



# Gila County

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## Roadway Design Standards Manual

*Prepared by:*



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December 2001

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*Revised \* By:*



**C.L. Williams Consulting, Inc.**

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\*Revisions to Document only as Noted in Table of Contents



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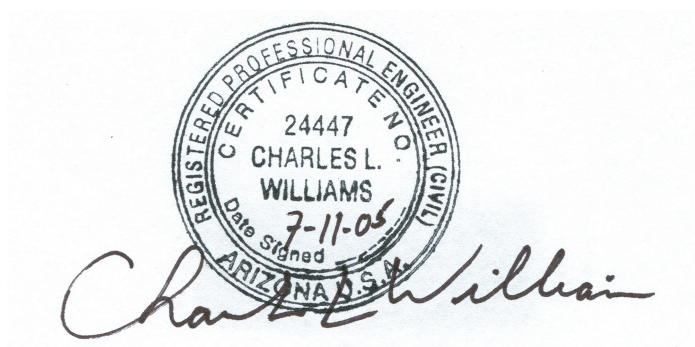
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# 1. INTRODUCTION

## 1.1 Purpose of Manual – (Revised 7-05)

The Gila County Roadway Design Standards Manual has been developed by the Gila County Engineering Department for use by designers of new or upgraded County roadways. Maintenance of existing non-compliant County-maintained road may be exempted from these standards. This manual is intended to standardize roadway elements and to ensure that the appropriate design values are applied. The standards identified in this document supplement existing nationally accepted design criteria.

The roadway designer is expected to exercise professional judgment in producing roadway designs for Gila County. The standards outlined in this manual cannot apply to all situations. While every effort has been made to ensure the accuracy and completeness of these guidelines, Gila County shall not be held responsible for any errors or omissions. All construction documents and engineering reports submitted to Gila County shall be sealed and signed by a Professional Engineer registered in the State of Arizona, per Arizona Revised Statutes (ARS) Section 32-121, who shall be responsible to ensure a proper design and the accuracy and completeness of construction documents and reports. Gila County acceptance of plans/reports does not imply any liability in the part of Gila County for the design, engineering reports, or construction documents submitted by consultants.

The manual presents design information and standards for use on all new Gila County roadway projects involving arterial, collector, and local roadways in both rural and urban conditions. The following shall be established for each new roadway project:

- Functional classification;
- Design vehicle;
- Future traffic volumes; and
- Topography of the area.

These basic criteria shall dictate the design standards to be used for all new roadway projects.

For existing roadways, Gila County reserves the right to make improvements to existing corridors without necessarily conforming to all standards presented in this manual. It is intended that all Gila County roadways will eventually meet the standards outlined in this manual.

In the course of preparing roadway designs, the designer may determine that it is necessary or desirable to use standards other than those presented herein. Any proposed departure from these standards will be judged on the basis of whether such a variance will yield a comparable result that is fully adequate for road users and County residents.

- The need for multi-modal facilities and utilities in the right-of-way may require greater dedication of right-of-way as determined on a case by case basis and approved by the County Engineer or his designee.
- Drainage and snow storage needs may require greater dedication of right-of-way as determined on a case by case basis and approved by the County Engineer or his designee.



- Variances to the minimum right-of-way width requirements may only be granted for existing non-standard roads when dedication of the minimum requirements is determined to be unfeasible by the County Engineer or his designee.
- Variances to the minimum structural section may only be granted by the County Engineer or his designee when construction to the minimum requirements is determined to be not necessary due to geotechnical evaluation.

The designer must formally request County Engineer approval for any variance from the standards presented in this manual. No other official, employee, or Commission other than the Gila County Board of Supervisors has authority to grant variance from these standards. Such requests will be considered and may, at the discretion of Gila County, be accepted or rejected.

## **1.2 Contents of Manual**

Chapter 2 provides general information on the use on these design standards. Chapter 3 discusses the design elements of roadway design, including subdivision street planning. The pavement structural design standards are documented in Chapter 4. Chapter 5 discussed access to the County roadway network and the design of driveways. Chapter 6 provides information on sidewalks. Roadway construction and improvement processes are outlined in Chapter 7. Chapter 8 outlines the requirements for roadway design plans. Chapter 9 provides information on the drainage standards for roadways. The technical reports, which must be produced to support a specific design effort, are described in Chapter 10.

## **1.3 Updates of the Manual**

For information on revisions and updates to this edition of the Roadway Design Standards Manual, please contact:

Gila County Engineering Department  
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1400 East Ash Street  
Globe, Arizona 85501  
Phone: (928) 425-3231  
<http://www.co.gila.az.us>

## **1.4 Definitions**

AASHTO – American Association of State Highway and Transportation Officials.

ABC – Aggregate Base Course.

Acre Net – 43,560 square feet not including Right-of-ways, roadway easement or ingress and egress easements.

ADA – Americans with Disabilities Act.

ADOT – Arizona Department of Transportation.

ADT – Average Daily Traffic.

ADWR – Arizona Department of Water Resources



Alley – A public thoroughfare that affords only a secondary means of access to abutting property.

All Weather Access – (See definition of primary access in Sec. 9.2.1.2.)

Appeal – A request for review of the Drainage Administrator's interpretation or application of the provisions of these Standards.

ARS – Arizona Revised Statutes.

Arterial Roadway – a street or road with the principal function of serving as a part of a major network for the through traffic flow (separate from local traffic) to and from areas of principal traffic generation – of adequate design, capacity and construction to provide for the safe and rapid distribution and collection of through traffic, and to provide limited ingress and egress to and from collector and local streets.

CAAG – Central Arizona Association of Governments.

CLOMR – Conditional Letter of Map Revision.

Collector Roadway – a street or road that serves local traffic movements within an area, and traffic between major arterials and local streets; provides a means of ingress and egress to local streets and abutting property; serves to connect adjacent neighborhoods; and includes the principal entrance streets into residential neighborhoods. There also may be provisions for parking and loading or unloading on collector streets.

Commercial Driveway – a driveway that provides access to an office, retail, or institutional building, or to an apartment building having more than five dwelling units. Such buildings are customarily serviced by trucks as an incidental rather than a principal driveway use. Industrial plant driveways whose principal function is to serve administrative or employee parking lots also are considered commercial driveways.

Comprehensive Plan – a plan adopted by Gila County providing a program to guide the orderly growth of the County.

Cul-de-sac Road – a street or road having a traffic outlet on one end only and having the other end designed to facilitate the turning around of vehicular traffic.

Design Flow – The peak flow rate of runoff resulting from the design storm generated within a defined area.

Design Standards – Criteria for design of grading and drainage facilities, and criteria for preparation of Drainage and Grading Report/plan, as determined and published by the Drainage Administrator.

Design Storm – The storm used for the design of a particular aspect of the roadway drainage system. In these standards, the 25-year and 10-year design storms are used. The design storms are to use precipitation depths and temporal precipitation distributions based on generally accepted and defensible criteria, and any hydrologic criteria that may be adopted by the Gila County Engineering Department.

Design Storm Duration – The length of time over which the design storm occurs.

Detention System – A system that detains runoff in a controlled manner through the use of storage facilities. Stored runoff is metered out at a specified rate to accomplish the detention design objectives.



**Developer** – An individual, firm, corporation, partnership, association, syndicate, trust, or other legal entity that files the application and also initiates proceedings for the development and or subdivision of land in accordance with County Guidelines. The said developer need not be the owner of record of said land.

**Development** – Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

**DHV** – Design Hour Volume.

**Drainage** – Runoff that flows overland as a result of precipitation. This shall include sheet flow and flows that may concentrate in local drainage systems with or without defined channels.

**Drainage and Grading Report/Plan** – The report and drawings detailing a proposed development and supporting calculations. The drainage report shall address all roadway drainage issues. The Drainage and Grading Report/Plan must be prepared under the direct responsible charge of a Professional Engineer registered in the State of Arizona per ARS 32-101 (11) (et. seq.), who shall seal the work per ARS 32-125 (et. seq.).

**Drainage Easement** – A grant by the owner for the use of specified land for drainage purposes by the public, a corporation, or persons, and so designated and recorded in the County recorder's office.

**Drainage Right-of-Way** – Any land which by deed, conveyance, dedication, process of law or other means is dedicated to Gila County for drainage purposes.

**Drainage System** – A system of lakes, rivers, creeks, streams, washes, arroyos, channels, closed conduits, or other topographic features on, through, or over which stormwater flow at least periodically.

**Driveway** – A private road which allows vehicular ingress and/or egress access from a public road.

**Easement** – A grant by the owner for the use of specified land by the public, a corporation, or persons, for specific uses and purposes and so designated and recorded in the County recorder's office.

**Erosion** – The transportation of sediment and change of the ground surface as a result of the movement of wind, water, ice and other geologic agents.

**FEMA** – Federal Emergency Management Agency.

**High Altitude Roadway** – A roadway located at an elevation of 4,000 feet or greater.

**Industrial Driveway** – a driveway that directly serves a substantial numbers of truck movements to and from loading docks of an industrial facility, warehouse, or truck terminal. A centralized retail development, such as a community or regional shopping center, may have one or more driveways specially designed, signed, and located to provide access for trucks. These also are classified as industrial driveways.

**Intersection** – The general area where two or more roadways join or cross, including the roadway and roadside facilities for traffic movements within it.



Intersection Sight Distance – The length of roadway that is visible to the driver and clear of obstructions at an intersection.

MAG – Maricopa Association of Governments.

Maintenance – The upkeep of property, roadway, or signing and striping to restore it to a conditions similar to the originally constructed roadways, except for work classified as reconstruction.

Major Intersection – For urban areas, major intersections are considered roadway crossings of arterial-arterial streets and arterial-collector streets. For rural areas, major intersections are considered roadway crossing of arterial-arterial streets, arterial-collector street, and collector-collector streets.

Median – The raised, depressed, or flush portion of a divided roadway separating the travelways for traffic in opposite directions. Medians are designated to separate and control vehicular movement. Median width is the distance between near traffic-lane edges.

MUTCD – Manual on Uniform Traffic Control Devices.

New Construction – Blading a roadway or other construction where a roadway did not previously exist or surfacing a previously unsurfaced roadway.

Off-site Runoff – Runoff produced from precipitation which falls outside the limits of the parcel on which development is proposed, and which drains through that parcel.

On-site Runoff – Runoff produced from precipitation, which falls within the limits of a development or the parcel on which development is proposed, including easements and dedicated right-of-way.

Primary Access – The major access to a development that meets the requirements of an all-weather access roadway.

Private Street – A roadway that is in private ownership and that is used for vehicular travel by the owner and those persons who have express or implied permission from the owner but not by other persons.

Rainfall Event – Precipitation falling in a specified temporal distribution.

Reconstruction – Removal and replacement of existing roadway surface.

Retention System – A system that retains runoff in a controlled manner through the use of storage facilities. Stored runoff is evacuated by percolation and evaporation.

Right-of-way – Any land which by deed, conveyance, dedication, process of law or other means is dedicated to Gila County for street, highway, alley, public utility, or pedestrian walkway purposes.

Road, Roadway, or Street – That area, whether public or private, between right-of-way or easement lines, dedicated, reserved, or provided for purposes of vehicular and pedestrian traffic and other uses consistent therewith.

Secondary Access – A minor access to a development that is not required to meet the requirements of an all-weather access roadway.



Sidewalk – An improved area, within the roadway right-of-way or easement and outside the vehicular travel lanes and shoulder, if any, that is intended for the use of pedestrian.

Sight Distance – The distance along a roadway that an object of specified height is continuously visible to the driver. This distance is dependent on the height of the driver's eye above the road surface, the specified object height above the road surface, and the height of sight obstructions within the line of sight.

State Standards – The standards and guidelines developed by the Arizona Department of Water Resources under authority of ARS 48-3605 (A).

Subdivision – A subdivision as defined in ARS 32-2101.

TDN – Technical Data Notebook.

Temporal Distribution – A specified distribution of rainfall over time.

Upgraded Roadway – Any improvements to an existing roadway.

Variance – A grant of relief from the requirements of these Standards which permits construction or other uses of property in a manner that would otherwise be prohibited or restricted by these Standards.



## 2. GENERAL COMMENTS

The requirements described herein are primarily based on safety considerations; therefore, standards that provide a greater degree of safety may be used, but standards that provide a lesser degree of safety may not be used without written approval of the Gila County Board of Supervisors.

These standards shall govern all new construction and reconstruction of transportation facilities in Gila County right-of-way, easements, or private streets within subdivisions. They also shall apply to all transportation facilities proposed to be built in rights-of-way that are intended to be dedicated to Gila County and accepted into the County Roadway System for maintenance, unless written approval is otherwise obtained from the Gila County Board of Supervisors.

These standards shall be used by private parties, consulting engineers, public utilities, agencies, and Gila County staff. The standards apply to rural and urban roadways except for freeways or freeway-type improvements to surface street intersections. In these latter cases, the current applicable standards of the Arizona Department of Transportation (ADOT) shall apply.

### 2.1 Use of National Standards

#### 2.1.1 *Geometric Design Standards*

The American Association of State Highway and Transportation Officials (AASHTO) policy on highway design is an approved reference and is to be used together with this manual, including all revisions there to.

#### 2.1.2 *Traffic Control Standards*

All traffic control devices shall be in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) 2000 (et. seq.) prepared by the United States Department of Transportation (USDOT), and as modified by ADOT.

### 2.2 Use of Other Standards

#### 2.2.1 *MAG Standard Specifications and Details*

The latest revisions of the Uniform Standard Specifications and Details, prepared by the Maricopa Association of Governments (MAG), are acceptable to the extent that they do not conflict with Gila County Standards presented in this document or as modified by this document.

#### 2.2.2 *ADOT Standard Details and Specifications*

The latest revisions of the ADOT Standard Details and Specifications and Standard drawings are acceptable to the extent that they do not conflict with Gila County standards presented in this document, or as modified by this document.



## 2.3 Roadway Types - (Revised 7- 05)

Urban and rural areas have fundamentally different characteristics with regard to density and types of land use, density of street and highway networks, nature of travel patterns, and the way in which these elements are related. Consequently, urban and rural functional systems are classified separately.

Deciding the location of local, collector, and arterial roads is usually part of the development site planning process. Frequently, planning for local roads is influenced by the plans for adjacent developments, which have recently been approved. The Engineering and Planning Departments will review each preliminary proposal for development and will specify any changes needed to conform to previously planned and approved street alignments. They also will specify the classification for each street involved in the plan if not illustrated in the Comprehensive Plan.

Developments being constructed within rural areas (i.e., outside the urban boundary) at densities consistent with urban standards (average lot size of one unit per one or less acres) must use urban roadway standards. If rural density developments (average lot size of one unit per one or more acres) are proposed within urban area, the County may allow rural roadway standards to be applied.

### 2.3.1 Urban Roadway Types

Urban areas are considered those places within urban boundaries designated in the Gila County Comprehensive Plan. The typical cross-sections for Gila County urban roadways are shown in **Figures 2-1** through **2-5**.

There are five urban roadway functional classifications based upon the type and level of use for which urban roads are intended. Following is a listing of each classification followed by the number of the figure that depicts the standard roadway cross-section for that classification. Criteria for determining the functional classification are noted on **Figures 2-1** through **2-5**.

<b><u>Functional Classification</u></b>	<b><u>Figure</u></b>
Urban Principal Arterial	Figure 2-1
Urban Major Arterial	Figure 2-2
Urban Collector	Figure 2-3
Urban Minor Collector	Figure 2-4
Urban Local	Figure 2-5

#### 2.3.1.1 Principal Arterial Roads

Principal arterial roadways are six-lane divided roadways that provide regional continuity within urban areas. These roadways will carry high volumes of traffic along major corridors. **Figure 2-1** shows the typical cross-section for an urban principal arterial road.



### 2.3.1.2 Urban Major Arterial Roads

Urban major arterial roadways are four-lane divided roadways that provide regional continuity. These roadways also will carry high volumes of traffic along major corridors. **Figure 2-2** shows the typical cross-section for an urban major arterial road.

### 2.3.1.3 Urban Collector Roads

Urban collector roadways are two-lane roadways with bike lanes. Collector roadways provide for traffic movements between arterial and local streets. Collector roads service residential/local streets; and relieve traffic within, adjacent to or between subdivisions. **Figure 2-3** shows the typical cross-section for an urban collector road.

### 2.3.1.4 Urban Minor Collector Roads

Urban minor collector roadways are two-lane roadways with bike lanes and serve the same purpose as urban collector roads; however, minor collector roads will carry less traffic and have a lower design speed. Minor collector roads may be modified to allow for on-street parking. **Figure 2-4** shows the typical cross-section for an urban minor collector road.

### 2.3.1.5 Urban Local Roads – (Revised 7-05)

Urban local roadways are two-lane roadways, typically serving residential subdivisions. Local roads (residential/subdivision/low volume) provide direct access to abutting land uses, handle local traffic, and provide access to the collector road system. Local streets normally will not be connected to arterial streets. Heavier traveled subdivision streets may be considered for minor collector roadway design. **Figure 2-5** shows the typical cross-section for an urban local road.

## 2.3.2 Rural Roadway Types

Rural areas are those areas outside the boundaries of urban areas.

There are five rural roadway functional classifications based upon the type and level of use for which the rural roads are intended. Following is a listing of each classification followed by the number of the figure that depicts the standard roadway cross-section for that classification. Criteria for determining the functional classification are noted on **Figures 2-6** through **2-10**.

<b><u>Functional Classification</u></b>	<b><u>Figure</u></b>
Rural Major Arterial	Figure 2-6
Rural Arterial	Figure 2-7
Rural Collector	Figure 2-8
Rural Local	Figure 2-9
Rural Very Low Volume Road	Figure 2-10



### 2.3.2.1 Rural Major Arterial Roads

Rural major arterial roadways are four-lane roadways that provided regional continuity in rural areas. **Figure 2-6** shows the typical cross-section for a rural major arterial road.

### 2.3.2.2 Rural Arterial Roads

Rural arterial roadways are two-lane roadways that provide regional continuity in rural areas. These roadways carry lower volumes than the major arterial roadways. **Figure 2-7** shows the typical cross-section for a rural arterial road.

### 2.3.2.3 Rural Collector Roads - (Revised 7-05)

Rural collector roadways are two-lane roadways that will provide for traffic movement between arterial and local streets. **Figure 2-8** shows the typical cross-section for a rural collector road.

### 2.3.2.4 Rural Local Roads – (Revised 7-05)

Rural local roadways are two-lane roadways that serve the same purpose as that mentioned in Section 2.3.1.3 for urban local roads. **Figure 2-9** shows the typical cross-section for a rural local road.

### 2.3.2.5 Rural Very Low Volume Roads – (Revised 7-05)

Rural very low volume roadways are two-lane roadways, designed to carry an average daily traffic volume of 400 vehicles per day or less. **Figure 2-10** shows the typical cross-section for a rural very low volume road.

## 2.4 County Highway System

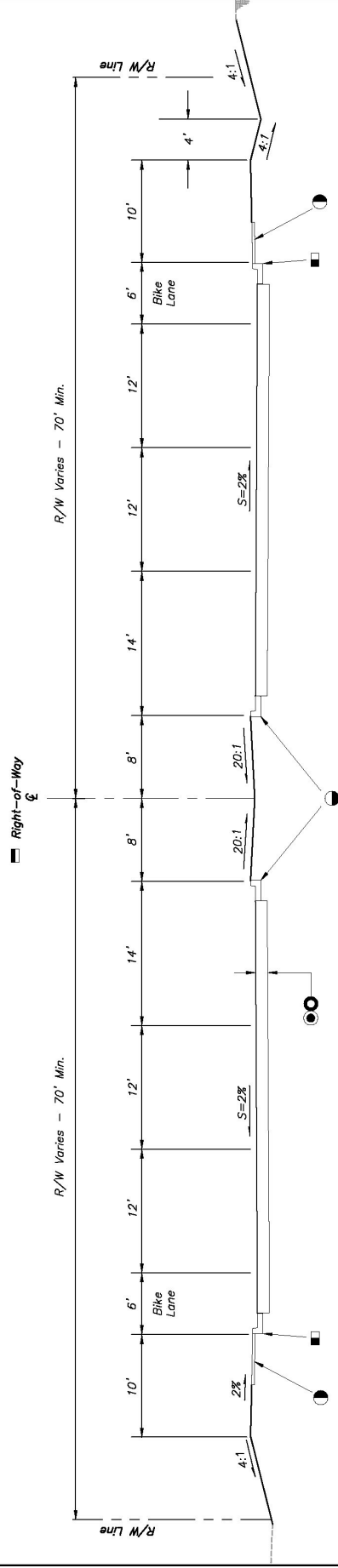
The requirements for a county highway to be established are as follows:

- The roadway must meet the current County roadway standards;
- Entire length of roadway must become a county highway
- Establishment of the highway must have the approval of the Gila County Board of Supervisors, in compliance with ARS 28-6701.

These requirements apply for all roadways within existing and new developments, desiring to become county highways.

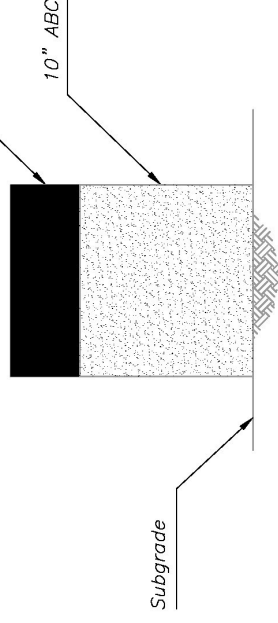
For roadways that may be annexed in the future by a city or town, Gila County may elect to incorporate none, some, or all of the City's or Town's standards into the design.

Before the County accepts a road for maintenance, it shall meet the standards outlined in this manual. Permitted work also shall conform to the requirements of the current County Resolutions governing permitted work. If field conditions change after plan approval, improvements shall be made as necessary in order to bring the transportation facilities up to these standards.



DESIGN SPEED: 55 MPH  
 DESIGN ADT: >20,000 VPD  
 MAXIMUM LONGITUDINAL GRADE: 6%

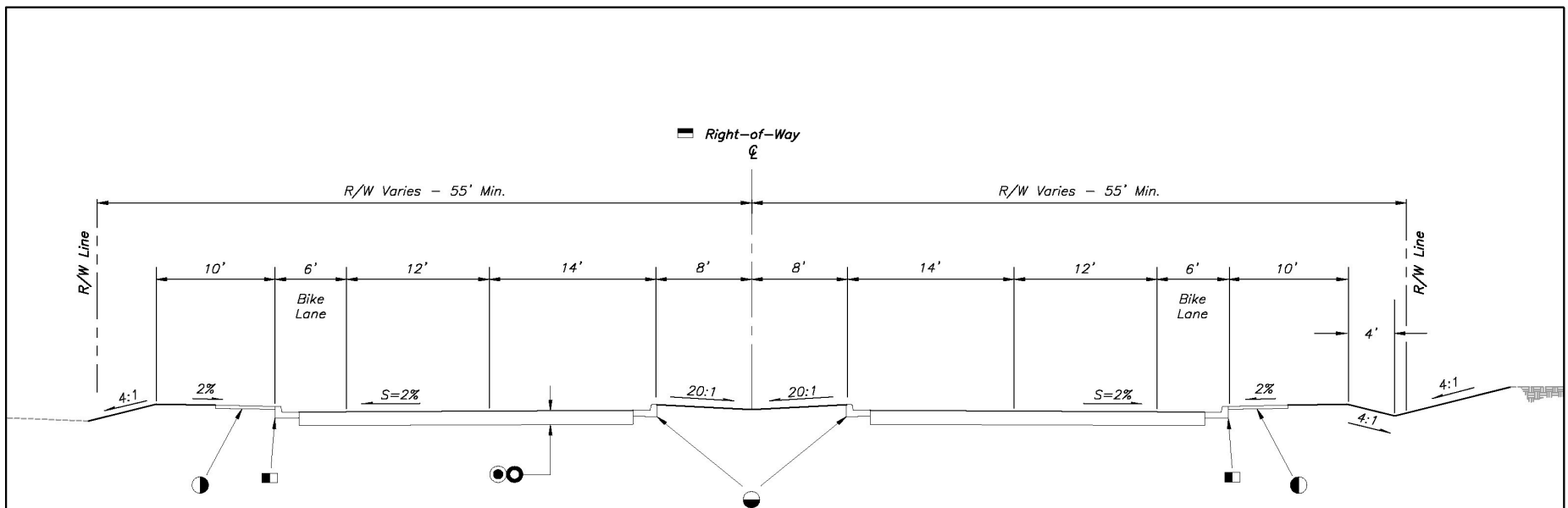
- Minimum Standard R/W Requirements - 70' Typical Half-Width Minimum
- Vertical Curb and Gutter per MAG Std. Detail 220, Type A,  $h=6"$
- Vertical Curb with depressed lip per MAG Std. Detail 220, Type A
- 5' Min. Sidewalk per MAG Std. Detail 230.
- The Arizona Department of Transportation "Preliminary Engineering and Design Manual" will be used for pavement design
- 4" Min. A.C. over 10" Min. ABC



Total Thickness = 14"  
 MIN. PAVEMENT SECTION

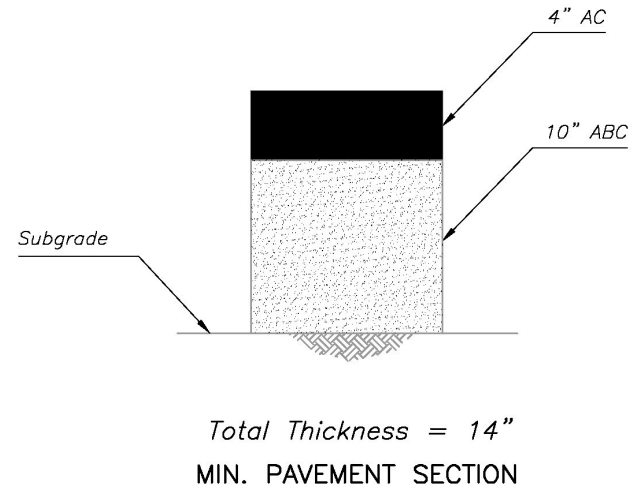
TYPICAL SECTION -URBAN PRINCIPAL ARTERIAL ROAD

Fig. 2-1



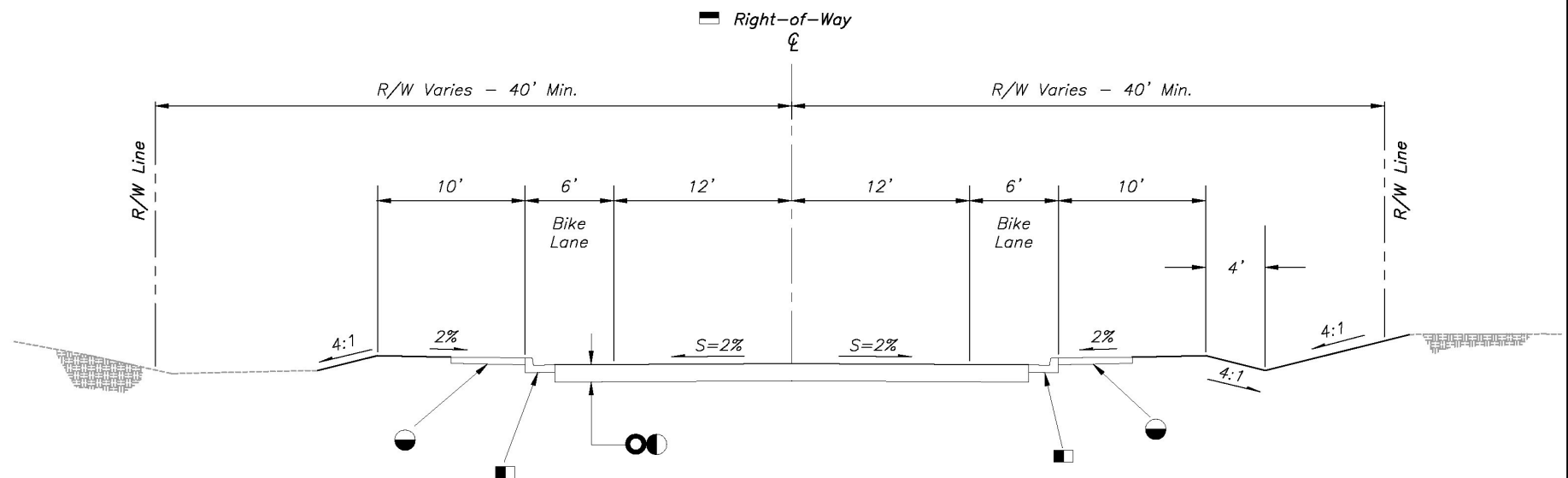
DESIGN SPEED: 55 MPH  
 DESIGN ADT: 7,000 – 20,000 VPD  
 MAXIMUM LONGITUDINAL GRADE: 6%

- Minimum Standard R/W Requirements – 55' Typical Half-Width Minimum
- ▣ Vertical Curb and Gutter per MAG Std. Detail 220, Type A.  $h=6"$
- ◐ Vertical Curb with depressed lip per MAG Std. Detail 220, Type A
- ◑ 5' Min. Sidewalk per MAG Std. Detail 230
- ⊙ The Arizona Department of Transportation "Preliminary Engineering and Design Manual" will be used for pavement design
- ⊖ 4" Min A.C. over 10" Min. ABC



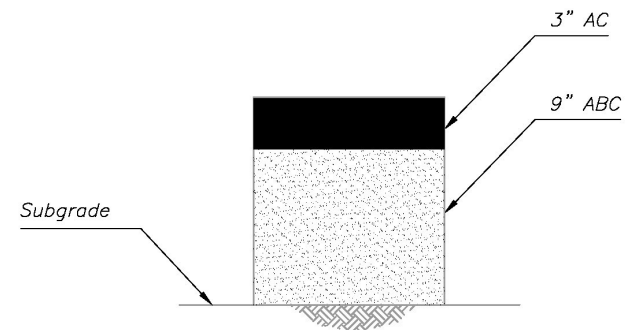
**TYPICAL SECTION - URBAN MAJOR ARTERIAL ROAD**

**Fig. 2-2**



DESIGN SPEED: 45 MPH  
 DESIGN ADT: 3,000 – 7,000 VPD  
 MAXIMUM LONGITUDINAL GRADE: 9%

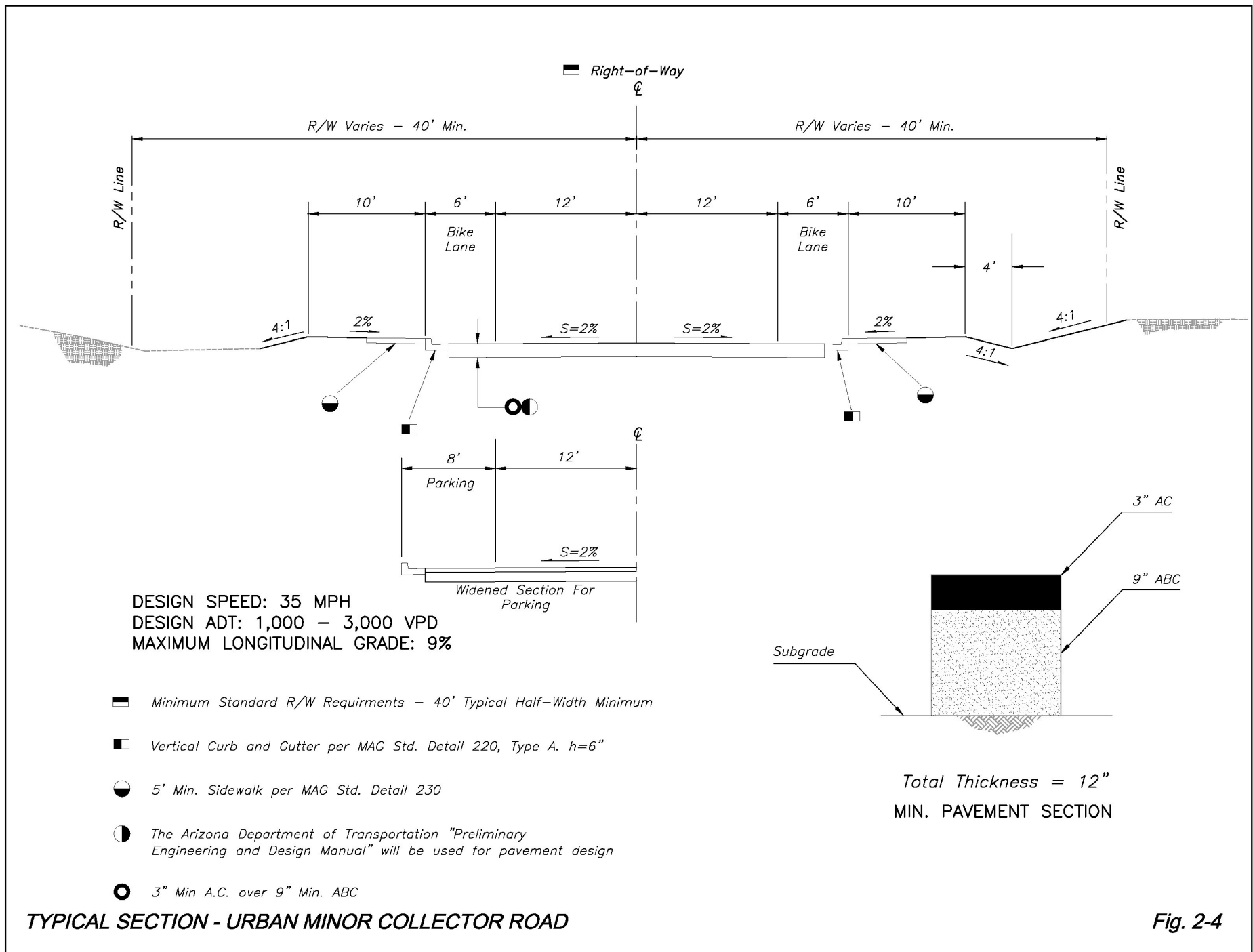
- Minimum Standard R/W Requirements – 40' Typical Half-Width Minimum
- Vertical Curb and Gutter per MAG Std. Detail 220. Type A.  $h=6"$
- 5' Min. Sidewalk per MAG Std. Detail 230
- The Arizona Department of Transportation "Preliminary Engineering and Design Manual" will be used for pavement design
- 3" Min A.C. over 9" Min. ABC



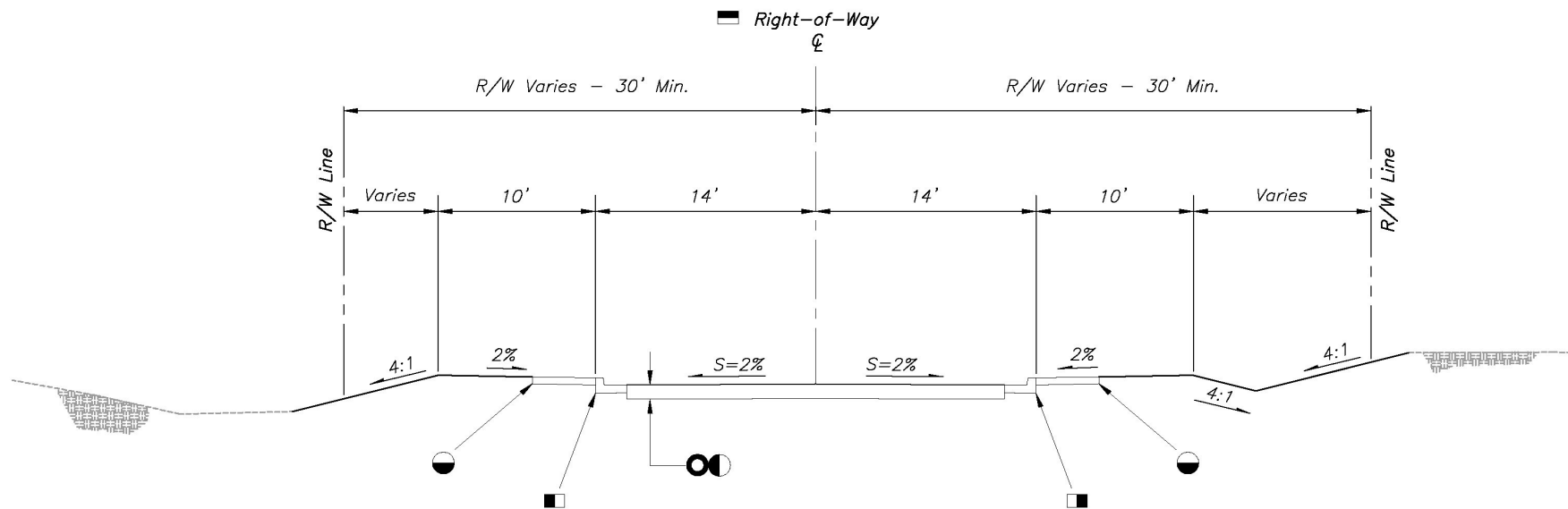
Total Thickness = 12"  
 MIN. PAVEMENT SECTION

TYPICAL SECTION - URBAN COLLECTOR ROAD

Fig. 2-3



**Fig. 2-4**



DESIGN SPEED: 35 MPH  
 DESIGN ADT: <1,000 VPD AT FULL BUILDOUT  
 MAXIMUM LONGITUDINAL GRADE: 12% < 4,000' ELEVATION  
 10% > 4,000' ELEVATION

Minimum Standard R/W Requirements - 30' Typical Half-Width Minimum

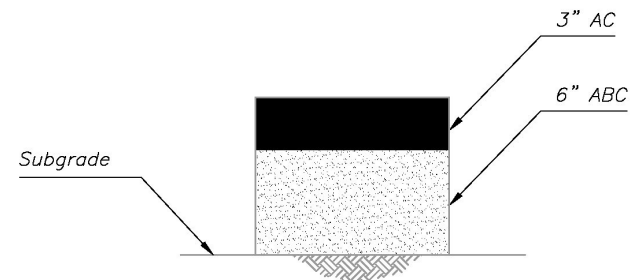
Curb and Gutter per MAG Std. Detail 220, Type A (h=6") or C (h=4"), both sides.

Curb and Gutter per MAG Std. Detail 220, Type B. (Typ. Both Sides) allowed for streets within recorded subdivisions with average lot sized greater than one acre.

4' Min. Sidewalk per MAG Std. Detail 230

The Arizona Department of Transportation "Preliminary Engineering and Design Manual" will be used for pavement design

3" Min A.C. over 6" Min. ABC

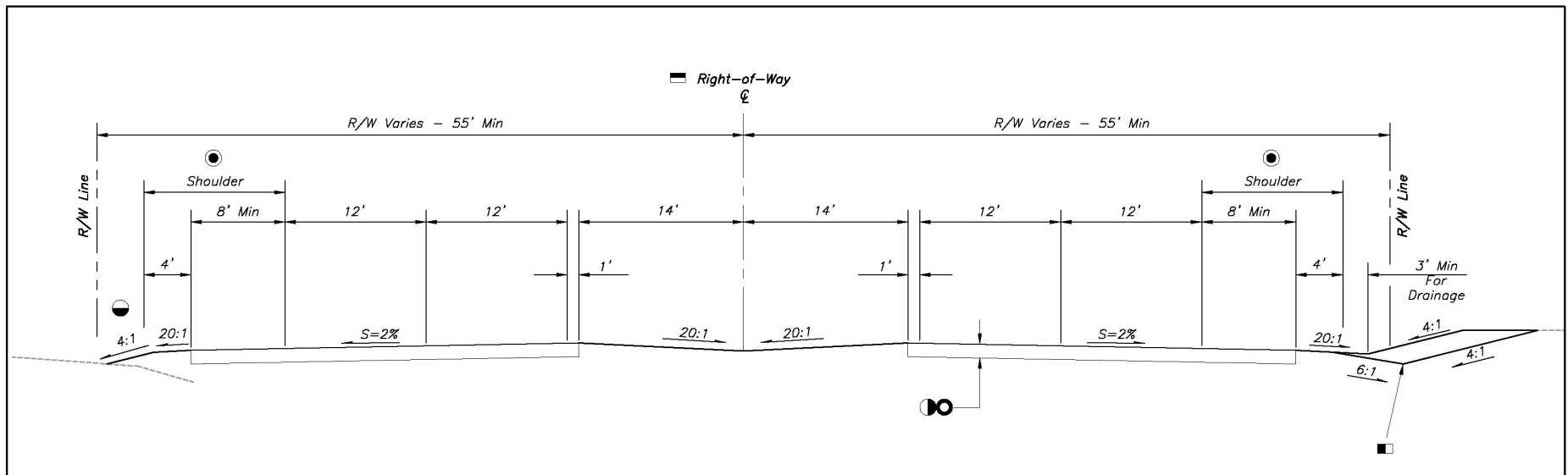


Total Thickness = 9"  
 MIN. PAVEMENT SECTION

TYPICAL SECTION - URBAN LOCAL ROAD

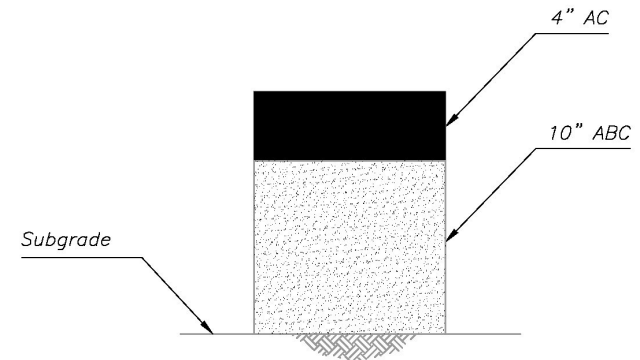
REVISED JULY, 2005

Fig. 2-5



DESIGN SPEED: 65 MPH  
 DESIGN ADT: >15,000 VPD  
 MAXIMUM LONGITUDINAL GRADE: 6%

- Minimum Standard R/W Requirements – 55' Typical Half-Width Minimum
- Special Drainage Ditch as Required.
- For Guardrail Installation See ADOT Standards.  
 For Requirements for Guardrail Installation See AASHTO Roadside Design Guide – Warrants for Fill Section Embankments.
- The Arizona Department of Transportation "Preliminary Engineering and Design Manual" will be used for pavement design
- 4" Min A.C. over 10" Min. ABC
- For Clear Zone Requirements, refer to AASHTO Roadside Design Guide.

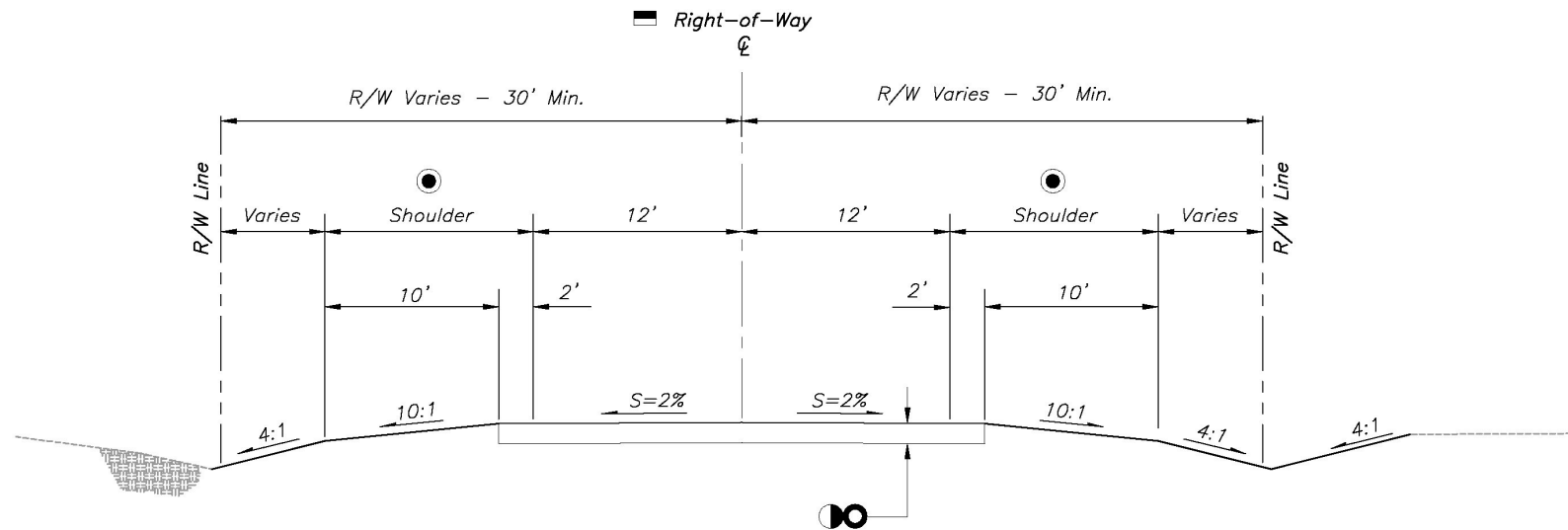


Total Thickness = 14"  
 MIN. PAVEMENT SECTION

**TYPICAL SECTION - RURAL MAJOR ARTERIAL ROAD**

**Fig. 2-6**





DESIGN SPEED: 45 MPH  
 DESIGN ADT: 1,000 – 5,000 VPD  
 MAXIMUM LONGITUDINAL GRADE: 9%

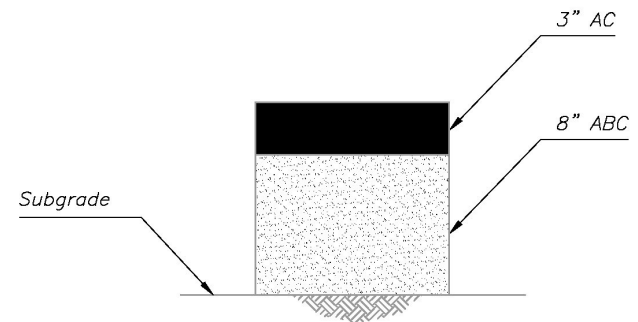
Minimum Standard R/W Requirements – 30' Typical Half-Width Minimum.

The Arizona Department of Transportation "Preliminary Engineering and Design Manual" will be used for pavement design

3" Min A.C. over 8" Min. ABC

For Clear Zone Requirements, refer to AASHTO Roadside Design Guide.

Note: If a Center Turn Lane is Required, then the Minimum Width of the Turn Lane shall be 14'.

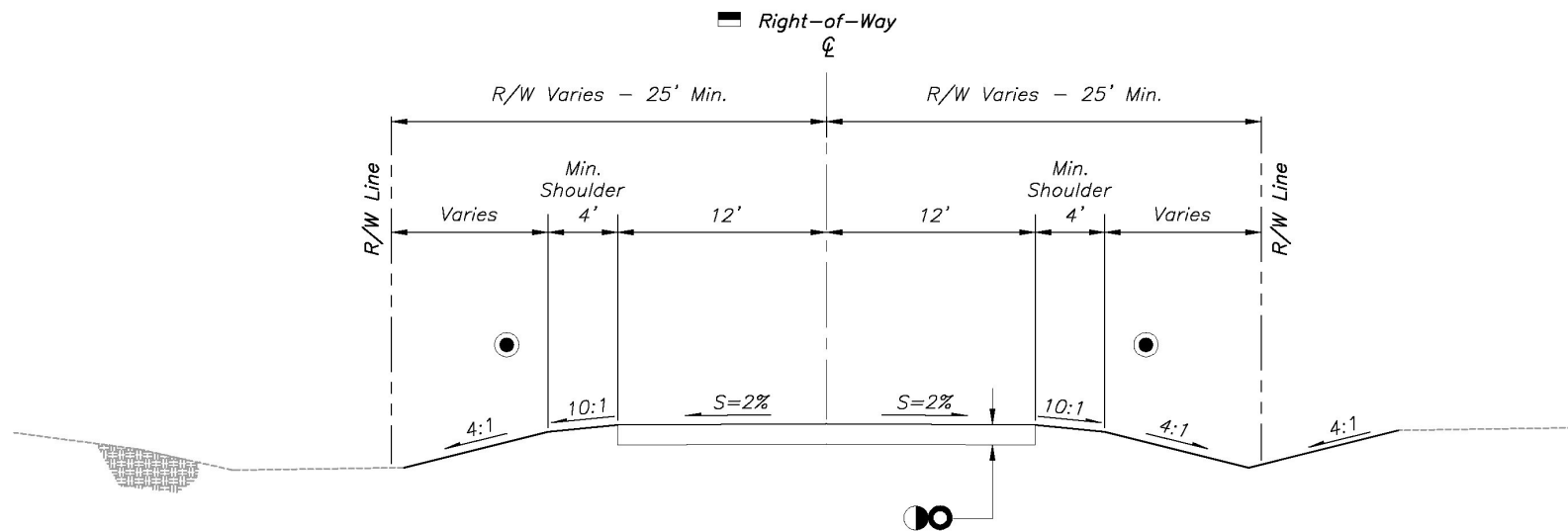


Total Thickness = 11"  
 MIN. PAVEMENT SECTION

TYPICAL SECTION - RURAL COLLECTOR ROAD

REVISED JULY, 2005

Fig. 2-8



DESIGN SPEED: 35 MPH  
 DESIGN ADT: 400 – 1,000 VPD  
 MAXIMUM LONGITUDINAL GRADE: 12% < 4,000' ELEVATION  
 10% > 4,000' ELEVATION

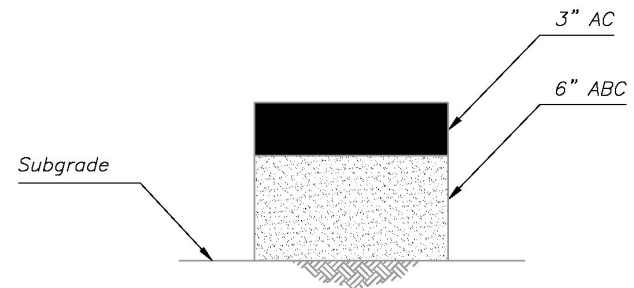
Minimum Standard R/W Requirements – 25' Typical Half-Width Minimum. If Curb & Gutter are used, then Additional Right of Way May be Required.

The Arizona Department of Transportation "Preliminary Engineering and Design Manual" will be used for pavement design

3" Min A.C. over 6" Min. ABC

For Clear Zone Requirements, refer to AASHTO Roadside Design Guide.

Note: If a Center Turn Lane is Required, then the Minimum Width of the Turn Lane shall be 14'.

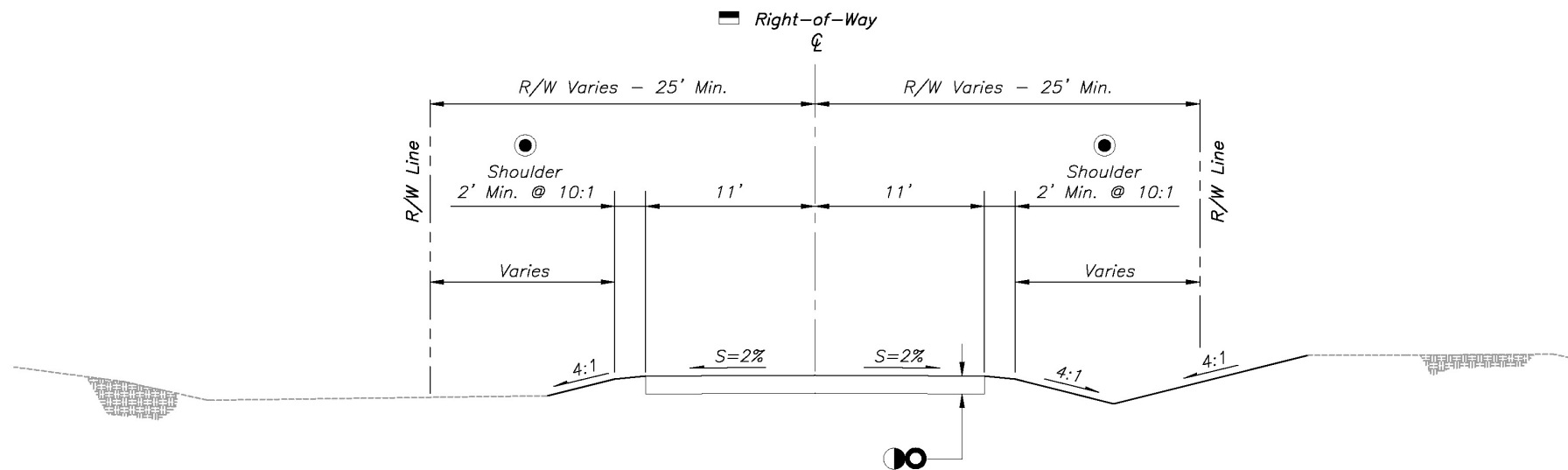


Total Thickness = 9"  
 MIN. PAVEMENT SECTION

TYPICAL SECTION - RURAL LOCAL ROAD

REVISED JULY, 2005

Fig. 2-9



DESIGN SPEED: 25 MPH

DESIGN ADT: <400 VPD

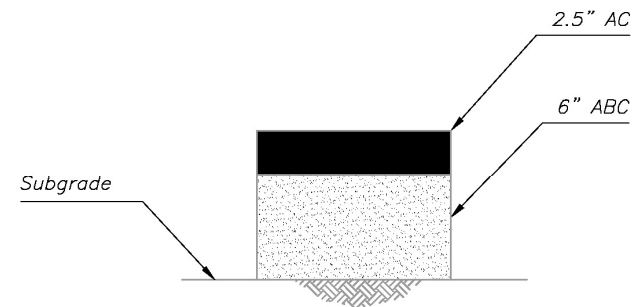
MAXIMUM LONGITUDINAL GRADE: 12% < 4,000' ELEVATION  
10% > 4,000' ELEVATION

Minimum Standard R/W Requirements - 25' Typical Half-Width Minimum

The Arizona Department of Transportation "Preliminary Engineering and Design Manual" will be used for pavement design

Bituminous Penetration & double chip seal over 8" Min. ABC  
< 4000' Elevation, 2.5" Min A.C. over 6" Min. ABC > 4,000' Elevation

For Clear Zone Requirements, refer to AASHTO Roadside Design Guide.



Total Thickness = 8.5"  
MIN. PAVEMENT SECTION  
> 4,000' ELEVATION

TYPICAL SECTION - RURAL VERY LOW VOLUME ROAD

REVISED JULY, 2005

Fig. 2-10



### 3. DESIGN STANDARDS

The subsequent paragraphs in this document discuss the design standards necessary for the design of roadways within Gila County.

#### 3.1 Right-of-Way Requirements – (Revised 7-05)

The right-of-way requirements shown in **Figures 2-1** through **2-10** are based on the space needed for the roadway when it is constructed to meet ultimate development requirements. The right-of-way also must provide space for utilities, cut or fill slopes, sidewalks, bicycle paths, trails, traffic control devices and information signs, fire hydrants, landscaping, transit facilities, and other public facilities that must be located adjacent to roadway pavements.

Right-of-way widths in excess of the standard widths may be required in special circumstances such as when:

- Cut or fill slopes cannot be confined within the standard width;
- Minimum sight distance lines on horizontal curves are not within the standard right-of-way;
- Minimum sight distances at intersections are not within the standards; and
- Auxiliary lanes are to be provided.

#### 3.2 Lane and Shoulder Width

Lane widths are depicted on **Figures 2-1** through **2-10**. Modification of the lane widths requires approval by the Gila County Board of Supervisors.

For urban conditions, Gila County requires at least ten feet of graded area behind curb at no greater than a 2% slope to allow for sidewalk, utilities, and other appurtenances. Shoulder widths of 12 feet are used in rural conditions.

#### 3.3 Roadway Cross-Section Slopes

##### 3.3.1 *Pavement Cross-Section Slopes*

Paved surfaces of undivided streets should have a normal crown that has a two-way cross-slope with the cross-section high point on the street centerline. Divided streets should have cross-slope on each pavement section. The high point of each slope on each pavement section shall occur on the edge of the pavement nearest to the median. Unusual conditions may cause cross-slope requirements to vary, but normally, the desirable cross-slope is 2%, with a maximum cross-slope of 3%. Any deviation from the desirable cross-slope is subject to review and approval by the Gila County Engineering Department.



### 3.3.2 *Inverted Crown Cross-Section Roads*

Inverted crown cross-section roads shall not be used unless special approval is obtained from the Gila County Engineering Department. If deemed appropriate, the following shall apply:

- Inverted crown cross sections shall only be used on local urban or local rural roadways;
- Inverted crown cross-section roadways will have curb and gutter with inverted gutters. Ribbon curb also may be used; and
- Four-foot wide concrete valley gutters, per MAG Standard Detail 240, will be required on all sections of roads having a slope greater than 8% or less than 0.75%.

### 3.3.3 *Clear Zone and Cross Slope*

The designer is referred to the most recent version of the AASHTO *Roadside Design Guide* for further discussion on clear zone and traversable and recovery slopes. Drainage structures should extend beyond the clear zone limits.

For urban roadway classifications, the cross slope of bikeways or other paved shoulders will match the cross slope of the pavement section (typically 2%). Unpaved parkway areas behind sidewalks will provide a 2% cross slope, toward the roadway. Typical cross slopes for urban roadways are depicted in **Figures 2-1** through **2-5**.

For rural roadway classifications, the cross slope of the paved shoulder shall match the slope of the pavement surface (typically 2%). The cross slope of the unpaved shoulder will vary with roadway classification, see **Figures 2-6** through **2-10**.

### 3.3.4 *Cross-Sections in Street Dip Sections*

While dip sections are discouraged, where storm drainage runoff flows must cross the street, dip sections are needed. The pavements through the dip section should have a one-way slope (no crown), curbing and medians must not be raised, and cut-off walls (MAG Std. Detail 552) shall be installed in accordance with MAG standard details. Transitions back to normal street cross-slopes will be needed at both ends of the dip section. The dip section shall be reinforced concrete and the reinforcement shall be tied to the cut-off walls. Dip sections are only allowed for secondary access and for County improvements of existing roadways. Dip section may be allowed on primary access roadways if the dip section meets the criteria for all weather access. Signing in accordance with the current version of the MUTCD will be provided.

### 3.3.5 *Side Slope*

Side slopes should be designed for functional effectiveness, ease of maintenance, and pleasing appearance. **Figures 2-1** through **2-10** illustrate required side slopes, both in cut and fill sections. For both urban and rural conditions, a 4:1 slope is the Gila County standard for cut and fill sections.

In certain cases, Gila County may consider the use of steeper maximum slopes for cuts and fills, based on a Geotechnical Report. Rounding of cut slopes is illustrated in **Figure 3-1** for designs, which are approved for less than standard cut slopes.



### 3.4 Medians

#### 3.4.1 Median Openings

Median openings along Gila County arterials and collectors shall be spaced (centerline to centerline) generally at one-half to one-quarter mile spacing, but no closer than 660 feet to other median openings and major intersections. Within the functional limits of an intersection, median openings shall not be allowed. Functional limits are defined as the beginning and endings of tapers of auxiliary lanes or of redirection tapers for through lanes, or from the near curb line of an intersection street to the end of such tapers.

#### 3.4.2 Median Widths

The width of the median is measured from back of median curb to back of median curb. If the median has no curb, the width is measured between the centers of the continuous, painted median stripes.

The standard median width for rural major arterial roadways is 30 feet, as shown in **Figure 2-6**. Widths less than 30 feet must be approved by the Gila County Board of Supervisors. Widths less than 30 feet will require vertical curbing of the median area.

For urban principal arterial and urban major arterial roadway cross sections have a standard median width of 16 feet back of curb to back of curb, as shown in **Figures 2-1** and **2-2**. For urban areas, the median shall require vertical curbing.

#### 3.4.3 Paved Medians

A median less than four feet wide should be paved. Paving materials must be approved by the Gila County Engineering Department.

#### 3.4.4 Unpaved and Landscaped Medians

Medians that are four feet or more in width are normally not paved. The grading of the unpaved area should provide for a cross-slope toward the centerline of the roadway, as shown in **Figures 2-1**, **2-2**, and **2-6**. For drainage purposes the median cross slope may be modified with the approval of the Gila County Engineering Department. For curbed medians, the grading should be two inches below the top of curb.

If a median is to be landscaped, a landscape plan shall be submitted for review and approval by the Gila County Engineering Department. Plantings within landscaped medians shall not adversely affect sight distance requirements, shall not require irrigation once established if within public roads, and shall require minimal maintenance. These requirements must be adhered to unless an agreement with the County is made, whereby the homeowners association accepts responsibility and documents its ability to maintain the landscaped area.

### 3.5 Curbs

#### 3.5.1 Vertical Curbs

Vertical curbs with gutter are required for all urban roadways except local streets, as shown in **Figures 2-1** through **2-4**. Vertical curbs may be used where roll curbs are specified if desired.



Vertical curbs with gutter are to be constructed in accordance with MAG Standard Detail 220, Type A. Vertical curb and gutter type shall match the adjacent pavement slope to the gutter cross slope direction. The curb height shown on the standard is six inches. Variations may be approved by the Gila County Engineering Department where appropriate.

### **3.5.2 Roll Curb, Ribbon Curb**

Roll curbing is required for urban local residential streets, except where vertical curb is desired. Where appropriate, a roll curb is to be constructed in accordance with MAG Standard Detail 220, Type C.

Ribbon curbing is to be constructed in accordance with MAG Standard Detail 220, Type B. Ribbon curb may be used in subdivisions having an average lot size of one acre or greater.

### **3.5.3 Curb Returns**

All street intersections shall be constructed with concrete vertical curb returns and a sidewalk ramp per MAG Standard Details and the Americans with Disabilities Act (ADA). Curb returns shall be constructed with sidewalk ramps per MAG Standard Detail 231. If adjacent curb and gutter is not vertical curb, the curb transitions shall occur outside of the curb returns.

### **3.5.4 Curb Return Radii**

Curb return radii are measured to the back of curb. Radii shall be in accordance with **Table 3-1**.

**Table 3-1 – Intersection Curb Return Radii**

<b>Intersecting Roadways</b>	<b>Arterial</b>	<b>Collector</b>	<b>Local</b>
Arterial	50 feet	40 feet	30 feet
Collector	40 feet	35 feet	25 feet
Local	30 feet	25 feet	25 feet

## **3.6 Selection of a Design Speed**

The design of geometric features such as horizontal and vertical curves will depend upon the design speed selected for the street. The choice of the design speed is primarily determined by the street classification. The design speed is the maximum speed for the safe operation of a vehicle that can be maintained over a specific section of a street when conditions are so favorable that the design features of the street govern.

Design speeds for the various classifications of streets may be found on **Figures 2-1 through 2-10**. The use of design speeds other than those shown on the figures must be approved by the Gila County Engineering Department. Design speeds for existing County roads may be modified based on standard engineering analysis, using existing site constraints.



### 3.7 Superelevation in Curves

Superelevation refers to cross slope introduced into the cross section of a roadway in order to compensate for the centrifugal forces created by horizontal curves. In Gila County, 0.08 ft/ft and 0.06 ft/ft are the maximum rates for rural and urban roadways, respectively. For further details, refer to the most recent version of the AASHTO *A Policy on Geometric Design of Highways and Streets* and ADOT's *Roadway Design Guidelines*. Superelevation of roadways should be discouraged in areas with significant access.

#### 3.7.1 Axis of Rotation

When superelevation is introduced to account for horizontal curvature and to provide a stable turning motion for vehicles travelling at or below the design speed, the rotation of the pavement section must be designed along a given axis. The axis of rotation shall generally be about the pavement centerline.

#### 3.7.2 Superelevation Transitions

Superelevation transitions refer to the length of highway which is used to bring a normal crown section up to the superelevation rate which is being designed. Transitions also are used to bring a superelevated section back to the normal crown section.

The two components that make up the total transition for a superelevated section are superelevation runoff and tangent runout. Superelevation runoff denotes the length of highway needed to accomplish the change in cross slope from a section with adverse crown removed to a fully superelevated section, or vice versa. Tangent runout denotes the length of highway needed to accomplish the change in cross slope from a normal crown section to a section with the adverse crown removed, or vice versa. The length of superelevation transition shall be based on the superelevation rate and the width of rotation. For superelevations, refer to AASHTO *A Policy on Geometric Design of Highways and Streets* and ADOT's *Roadway Design Guidelines*.

For horizontal alignment designs, curves should be designed with one-third (1/3) of the transition on the curve and two-thirds (2/3) of the transition on the tangent pavement section.

### 3.8 Horizontal Curves

Horizontal alignments should provide for safe and continuous operation of motor vehicles at a uniform design speed for substantial lengths of street. A horizontal curve is required when the angle of change in horizontal alignment is equal to or greater than 45 minutes. The nature of the surrounding development and topography, and the street classification will establish the factors that determine the radius of a curve.

#### 3.8.1 Minimum Radii of Curvature

The minimum radius of curvature will be determined by the design speed or by the stopping sight distance. For further details, see the AASHTO publication, *A Policy on Geometric Design of Highways and Streets*.

An important element in the design and review of horizontal alignment is the sight distance available to driver across the inside of horizontal curves. When sight obstructions such as



walls, cut slopes, buildings, and continuous median barriers exist on the inside of curves, the distance to the obstruction from the center of the nearest travel lane must be checked. This distance,  $M$ , is termed the middle ordinate of the curve. The clear distance,  $M$ , is measured from the center of the inside lane to the view obstruction. Based on the design speed of the roadway and the stopping sight distances which must be provided, the values for the required middle ordinate are given in the AASHTO *A Policy on Geometric Design of Highways and Streets, Sight Distance on Horizontal Curves*. For use on Gila County projects, the higher values for  $M$  shall be used.

### ***3.8.2 Reduced Design Speeds on Curves***

The reduction of a street design speed on a curve should be avoided; however, where physical restrictions prohibit increasing the radius of the curve or the clear distance,  $M$ , the design speed for the curved section may be reduced. In such circumstances, signing in accordance with the MUTCD is required. The difference between the design speed for the roadway approaching the curve and the design speed of the curve shall not be greater than ten miles per hour. The design speed for the curved roadway section must not be reduced if the reduction would occur at the end of a long tangent or at any location where high approach speeds may be expected.

### ***3.8.3 Compound Curves***

The use of compound circular curves is to be avoided. In special cases where topography or right-of-way constraints require the use of compound curves, the radius of the flatter curve should not exceed 1.5 times the radius of the sharper curve.

### ***3.8.4 Tangent Sections Between Curves in the Same Direction***

Another type of curvature to be avoided when designing the horizontal alignment is a broken back curve. This design consists of two curves in the same direction connected by a short tangent section. Broken back curves shall not be used in the design of horizontal alignment. Generally, a single curve can be used.

### ***3.8.5 Tangent Sections Between Reverse Curves and Approaching Intersections***

Where topographic or right-of-way constraints require the use of reverse simple curves, a minimum tangent separation between the curves equal to at least  $4/3$  the superelevation runoff length shall be used. Special attention to drainage requirements of the roadway must be given when using reverse curves.

For curvature and superelevation transitions near bridges, the beginning and end of horizontal curves should occur sufficiently beyond the bridge limits such that the superelevation transition sections do not fall on the bridge or its approach slabs.



### 3.9 Vertical Alignment

A vertical curve is required on roadways when the algebraic difference in grade is equal to or greater than the values specified for the following conditions:

- 0.2% Federal Aid Projects;
- 0.3% Equal to or greater than 55 mph;
- 0.5% Equal to or greater than 40 mph, but less than 55 mph;
- 1.0% Less than 40 mph; and
- 1.5% Urban Local Streets.

All sections of a street's vertical alignment must meet passing and stopping sight distance requirements for the design speed established for the street. For further details, see the AASHTO publication, *A Policy on Geometric Design of Highways and Streets*.

#### 3.9.1 Longitudinal Street Grades

Gila County standards for maximum and minimum profile grades are as follows.

- Maximum longitudinal street grade varies by roadway classification, as shown in **Figures 2-1** through **2-10**, and must be approved by the Gila County Engineering Department.
- Minimum longitudinal street grade for all roadway classifications shall be 0.5%.

For further detail, see the AASHTO publication, *A Policy on Geometric Design of Highways and Streets*.

#### 3.9.2 Vertical Curves

Properly designed vertical curves should provide adequate sight distance, safety, and effective drainage. Vertical curves generally should be made as long as possible to provide greater stopping sight distance and pleasing aesthetics; however, in some cases, a minimum length vertical curve may be required to reduce the amount of excavation in rolling or mountainous terrain.

Gila County requires the design of vertical curves be based on the simple parabola with the vertical axis centered on the point of intersection.

##### 3.9.2.1 Crest Vertical Curve Lengths

Minimum lengths of crest vertical curves as determined by sight distance requirements generally are satisfactory from the standpoint of safety, comfort, and appearance. An exception may be at decision areas, where longer lengths are necessary.

Because the required lengths of vertical curves differ with different values of A (the algebraic difference in grades in percent), the recommended length of crest vertical curves is  $L=KA$ , where K is the rate of vertical curvature. **Table 3-2** summarizes the stopping sight distance and rate of vertical curvature recommended for each roadway design speed.



**Table 3-2 – Design Controls for Crest Vertical Curves based on Stopping Sight Distance**

Design Speed	Coefficient of Friction	Stopping Sight Distance (ft)	Rate of Vertical Curvature, K (length (ft) per percent of A)
20	0.40	125	10
25	0.38	150	20
30	0.35	200	30
35	0.34	250	50
40	0.32	325	80
45	0.31	400	120
50	0.30	475	160
55	0.30	550	220
60	0.29	650	310
65	0.29	725	400
70	0.28	850	540

*AASHTO A Policy on Geometric Design of Highways and Streets, 1990.*

The design control for Gila County is a minimum stopping sight distance, discussed in **Table 3-2**. Additionally, the length of a crest vertical curve shall not be less than three times the project design speed. The use of longer than minimum crest vertical curve lengths is encouraged for most projects. For further detail, refer to *AASHTO A Policy on Geometric Design of Highways and Streets*.

### 3.9.2.2 Sag Vertical Curve Lengths

When a vehicle traverses a sag vertical curve at night, the portion of roadway lighted ahead is dependent on both the position of the headlights and the direction of the light beam. Assumed design values are a headlight height of two feet and a one-degree upward divergence of the light beam from the longitudinal axis of the vehicle. For overall safety, the light beam is nearly the same as the stopping sight distance. Accordingly, it is pertinent to use stopping sight distances for the different design speeds.

Similar to crest vertical curves, the minimum length of sag vertical curves is calculated as  $L=KA$ , where K is the rate of vertical curvature and A is the algebraic difference in grades. **Table 3-3** summarizes the recommended stopping sight distance and rate of vertical curvature for various roadway design speeds.



**Table 3-3 – Design Controls for Sag Vertical Curves based on Stopping Sight Distance**

Design Speed	Coefficient of Friction	Stopping Sight Distance (ft)	Rate of Vertical Curvature, K (length (ft) per percent of A)
20	0.40	125	20
25	0.38	150	30
30	0.35	200	40
35	0.34	250	50
40	0.32	325	70
45	0.31	400	90
50	0.30	475	110
55	0.30	550	130
60	0.29	650	160
65	0.29	725	180
70	0.28	850	220

*AASHTO A Policy on Geometric Design of Highways and Streets, 1990.*

In Gila County, the value for sight distance for design of sag vertical curves is taken as the minimum safe stopping sight distance. By using stopping sight distance, the design will approximate the nighttime situation of headlight distance on the pavement. For design of sag vertical curves, the assumption should be that no continuous street lighting will exist, and that headlight distance will govern. Additionally, the length of a sag vertical curve shall not be less than three times the project design speed. The use of longer than minimum sag vertical curve lengths is encouraged for most projects. For further detail, refer to *AASHTO A Policy on Geometric Design of Highways and Streets*.

### 3.9.2.3 Design Considerations

Some of the important design considerations for both crest and sag vertical curves are as follows:

- A smooth grade line with longer tangent grades and fewer vertical curves should be a design objective;
- Broken-back grade lines (two vertical curves in the same direction separated by short sections of tangent grade) should be avoided;
- For long upgrades it generally is preferable to place the steepest grade at the bottom and reduce the grades at the top. Roller coaster and hidden dip types of profiles should be avoided; and
- Specific attention to drainage considerations at the top of the crest and the bottom of sag curves should be made.



### 3.9.3 Stopping Sight Distance

The principal design control for both crest and sag vertical curves is the provision of adequate stopping sight distance along the entire length of the curve. The criteria used in Gila County is for the drivers eye height of 3.5 feet above the pavement surface and an object six inches above the pavement. The equation used to calculate stopping sight distance is as follows:

$$SD = 1.47Vt + \frac{V^2}{30(f \pm G)}$$

where:

SD = stopping sight distance (ft)

V = design speed (mph)

f = coefficient of friction (wet), from **Tables 3-2 and 3-3**

G = grade of road in decimal form (ft/ft) (- is downhill, + is uphill)

t = brake reaction time (sec) (use 2.5 sec for Gila County)

Note that for upgrades, G is positive; for downgrades, G is negative.

Source: AASHTO *A Policy on Geometric Design of Highways and Streets*, 1990.

Values for stopping sight distance for Gila County roadway design shall be calculated using the above formula.

### 3.9.4 Passing Sight Distance

On two lane highways, provision of passing sight distance can be an important consideration. Generally, for crest vertical curves, the passing sight distance is substantially longer than the stopping sight distance and the latter is used as the design control. Appropriate no passing zones and marking must be in place to enforce the no passing criterion. For multilane highways, the stopping sight distance is again used as the design control for vertical alignment. The designer should be aware of this concept and is referred to AASHTO *A Policy on Geometric Design of Highways and Streets* for specific minimum passing sight distances for various design speeds. Note that the AASHTO standard is based on a vehicle height of 4.25 feet and a driver's eye height of 3.5 feet.

## 3.10 Combined Horizontal and Vertical Curves

The combined effect of vertical and horizontal alignment along a given section of roadway is an important factor to consider. Although there are no specific design values or specific criteria, there are a number of general considerations that the designer should address. These are as follows:

- A balanced design that provides horizontal and vertical alignments in the middle range of values is preferable to allowing either horizontal or vertical to become extreme in order to optimize the other;
- Crest vertical curves should not be coincident with or immediately precede sharp horizontal curves;



- Sharp horizontal curvature near the low point of a sag vertical curve is to be avoided; and
- Both horizontal and vertical curvature should be as flat as possible at intersections where vehicles have to decelerate, stop, or accelerate.

### 3.11 Intersections

The goal of the designer in providing intersection layouts is to allow for safe and efficient crossing, merging, and diverging of conflicting vehicle streams. These conflicts can be significantly reduced through the provision of adequate sight distances and efficient traffic control devices. Providing safe sight distances and effective control will depend on human factors related to the drivers, bicyclists, and pedestrians, the traffic volumes to be accommodated, and the geometric and topographical characteristics of the intersection itself.

#### 3.11.1 *Design Elements*

##### 3.11.1.1 Human Factors

Two of the most important human factors that impact the design of intersections are the perception reaction time of drivers and the walking speed of pedestrians. The perception reaction time affects required intersection sight distances and also affects traffic signal timing. Pedestrian walking speed affects traffic signal timing, as well as placement of channelization and islands. The values that are appropriate for Gila County design work are a driver perception reaction time of 2.5 seconds and a pedestrian walking speed of four feet per second. In areas where the proportion of older drivers or pedestrians is greater than average, these human factor values should be reviewed and may be revised upward in the case of the perception reaction time, and downward in the case of pedestrian walking speed. For projects where the proportion of older drivers or pedestrians is higher, a pedestrian walking speed of 3.0 feet per second should be used.

##### 3.11.1.2 Traffic Demand

There are two major items relative to traffic demand that must be identified early in the design process. First, the design hour volume (DHV) must be established. In Gila County, typical practice is to use the 20-year traffic forecasts produced by the Central Arizona Association of Governments (CAAG). These forecasts provide average daily traffic over a 24-hour period on the major roadway system in the County. Second, a set of recent traffic volumes and turning volume counts at major intersections shall be used. Using the 20-year forecasts and existing data, a set of volumes for through and turning traffic is established for the design. This should be contained in a Traffic Report when requested by Gila County as part of the design process.

##### 3.11.1.3 Design Vehicles

Selection of a design vehicle is important for roadway projects. Where needed and with the approval of the Gila County Engineering Department, a design vehicle shall be selected for design elements not specifically defined in these standards.



#### 3.11.1.4 Traffic Control

Identification of the type of traffic control to be installed along with the roadway improvement will generally be made in consultation with Gila County at the start of a design project. The designer is to assess the requirements for two-way stop control, all-way stop control or traffic signal control. These analyses would be included in the Traffic Report submitted to Gila County. Once a specific form of control is selected, it will have significant impact on design elements such as length of storage for exclusive turn lanes, warning and regulatory signs, sight distance required, and the need for auxiliary acceleration and deceleration lanes. Also, the type of control to be implemented will affect how pedestrians and bicycles are managed and controlled at the intersection.

It should be noted that if forecasted traffic volumes are used to warrant the need for specific traffic control, Gila County will traditionally require that the traffic volumes must be present prior to the implementation of the traffic control. Many times the identification of the ultimate type of traffic control will impact roadway geometrics and intersection design.

#### 3.11.2 Location and Configuration

Intersections shall be created or revised according to the following guidelines:

- 90 degree intersections are almost always preferable to skewed intersections;
- Skews greater than two degrees on arterial and collector roads, and skews greater than four degrees on local roads are to be avoided and require approval of the Gila County Engineering Department;
- Intersections should be located along tangent sections of the roadway;
- Signalized intersections should be spaced no closer than 0.5 miles; and
- Intersections with more than four entering approaches shall not be used.

Any variances must be approved by the Gila County Board of Supervisors.

#### 3.11.3 Intersection Sight Distance

Intersection sight distance shall be provided at all intersections and driveways. This condition can be waived at the discretion of the Gila County Engineering Department as long as the intersection sight distance provided is not less than stopping sight distance.

The large number of potential vehicle conflicts at intersections is significantly reduced through provision of appropriate intersection sight distance and appropriate traffic controls. For vehicles approaching an intersection, an unobstructed view of both the intersection and the intersecting highway permit the driver to avoid conflicts. The sight distances required for intersections with stop control on the minor roadway or for signalized intersections are described in detail in the AASHTO *A Policy on Geometric Design of Highways and Streets*. Any such assessment should be based on a driver eye height of 3.5 feet, located 20 feet from the edge of the near travel lane, with an object vehicle height of 4.25 feet.



#### *3.11.4 Stopping Sight Distance*

Stopping sight distance shall be provided at all intersections and driveways. The standard values are given in the previous Section 3.9.3.

#### *3.11.5 Sight Triangles*

Sight triangles should be used as a means to limit the height of structures, vegetation, and other improvements on corner properties immediately adjacent to intersections and driveways. Sight triangles are not to be used as a substitute for intersection sight distance. Intersection sight triangles are applied both to approaching vehicles and departing vehicles. Obstructions in both the horizontal plane and the vertical plane must be reviewed when designing the intersection. Sight triangles provide additional visibility around corners for all intersection approaches, and should be applied to the design of perimeter walls and landscape features. Items within the sight triangle shall be no higher than 24 inches measured from the roadway surface. **Figure 3-2** depicts the method used to determine the sight triangle location.

#### *3.11.6 Valley Gutters at Street Intersections*

Where a proposed drainage pattern crosses an intersecting street, valley gutters shall be used. Concrete valley gutters (as per MAG Std. Detail 240) shall be constructed at all intersections where the drainage pattern requires them. Valley gutters should be constructed to a width of four feet. Valley gutters may only be used across minor and local collector streets, and local residential streets. Exceptions must be approved by the Gila County Engineering Department.

#### *3.11.7 Turning Lanes*

A separate turning lane permits separation of conflicting traffic movements and removes turning vehicles from the intersection area. Right and left turn lanes and bay tapers shall be provided as recommended in the Traffic Report. Further discussion on the requirement criteria for deceleration lanes is provided in Section 5.5.7 of this manual.

### **3.12 Street Planning**

Street plans should produce the minimum number of intersection and wash crossings, and discourage through traffic on local streets.

#### *3.12.1 Street Abandonment*

The abandonment of an existing street must follow the procedure outlined in the *Guidelines for Vacation of Public Roadways in Gila County*. A copy of this document is provided in the **Appendix**.

#### *3.12.2 Cul-de-Sac Street Lengths*

A cul-de-sac street is a street that serves more than one property owner and has only one direct access to the public street system. The following requirements apply to both public and private streets. The length of a cul-de-sac is measured between the centerline of an intersecting street and the radius point of the cul-de-sac. The minimum length of a cul-de-



sac is two times the cul-de-sac radius (R1). A cul-de-sac street shall not be longer than 1,320 feet and it shall not serve more than 14 single-family dwelling units.

Typically, cul-de-sac streets shall terminate with an improved traffic turning circle radius (R1) of 40 feet to face of curb within a circular right-of-way radius (R2) of 50 feet.

### *3.12.3 Dead-End Streets*

Dead-end streets will be required where a street connection is necessary to serve adjacent properties that will develop at a future date. When a dead-end street is required and it serves more than four lots, a temporary cul-de-sac shall be provided. In addition, the minimum/maximum length of a dead-end street shall be the same as that of a cul-de-sac street.

### *3.12.4 Bubbles and Turn-Arounds*

Bubbles are areas on the roadway expanded to provide a turn-around and additional access or lot frontage on minor collector and local streets. Bubbles are required at intersections where each street extends in only one direction from the intersection. Bubbles are permitted between intersections to improve accessibility to odd-shaped site or on minor collector streets where direct access is not permitted. The center radii for bubbles are typically 40 feet to face of curb within a circular right of way of 50 feet and 25 feet (to the face of curb) for the reverse curves on each side of the center curve. The use of bubbles (except for on a cul-de-sac) on other than local residential streets must be approved by the Gila County Engineering Department. Radii appropriate for bubbles will be established as part of that approval.

### *3.12.5 Alleys*

Alleys are discouraged and must be approved by the Gila County Engineering Department; however, alleys may be required where other alleys exist within an area or the extension of existing alley or alley system is necessary. Dead-end alleys will not be permitted.

#### *3.12.5.1 Alley Widths*

Residential alleys abutting single family uses shall be 16 feet in width. For other abutting uses, an alley 20 feet in width shall be provided.

#### *3.12.5.2 Alley Intersections*

Alley intersections and sharp changes in alignment should be avoided. When two alleys intersect or when sharp alignment changes are allowed, a triangular corner cutoff of not less than 15 feet along each property line should be provided.

#### *3.12.5.3 Alley Paving*

All alleys in urban areas are to be paved full width with at least two inches of asphaltic concrete over six inches of Aggregate Base Course (ABC).



### 3.12.6 Offset Intersections

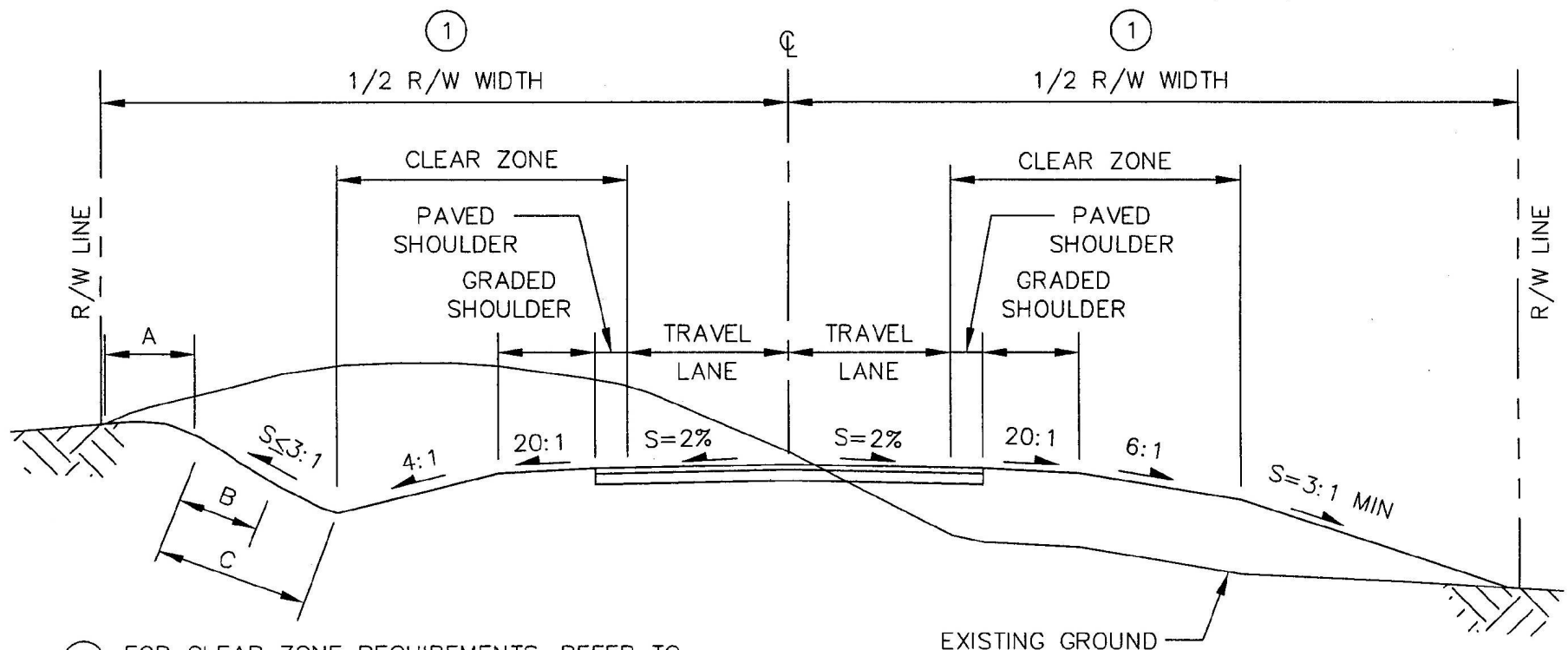
Street jogs with centerline offsets less than 250 feet shall not be permitted along arterial and major collector streets, or on minor collector and local commercial and industrial streets where interlocking left turns will occur. Offsets as small as 125 feet are allowed on minor collector and local commercial and industrial streets where interlocking left turns will not occur and on local residential streets.

### 3.12.7 Intersection Tangents

A tangent section of roadway is required prior to an intersection on a curvilinear street. **Table 3-4** shows the minimum tangent lengths approaching an intersection that are required.

**Table 3-4 – Minimum Tangent Lengths Approaching an Intersection**

Street Classification	Min. Tangent Length
Urban Principal Arterial	350 feet
Urban Major Arterial	300 feet
Urban Collector	250 feet
Urban Minor Collector	200 feet
Urban Local	150 feet
Rural Major Arterial	300 feet
Rural Arterial	250 feet
Rural Collector	200 feet
Rural Local	150 feet
Rural Very Low Volume Road	100 feet



① FOR CLEAR ZONE REQUIREMENTS, REFER TO AASHTO ROADSIDE DESIGN GUIDE.

**CASE 1**

CUT SLOPES STEEPER THAN 3:1 AND CUT SLOPE DISTANCE  $C \geq 10$ :  $A=B=10'$

NOTE: WHERE R/W IS LIMITED, ROUNDING OF SLOPES MAY BE REDUCED TO  $A = B = 5'$

**CASE 2**

CUT SLOPES STEEPER THAN 3:1 AND CUT SLOPE DISTANCE  $C < 10$ :  $A=B=C$

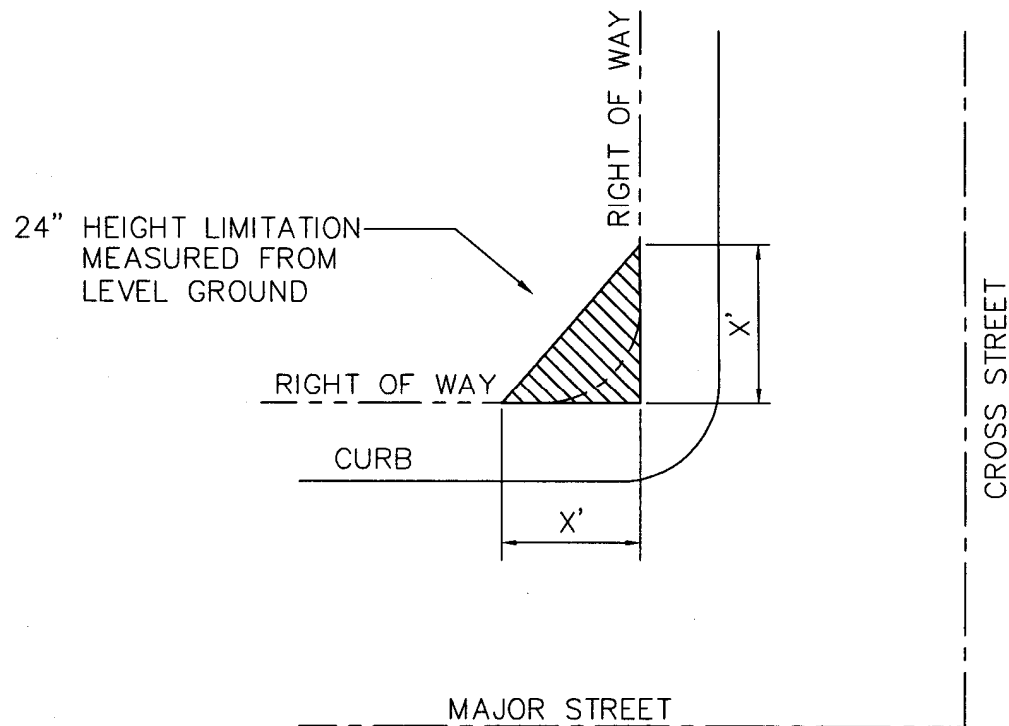
**CASE 3**

CUT SLOPES FLATTER THAN OR EQUAL TO 3:1; ROUNDING OF CUT SLOPE IS REQUIRED

GILA COUNTY  
PUBLIC WORKS

TYPICAL SECTION FOR ROUNDING OF CUT SLOPES

FIG. 3-1



MAJOR STREET CLASSIFICATION	X(IN FEET)
URBAN PRINCIPAL ARTERIAL	25
URBAN MAJOR ARTERIAL	25
URBAN COLLECTOR	25
URBAN MINOR COLLECTOR	35
URBAN LOCAL	35
RURAL MAJOR ARTERIAL	25
RURAL ARTERIAL	25
RURAL COLLECTOR	35
RURAL LOCAL	35
RURAL VERY LOW VOLUME ROAD	35



## **4. PAVEMENT STRUCTURAL DESIGN STANDARDS – (REVISED 7-05)**

### **4.1 Flexible Pavement – (Revised 7-05)**

A Geotechnical Report shall be required to establish the required pavement structure of the roadway, as per ADOT's *Preliminary Engineering and Design Manual* for pavement design. The Gila County Standard Details, **Figures 2-1** through **2-10**, for street cross-sections also include notes referring to minimum asphaltic pavement thickness for each roadway classification.

### **4.2 Rigid Pavement**

Rigid pavements, such as Portland cement concrete, are generally not used for Gila County streets. If rigid pavements are used, the Gila County Engineering Department must approve each design.

### **4.3 Miscellaneous Pavement Standards**

For cases where the full depth of base course cannot be constructed due to insufficient cover over existing facilities, the County reserves the authority to approve equivalent alternate designs if justified.

The minimum pavement cross sectional requirement for temporary turnarounds, which are constructed at project phase lines, is six inches of aggregate base course over six inches of compacted subgrade; see MAG Standard Specifications Sections 301, 310, and 702. If the temporary turnaround is constructed at a project boundary, a surface course of three inches of asphaltic concrete is required in addition to the base and subgrade noted above; see MAG Standard Specifications Sections 321 and 710, without lime.

Temporary pavement cross sections shall consist of three inches of asphaltic concrete over six inches of aggregate base course over six inches of compacted subgrade; see the same MAG Standard Specifications Sections noted above.

Decomposed granite may be used as fill or subbase. It is not allowed as a base material.



## 5. ACCESS AND DRIVEWAYS

### 5.1 Access Control

The efficiency and safety of a roadway or highway depends largely on the number and character of interferences affecting vehicles moving along the facility. Major interferences are caused on most street by vehicles entering, leaving, or crossing the road at intersecting streets and driveways. In order to minimize accidents and to assure best overall use of the facility by the general public, it is necessary to regulate vehicle movements in and out of abutting developments and cross streets.

With respect to driveways, road users have certain rights of access to abutting property as well as the right to travel on the road with relative safety and freedom from interference. Because these various rights sometimes conflict, the County is given the responsibility for reconciling and satisfying, to the extent feasible, the needs and rights of all road user with respect to driveway location, design, and operation. When conflicts cannot be fully resolved, preference will be given to the safe and efficient use of the road.

Existing accesses, even if not in use, must not be relocated, altered, or reconstructed without approval from Gila County. When an access to a roadway with a curb and gutter is abandoned, it must be replaced by a full height curb across the abandoned access and the depressions behind must be filled. When an access to a roadway with a shoulder and ditch is abandoned, it must be replaced by a matching existing shoulder and ditch.

#### 5.1.1 Access to State Highways

Access to State highways is regulated by ADOT. Gila County will not review changes to an existing access or any new access that is in State right-of-way. Encroachment permits for access to State highways must be obtained directly from ADOT. The County shall review requests for new access where any portion of the access is in County right-of-way.

#### 5.1.2 Access to City Street

Accesses to city streets are regulated by the appropriate city. Gila County will not review any changes to an existing access or any new access that is in any city's right-of-way. Encroachment permits for access to city streets must be obtained directly from the cities. Gila County shall review a request for new access where any portion of the access is in County right-of-way.

#### 5.1.3 Access to County Roads

All construction to connect or change driveways entering County roads must first be authorized by a valid Gila County permit.

The design, number, and location of access points must be approved by the Gila County Engineering Department when a change in the use of any property necessitates a change in its access. The number of access points should be kept to a minimum. No access points will be approved without an acceptable project site plan.



The following are general guidelines indicating when a change of access points to a public road may be required:

- When the use of the access increases in actual or proposed vehicular volume by 20% or more;
- When a particular directional characteristic (such as left turns) increase by 20% or more;
- When a change in the use of a property causes the flow of entering vehicles to be restricted, or causes such vehicles to line up or be otherwise delayed on a public road; and
- When use of the access by vehicles exceeding 30,000 pounds gross vehicle weight increases by 20% or ten vehicles per day.

When any of these conditions occur, a new driveway permit may be required. Further, a new driveway permit also may be required when significant changes are made by structural modifications, remodeling, type of business, expansion, change in zoning, or when changes in property division create new parcels. Modifications in advertising, landscaping, general maintenance, or aesthetics that do not affect internal or external traffic flow or safety do not require a new driveway permit.

In general, any proposal that requires a discretionary review will be considered a potential change in use.

## 5.2 Driveway Types

A driveway is any access constructed within the public right-of-way, connecting the public roadway with adjacent property and which does not cause the blocking of any sidewalk, border area, street, or roadway.

### 5.2.1 Residential Driveways

A residential driveway is one providing access to a single family residence, a duplex, or an apartment building containing five or fewer dwelling units.

#### 5.2.1.1 Single Family Residential Development

Driveways serving single family residential units should be S-1 type driveways as shown in **Figure 5-1**, “Residential Driveways.” If the driveway is to serve one single family unit, the maximum width should be 24 feet. Refer to MAG Standard Detail 250 and 251. For single family residential accesses, the width must equal the width of the garage or carport opening if the garage is within 25 feet of the right-of-way line, up to a maximum of 30 feet. The minimum length is 20 feet, measured from the face of the garage or carport opening to the back of sidewalk or the back of curb if no sidewalk is provided. If one driveway is to serve two single family units, the maximum width should be 30 feet. Only one driveway per lot is allowed, except where the street frontage is of sufficient width to maintain a separation as shown in **Table 5-1**.



#### 5.2.1.2 Multifamily Residential Development

The M-1 and M-2 type driveways, as shown in **Figure 5-1**, are to be used to serve multifamily developments. Type M-1 is a low volume driveway serving more than three off-street parking stalls for more than two dwelling units. Type M-2 is a high volume driveway serving more than 50 dwelling units, and is normally on a collector or an arterial street. With the approval of the Gila County Engineering Department, Type M-1 and M-2 driveways may be widened up to 12 feet on the egress side to provide for a separate left turn lane. The minimum driveway length is 20 feet, measured from the entrance to the off-street parking area to the back of sidewalk, or to the back of curb if no sidewalk is provided.

#### 5.2.1.3 Limitations on Residential Access

Residential properties that have frontage on a local street as well as on an arterial or collector street shall only access the local street.

In some instances, residential parcels fronting only on arterial or collector streets will be given access if reasonable alternate public access is not available. When such access is allowed, the driveway must be circular or it must have a turn-around area, if at all possible, to ensure that there is no need for vehicles to back onto the street.

### 5.2.2 Commercial and Industrial Driveways

Driveways for commercial and industrial development are shown in **Figures 5-2** through **5-4**. **Figure 5-2** has the CL type driveways, **Figure 5-3** has the CH type driveway, and **Figure 5-4** has the CI type Driveways. The minimum length for a commercial or industrial driveway is 30 feet, measured from the entrance to the off-street parking area to the back of sidewalk or the back of curb if no sidewalk is provided.

#### 5.2.2.1 Commercial Driveways

The CL-1 and CH-1 type driveways shall be used to serve commercial properties. A CL type driveway is to be used on low volume driveways in commercial area. A CH type driveway is to be used for high volume driveways along high-speed arterial street or at other location when required by the Gila County Engineering Department. The CL-2, CH-2, and CH-3 type driveways are to be used at all access driveways opposite median openings, but may be used at other location when approved by the Gila County Engineering Department. The CL-3, CL-4, and CI one-way type driveways may be allowed on arterial streets with raised medians or other locations when approved by the Gila County Engineering Department.



#### 5.2.2.2 Industrial Driveways

The CL-1 type driveway shall be used to serve industrial properties. Under unusual circumstances, other CL, CH, and CI driveways are allowed in industrial areas. When the Gila County Engineering Department allows or requires them, the related requirements of commercial driveways shall apply. Generally, industrial driveways are not permitted on arterial or collector streets; however, if the Gila County Engineering Department allows or requires such access, commercial driveway standards apply.

### 5.3 Number of Driveways

The number of driveways is dependent upon the size and use of the property. Basically, each parcel is limited to one two-way driveway or a pair of one-way driveways. For consideration of additional driveway(s), the minimum driveway spacing criteria as outlined in **Table 5-1** must be satisfied.

Where a property has access to more than one road, access may be limited to the lowest volume road where the impacts of new access will be minimized. Access on other higher volume roads may be denied.

#### 5.3.1 Additional Driveways

Additional driveways may be needed and provided under the following conditions:

- If the daily volume using one driveway would exceed 2,500 vehicles (both directions);
- If traffic using one driveway would exceed the capacity of a stop-sign-controlled intersection during one peak street traffic hour or the peak site traffic hour;
- If a traffic analysis shows that the traffic conditions warrant two or more driveways; and
- Residential lots with frontage greater than or equal to 100 feet may have an additional driveway to allow for a circular driveway.

#### 5.3.2 Temporary Access

Temporary access will be granted to undeveloped property prior to development of a final plan if access is needed for construction or preliminary site access. Temporary accesses are subject to removal, relocation, or redesign after final development plan approval.

Secondary access for emergency vehicles must be provided for all developments when deemed necessary.

#### 5.3.3 Large Developments

For larger development, the Gila County Engineering Department may require the developer to consolidate access traffic to a single point, which may be signalized. Driveway signals must be located to provide satisfactory signal progression for through traffic on the public road.



## 5.4 Location and Spacing of Driveways

The location and spacing of driveways which provide access along major collectors and arterials has an impact on both safety and capacity of the roadway.

### 5.4.1 Driveway Spacing

The distance between adjacent driveways must be adequate to allow driveway vehicles to safely queue, accelerate, decelerate, and cross-conflicting traffic streams without excessive interference with through traffic, or traffic using adjacent driveways. **Table 5-1** lists the minimum driveway spacing for various roadway classifications. These distances are measured from driveway centerline to driveway centerline.

**Table 5-1 – Minimum Driveway Spacing**

Land Use	Street Type	Driveway Type	Min. Spacing (ft)
Single Family	All	S-1	50 *
Multi-Family	All	M-1	165
		M-2	330
Commercial	Minor Collector/Local	CL-1	165
	Major Collector/Minor Arterial	CH-1	330
	Major Arterial	CH-1	660
		CH-2, CH-3	1320
Industrial	Minor Collector/Local	CI	165
	Major Collector/Minor Arterial	CH-1	330
	Major Arterial	CH-1	660
		CH-2, CH-3	1320
	Parkway/Expressway	CH-2, CH-3	1320

\* Spacing required for more than one driveway per parcel only.

For residential developments, a minimum five-foot setback from the property line is required unless adjoining lots share a common driveway.

A maximum of one driveway opening shall be permitted to a particular site or parcel from each of any one or two abutting streets. One additional driveway entrance may be permitted by the Gila County Engineering Department when projected travel demands indicate it is in the interests of good traffic operation and adequate street frontage exists to maintain the above guidelines.

### 5.4.2 Joint Access

Joint (or shared) access and/or cross access easements will be required for two adjacent development where a proposed new access will not meet the spacing requirement set forth in **Table 5-1**. Joint access must be approved by the Gila County Engineering Department.



### 5.4.3 *Driveway Corner Clearance*

#### 5.4.3.1 Major Street Intersections

The location and spacing of driveways which provide access along collectors and arterials has an impact on both safety and capacity of the roadway. Driveways located near major intersections or median openings shall meet the following requirements:

- A minimum of 150 feet, measured at the curb line, shall separate the nearest pavement edge of any entrance or exit driveway and the curb line of the nearest intersecting street; and
- Driveways near median openings shall either be centered with the center of the median opening or be a minimum of 100 feet from the center of the median opening.

#### 5.4.3.2 Residential Lots

On local roads or at major intersections when the 150-foot setback cannot be met because of lot size, a minimum of 50 feet shall separate the nearest pavement edge or curbline from the nearest driveway edge.

### 5.4.4 *Driveway Location Restrictions*

A new driveway or a driveway with changed access will not be allowed under the following conditions:

- Within ten feet of any commercial property line, except when it is a joint-use driveway serving two abutting commercial properties and access agreements have been exchanged between, and recorded for, the two abutting property owners;
- Within 25 feet of a guardrail ending;
- Within 100 feet of a bridge or other structure;
- Within the minimum spacing as established in **Table 5-1**;
- Within 150 feet of the right of way line of an intersecting arterial street;
- Within 100 feet of an approved median opening location;
- When adequate sight distance cannot be provided for vehicles on the driveway attempting to access the street, as those movements will be prohibited;
- When the nearest edge of any driveway flare or radius must be at least two feet from the nearest projection of a fire hydrant, utility pole, drop inlet and or appurtenances, traffic signal, or light standards; and
- For parking or loading areas that require backing maneuvers in a public right-of-way except for single family or duplex residential uses on local roads.

If a property has frontage on more than one street, access will be permitted only on those street frontages where standards contained in this manual and other County Regulations can be met.

If a property cannot be served by any access point meeting these standards, the County may designate one or more access point(s) based on traffic safety, operational needs, and



conformance to as many of the requirements of these guidelines as possible. This does not constitute a guarantee by the County to provide access to a property.

Variances for residential developments may be made by the Gila County Engineering Department where the application of these standards would create an undue hardship to the abutting property owners and good traffic engineering practice can be maintained. Variances for commercial and industrial development must be made by the Gila County Board of Supervisors.

#### **5.4.5 Driveway Location Coordination**

It is necessary to coordinate the location of access for properties on opposite sides of the highway so that they do not interfere with each other.

- Driveways should be located directly opposite each other at median openings or along major facilities without a median to ensure that they share a single access location.
- Where lots are not large enough to allow accesses on opposite sides of the street to be aligned, the center of driveways not in alignment will normally be offset a minimum of 150 feet on all collector roads, and 330 feet on all arterial roads. Greater distances may be required if left turn storage lanes require them.

### **5.5 Driveway Design**

#### **5.5.1 Restriction of Turning Movements**

Where necessary for the safe and efficient movement of traffic, Gila County may require access points to be geometrically designed so as to provide for only limited turning movements. The restriction of movements should not affect the number and location of access points. The designer is referred to AASHTO's *A Policy on Geometric Design of Highways and Streets*, regarding the design details for islands. Additional right-of-way or easement may be required to accommodate these designs. Acceleration and deceleration lanes may be required to be incorporated into the design. Islands must be proposed with vertical curbs. The ends of the islands should typically be provided with two-foot back of curb radii.

Where site plans do not permit installation of islands, Gila County may require the installation of a center median on the adjacent public street as an alternative.

#### **5.5.2 Radii and Widths**

Generally all new driveways shall be curb cut driveways unless turning movement requirements (e.g., right turns in and out allowed) dictate the use of curb radii.

Recommended driveway widths and radii are discussed in Section 5.2 of this manual. **Figures 5-1** through **5-4** provide typical details for standard types of driveways. All radii are in feet as measured to the face of the curb or the edge of the pavement where no curb exists.



Modification of the driveway radii may be allowed and/or required by Gila County, wherever customized driveways or islands are constructed in the driveway to control turning movements. The design of accesses also must take into consideration the appropriate turning template. Drainage patterns also must be taken into consideration in the design of accesses.

### *5.5.3 Relocation of Utilities, Structures, and Trees*

Prior to commencing any work, arrangements for the necessary removal or relocation of any public utilities, structures, trees, plantings, or drainage facilities must be made by the developer or permittee with the person or persons having ownership or control thereof. All relocations shall be in accordance with Gila County standards.

### *5.5.4 Driveway Sight Distance*

Adequate sight distance must be provided for vehicles exiting and entering a driveway. Driveway locations should be evaluated to determine whether a sight obstruction exists, such as buildings, fences, signs, vegetation, parked vehicles, horizontal or vertical highway alignments, etc. The designer is referred to AASHTO, *A Policy on Geometric Design of Highways and Street*, for detailed information regarding sight distance at intersections.

If the sight distance is not adequate, consideration should be given to the following options:

- Remove the sight obstruction;
- Relocate the driveway to a more favorable location along the frontage;
- Prohibit critical movements at the driveway; and
- Relocate access to another street, a frontage road, or a joint access location.

In all cases, stopping sight distance must be provided.

### *5.5.5 Driveway Profiles*

Adequate design of driveway grades should reflect consideration for basic functions of the adjacent street and the site that the access driveway serves. Generally, in order to enable safe ingress and egress maneuvers, driveway profiles should provide for sufficient clearance between the vehicle and the driveway surface. **Figure 5-5** illustrates driveway profile standards.

### *5.5.6 Driveway Angles*

A two-way driveway should intersect the roadway as close to 90 degrees to the roadway as possible (no less than 75 degrees); however, a minimum of an 85 degree angle is recommended for driveways in areas where pedestrian sidewalks or bicycle lanes are present.

### *5.5.7 Deceleration Lanes*

Deceleration lanes are required at all street intersections on urban principal and major arterials. Deceleration lanes may be required on minor arterial and collector streets when required by the Gila County Engineering Department.

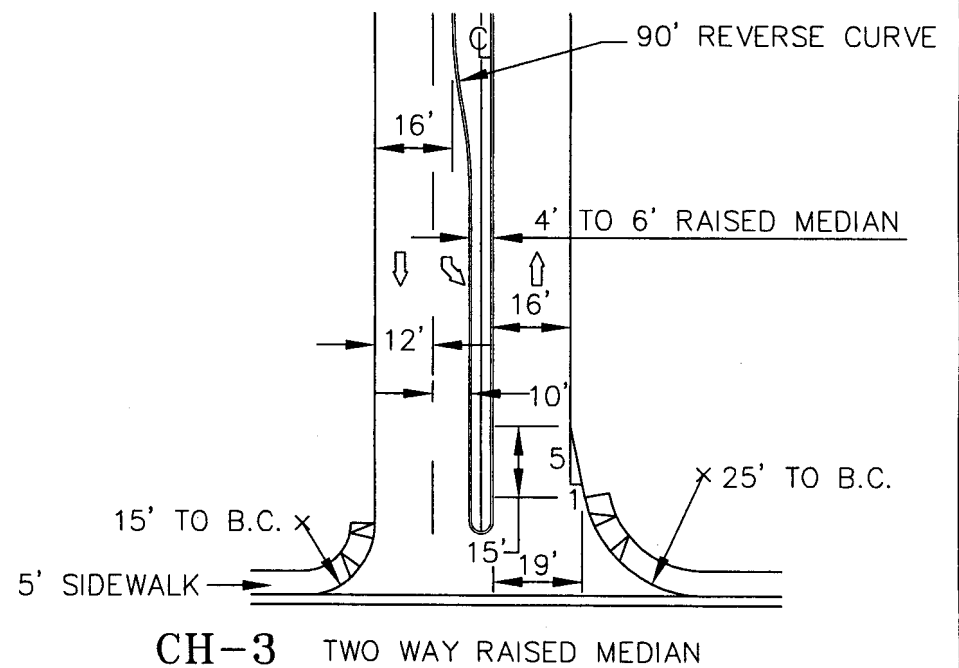
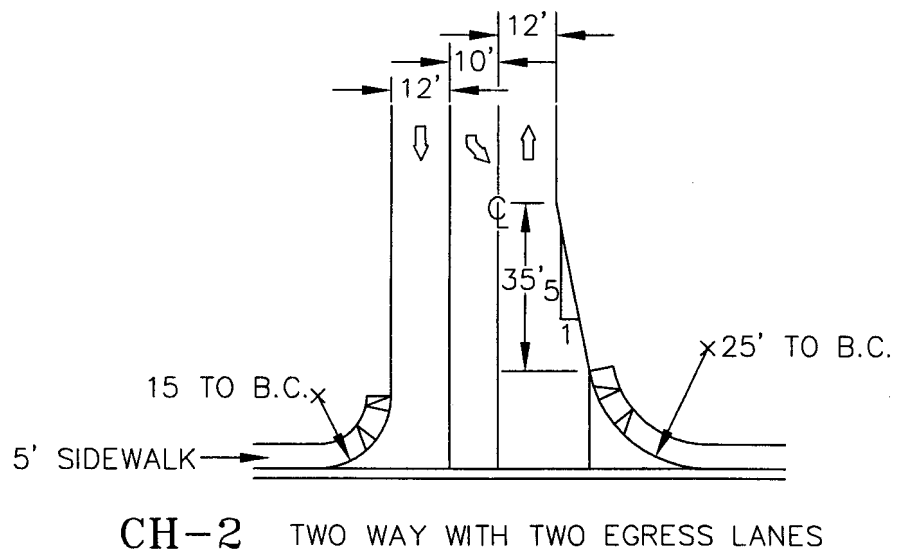
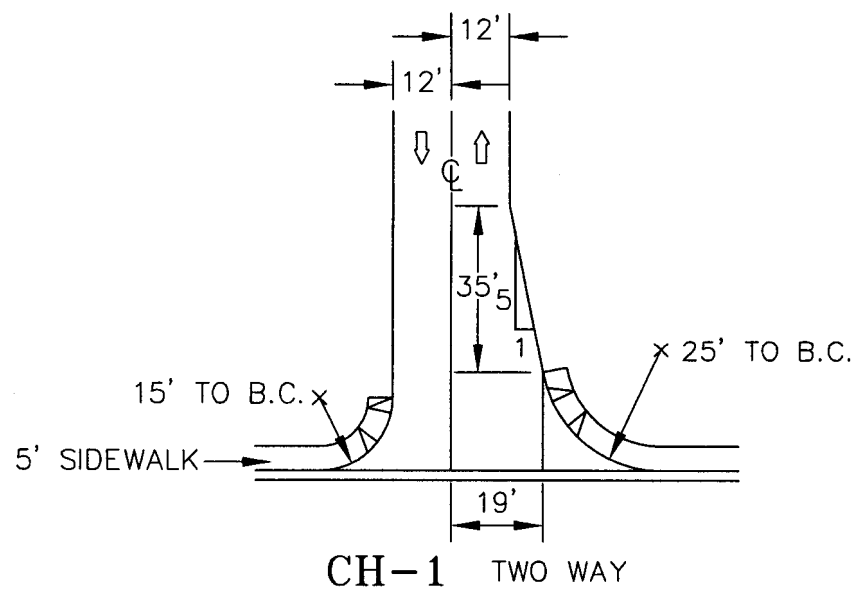


Deceleration lanes are required in conjunction with driveways on major arterial roadways. Deceleration lanes for driveways may be required on minor arterial and collector roads, and may require additional right-of-way. The lane length must be determined on a case-by-case basis and must be approved by the Gila County Engineering Department. To determine the need for a deceleration lane on streets classified as minor arterial and collector, all of the following criteria must be met:

- At least 5000 vehicles per day using or expected to be using the street;
- The 85th percentile traffic speed on the street is at least 35 mph; or 45 mph for a two lane (one lane in each direction) roadway; and
- At least 40 vehicles will be making right turns into the driveway during a one hour period.

<p>WIDEN 5' AND USE 5:1 TAPER WHEN VERTICAL CURB IS USED.</p> <p>CURB CUT OPTIONAL WHEN ROLLED CURB IS USED.</p> <p>16' MIN 24' MAX</p> <p>SIDEWALK</p> <p><b>S-1 SINGLE FAMILY UNITS</b></p>	
<p>12'</p> <p>12'</p> <p>18'</p> <p>SIDEWALK</p> <p><b>M-1 MULTI FAMILY UNITS (LOW VOLUME)</b></p>	<p>12'</p> <p>12'</p> <p>19'</p> <p>35'</p> <p>5'</p> <p>1'</p> <p>15 TO B.C.X</p> <p>25' TO B.C.</p> <p><b>M-2 MULTI FAMILY UNITS (HIGH VOLUME)</b></p>
<p><b>GILA COUNTY PUBLIC WORKS</b></p>	<p><b>RESIDENTIAL DRIVEWAYS</b></p> <p><b>FIG. 5-1</b></p>

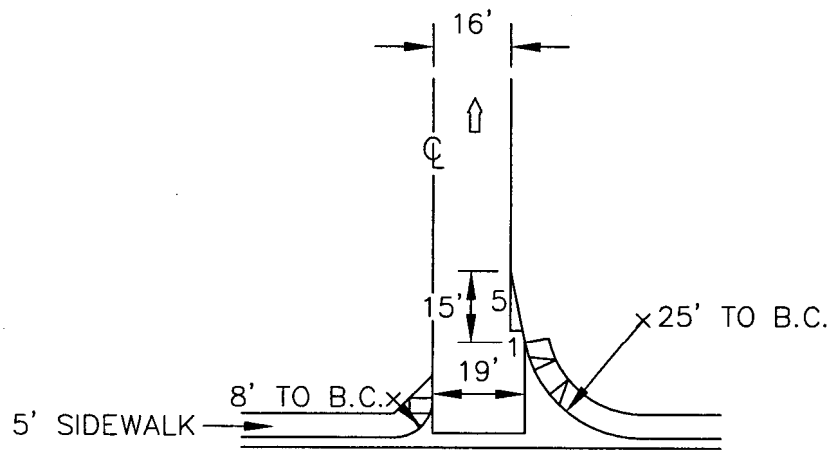
	<p>CL-1 TWO WAY</p>		<p>CL-2 TWO WAY WITH TWO EGRESS LANES</p>
	<p>CL-3 ONE WAY INGRESS</p>		<p>CL-4 ONE WAY EGRESS</p>
<p>GILA COUNTY PUBLIC WORKS</p>	<p>COMMERCIAL DRIVEWAYS-TYPE CL</p>	<p>FIG. 5-2</p>	



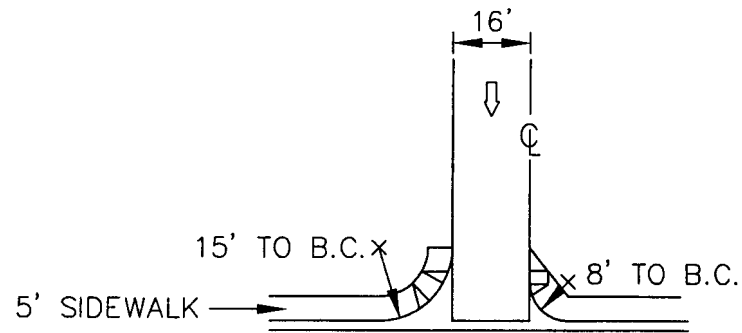
GILA COUNTY  
PUBLIC WORKS

COMMERCIAL DRIVEWAYS-TYPE CH

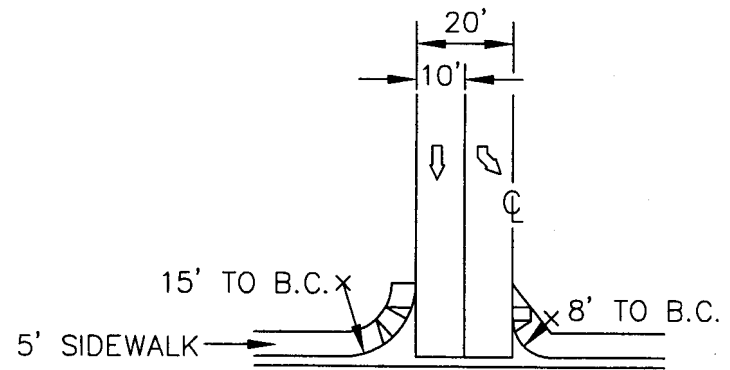
FIG. 5-3



CI-1 ONE WAY EGRESS



CI-2 ONE WAY EGRESS

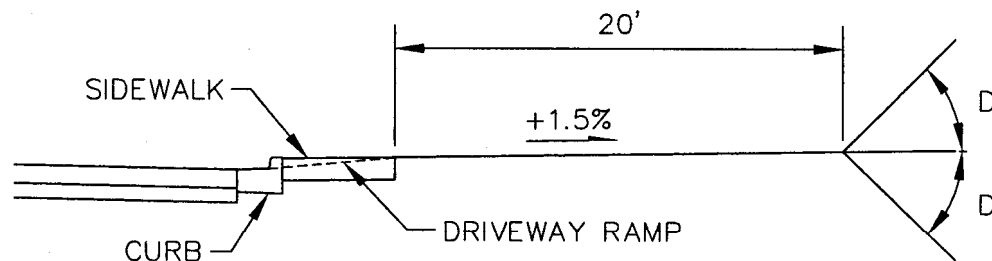


CI-3 TWO LANES ONE WAY EGRESS

GILA COUNTY  
PUBLIC WORKS

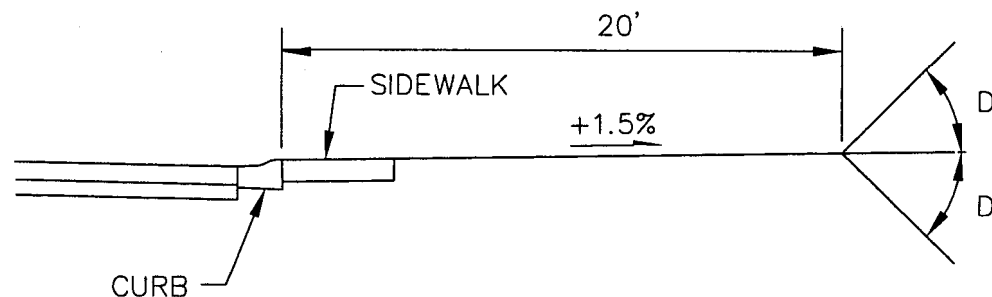
COMMERCIAL DRIVEWAYS-TYPE CI

FIG. 5-4



VERTICAL CURB ACCESS

A.D.T. FOR DRIVEWAY		GRADE DIFFERENCE, D	
		DESIRABLE	MAXIMUM
LOW VOLUME	1 - 500	6%	8%
MEDIUM VOLUME	500 - 1500	3%	8%
HIGH VOLUME	1500 OR MORE	0%	8%



ROLLED CURB ACCESS



## 6. SIDEWALKS

Pedestrian walkways (sidewalks and paths) may be incorporated in a roadway cross-section if requested or approved by the Gila County Engineering Department. The standard width for walkways is five feet for all urban collector and arterial roadways. For urban local roads, a sidewalk width of four feet may be used. Multi-purpose paths may be used, if desired. The design of multi-purpose paths will be based on applicable, current standards.

Sidewalks shall be provided on all urban streets except on single-family residential local streets where all lots or parcels are one net acre or more in area and shoulders are provided.

Sidewalks shall be provided on rural roads adjacent to lots smaller than one net acre, unless otherwise approved by the Gila County Board of Supervisors.



## **7. ROADWAY CONSTRUCTION AND IMPROVEMENTS**

### **7.1 Construction of Less than Ultimate Cross-Section Improvements**

A full street cross-section is required for the interior streets of a development and a complete half-street cross section for the perimeter streets; however, if the street is specified on the Comprehensive Plan or meets the criteria for ultimate development as a principal arterial, and if the design Average Daily Traffic (ADT) is not expected to occur within 20 years, four of the six lanes of the full street or two of the three lanes of the half-street may be allowed. The outer edge of the cross section shall be constructed first. If the opposite side of the perimeter street is adjacent to public lands, the full street improvement is required in lieu of a half-street improvement.

### **7.2 Construction of Half-Streets**

#### *7.2.1 Design of Cross Section for Half-Streets*

Half-street construction shall consist of a minimum 24-foot wide pavement section. In the event half-street construction is to be provided, the engineer shall design the full cross section of the street. The plans shall include in dashed lines the half-street, which will be constructed in the future. The half-street construction shall provide adequate transitions and tapers to the adjoining roadways.

#### *7.2.2 Design of Half-Street to Joining Existing Street Pavement*

The half-street shall be designed to match existing construction as much as possible unless doing so is likely to create an unsatisfactory condition. If changes are needed to correct conditions on an existing half-street in order to properly construct the other half of the street, the solutions must be developed with Gila County staff on a case-by-case basis. The plans for the new half-street must contain sufficient information on the profile and cross-sections of the existing street to demonstrate that the new construction will match the old construction, result in a full street with proper cross-sections.

#### *7.2.3 Culvert Under Half-Streets*

A culvert to be provided in conjunction with half-street construction must extend beyond the edge of the traveled way a minimum of ten feet into the area where the other half of the street will be constructed in the future. The ten-foot distance is measured perpendicular to the street alignment. The culvert capacity, flow line slope and alignment must be based upon the ultimate design requirements for the culvert if it were to be built under the full cross-section where it could be considerably longer.

### **7.3 Pavement Transitions**

When development causes the widening on a portion of the pavement of an existing road, pavement transitions are required at each end of the widened portion. Design of the various features of the transitions between pavements of different widths should be consistent with the design standards of the superior facility. The transitions should be made on a tangent section whenever possible. Locations with horizontal and vertical sight distance restrictions should be avoided. Whenever feasible, the entire transition should be visible to the driver of a vehicle



approaching the narrower section. Intersections at grade within the transition area should be avoided.

#### *7.3.1 Transition to a Narrower Pavement Section*

When a proposed roadway will directly connect with an existing roadway of a smaller width, it is necessary to install a transition taper between the two. Taper lengths shall be calculated following the procedure outlined in the MUTCD.

Taper lengths on roads with a design speed less than or equal to 40 mph shall be:

$$L = WS^2/60$$

Where the design speed is greater than 40 mph:

$$L = WS$$

where:

W= Offset from drivable through lane (feet)

S = Design Speed (mph)

L = Taper length (feet)

#### *7.3.2 Transition to a Wider Pavement Section*

The transition length from a narrower cross-section to a wider cross-section shall approved by the Gila County Engineering Department.

### **7.4 Access Road Into Developments**

For new development or developments desiring roads to be taken into the County system, the roadway shall be constructed to Gila County standards, as documented in this report. The roadways shall meet the guidelines presented in Section 2.4 of this report.



## 8. ROADWAY DESIGN PLAN REQUIREMENTS

### 8.1 Typical Cross-Sections

Typical roadway cross-sections shall be shown on the details sheets. The sections must include the following items:

- Right-of-way width;
- Width of sidewalk;
- Width of improved surface;
- Type of curb and gutter;
- Pavement cross-sections;
- Minimum allowable pavement cross-slope;
- Label private streets as applicable;
- Label all easements;
- Street names; and
- Stations.

### 8.2 Roadway Design Plans

The following geometric data must be shown on each roadway design sheet and must be in conformance with County standards:

- Station and sheet reference at all match lines in plan or profile;
- Centerline data;
- Station all changes in street alignment and all proposed improvements;
- Gutter and centerline spot elevations at all grade breaks;
- Gutter spot elevations at all intersections;
- Centerline spot elevations at all intersections;
- Show grade breaks in plan;
- Tangent lengths between curves;
- Tangent lengths at intersections;
- Pavement tapers;
- Intersections angles;
- Vertical curve lengths;
- Maximum longitudinal slope changes;
- Barrier median construction; and
- Driveway type and station.

#### 8.2.1 Roadway Plan View

The roadway plan portion of the roadway drawing shall include but is not limited to the following items:

- North arrow and bar scale;
- Roadway centerline;



- Roadway stationing;
- Existing right-of-way, with width dimensioned;
- Existing pavement, with width dimensioned;
- Existing curbs including curb type;
- Existing sidewalk, with width dimensioned;
- Existing utilities, labeled;
- Proposed right-of-way, with width dimensioned;
- Proposed pavement, with width dimensioned;
- Proposed curbs, with width dimensioned and reference standard detail;
- Proposed sidewalk, with width dimensioned and reference standard detail;
- Proposed sidewalk ramps;
- Proposed utilities, labeled;
- Existing items “to be protected in place or relocated” must be noted;
- Curb transitions, with standard detail number call-out;
- Curb/curve data (including curb returns);
- Survey monuments, with standard detail number call-out;
- City limits where applicable;
- Label street names;
- Label streets as “public” or “private”;
- Call out limits of construction;
- Show adjacent grading;
- Cross reference adjacent improvement plans by plan check number;
- “Screen in” proposed water, sewer, and storm drain facilities if applicable;
- Conduit crossings including traffic signal and irrigation; and
- Roadway construction notes.

### *8.2.2 Road Profile View*

The roadway profile portion of the roadway drawing shall include but is not limited to the following items:

- Existing grade at centerline;
- Proposed grade at centerline;
- Proposed crown transitions at intersections;
- Label longitudinal grades;
- Storm drain crossings;
- Utility and other crossings;
- Scupper/curb-cuts with station; and
- Lowpoints with station.



### 8.3 Signing and Marking Plans

The following items should be included on signing and pavement marking plans:

- North arrow and bar scale;
- Construction notes;
- Existing signing;
- Proposed signing;
- All signs to be graphically depicted in the direction of travel;
- Station location of each sign;
- Reference each sign with appropriate MUTCD sign designation and note sign size;
- Identify existing signs to either remain, be removed, or be relocated;
- Existing pavement marking shown fully as screened or lightly inked lines;
- Proposed pavement marking;
- Existing pavement marking shall be identified by type and width, and completely dimensioned across roadway;
- Proposed pavement marking shall be identified noting color and line width;
- Striping to be removed shall be identified on plans;
- All striping shall be fully dimensioned across roadway and tied to a construction centerline or monument line at each side of an intersection; and
- All pavement arrows, legends, crosswalks, etc., shall be located by station or dimension lines.



## 9. DRAINAGE STANDARDS FOR ROADWAYS

### 9.1 Introduction

It is the purpose of this chapter to promote the public health, safety, and general welfare, and to minimize public and private losses by regulating drainage and grading of roadways within Gila County, Arizona

### 9.2 Policies

#### 9.2.1 *Guidelines and General Policies*

##### 9.2.1.1 Urban Roadway Drainage

Intersections – Drainage through intersections should be minimized as much as possible. The placement of catch basins should be positioned so that as much surface drainage as is feasible is captured before it enters the intersection. Catch basins should be located at the end of curb returns.

Depth Limitation – For flow along the direction of travel, at least one twelve-foot travel lane in each direction shall have a depth of flow less than or equal to one foot in a 100-year event. The 100-year storm shall be contained within the roadway right-of way or easement.

Concrete Valley Gutters – Concrete valley gutters should be utilized to allow flow to pass through intersections. The placement of the concrete valley gutters should allow flow to occur parallel to the higher classification of roadway. Concrete valley gutters shall be per MAG Standard Detail No. 240, and shall be four feet wide. Underground pipes shall be used in lieu of valley gutters for elevations greater than 4,000 feet.

Roadway Drainage Collection System – A drainage collection system shall be a combination of inlets, a method of transporting the captured flow (i.e. storm drainpipes, concrete lined channels, scuppers) and a means to discharge the captured flow.

##### 9.2.1.2 Rural Roadway Drainage

Unimproved Low-Flow Crossings – All unimproved low-flow crossings shall have the appropriate number of warning signs and road edge delineators. Each direction of crossing will require a warning sign. The placement of the warning sign shall be in accordance with the MUTCD 2000 (et. seq.) prepared by the USDOT, and as modified by ADOT.

Primary Access – Primary access shall be an all weather access. The maximum allowable depth of flow over a roadway will be 12" in the 100-year event. Maximum velocity shall be five feet per second for brief intervals. The 25-year event shall be conveyed underneath the crossing.

Drainage Crossing a Roadway – Cut off walls or headwalls shall be required on each side of the roadway where drainage is allowed to overflow the roadway. The roadway section within the 100-year event flowage is to be reinforced concrete,



with reinforcing steel tied into the cutoff walls. The roadway should intersect the drainageway as close to a 90 degree angle as possible.

All low-flow crossings with a stable concrete paved invert shall have a depth gauge and the appropriate number of warning signs and road edge delineators. Each direction of crossing will require a warning sign. The placement of the warning sign shall be in accordance with the MUTCD 2000 (et. seq.) prepared by the USDOT, and as modified by ADOT.

#### 9.2.1.3 High Altitude Roadway Drainage

The review process of the design of high-altitude roadways drainage facilities (4,000 foot elevation and above) will involve Gila County staff familiar with roadway maintenance. Participation by Gila County staff regarding the preservation of roadway surfaces, and the removal of snow and ice may reduce the effort for maintenance as well as increase public safety.

During the design of drainage for high-altitude roadways, issues that should be considered include but not limited to the following items:

- Optimize roadway design to minimize potential drainage problems;
- Optimize roadside drainage ditch design (width and depth) for the storage of snow and ice from roadway surface;
- Placement of drainage inlets should promote drainage of areas susceptible to standing snow; and
- Items should be considered during the roadway design to minimize snow drifts across roadways.

#### 9.2.1.4 Drainage System

##### 9.2.1.4.1 Roadway Collection Systems

Roadway collection systems shall consist of structures to collect, transport and discharge the captured flow. Where a pipe is used instead of open channel, the minimum storm drainage pipe size shall be 18" in diameter. With the exception of storm drain connections at inlets, all storm drain conduits shall have a minimum cover of three feet. In areas where minimum cover is not achievable, the storm drain conduit shall require additional protection from deformation or failure. The additional protection shall be designed to an H<sub>2</sub>O highway loading criteria.

##### 9.2.1.4.2 Roadside Drainage Collection and Routing:

Roadside drainage collection systems shall convey drainage runoff to a collection point at which the runoff can be disposed of to either a closed conduit drainage system or a natural or man-made drainage ways. The roadside drainage system, including all cut and fill limits and erosion control measures, shall be placed within the proposed right-of-way limits.



#### 9.2.1.5 Culverts

Culverts shall have a load design equal to sum of the depth of cover and H<sub>2</sub>O highway loading, unless special circumstances makes additional loading necessary. The alignment of the culvert shall be parallel to the natural drainage of the wash or stream crossing.

#### 9.2.1.6 Drainage Report/Plan

A drainage report shall be required for all roadway improvement projects. Exemptions to this shall require the approval of the County Engineering Department. The report shall address existing drainage conditions as compared to drainage conditions impacted by the roadway improvements. Based upon the conclusions of the report and/or field inspection, reasonable modifications to the plan may be required. All submitted drainage reports/plans shall be prepared and sealed by a Registered Professional Civil Engineer, registered in the State of Arizona per ARS 32-101 (et. seq.). The drainage report/plan shall be based on minimum criteria established by the State Standards, or more restrictive Gila County Standards.

The drainage portion of the roadway improvement plans shall accompany the drainage report. The drainage plan shall include a plan and profile view. Drainage details shall be included in the submittal. Connector pipe profiles shall be included in the submittal.

#### 9.2.1.7 Drainage Rights-of-Way

Drainage rights-of-way are required for all drainage improvements that extend beyond the existing or proposed roadway right-of-way limits. The need for drainage rights-of-way should be determined at the preliminary design stage. The area required for drainage rights-of-way should be noted in the initial roadway submittal.

A legal description should be prepared for all drainage rights-of-way and submitted to the County for review and approval. All drainage rights-of-way legal descriptions shall be prepared under the supervision of an Arizona Registered Land Surveyor. All submitted legal descriptions should be signed and sealed by a Registered Land Surveyor, registered in the State of Arizona.

The limits for the drainage rights-of-way should extend a minimum of 25 feet upstream and downstream from all improvements or disturbed areas. The drainage rights-of-way limits should extend ten feet past all improvements or disturbed areas on either side.

### 9.3 Design Standards

#### 9.3.1 *Urban Roadway Drainage*

##### 9.3.1.1 Intersections

Inlet spacing shall allow intersections to maintain a minimum of one lane of travel in all directions.



#### 9.3.1.2 Concrete Valley Gutters

Concrete valley gutters shall conform to MAG Standard Detail 240. The width of the valley gutter shall be 4'-0".

#### 9.3.1.3 Roadway Drainage Collection System

If used, inlets shall conform to MAG Standard Details. The depth limitation and the proximity of the inlet to an intersection shall determine the location and quantity of inlets required.

#### 9.3.1.4 Roadside Drainage Collection and Routing

If used, inlets shall conform to MAG Standard Details. The depth limitation and the proximity of the inlet (or other means of draining the roadway) to an intersection shall govern the placement of the inlet. A 20% clogging factor shall be used for curb opening or slotted drain inlet calculations.

If used, grated inlets at intersections shall be adequately sized and positioned so that drainage can occur without ponding into the travel lanes. A 50% clogging factor shall be used for all grated inlet calculations.

### 9.3.2 *Rural Roadway Drainage*

#### 9.3.2.1 Roadside Drainage Collection and Routing

If used, inlets shall conform to MAG Standard Details. The depth limitation and the proximity of the inlet to an intersection shall govern the placement of the inlet. A 20% clogging factor shall be used for curb opening or slotted drain inlet calculations.

If used, grated inlets at intersections shall be adequately sized and positioned so that drainage can occur without ponding into the travel lanes. A 50% clogging factor shall be used for all grated inlet calculations.

Storm water flows may be conveyed alongside roadways to collection or outlet points. Storm water shall not be retained within the right-of-way limits.

#### 9.3.2.2 Depth Gauges and Warning Signage

A depth gauge placed at the flow line of a stabilized reinforced concrete drainage crossing shall be marked in feet and incremented in tenths of feet. The markings shall be visible from both directions of travel along the roadway.

Warning signs shall be posted in accordance with the MUTCD 2000 (et. seq.) prepared by the USDOT, and as modified by ADOT.

### 9.3.3 *Cross Culverts*

#### 9.3.3.1 Cut off Walls/Headwalls

Cut off walls shall be placed directly upstream and downstream of all drainage structures that cross the roadway. The cut off walls shall be incorporated into



headwall and apron designs. Cut off walls shall have a minimum depth of four feet. All drainage structures shall have headwalls and aprons.

#### 9.3.3.2 Embankment Protection

Embankment protection shall be placed in areas subject to erosion to minimize such erosion. The amount and type of bank protection shall be designed with calculations discussed within the roadway drainage report.

#### 9.3.3.3 Drainage Rights-of-Way

Drainage rights-of-way are required to construct and maintain drainage structures that are not within the roadway right-of-way. All property corners of the drainage right-of-way shall be marked and noted on the drainage plans. Legal descriptions of additional rights-of-way needed shall be provided to Gila County.

### 9.3.4 *Drainage Reports*

#### 9.3.4.1 Drainage Report Format and Submittal Requirements

A preliminary drainage report shall at a minimum include the following items:

- Project location;
- Description of the existing roadway improvements;
- Description of the proposed roadway improvements
- Existing drainage facilities;
- Proposed drainage facilities;
- Locations of proposed drainage right-of way;
- Hydrology;
- Summary; and
- Recommendation.

The final drainage report should reflect all relevant comments from previous roadway submittals. The final drainage report shall at a minimum include the following items:

- Project location;
- Description of the existing roadway improvements;
- Description of the proposed roadway improvements;
- Existing drainage facilities and existing drainage systems;
- Proposed drainage facilities;
- Location and descriptions of proposed drainage easements;
- Hydrology;
- Hydraulics;
- Summary;
- Recommendation;



- Appendix:
  - A-1 Data and calculations with corresponding charts, tables, graphs, and forms; and
  - A-2 Legal Descriptions of Drainage Rights-of-Way.

For a checklist of items to be included in a drainage report, refer to Appendix A-1 Checklist for Drainage Report Submittal.

#### 9.3.4.2 All Weather Access

If a roadway crosses a federally-mapped floodplain, the drainage report shall follow the Technical Data Notebook (TDN) format outlined in Arizona Department of Water Resources (ADWR) State Standard 1-97 or subsequent revision. If the floodplain is proposed to be altered, a Request for Conditional Letter of Map Revision (CLOMR) shall be submitted to the Federal Emergency Management Agency (FEMA) and the receipt of a CLOMR shall be one condition for Gila County acceptance of the drainage report.

All flows crossing a roadway must be conveyed in such a manner as to not to significantly increase the water surface elevation to pre-roadway construction conditions.

All primary access roadways shall convey a 25-year flow under the roadway. In addition, a 100-year flow shall not exceed a depth of one foot above the roadway surface. Maximum velocity above the roadway shall be eight feet per second.

For crossings where the water surface is raised above the 100-year flood level, any area that is inundated because of an increase in the flood level must be contained within the roadway rights-of-way or drainage rights-of-way.

The following shall be considered for the design of roadway drainage:

- Roadway Classifications
  - Urban Roadways;
  - Rural Roadways;
- Storm Drain Conduits;
- Cross Culverts;
- Curb Inlets; and
- Grated Inlets.

#### 9.3.4.3 Analysis (Hydrology/Hydraulic)

The drainage report shall include hydrology analysis of pre and post design conditions.



## 9.4 Drainage Plan Requirements

### 9.4.1 Drainage Plan View Requirements

Based upon the assumption that the drainage plans are incorporated into the roadway plan set, the drainage plan portion shall include but is not limited to the following items:

- Plans shall be prepared and sealed by a Registered Professional Civil Engineer, registered in the State of Arizona per ARS 32-101 (et. seq.)
- North arrow and bar scale;
- Existing topography;
- Existing roadway improvements;
- Existing easements, dedications and right-of-way limits;
- Existing contours with a maximum two foot interval;
- Existing spot elevations every 100 feet on adjacent properties to depict existing conditions affecting drainage of property to be filled;
- Existing utility locations;
- Existing retention/detention systems;
- Proposed roadway features;
- Roadway stationing;
- Proposed improvements in existing drainage channels;
- Proposed utility locations;
- Storm drain conduit type, size, and locations;
- Inlet type and location;
- Drainage construction notes;
- Proposed drainage rights-of-way and locations;
- Toe/top of slope lines indicating cut and fill limits of proposed improvements; and
- Roadways that incorporate roadside drainage systems should note flow line elevations at one hundred foot intervals, all grade breaks, and invert elevations at drainage structures.

### 9.4.2 Drainage Profile View Requirements

The drainage profile portion of the drainage drawing shall include but is not limited to the following items:

- Elevations;
- Roadway stationing;
- Existing ground profiles at the centerline;
- Existing and proposed utilities crossing the main storm drain;
- Existing storm drain system information;
- Roadside ditch profile;
- Proposed grade profile;
- Inlet locations and inverts;



- Main storm drain line profile, length callout, type, inverts, size and slope;
- All conduits should graphically indicate diameter; and
- Where the roadway improvements include curb and gutter, profiles shall be indicated along the gutter lines and the top of curb, left and right.

#### **9.4.3 Roadway Plan and Profile Requirements**

The proposed drainage design should be reflected in the plan view of the roadway plan and profile drawings. A note should be placed on the roadway plans referencing the drainage drawings. The note should state that descriptions regarding pipe sizes and slopes, inlet locations, and drainage structures will be reflected on the drainage plans.

A drainage structure should be shown in the profile portion of the roadway plans at locations where the structure intersects the centerline profile. The drainage structure should be labeled and the invert noted. In the event that the invert can not be shown, the top of the drainage structure should be represented and noted.

Where the edge of roadway or gutter profiles are shown, a drainage structure should be noted at locations where the structure intersects the edge of roadway or gutter profiles.

#### **9.4.4 Existing and Proposed Utilities**

All existing and proposed utilities shall be shown on the drainage plans. The existing utility information may be obtained from, but not limited to, utility company records and record drawings of previous improvement projects.

All utility companies shall be provided a copy of the preliminary drainage plans, for verification purposes, indicating the location of utilities and all proposed drainage inlets, drainage structures, and storm drain conduits. Upon receipt of the reviewed plans, the drainage plans should be revised to accommodate any revisions made by the utility companies.

All utilities crossing a storm drain shall be indicated on the plan and profile plans as well as any affected connector pipe profile.

The protection of existing utilities shall be noted on the drainage plans. All efforts should be made during the design phase of a drainage system to avoid the relocation or interruption of existing utility services.

### **9.5 Appendix**

The following sections should be referred to for approved forms that should be utilized in the preparation of the drainage report:

- A-1 Checklist for Drainage Report Submittal
  - Drawings shall be 24"x36". Submit three sets of drainage plans and two sets of roadway plans.
  - Project Name
  - Project Location – Vicinity Map with roadway with milepost limits; Township and Range
  - Description of Existing Roadway Improvements
  - Description of Existing Drainage Facilities



- Description of off-site watershed areas including future planned conditions if different from existing.
- The project geotechnical report shall be referenced in the drainage report and a copy of the geotechnical report should accompany the drainage report submittal.
- Existing hydrology on all watercourses that cross the roadway. Study should include hydrology parameters and assumptions and include methodology for developing quantities. Also include computer runs from HEC-1, TR-20, or other programs utilized to develop flows from contributing areas. Storm water routing through channels should include HEC-2, including backwater calculations. Should a computer program be utilized in design, an electronic copy of the input data should be furnished with the plan review submittal.
- Drainage arrows and topography with sufficient contour interval or spot elevations to determine existing direction of flows.
- General description of proposed drainage facilities, including drainage criteria and probable effect on the existing upstream and downstream drainage system.
- Description and locations of proposed major drainage structures.
- Data analysis methods
  - ◆ Hydrologic procedures and assumptions
  - ◆ Hydraulic procedures, methods and assumptions
- Location and legal description of proposed drainage right-of-way with exhibits or reference to location on drainage plans by station and offset.
- Request for CLOMR (see Section 9.3.4.2 All Weather Access)
- Summary and Recommendations
- References (Optional)
- Appendix
  - ◆ Data and Calculations
    - Peak Flow Calculations
    - Channel Design Calculations
    - Culvert Design Calculations
    - Floodplain Calculations
    - Street Capacity Calculations
    - Curb Opening, Inlet Basin Calculations
    - Storm Drain Calculations
    - Sediment and Scour Calculations
    - Construction Phasing (if applicable)
    - Erosion/Sediment Control Plan (if applicable)
- The drainage report shall include in the appendix all charts, tables, graphs and forms utilized to perform calculations and formulate assumptions.
- All submitted drainage reports/plans shall be prepared and sealed by a Registered Professional Civil Engineer, registered in the State of Arizona per ARS 32-101 (et. seq.).



- A-2 Notes to be shown on the Drainage Plans
  - Excavating Contractor must give the location for wasting excess excavated material and a letter from the Owner of the property giving permission for dumping prior to starting construction. If excess excavation exceeds 100 cubic yards, the disposal site also will require a grading and drainage permit.
  - Gila County Engineering Department shall be notified 48 hours prior to any construction activity.
  - Grades shown on plans are design finish grades. Should the contractor or a sub-contractor plan to place spoil dirt from utility trenches, drainage excavation or structural excavation within the side slope limits, the area should be sufficiently over-excavated during rough grading operation to allow for the placement of the fill. All excavated material shall meet the geotechnical recommendation and criteria for approved fill material.
  - Contractor is responsible for locating and confirming depths of all utility lines within proposed excavation areas. If a conflict occurs between an existing utility and a proposed drainage structure, the contractor shall notify the Gila County Engineering Department in writing within 24 hours of identifying the conflict.
  - The engineering design on these plans are only approved by the County in scope and not in detail. The County does not verify construction quantities on these plans. Approval of these plans are for permit purposes only and shall not prevent the County from requiring correction of errors in the plans where such errors are subsequently found to be in violation of any law, ordinance, health, safety, or other design issues.
  - All plans revised after the original approval shall be re-approved. The nature of the revisions also must be called out on the sheet that the revision appears. The revision number itself shall consist of a numeral within a triangle and the revision on the plans shall be highlighted with “clouding”. The contract documents shall be updated by replacing the original drawing with the revised drawing. The revised drawing shall be prepared and sealed by a Registered Professional Civil Engineer, registered in the State of Arizona per ARS 32-101 (et. seq.).
  - If the drainage improvements are adjacent to hillside areas, no disturbance of hillside areas for access, grading or other construction purposes will be allowed.



## 10. TECHNICAL REPORTS

### 10.1 Traffic Impact Analysis

Developers are responsible for submitting a traffic impact analysis for all proposed new development or expansions of existing developments that request access, direct or indirect, or modification of access to the County roadway system. In general, a traffic impact analysis shall be required for all new developments or additions to existing developments that generate 100 or more trips during any one hour of a day. Traffic impact analyses submitted to Gila County shall follow the guidelines in the ADOT Traffic Manual, Section 240 – Traffic Impact Analyses. This document provides information on the level of detail and specific analysis requirements.

### 10.2 Design Study Report

Developers are responsible for submitting a Design Study Report to validate the design shown on the construction plans. The Design Study Report should not be excessively long or complex. Rather it is to briefly describe the basis of the design and the assumptions made, explain “special” solutions to problems encountered, etc.

The report shall include a Soils Report, Drainage Report, Pavement Evaluation Report, and appropriate supplemental sketches, details, calculations, and design rationale.

#### *10.2.1 Geotechnical Report*

A Geotechnical Report shall be submitted with new street construction plans indicating “R” value, sieve analysis, plastic index of the subgrade, and street structural cross section design. The traffic volumes and percent trucks used to develop the street structural cross section design shall be documented.

#### *10.2.2 Drainage Report*

A Drainage Report shall be submitted with new street construction plans and/or the grading plans. This report shall be prepared per Gila County Engineering Department requirements.

#### *10.2.3 Pavement Evaluation Report*

A Pavement Evaluation Report shall be submitted with new street construction plans when it is proposed to match existing pavement. The design engineer is responsible for investigating and evaluating the existing pavement structure.



## APPENDIX