system of United States Numbered Highways was adopted in 1926 in order to provide a uniform system of numbered highways extending across the nation for the benefit of the interstate traveler. The numbering system and the distinctive markers were developed by AASHTO at the request of the Federal Highway Administration and with the advice of several states. This system is kept current through the coordination of AASHTO and the cooperation of the states. From about 40 routes when the system was established there are now close to 200 U.S. routes in the continental United States. Even numbered routes generally follow an east-west alignment, while odd numbered routes are generally north-south. Any proposed changes to this system must be coordinated through the Route Numbering Committee since the approval of the Executive Board of AASHTO is necessary. The U.S. route system is only a route numbering signing system and is not related to Federal funding.

13-4.07 Trunk Highway Routes

All routes not designated as part of the Interstate or U.S. Route number systems are given a "Minnesota" route number. These numbers are assigned by the Route Numbering committee and all requests for new numbers or changes must be coordinated through that committee.

13-4.08 Turnbacks

As roads are rebuilt or new roads are constructed, certain old routes are turned back to the counties and municipalities. The route is deleted from the Trunk Highway system and is normally assigned a route number by the involved jurisdiction. Funds are available for restoration of the roads that have reverted to county and municipal jurisdiction (see Minnesota Statutes 161.082 and 161083). Rules and regulations for implementing a "turnback" are set forth in the current Right-of-Way Manual (5-491.128). Upon completion of a "turnback" all responsibility for providing traffic control devices rests totally with the local jurisdiction.

13-4.09 Reference Point System

Reference posting is a continuous distance reference system which indicates the distance from a known starting point. The purpose of a reference point system on freeways and highways is to provide uniform and accurate reference points for all highway-oriented activities. The actual physical reference points consist of reference post marker plates, installed approximately at either one mile intervals along the roadside, which show the continuous distance along the route.

Distance numbering is continuous for each route within the State, except where overlaps occur. Distances are computed from the west State line or the westerly terminus for highways running in a general west-east direction, and from the south State line or the southerly terminus for highways running in a general south-north direction.

The Trunk Highway Logpoint Listing specified the locations of side roads, bridges, crossroads, culverts and other identifiable physical features to the nearest mile. The Logpoint Listing was developed for the purpose of providing more precise and specific reference to locations between the reference posts. Logpoint systems will be developed for both county and municipal road systems.

The Reference Point System and Trunk Highway Logpoint Listing are used to aid the several offices and organizations directly associated with highway maintenance and control. Included in the practical uses of the system are the following:

1. Precise identification of crash locations.
2. Reference for the location of emergency incidents.
3. Reference points for roadway maintenance servicing.
4. Reference points for use in road inventory records.
5. Aid to motorists in estimating their progress.

13-4.09.01Overlapping Routes

Mileage numbering should be continuous for each route within the state. On overlapping routes, continuity should be established for only one of the routes in accordance with the Control Section Record. On the route without Reference post continuity, the first Reference post beyond the overlap should indicate the approximate distance traveled from the beginning of the route.

13-4.09.02Divided Highways

For divided highways, mileage measurements shall be made on northbound and eastbound roadways. The Reference posts for southbound and westbound roadways shall be set at directly opposite locations.

13-4.09.03Transportation Information System (TIS)

Reference posts play a critical role in the TIS, as all road features, inventory items, or crash locations are directly or indirectly referenced to the field Reference post. It is imperative that the post be in place. If replacement is required, it must be done in accordance with location instructions from the Program Management Division, if its previous position cannot be precisely determined.

When construction projects or turnbacks affect reference posting on any Trunk Highway, the Transportation Research and Investment Management Division should be contacted as to placement of the required posts. Do not invent a new method, as the True Mileage System of the TIS established adjustment rules and procedures to follow.

13-4.10 Exit Numbering

Exits from Interstate highways in Minnesota are numbered in accordance with Federal Highway Administration requirements which specify a reference post format. Exit numbers are displayed at the top of major guide signs located in advance of an interchange at the exit. The exit number normally utilizes the last reference post number in a decreasing reference post direction from the interchange. When there are multiple exits at an interchange (cloverleaf, for example), or more than one interchange for a given reference post, the first exit number in the increasing reference post direction is given the letter "A" and the second the letter "B". Occasionally, a third exit may occur within the same reference post number assigned to an interchange. In that case, the exit would carry the reference post number followed by the letter "C".

13-5.00 SPECIAL INVESTIGATIONS AND STUDIES

13-5.01 Videologging

Mn/DOT has been recording images of Minnesota's trunk highway system since the summer of 1973. The initial system was a photographic system using a 35mm camera, mounted on a van, triggered to take photographs of the roadway every one-hundredth of a mile. In 1987 the system was improved by capturing images on video disc, and transferring them to an optical disc for viewing on dedicated view stations. Today, the video system is state of the art technology with two Video Image Capturing Systems in digital format. These digital images can be conveniently viewed on personal computers that have access to Mn/DOT's internal network system.

Since the photos are taken in both directions, 24,000 miles are being photographed and cataloged in the Department's video library. Video pictures are readily available for road condition studies, sign inventories, right-of- way development surveys, and traffic control device evaluation.

They also serve as an accurate record for estimating damages resulting from crashes and natural disasters. Viewing equipment is available in the Central Office as well as all District Offices. Copies of photographs can be obtained for Department use at no charge through the Office of Traffic, Safety and Operations.

Construction projects, maintenance or utility work and similar activities frequently offer the opportunity to make a photographic record of good or bad applications of traffic control devices. Therefore, when such situations are encountered and are deemed appropriate for photographic study and use in future analysis or training, the District Traffic Engineer is encouraged to request that the site be videologged. In all cases involving the videologging process, the Pavement Management Engineer, Office of Materials and Road Research should be notified so that duplication of requests is avoided.

Public access to the photographs will be balanced with Mn/DOT job requirements. Members of the public may view 35mm photographs, optical discs, or digital imagery with the assistance of Department personnel only. Print copies of the photographs may be purchased. This is the only form of duplication currently available. Uniform access to the videolog/photolog viewing equipment for the general public will be based on equipment and personnel availability through the following methods, which are flexible in unusual circumstances.

A member of the general public may come to the Office Traffic, Safety, and Technology (OTST), videolog/photolog viewing room or District Office to view the photographs by appointment with the conditions below.

1. Prior to the review, the OTST Tort Claims Office must be contacted so that a determination can be made as to whether or not the State of Minnesota is involved in any litigation relative to this request. If, as a result of this review, it is judges that the State is involved in the litigation, the interested party must make their request for information to the Attorney General's Office and follow the rules of discovery.
2. One week advance notice to arrange an appointment may be required depending on resources.
3. Appointments should be limited to approximately one hour. To accommodate work flow and public access, individuals will be allowed one appointment per week.
4. Prints of videolog/photolog photographs are available to the public from the OTST for a fee.

Viewing equipment and photographs may be used in court cases. Uniform guidelines for all personnel who must present photos of Minnesota's Trunk Highway System in court are as follows:

1. If the photographs are requested to be shown in court, a subpoena must be issued for the film or disc, viewing equipment and operator. (Print copies of the photographs may be obtained without a subpoena being issued if the State is not involved in the litigation. However, if copies of photographs pertaining to litigation against the State of Minnesota are requested, the request must follow the Rules of Discovery. The request MUST be made to the Attorney General's Office.)
2. The user will be charged for all costs incurred. These costs will include: labor costs (to include travel time) for the personnel, transportation costs, all applicable overhead costs, and $150.00 per day for the equipment usage.
3. If it is requested that the disc or film be shown at a speed equivalent to a highway travel speed, make it clear that it will be an approximation only.
4. The requester should be reminded that the photographs represent the date of filming or recording only.

13-5.02 Rumble Strips

Rumble strips may be used when unusual alertness is required of drivers, and standard traffic control devices such as signs and/or flashers have apparently not proven to give adequate warning. Several strips are placed laterally across the pavement to cause a rumble or bumpy motion that, when traversed by a vehicle, will alert the driver. Typical locations for use of rumble strips are approaches to toll gates and to stop signs hidden by horizontal or vertical curves. Proximity of the rumble strip to the hazard is important. If the rumble strip is located too close to the hazard, sufficient driver reaction time is not given; and if they are located too far away, the driver may not relate the rumble strip to the hazard. Mn/DOT has developed a formal rumble strip layout. See the Mn/DOT Road Design Manual, section 4-4.02.02.

13-5.03 Experimental Traffic Control Devices

13-5.03.01Legal Authority

Minnesota Statutes 169.06, Subdivision 2, states, "The Commissioner may authorize variations from the manual and specifications for the purpose of investigation and research into the use and development of traffic control devices. When such authorized variation pertains to the regulations of traffic, notice of the intended regulatory purpose shall be published in a qualified newspaper of general circulation in the area where the research is being conducted."

13-5.03.02Procedures

The following procedures shall be followed to obtain approval to use experimental traffic control devices:

1. The District Traffic Engineer or Traffic Research Engineer shall originate the procedure by making a thorough investigation relative to the needs for the experimental device, reasons for choosing it, description of devices and expected results.
2. The originator shall submit the above information to the State Traffic Engineer, Office of Traffic, Safety and Technology (OTST) for review with a request for approval.
3. Upon approval, the State Traffic Engineer, OTST shall draft a Commissioner's Order and shall send a copy to the Transportation District Engineer.
4. The Transportation District Engineer shall arrange for the required legal notice to be published in local newspapers.

5. The District Traffic Engineer shall prepare the appropriate Traffic Control Order covering the experimental devices for the State Traffic Engineer's, OTST signature.
6. The District Traffic Engineer and/or Traffic Research Engineer shall review the site upon installation of the device and shall monitor it periodically to assure safe and efficient operation of the device and to recommend any necessary alterations to the State Traffic Engineer, OTST.
7. Upon termination of the operation or experiment, the originator shall submit a report to the State Traffic Engineer, OTST outlining all aspects of the experiment and evaluating the device, recounting both positive and negative aspects, and including comments and suggestions.

13-5.04 Speed Trend Studies

A speed trend study is a method of determining long or short range changes in motorist's travel speed. The study is a compilation of data collected from individual speed monitoring sessions (sometimes called speed surveys) which are analyzed and evaluated. The results from a speed trend study may identify changes in speeds within a certain area which may be attributable to reconstruction, improved lighting, or other roadway changes. Districts can perform speed trend studies to collect information about road segments where speed may be a concern.

Historically, speed trend studies were also performed for the Federal Speed Monitoring Program. This program was developed to establish a valid statistical method of measuring a sample of vehicle speeds on a sample of highways posted at 55 mph and 65 mph with sufficient accuracy to support a determination of compliance by a State's motoring public with the National Maximum Speed Limits.

In late 1995, the National Maximum Speed Limit was repealed and the submittance of speed monitoring data to the FHWA was performed on a voluntary basis as determined by each state. In order to provide continuity in Minnesota's speed data, it was decided that the monitoring program would continue. Since there are no longer FHWA guidelines to be followed, the program has been modified to best fit Minnesota's needs.

13-5.04.01Minnesota Speed Monitoring Program

Every Federal Fiscal Year (October through September), quarterly and annual speed monitoring reports are prepared by the OTST and submitted to the Federal Highway Administration (FHWA) Division Administrator. The results of this program are used to determine speed trends throughout the United States. Additional reports are sent to the Commissioner, all Mn/DOT districts, the Mn/DOT Library, Department of Public Safety, and the Legislative Reference Library.

State roadways are divided into 5 categories. Within each of these categories, the total number of roadway miles determines the number of monitoring sites, which are shown below.

Category	Number of Monitoring Sites	
Urban Freeway (60 - 70 mph)	2	
Rural Freeway (70 mph)	7	
Rural 2-lane, 2-way Highway (55 mph)	14	
Rural Divided Highway (65 mph)	6	
Urban Divided Highway (55 mph)	2	
	31	Total

The 31 sites are located throughout the State and each site will be monitored four times a year, once each quarter. A quarterly monitoring schedule is prepared each year.

1. Speed Monitoring Sessions

   Speed monitoring sessions are performed to collect vehicle speed data which will be incorporated into the speed monitoring program. Various methods are currently being used for the collection of data. Radar transmission devices, although useful in certain situations, are not used in the speed monitoring program due to manpower requirements. Below is a list of speed data collection devices.

   a. Weigh-In-Motion (WIM) Stations

      These devices are located throughout the State and collect a variety of data including the weight and speed of vehicles. The information is collected automatically.

   b. Automatic Traffic Recorders (ATR) Sites

      ATRs automatically collect information by means of in-pavement loop detectors. ATRs are located throughout the State and are typically used to determine vehicle counts. A small number of them have been installed to allow the collection of speed data.

   c. Portable data collection machines with road tubes, in-pavement loop detectors, or portable magnetic sensing devices. This method of data collection requires the placement of a sensing device on the road surface which connects to the data collection machine located off the road. This method is undesirable due to manpower requirements.

   Data for all WIM and ATR sites is obtained from the Traffic Forecasts and Analysis Section. The districts are not directly responsible for obtaining WIM and ATR data.

   Each speed monitoring session will place vehicle speeds into speed ranges as follows:

   Number of vehicles from 00 to 40 mph
   Number of vehicles from 41 to 45 mph
   Number of vehicles from 46 to 50 mph
   Number of vehicles from 51 to 55 mph
   Number of vehicles from 56 to 60 mph
   Number of vehicles from 61 to 65 mph
   Number of vehicles from 66 to 70 mph
   Number of vehicles from 71 to 75 mph
   Number of vehicles from 76 to 80 mph
   Number of vehicles from 81 to 85 mph
   Number of vehicles from 86 to 100 mph

   This data is then used for the computation of speed trends for the 5 roadway categories. Errors is vehicle speeds are put into a 110 mph range and should not be used in calculations.

2. Speed Monitoring Session Procedures

   The following procedures shall be followed in analyzing speed data:

   a. All sessions will be 24 hours in length to account for varying hourly traffic conditions and to facilitate the scheduling of data collection.

   b. No monitoring should be performed on holidays or weekends on recreational routes.

   c. The monitoring schedule for the program shows the month and day of week that each monitoring session is to take place. Due to inclement weather and other factors it is not always possible to meet the requirements of the schedule. In the event that the schedule has to be adjusted and a session performed on a different day, keep in mind that all sessions should be evenly distributed by day of week. Data should not be collected on any monitoring station more than once on any day of the week in any one year.

3. Speed Monitoring Session Location Requirements

   When performing temporary speed monitoring sessions or placing permanent speed monitoring equipment, the following situations must be avoided:

   a. near or at a sharp horizontal curve with a speed advisory plate less than the posted speed limit.

   b. Steep grades (i.e. greater than 4%).

   c. Within 100 feet of a significant at-grade intersection.

   d. Within 1000 feet of an exit ramp or entrance ramp of an interchange.

   e. Anywhere within the interchange (defined as the distance from the beginning of a deceleration lane through the end of an acceleration lane).

   f. Where other unusual features exist that might influence vehicle speeds (e.g. a narrow bridge or railroad crossing).

13-5.05 Plat Review (MSA 160.085, 161.19, 505.02)

13-5.05.01 General Requirements

Any proposed plat which includes lands abutting upon an existing or proposed Trunk Highway which has been designated by a Centerline Order filed in the Office of the Register of Deeds shall first be presented to the Department for written comments and recommendations.

Where the plat includes land abutting upon an existing or established county or County State-Aid Highway, it shall first be submitted to the County Engineer for his written comments and recommendations. Plats involving both a Trunk Highway and a highway under County jurisdiction shall be submitted to both the Department and the County Highway Engineer.

13-5.05.02 Preliminary Drawing

A legible preliminary drawing or print of a proposed plat shall be acceptable for purposes of review by the Department or the County Highway Engineer. A written statement shall be attached describing the outlet for, and means of disposal of, surface waters from the proposed platted area.

13-5.05.03 Review Period

Written comments and recommendations shall be submitted to the city, town or county within 15 days after receipt of the plat for review. Final action on the plat by the city, town or county shall not be taken until after these required comments and recommendations have been received or until the 15-day period has elapsed.

Failure to obtain the written comments and recommendations of the Department or the County Highway Engineer shall in no manner affect the title to the lands included in the plat or the platting of said lands. No certificate or other evidence of written comments and recommendations is required to file the plat in the Office of the Registrar of Deeds or Registrar of Titles.

13-5.06 Sight Distance at Crossroads

A major safety aspect is the sight obstruction caused by noise barriers, plantings, poles, signs, fences, bridge rails, etc., at or near the intersections of ramps, frontage roads, and crossroads.

When evaluating sight distance at intersections, two different procedures must be followed in order to determine if it is adequate--perceptual and driver acceptance of a minimum 10 second vehicle interval. It is very desirable that both of these be met at all intersections.

13-5.06.01 Perceptual

When approaching an intersection at grade, the operator of a vehicle should have an unobstructed view of the whole intersection and enough of the intersecting highway such that the driver can perceive a hazard in sufficient time to alter the speed of his vehicle as necessary before reaching the intersection. Minimum distances along the intersection road (setback distance) which should be unobstructed are determined by the approach speed and the distance traveled by the vehicle in three seconds. This does not provide enough distance to stop the vehicle; however, the three seconds gives the driver two seconds for perception and reaction plus one additional second to actuate braking or accelerating his vehicle to avoid a collision. For additional information see Chapter 5 of the Road Design Manual.

13-5.06.02 Driver Acceptance of a 10-Second Vehicle Interval

Once a vehicle has stopped at the intersection, the driver must be provided adequate sight distance to safely enter the intersection. This distance is based on the acceptance of a 10 second vehicle interval. This may or may not be provided using the perceptual sight triangle method. Telephone and power poles, fences, and bridge rails do not obstruct vision when approaching an intersection (i.e., perceptual sight) but can block the entire view when stopped at the intersection. Figure 5-2.01A of the Road Design Manual provides the necessary information to determine the lengths needed for this sight distance.

13-5.07 Railroad Crossing Review

13-5.07.01 Background

See Part VIII of the Manual on Uniform Traffic Control Devices as well as Chapter 8830 of Minnesota Rules.

13-5.07.02 Federal and State Requirements

FHWA regulations require that Federally funded projects which cross any of Minnesota's 4,500 public railroad crossings at grade include a determination of adequate protective devices. Responsibility for advance warning signs and pavement markings at grade crossings belongs to the local road authority. The District Traffic Office must insure adequate traffic control devices at all Trunk Highway grade crossing approaches. This will entail an engineering review at unsignalized and authorized stop or yield crossings. It will entail verification of basic advance signs and pavement markings, at proper distances.

1. Signal Recommendations - When there are high speeds and high volumes on either the railroad or highway approaches to the crossing, and/or restricted sight corners, em engineering review, with participation from the Railroad Administration section of the Office of Freight and Commercial Vehicle operations, should be done to determine adequate protective devices. The District Office should communicate with the Rail Administration section of the Office of Freight and Commercial Vehicle Operations relative to all signal questions, considerations, minimum warrants, etc.
2. Study Reports - A grade crossing review and recommendations, with participation from the Rail Administration section of the Office of Freight and Commercial Vehicle Operations, should be included with all study reports on projects which involve Federal aid and which include at-grade railroad crossings.
3. Local Requests - Occasionally, the District Office may be requested to conduct a railroad crossing review at a county or municipal crossing, in order to assist the local agency. These requests should be directed to the Rail Administration section of the Office of Freight and Commercial Vehicle Operations or the Office of State Aid. The primary goal of all railroad crossing reviews is to improve traffic safety by applying standard traffic control devices where needed and as appropriate for each unique situation.

13-5.07.03 Principles of Grade-Crossing Protection

The adequate protection of grade crossings is based on basic traffic engineering principles and professional judgment. Prerequisites for protection at non-signalized crossings are outlined below. Signalization may be warranted where sight distances are inadequate and cannot be corrected with signing, speed zoning or other measures.

1. Standard advance warning signs should be properly placed and fully reflectorized. Pavement markings should be applied on hard surfaced roads.
2. The crossing should be visible to the motorist at a safe stopping distance based on the posted or 85th percentile speed.
3. Based on the posted or 85th percentile speed, the type of roadway surface, and the maximum train speed, motorists should be provided with sufficiently clear sight quadrants in either direction so that they can observe an oncoming train as they approach the crossing in time to either stop at the crossing or proceed through ahead of the train.
4. Adequate sight distance along the tracks must be provided for a stopped motorist to accelerate through the crossing in advance of an oncoming train, based on maximum train speeds. Examples of vehicles which must be considered are petroleum trucks, school buses, and vehicles with limited acceleration capabilities.

13-5.07.04 Review Procedures

A thorough review of a grade crossing with participation from the Rail Administration section of the Office of Freight and Commercial Vehicle Operations

13-5.07.05 Evaluation Criteria

Table 13.1a, taken from the 2001 AASHTO Green Book, Exhibit 9-104, presents data on sight distances as a function of highway and train vehicle speeds, and includes factors obtained from AASHTO showing the effect of grade on stopping site distance. Tables 13.2 and 13.3 illustrate sight triangles for stopped and moving vehicles.

13-5.08 Advisory Curve Study

Curve and turn signs should be used to inform the driver of a change in geometrics that is not readily apparent or occurs in an unexpected location compared to the typical character of the roadway. These warning signs require caution on the part of the vehicle operator and may call for reduction of speed or a maneuver in the interest of comfort and safety. The need for curve and turn signs may be determined in the field by making several trial runs through the curves in a test vehicle equipped with a slope meter or an electronic meter, such as Model E45 manufactured by Rieker Instrument Company. The ball-bank reading is a measure of the amount of centrifugal force on the vehicle.

1. Slope Meter

The slope meter is an instrument used to determine the comfortable speed that a passenger vehicle can travel around a curved roadway section. This instrument consists of a steel ball in a sealed, curved glass tube filled with an alcohol solution. The tube, bent on the arc of a circle, is graduated from 0 to 20 degrees, both to the left and right of the zero point. The tube is enclosed in a metal case. When mounting the ball-bank indicator, the vehicle should be in a stationary level position. The speedometer of the test vehicle must be accurately calibrated and the tires uniformly inflated. The indicator should be mounted vertically, with the steel ball at the zero point. All occupants who are to be in the vehicle when the observations are made should be in the same position when mounting or checking the instrument as when making the test drive. This is necessary because changing the position of a passenger or the load in the test vehicle may cause the vehicle body to tilt to the right or left. This tilting action or body roll will cause a change in the slope meter readings.

2. Procedures for Testing A Curve

The use of the slope meter or electronic meter to measure the comfortable speed on curves involves the efforts of two people--one to drive and the other to observe the meter. The following procedures should be followed in each test:

a. The curve under observation should first be appraised by the driver to determine the approximate safe speed which can be maintained.

b. The driver should then conduct the first test at a speed 10 mph below the appraised speed.

c. Each succeeding test should be made at a speed 5 mph greater than the preceding test, until the meter has reached 10 degrees, except as indicated on Chart 13-1.

d. On each test, the driver should attain the trial run speed at a distance of at least 1/4 mile from the beginning of the curve.

e. The course throughout the curve should be maintained precisely in the center of the lane and at uniform speed. Using a vehicle with cruise control aids in this process.

f. The observer shall note carefully the position of the ball on the slope meter or the display on an electronic meter at the approximate center of the curve and shall record the reading.

g. The reading shall be recorded as right or left of zero. The turn sign showing an arrow bent at a right angle (W1-1 left or right) should be used to mark curves on which a meter indicates 10 degrees or more at a speed of 30 mph or less. Additional protection may be provided by use of the Advisory Speed plate.

h. The curve sign showing a curved arrow (W1-2 left or right) should be used to mark a curve where a test with a meter gives readings of 10 degrees or more at speeds equal to or greater than 35 mph and equal to or less than the legal speed limit established on that section of highway. Additional protection may be provided by the use of the Advisory Speed plate.

i. The reverse curve sign (W1-4 Left or Right) and reverse turn sign (W1-3 Left or Right) shall be installed to mark two curves or two turns as defined above and connected by a tangent of less than 600 feet. When an advisory speed plate is used, the lower of the two recommended speeds will prevail.

3. Curve Study Sheet

It is important that all information be recorded as indicated on a curve study sheet. As provided on the curve study sheet, trial runs should be made in each direction. The ball bank angles in Chart 13-1 shall be used to establish the safe speed on curves. As an example, for the speed range 35 mph and above, the comfortable speed for the curve is the exact speed which swings the ball 10 degrees off center on a slope meter or displays 10 degrees on an electronic meter. Any speed which causes the ball to move more than 10 degrees away from the zero position is considered uncomfortable to the driver and possibly unsafe at higher speeds.

13-6.00 ENGINEERING AND TRAFFIC INVESTIGATION REQUIREMENTS TO ESTABLISH OR CHANGE REGULATORY SPEED LIMITS

13-6.01 Authority

Minnesota Statute (MS) 169.14 sets forth speed limits to govern all highways and alleys in the state. Any posted speed limit greater or less than the statutory limits must be authorized by the Commissioner of Transportation. Any alteration of statutory speed limits on any public road or street shall be based upon the results of an engineering and traffic investigation. It is Mn/DOT policy that the entire Trunk Highway system shall have regulatory speed limits and they shall be determined by an engineering and traffic investigation. The regulatory speed limit shall be effective when such signs are erected.

There are exceptions to the Commissioner's authority to establish regulatory speed limits.

1. School zone speed limits greater than 15 mph, but no more than 20 mph below the established limit, may be set by local authorities according to MS 169.14 Subd. 5a. See Chapter 13 in this manual.
2. Work zone speed limits between 20 and 40 mph and up to 55 mph on divided highways may be set by local authorities according to MS 169.14 Subd. 5d. See Chapter 8 in this manual.
3. A municipality may establish a speed limit from 10 to 30 mph in a mobile home park according to MS 327.27.
4. Local authorities may establish speed limits not lower than 25 mph on a roadway that has a designated bike lane according to MS 160.263.
5. A political subdivision may establish a speed limit on a road within a park. The speed limit shall not be lower than 20 mph and shall be established in accordance with guidelines prescribed by the commissioner. The guidelines are the same as those outlined in this section.
6. A road authority may establish a 25 mph zone on a residential roadway. MS 169.01, subd. 81 defines a residential roadway as a local street less than one-half mile in length.

13-6.02 Administrative Procedures

The Commissioner has delegated authority to the Assistant State Traffic Engineer, OTE-ITS, to authorize the establishment of speed limits. The District Traffic Engineer is responsible for performing the engineering and traffic investigation necessary for speed limit determination.

1. Trunk Highways

   A complete investigation report, along with a completed Trunk Highway Speed Limit Authorization Form Mn/DOT 29212, covering the entire Control Section, shall be submitted to the Assistant State Traffic Engineer, OTE-ITS, for signature. After this review and approval, the authorization will be returned to the district for implementation.

2. Local Streets and Highways

   When a local authority deems an existing speed limit is not reasonable or safe on a road under its jurisdiction, the local road authority may request Mn/DOT to make an engineering and traffic investigation to determine if a change in the speed limit is necessary.

   The procedure is for the local road authority to draw up a formal resolution requesting an investigation. The resolution should describe the road or street fully and should indicate the exact termini of each section where an investigation is desired. Normally the termini should describe a sufficiently long section (at least 1/4 mile or more) to provide for a meaningful study. The resolution should be forwarded to the District Traffic Engineer to initiate the investigation.

The District Traffic Engineer shall then make the field investigation and prepare speed limit recommendations. These recommendations should be discussed with the local authority after completion of the investigation. The local authority may be furnished with a copy of the investigation results, if they desire.

The District Traffic Engineer shall submit a speed limit recommendation report to the Assistant State Traffic Engineer, OTE-ITS, for review and approval. A formal authorization is then prepared by OTE-ITS for the approved speed limits. This authorization shall be limited to speed zoning only, and shall be signed by the Assistant State Traffic Engineer, OTE-ITS.

Following receipt of Mn/DOT authorization, the local authority shall install the speed limit signs implementing the authorization. Installation shall conform to the current MN MUTCD.

When roadways are turned back, exchanged with other roadways or renumbered, technically the speed limit authorization is still in effect. However, to prevent confusion and provide for unquestionable documentation in prosecuting speeding offenses, it is highly advised that the new road authority request a study of the road in question. Subsequently, the new authorization will list all information correctly.

13-6.03 Principles of Speed Zoning

The statutory speed limits are intended to provide uniformity for typical highways, under ideal conditions and no apparent hazards. Alteration of the statutory speed limits to fit existing traffic and physical conditions of the highway constitutes the basic principle of speed zoning. The objective of correct speed zoning is to influence as many drivers as possible to operate at or near the same speed, thus reducing conflicts created by wide differentials in speed. It is widely recognized by traffic engineers and is a proven fact that wide differences in speed frequently contribute to crashes. The speed zone study is conducted to determine the maximum safe speed that should be posted for that location to provide continuity of traffic flow.

Correct and realistic speed zoning will serve to protect the public and regulate the unreasonable behavior of an individual. Having recognized that normally careful and competent actions of a reasonable driver should be considered legal, Mn/DOT has a responsibility to assure this protection. If a speed zone is determined by the actions of the majority of drivers on a highway, then it is hoped that speed zoning will facilitate the most efficient and orderly movement of traffic by increasing driver awareness of a reasonable and prudent speed. The speed limit should aid the motorist in adjusting speed to the conditions and furnish police officers with an indication of what is excessive and unreasonable speed.

13-6.04 Determination of Speed Limits

The posted regulatory speed limits should be for off-peak hour traffic on an average weekday. The speed limit on a hard-surfaced road must reflect clear, dry and ideal conditions, so that the road may be driven at the highest safe speed. When the weather, or road surface, deteriorates or traffic congestion occurs, it is then the driver's responsibility to reduce speed and drive accordingly. When physical features at spot locations (such as limited sight distance, narrow bridges, blind intersections, etc.) or potential hazards (such as pedestrians, children in unfenced playgrounds, etc.) occur, the use of warning signs and advisory speeds should be considered.

Prevailing speeds, physical features, crash experience and traffic characteristics are the primary factors in determining the appropriate speed limit. The most important factor is the 85th percentile speed from a spot speed study. The 85th percentile speed reflects a safe speed for existing conditions as perceived by the majority of motorists. Using the 85th percentile speed tends to group the other factors since they are reflected in the driver's choice of speed, which is altered to adjust for those conditions. It also recognizes the need for considering the majority of drivers to be involved in the decision-making process which is necessary to establish an enforceable limit. The 85th percentile speed is usually at or near the upper limits of the 10 mile per hour incremental "pace speed". Posting a speed limit near the 85th percentile speed will result in the highest percentage of drivers being grouped in the pace speed.

Speed limits less than the midpoint of the pace should generally be avoided because they tend to increase the relative speed differentials among vehicles and, therefore, the potential for vehicle conflicts.

Physical features may dictate the regulatory speed limit. Where a continuous curvilinear section of roadway with short connecting tangents exists, a regulatory speed limit should be posted to aid the motorist in determining an appropriate speed to travel. On a section of road with only infrequent horizontal curves, "curve" or "turn" warning signs with correct advisory speed plates should be erected, with speed zoning determined by the essentially tangent alignment of the road and other factors. Safe speeds on the curves should be determined using a ball-bank indicator.

Other physical features which affect speed are roadway surface condition, shoulder width, lane width, and obstacles near the road. The effects of these factors are not easily measured but are reflected by checking the prevailing speed.

Traffic characteristics such as turning vehicles, traffic volumes, parking, traffic signals, and pedestrians all affect speed. Intersections by themselves do not necessitate a reduction in speed, but the traffic characteristics that occur near intersections do affect speed. It is difficult to measure the impact of any one of these factors or the collective affect. The varying speeds necessary for each reaction emphasizes why the study should be done in an off-peak period, so as to minimize this wide variation in speed. Again, the 85th percentile speed will reflect the maximum safe speed for the roadway without measuring the impact of each factor.

Crash experience should be reviewed for the preceding 3-year period. Contrary to popular belief, speed in itself is not a major cause of crashes. There is a consensus of professional opinions that many speed-related crashes result from both excessively low and high speeds. Many requests for a speed study will be initiated by an emotionally aroused public after a specific crash. It is important to review the crashes for the study area and determine if there is a problem that should be resolved rather than changing the speed limit. Typically, speed reductions may decrease the severity of crashes but not necessarily the frequency.

13-6.05 Investigation Procedures

When an engineering and traffic investigation is requested by local authorities, the exact length, as requested, must be investigated. If that length is too short to provide for a meaningful study, then the requesting authority should be notified and an amended resolution passed. On the Trunk Highway system, the area in question should be studied and the entire control section should be test driven to determine and verify the impact of any recommended speed change.

The location of the speed check is singularly important because it determines whether or not a complete picture of the speeds in the area is being obtained. The speed check locations must be strategically located to show all the important changes in prevailing speeds. In urban districts and on approaches to cities they should generally be located at intervals not to exceed 1/2 mile, depending upon the locality and the uniformity of physical and traffic conditions. Trial runs through the area may be of help in determining the speed check locations. Care should be taken to select locations sufficiently removed from any stop signs, traffic signals, or other traffic flow interruptions that significantly affect operating speeds. Mid-block locations generally represent typical flow conditions for accurate sampling. In rural areas, the spacing of speed check locations may be at much greater intervals so long as they reflect the general speed pattern. One speed check located at each end and the middle point of the selected zone should be sufficient.

Speed checks on new or reconstructed highway sections should not be performed until it is apparent that the traffic speeds have stabilized. Where speed limits are immediately necessary for the correct operation of the new roadway, then design speed and test run data will be acceptable for a temporary speed limit authorization. Local authorities should be made aware of this procedure when the initial study is done. A minimum of 100 cars should be checked. On highways carrying low traffic volumes, (up to 1000 ADT) the minimum of 30 samples may be used and, in any event, the study should be discontinued after two hours.

The cars checked should be the ones in which drivers are choosing his/her own speed and which have at least 6 to 9 second headways. When a line of vehicles moving closely behind each other passes the speed check station, only the speed of the first vehicle should be checked since the other drivers may not be selecting their own speeds. Cars involved in passing maneuvers should not be checked because they are probably traveling at an abnormal rate of speed. Speeds of trucks and buses may be recorded separately, and are not normally used in the calculations to determine the posted speed. Trucks and buses are usually a minor percentage of the traffic population and their speeds may not be representative of the rest of the traffic being studied. The truck and bus data is useful, however, in the evaluations of the speed profile, especially if the volume of trucks and buses is significant.

For both rural and urban areas, a map should be prepared showing the length of study area, north arrow, scale, in place speed limit zones, proposed speed limits, and the speed limits adjoining the study area. In urban or suburban areas, an accurate log should be made of all traffic signs, traffic signals, intersections, curves over 2 degrees, grades over 3 percent, and location of businesses and residences. Rural zones should have a log only if a speed limit, other than a statutory value, is being recommended. Normally in rural areas the Transportation Information System (T.I.S.) log point listing is adequate to show intersection spacing, along with some general comments about land use adjacent to the roadway.

All reports should contain physical characteristics such as surface type and width, shoulder type and width, condition of both, number of lanes, location of turn lanes, and ADT. The location, type and numerical limit of all advisory speed signs should be logged.

On trunk highways, the crash rates should be submitted for the study area. A comparison should be made with the district annual average crash rate by highway type. If the study area is significantly above the average rate, an crash summary report should be printed out and analyzed. Average rates are not published for local roads, but summary printouts can be obtained. Anytime the request for an investigation is the result of crash experience, the summary printout should be included in the study. Adequate consideration may then be given to corrective measures, the degree of enforcement emphasis needed and the impact of any speed changes.

13-6.06 Conditions Justifying Variations from the 85th Percentile Speed

The approved posted speed should normally be the nearest value below the 85th percentile speed which ends in 5 or 0. Conditions which justify varying the zone speed from the 85th percentile speed are:

1. If the 85th percentile speeds for adjacent speed check stations are approximately the same, they may be averaged to determine the zone speed. This method may also be used when differences occur in opposing directions. If directional speed differences are greater than 10 mph, different zones may be established for opposing directions. Enforcement officials should be notified of this decision and their reaction submitted with the investigation results.
2. Speed limits may be established 5 mph under the 85th percentile speed when there is a high crash record involving crashes of a type that would be reduced by enforcement of a lower speed limit. Crash severity rates should be calculated for each of the preceding 3-5 years and demonstrate an increasing progression of severity. These rates and the computer printouts used to determine them should be submitted with the report. **A lower speed limit should be established only after the commitment of reasonable enforcement is assured.**
3. At locations where traffic volumes are very light and a sufficient number of cars cannot be checked in the two hours that the speed check station is operated, the 85th percentile speed may not be reliable. In these cases, test runs should be done by experienced traffic engineering personnel. Test run speeds should be selected in 5 mph increments. Ideally, two test runs at each speed should be conducted out in each direction by two different drivers. The vehicle should have a calibrated speedometer. Test runs should provide a basis from which to select a reasonable and safe speed. This data and the recommended speed with a short justification statement should be marked on the report.

4. School zone speed limits are not based on the 85th percentile speed. Speed checks do provide an accurate reflection of the prevailing speed for average conditions and may be used as the base point from which speed limits can be adjusted downward for special conditions such as children crossing. The booklet "A Guide to Establishing Speed Limits in School Zones" outlines the methods to conduct the engineering and traffic investigation at these sites. This booklet is available from OTE-ITS and has been adopted by Commissioner's Order No. 63700 as the official method described in MS 169.14 Subd.5a.
5. If the study area is of a continuous curvilinear design, the area should be test driven and a ball bank survey done. Radar checks should be made at midpoints of tangents and used as a guideline for determining reasonable values, but the controlling factor of the speed limit will be the average of the safe speeds as determined by the ball bank survey. Establishing a speed limit by this method will prevent unnecessary accelerations by the driver, conserve fuel and provide safe traveling with minimum frustration encountered on winding roadways. Individual curves will still have to be checked and advisory speeds posted where necessary.

13-6.07 Speed Zone Locations

The length of any section of zone set for a particular speed should be as long as possible and still be consistent with the 85th percentile speeds. Transition zones may be used on approaches to a city to accomplish a gradual reduction from highway speeds to the speed posted in the city. In case the transition zones on the approach to the city are at locations where speeds fluctuate, the sections of such a zone may be as short as 1/4 mile. The change in speed between two transition zones should be greater than 5 mph, but should not normally be greater than 15 mph, because the change in speed would be too abrupt for driver observance.

Minnesota law states that the maximum speed limit in an urban district is 30 mph. It is possible that the engineering and traffic investigation will show that the 85th percentile speed reaches a value considerably higher than 30 mph in an urban district of an incorporated area, thus indicating that a speed limit of 30 mph is too low to be reasonable and prudent. Therefore, a reasonable and prudent speed limit should be determined and set by the Commissioner. On a city street, municipal state-aid street or town road, the governing body may elect to decrease the speed limit to 30 mph by the procedures defined in Minnesota Statute 169.14, Subd. 5b.

At locations where the study is extended into or through city limits, the exact point where the definition of urban district is met should be recorded. This is necessary because the speed limits inside the limits of the urban district may be established by the city government as described above, while the speed limits outside the urban district shall be established by the Commissioner. It is also necessary to show on the strip map, the exact location of the city limit either by station and project number, by reference post numbers, or by some other geographical physical feature to prevent misinterpretation if the city limits are changed.

Other important factors in speed zone locations include the speed limit and conditions presented in front of the driver as he leaves a zone. If an in place zone is being changed or a new zone established, the roadway on each adjoining side of the study area should be driven to determine if it is impacted by the recommended speed limit. The adjoining segments should be test driven for a length equal to 10 seconds of travel time at the posted or statutory speed limit. If adjoining speed limits are affected or there are potential hazards present that would affect the driver's choice of speed, then the road authority (or the adjacent road authority) should be notified that the study area should be expanded. If the road authority (or the adjacent road authority) refuses expansion of the study, this should be documented and included with the study report when it is submitted to OTE-ITS.

13-6.08 Checklist of Items Submitted with Speed Report

1. Administration Items

   - Resolution or reason for initiating study from road authority.
   - Exact road name and termini of study.
   - Entire control section reviewed and listed on Form 29212.
   - Reaction of local officials to proposed zoning.
   - Reaction of enforcement officials to proposed zoning.
   - Relative correspondence from citizens or political factions.
   - in place road, reconstructed or new construction.
   - Other

2. Roadway Features

   - North arrow, scale and copy of map with designated road shown.
   - Roadway width, shoulder width, surface type and condition.
   - Urban district limits and incorporated city limits.
   - Locations of buildings and entrances along road.
   - Crossroads with names or numbers.
   - Locations of traffic signals, signs and/or markings.
   - Limits of proposed zones, limits of existing zones and the limits of the zones entering and exiting the study area.
   - Horizontal and vertical curve locations.
   - School zones, playgrounds or other special zones.
   - Crash rates for the roadway.

3. Speed Data

   - Location of radar checks shown on map.
   - Speed data sheet with 10 mph pace, percent in pace, 50th percentile and 85th percentile shown.
   - Range of speeds at which test runs were executed if radar checks not feasible.
   - Corresponding advisory speeds listed for in place warning signs.
   - Show values of any other in place speed zones such as school zone speed limit or bridge speed limit.

13-6.09 Speed Zones on Gravel Roads

Gravel roads have considerable differences from paved roads. Typically, gravel roads are designed with minimal design criteria, are subject to fluctuating surface conditions, have low enforcement priority, and serve low ADT's usually comprised of local repeat traffic. The principles of speed zoning are described in the ITE Traffic Engineering Handbook (4th Edition). In summary they address reduced stopping distance, traffic flow, capacity, safety and crash severity reduction. It is very difficult to equate these principles with the conditions that usually exist on a gravel road. Due to these principles and operational characteristics of gravel roads, Mn/DOT has generally not set speed limits on gravel roads and has relied on the "Basic Rule" described in MN Statute 169.14.

It is Mn/DOT's policy to evaluate gravel roads based on the merits of the principles described above and if these principles are not met or there will be no improvement in the operation or safety of the road, then a reduced speed limit will not be authorized. Mn/DOT will honor all requests to investigate any type of road and perform the traffic investigation. Due to workload and economic factors, it will be necessary to quickly and accurately determine the type of road and whether speed limits would benefit the road based on the above principles.

To aid the study teams, the following list of typical qualifications should be used in the first phase of the investigation to facilitate their prompt judgement of whether or not a speed limit should be established on a gravel road.

1. Typical gravel roads where speed limits are not necessary:
   a. A gravel road that would not be zoned even if it was paved. (Many requests originate from dust control problems. Paving, not a speed limit, is the correct solution.)
   b. A DEAD END road without continuous traffic flow.
   c. Gravel roads that do not provide a connection (at both ends) between arterial roads or major traffic generators.
   d. Rural or urban non-collector type roads that serve scattered local residents only.
   e. Gravel roads that have no practical enforcement potential. Origin of the request should be determined so that unique problems can be isolated and solved by enforcement rather than a regulatory speed limit being used as a net to catch one violator.
2. Typical gravel roads where speed limits may be beneficial are:
   a. When there is a connecting section of gravel road that is between two paved roads, that serves to provide a continuous roadway. If the paved sections have speed limits, then a safe speed limit should be considered for the gravel section.
   b. When the gravel roadway meets or substantially meets urban district criteria (MS 169.01 subd.59), and the housing and roadway are predominantly used by seasonal tourists unfamiliar with the road, the posting of a safe speed will aid the motorist in his selection of speed to navigate the road and the potential hazards of pedestrians.

All gravel road speed limit authorizations will have a contingency typed on each authorization. The contingency will void the speed limit authorization in the event that the gravel road is paved or reconstructed with new alignment or grade.

It should be stressed and communicated to local authorities, that it is the local authorities' judgement and decision making power as to whether a resolution should be pursued. Two sections of statute that reference this decision making ability of the local authority are MS 160.13, which in part states, ". . . may install other safety devices as they deem necessary"; and MS 169.14, subd. 5, which in part states, "When local authorities believe . . ." This language allows the local authority to decide if a speed limit investigation is really necessary and if not, then they are not bound by statute to pass a resolution requesting one. Mn/DOT guidelines should be freely conveyed to them so that they are better able to make the right decision in requesting investigations.

13-7.00 REFERENCES

1. 1987 Minnesota Rules
2. Manual on Uniform Traffic Control Devices
3. AASHTO - Geometric Design of Highways and Streets, 1994.
4. Transportation and Traffic Engineering Handbook

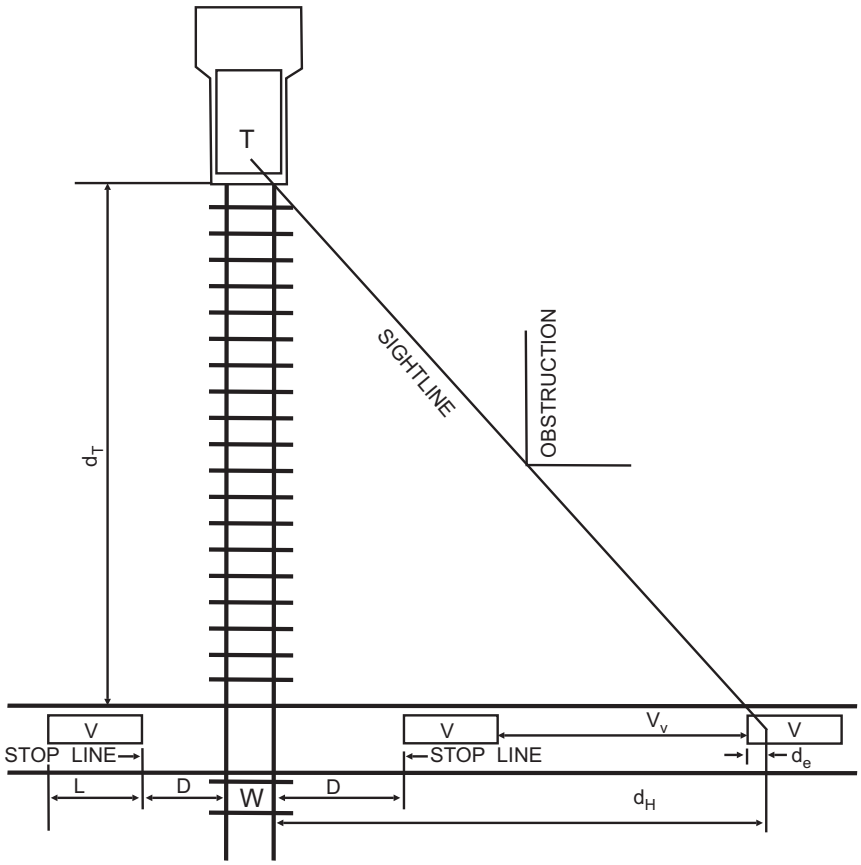
Train Speed (mph)	Case B Departure from stop	Design Sight for Highway Speed of:							
		Vehicle Speed (mph)							
	0	10	20	30	40	50	60	70	80
	Distance Along Railroad from Crossing, d_T (ft.)								
10	240	146	106	99	100	105	111	118	126
20	480	293	212	198	200	209	222	236	252
30	721	439	318	297	300	314	333	355	378
40	961	585	424	396	401	419	444	473	504
50	1201	732	530	494	501	524	555	591	630
60	1441	878	636	593	601	628	666	709	756
70	1681	1023	742	692	701	733	777	828	882
80	1921	1171	848	791	801	838	888	1008	1008
90	2162	1317	954	890	901	943	999	1134	1134
	Distance on Highway from Crossing, d_H (ft.)								
		69	135	220	324	447	589	751	931

NOTE: This is for a 65-foot truck crossing a single set of tracks at 90 degrees.

Source Ref.: AASHTO -- Geometric Design of Highways and Streets, 2004

Text Ref.: 13-5.07

July 1, 1992	**REQUIRED DESIGN SIGHT DISTANCE FOR COMBINATION OF HIGHWAY AND TRAIN VEHICLE SPEEDS (ENGLISH)**	TABLE 13.1a



$$d_H = 0.28\ V_V\ t + \frac{V_V^2}{254f} + D + d_e$$

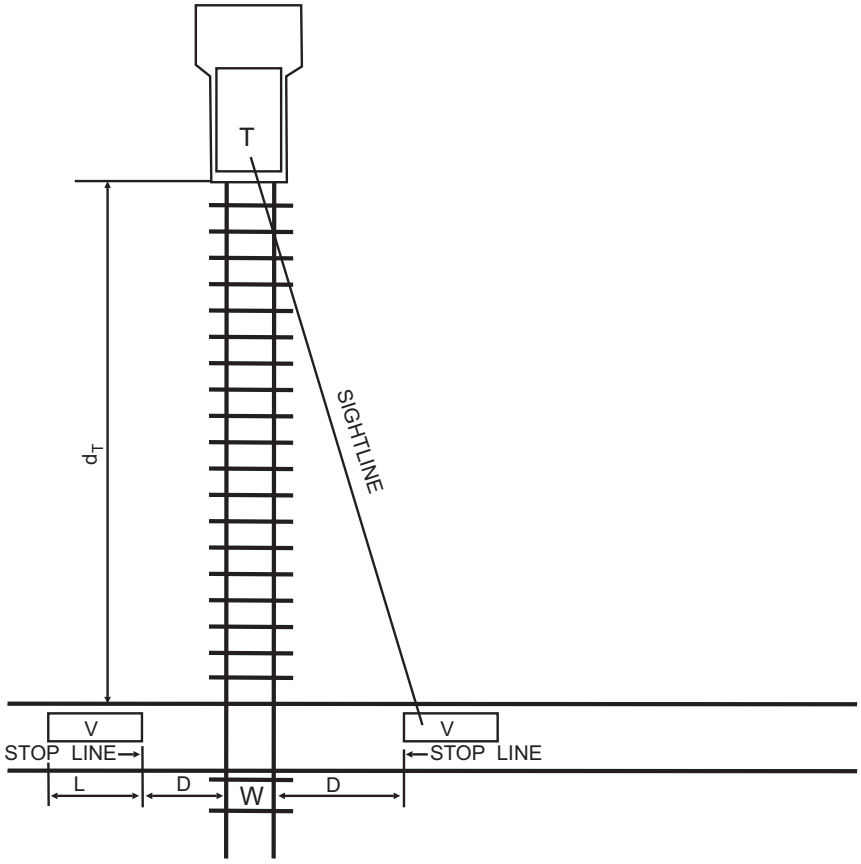
$$d_T = \frac{V_T}{V_V}\left[(0.28)\ V_V\ t + \frac{V_V^2}{254f} + 2D + L + W\right]$$

d_H = sight distance along the highway
d_T = sight distance along the railroad tracks
V_V = velocity of the vehicle
V_T = velocity of the train
t = perception/reaction time (assumed to be 2.5 seconds)
f = coefficient of friction (see Table III-1)
D = distance from stopline to the nearest rail (assumed to be 15 feet)
W = distance between outer rails (single track W = 5 feet)
L = length of vehicle (assumed to be 65 feet)
d_e = distance from driver to front of vehicle (assumed to be 10 feet)

Source Ref.: AASHTO -- Geometric Design of Highways and Streets, 1994

Text Ref.: 13-5.07

January 1, 1996	**SIGHT TRIANGLES FOR MOVING VEHICLE TO SAFELY CROSS AT RAILROAD CROSSING**	TABLE 13.2



$$d_T = 0.28\, V_T \left(\frac{V_G}{a_1} + \frac{L + 2D + W - d_a}{V_G} + J \right)$$

d_T = sight distance along the railroad tracks
V_T = velocity of the train
V_G = maximum speed of the vehicle in first gear (assumed to be 9 ft./s)
a_1 = acceleration of the vehicle in first gear (assumed to be 1.5 ft./s^2)
D = distance from stopline to the nearest rail (assumed to be 15 feet)
J = Sum of the perception time and the time to activate the clutch or the automatic shift (assumed to be 2.0 seconds)
W = distance between outer rails (single track W = 5 feet)
L = length of vehicle (assumed to be 65 feet)

$$d_a = \frac{V_G^2}{2a_1}$$ or the distance that the vehicle travels while accelerating to maximum speed in first gear

Source Ref.: AASHTO -- Geometric Design of Highways and Streets, 1994

Text Ref.: 13-5.07

January 1, 1996	**SIGHT TRIANGLES FOR DEPARTURE OF VEHICLE FROM A STOPPED POSITION**	TABLE 13.3