CHAPTER 2

DESIGN CONSIDERATIONS

2-1. General. Geometric design deals with the dimensions of the visible features of a facility such as alinement, sight distances, widths, slopes, and grades. Geometric design critieria are set forth in tables 1-1 and 1-2 and discussed in subsequent paragraphs.

2-2. Road and street types.

a. Designations of types. Highways are generally typed according to the number of traffic lanes as single-, two-, and three-lane, and undivided or divided multilane (four or more traffic lanes) highways. When information is available relative to volume and composition of traffic and type of terrain for a proposed highway, the type required can be readily determined by comparing the traffic volume expected on the proposed road or street with the design hourly volume shown in tables 1-1 and 1-2.

b. Single-lane roads. Geometric design criteria for single-lane roads are shown in table 1-1 under "Class E Roads - mountainous." Where shoulders are not sufficiently stable to permit all-weather use and the distance between intersections is greater than 1/2 mile, turnouts will be provided at 1/4-mile intervals for use by occasional passing or meeting vehicles. Single-lane pavements may be provided for fire lanes and approach drives to buildings within built-up areas, in which case the pavement will be at least 12 feet wide in all cases.

c. Two-lane roads and streets.

(1) Class B, D, and E roads. The bulk of the roads and streets at Army installations are two-lane highways. These include Class B, D, and E roads and Class B, D, and E streets.

(2) Class A, C, and F roads. Road classifications A, C, and F need not be used for mobilization conditions. Class B roads will allow adequate traffic pattern considerations to provide criteria for road design thicknesses commensurate with the 5-year life expectancy of the mobilization program. The use of four lane roads is to be minimized for mobilization construction. Where four lane roads cannot be avoided, Class B criteria will be used. When the road classifications were reviewed in light of mobilization requirements, it was determined that the requirements of Class B roads or Class D roads could be used to satisfy the traffic range of Class C roads. The single lane roads of Class F can readily be designed as minimum Class E roads. By reducing the number of road classifications, the refinement and detail of traffic flow data is greatly reduced without seriously affecting the development of road systems for Army installations under mobilization conditions.

d. Multilane (four traffic lanes or more) highways. The design criteria presented herein for highways are generally applicable to multilane highways also, except that passing sight distance is not required. Where multilane highways are designed for relatively high speeds, opposing traffic should be separated by properly designed medians.

2-3. Design controls.

a. Topography and land use. Tables 1-1 and 1-2 set forth appropriate design standards for roads and streets traversing flat, rolling, or mountainous terrain in built-up or open areas.

b. Vehicle characteristics. Table 2-1 shows dimensions of design vehicles on which the geometric design criteria presented herein are based. Some of these vehicles are wider than 8.5 feet, which is the maximum width shown in table 2-1 for any of the design vehicles. The turning radii and dimensions of special vehicles will be obtained from the Facilities Engineer. Methods for modification of these criteria for use on roads and streets subject to vehicles greater in overall width than 8.5 feet are presented later in this manual.

c. Traffic. The geometric design criteria presented in tables 1-1 and 1-2 have been developed on the basis of horizontal area requirements for various combinations of number and kind of vehicles expected in the traffic stream. The general unit for measurement of traffic is average daily traffic (ADT); the basic fundamental unit of measurement of traffic is design hourly volume (DHV).

(1) Volume. Traffic volumes are expressed as ADT and DHV in tables 1-1 and 1-2. The ADT represents the total traffic volume for the year divided by 365. It is a value needed to determine total service and economic justification for highways but is inadequate for geometric design because it does not indicate the significant variation in the traffic during seasons, days, or hours. If a road or street is to be designed so that traffic will be properly served, consideration must be given to the rush-hour periods. The rush hour volume represented as an average daily peak hour is the basis of the DHV. The DHV is to be used for geometric design. Limited studies made of traffic flows at Army installations indicate that because of the high frequency with which peak hourly traffic occurs, the average daily peak can be economically and efficiently used as the DHV. The DHV in tables 1-1 and 1-2 are shown as 15 and 12 percent, respectively, of the ADT. These are median values selected for Army installations.

(2) Composition. Traffic on installation roads and streets may consist of a combination of passenger cars, light-delivery trucks, single-unit trucks, truck combinations, buses, and half-or full-track tactical vehicles. Trucks, buses, and tracked vehicles have more severe operating characteristics, occupy more roadway space, and

Table 2-1. Design Vehicle Dimensions

Vehicle		Dimensions in Feet						
			Overhang		Overall	Overall		Turning
Type	Symbol	Wheel Base	Front	Rear	Length	Width	Height	Radius [c]
Passenger	P	11	3	5	19	7	--	24
Single-unit truck	SU	20	4	6	30	8.5	13.5	42
Single-unit bus	BUS	25	7	8	40	8.5	13.5	42
Semitrailer combination								
Intermediate	WB40	13 + 27 = 40[a]	4	6	50	8.5	13.5	40
Large	WB50	20 + 30 = 50[a]	3	2	55	8.5	13.5	45
Full trailer combination	WB60	9.7 + 20 + 9.4[b] + 20.9 = 60	2	3	65	8.5	13.5	45

NOTE: In designs for normal operations, the largest vehicle representing a significant percentage of the traffic should be used. In designing roads or streets to accommodate truck traffic, one of the semitrailer combinations should be used. A design check should be made to insure that the largest vehicle expected to use the road or street can negotiate all turns, particularly if pavements are curbed.

a Length of tractor plus length of trailer.
b Distance between rear wheels of front trailer and front wheels of rear trailer.
c Minimum turning radius outside front wheel.

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consequently impose a greater traffic load on highways than do passenger cars and light-delivery trucks. ADT and DHV for various combinations of vehicular traffic are shown in tables 1-1 and 1-2. The larger the proportions of buses, trucks, and tracked vehicles present in the traffic stream during the selected design hour, the greater the traffic load and highway capacity required. The DHV of tables 1-1 and 1-2 diminish for each highway class as the percentage of buses, trucks, and tracked vehicles in the traffic stream increase. The tables provide design data for traffic containing 0, 10, 20, and 30 percent buses, trucks, and tracked vehicles.

2-4. Speed and capacity influence.

a. Speed.

(1) Influence on geometric design. Vehicular speed varies according to the physical characteristics of the vehicle and highway, weather conditions, volume of traffic, and the type of shoulders and other roadside features. On streets, the speed generally will depend on traffic control devices when weather and traffic conditions are favorable. On roads, the physical features of the roadway usually control speed if other conditions are favorable. Therefore, speed is a positive control for geometric design. Consideration must be given to the selected design speed and average running speed if adequate designs are to be developed.

(2) Design speed. The speed selected for design is the major control in designing physical features of highways. Practically all features of a highway will be affected to some extent by the design speed. Maximum curvature, superelevation, and minimum sight distance are automatically determined by the selected design speed. Other features such as pavement and shoulder width, and lateral clearance to obstructions are not directly affected by design speed but do affect vehicle speed. The design speed should be selected primarily on the basis of terrain characteristics, land use, and economic considerations. The geometric design criteria presented herein are based on the design speeds shown under "Design Controls" in tables 1-1 and 1-2.

(3) Average running speed. The average running speeds on which the geometric design criteria are based are shown under "Design Controls" in tables 1-1 and 1-2.

b. Capacity.

(1) Conditions affecting capacity. The capacity of a road or street will vary with lane width, distance to lateral obstructions, condition and width of shoulders, profile and alinement, and with the composition and speed of traffic. These factors are referred to

collectively as prevailing conditions. Those factors depending on physical features of the highway are called prevailing roadway conditions, and those depending on the character of the using traffic are called prevailing traffic conditions. The term capacity in itself has no significance unless the prevailing roadway and traffic conditions are stated.

(2) Capacity analysis. Capacities under ideal conditions are presented in the TRB Highway Capacity Manual. Uninterrupted flow capacities under ideal traffic and roadway conditions for 2-lane, 2-way, highway, (total for both lanes) and for multilane highway (average per lane for direction of heavier flow), will be 2,000 passenger cars per hour.

(3) Capacity for uninterrupted flow. The DHV shown in tables 1-1 and 1-2 are equal to the capacity for uninterrupted flow for each class of road and street on the basis of the geometric design criteria presented. Highway capacity is directly related to the average running speed. Maximum capacity occurs when average running speed is between 30 and 45 mph. Any factors which reduce or increase the average running speed will also reduce capacity. The capacities (DHV) shown in tables 1-1 and 1-2 for Class B roads, and Class B and D streets will be reduced in accordance with the following tabulation in all cases where it is anticipated that the average running speed on a substantial length of a road or street will be appreciably less than 30 mph.

Average Running Speed, mph	Capacity (DHV) in Percentage of Values Shown in Tables 1-1 and 1-2
30	100
25	95
20	87
15	72