The information contained in Chapter Fourteen: Traffic Engineering, dated July 2006, has been updated to reflect the June 2016 Errata. The errata addresses errors, changes in procedure, changes in NDOR department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Chapter Fourteen
Traffic Engineering

1. TRAFFIC ENGINEERING STUDIES

The **Traffic Engineering Division** is responsible for conducting a variety of studies. These studies are summarized in the following sections. The roadway designer is responsible for requesting necessary traffic information from the **Traffic Engineering Division**.

1.A Capacity Analysis

The principal objective of capacity analysis is to estimate the amount of traffic that can be accommodated by a given facility while maintaining a predetermined level of service. Capacity analysis provides the necessary information to evaluate improvement alternatives. The designer should confirm with the **Traffic Engineering Division** that the design typical section and alignment, contained in the Engineering Review, provides the intended capacity and level of service for the project. See Chapter One: Design Standards, Section 7.A and Chapter Four: Intersections, Driveways and Channelization, Section1.C.1.

1.B Volume Studies

Traffic volume studies are conducted to determine the levels of traffic during specified time periods, e.g., annual average daily traffic (ADT), peak hour traffic, etc. Traffic study results are used for choosing the appropriate design standard and for planning, capacity analysis, accident rate analysis, etc.

1.C At-Grade vs. Interchange Recommendations

The **Traffic Engineering Division** develops recommendations for consideration of interchange type and design alternatives, e.g., at-grade intersection or interchange, where two or more roadways intersect.

1.D Weaving Section Analysis

The **Traffic Engineering Division** analyzes weaving sections where traffic entering and exiting a roadway facility will cross paths. The length and number of lanes necessary in a weaving section are determined using capacity analysis techniques.

1.E Lane Configuration

Auxiliary lanes may be provided for left turn lanes, right turn lanes or free flow right turn lanes as recommended by the **Traffic Engineering Division**. The length of the turn lanes should be verified with the **Traffic Engineering Division**. See Chapter Four: Intersections, Driveways and Channelization, Section1.D.

1.F Traffic Control Studies

Traffic control determination is the responsibility of the **Traffic Engineering Division**. Warrants for traffic control devices at intersections (See the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), Reference 14.1), (http://www.transportation.nebraska.gov/traffeng/mutcd.htm) are addressed and recommendations are made with regard to the type of traffic control necessary, i.e., stop or yield sign, traffic signal. If traffic signalization is recommended, the **Traffic Engineering Division** will also develop the signal timing design. See Section 4 and Chapter Four: Intersections, Driveways and Channelization, Section 1.E.

1.G Pedestrian Crossings

Pedestrian crossings are used to facilitate the movement of the walking public and/or bicycles across highways, railroad tracks, and rivers or streams. Warrant analysis for mid-block pedestrian crossings, pedestrian crossings at railroad tracks, and for pedestrian overpasses and underpasses are the responsibility of the **Traffic Engineering Division.** The roadway designer should coordinate the geometric design of the pedestrian crossing with the geometric design of the highway, sidewalk/bikeway, railroad crossing, or bridge. When a pedestrian overpass/underpass is required, the roadway designer will coordinate with the **Bridge Division**, which will be responsible for the design of the structure. For additional information see Section 4.A, Chapter Four: Intersections, Driveways and Channelization, Section 1.C.10, and Chapter Ten: Miscellaneous Design Issues, Section 8.

2. ROADWAY SIGNS

Roadway signs are used to regulate traffic and to advise and inform motorists in order to provide for safe and efficient vehicle operation on highways. Signing should be considered an integral part of design and should be designed concurrently with geometrics. The designer should submit a preliminary alignment design to the **Traffic Engineering Division** at “Preliminary Roadway Design”, Activity 5300, Clarity Task Code 5336 (See the Design Process Outline (*DPO*), Ref. 14.4).

Because supports for highway signs are potential obstacles to motorists, they should be located outside the clear zone or behind traffic barriers to shield motorists from the obstacle. If these measures are not possible, supports for signs should be the "breakaway" type. Exceptions to the “breakaway” requirement may occur in urban areas with significant pedestrian traffic and/or restricted right-of-way.

The **Traffic Engineering Division** determines the need for overhead signs. Although the roadway designer does not design the signs, he/she should confirm that any overhead signs are included in the cost estimate for the project and should ensure that the locations of overhead signs meet lateral and vertical clearances as defined in Chapter Three: Roadway Alignment, Section 3.D.

3. MARKINGS

Markings should be an integral part of roadway design and should be designed concurrently with roadway geometrics. There are three general classifications of markings: pavement markings, object markings, and delineators.

Pavement markings usually consist of line markings such as center lines, edge lines, lane lines, parking lines, cross walk lines, etc. The roadway designer should submit a preliminary lane configuration to the **Traffic Engineering Division** for review of pavement joints with respect to the location of pavement markings as soon as the alignment and geometrics are designed during "Functional Design", Activity 5400, Clarity Task Code 5428 (See the *DPO*, Ref. 14.4). In addition, roadway designers should run a passing sight distance computer program that provides station-to-station no passing zone locations. The information from this program is given to the **District Maintenance Engineer** and reviewed with the **Traffic Engineering Division** during "Final Design Review", Activity 5500, Clarity Task Code 5508 (See the *DPO*, Ref. 14.4).

Object markers warn of physical obstructions within or adjacent to the roadway that pose an obstacle to motorists such as piers, bridge abutments, handrails and culvert headwalls. Object markers may warn of roadside conditions such as abrupt changes in alignment or the end of a roadway. Object markers are considered maintenance items and are not included in the roadway quantities and cost estimate.

Delineators are retroreflective devices mounted at the side of the roadway. They are used to guide traffic, especially at night. The units are installed at specified heights and spacing to delineate changes in the roadway. Designers are responsible for determining the locations and quantity of the delineators for a project and should refer to the Standard/Special Plans Book, (Reference 14.2) for information concerning location and spacing of delineators.

4. TRAFFIC SIGNALS

Traffic signals are used to direct conflicting movements of vehicles and/or pedestrians by assigning the right-of-way to various movements at different times. The design of traffic signals and signal timing should be coordinated with the geometric design of the intersection. Refer to Chapter Four: Intersections, Driveways and Channelization, Section 1.E.2, for additional information concerning the coordination of signal design with intersection design.

4.A Pedestrian Crossing Signals

Warrant analysis for pedestrian crossing signals, as outlined in the Manual on Uniform Traffic Control Devices, (Reference 14.1), is the responsibility of the **Traffic Engineering Division**. For further information see Section 1.G.

5. DETOURS AND TRAFFIC THROUGH CONSTRUCTION

Traveling through a construction work zone or through a detour can be confusing to drivers. To alleviate the confusion, a well-designed traffic control plan (TCP) of warning signs, markings, channelization devices, etc. should be developed. The **Traffic Engineering Division** is responsible for developing the traffic control plan, and the roadway designer should address construction-sequencing issues and coordinate the development of the traffic control plan with the **Traffic Engineering Division** early in the design process. For additional information see Chapter Ten: Miscellaneous Design Issues, Section 9.

The roadway designer should consider the following when preparing roadway and construction phasing plans:

- Capacity of a detour or temporary road should be adequate to handle expected traffic around or through the construction zone.
- Geometrics should meet minimum guidelines so the driver can travel safely through the work zone.
- Roadside safety and clear zone requirements should be addressed.
- Traffic control devices should be selected appropriately.
- Construction sequencing should be constructable.
- Economic costs to users and adjacent property owners and businesses should be considered.
- Community and social impacts should be considered.
- Traffic control plans should have some flexibility to accommodate changes in work schedule and traffic patterns.

The use of a detour versus construction under traffic should be addressed.

5.A Detours

Detours guide traffic around construction zones outside the project right-of-way instead of through the construction. A detour is a signed alternate route within an existing roadway system that is adequate or appropriate for the intended traffic and the intended duration.

At the plan-in-hand the following items should be considered in determining if a detour is practical:

- The speed of the proposed detour should be relatively close to the speed of the facility being improved.
- The existing roads should be able to adequately and safely handle the expected volumes of traffic generated by the proposed detour. Geometric improvements along the proposed detour route may be required.
- The existing pavements should be structurally adequate to handle the expected traffic volumes. Surfacing improvements along the proposed detour route may be necessary.
- The detour route should be a reasonable length and should not require the motorist to travel too far from the normal route.
- The detour should not significantly affect the operation of businesses along the proposed improvement.
- Local access should be provided to residents and businesses.
- The detour should not adversely affect emergency vehicle operations.
- Approvals should be obtained from applicable governing agencies.
- Detours around railroad tracks should be coordinated.

The **District Operations & Maintenance Manager** should be consulted at the plan-in-hand about the feasibility of maintaining the detour during construction.

The roadway designer provides the detour route to the **Traffic Engineering Division** and designs any geometric and surfacing improvements that may be required. Pavement for detour improvement is a separate pay item group.

The **Traffic Engineering Division** will review the proposed detour route. If roads other than state roads are proposed for use as a detour, approval should be obtained from the appropriate governing agencies. Covenant agreements should reflect the detour route. It is also important to discuss proposed detour routes at the public meetings. See the *DPO*, (Ref. 14.4), Activity 5300, Clarity Task Code 5350 and **EXHIBIT C** and Chapter Thirteen: Planning and Project Development, Section 5.A, for additional information concerning coordination with other political entities.

5.B Traffic Through Construction

Although it is often better to provide detours around construction there are times when this is not practical and it is necessary to maintain traffic through construction. It may be necessary to encroach upon travel lanes, shift lanes or even close lanes during construction. When this is needed, the frequency and length of time traffic must be routed through the construction zone should be kept to a minimum. Adequate warning should be provided to motorists.

Throughout the entire design process, the roadway designer should consider construction sequencing and the maintenance of traffic during construction. The following items should be considered and provided for in the design of a project that is to be built under traffic:

- A clear zone and/or a positive barrier should be provided where construction is to take place adjacent to traffic. The desirable distance from the driving lane to the edge of the new pavement should be a minimum of 10 ft (3 m), 2 ft (0.6 m) for barrier width and a 2 ft (0.6 m) empty space behind the barrier, leaving a 6 ft width (1.8 m) for working area.
- Taper lengths for lateral lane transitions and lane drops should meet minimums set by the MUTCD (Reference 14.1).
- Day and night sight distances should meet minimums set by **AASHTO's** A Policy on Geometric Design of Highways and Streets (Reference 14.3).

Often road improvements such as milling, armor coat and asphalt surfacing, and shoulder work will require the closing or partial closing of travel lanes on highways during construction. On highways of four lanes or more, this may simply involve reducing the number of lanes in each direction so construction work can be completed. On two-lane highways this may involve the actual closing of an entire lane and the use of a flagger to direct traffic through the construction. The **Traffic Engineering Division** will recommend what type of traffic control is needed.

5.C Temporary Roads

The construction of culverts, bridges, etc. may require a temporary road to allow traffic to bypass the construction site. For these situations it may be more practical to construct a short route around the work zone than to build the project under traffic, (See Chapter Ten: Miscellaneous Design Issues, Section 9.B).

6. REFERENCES

14.1 United States Department of Transportation Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways, Washington, D.C., 2009. (http://www.transportation.nebraska.gov/traffeng/mutcd.htm)

14.2 Nebraska Department of Roads, Standard/Special Plans Book, Current Edition.

14.3 American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 2011.

14.4 Nebraska Department of Roads, Design Process Outline (*DPO*), Current Edition. (http://www.nebraskatransportation.org/roadway-design/downloads.htm)