FHWA Design Element Definitions
(http://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/)

DS- Design Speed

Design speed is a selected speed used to determine the various geometric features of the roadway. The assumed design speed should be a logical one with respect to the topography, anticipated operating speed, the adjacent land use, and the functional classification of the highway. Design speed is different from the other controlling criteria in that it is a design control, rather than a specific design element. In other words, the selected design speed establishes the range of design values for many of the other geometric elements of the highway.

LW- Lane Width

The adopted criteria describe design values for through travel lanes, auxiliary lanes, ramps, and turning roadways. There are also recommended widths for special-purpose lanes such as continuous two-way left-turn lanes. AASHTO also provides guidance for widening lanes through horizontal curves to provide for the off-tracking requirements of large trucks. Lane width does not include shoulders, curbs, and on-street parking areas.

SW- Shoulder Width

Shoulders provide a number of important functions. Safety and efficient traffic operations can be adversely affected if any of the following functions are compromised:

- Shoulders provide space for emergency storage of disabled vehicles. Particularly on high-speed, high-volume highways such as urban freeways, the ability to move a disabled vehicle off the travel lanes reduces the risk of rear-end crashes and can prevent a lane from being closed, which can cause severe congestion and safety problems on these facilities.

- Shoulders provide space for enforcement activities. This is particularly important for the outside (right) shoulder because law enforcement personnel prefer to conduct enforcement activities in this location. Shoulder widths of approximately 8 feet or greater are normally required for this function.

- Shoulders provide space for maintenance activities. If routine maintenance work can be conducted without closing a travel lane, both safety and operations will be improved. Shoulder widths of approximately 8 feet or greater are normally
required for this function. In northern regions, shoulders also provide space for storing snow that has been cleared from the travel lanes.

- Shoulders provide an area for drivers to maneuver to avoid crashes. This is particularly important on high-speed, high-volume highways or at locations where there is limited stopping sight distance. Shoulder widths of approximately 8 feet or greater are normally required for this function.

- Shoulders improve bicycle accommodation. For most highways, cyclists are legally allowed to ride on the travel lanes. A paved or partially paved shoulder offers cyclists an alternative to ride with some separation from vehicular traffic. This type of shoulder can also reduce risky passing maneuvers by drivers.

- Shoulders increase safety by providing a stable, clear recovery area for drivers who have left the travel lane. If a driver inadvertently leaves the lane or is attempting to avoid a crash or an object in the lane ahead, a firm, stable shoulder greatly increases the chance of safe recovery. However, areas with pavement edge drop-offs can be a significant safety risk. Edge drop-offs occur where gravel or earth material is adjacent to the paved lane or shoulder. This material can settle or erode at the pavement edge, creating a drop-off that can make it difficult for a driver to safely recover after driving off the paved portion of the roadway. The drop-off can contribute to a loss of control as the driver tries to bring the vehicle back onto the roadway, especially if the driver does not reduce speed before attempting to recover.

- Shoulders improve stopping sight distance at horizontal curves by providing an offset to objects such as barrier and bridge piers.

- On highways with curb and enclosed drainage systems, shoulders store and carry water during storms, preventing water from spreading onto the travel lanes.

- On high-speed roadways, shoulders improve capacity by increasing driver comfort.

HC- Horizontal Curve Radius

The adopted design criteria specify a minimum radius for the selected design speed, which is calculated from the maximum rate of superelevation (set by policy from a range of options) and the side friction factor (established by policy through research).
SR- Superelevation Rate

Superelevation is the rotation of the pavement on the approach to and through a horizontal curve. Superelevation is intended to assist the driver by counteracting the lateral acceleration produced by tracking the curve. Superelevation is expressed as a decimal, representing the ratio of the pavement slope to width, ranging from 0 to 0.12 foot/feet. The adopted criteria allow for the use of maximum superelevation rates from 0.04 to 0.12. Maximum superelevation rates for design are established by policy by each State.

MG- Maximum Grade

Grade is the rate of change of the vertical alignment. Grade affects vehicle speed and vehicle control, particularly for large trucks. The adopted criteria express values for both maximum and minimum grade. The inability to meet either a maximum or minimum value may produce operational or safety problems.

SSD- Stopping Sight Distance

Stopping sight distance is defined as the distance needed for drivers to see an object on the roadway ahead and bring their vehicles to safe stop before colliding with the object. The distances are derived for various design speeds based on assumptions for driver reaction time, the braking ability of most vehicles under wet pavement conditions, and the friction provided by most pavement surfaces, assuming good tires. A roadway designed to criteria employs a horizontal and vertical alignment and a cross section that provides at least the minimum stopping sight distance through the entire facility.

Stopping sight distance is influenced by both vertical and horizontal alignment. For vertical stopping sight distance, this includes sight distance at crest vertical curves (Figure 18), headlight sight distance at sag vertical curves, and sight distance at undercrossings.

For crest vertical curves, the alignment of the roadway limits stopping sight distance. Sag vertical curves provide greater stopping sight distance during daylight conditions, but very short sag vertical curves will limit the effective distance of the vehicle’s headlights at night. If lighting is provided at sag vertical curves, a design to the driver comfort criteria may be adequate. The length of sag vertical curves to satisfy the comfort criteria over the typical design speed range results in minimum curve lengths of about half those based on headlight criteria.

For horizontal curves, physical obstructions can limit stopping sight distance. Examples include bridge piers, barrier, walls, backslopes, and vegetation.
CS- Cross Slope

Pavement cross slope is an important cross-sectional design element. The cross slope drains water from the roadway laterally and helps minimize ponding of water on the pavement. This prevents maintenance problems and also minimizes icing from occurring on poorly drained pavement. On roadways with curbed cross sections, the cross slope moves water to a narrower channel adjacent to the curb, away from the travel lanes, where it can be removed. Cross slopes that are too steep can cause vehicles to drift, skid laterally when braking, and become unstable when crossing over the crown to change lanes. These conditions are exacerbated by icy, snowy, or windy conditions. Both maximum and minimum criteria exist for cross slope. A formal design exception is required wherever either cannot be met.

VC- Vertical Clearance

The adopted criteria provide vertical clearance values for the various highway functional classifications. These criteria are set to provide at least a 1-foot differential between the maximum legal vehicle height and the roadway, with additional allowances for future resurfacing. These clearances apply to the entire roadway width (traveled way and shoulders). A formal design exception is required whenever these criteria are not met for the applicable functional classification.

SC- Structural Capacity

The 13th controlling criterion is structural capacity. This refers only to the load-carrying capacity of the bridge. Because it is not strictly an element of geometric design, structural capacity will not be covered in detail in this guide. Designers should be aware, however, that the inability to design for the designated structural capacity requires a design exception. There is also information in the Green Book on conditions under which existing bridges may remain in place.
MaineDOT Design Element Definitions

CZ - Clear Zone

The clear zone is an unobstructed, traversable area provided beyond the edge of the traveled way for the recovery of errant vehicles. Clear zone widths are most effected by the traffic’s speed, volume, and alignment along with the slope of the area adjacent to the travel way.

Clarifications

Cross slope criteria apply to typical tangent alignments. On high-speed roadways, normal cross slope is 1.5–2.0 percent, with the cross-slope break (the algebraic difference in slopes between the lanes) at the centerline not exceeding 4 percent. In areas of intense rainfall and where there are three or more lanes in each direction, additional cross slope may be necessary for adequate drainage. Accomplishing other design features (superelevation transitions, pavement warping at intersections, etc.) will inevitably require removal of cross slope in spot locations. These cases are routine and necessary in design and a design exception is not required.

In addition to the cross slope of the lanes, the cross-slope break on the high side of superelevated curves should not exceed 8 percent. A formal design exception is required when this condition is not met.