ARIZONA DEPARTMENT OF TRANSPORTATION
ROADWAY ENGINEERING GROUP
OFFICE MEMO

December 23, 1997

TO: Roadway Design Personnel
ADOT and Consultants

THRU: Roadway Engineering Group
Statewide Project Management Group

FROM: Terry H. Otterness THO
Design Program Manager
Roadway Design Section

RE: A Policy on the Design of Passing Lanes and Climbing Lanes- 12/97

The enclosed policy has been developed to provide guidance for scoping and designing projects involving passing lanes and climbing lanes on our state highways. Please provide copies of this document to the appropriate design and predesign personnel, consulting engineers, and project managers within your Group.

Any questions regarding the content may be directed to me, John Louis, or Mike Manthey.

c: Mike Manthey
Districts
Valley Freeway Group
Bridge Group
Regional Traffic Engineers
Materials Group
FHWA

ARIZONA DEPARTMENT OF TRANSPORTATION

INTERMODAL TRANSPORTATION DIVISION

ROADWAY ENGINEERING GROUP
TRAFFIC ENGINEERING GROUP

A POLICY ON THE DESIGN OF PASSING LANES AND CLIMBING LANES

Approved: _____ **Date:** 12-19-97
Assistant State Engineer
Roadway Engineering Group

Approved : _____ **Date:** 12-19-97
Assistant State Engineer
Traffic Engineering Group

DECEMBER , 1997

A POLICY ON THE DESIGN OF PASSING LANES AND CLIMBING LANES

BACKGROUND

Passing and/or climbing lanes may be added to new highway construction projects or to existing highways to improve safe operation by providing an extra lane for slower-moving vehicles so that other vehicles using the normal lane to the right of the centerline are not excessively delayed.

When designing passing or climbing lanes, a distinction must be made between the situation where the lanes are constructed as a part of a new or a major reconstruction of a highway and the situation where the lanes are added to an existing highway as a spot improvement. In both cases, the intent of adding the lanes is to improve the operational characteristics of the highway while meeting the constraints of reasonable cost and maintaining a consistent character throughout the highway segment. However, because of the inherent differences between the two cases, these constraints result in different criteria for establishing the design parameters for each case. For example, funding for spot improvement climbing / passing lanes is limited as these projects must compete with numerous other statewide needs. Therefore, these improvements are limited to only providing what is sufficient for operational improvement.

Consistency of roadway character is a prime concern in the design of a highway. AASHTO's *Geometric Design of Highways and Streets 1994*, (the 1994 Green Book) cautions the roadway designer against introducing design elements which are inconsistent with the remainder of the highway segment. According to AASHTO, "...design elements should be applied consistently throughout a highway segment. Care should be taken to maintain consistency from one segment to another." Changing the design elements within a highway segment can lead to confusion in drivers' expectations. Introducing a higher level of roadway design elements for a short distance in an existing highway can lead to driver confusion when the roadway reverts to the established level of design.

On new construction or major reconstruction projects, it is appropriate to use a high level of design parameters consistent with the type of highway. On spot improvements, the character of the existing roadway should be maintained to the fullest extent possible to avoid introducing unnecessary driver confusion.

The design of these spot improvements should provide as economical a solution as possible while meeting the objectives of the project. The difficulty of construction, cost, and traffic operations during and after construction should be considered in the project development process. The scope of the spot improvement project should be limited to the work necessary to construct the passing / climbing lane. Generally, the construction takes place on the side of the roadway where these lanes are being added and will not extend beyond the lane entrance and exit tapers.

The major roadway design elements associated with the construction of passing or climbing lanes on existing roadways are horizontal and vertical geometry, lane width and shoulder width. Site specific roadside features such as traffic barriers and side slopes must also be considered in the design. The horizontal and vertical geometry of a passing or climbing lane will be parallel to and controlled by the existing roadway. The passing or climbing lane will have a width of 3.6 m (12 ft). The width of the shoulder should be consistent with the remainder of the highway segment. Ditch widths should be compatible with those of the existing roadway. With due regard to cost and the existing right-of-way, side slopes, traffic barriers and other roadside features should be in accordance with the *Roadway Design Guidelines*.

In some instances of spot improvements, the existing shoulder width may be less than the values given for new construction in the *Roadway Design Guidelines*. Consistency in design to meet driver expectations would require that the existing shoulder width should be carried through the improvement regardless of the width. However, a minimum width of shoulder should be provided for traffic capacity of the passing or climbing lane and for structural support to the traveled way pavement.

The width of the passing or climbing lane shoulder should have no significant effect on the capacity of the highway since the through lane and the additional lane together have more capacity than the roadway sections approaching and departing the additional lane. However, a paved width of 0.6 m (2 ft) outside the passing or climbing lane will aid the drivers in feeling more comfortable in the additional lane thus increasing its use and decreasing encroachments upon the through lane. A greater paved width is not justified by the capacity reduction factors given in Table IV-2 of the 1994 Green Book. The 0.6 m (2 ft) paved width is adequate for providing structural support to the traveled way pavement.

There seems to be no real justification for providing more shoulder width for emergency stopping adjacent to the passing or climbing lane than the existing width in the rest of the section or the 0.6 m minimum paved width because the probability of emergency stopping is no greater in this area than in any other section of the highway. Further, the two 3.6 m (12 ft) -lanes plus a 0.6 m (2 ft) paved width will provide a better opportunity to pass a stopped vehicle than is afforded by the existing roadway. With a passing or climbing lane, vehicles are not required to stop or encroach upon the oncoming traffic lane to pass the stopped vehicle.

The above discussion of a 0.6 m (2 ft) minimum shoulder width for passing / climbing lanes should not be construed as implying that the maximum shoulder width could also be 0.6 m (2 ft). Such is not the case. It is desirable to carry the existing shoulder width throughout the improvement as discussed above. However, where project constraints such as limited right-of-way or high earthwork costs, among others, make it impractical to provide the full existing shoulder, the passing / climbing lane shoulder may be reduced to as little as 1.2 m (4 ft) without unduly affecting the traffic capacity of the improvement. However, the minimum acceptable shoulder width for interstate highways is 1.8 m (6 ft). The 1.2 m (4 ft) shoulder width is also appropriate for those passing / climbing lane spot improvements intended as interim capacity enhancements even though the existing shoulders are greater than 1.2 m (4 ft).

The Traffic Studies Section may recommend a minimum width of shoulder for a passing / climbing lane spot improvement to correct a deficiency identified by an operational analysis based on the traffic accident history of the site and the proposed project improvements. The operational analysis minimum shoulder width should be used for the passing / climbing lane spot improvement.

The *Roadway Design Guidelines* note that, in general, the use of guardrail should be avoided. On new construction, the side slope rates, pipe extensions, etc., can be set to minimize the need for guard rail and the right-of-way limits set accordingly. On spot improvement passing / climbing lane projects, the existing right-of-way was based upon the original requirements of the existing highway. It is not desirable to acquire additional right-of-way for such spot improvements and the new side slopes, pipe extensions and headwalls must be designed to stay within the existing right-of-way. Preferably, the new side slopes, pipe extensions and headwalls should be designed to eliminate the need for guard rail per Chapter 300 of the *Roadway Design Guidelines* while staying within the existing right-of-way. It usually is not economical to extend major drainage structures to meet the requirements for eliminating guard rail.. Where the fill heights, major structures, or right-of-way constraints do not permit the elimination of guard rail, the side slopes, pipe extensions, etc., should be designed to minimize construction costs.

POLICY

For New or Major Reconstruction Projects

Where passing lanes or climbing lanes are constructed as a part of a major reconstruction of a highway, the normal highway shoulders (see ADOT *Roadway Design Guidelines* Chapter 300) should be carried throughout. Where project design and construction considerations make providing a full normal shoulder unreasonably difficult or costly to achieve, the shoulder may be reduced to a minimum of 1.2 m (4 ft), 1.8 m (6 ft) for interstate highways, with the concurrence of the Roadway Engineering Group Manager or designee. However, a wider shoulder should be provided when indicated by a Traffic Studies Section operational analysis. At locations where traffic barriers are provided along the shoulder, a 0.6 m (2 ft) paved offset should be provided to the face of the barrier in accordance with the *Roadway Design Guidelines* and the Construction Standard Drawings.

For Spot Improvement Projects

Where a passing lane or climbing lane is constructed as a spot improvement to a highway segment, the existing roadway geometry, lane width and shoulder width should be the design basis for establishment of the additional lane to provide a continuity of roadway characteristics. The scope of the spot improvement project should be limited to the work necessary to construct the passing / climbing lane. Generally, the construction will be on the side of the roadway where these lanes are being added and will not extend beyond the lane entrance and exit tapers. A controlling design criteria analysis is not required; however, the existing roadway geometrics, the existing right-of-way, and factors affecting construction cost should be considered in determining the project design parameters. The characteristics of the passing / climbing lane and the criteria for its location, including passing opportunities for opposing traffic, should be as discussed in Sections 209.1 and 209.2 of the *Roadway Design Guidelines*.

The existing shoulder widths will normally be maintained except that where the existing shoulder is less than 0.6 m (2 ft) the passing or climbing lane shoulder should be widened to 0.6 m (2 ft). When the existing shoulder is greater than 1.2 m (4 ft), the passing or climbing lane shoulder may be limited to 1.2 m (4 ft) or 1.8 m (6 ft) for interstate highways. In both cases, a wider shoulder should be provided when indicated by a Traffic Studies Section operational analysis based on the traffic accident history of the site.

With due consideration to constructability, cost, traffic operation, and the existing right-of-way; side slopes, traffic barriers, and other roadside features should be in accordance with the *Roadway Design Guidelines*, Chapter 300. However:

- The new ditches should have widths consistent with the existing ditches; but they may be widened, if appropriate, to provide a beneficial source of embankment material for the project.
- When practical and within the constraints of the existing right-of-way, new embankment slopes should be designed to eliminate the need for guard rail (see Figure 303.2 of the *Roadway Design Guidelines*).
- Where guard rail must remain or be included due to embankment heights and/or the existence of major structures in accordance with the *Roadway Design Guidelines*, the side slope rates and structure lengths should be determined based on economy.
- The relocation of culvert headwalls and the extension of pipe culverts should be designed in concert with the embankment slope design to eliminate the need for guard rail, consistent with project funding. Generally, it will not be feasible to extend box culverts of three barrels or more or equipment passes to eliminate the need for guard rail protection.
- Guard rail, where required by the *Roadway Design Guidelines*, should be placed relative to the shoulder edge in a manner which is consistent with the existing guard rail placement.

A nominal 1:6 (6:1) shoulder wedge should be provided to the slope hinge as shown in *Roadway Design Guidelines* Figure 303.1.

The addition of a passing / climbing lane to an existing four-lane divided highway should be in accordance with the above criteria except that the existing right shoulder width may be reduced to a minimum of 1.2 m (4 ft), 1.8 m (6 ft) for interstate highways, if required to meet constrained site conditions.