Temporary Asphalt Medians for Two-Lane, Two-Way Operation

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The objectives of this research were to evaluate the performance of temporary asphalt medians for use in two-lane, two-way operations as an alternative to portable concrete barriers and, if appropriate, to develop guidelines for the use of temporary asphalt medians. Use of the temporary asphalt median was evaluated at one site. The median was installed and removed at least twice as fast as concrete barriers, thereby reducing the time traffic was exposed to such activities by at least 50 percent. There was no difference in the cost per linear foot between the median and the concrete barrier because of the relatively high contract cost for the median compared with median costs in other states. However, use of the median will save a minimum of $40,000 ($80,000 on this project) by eliminating the use of impact attenuators at the concrete barrier end sections. It is expected that the costs will decrease as more medians are used; the cost per linear foot of the median was 40 percent lower on the second project in Virginia using the median. There is no evidence to suggest that the temporary asphalt median directly contributed to any accidents. However, it does appear that the presence of an intersection within two-lane, two-way operation may have been a factor in some accidents. The median performed well. Guidelines were developed for the use of the median.

Two-lane, two-way operation (TLTWO) describes the traffic flow pattern that results when one side of a four-lane divided highway is closed for reconstruction or repair and its traffic is diverted to the other side. Traffic flowing in opposing directions is limited to two lanes. A TLTWO is used when there is no feasible alternative. In Virginia, portable concrete median barriers are typically used to separate opposing streams of traffic in TLTWO.

Temporary barriers have four specific functions: to protect traffic from entering work areas, to provide positive protection for workers, to separate two-way traffic, and to protect construction (*1*). When struck, the portable concrete barrier provides protection by redirecting vehicles. The need for such positive protection to enhance safety is an important factor to consider in determining the type of treatment for TLTWO. The use of the barriers should be based on an engineering analysis that includes such factors as traffic volumes, traffic speeds, offset, and duration (*1*). There is no consensus on specific warrants for temporary barriers (*1*).

Because the portable concrete median barrier is expensive and it may not be needed or desired under certain traffic conditions, there is a need for a safe, cost-effective alternative for separating opposing traffic streams in TLTWO. Moreover, although experience with TLTWO in Virginia is limited, its use is expected to increase given the current and expected levels of bridge rehabilitation activities.

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A typical temporary asphalt median (also called an island) is 12 in. to 18 in. wide and 4 in. high, is painted with reflectorized yellow paint, and has orange tubes with reflectorized white collars mounted about 50 ft apart as shown in Figure 1 (*2*). The median is highly visible and provides more positive delineation than the concrete barrier, especially at night. Because the median is narrower than the barrier, it occupies less of the travel lane. Several state departments of transportation, including those of North Carolina, Florida, Ohio, and Pennsylvania, have successfully used the medians, typically on roads with average daily traffic (ADT) volumes under 30,000. The medians are generally not recommended where physical (protective) separation of the opposing lanes is required or where the traffic volume is high, for example, where the ADT is above 50,000.

The estimated costs of installing, maintaining, and removing temporary asphalt medians was expected to be about one-third to one-sixth of those for portable concrete median barriers in Virginia. The time required to install and remove an asphalt median was found to be substantially less than that required for installing and removing a concrete barrier (*3*). This difference in time is an important safety consideration if the installation and removal must be done during exposure to traffic.

Because of limited operational experience with the medians, there is no consensus on the traffic and geometric conditions that warrant the use of temporary asphalt medians (*1*).

OBJECTIVES AND SCOPE

The objectives were to evaluate the performance of temporary asphalt medians for use in TLTWOs as an alternative to the portable concrete median barrier and, if appropriate, to develop guidelines for the use of temporary asphalt medians for the Virginia Department of Transportation (VDOT). Both medians and concrete barriers were studied. Emphasis was on a comparison of the installation and removal costs and the performance of the asphalt median.

METHODS

Five activities were conducted to accomplish the study objectives.

Development of Specifications

Specifications for the temporary asphalt medians were developed primarily on the basis of a telephone survey of state

FIGURE 1 Temporary asphalt median.

departments of transportation (DOTs) that have used the median. Following the survey, the respondents sent additional information, such as specifications and guidelines on the temporary asphalt medians. A computerized literature search and a literature review supplemented the survey. A synthesis of this information resulted in a proposed specification that was reviewed and revised by VDOT staff.

Selection of Sites

Much effort in soliciting sites for this study was directed toward the district traffic engineers and the Location and Design and Traffic Engineering Divisions. Criteria for site selection were developed. The solicitations were made periodically throughout the study period.

Field Evaluation

Data were collected at the study site on three phases of the field evaluation: installation of the median and TLTWO, maintenance of TLTWO, and removal of the median and TLTWO. Traffic volume, speed, and vehicle classification data were collected. Research Council staff collected data during the installation and removal phases, and they also collected the traffic data. The VDOT on-site project inspector provided data on the maintenance of the TLTWO work zone.

Comparative Analysis

An attempt was made to comparatively analyze the temporary asphalt median and the concrete barrier. Comparisons were made of the rates and costs of installation and removal.

Development of Guidelines

Guidelines for the use of the temporary asphalt median for TLTWO were developed based on the study activities.

RESULTS AND DISCUSSION

Survey Results and Specifications Development

Survey Results

Information on the use of temporary asphalt medians in five states was obtained through telephone surveys of five state DOTs. The median cross section was either the shape of a trapezoid or a rectangle with rounded corners. The base width ranged from 12 in. through 18 in. with a height of 4 in. The median was painted with yellow reflectorized paint. A curb machine was typically used to install the median (a small pavement-widening machine may also be used). Orange tubular markers 18 to 36 in. high, spaced 50 to 55 ft apart, with white reflectorized sleeves or collars provided additional delineation for the median. Raised pavement markers were used in one state as an alternative delineator. Drainage openings were provided in the median at a spacing of 25 to 500 ft, depending on drainage requirements.

Use of a temporary asphalt median is not a factor in determining the speed limit for TLTWO. The speed limit is determined on the basis of factors such as work zone conditions, road geometrics, and traffic volumes. In addition, lower speed limits through work zones are often ignored by motorists. The *Roadside Design Guide* conservatively suggests that the temporary asphalt median be used with speeds of 45 mph or less until there is more operational experience with the median (*1*). From the survey findings, the speed limit was eliminated as a factor in the use of the temporary asphalt median.

There have been no accident problems as a result of using the median on four- and six-lane divided roads under ADT volumes ranging from 10,000 to 60,000. On one project, a six-lane, divided roadway was converted to a four-lane, two-way operation on one side of the road using the shoulder as a lane. Overall, the median was successfully used by all five state DOTs.

Specifications

The specifications used for the study are shown in Figure 2. They were developed from a synthesis of the survey of state DOTs with minor revisions by VDOT personnel.

Site Selection

The following three criteria were used for selecting the site for the temporary asphalt median: ADT between 6,000 and 30,000 vehicles per day, TLTWO maintained a minimum of 2 months, and a four-lane highway. In addition, sites that satisfied these criteria and that used the New Jersey concrete barrier to separate traffic were of interest as comparison sites.

One site was selected for use of the temporary asphalt median. Additional study sites were not found because of infrequent use of TLTWO, which limited the number of potential sites, and reservations by VDOT to using the median.

The temporary asphalt median for TLTWO was selected for installation on the eastbound approach of a U.S. primary

VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION
SPECIAL PROVISION FOR
TEMPORARY ASPHALT MEDIAN

October 29, 1986

I. Description:

This work shall consist of the construction, maintenance and removal of a temporary asphalt median for maintenance of traffic.

II. Materials:

(a) Asphalt median shall be Type I-2 bituminous concrete conforming to Section 212 of the Specifications.

(b) Raised pavement markers shall conform to Section 243 of the Specifications, except both sides of the pavement marker shall be yellow.

(c) Tubular pavement markers shall be from the Department's approved products list.

III. Construction Methods:

The bituminous materials shall be placed and compacted, on a clean pavement surface without using a tack coat, at the locations and to the dimensions shown in the provisions or as directed by the Engineer.

Drainage openings shall be 12 inches in length and spaced at 300 foot intervals or as directed by the Engineer.

The Department will paint the temporary asphalt median, before the Contractor installs the tubular and raised pavement markers; installation shall be in accordance with the provisions and manufacturer's recommendations.

The Contractor shall maintain the temporary asphalt median until its removal is required and replace any missing or damaged tubular or raised pavement markers within 24 hours of notification by the Engineer.

IV. Method of Measurement:

Temporary asphalt median will be measured in units of linear feet.

Tubular pavement markers will be measured in units of each.

V. Basis of Payment:

Temporary asphalt median will be paid for in units of linear feet, complete-in-place, which price bid shall include furnishing, placing and maintaining raised pavement markers, removal of temporary median and markers and all materials, labor, tools, equipment and incidentals necessary to complete the work.

Tubular pavement markers will be paid for in units of each, complete-in-place, which price bid shall include furnishing, placing and removal of tubular pavement markers and for all materials, labor, tool, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Temporary Asphalt Median	Linear Foot
Tubular Pavement Markers	Each

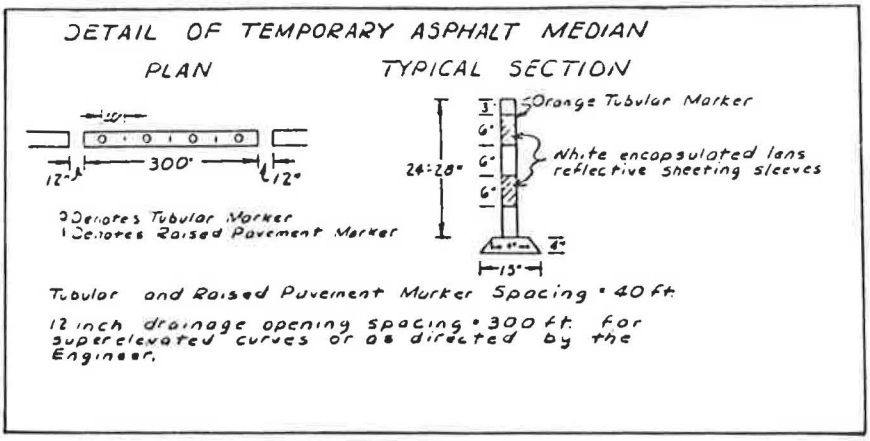

FIGURE 2 VDOT special provision.

route during reconstruction of the westbound bridge across a river. The study site is a four-lane, divided, rural highway section. A unique feature of this site is the presence of an intersection with a two-lane local road within the TLTWO section. The vertical alignment was relatively level. There was a slight horizontal curve near the western end of the TLTWO. The temporary asphalt median was used from the beginning of the crossover transition through the tangent section to the beginning of the exiting crossover transition.

Field Evaluation

Median Installation

A temporary asphalt median was installed on August 10–11, 1987. The length of the median was 2,280 ft. About one-half of the median was installed on the first day before the asphalt curb machine malfunctioned. It was noted that the asphalt mixture (VDOT Type I-2) was crumbling. Consequently, on the second day, a finer, modified Type I-2 asphalt mixture was used. Four workers were involved in the median installation: (a) the curb machine guider, (b) the dump truck driver, (c) the monitor of the asphalt entering the machine, and (d) the inspector of the median and cleaner of loose asphalt (Figure 3). The asphalt median was installed at a rate of 420 ft/hr.

After a section of the median was installed, the median was painted yellow with a spray gun, and reflectorized glass beads were manually spread on the top of the median. Three problems were encountered in the paint process: (a) the manual painting with the spray gun was slow, (b) the paint was absorbed by the hot asphalt, and as a result (c) the glass beads did not adhere to the paint. Therefore, there was little or no reflectorization from the paint. Next, raised pavement markers and tubular markers were installed on the median. The two markers were alternated every 40 ft.

Traffic Data

The ADT was about 7,000 vehicles, 87.7 percent of which were passenger cars and long, two-axle, four-tire vehicles; 5.4 percent were two-axle vehicles with six tires or three- or four-axle vehicles; and 6.7 percent were vehicles with five or more axles. The 85th percentile speeds for westbound and eastbound approaches were 48 mph and 58 mph, respectively. The speed of the traffic on the westbound approach may have been lower because it was the approach that crossed over the existing median and the data collection point was about 200 ft from the first crossover. Data collected on lateral placement and headway were omitted because of an equipment malfunction.

Monitoring TLTWO

The VDOT project inspector monitored and recorded the activities related to work zone traffic control (Figure 4). The contractor maintained the TLTWO. A summary of the incidents is presented in Table 1.

FIGURE 3 Median installation process.

There were nine incidents in which a total of 23 tubular markers were hit by vehicles, primarily farm machinery. Cold weather and wind appeared to cause six tubes to break, and hot weather resulted in the bending of five tubes. A total of 34 tubular markers were replaced. Initially, 29 tubular markers were installed and 4 more were added to mark the ends of the median for snowplows. The replacement rate for the tubes was about 100 percent. Four of the six incidents of Type II barricades being hit in the transition occurred in the first five weeks of TLTWO. Accidents at the intersection occurred throughout the duration of the project. Accidents are discussed in the next section. From the tire marks, it appeared that in one incident an eastbound vehicle drove onto the right shoulder and then crossed over the median. It is not known whether this incident was intentional. This was the only incidence of a vehicle crossing the median, and it occurred about 2 months after installation. No damage was reported.

Accidents

Between August 11, 1987, and August 8, 1988, 11 accidents occurred during TLTWO: 9 angle accidents at the intersection; 1 overturn, alcohol-influenced accident; and 1 run-off-the-road (ROR) accident. There were five injury accidents and six property damage accidents. None of the accidents involved a fatality.

The following trends were noted: (a) 7 of the 11 accidents occurred during the daytime on the weekend, (b) 9 of the 11 accidents occurred during the daytime with clear weather, (c) 5 of the 9 angle accidents involved drivers aged 60 or over failing to yield (3 of the 9 angle accidents involved a driver aged 79 or over failing to yield the right-of-way), and (d) 7 of the 9 angle accidents involved a westbound vehicle on the U.S. primary route and a northbound vehicle on the local road.

In the 1-year period before the installation of TLTWO—August 11, 1986, through August 9, 1987—there were no accidents. Two years before, there were three accidents, one angle at the intersection and two ROR accidents. In the third

Route 360 King & Queen and King William Counties
Approaches and Bridge over Mattaponi River

WORK ZONE TRAFFIC CONTROL LOG

Month and Year: _____

Name and Title: _____

Date	Damage Description	Location (see reverse)	Action Taken and Date

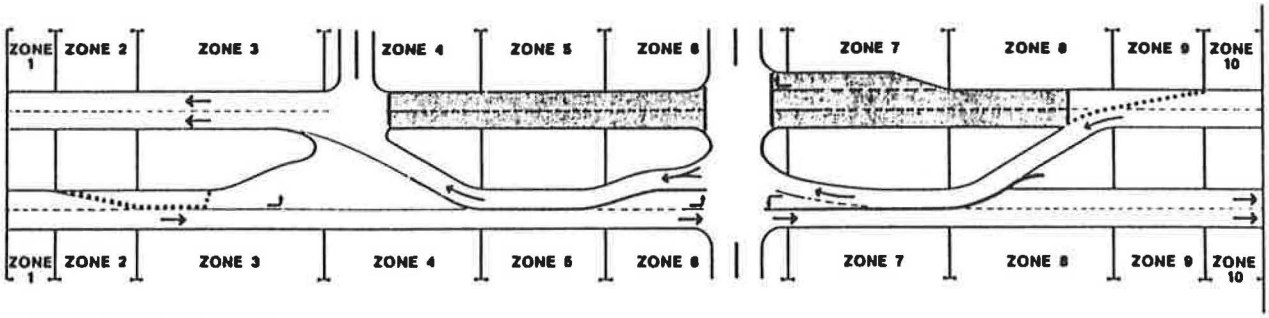

FIGURE 4 Monitoring form.

TABLE 1 INCIDENTS BY FREQUENCY OF OCCURRENCE

Type of Incident	Number of Incidents
Tubular markers broken/damaged	11
Type II barricades hit	6
Accidents at the intersection	5 (9 based on accident reports)
Type III barricades or barrels vandalized	2
Warning signs hit	2
Type II barricade stolen	1
Vehicle crossed median	1
TOTAL	28

year before, there was one accident, an angle accident at a store entrance.

Intersection control beacons (flashing overhead caution signals) were installed at the intersection several years before construction as a countermeasure to reduce intersection accidents. The beacons were removed during construction because the support poles were in conflict with temporary pavement construction. Maintaining intersection control beacons during construction may have resulted in a lower accident frequency.

In the traffic control planning phase of this project, there was some concern about the presence of this intersection within TLTWO. A special effort was made to provide temporary and permanent warning signs on the approaches of the local road and delineation of travel through the intersection.

It is suspected that violations in driver expectancy at intersections of four-lane divided roads may have contributed to the seven angle accidents involving a westbound vehicle on the U.S. primary route and a northbound vehicle on the local road. Usually, the driver of a northbound vehicle stops at the intersection, looks left (for eastbound vehicles) to see if it is safe to proceed, proceeds to the median opening, and stops and looks right (for westbound vehicles) to see if it is clear. But with TLTWO on the eastbound approach, it is necessary for the driver of a northbound vehicle to look both left and right to see if it is clear before entering the intersection.

Some older drivers have some difficulty at intersections with information processing and decision making (*4*); these difficulties are compounded by the presence of TLTWO.

It is further suspected that the conditions of the intersection would be worse with the use of the concrete barrier instead of the median because the higher barrier would further restrict sight distance at the intersection.

Initially, a before-after accident study with a comparison group was planned. This study was eliminated because the lack of accidents 1 year before reconstruction would have resulted in division by zero in the analysis (*5*).

Because the accident experience during reconstruction was high, it appears that the accidents were connected with the presence of an intersection within the TLTWO. There is no evidence to suggest that the temporary asphalt median directly contributed to any of the accidents.

Removal of the Median and TLTWO

TLTWO ended on August 8, 1988, with the opening of the new westbound bridge. The median was removed on August 8–9, 1989, in three phases (Figure 5): a front-end loader was used to push the asphalt median into a pile toward the left shoulder, a tractor with a sweeper attachment swept the loose asphalt from the travel lane toward the shoulder, and a second front-end loader loaded the asphalt from the median onto a dump truck for transport to a storage area. During the first two phases, the second front-end loader was removing the median crossover pavement.

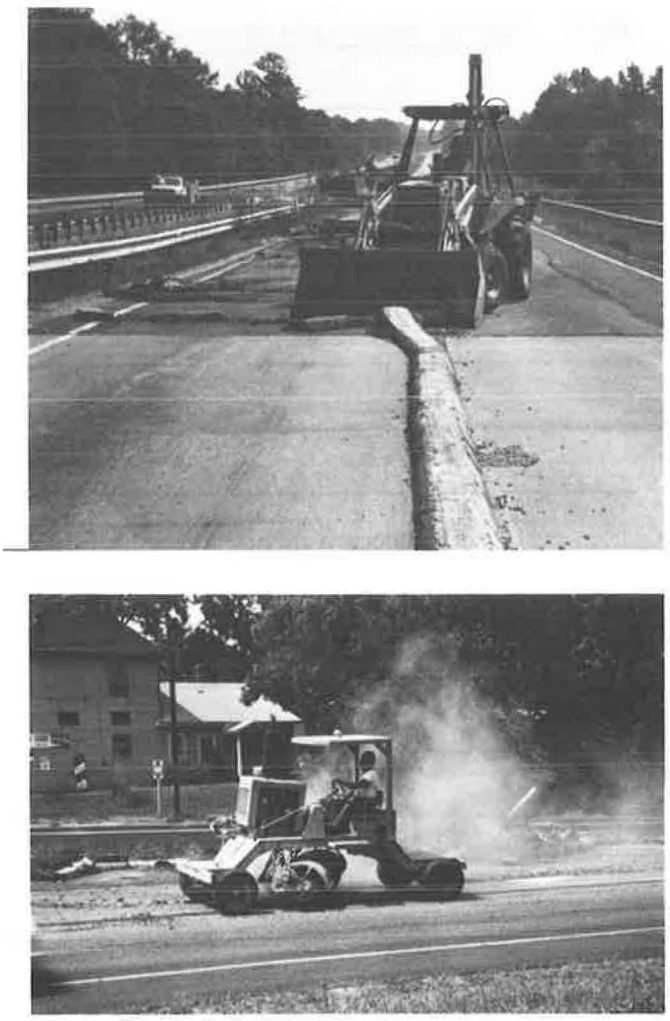

FIGURE 5 Median removal: *top*, front-end loader removing median; *bottom*, sweeping loose gravel.

The median was removed under traffic conditions. The front-end loader operator moved the median out of its position and

into the closed left lane during gaps in the traffic stream. The median was then pushed into piles about 500 ft apart. The average rate of removal by the loader was 606 ft/hr (with a standard deviation of 144 for four samples).

Field Evaluation Finding

The temporary asphalt median performed well at the study site.

Comparative Analyses

Two comparative analyses were made between the temporary asphalt median and the New Jersey concrete barrier for TLTWO: (a) installation and removal rate and (b) cost.

Installation and Removal Rate

Using an asphalt curbing machine, the temporary asphalt median was installed at a rate of 420 ft/hr. The concrete barrier was installed at a rate of 200 ft/hr based on a study on a four-lane interstate highway on September 1, 1987. The temporary asphalt median can be installed about twice as fast as the concrete barrier. Therefore, the time that traffic is exposed to installation activities is about 50 percent lower for the median than for the barrier. The rates are not for a complete installation because painting the median, installing markers for the median, installing warning lights on panels, and painting the temporary pavement marking adjacent to the barrier are not included. Because these activities are typically done concurrently with the median or barrier installation, it is expected that the additional time would be relatively small.

The removal rate for the median was 606 ft/hr. It is estimated that the removal rate for the barrier is equal to the installation rate of 200 ft/hr because the procedure is reversed. If the removal rate for the median is reduced to 450 ft/hr to allow for complete removal, this will mean that the median can be removed 2½ times faster than the barrier, thus reducing exposure to traffic by 60 percent.

Cost

The contract price for the complete installation and removal of the temporary asphalt median was $10.00 per linear foot. Because the average cost of the concrete barrier is $10.00 to $11.00 per linear foot, there was no difference in cost in Virginia. The tubular markers were priced at $50.00 each. Average costs for temporary asphalt median projects in other states are shown below.

State	*Asphalt Median Cost ($/linear foot)*	*Unit Cost ($/tubular marker)*
Pennsylvania	2.10	18.00
Ohio	2.35	18.70
West Virginia	7.18	34.00

In every case, especially for Pennsylvania and Ohio, the costs are substantially lower than for Virginia. It is expected that the prices will decrease as VDOT uses more temporary asphalt medians. In the second project in Virginia using a median, the contract price was $6.00 per linear foot. This parkway project on a six-lane, divided highway in a suburban area was initiated near the completion of this study.

In the initial project plans, four G.R.E.A.T. impact attenuators were proposed for the two ends of the concrete barrier and at both sides of the break in the barrier at the intersection. At a unit cost of $20,000 for the impact attenuators, $80,000 was saved by eliminating them when the temporary asphalt median was chosen over the concrete barrier. In addition, sight distance at the intersection was improved with the use of the temporary asphalt median instead of the concrete barrier.

Development of Guidelines

The second project objective was to develop guidelines for the temporary asphalt median, if appropriate. The Location and Design Division was directed to develop guidelines for the use of temporary asphalt medians to provide information and instruction and to promote use of the median. The guidelines were developed with input from the Traffic Engineering Division and the principal investigator of this research. Consequently, instead of developing separate guidelines for the temporary asphalt medians in this research, this researcher reviewed the Location and Design Division's guidelines and special provision and made comments and suggestions.

Guidelines

The VDOT's guidelines for the use of temporary asphalt medians are shown in Figure 6. The guidelines consist of two parts: general notes and a detailed drawing of the temporary asphalt median.

Considering the median for TLTWO with traffic volumes between 4,000 and 15,000 vehicles per day is restrictive compared with the approach of other state DOTs. However, this restriction reflects VDOT's cautious approach to using the median. Although it is mostly used on four-lane divided roads, the median in TLTWO is suitable for use on four-lane undivided roads. The guidelines do not address four-lane, two-way operations (FLTWO). However, FLTWO was used on the parkway project; therefore, FLTWO should be mentioned in the guidelines. The decision to use the asphalt median is made on a project-by-project basis, typically using traffic analysis methods. The volume guidelines are not very useful compared with the traffic analysis. Therefore, volume guidelines may be omitted.

From the experience at the study site, the following two suggestions are noted:

1. Tubular markers should be placed at the ends of the median to delineate them for snow removal activities.
2. Special attention should be given to traffic control at an intersection that is within a TLTWO, especially the side street approaches of the intersection. Special attention may include extensive warning signing, supplemental pavement markings, and intersection control beacons.

May 16, 1988

ERRATA SHEET

INSTRUCTIONAL AND INFORMATION MEMORANDUM
LD-87(D) 93.8
CONSTRUCTION ZONE SAFETY
Sheet 7 of 10 (7 sheets added)

This revision is to add, under the subheading GENERAL, the following guidelines for the use of Temporary Asphalt Medians and for the use of Police Patrols in construction zones:

Temporary Asphalt Medians

- Temporary asphalt medians are to be considered on two-lane, two-way temporary detours for traffic volumes between 4000 and 15,000 VPD.
- Each location is to be reviewed and have the joint approval of applicable District, Traffic Engineering and Location & Design personnel.
- Each location should use geometrics that provide an operating speed equal to that of the existing roadway, where possible, to minimize operational problems. (See Standard GS-10)
- The SEQUENCE OF CONSTRUCTION/TRAFFIC CONTROL PLAN is to include the required temporary asphalt median layout details along with the included "DETAIL OF TEMPORARY ASPHALT MEDIAN" that is available in the CADD SECTION for inclusion in the plans.
- Payment will be made under:

Pay Item	Pay Unit	Item Code
Temporary Asphalt Median	Lin. Ft.	24285
Flexible Post Delineator	Each	24286

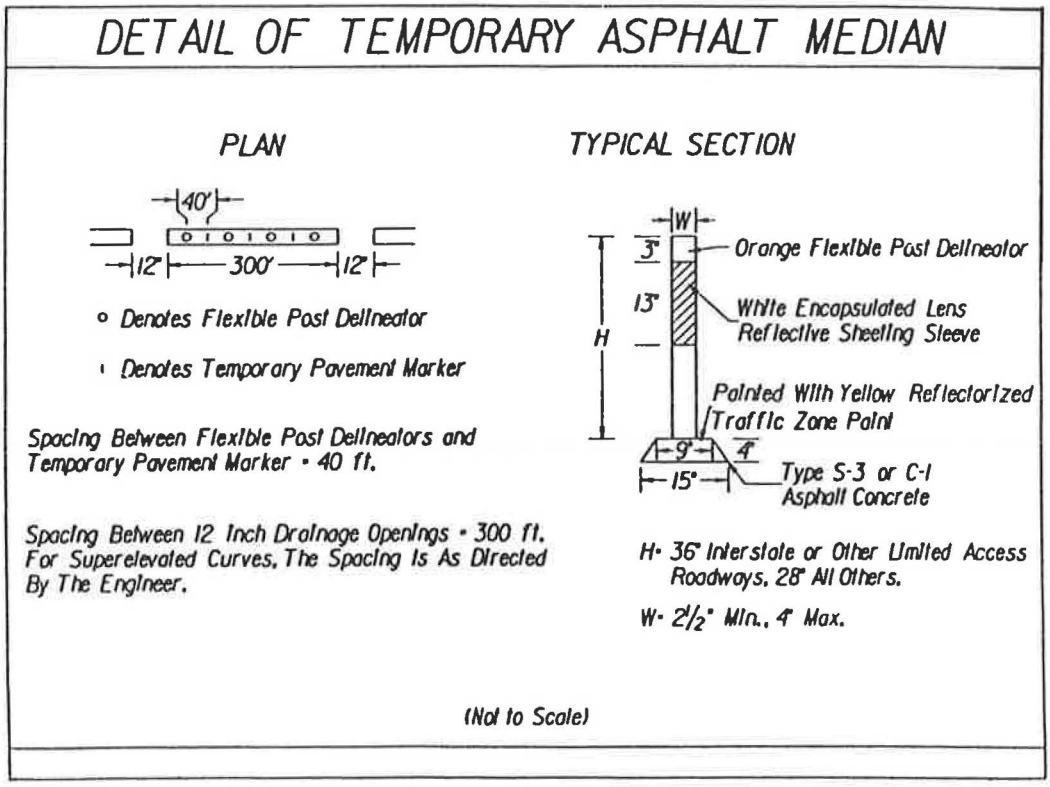

FIGURE 6 VDOT guidelines for use of a temporary asphalt median.

Special Provision

From the experiences at the study site and this review, additional notes and changes on field practices for the installation, maintenance, and removal of the median are suggested below.

- For better quality, faster application, and better reflectivity, the median should be painted with a paint truck instead of manually with a spray gun. (At maximum height the paint truck carriage can apply a 10-in. swath of paint and glass beads, so two passes are necessary.) The hot asphalt median should be allowed to cool before painting for better paint adhesion and less paint absorption. Other options to consider are the use of (a) temporary pavement marking tape on the side of the median and paint on the top and (b) raised pavement markers on the side of the median to supplement the paint.
- Some districts prefer that the contractor instead of VDOT be responsible for painting the median. In some districts, much of the painting related to construction, as well as other construction-related traffic activities, is done by contract. This not only allows VDOT traffic forces to focus on maintenance activities but also relieves them of tying up a paint crew that is dependent on the contractor's schedule. It is suggested that the district determine whether VDOT or the contractor will paint the median.
- The two 6-in. reflective sleeves on the tubular marker should be replaced by the option of a 13-in. reflective sleeve (as shown in the guidelines) or a 6-in. (at the top) and 4-in. sleeve spaced 2 in. apart. The 13-in. sleeve was recommended based on a study to optimize the tubular marker design (*6*), whereas the latter option is in accordance with a recent change in the *Manual on Uniform Traffic Control Devices* (*7*).
- The contractor should be encouraged to use efficient methods for the installation and removal of the median.

These VDOT guidelines and the special provision should be expected to change as VDOT gains experience with the temporary asphalt median. To aid in the evolution of the guidelines and the special provision, it is necessary to document each use of the temporary asphalt median by VDOT. The report should include

1. The project title and location;
2. The time period of median use and the location of the TLTWO;
3. The contract price for the median and tubes;
4. Median installation and removal methods;
5. A description of any deviations from the guidelines, including the reason and the result;
6. A general description of incidents and accidents during TLTWO;
7. A description of any problems encountered and their solutions; and
8. The name, address, and telephone number of the project inspector or person submitting the report.

The report should be submitted to the Traffic Engineering Division.

CONCLUSIONS

The following conclusions can be drawn from this study:

- The temporary asphalt median was installed two times faster than the concrete barrier, thereby reducing the time traffic was exposed to installation activities by about 50 percent.
- The median was removed roughly 2½ times faster than the concrete barrier, thereby reducing the time traffic was exposed to removal activities by about 60 percent.
- There was no difference in the cost per linear foot between the median and the concrete barrier because of the relatively high contract price for the median ($10.00 per linear foot) compared with median costs in other states (28 to 79 percent less). However, an $80,000 savings was achieved with the median by eliminating the need for impact attenuators at concrete barrier end sections. It is expected that the cost will decrease as VDOT uses more medians. (The median cost per linear foot was 40 percent lower on a recent project.)
- There is no evidence to suggest that the temporary asphalt median directly contributed to any accidents. However, it does appear that several accidents can be attributed to the presence of an intersection within TLTWO.
- The temporary asphalt median performed well at the study site.
- VDOT has a special provision and guidelines for the use of temporary asphalt medians for TLTWO. Suggestions were made to improve these items.

ACKNOWLEDGMENTS

The research reported here was financed from Highway Planning and Research funds administered by the Federal Highway Administration.

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The opinions, findings, and conclusions are those of the author and not necessarily those of the sponsoring agencies.