General Traffic Circulation Overview

General Plan Committee

April 25, 2012

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General Terminology - Traffic Circulation

- Traffic Circulation refers to the movement of people ,goods and services within a community and throughout the immediate region using the roadway network. All ground transportation modes are included. (Bike, pedestrian, transit, etc.)
- The Circulation Element sets forth goals and strategies to ensure that traffic circulation is efficient within the community and throughout the immediate region.
- Prescott strives to have a well planned local and regional road network which can provide improved mobility opportunities for all residents, both within the City and throughout the region.
- To achieve this the plan should include regional and local road networks in coordination with neighboring jurisdictions, integrated land-use, transportation and capitol improvement planning.

General Terminology - Travel Demand

- Travel demand is the demand required by roadway users to access the transportation network for the purpose of travelling between various origin and destination points.
- Travel demand is generated by activity – people going places for work, shopping, recreation , and other purposes.
- The process of estimating and assigning demand is the subject of transportation planning.
- This is either done through basic assumption methods used in most Traffic Impact Analysis (TIAs) or computerized traffic models used in most long range transportation plans (TransCADD).
- Travel demand is influenced by how planners strategically place trip generation centers in relationship to each other and what roadway network is available.

General Terminology - Capacity

- Capacity is the maximum rate of flow which a facility can accommodate.
- It is typically used to define the rate of flow per peak hour or other short peak period (15 min.) per lane.
- Typically a maximum capacity of 1900 vehicles per lane per hour is used.

General Terminology - Capacity

- The capacity of a roadway facility is important but operating conditions at capacity are usually poor because this is the maximum number of cars that can travel the road per hour.
- This is at speeds and spacing that are not desirable :low speed and close spacing = congested condition.
- Capacity can also be used in terms of the total capacity of a roadway.
- This leads to a concept called Level of Service.

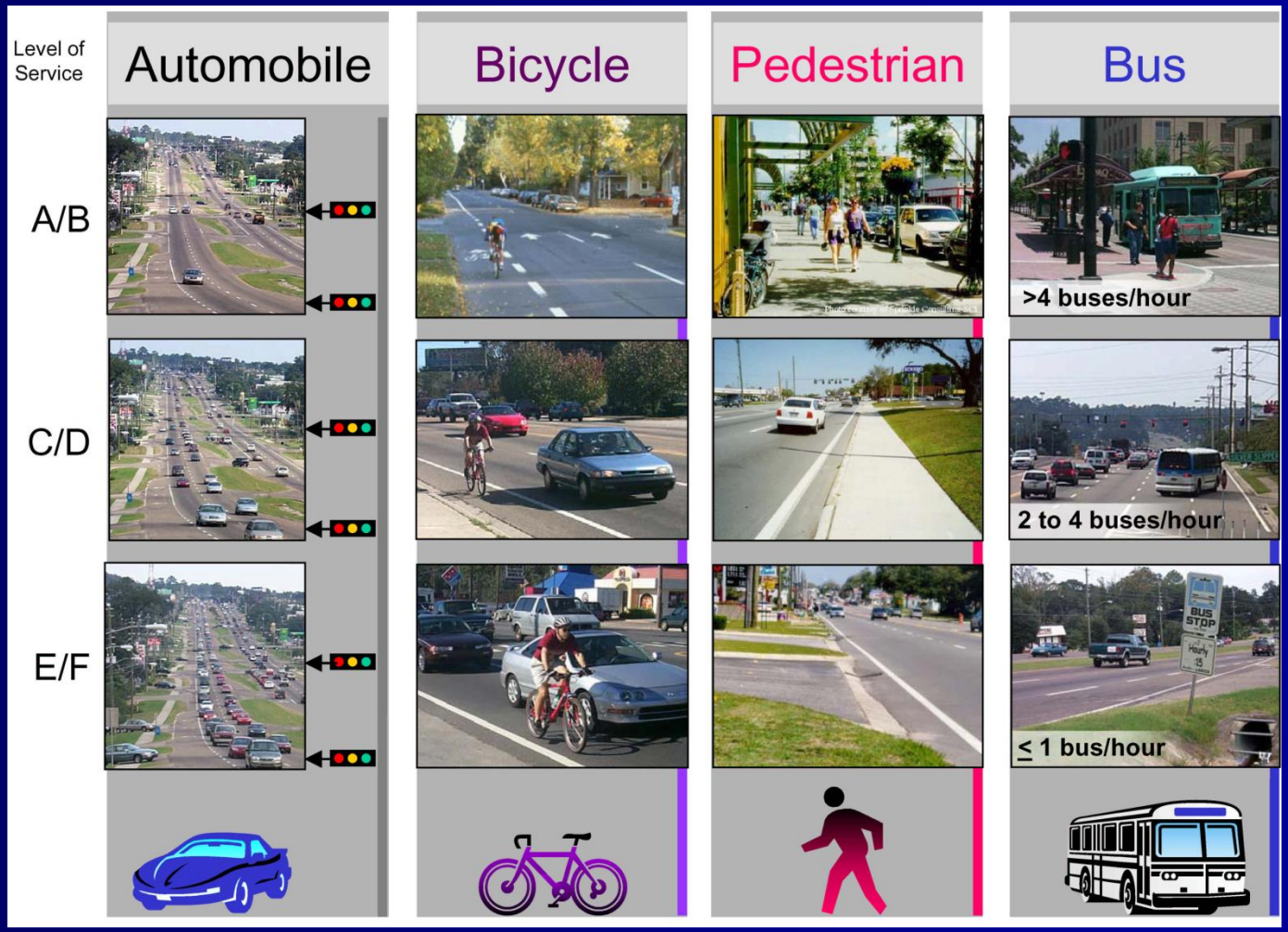
General Terminology
- Level of Service (LOS)

- Is a letter designation that describes (ranks) a range of operating conditions on a particular type of facility.

- Six levels of service are defined for capacity analysis using an A to F scale:
  - A= Free flow
  - B=Reasonably free flow
  - C = Stable flow
  - D=Approaching unstable flow
  - E=Unstable flow
  - F=Forced or breakdown flow

- LOS is typically used to describe roadway capacity and intersection operation.

General Terminology
- Level of Service (LOS)



General Terminology - Traffic Volumes

- Traffic volume is defined as the number of vehicles that pass a point on a highway, or a given lane or direction of a highway, during a specified time interval.
- A common time interval is a day (24 Hour) and is used as the basis for roadway planning and general observation of trends.
- Average Daily Traffic (ADT) is the term used to describe the amount of daily traffic, averaged over some period of time less than a year, at a given location.
- 24 Hour Volumes (ADT) are typically collected during the middle of a week (Tuesday through Thursday) to best represent normal traffic patterns and avoid variations caused by the weekend.
- Peak hour volumes are also very useful and represent the one hour period in the morning (AM) and afternoon (PM) in which traffic is heaviest. (The hour can be split across any four (4) fifteen (15) minute periods.)
- Peak hour volume is often used as the basis for LOS ratings.

General Terminology
- Functional Roadway Classification

- Functional classification is a method of classifying roads by the service they provide as part of the overall highway system.
- Functional classification defines the nature of travel within a network in a logical and efficient manner by defining the part that any particular road or street should play in serving the flow of trips through the entire highway network.
- Prescott uses six functional classifications for its roadway network.

General Terminology
- Functional Roadway Classification

- Major Arterial – facilitate relatively long trip lengths at moderate to high operating speeds with somewhat access to adjacent properties. They generally serve major centers of activity in urban areas and have the highest traffic volume corridors. These streets are often major gateways to the community. *Ex. Include State Roads 69 and 89.*

- Minor Arterial – provide somewhat shorter trip lengths than major arterials, generally interconnect with an augment these routes at moderate operating speeds, and allow somewhat greater access to adjacent properties than major arterials. *Ex. Include Montezuma Street and Willow Creek Road.*

- Major Collector – collect and distribute significant amounts of traffic between arterials, minor collectors, and local roads, at moderate to low operating speeds. Major collectors provide for more accessibility to adjacent properties that arterials. *Ex. Include Gail Gardner Way and Rosser Street.*

General Terminology
- Functional Roadway Classification

- Minor Collector – collect and distribute significant amounts of traffic between arterials, minor collectors, and local road, at moderate to low operating speed. Minor collectors provide for more accessibility to adjacent properties that arterials. *Ex. Include Haisley Road and Bradshaw Drive.*

- Local Commercial – generally provide direct access to commercial properties. The commercial street usually has low volumes, speeds, trip length and minimal through traffic. *Ex. Include Corsair Avenue and Dollar Mark Way.*

- Local Streets – generally provide direct access to abutting properties. Local street possess relatively low traffic volumes, operating speeds, tri lengths, and minimal through traffic movements. *Ex. Include Eagle Ridge and Boardwalk Avenue*.

Traffic Management - Traffic Calming

- Traffic Calming is a combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users (Source: Institute of transportation Engineers, and the adopted definition of the Council Traffic Calming Policy)

- Traditionally traffic calming has been done as a reactive improvement to correct a traffic issue (speeding, cut-through traffic, pedestrian and/or bike safety). Examples:

  - Rosser Street : Eagle Ridge subdivision medians
  - Schemmer Drive: speed humps
  - Aubrey Drive: half closure
  - Willow Drive: half closure

- Move toward having traffic calming included in the design phase of roadway improvement projects. Examples:

  - Rosser Street – Cliff Rose speed signs, pavement treatments
  - Idyllwild: Speed humps

Traffic Management - Traffic Calming

Traffic Calming Policy & Procedures:

- Implemented in 2004 and updated in 2010
- A policy of the City Council regarding the deployment of traffic calming measures, sets forth uniform application and processing procedures.
- Allows a process for neighborhoods to request physical calming measures to promote lower speeds, discourage cut-through traffic, create safer streets and preserve quality of life.
- Measures are to be used selectively based on emergency response, functional street classification, goal of the measure (speed or volume control) and field conditions.
- Staff administers the Policy, works with the neighborhood to develop a reasonable plan and coordinates the installations.
- City Council makes the final decision on all traffic calming installations

Traffic Management - Speed Limits

- Speed limits in Prescott are set based on one or more of the following methods:
  - Prima Facie speeds as defined in Arizona Revised Statutes
  - Design Speed of the roadway
  - 85th percentile speed
- Speed zone limits should be set to ensure that to the extent possible the highest percentage of motorists possible are driving within a ten mile per hour pace to avoid large speed differentials.
- Prima Facie speeds
  - 15 MPH in alleyways and school zones and 25 MPH in residential areas
  - Basic speed limit used in most areas

Traffic Management - Speed Limits

- Design speed
  - Maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features (geometric elements) of the highway govern.
  - Used as the maximum possible speed posting on roadways when engineering study or prima facie speeds do not regulate
  - Collector roadways and greater street classification

- 85th percentile speed
  - Speed at below which 85% of the motorists travel.
  - Used as a basis for posting when design speed and prima facie does not limit

Traffic Management - Speed Limits

Arterial Speed Zoning Policy

- Adopted to ensure that posted speed zones on the Arterial street system are the result of proper traffic engineering analyses.
- Establishes uniform guidelines for conducting the traffic analyses and posting the speed zone limits.
- City Traffic Engineer is authorized to modify speed limits on City streets.
- City Council is notified of all proposed speed changes and can place the item on a Council meeting agenda if further discussion is desired.
- Fundamental Speed Zone Concepts
  - Speed limits should be posted no lower than five MPH of the 85th percentile speed
  - Artificially low speed limits are generally ignored by a majority of motorists
  - Special conditions shall not be the basis for an entire speed zone posting.

Traffic Management
- Access Management

- Access management, when used in traffic engineering, generally refers to the regulation of interchanges, intersections, driveways and median openings to a roadway.
- Particularly important for major roadways intended to provide efficient service to through-traffic movements.
- Objectives:
  - Enables, maintains and improves access to land uses (business, commercial and residential).
  - Maintain Roadway Safety.
  - Maintain (preserve and protect) mobility for the economic and social well being of the community.
  - Discourages congested development that diminishes property values and degrades quality of life.
  - Compatible with Public health and safety (emergency access).
  - Prolong the service life of roadway facilities thereby reducing public costs.

Traffic Management - Access Management

- Accomplished by:
  - Location of intersections, driveways and median openings
  - Spacing of intersections and driveways
  - Design of new facilities, through implementation of spacing requirements, median installations and limiting direct access.
- Failure to effectively manage access can lead to:
  - Crashes
  - Reduced operating speed
  - Reduced traffic capacity
  - Unsightly commercial strip development
  - Proliferation of poorly located, inadequately designed, and closely spaced driveways, intersections, and traffic signals
  - Degradation of scenic landscapes
  - Increased cut-through traffic in residential areas
  - Increased vehicle fuel consumption and emissions

Traffic Management
- Access Management

- Prescott currently uses curb cut separation distances by street classification to control access on its roadway network as defined in the Land Development Code.
- Arterial and Major Collectors are primarily address with other roadways left to engineering judgment.
- An attempt to provide increased direction to Engineers and Designers has been provided in the draft General Engineering Requirements (GERs)
- Key changes include a defined number of driveways allowed by classification and frontage length

Design Considerations - Roadway Network

- Roadway Network: is the system of interconnecting streets and highways either publicly or privately owned that is open to the public for the purpose of travel.
- Typically paved, however many streets within Prescott are stilled unpaved.
- Planning process for creating an effective and efficient roadway network:
  - Adopting a realistic land use plan which considers centers of employment, residential and commercial development.
  - Understanding the travel demand created by these decisions
  - Determining the trip generation of the uses and the resultant traffic volumes
  - Determining the capacity needs of the system and how many lanes are needed.

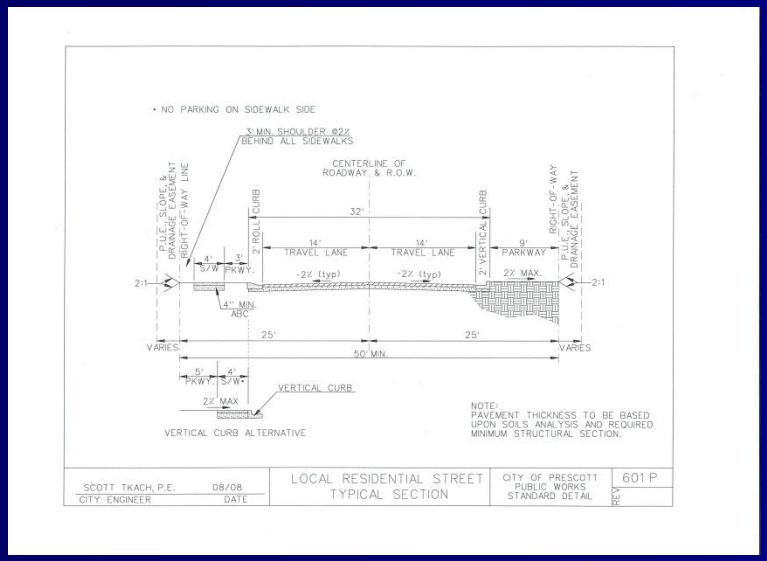
Design Considerations - Roadway Network

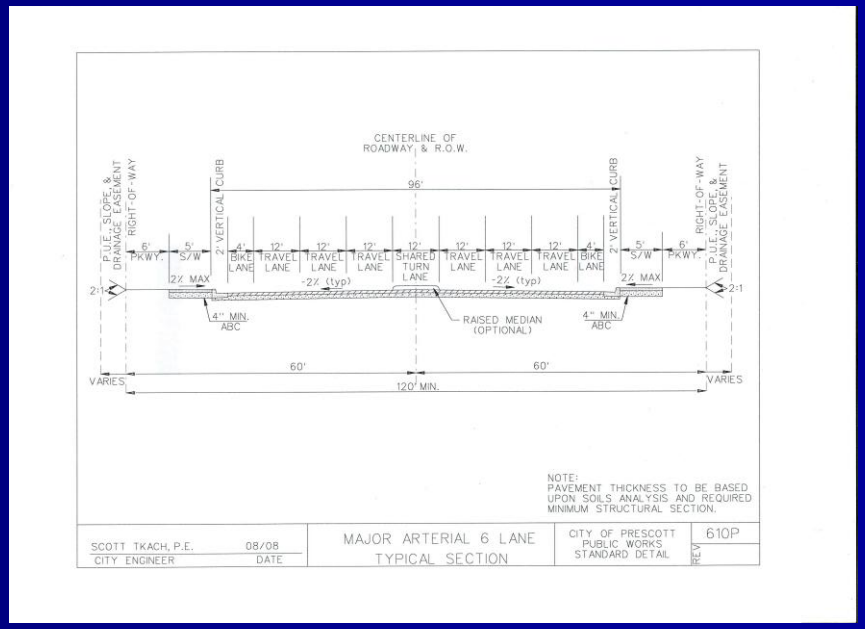
- Typically done through long range planning studies and local area plans and studies that recommend new infrastructure and/or improvements.
  - CYMPO 2030 Transportation Plan
  - West Area Transportation Plan
- Implications of building the system:
  - Can the improvements be funded? Public or Development Driven
  - Timeframe for implementation
- Widening project examples:
  - Willow Creek Road
  - Williamson Valley Road
  - Iron Springs Road
- New and relocated facilities examples:
  - Granite Dells Parkway Traffic Interchange
  - Sundog Connector
  - Willow Creek Road Realignment

Design Considerations - Typical Sections

- Eleven (11) roadway typical sections are used in Prescott.
- Each Roadway Classification has a one or more typical sections with variations due to bike lanes, parking and medians.
- Roadways vary in width and right of way from 28′ (50′) to 92′ (120′).
- Applicable to new development.
- Improvement projects on existing roadways typically cannot accommodate the new sections due to:
  - Limited right-of-way
  - Topography
  - Limited funding

Design Considerations
- Typical Sections





Design Considerations - Intersection Controls

- Intersection Controls and the decision of when and where they should be used are critical to the successful operation of the transportation network.
- Designed to assign right-of-way at intersecting roads and not for other purposes.
- Several options exist for controlling traffic at intersections:
  - No control and Yield Signs
  - Stop Signs
  - Traffic Signals
  - Roundabouts
- Installation Warrants and engineering judgment determine when each type of device should be used and is specified in the Manual of Uniform Traffic Control Devices (MUTCD).
- A decision to install intersection controls apart from meeting these warrants is not recommended and can lead to negative effects.

Design Considerations - Intersection Controls

- Two highest levels of control are traffic signals and roundabouts.
- They are interchangeable and the use of one over the other is not always clearly evident.
- Guidance is provided in the General Engineering Requirements (GERs) on choosing one over the other when a location meets the warrants for a traffic signal installation.
- Roundabouts shall be considered the most appropriate form of control at any intersection if three general questions can be answered positively.
  - Will a roundabout be expected to perform better than other alternative control modes by:
    - Reducing delay, or
    - Increasing capacity, or
    - Reducing queue lengths, or
    - Solve some other operational problem?
  - Will a roundabout provide improved safety over other alternative control devices?
  - Will a roundabout be expected to provide improved operational characteristics over other alternative control devices?
- Once it is determined a roundabout is the most appropriate form of control based on the operational criteria; the final stage is to compare the construction cost, life-cycle cost, right-of-way considerations, "reserve capacity" (the ability to accommodate traffic growth), and constructability. If no clear disadvantage is evident with the roundabout then it shall be moved forward as the preferred traffic control device.

Design Considerations - Design Geometry

- Design Geometry includes the geometric elements of design related to transportation infrastructure, specifically new roadways.

- Elements of Transportation Design Geometry include:

  - Longitudinal Street Grade
  - Horizontal curvature
  - Vertical Curvature
  - Super Elevation
  - Cross Section slopes (Crown)
  - Sight Distance

- Longitudinal Street Grade is the running slope of the roadway and has different maximums by classification: (.5% minimum is desirable)

  - Major & Minor Arterial 6%
  - Major Collector 6%
  - Minor Collector 8%
  - Local Commercial 8%
  - Local Residential 12%

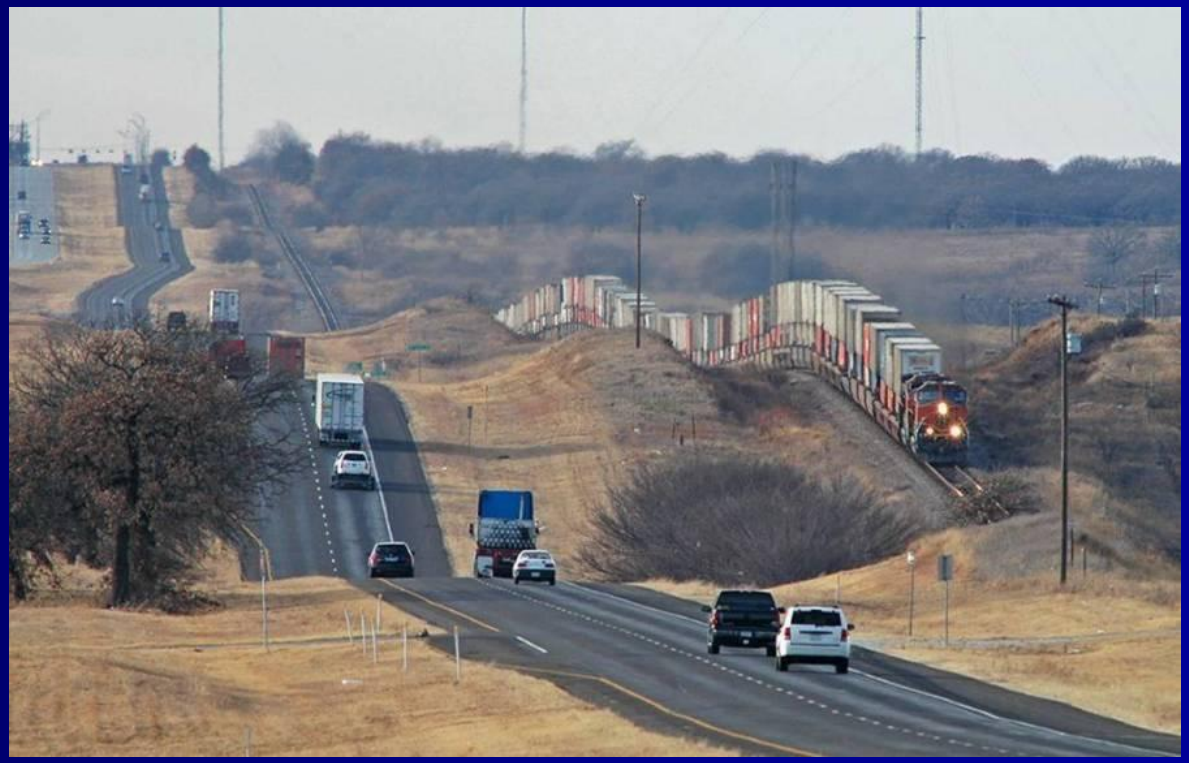
Design Considerations
- Design Geometry

- A Horizontal Curve provides a transition between two tangent strips of roadway, allowing a vehicle to negotiate a turn at a gradual rate rather than a sharp cut. The design of the curve is dependent on the intended design speed for the roadway, as well as other factors including drainage and friction

Design Considerations
- Design Geometry

- Vertical Curvature provides a transition between two sloped roadways, allowing a vehicle to negotiate the elevation rate change at a gradual rate rather than a sharp cut. Dependent on the intended design speed, drainage, slope, acceptable rate of change, and friction.

- Two types:
  - Sag Vertical
  - Crest Vertical



Design Considerations
- Design Geometry

- Superelevation is the banking of the roadway along a horizontal curve so motorists can safely and comfortably maneuver the curve at reasonable speeds.

Design Considerations - Design Geometry

- Cross Section Slope describes the slope across the road surface perpendicular to the travel direction.
- Prescott typically uses a normal crown section with a high point located at the center of the roadway with each side sloping away.
- Inverted crown sections are not allowed in Prescott, except as required at arterial or collector street intersections and alleyways. (using some type of gutter)
- Desirable cross slope is two (2%) percent.

Design Considerations - Bike & Pedestrian Facilities

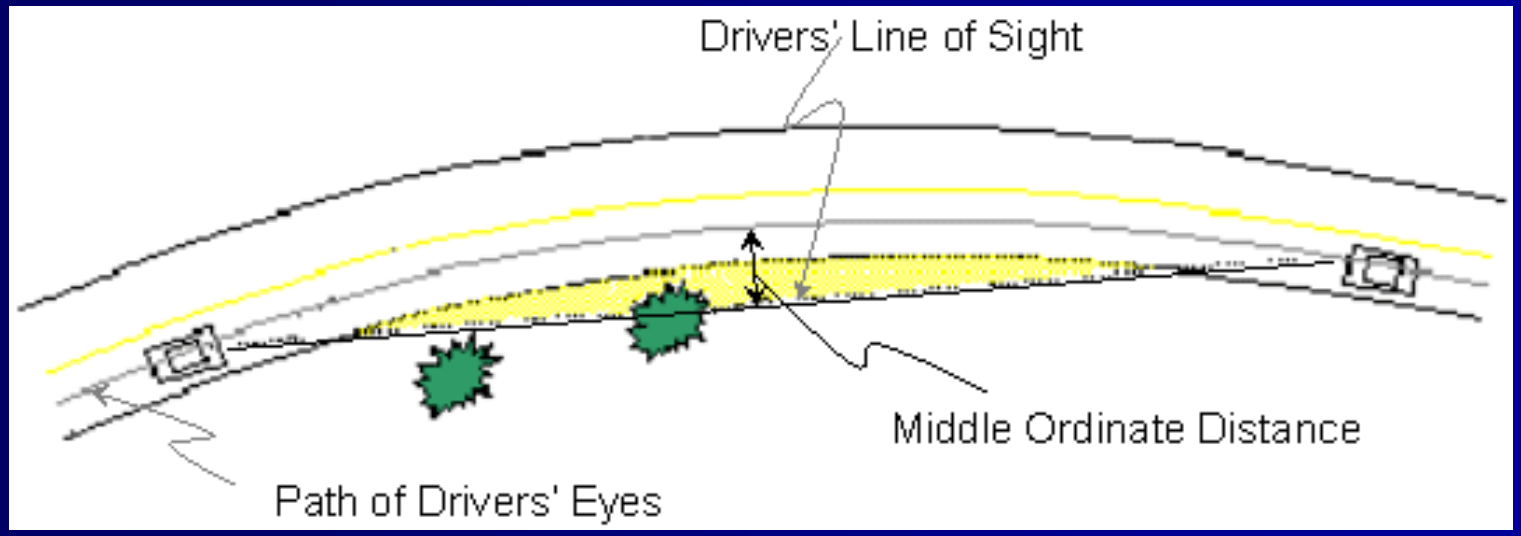
- Bike & Pedestrian Facilities are provided on new roadways to promote and enhance multi-modal transportation.
- Facilities consist mainly of:
  - Striped Bike Lanes
  - Signed Bike routes
  - Sidewalks
  - Multi-use paths
- Pedestrian use is very high in the downtown district, lower in outlying areas
- Bicycling is becoming increasingly popular with a large recreational trail network and several high profile special events.
- Prescott's adopted street typical sections include sidewalk(s) and many include striped bike lanes.
- Consistent with adopted plans
  - 2003 Bicycle and pedestrian Master Plan
  - General Plan – Circulation element

Design Considerations - Sight Distance

- Sight Distance is how far a road user (usually a vehicle driver) can see before the line of sight is blocked by an obstacle or the vertical curvature (crest) of the roadway.
- Sight Distance is an important design consideration to ensure that new facilities are safe.
- Roadway Design shall consider sight distance for both the roadway and its intersections by using proper horizontal and vertical curvature and eliminating roadside obstructions.
- The distances required are based primarily on vehicle speed, with longer distances required with higher speeds.
- Insufficient sight distance can have implications for the safety and operation of a roadway or intersection.

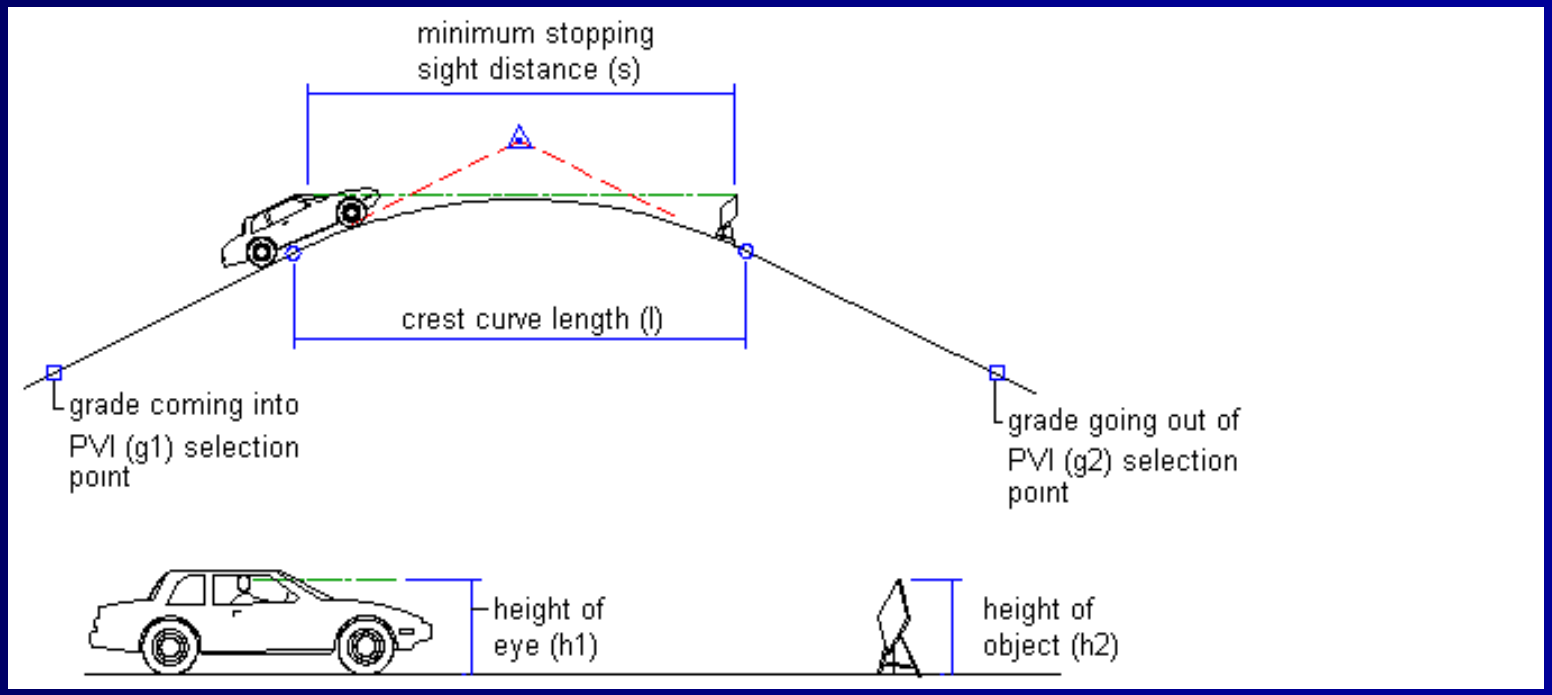
Design Considerations - Sight Distance

- Sight Distance and horizontal curves



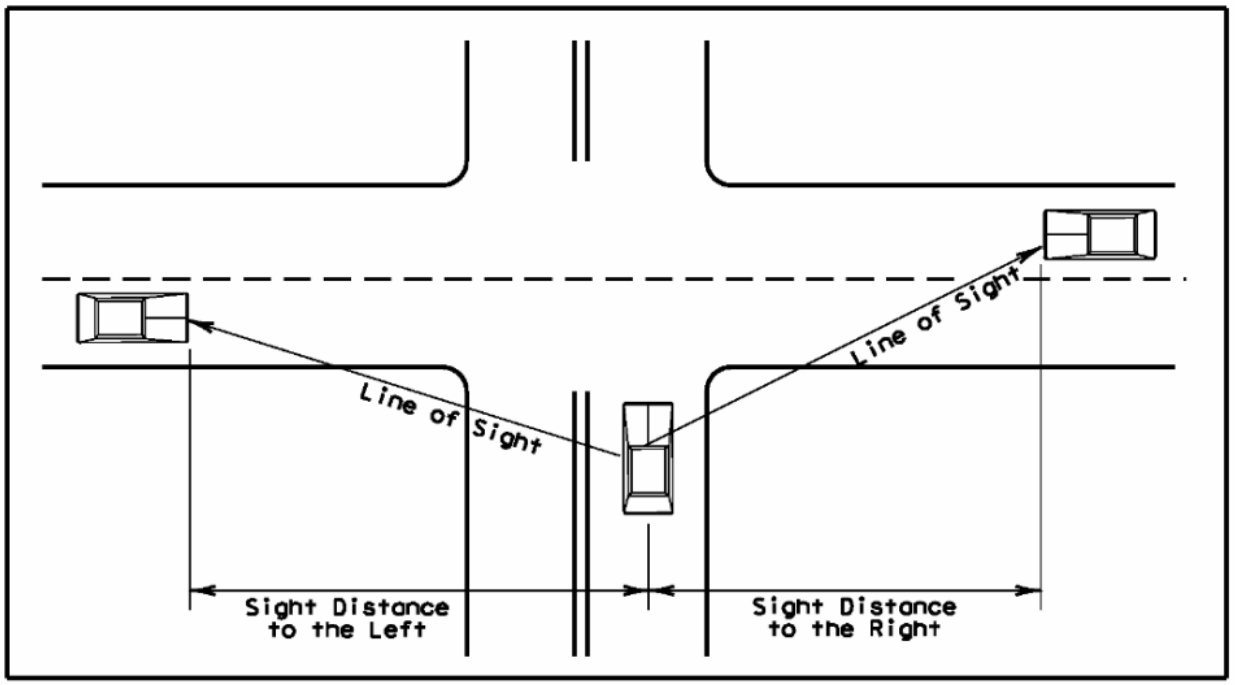
Design Considerations - Sight Distance

- Sight Distance and vertical curves



Design Considerations - Sight Distance

- Sight Distance and intersection and driveways



Entering Sight Distance Criteria

Traffic Safety
- Crash Mitigation

- Prescott experiences approximately 850 crashes per year Citywide, down from a peak of 1200 in 2006.
- Crash Mitigation is a primary goal of the City to improve roadway safety.
- Accomplished through:
  - Monitoring crash statistics by Police and Engineering to identify problem areas and trends.
  - Maintain a comprehensive crash data base.
  - Conducting an Annual report on the top ten collision intersections with statistics on type of crash, day of the week, time of day, cause, etc.
  - Directing focused enforcement toward problem areas.
  - Implementing engineering solutions when possible.
  - Educating the public on safe driving.

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