

CHAPTER 12

TRAFFIC OPERATIONS

MAINTENANCE OF TRAFFIC DURING CONSTRUCTION12-1

In the design of a project, the traffic control plan is an essential element in determining a method for maintaining a safe flow of traffic through a construction zone, determining the need for on-site detours, or directing traffic to alternate routes. The traffic control plans are a part of the final construction plans and are prepared by the Traffic Control Unit in coordination with the Roadway Project Design Engineer.

Maintenance of traffic should be considered during the functional and preliminary designs. A conceptual plan should be prepared for any detours, and should be made a part of the Combined or Design Public Hearing Map, especially if the detour will require additional right of way. On Categorical Exclusions for Bridge replacements projects, the determinations of either an on-site detour, or detouring traffic around the project by alternate routes, is an integral part of the document.

TRAFFIC OPERATIONS PLAN12-2

The Roadway Project Design Engineer, in coordination with the Traffic Control Project Engineer, shall prepare a Traffic Operations Plan. This plan should be used to convey the design decisions that were determined necessary to provide constructability of the project, while safely maintaining traffic through the construction zone. It should be included with a set of plans submitted to the Traffic Control Unit at the same time plans are submitted to the Hydraulics Unit.

The Traffic Operations Plan should include the following:

- 1) A sketch map showing the overall project, along with roads and streets planned to be used for alternate routes during construction, or phases of construction should be provided. Proposed off-site detours should be marked on the map and described with a note. (Maps similar to a county map would be adequate for a sketch map.)

- 2) A layout map, similar to the plan sheet layout on the title sheet, should be used to show on-site detours, off-site detours, construction phasing and traffic patterns through the construction zone. Notes describing the phasing or traffic shifts should be included on the layout map. On complicated projects, two or more layout maps may be required for clarity of construction phasing. Controlling earthwork and undercutting operations must be carefully considered to ensure constructability.
- 3) Using construction year traffic, a capacity analysis of all streets, roads and intersections that will be used for detours should be performed, and reviewed to determine if improvements will be required to handle additional traffic.
- 4) Show a typical section of any proposed new detour alignments or phasing areas.
- 5) Mark any streets that will be dead ended.
- 6) Show locations of existing signals and proposed temporary signals.
- 7) Identify culverts and bridges that will require staged construction.
- 8) Identify potential grade problems between existing and proposed.

The Work Zone Traffic Control Unit will further develop this Traffic Operations Plan, coordinating with the Roadway Design Project Engineer, to prepare a Construction Staging Concept package to be incorporated into the Final Design Field Inspection plans and presented by the Work Zone Traffic Control Unit at the Final Design Field Inspection meeting. After initial discussions at the Final Design Field Inspection, The Construction Staging Concept should be removed from the plans.

TRAFFIC CONTROL PLAN REVIEW MEETINGS

12-3

Approximately 4 to 6 weeks after the Final Design Field Inspection, a separate meeting may be held, if needed, to discuss constructability and design problems related to the maintenance of traffic. Attendees normally should include at least one member each from Roadway Design and Work Zone Traffic Control, as well as the Resident Engineer and/or their Assistant, Division Construction Engineer, Area Roadway Construction Engineer and/or Area Bridge Construction Engineer, Division Traffic Engineer and others, as required. The Traffic Control Unit, notifying the appropriate personnel will coordinate this meeting by form letter.

Similarly, another meeting to discuss details of traffic control may be held after the Pre-Let Field Inspection, approximately three weeks prior to the date that the Traffic Control Plans are due to be turned in. At this time, the Work Zone Traffic Control Unit will present plans for review and discussion that incorporated any recommendations from the Pre-Let Field Inspection meeting, and are approximately 90% to 100% complete for turn-in.

These traffic control plan review meetings are additional meetings to discuss the traffic control in depth. They are not a replacement for the Final Design and Pre-Let Field Inspections. Traffic Control Plans should still be presented and discussed at these meetings.

DESIGN OF ON-SITE DETOURS AND MEDIAN CROSSOVERS

12-4

After the Final Design Field Inspection, the Roadway Project Design Engineer will coordinate the location and design of on-site detours and median crossovers with the Work Zone Traffic Control Project Engineer. The design of on-site diversions and median crossovers (including horizontal and vertical alignments) will be the responsibility of the Roadway Design Unit, and will be a part of the roadway plans. The design of the crossovers or diversions may be shown on a separate plan sheet, and should be included in the roadway plan. Similarly, typical sections for detours, median crossovers and temporary widening should also appear in the roadway plans.

Median crossovers or detours not requiring right of way can be included with the detail sheets. Cross-reference notes will be required on both roadway plans and traffic control plans.

DESIGN OF ON-SITE DETOURS AND MEDIAN CROSSOVERS (continued) 12-4

Detour designs will be based on the functional classification of the roadway. **THE FOLLOWING CRITERIA WILL BE THE MINIMUM ACCEPTABLE DESIGN STANDARDS FOR EACH CLASSIFICATION:**

INTERSTATE AND FREEWAYS:

The design speed (V) of horizontal and vertical curves for crossovers and diversions on interstates and freeways will be the same or greater than the posted speed limit. They will be designed so that there will not be a need for a reduction in the posted speed limit.

Exceptions:

- 1) For short-term lane closures, design speed (V) does not have to be maintained for cross-over designs. It is often desirable to slow down the traffic.

Detours and median cross-overs should also be designed without a reduction in the number of lanes of traffic.

Exceptions:

- 1) Traffic Control phasing will sometimes allow short term lane closures during daylight hours, but detours should be designed to maintain existing number of lanes during peak hours.
- 2) Certain Interstate and freeway routes may have low traffic volumes. The Traffic Control Unit will determine on a case-by-case evaluation if long-term lane closures are permitted.

Superelevation for proposed horizontal alignments in median crossovers cannot meet design speed standards due to existing restraints. It is more desirable to have lower Superelevation rates, that smoothly transition vehicles through the alignment, than higher rates, with short lengths of change that create abrupt vehicle behavior. It is, however, critical that the surface of the proposed roadway be reviewed for areas that do not drain well. Hydroplaning during periods of rain can be created by long, level sections of pavement, and also by concrete barrier placed along the edge of the roadway. Grade and superelevation changes or special drainage features should correct these problems. Shoulder widths should be a minimum of 4' wide with 2' paved shoulders. The clear zone and recovery area should be maintained in accordance with the "Roadside Design Guide," or protected by guardrail or concrete median barrier. In areas where guardrail or median barrier is placed in close to the travel lane, special care shall be taken to avoid creating an unpaved drop-off area between the edge of the paved shoulder and the face of the barrier or guardrail.

DESIGN OF ON-SITE DETOURS AND MEDIAN CROSSOVERS (cont'd) 12-4

In construction areas, it is preferred that the face of temporary guardrail or barrier be placed flush with the edge of pavement to eliminate this problem.

EXPRESSWAYS AND MAJOR ARTERIALS:

The design speed (V) of detours, and median crossovers for expressways and major arterials with partial or no control of access may be lowered to 10 miles per hour below the posted speed limit. This should only take place when the capacity of the roadway is not affected by the lowering of the speed limit. It is possible to temporarily increase capacity by adjusting signal timings, eliminating drives, median openings, and specific movements at intersections, such as left turns, removing parking, or diverting wide vehicles to other routes.

The number of lanes required for the detour of an expressway or major arterial in operation during peak hours should be based on current average daily traffic.

Necessary # of Lanes for Detour

Unrestricted Traffic	During Peak Hours
0 to 30,000 ADT	Two lanes (one in each direction)
30,000 to 50,000	Four lanes (two in each direction)
50,000 to 80,000	Six lanes (three in each direction)
80,000 +	Eight lanes (four in each direction)

Shoulder widths should be a minimum of 4' wide with 2' paved shoulders. The clear zone and recovery area should be maintained in accordance with the "Roadside Design Guide" or protected by guardrail or concrete median barrier. In areas where guardrail or median barrier is placed in close proximity to the travel lane, special care shall be taken to avoid creating an unpaved drop-off area between the edge of the paved shoulder and the face of the barrier or guardrail.

MINOR ARTERIALS, COLLECTORS, AND LOCAL ROADS:

During construction activity, it will be permissible to control traffic in a one-lane, two-way pattern controlled by a flagging operation. This operation should not be scheduled or permitted during peak hours of that facility.

DESIGN OF ON-SITE DETOURS AND MEDIAN CROSSOVERS(cont'd)

12-4

A traffic signal may be utilized in lieu of a flagger during one-lane, two-way operation in special conditions approved by the Traffic Control Unit. Two-way peak hour traffic volume should not exceed 670 vehicles.

The design of an on-site detour to be used without a traffic signal or flagger, should be two-lane, two-way, with a minimum posted speed of 35 MPH.

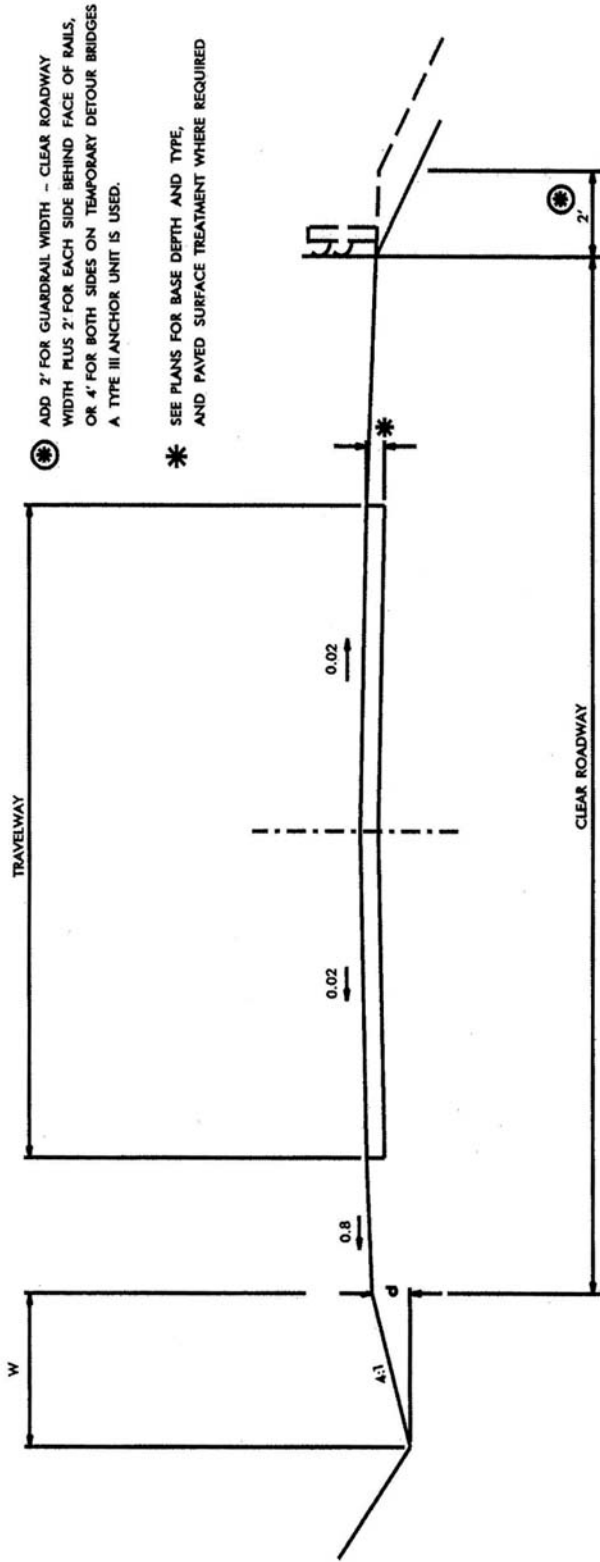
The design speed of the detour should not be more than 10 MPH below the posted speed of the existing roadway. Minimum widths for traveled way and shoulders should be determined by traffic volumes according to the following criteria:

	DHV < 100	DHV 100-400	DHV 400+
Width of Traveled Way (ft)	20	22	24
Graded Shoulder Width, each side, (ft)	4	6	8

Shoulder widths should be a minimum of 4' wide, with 2' paved shoulders. The clear zone recovery area should be maintained in accordance with the "Roadside Design Guide," or protected by guardrail or concrete barrier. In areas where guardrail or median barrier is placed in close proximity to the travel lane, special care shall be taken to avoid creating an unpaved drop-off area between the edge of the paved shoulder and the face of the barrier or guardrail.

When a one-lane, two-way bridge structure is being replaced, a similar one-lane, unsignalized temporary detour structure may be utilized. In this situation, the sight distance shall allow the entire bridge travelway to be seen from either approach, two-way ADT must be 1000 VPD or less, and the detour structure should be adjacent to the existing structure, such that the detour approach alignments are operating with essentially the same traffic pattern as existing.

FIGURE 1



TYPICAL SECTION

	SPEEDS			
	0-25	26-35	36-45	46-55
MAX. DEGREE	30°	30° - 15°	15° - 8° 30'	8° 30' - 5° 30'
MAX. GRADE	15 %	12 %	9 %	8 %
DESIRABLE STOPPING SIGHT DISTANCE	160'	160' - 250'	250' - 375'	375' - 550'
SUPER ELEVATION (MIN.)	.02 - .06	.02 - .06	.02 - .06	.02 - .06
				55 + 5° 30' OR LESS

TYPE	VPD	SURFACE		MIN. ROADWAY SHOULDER TO SHOULDER	DITCH WIDTH (w)	DITCH DEPTH (d)
		UNPAVED	PAVED			
A	0-250	✓		20'	2'	9"
B	251-750	✓		24'	2'	9"
C	751-2000	✓	DESIRABLE	28'	3'	12"
D	2001-5500	✓	✓	32'	3'	12"
E	5501-15000	✓	✓	38'	3'	12"
F	15000-ABOVE	✓	✓	40'	3'	12"

WIDTHS FOR TWO WAY TRAFFIC (LESSER WIDTH MAY BE USED FOR ONE-WAY)

STANDARD DESIGN CRITERIA FOR TEMPORARY DETOURS (MAINTENANCE OF TRAFFIC)

OFF-SITE DETOURS

12-5

Where adequate alternate routes exist in reasonable proximity to the project, they should be used to re-route traffic as much as possible. Before making a final determination, all potential detour routes should be visually inspected to evaluate the condition of the existing pavement and bridges.

If the adequacy of the existing pavement is questionable, or if it is determined that additional surfacing is required to enable a selected detour route to carry the additional traffic, the Pavement Design Engineer shall be consulted. It will also be necessary to consult with the Federal Highway Administration on projects with federal funding, and to coordinate with Project Management. Where City streets are required for an off-site detour, coordination and approval from the municipality will be required.

PAVEMENT MARKINGS FOR CONSTRUCTION PROJECTS

12-6

The Work Zone Traffic Control Unit will provide the Roadway Design Unit with recommendations for final pavement markings and markers for all contract construction projects.

The recommendations will be based on the Work Zone Traffic Control Unit's "Long Life Pavement Marking Policy" and "Reflective Pavement Marker Policy," and will be made early in the design stages of the traffic control plan. Initial recommendations and estimates will be provided as part of the preliminary scoping estimate, when applicable.

The Work Zone Traffic Control Unit will discuss their intentions with the Division Construction Engineer, the Area Traffic Engineer, and the Roadway Design Project Engineer prior to sending a formal recommendation letter. The Work Zone Traffic Control Unit recommendations for final pavement markings will be forwarded to the Roadway Design Project Engineer by form letter.

The determination of types of pavement markings and raised markers will be based on many factors such as ADT (volume per lane), length of project, type of facility, type of pavement, speed limits, geometrics, date of application (seasonal restrictions), annual snowfall, prevalent fog, ambient light conditions, and consideration of adjacent projects and existing marking materials.

PAVEMENT MARKINGS FOR CONSTRUCTION PROJECTS (continued) 12-6

In general, current policy normally calls for long-life pavement marking material for final pavement markings on Interstate and Freeways, or when the traffic volumes exceed 2000 vehicles per day, per lane, for thru-lanes. Long-life pavement markings utilized by NCDOT consist of thermoplastic, epoxy, preformed plastic, or other durable markings. Raised, reflective pavement markers will normally be applied to Interstate and Freeways, and for other roadways with traffic volumes in excess of 1000 vehicles per day for thru-lanes. (Snowplowable markers are not normally warranted unless these volumes exceed 2500 vpd per thru-lane). Projects qualifying for permanent raised pavement markers should have temporary raised pavement markers throughout the construction limits, for the duration of construction, for any traffic pattern that exceeds, or is expected to exceed 30 calendar days. Temporary raised pavement markers are also to be used for delineation of construction detours. For additional information concerning warrants, types, and selection of pavement markings and reflective markers, consult the Work Zone Traffic Control Unit