AC 150/5300-4B

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ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Washington, D.C.

Subject: UTILITY AIRPORTS--AIR ACCESS TO NATIONAL TRANSPORTATION

* 1. PURPOSE. This advisory circular establishes design, operation, and maintenance standards for utility airports.

2. CANCELLATION. Advisory Circular 150/5300-4A, Utility Airports--Air Access to National Transportation, dated November 1968, is cancelled.

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Acting Associate Administrator for Airports *

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CHAPTER 1. INTRODUCTION

* 1. GENERAL. Section 103 of the Federal Aviation Act of 1958 states in part, "In the exercise and performance of his power and duties under this Act the Secretary of Transportation shall consider the following, among other things, as being in the public interest: (a) The regulation of air commerce in such manner as to best promote its development and safety and fulfill the requirements of defense; (b) The promotion, encouragement, and development of civil aeronautics . . . ." This public charge to promote, encourage, and develop civil aeronautics carries with it the need to foster a national system of safe and efficient airports. The Federal Aviation Administration (FAA) presents the standards and recommendations in this publication to guide interested persons in the development of safe and efficient airports.

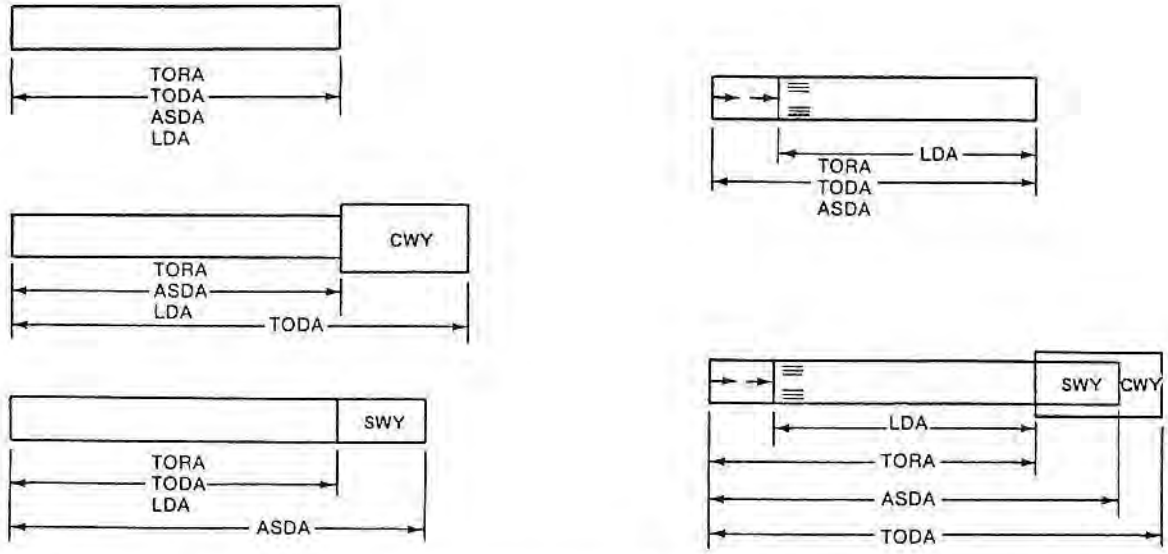
2. AIRPORT STANDARDS. The standards, recommendations, and guidance material in this Advisory Circular (AC) define an airport suitable for the less demanding Aircraft Approach Category A and B airplanes, i. e., airplanes with approach speeds of less than 121 knots. The other airports need to be designed and maintained to the standards and, to the extent physically feasible, to the recommendations in AC 150/5300-12, Airport Design Standards--Transport Airports, current edition. The FAA uses the standards and recommendations in this publication to provide technical guidance for the design of safe and efficient airports; and to evaluate both the effect of proposed construction, alteration, activation, and deactivation of airports on the national airport system and the effect of proposed construction and alteration of objects on air navigation. The standards and recommendations in this publication complement, but are not intended to take precedence over, aircraft operating rules and procedures. *

a. Metric Units. Airport authorities may design their facilities in the metric system of units or in the U.S. customary system. In general, where additions or expansions are planned to an existing facility, such as a runway, taxiway, or apron, either system of units may be used. Where a new facility is to be built, the use of metric units is encouraged. Chapter 14 contains the policy for the use of and conversion to metric units.

* b. Technical Assistance. Technical assistance in the planning, design, construction, maintenance, and modernization of airports may be obtained from state aviation officials, FAA airport engineers, and experienced engineering firms. AC 150/5000-3, Address List for Regional Airports Divisions and Airports District/Field Offices, current edition, contains the addresses for all FAA Regional Airport Divisions and Airports District/Field Offices.

3. DEFINITIONS AND EXPLANATIONS OF TERMS. The following subparagraphs define the terms used in this publication: *

*



Note. All declared distances are illustrated for operations from left to right

j. Displaced Threshold. A displaced threshold is a threshold located at a point on the runway other then at the runway end. Except for the approach standards defined in FAR Part 77, approach surfaces are associated with the threshold location.

k. Hazard to Air Navigation. Any object which has a substantial adverse effect upon the safe and efficient use of navigable airspace by aircraft or on the operation of air navigation facilities is a hazard to air navigation. In and of itself, an obstruction to air navigation may not be a hazard to air navigation, however, FAA presumes it to be and treats it as a hazard to air navigation until an FAA aeronautical study has determined it does not have a substantial adverse effect upon the safe and efficient use of navigable airspace by aircraft or on the operation of air navigation facilities. The FAA will conduct an aeronautical study of any object when the FAA deems a study is necessary to eliminate a specific presumption of hazard to air navigation. As part of the airport layout plan approval process, the FAA conducts aeronautical studies of all obstructions to air navigation identified on the airport layout plan. Hazards or potential hazards to air navigation are eliminated by either altering the existing or proposed object or adjusting the aviation operations to accommodate the object in that order of priority.

l. Large Aircraft. A large aircraft is an aircraft of more than 12,500 pounds (5 700 kg) maximum certificated takeoff weight.

m. Nonprecision Instrument Runway. A nonprecision instrument runway is one with an instrument approach procedure utilizing air navigation facilities, with only horizontal guidance, or area-type navigation equipment for which a straight-in nonprecision instrument approach procedure has been approved or planned, and no precision approach facility or procedure is planned or *
indicated on an FAA or DOD approved airport layout plan, or on other FAA or DOD planning documents.

n. Obstacle Free Zone (OFZ). An OFZ is an area:

(1) Comprised of the runway OFZ, the approach OFZ, and the inner-transitional surface OFZ.

(a) Runway OFZ. The runway OFZ is the volume of space above a surface longitudinally centered on the runway. The elevation of any point on the surface is the same as the elevation of the nearest point on the runway centerline. The runway OFZ extends 200 feet (60 m) beyond each end of the runway and its width is:

1 120 feet (36 m) for visual runways serving or expected to serve only small airplanes with approach speeds less than 50 knots.

2 250 feet (75 m) for nonprecision instrument and visual runways serving or expected to serve small airplanes with approach speeds of 50 knots or more and no large airplanes.

3 300 feet (90 m) for precision instrument runways serving or expected to serve only small airplanes. (See figure 1-1.)

4 180 feet (54 m), plus the wingspan of the most demanding airplane, plus 20 feet (6 m) per 1,000 feet (300 m) of airport elevation; or, 400 feet (120 m), whichever is greater, for runways serving or expected to serve large airplanes. (See figure 1-1.)

(b) Approach OFZ. The approach OFZ is the volume of space above a surface which has the same width as the runway OFZ and rises at a slope of 50 (horizontal) to 1 (vertical) away from the runway into the approach area. It begins 200 feet (60 m) from the runway threshold at the same elevation as the runway threshold and it extends 200 feet (60 m) beyond the last light unit in the approach lighting system. The approach OFZ applies only to runways with an approach lighting system. (See figure 1-1.)

(c) Inner-Transitional Surface OFZ. The inner-transitional surface OFZ is the volume of space above the surfaces which slope 3 (horizontal) to 1 (vertical) laterally from the edges of the runway OFZ and approach OFZ and end at the height of 150 feet (45 m) above the established airport elevation. The inner-transitional surface OFZ applies only to precision instrument runways. (See figure 1-1.)

* (2) Free of all fixed objects. FAA approved frangible equipment which provides an essential aviation service may be located in the OFZ, provided the amount of penetration is kept to a practical mimimum. *

(3) Clear of vehicles as well as parked, holding, or taxiing aircraft in the proximity of an airplane conducting an approach, missed approach, landing, takeoff, or departure.

* o. Obstruction to Air Navigation. An existing object, including a mobile object, is, and a future object would be, an obstruction to air navigation if it is of a greater height than any of the heights or surfaces defined in FAR 77.23.

p. Precision Instrument Runway. A precision instrument runway is one with an instrument approach procedure utilizing an instrument landing system (ILS), microwave landing system (MLS), or precision approach radar (PAR). A planned precision instrument runway is one for which a precision approach system or procedure is indicated on an FAA or DOD approved airport layout plan, or on other FAA or DOD planning documents.

q. Relocated Threshold. A relocated threshold is a permanent threshold located at the relocated runway end. *

r. Runway. A runway is a defined rectangular area on an airport prepared for the landing or takeoff of airplanes.

s. Runway Clear Zone. A runway clear zone is a trapezoidal area at ground level, under the control of the airport authorities, for the purpose of protecting the safety of approaches and keeping the area clear of the congregation of people. The runway clear zone begins at the end of each primary surface and is centered upon the extended runway centerline. See appendix 6 for runway clear zone standard dimensions.

t. Runway Safety Area. A runway safety area is a rectangular area, centered on the runway centerline, which includes the runway (and stopway, if present) and the runway shoulders. The portion abutting the edge of the runway shoulders, runway ends, and stopways is cleared, drained, graded, and usually turfed. Under normal conditions, the runway safety area is capable of supporting snow removal, firefighting, and rescue equipment and accommodating the occasional passage of aircraft without causing major damage to the aircraft.

u. Small Aircraft. A small aircraft is an aircraft of 12,500 pounds (5 700 kg) or less maximum certificated takeoff weight.

v. STOL Aircraft. A STOL aircraft is an aircraft with a certified performance capabilty to execute approaches along a glide slope of 6 degree or steeper and to execute missed approaches at a climb gradient sufficient to clear a 15:1 missed approach surface at sea level. The gradient is based on the airport elevation and decreases at the rate of 5 percent per 1,000 feet (300 m), i.e., for an airport at 4,000 feet (1 200 m) above mean sea level (MSL), the gradient of the missed approach surface would be 18:1, 120 percent of 15:1.

w. STOL Runway. A STOL runway is one which is specifically designated and
* marked for STOL aircraft operations. Except for the standards for locating thresholds, specified in appendix 9, and for marking and lighting, STOL runways are designed and maintained to the standards and recommendations applicable to conventional takeoff and landing airplanes. *

x. Stop End of Runway. The stop end of runway is the far runway end as viewed from the cockpit of a landing airplane.

y. Stopway. A stopway is an area beyond the stop end of the takeoff runway which is no less wide than the runway and is centered on the extended centerline of the runway. It is able to support an airplane during an aborted takeoff without causing structural damage to the airplane, and designated by the airport authorities for use in decelerating the airplane during an aborted takeoff.

* z. Taxilane. A taxilane is the portion of the aircraft parking area used for access between taxiways, aircraft parking positions, hangars, storage facilities, etc. A taxilane is outside the movement area. *

aa. Taxiway. A taxiway is a defined path, from one part of an airport to another, selected or prepared for the taxiing of aircraft.

bb. Taxiway Safety Area. A taxiway safety area is an area centered on the taxiway centerline, which includes the taxiway and taxiway shoulders. The portion abutting the edge of the taxiway shoulders is cleared, drained, graded, and usually turfed. Under normal conditions, the taxiway safety area is capable of supporting snow removal, fire fighting, and rescue equipment and accommodating the occasional passage of aircraft without causing major damage to the aircraft.

cc. Threshold. The threshold is the beginning of that portion of the runway available and suitable for the landing of airplanes.

dd. Transport Airport. A transport airport is an airport designed, constructed, and maintained to serve airplanes in Aircraft Approach Category C and D.

ee. Utility Airport. A utility airport is an airport designed, constructed, and maintained to serve airplanes in Aircraft Approach Category A and B. For discussion on airport type, see paragraph 5.

ff. Visual Runway. A visual runway is a runway intended solely for the operation of aircraft using visual approach procedures, with no straight-in instrument approach procedure and no instrument designation indicated on an FAA or DOD approved airport layout plan, or, on other FAA or DOD planning documents.

gg. Wind Coverage. Wind coverage is the percent of time for which aeronautical operations are considered safe due to acceptable crosswind components.

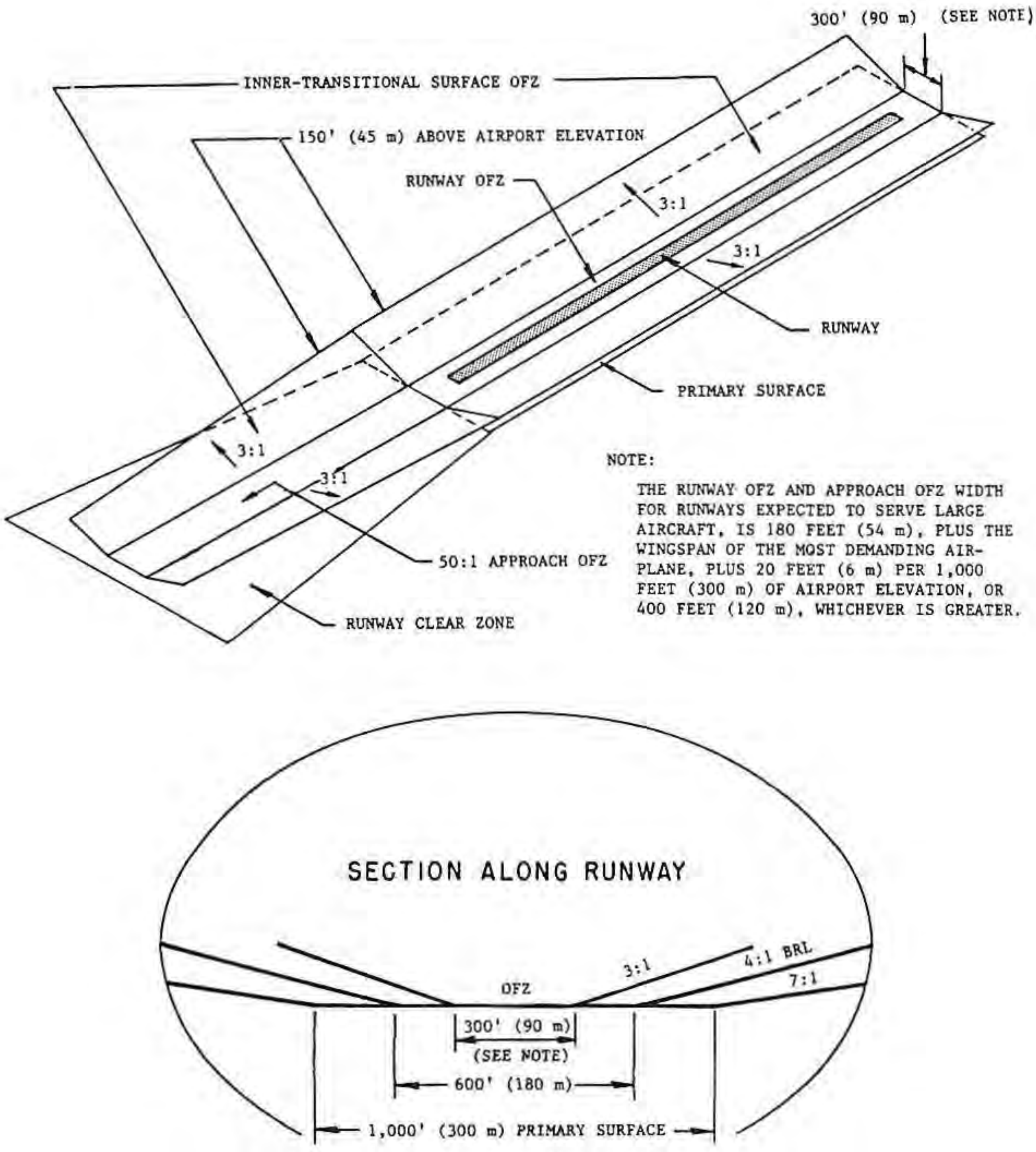


FIGURE 1-1. OBSTACLE FREE ZONE (OFZ) FOR PRECISION INSTRUMENT RUNWAY

CHAPTER 2. PRINCIPLES OF APPLICATION

4. AIRPORT ROLE. An airport may serve primarily a community and secondarily a nearby recreational area; or, it may serve mainly as a feeder stop for air taxi operations enroute to a regional air carrier airport. In certain cases its role may be to provide access to the airways from a relatively remote community.

   a. Prior to the development of precision instrument runway standards for utility airports, the role of a utility airport was limited to those activities
* performed by small aircraft on nonprecision instrument and visual runways. *

   b. With deregulation of the airlines and an increase in commuter operations, the FAA and the aviation industry recognized that standards for precision instrument runways at utility airports were both needed and feasible.
* Airport design standards based exclusively on the requirements of small *
aircraft were subsequently developed for utility airports having an expanded role of providing for all-weather operations. These standards were less demanding than the precision instrument runway standards for transport airports, in terms of real estate and clearing required. These standards were adopted with full recognition that the resulting more economical precision instrument facilities could also safely accommodate larger aircraft with approach speeds up to 120 knots.

   c. Recognizing the need to reduce overall airport development cost, the FAA and the aviation industry also developed the airplane design group concept which links airport requirements to using aircraft. (See paragraph 3.)

   d. To preserve the traditional roles of existing airports, however, Design Group I is subdivided into two groups, distinguishable by aircraft weight. The first includes just small aircraft or the family of aircraft expected at utility airports built to design standards prior to January 30, 1981. The second expands the service coverage to accommodate a limited number of larger aircraft.

5. AIRPORT TYPE. Runway length separates utility airports into basic and general utility types. The small airplanes, commonly used for personal and business flying and for commuter and air taxi operations, which are served by Basic Utility and General Utility--Stage I airports are shown in figure 2-1. These airports can be expected to have the following kinds of activity:

   a. Basic Utility--Stage I. This type of airport serves about 75 percent of the single-engine and small twin-engine airplanes used for personal and business purposes. Precision approach operations are not usually anticipated. This airport is designed for small airplanes in Airplane Design Group I.

   b. Basic Utility--Stage II. This type of airport serves all the airplanes of Stage I, plus some small business and air taxi-type twin-engine airplanes. Precision approach operations are not usually anticipated. This airport is also designed for small airplanes in Airplane Design Group I.

c. General Utility--Stage I. This type of airport serves all small airplanes. Precision approach operations are not usually anticipated. This airport is also designed for small airplanes in Airplane Design Group I.

d. General Utility--Stage II. This type of airport serves large airplanes in Aircraft Approach Category A and B and usually has the capability for precision approach operations. This airport is normally designed for airplanes of Airplane Design Groups I and II. It may also be designed to serve Aircraft Approach Category A large airplanes in Airplane Design Group III. While runways serving or expected to serve large airplanes may be built to utility airport standards, they are considered as other than utility runways in aeronautical studies.

6. FUTURE CONSIDERATIONS.

a. One factor for future consideration in the utility type airport is the probable requirement to operate during periods when the weather is below the minimums authorized for visual flight rules (VFR). The requirement for this capability is highest among airplanes used for commuter, business, and air taxi purposes.

b. The criteria contained in this publication provide the potential capability for the development of instrument runways. Air navigational aids (NAVAIDs), such as instrument landing systems (ILS), microwave landing systems (MLS), very high frequency omnidirectional radio ranges (VOR), or nondirectional radio beacons (NDB), are needed in order to take advantage of this potential. AC 150/5300-2, Airport Design Standards--Site Requirements for Terminal Navigational Facilities, current edition, describes in general terms the land area, grading requirements, and operational clearances desired for NAVAIDs and air traffic control (ATC) facilities.

c. If the ultimate development plans include expansion of the airport to serve airplanes in Aircraft Approach Category A with wingspans greater than 118 feet (36 m), or airplanes in Aircraft Approach Category B with wingspans greater than 79 feet (24 m), or airplanes with approach speed greater than 120 knots, the airport should be designed to the criteria in AC 150/5300-12.

7. OTHER CONSIDERATIONS. A properly planned and designed utility airport is a definite asset to a community. Although the single event noise levels generated by aircraft using utility airports may not be as high as those at transport airports, the cumulative effect of a large number of operations may have an equivalent or greater overall noise impact than a transport airport with fewer operations. Therefore, it is important that airport planners locate the proposed utility airport in an area that is compatible with adjacent communities and will remain compatible in the future as a result of land use controls. It is also important that airport planners inform local residents, as early in the airport development process as possible, of the proposed location of the airport, the scope of the airport operation, the measures which will be undertaken to minimize noise, and of the value of the airport to their communities. Failure to do this can result in public sentiment turning against the airport and the imposition of severe operational limitations on it. (See paragraph 25 for further discussion of airport-community compatibility.)

BASIC UTILITY STAGE I	BASIC UTILITY STAGE II	GENERAL UTILITY STAGE I
Beech B19 Sport/150	Beech F33A Bonanza	Beech B58P Baron
Beech B24R Sierra/200	Beech V35B Bonanza	Beech B60 Duke
Bellanca Citabria Series	Beech A36 Bonanza	Beech B80 Queen Air
Bellanca 8GCBC Scout	Beech C23 Sundowner	Beech E90 King Air
Bellanca 300A Super Viking	Beech B55 Baron	Beech B99 Airliner
Cessna 150 Series	Cessna 204 Skywagon	Cessna 340A
Cessna 172 Skyhawk	Cessna 337 Skymaster	Cessna 402B Businessliner
Cessna 182 Skylane	Cessna P337 Skymaster	Piper PA-24 Series
Cessna T206 Stationair	Cessna 310	Piper PA-30-150 Twin Commanche
Grumman American AA-1B Trainer	Piper PA-32-260 Cherokee Six	Piper PA-31-350 Chieftain
Grumman American AA-5A Cheetah	Piper PA-23-250 Aztec	Piper PA-31-425 Navajo
Grumman American AA-5B Tiger	Piper PA-34-200 Senaca II	Rockwell Int'l. 500S Shrike
Mooney M20C Ranger	Ted Smith Aerostar 600	Rockwell Int'l. 685 Commander
Mooney M20E Chaparral	Ted Smith Aerostar 601	Also accommodated are the airplane models listed under Basic Utility Stages I and II.
Mooney M20F Executive	Also accommodated are the airplane models listed under Basic Utility Stage I.	Note: Some of the above airplane models have an option for a seating configuration of 10 passenger seats or more. See Figure 4-2 for additional listing of airplane models.
Navion Rangemaster H		
Piper PA-11 thru PA-22 Series		
Piper PA-28 Series		
Piper PA-32-300 Cherokee Six		
Piper PA-32-300R Lance		
Rockwell Int'l. 112 A Commander		
Rockwell Int'l. 112 TC Commander		
Rockwell Int'l. 114 Commander		

The recommended runway length required to accommodate all the airplanes grouped under a specific airport type is obtainable from Figure 4-1.

FIGURE 2-1. EXAMPLES OF SMALL AIRPLANES ACCOMMODATED BY AIRPORT TYPE

CHAPTER 3. WIND ANALYSIS AND RUNWAY ORIENTATION

8. GENERAL.

a. The configuration of the airport is determined by the number and orientation of the runways. One of the primary factors influencing runway orientation is wind. Ideally the runway should be aligned with the prevailing winds. Wind conditions affect all airplanes, the smallest to the largest, in varying degrees. Generally, the smaller the airplane, the more it is affected by wind, particularly crosswind components. Crosswinds are often a contributing factor in small airplane accidents. In some cases, construction of two runways may be necessary to give the desired wind coverage.

b. Airport planners and designers should, therefore, make an accurate analysis of wind to determine the orientation and number of runways. The proper application of the results of this analysis will add substantially to the safety and usefulness of the airport. Appendix 3 provides information on wind data for the purpose of airport planning and design, and the following paragraphs give procedures in its application to runway orientation concepts.

9. CROSSWINDS.

a. A crosswind component of wind direction and velocity is the resultant vector which acts at a right angle to the runway. It is equal to the wind speed multiplied by the trigonometric sine of the angle between the wind direction and the runway direction. Normally, these wind vector triangles are solved graphically. An example is shown in Figure 3-1. From this diagram, one can also ascertain the headwind and tailwind component of combinations of wind velocities and directions.

b. Study and analysis of different combinations of velocities and directions, having an 11.4-mile-per-hour (mph) (9.9 knots) crosswind component, have found that different combinations produce similar adverse effects on the control handling characteristics of airplanes. Considering this and the method of reporting wind data, the 12-mph or 10.5-knot speed was selected as a reasonable and convenient figure upon which to base runway orientation.

10. ORIENTATION AND COVERAGE. The most desirable runway orientation based on wind is the one which has the largest wind coverage and minimum crosswind components.

a. Wind coverage is that percent of time for which operations are considered safe due to acceptable crosswind components. The desirable wind coverage for an airport is 95 percent, based on the total hours of weather observations. At some locations, the daily time period for weather observations is less than 24 hours; i.e., 16 hours. In any event, the data collected must be applied with an understanding of the objective; i.e., to attain 95-percent usability. At many airports, airplane operations are almost nil after dark. Accordingly, it may be desirable to analyze the wind data on less than a 24-hour observation period. Also, at resort airports, where operations are predominantly seasonal, regard should be given to the wind data for the predominant-use period.

b. Where a single runway cannot be oriented to provide 95-percent coverage, one or more additional runways will be required to raise the coverage to that value.

c. The acceptable coverage value of 95 percent was selected after consideration of various factors influencing operations to and from airports and the economics of providing the coverage. In any airport operation, there are periods when factors other than wind determine when a runway may be used. Low ceilings, reduced visibility, periods of runway maintenance, etc., may preclude use of a particular runway even though existing wind conditions are favorable.

d. Appendix 3, Weather Data Source and Analysis, states in detail how a standard wind rose is compiled and used.

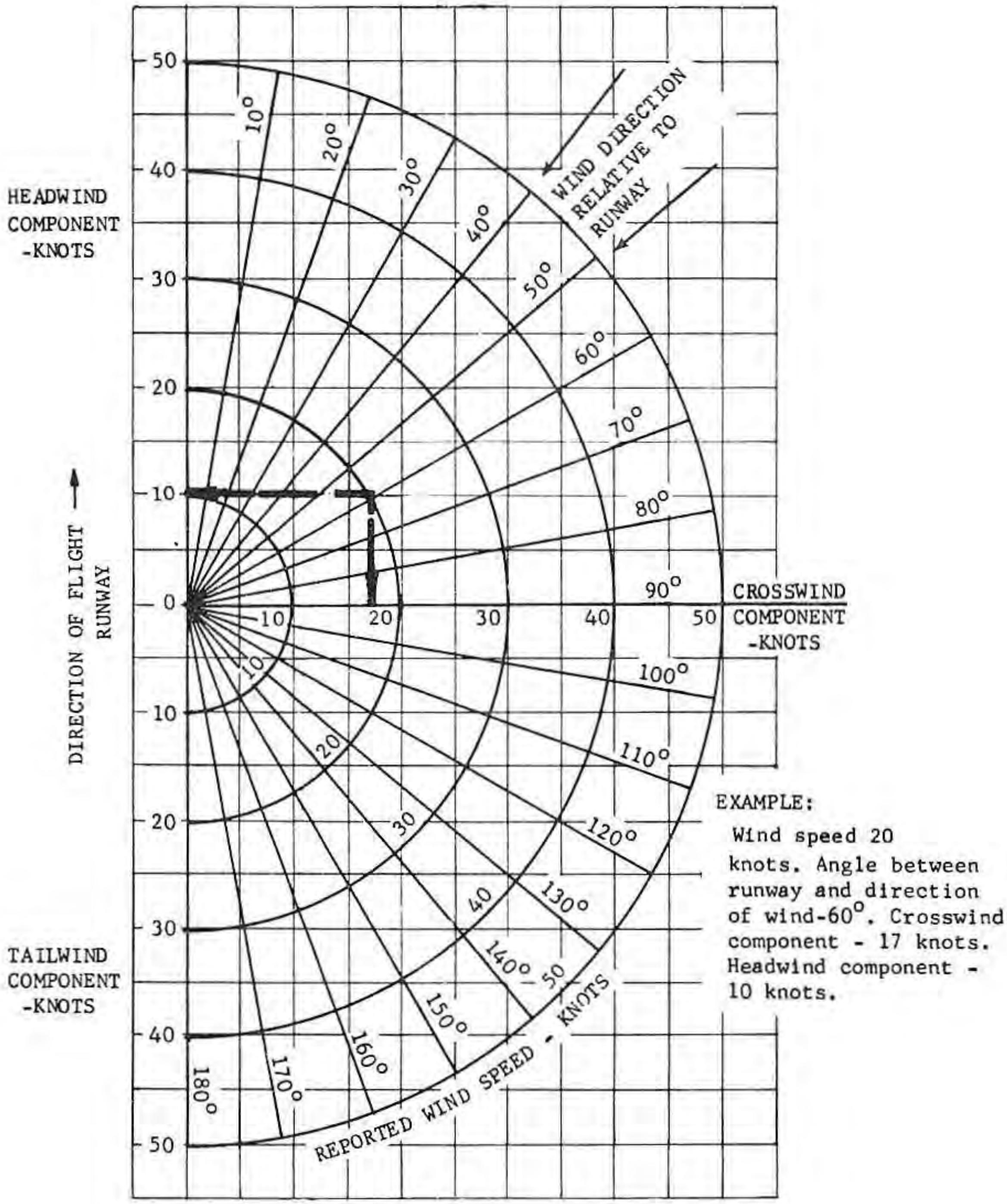


FIGURE 3-1. WIND VECTOR DIAGRAM

CHAPTER 4. RUNWAY LENGTH REQUIREMENTS AND CAPACITY

* 11. PRIMARY RUNWAY LENGTH. Airplane flight manuals (supplemented with user operating data), AC 150/5300-12, and the runway length curves in this chapter provide guidance on the runway lengths needed to accommodate the airplanes expected to use a utility airport.

a. A runway length of at least 300 feet (90 m) is recommended to serve small airplanes with approach speeds less than 30 knots. The runway length is based on the airport elevation and increases at the rate of 30 feet (9 m) per 1,000 feet (300 m) of airport elevation above mean sea level (MSL).

b. A runway length of at least 800 feet (240 m) is recommended to serve small airplanes with approach speeds less than 50 knots. The runway length is based on the airport elevation and increases at the rate of 80 feet (24 m) per 1,000 feet (300 m) of airport elevation above mean sea level (MSL).

c. Figure 4-1 presents curves for determining the runway length to serve small airplanes with approach speeds of 50 knots or more, which accommodate less * than 10 passengers. The recommended minimum runway length is the length for the airport elevation and the mean daily maximum temperature of the hottest month at the airport.

d. Figure 4-2 presents curves for the runway length to serve small airplanes, which accommodate 10 or more passengers, or small turbojet airplanes.

e. AC 150/5300-12 should be used if the runway is expected to serve large airplanes.

12. CROSSWIND RUNWAY LENGTH. At some airport sites, it is not feasible to obtain 95 percent wind coverage with one runway. In such cases, it may be determined that the benefits from a crosswind (or secondary) runway will justify its construction. Accordingly, the question arises: How long should the crosswind runway be? Where feasible, it should be at least 80 percent of the length recommended for the primary runway.

13. DEVELOPMENT OF RUNWAY LENGTH CURVES (FIGURES 4-1 AND 4-2).

a. Federal Aviation Regulations, Part 23, Airworthiness Standards: Normal, Utility, and Acrobatic Category Airplanes, prescribes airworthiness standards for the issuance of small-airplane type certificates. The individual airplane flight manual contains the performance information for each airplane (defined in Section 23.51, Takeoff; Section 23.75, Landing; and, Section 23.1587, Performance Information). This information is provided to assist the airplane operator in determining the necessary runway length for safe operations.

b. Performance information from airplane flight manuals has been selectively grouped and used to develop the runway length curves in figures 4-1 and 4-2. The major parameters used in developing these curves are the landing and takeoff distances for figure 4-1 and the landing, takeoff, and accelerate-stop distances for figure 4-2. The following conditions have been assumed in developing the curves:

(1) zero headwind;

(2) maximum certificated takeoff and landing weights; and

(3) optimum flap setting for the shortest runway length (normal operation).

c. Other factors, such as relative humidity and runway gradient, have a limited effect on runway length. For small airplanes, these factors are negligible and thus are not used in computing runway length for small airplanes.

14. OTHER CONSIDERATIONS. In most cases, figures 4-1 and 4-2, AC 150/5300-12, and airplane flight manuals should be used for determining the runway length at a utility airport. However, the airport planner should consider the following conditions which also could affect the runway length for a particular airport:

a. While figure 4-1 presents runway lengths for elevations up to 9,000 feet (2 743 m), some of the airplanes listed in the example grouping in figure 2-1 are not capable of operating at high altitudes without modification. Therefore, special care must be exercised in adapting these curves to the critical airplane or group of airplanes for operations at elevations higher than 5,000 feet (1 524 m).

b. FAR Part 135 imposes the following conditions:

(1) For airplanes with a seating configuration of 10 passenger seats or more, the accelerate-stop distance must be considered in computing the required runway length. Figure 4-2 presents runway lengths considering accelerate-stop distance.

(2) The operators of small airplanes certificated prior to July 19, 1970, and having a seating configuration of 10 passenger seats or more, are permitted to use an overrun distance equal to that required to stop the airplane from a ground speed of 35 knots (40 miles per hour) in computing their accelerate-stop distance. This provision of FAR Part 135 may be met by providing a full length runway safety area beyond the runway end.

c. The runway length obtained from the airplane flight manuals may be used in lieu of the runway length curves depicted in figures 4-1 and 4-2 and AC 150/5300-12.

15. RUNWAY CAPACITY. The capacity of a runway is defined as the number of operations that the runway can accommodate in a limited time--usually 1 hour. An operation is defined as either a landing or a takeoff, therefore, a touch and
* go counts as two operations. AC 150/5060-5, Airport Capacity and Delay, current edition, explains how to compute airport capacity and aircraft delays. *

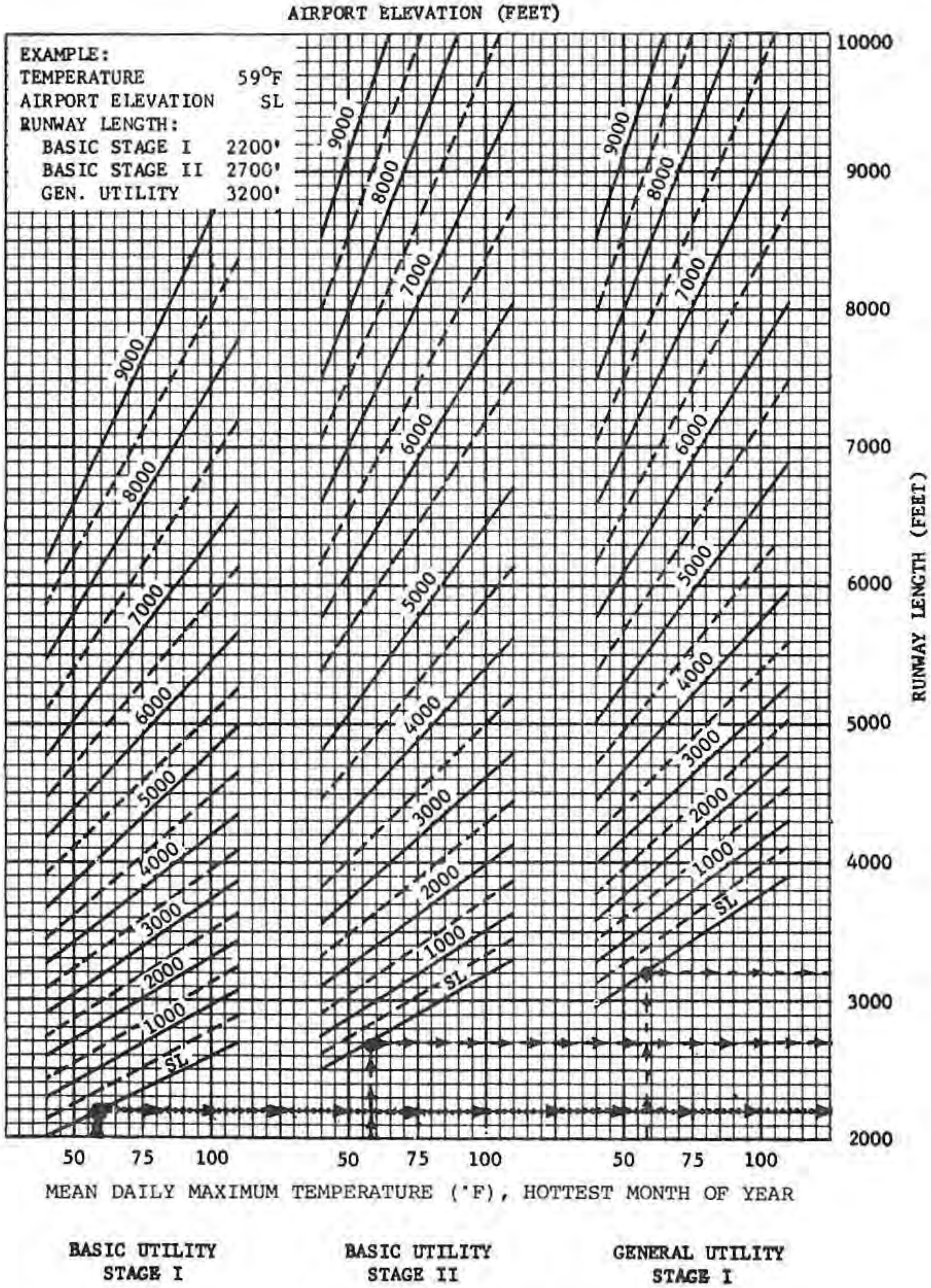


FIGURE 4-1. RUNWAY LENGTH CURVES

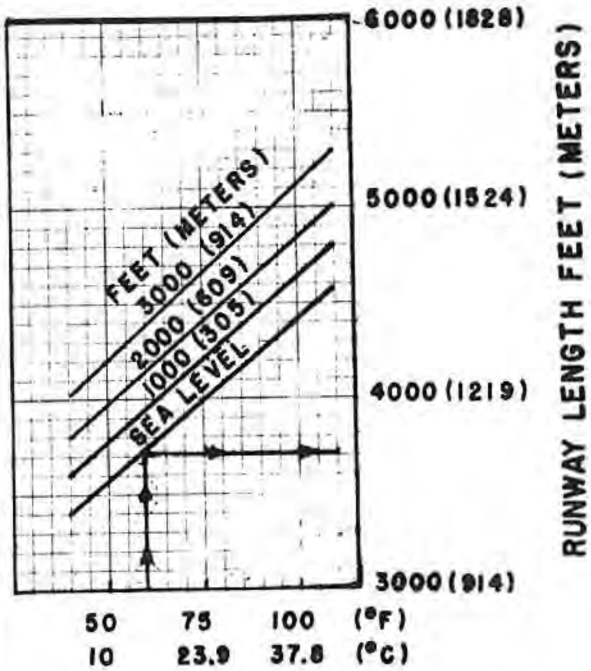
REPRESENTATIVE AIRPLANES	RUNWAY LENGTH CURVES
Beech B80 Queen Air Beech E90 King Air Beech B99 Airliner Beech A100 King Air Britten-Norman Mark III-I Trilander Mitsubishi MU-2L Swearigen Merlin III-A Swearigen Merlin IV-A Swearigen Metro II See Figure 2-1 for airplane models in the above group that also have an option for a seating configuration of less than 10 passenger seats.	EXAMPLE: TEMPERATURE 59°F (15°C) AIRPORT ELEVATION SEA LEVEL GEN. UTILITY 3700' (1 128 m) NOTE: For airport elevations above 3000 feet (914 m) use General Utility Curves, Figure 4-1.  MEAN DAILY MAXIMUM TEMPERATURE OF THE HOTTEST MONTH OF THE YEAR.

FIGURE 4-2. RUNWAY LENGTH TO ACCOMMODATE AIRPLANES HAVING A SEATING CONFIGURATION OF 10 PASSENGER SEATS OR MORE

CHAPTER 5. LAND CONSIDERATION, OBSTRUCTION RESTRICTION, AND AIRPORT HAZARD REMOVAL

* 16. AIRPORT HAZARDS. Airport hazards have a substantial adverse effect upon the safe and efficient use of the airport by aircraft and upon the safety of persons and property located on or near the airport. The term object as used in the following paragraphs includes, but is not limited to, above ground structures, people, equipment, vehicles, aircraft, natural growth, and terrain. Flammable material storage facilities, including fuel truck fill stands and unloading facilities that are located in any of the following areas are airport hazards. The following objects are airport hazards and must be removed:

a. Objects in the airport's airspace that are of a greater height than any of the heights or surfaces defined in FAR 77.23 and that have not been the subject of an FAA aeronautical study. The FAA conducts an aeronautical study of any object when the FAA deems a study is necessary.

b. Objects in the airport's airspace that the FAA has determined, as the result of aeronautical studies, to be hazards to air navigation.

c. Objects penetrating an established clearway plane. FAA approved frangible threshold lights 26 inches (66 cm) or less above the runway end elevation and located to each side of the runway penetrating an established clearway plane are not considered airport hazards. The clearway is defined in paragraph 3.

d. Objects penetrating an imaginary surface or plane associated with an obstacle free zone (OFZ), a threshold, or a visual NAVAID. FAA approved frangible equipment that provides an essential aviation service and penetrates one of these imaginary surfaces or planes is not considered an airport hazard provided it is not an airport hazard as defined in paragraph 16.c. The penetration of any frangible equipment must be kept to a mimimum. The OFZ is defined in paragraph 3. Surfaces associated with thresholds are defined in appendix 9. The design clearance planes associated with visual NAVAIDs are defined in AC 150/5300-2.

e. Objects located in the runway safety area. FAA approved frangibly-mounted equipment that provides an essential aviation service and is located in the runway safety area is not considered an airport hazard provided it is not an airport hazard as defined in paragraphs 16.c or d. The frangibly-mounted equipment in the runway safety area must be located as far as practical from the runway centerline. The runway safety area dimensional standards are provided in paragraph 28 and in AC 150/5300-12, paragraph 14. *

* f. Objects located either between a runway centerline and its aircraft parking line limits or within 0.75 times the wingspan of the most demanding airplane plus 7 feet (2 m) from a taxiway centerline. Frangibly-mounted equipment that provides an essential aviation service, airport service vehicles required to be in these areas for efficient airport operations, and holding and taxiing aircraft located in these areas are are not considered airport hazards provided they are not airport hazards as defined in paragraphs 16.c, d, or e. The frangibly-mounted equipment in these areas must be located as far as practical from the runway and taxiway centerlines. The runway centerline to aircraft parking area separation standard is provided in paragraph 28 and in AC 150/5300-12, paragraph 13. The aircraft parking line limit extends beyond the runway ends for a distance of at least 4 times its separation distance from the runway centerline.

g. Objects located either between a runway centerline and its building restriction lines (BRLs) or within 0.63 times the wingspan of the most demanding airplane plus 7 feet (2 m) from a taxilane centerline. Equipment that provides an essential aviation service, airport service vehicles, aircraft, and people required for efficient airport operations located in these areas are not considered airport hazards provided they are not airport hazards as defined in paragraphs 16.c, d, e, or f. The runway centerline to BRL separation standard is provided in paragraph 28 and in AC 150/5300-12, paragraph 13. The BRLs extend beyond the runway ends for a distance of at least 3,000 feet (900 m) or 4 times their separation distance from the runway centerline whichever is less.

h. Ditchs, rough surfaces, soft spots, or ponding areas located in a runway or taxiway safety area. Gentle drainage swales may be located near the runway or taxiway. The taxiway safety area dimensional standards are provided in paragraph 28 and in AC 150/5300-12, paragraph 23.

i. Garbage dumps or landfills located within 5,000 feet (1 500 m) of a non-turbojet runway or 10,000 feet (3 000 m) of a turbojet runway that may attract birds on or around an airport. *

17. <u>RECOMMENDED CLEARING</u>. Objects, other than airport hazards, for which removal is recommended include:

a. Obstructions that have adverse effect on air navigation as determined by FAR Part 77 or an aeronautical study;

b. The controlling obstacle to an existing or planned terminal instrument procedure that impairs the efficiency or capacity of an airport;

c. Objects which adversely affect departures; and

d. Objects located in a runway clear zone as defined in paragraph 3.

* 18. ZONING AND LAND USE COMPATIBILITY.

a. Land Use. Unconstrained use of land adjacent to or in the immediate vicinity of the airport can directly affect the efficiency and capacity of the airport. Airport authorities should:

(1) Prevent the construction, erection, alteration, or growth of any structure, tree, or other object in the approach areas of the runway or the airport, which would constitute an airport hazard; and

(2) Restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations including landing and takeoff of aircraft.

This may be accomplished by acquiring and retaining easements, other interests, or rights for the use of land and airspace; or by adopting and enforcing zoning regulations.

b. Noise Compatibility. Recipients of Federal aid for airport development need to assure that appropriate action, including the adoption of zoning laws, has been or will be taken, to a reasonable extent, in restricting the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations. Zoning ordinances developed for airspace protection will not necessarily ensure compatibile land use, with respect to noise, in the vicinity of the airport. Depending on the local situation, measures other than zoning or in addition to zoning may be necessary to achieve compatible land use with respect to noise.

(1) FAA Order 5050.4, Airport Environmental Handbook (available at FAA Airports Offices) provides guidance on land use compatibility. Appendix 1 of AC 150/5020-1, Noise Control and Compatibility Planning for Airports, contains a table identifying land uses normally compatible with various levels of noise exposure. The advisory circular also includes information on alternative strategies to achieve compatible land use.

(2) The airport operator may find it desirable to develop a comprehensive airport noise compatibility program in accordance with FAR Part 150, Airport Noise Compatibility Planning. The development of this program is recommended when a significant problem exists relative to noise and land use compatibility. Such a program must include recommended actions to reduce noncompatible areas identified in a thorough evaluation of existing and future noise and land uses in the airport vicinity. The program is developed in consultation with FAA, airport users, the state, and affected communities. The FAA approved program recommendations may be eligible for Federal aid under the Airport Improvement Program. *

* c. Zoning Ordinance. Zoning is adequate where the control is in line with the public interest in health, safety, and general welfare.

(1) Zoning laws and ordinances, enacted in the vicinity of an airport, need to concentrate on airspace protection, compatible land use, noise sensitive areas, esthetics, and consistency with master plans.

(2) Each section of a zoning ordinance is independently justified. Thus, to eliminate misapplication in granting variances, consideration must be given to the justification for each section of the zoning ordinance. An example of misapplication would be the use of an FAA airspace determination of NO HAZARD TO AIR NAVIGATION, which is limited to consideration of the navigable airspace, as the only justification for a variance to the zoning ordinance.

(3) FAA guidance in developing zoning ordinances dealing with protecting the navigable airspace in the vicinity of the airport is contained in AC 150/5190-4, A Model Zoning Ordinance to Limit Height of Objects Around Airports. *

19. LAND ACQUISITION.

a. The amount of land needed for any one of the four groups of utility airports will vary considerably. Factors, such as length and number of runways, lateral, clearances, areas required for buildings, hangars, aircraft tiedown, transient apron, automobile parking, and future expansion of the airport, should be studied in detail, and a plan for the construction and expansion of the airport, such as an airport layout plan, developed.

b. In the preliminary stage of airport development, it is desirable to know the approximate number of acres needed for the airport. Figure 5-3 indicates the approximate acreage needed for each group of airports broken down into three segments.

(1) Landing Area. This includes the runway, safety area, taxiways, and lateral clearances to building restriction lines. The acreages shown are based on a single-runway airport. If an additional runway is needed, a separate calculation must be made for the additional landing area and to provide unrestricted line-of-sight between runways.

(2) Runway Approach Areas. The airport owner should acquire control of the property within the runway clear zone, between the building restriction lines, and as may be required for airport hazard removal and approach protection (see paragraph 16). For those cases where this may be impossible or economically unfeasible, control of the land within the building restriction lines and that required for airport hazard removal and approach protection is an acceptable minimum. These areas are the most critical areas under the approach paths. Therefore, control of these areas is essential, and it is preferably acquired by purchase of the land fee title. If fee title cannot be

obtained, avigation easements may be acquired, although this is less desirable. The acreage required for airport hazard removal and approach protection varies with location, depending on the environment around the approach ends of the runway, local laws and ordinances, and the airport owner's ability to zone around the airport.

(3) Building Area.

(a) This includes all areas beyond the building restriction line which usually are the fixed-base operator facility, T-hangars, tiedowns, transient parking apron, automobile parking, access road, and utilities. In determining the configuration of the building area, physical factors, such as terrain, drainage, and land uses, will affect the efficiency of the layout.

(b) As the type of airport progresses from Stage I to General Utility, it has been assumed that the activity on the airport will also increase. For example, Stage I building area provides for two 10-unit T-hangars, tie downs for 10 airplanes, a parking apron for 10 transient airplanes, a 40-car parking lot, access road, and utilities. (This area is considered minimum.) If feasible, additional area should be acquired early in the airport's development for long-range expansion. The General Utility airport building area provides for two fixed-base operators, ten 10-unit T-hangars, tiedowns for 50 airplanes, a parking apron for 50 transient airplanes, a 100-car parking lot, access, road, and utilities. However, this is an illustration only since activities at the metropolitan airport may differ by as much as twofold or threefold over a community airport.

20. ACQUISITION PROCEDURES. The acreages given in figure 5-3 are calculated on the basis of an airport configuration closely approximating that illustrated. Nevertheless, it is realized that the layout of existing lots and parcels will often require acquisition of land which will result in a considerable variation from this configuration. Figure 5-4 shows an example of approach area acquisition related to existing parcel boundaries. The dashed lines represent the area which should be acquired to meet minimum requirements. However, if it is impractical or unfeasible to acquire a portion of the parcels, an evaluation must be made to determine the effect of deviation from the standard. The recommended property line on figure 5-4 represents one probable configuration of an approach area acquisition for the airport question.

21. FUTURE EXPANSION. It is a well-established fact that land around a metropolitan airport increases in value after the airport is built. To a lesser degree, this is also true for the community airport. Accordingly, parcels of land purchased beyond the minimum needed will often prove to be essential in permitting future expansion of the airport. This matter should be given detailed consideration during the airport master planning study. Generally, airport land should be acquired not only to meet the minimum requirements but also to accommodate future development of the airport required to realize its ultimate role. It may be feasible for this additional land (needed in the future) to be leased until required for airport development.

22. USE OF LAND FOR NONAERONAUTICAL PURPOSES.

a. The two areas on an airport which could be available for use by nonaeronautical activities are the portion of the building area reserved for future airport development and the runway approach area. Certain functions may be allowed in these areas to produce revenue for the airport provided present and future operations of the airport are not jeopardized.

(1) Building Area. A building area not needed immediately for airport development may be used for revenue-producing purposes by a variety of nonaeronautical activities. Such activities could be agricultural, recreational, commercial, or industrial. For example, airport property along a highway might provide good potential for small retail business which require a minimum investment in facilities. Again allow only short-term leases giving due consideration to the planned future of the area in question.

(2) Runway Approach Areas. Congregation of people or establishment of facilities, such as garbage dumps or land fill facilities that would attract birds, must be avoided within the runway clear zones. Limited agricultural uses, such as raising low growing crops, are compatible with the immediate runway approach area. Long-term leases in this area are not recommended unless recapture clauses are included since the land may be required within the period for airport uses such as runway extensions, etc.

b. Also, consider the possibility of establishing an industrial area on or adjacent to the airport. Guidance on this subject is provided in AC 150/5070-3, Planning the Airport Industrial Park. However, check the function of the activity to ensure no interference with the airport. For example, do not permit installation of lighting systems which could be confused with the runway lights, or industries which might produce electromagnetic or electronic disturbances which would interfere with aircraft navigational or communications equipment, or cause visibility problems due to smoke, dirt, steam, or fog. Also, limit the height of all structures to prevent airspace encroachment.

Withdrawn--Change 6

FIGURE 5-3. MINIMUM LAND REQUIREMENTS

RUNWAY TYPE	RUNWAY LENGH IN FEET (METERS)	LANDING AREA IN ACRES	APPROACH AREA IN ACRES	BUILDING AREA IN ACRES **	TOTAL AREA IN ACRES
BASIC UTILITY STAGE I	2000 (600)	23	21	8	52
	3000 (900)	32	21	8	61
	4000 (1200)	41	21	8	70
	5000 (1500)	50	21	8	79
BASIC UTILITY STAGE II	2500 (750)	27	21	12	60
	3500 (1050)	36	21	12	69
	4500 (1350)	45	21	12	78
	5500 (1650)	54	21	12	87
GENERAL UTILITY STAGE I	3000 (900)	39	30	24	93
	4000 (1200)	51	30	24	105
	5000 (1500)	63	30	24	117
	6000 (1800)	75	30	24	129
GENERAL UTILITY STAGE II	3500 (1050)	90	125	24	239
	4500 (1350)	113	125	24	262
	5500 (1650)	136	125	24	285
	6500 (1950)	159	125	24	308

** THESE FIGURES VARY DUE TO ASSUMED HIGHER DEGREE OF ACTIVITY AT THE HIGHER TYPE OF AIRPORT

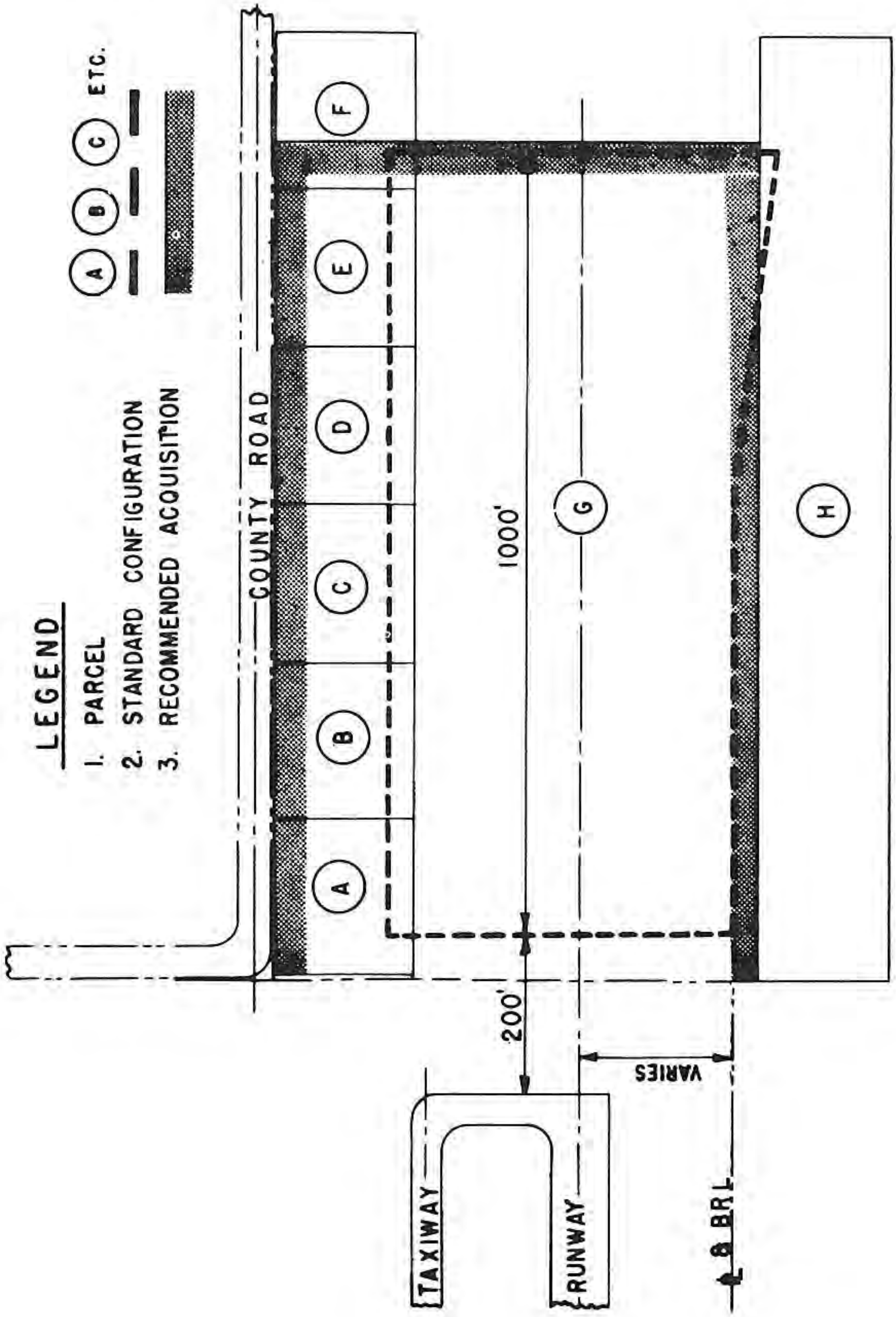


FIGURE 5-4. LAND ACQUISITION FOR APPROACH PROTECTION

CHAPTER 6. SITE INVESTIGATION

23. GENERAL. There are many factors which must be considered in selecting an airport site. These factors include such things as accessibility to the users; Government regulations affecting airport development; ease with which the site can be developed; the existence of obstacles that might interfere with aeronautical operations; the occurrence of conditions of reduced visibility (fog, smoke, etc.); the effect of the development on the surrounding environment; and the feasibility of future expansion and instrument operations. Advisory Circular 150/5070-6, Airport Master Plans, discusses in detail the subject of airport selection. The primary purpose of this chapter is to briefly present the Government regulations that must be considered and the engineering factors that must be analyzed in reviewing potential sites for a utility airport.

24. GOVERNMENT REGULATIONS.

a. Federal Aviation Regulations Part 157, Notice of Construction, Alteration, Activation, and Deactivation of Airports, requires that the FAA Airports District Office or regional office be notified by persons proposing to construct, alter, activate, or deactivate a civil airport. The FAA will conduct an aeronautical study to determine the effect of the proposal on the safe and efficient use of airspace. Upon completion of the study, the proponent will be notified of the FAA's determination. Advisory Circular 70-2, Airspace Utilization Considerations in the Proposed Construction, Alteration, Activation and Deactivation of Airports, discusses in detail this FAR Part 157 requirement. This advisory circular also contains the addresses and geographic jurisdictions of the FAA offices. These offices should also be contacted to determine the requirements which must be met if it is desired to develop the airport with Federal funds.

b. In addition, most states require their approval of the proposed airport through licensing or some similar means. The state in which the proposed airport will be located should be contacted directly to determine that state's requirements.

c. The local governing body should also be contacted to determine if they have any laws that may affect the proposed airport.

25. ENGINEERING ASPECTS OF SITE INVESTIGATION. An investigation of all potential sites must be made for two purposes: to determine an estimated cost of development, and to allow a comparative analysis of all potential sites. The services of an experienced engineer should be enlisted since the investigation will require a thorough knowledge of engineering principles and practices. The factors that should be analyzed in selecting an airport site are presented in the following paragraphs. For convenience, a checklist for the required engineering information is included in Appendix 2 of this publication.

a. Site Clearing. Site clearing should be analyzed from the standpoint of removing all objects (trees, buildings, powerlines, etc.) that may affect airplane operations (see Chapter 5). This often requires clearing both the landing area and the runway approaches.

b. Soil Survey. A preliminary soils survey is conducted to evaluate soils to approximate their classification in accordance with the FAA method for classifying soils. This method is described in Advisory Circular 150/5320-6, Airport Pavement Design and Evaluation. This will involve field investigation and office research of available data.

c. Drainage. Preliminary drainage investigation must determine the general limits of all drainage areas which affect the airport site, including tributary areas beyond the airport boundary. The maximum rainfall expected once in 5 years is generally recommended for estimating runoff for airports. A detailed discussion of this factor is contained in Advisory Circular 150/5320-5, Airport Drainage.

d. Grading. Preliminary grading layout, based upon a reasonably balanced runway profile, should allow a general estimate of the cubic yards of earth that must be moved for cut and fill and borrow operations. The maximum and minimum allowable transverse and longitudinal slopes for the airport will greatly restrict the possibilities for alternate grading schemes. Further, the drainage system must be considered jointly with grading since each affects the design of the other.

e. Paving. Pavement investigation includes a preliminary design of both the airport and access road pavements. It also requires determination of the availability and source of the various materials to make up the pavement structure. With these data, an estimate of the cost for pavement construction can be made. Chapter 12 discusses this subject in more detail.

f. Turfing. Turfing will usually provide the most economical means for protecting airport areas which are subject to wind or water erosion. Local conditions should dictate the choice of grass species for the turf. (The local office of the County Agent, Department of Agriculture, Soil Conservation Service is available to assist in the selection of appropriate grasses.)

g. Airport Lighting. Preliminary layout of the airport lighting system should include the runway lights, visual approach slope indicators (VASI), lighted wind cone, ducts, controls, and airport beacon. * Advisory Circulars 150/5340-24, Runway and Taxiway Edge Lighting System, and 150/5340-25, Visual Approach Slope Indicator (VASI) Systems, provide guidance for estimating the requirements of the * lighting system. In many cases, lighting may not be justified initially. Nevertheless, future planning should recognize the need for a lighting system and initial construction should include installation of ducts under pavement for the lighting system. Lighting of obstructions may also be required.

h. Utility System. Preliminary design of the utility system includes general layout of the water, sewer, communications, and power systems. In some locations, this will require provisions for on-site water supply and sewage disposal. Local ordinances often govern design criteria for these facilities.

* i. Site Location Compatibility. Airport-community compatibility is as important to the longevity of a utility airport as good pavement design. Airport-community compatibility is established by assuring that land uses within the airport-aircraft operational impact areas are limited to those uses that are compatible with the normal day-to-day activities at and around the airport facility. The airport site should be located in an area that is compatible and has the potential to remain compatible through land use controls. Land-use compatibility guidelines, based on yearly day/night average sound levels (Ldn), are found in Table 2, Appendix A of FAR Part 150, Airport Noise Compatibility Planning. For other environmental compatibility information, see FAA Order 5050.4, Airport Environmental Handbook. (This Order may be obtained by request at any FAA Airports Office.) *

CHAPTER 7. DESIGN CRITERIA AND DIMENSIONAL STANDARDS

26. GENERAL. The design standards represent a recognition of absolute minimum requirements for airplane operations plus a safety margin based upon airport research as well as operating experience. For example, the absolute minimum requirement for taxiway width is the outside-to-outside dimension of the landing gear configuration. The standard, however, provides additional width to account for the realities of airplane operations in daylight, nighttime, and all-weather conditions. Appendix 1 of AC 150/5300-12 discusses the effect of airplane physical characteristics on the design of airport elements. That rationale may be used on a case-by-case basis in adapting airport design standards and recommendations, primarily at existing airports, to accommodate unusual local conditions or a specific airplane within an airplane design group.

27. FUTURE ROLE CONSIDERATIONS. In applying design standards, airport authorities need to determine the airport's future role. Initial development of the airport should be planned to accommodate the future role. For example, when the initial and ultimate needs, respectively, are to accommodate airplanes in Airplane Design Groups I and II, the pavement widths for Airplane Design Group I should be used in conjunction with the lateral clearances of Airplane Design Group II. Specifically, the runway and taxiway widths should be 60 feet (18 m) and 25 feet (7.5 m), but with a runway to taxiway separation of 240 feet (72 m), rather than 150 feet (45 m).

* 28. DIMENSIONAL CRITERIA. Figure 7-1 specifies the minimum lengths, widths, and clearances for airport design. At least one set of dimensions is tabulated for each runway instrumentation configuration and airplane design group combination assuming 95 percent wind coverage. For airports with runway wind coverage of less than 95 percent, a crosswind runway may be needed (see chapter 3), or an increase in dimensions may be considered.

a. The Airplane Design Group I dimensions are for airports expected to serve airplanes in Aircraft Approach Category A and B with wingspans up to but not including 49 feet (15 m). This airplane design group has two sets of dimensions; one for facilities expected to serve only small airplanes and another for facilities expected to serve large airplanes.

b. The Airplane Design Group II dimensions are for airports expected to serve airplanes in Aircraft Approach Category A and B with wingspans up to but not including 79 feet (24 m).

c. The Airplane Design Group III dimensions are for airports expected to serve airplanes in Aircraft Approach Category A with wingspans up to but not including 118 feet (36 m) and airplanes in Aircraft Approach Category B with wingspans up to but not including 79 feet (24 m). For this airplane design group, the dimensional standards for precision instrument, nonprecision instrument, and visual runways are the same.

d. The dimensional standards for airport components expected to serve faster and larger airplanes are in AC 150/5300-12.

* 29. TYPICAL AIRPORT LAYOUT. Figure 7-2 illustrates the application of the dimensional standards and is keyed to the items in figure 7-1. This typical layout of a portion of an airport shows the relationship between the runway, taxiway, runway clear zone, building restriction line, and property line. *

30. RUNWAY AND RUNWAY SAFETY AREA LONGITUDINAL GRADE. The longitudinal grade limitations for the runway and the runway safety area along the runway are shown in figure 7-3. For the first 200 feet (60 m) of runway safety area beyond the runway end, the longitudinal grade needs to be such that the primary surface is not penetrated nor the grade steeper than 3 percent. The longitudinal grade limitations for the remainder of the runway safety area are shown in figure 7-6. In stage construction, it is important to consider the line-of-sight standard for the ultimate runway length.

31. LINE-OF-SIGHT. Line-of-sight standards impose an additional restraint on surface gradients. It is desirable to provide an unobstructed line-of-sight along the entire length of an individual runway or taxiway, as well as along the entire length of an intersecting runway. The following paragraphs provide line-of-sight standards:

a. Along Individual Runways.

(1) Airports Not Having a 24-hour Control Tower. Runway grade changes shall be such that any two points 5 feet (1.5 m) above the runway centerline will be mutually visible for the entire runway length. However, if the runway has a parallel taxiway for its full length, runway grade changes may be such that an unobstructed line-of-sight will exist from any point 5 feet (1.5 m) above the runway centerline to all other points 5 feet (1.5 m) above the runway centerline within a distance of half the length of the runway.

(2) Airports Having a 24-hour Control Tower. Although it is desirable to provide the above line-of-sight for the entire runway length, adherence to longitudinal gradient standards will provide an adequate line-of-sight. However, before applying these criteria, a careful analysis must be made of forecasted airport traffic to ascertain whether the tower will remain in 24-hour operation. Visibility requirements from the airport traffic control tower to the airport surface areas used in aircraft ground movement must also be considered.

b. Between Intersecting Runways.

(1) Airports Not Having a 24-hour Control Tower. Runway grades, terrain, structures, and permanent objects must be such that there will be unobstructed line-of-sight from any point 5 feet (1.5 m) above one runway centerline to any point 5 feet (1.5 m) above an intersecting runway centerline, both points being within the area of the runway visibility zone. The runway visibility zone is an area formed by imaginary lines connecting the two runways' visibility points as shown in figure 7-4. The location of each runway's visibility points is determined in the following manner:

(a) when the distance from the intersection of two runway centerlines to a runway end is 750 feet (250 m) or less, the visibility point is located on the centerline at the runway end;

(b) when the distance from the intersection of two runway centerlines to a runway end is greater than 750 feet (250 m) but less than 1,500 feet (500 m), the visibility point is located on the centerline, 750 feet (250 m) from the intersection of the runway centerlines; or

(c) when the distance from the intersection of two runway centerlines to a runway end is equal to or greater than 1,500 feet (500 m), the visibility point is located on the centerline and equidistant from the runway end and the intersection of the centerlines.

(2) Airports Having a 24-hour Control Tower. Although it is desirable to provide an unobstructed line-of-sight along the entire length of an intersecting runway, there are no mandatory line-of-sight requirements between intersecting runways at these airports. However, analysis should be made of forecasted airport traffic to ascertain whether the tower will remain in 24-hour operation.

c. Taxiways. There are no specific line-of-sight requirements for taxiways. However, the sight distance along a runway from an intersecting taxiway must be sufficient to allow a taxiing aircraft to enter safely or cross the runway.

32. TYPICAL CROSS SECTION. The transverse grade limitations for the runway and other airport surfaces are shown in figure 7-5. The transverse grade limitations for the portion of the runway safety area beyond the runway ends are in figure 7-6. The established transverse grades of the runway safety area, as shown in these figures, are necessary to maintain proper drainage and to control erosion. The grading for stage development should be compatible with the ultimate proposed final grades of a particular area. Failure to plan accordingly may lead to costly grade adjustments, resurfacing, and the rebuilding of drainage facilities or other structures during later stages of airport development.

33. APPLICATION OF DIMENSIONAL STANDARDS. An airport design standard suitable for use in all parts of the Nation, for a variety of airplanes and under many variations in local conditions, is based upon broad considerations. Where such a national standard is to be modified for a particular airport, competent engineers are required to adapt the standard to local conditions.

a. Certain standards, such as the standard for the transverse grade of the runway safety area, are expressed as a maximum and a minimum. The range presented reflects a standard adequate for surface drainage but not in excess of the reasonable requirements for safe and efficient airplane operation.

* b. The standards in figure 7-1 are also applicable to runways provided especially for airplanes in Aircraft Approach Category A and B at Transport Airports. However, regard must be given to assure that lateral clearances are maintained for airplanes in Aircraft Approach Category C and D. *

ITEM	DIM 1/	NONPRECISION & VISUAL RUNWAY			PRECISION INSTRUMENT RUNWAY			
		AIRPLANE DESIGN GROUP			AIRPLANE DESIGN GROUP			
		I 2/ Wingspan < 49'	I Wingspan < 49'	II Wingspan < 79'	I 2/ Wingspan < 49'	I Wingspan < 49'	II Wingspan < 79'	III Wingspan < 118'
Runway								
Length	A	- Refer to chapter 4 -						
Width	B	60 ft 18 m	60 ft 18 m	75 ft 23 m	75 ft 23 m	100 ft 30 m	100 ft 30 m	100 ft 30 m
Runway Safety Area 3/								
Length Beyond Runway End 4/	2C	240 ft 72 m	240 ft 72 m	300 ft 90 m	600 ft 180 m	600 ft 180 m	600 ft 180 m	600 ft 180 m
Width	C	120 ft 36 m	120 ft 36 m	150 ft 45 m	300 ft 90 m	300 ft 90 m	300 ft 90 m	300 ft 90 m
Taxiway								
Width	D	25 ft 7.5 m	25 ft 7.5 m	35 ft 10.5 m	25 ft 7.5 m	25 ft 7.5 m	35 ft 10.5 m	50 ft 15 m
Taxiway Safety Area								
Width		49 ft 15 m	49 ft 15 m	79 ft 24 m	49 ft 15 m	49 ft 15 m	79 ft 24 m	118 ft 36 m
Separation Distance:								
Runway Centerline to;								
Parallel Runway Centerline		700 ft 210 m	700 ft 210 m	700 ft 210 m	- Refer to AC 150/5300-12 -			
Parallel Taxiway Centerline 5/	E	150 ft 45 m	225 ft 67.5 m	240 ft 72 m	200 ft 60 m	250 ft 75 m	300 ft 90 m	350 ft 105 m
Building Restriction Line and Aircraft Parking Area 6/	F	125 ft 27.5 m	200 ft 60 m	250 ft 75 m	7/ 7/	7/ 7/	7/ 7/	7/ 7/
Runway Centerline and End to;								
Object		- Refer to paragraph 16 -						
Property Line	G	- Refer to paragraph 19 -						
Taxiway Centerline to;								
Parallel Taxiway Centerline		69 ft 21 m	69 ft 21 m	103 ft 31.5 m	69 ft 21 m	69 ft 21 m	103 ft 31.5 m	153 ft 46.5 m
Parked Aircraft and Object	H	- Refer to paragraph 16 -						
Taxilane Centerline to;								
Parked Aircraft and Object		- Refer to paragraph 16 -						

1/ Letters are keyed to those illustrated in figure 7-2

2/ These dimensional standards are for facilities which are to serve only small airplanes.

3/ This runway safety area standard applies to all runways and runway extensions, that are constructed or upgraded after February 24, 1983. For other runways, the maximum feasible length and width of runway safety area should be provided.

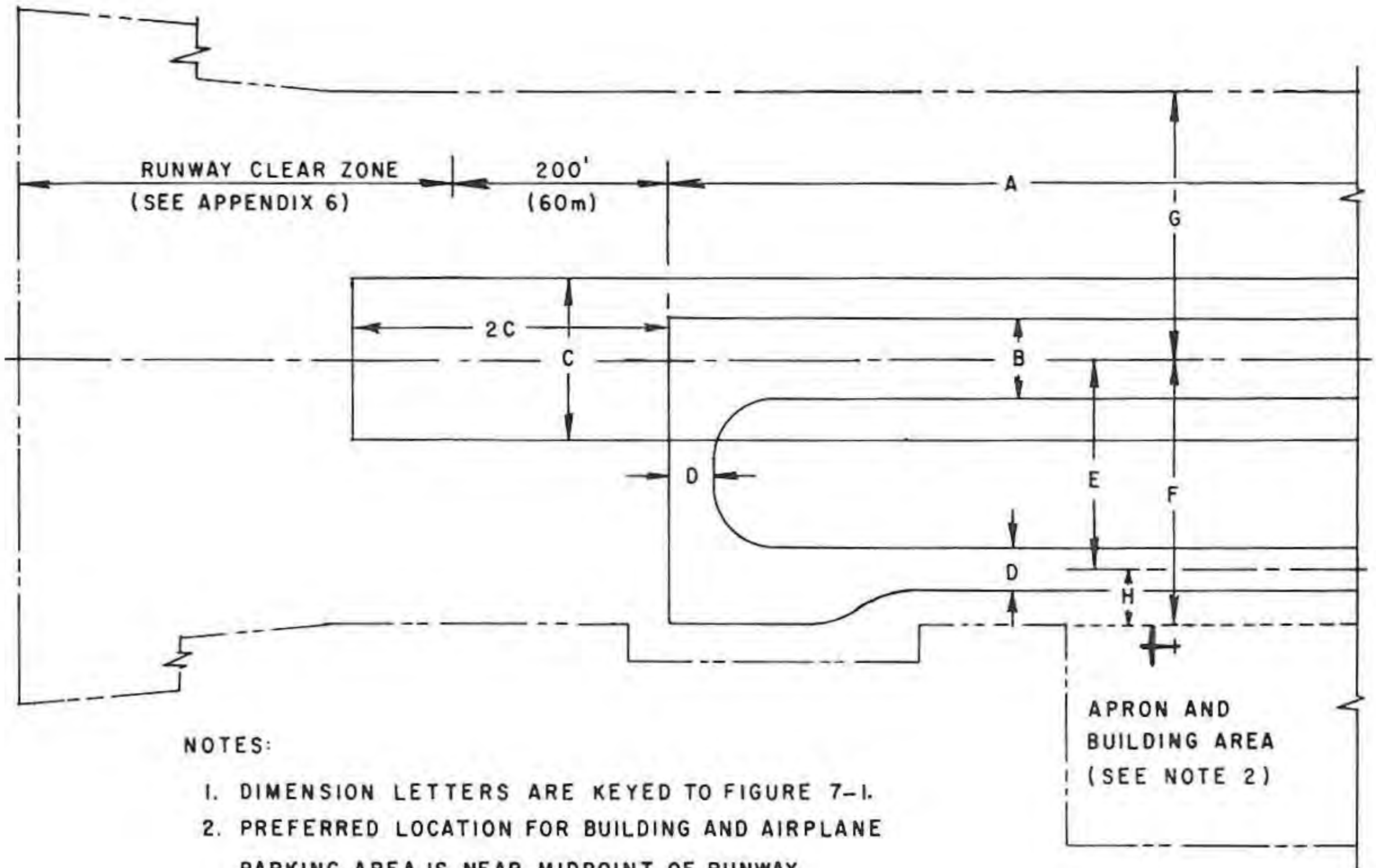
4/ These distances may need to be increased to keep the stopway within the runway safety area.

5/ The location of a parallel taxiway may be adjusted such that no part of an aircraft (tail, wing tip) on taxiway centerline penetrates the obstacle free zone (OFZ).

6/ Objects located outside of the building restriction lines may penetrate the airport imaginary surfaces defined in Subpart C of FAR Part 77 where an FAA aeronautical study has determined that the specific penetration will not result in a hazard to air navigation.

7/ The building restriction line for a Category I ILS runway precludes any part of a building, tree, or parked aircraft from penetrating surfaces originating 300 feet (90 m) from runway centerline and sloping laterally outward 4 (horizontal) to 1 (vertical).

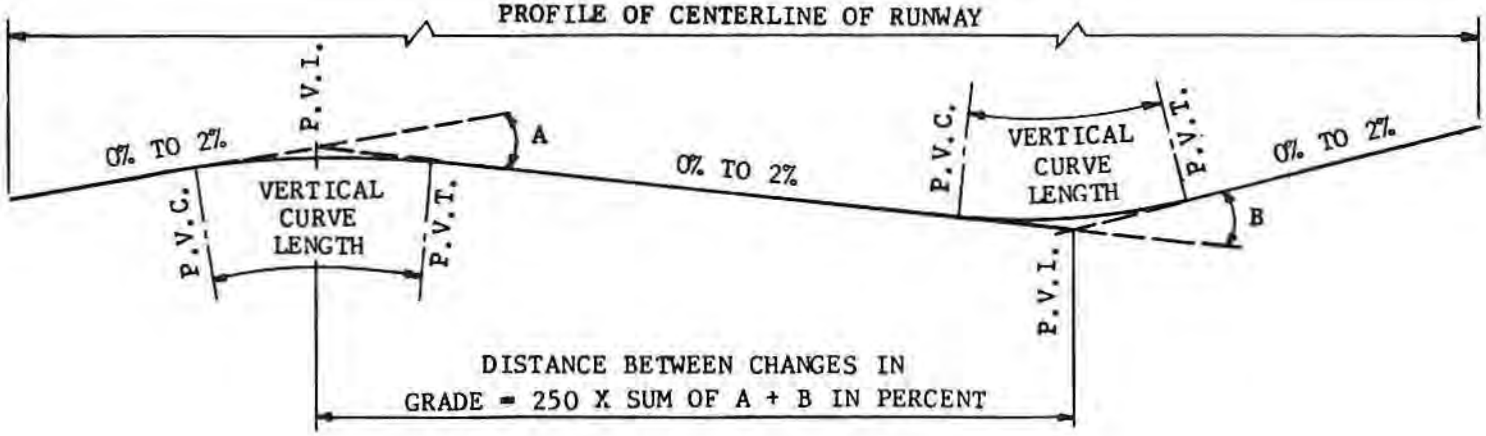
FIGURE 7-1. DIMENSIONAL STANDARDS



NOTES:

1. DIMENSION LETTERS ARE KEYED TO FIGURE 7-1.
2. PREFERRED LOCATION FOR BUILDING AND AIRPLANE PARKING AREA IS NEAR MIDPOINT OF RUNWAY.

FIGURE 7-2. AIRPORT LAYOUT



VERTICAL CURVES

LENGTH OF VERTICAL CURVES WILL NOT BE LESS THAN 300' FOR EACH 1% GRADE CHANGE, EXCEPT THAT NO VERTICAL CURVE WILL BE REQUIRED WHEN GRADE CHANGE IS LESS THAN 0.4%.

SIGHT DISTANCE

SEE PARAGRAPH 31.

GRADE CHANGE

MAXIMUM GRADE CHANGE SUCH AS (A) OR (B) SHOULD NOT EXCEED 2%.

FIGURE 7-3. LONGITUDINAL GRADE LIMITATIONS

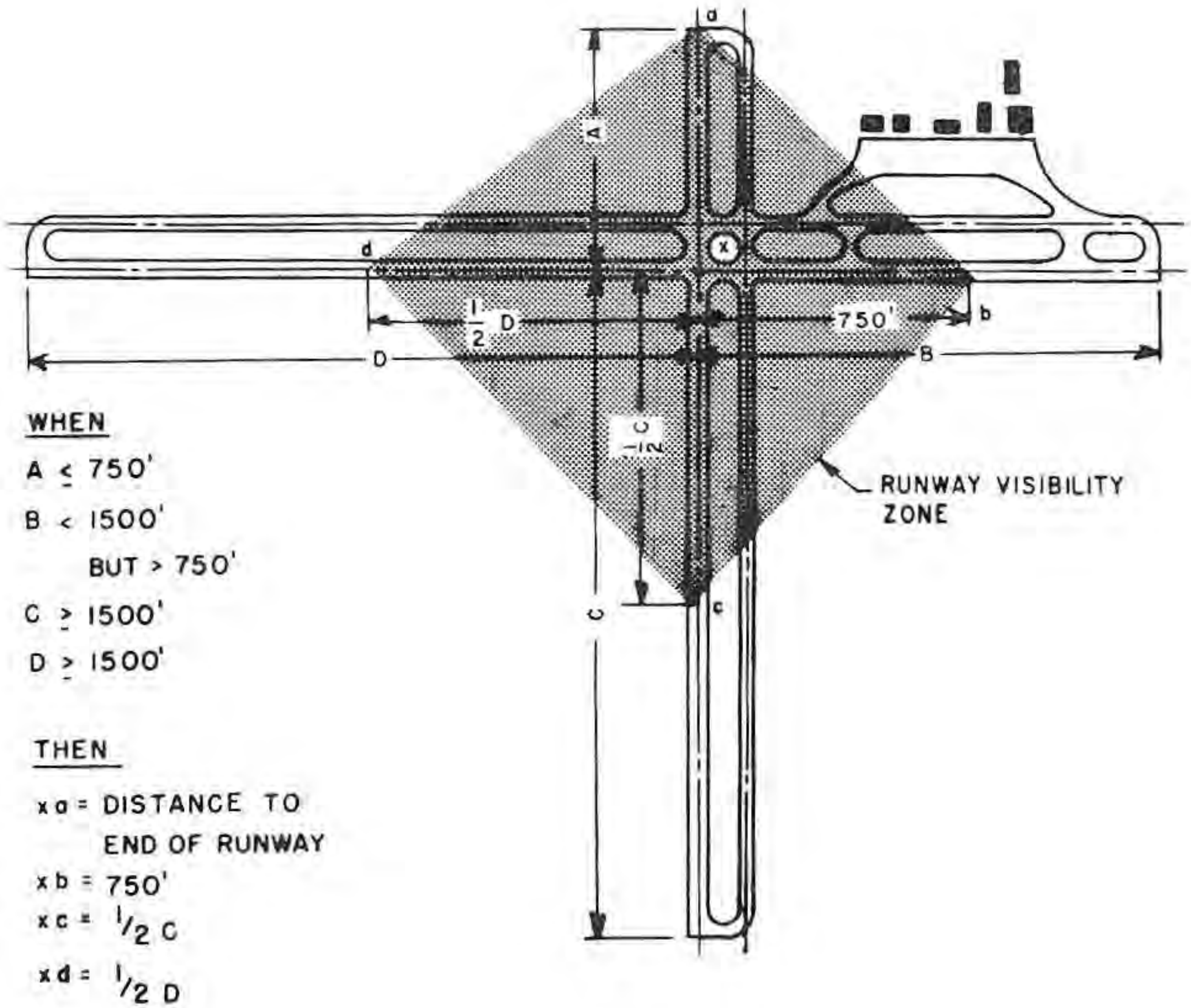


FIGURE 7-4. RUNWAY VISIBILITY ZONE

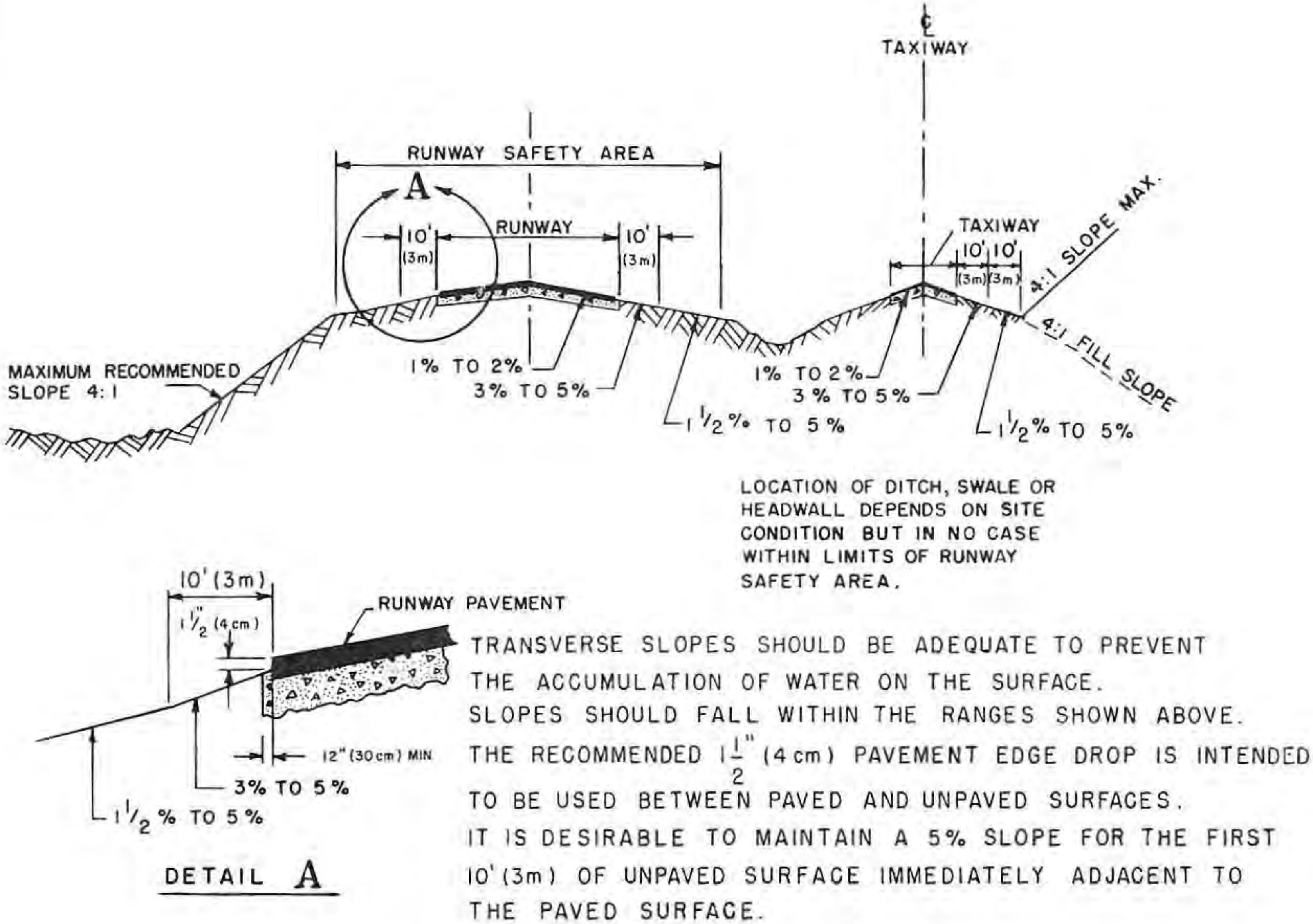
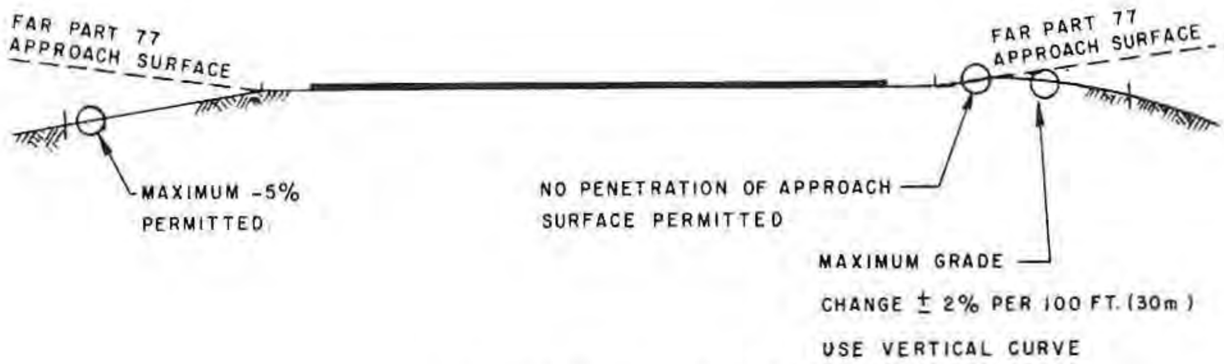
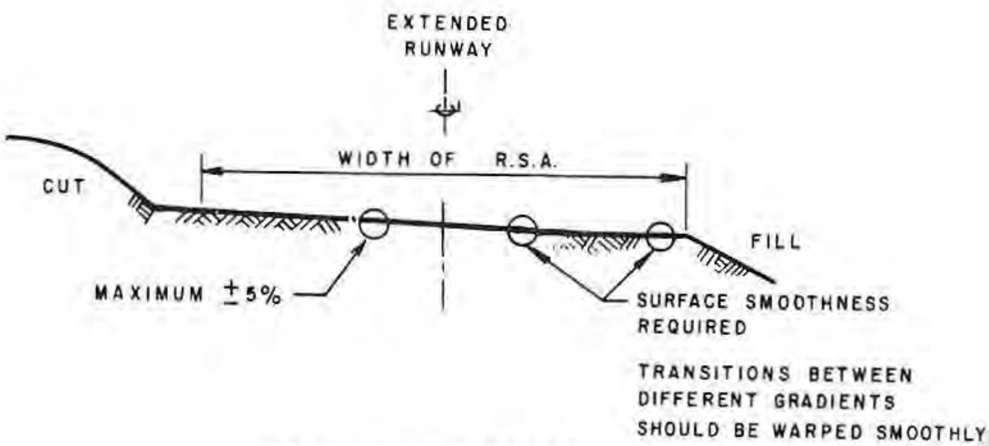


FIGURE 7-5. TYPICAL CROSS SECTION



LONGITUDINAL GRADE



TRANSVERSE GRADE

FIGURE 7-6. RUNWAY SAFETY AREA GRADES

CHAPTER 8. TAXIWAYS, TURNAROUNDS, AND HOLDING APRONS

34. GENERAL. Taxiways are constructed primarily to get airplanes off and onto the runway. In terms of use, taxiways can be classified into one of three groups: parallel, exit, and hangar and apron access. The pavement fillets depicted in this chapter are acceptable for airplanes whose sum of wheelbase length plus undercarriage width is less than the taxiways width. For taxiways expected to serve airplanes whose sum of wheelbase length plus under carrige width is
* greater than the taxiway width, the criteria in appendix 2 of AC 150/5300-12 are to be used.

35. PARALLEL TAXIWAYS. Provision of a parallel taxiway should be made with the initial runway development. When the construction of a full parallel taxiway * is not practical, the construction of a partial parallel taxiway should be considered. The construction of a parallel or partial parallel taxiway will significantly improve airport safety and efficiency.

36. EXIT TAXIWAYS.

a. For a runway with a parallel taxiway, three exit taxiways will usually suffice, i.e., the two end exits and one approximately at the center of the runway. If a parallel taxiway or partial parallel taxiway is not constructed, an exit taxiway leading directly from the runway to the parking apron may suffice.

b. Figure 8-1 shows the recommended fillet radii for taxiway-runway intersections. It might appear that increasing a fillet radius would allow more rapid operations to and from the runway, but a special study of the fillets needed for exit taxiways at the end of runways found that the normal ground operating speeds of small airplanes are such that the overall effect on airport capacity is negligible.

c. As traffic increases, particularly at the general utility airport, the number and location of the exit taxiways will significantly increase runway capacity.

37. HANGAR AND APRON ACCESS TAXIWAYS. The most common use of a hangar taxiway is to provide access to the T-hangar area. A 20-foot (6 m) wide taxiway will normally accommodate this function. Figure 10-2 shows the clearances recommended for taxiways between hangars. Taxiways providing access to tiedown areas which are separate from the parking apron may also be constructed at the 20-foot (6 m) width.

* 38. TURNAROUNDS. At low traffic airports, turnarounds may be considered during the initial runway development as an alternative to a full or partial parallel taxiway. Figures 8-2, 8-3, and 8-4 show three types of turnarounds. Other designs may also be effective, provided that sufficient space is established for the airplanes beyond the holding line. (See paragraph 58b for details on holding line requirements.) Drainage, snow removal, and construction costs * should be considered in selecting a design configuration. The pavement required to build the turnarounds shown in figures 8-2 and 8-3 would provide for a portion of a parallel taxiway, and a moderate increase in cost may allow the construction of a partial parallel taxiway rather than a turnaround.

39. HOLDING APRONS. The purpose of a holding apron is to provide an area clear of taxiway traffic for aircraft to park while the "before-takeoff-checklist" review is performed. The construction of a holding apron will minimize delays to departing aircraft by providing taxiway bypass capability. When runway traffic is forecasted to reach 30 operations per peak hour (see paragraph 48, Airport Survey, for peak-hour determination), plans should be made for developing a holding apron. Figures 8-2, 8-3, and 8-5 show typical layouts of holding aprons for small airplanes.

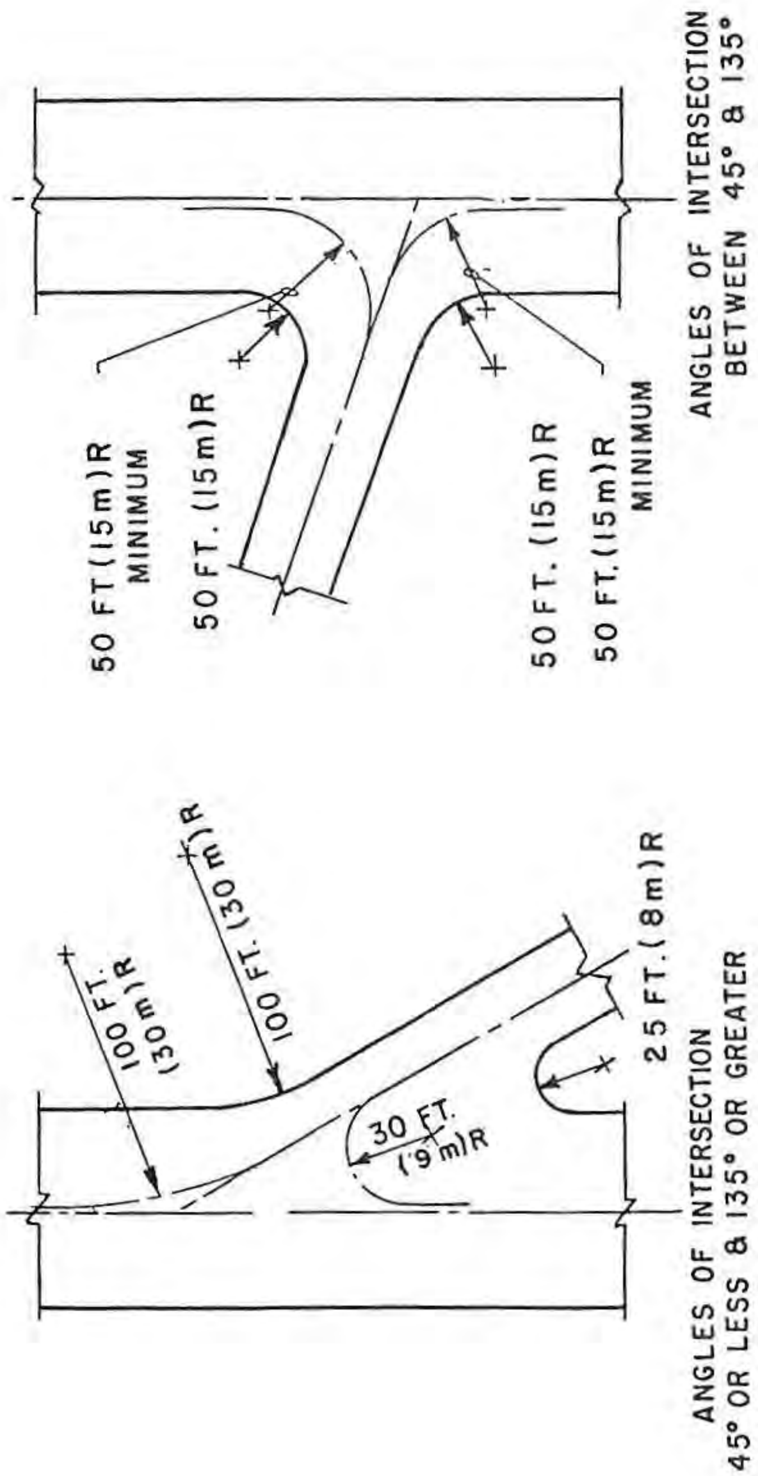


FIGURE 8-1. TYPICAL RUNWAY AND TAXIWAY FILLETS

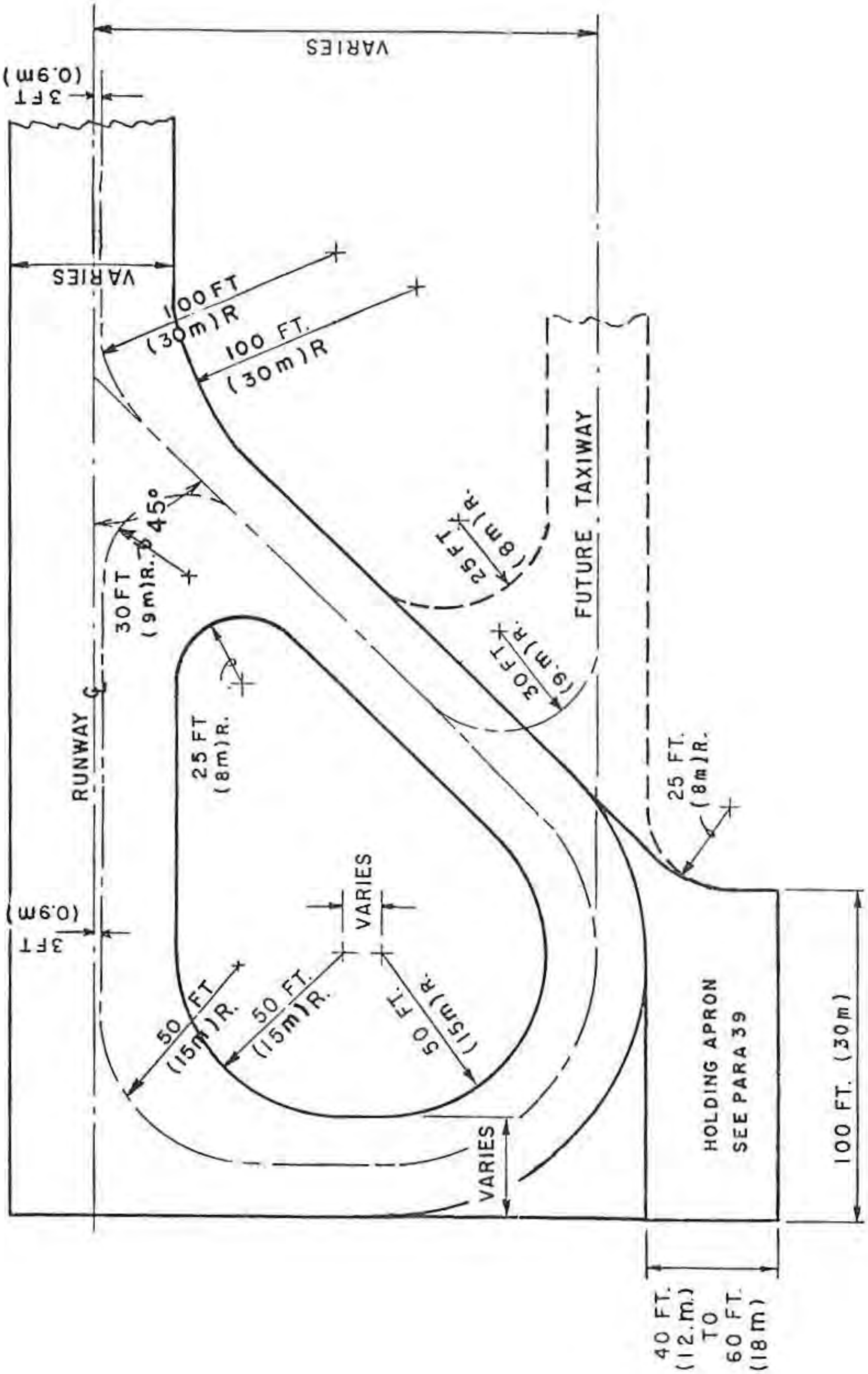


FIGURE 8-2. TURNAROUND--ANGULAR

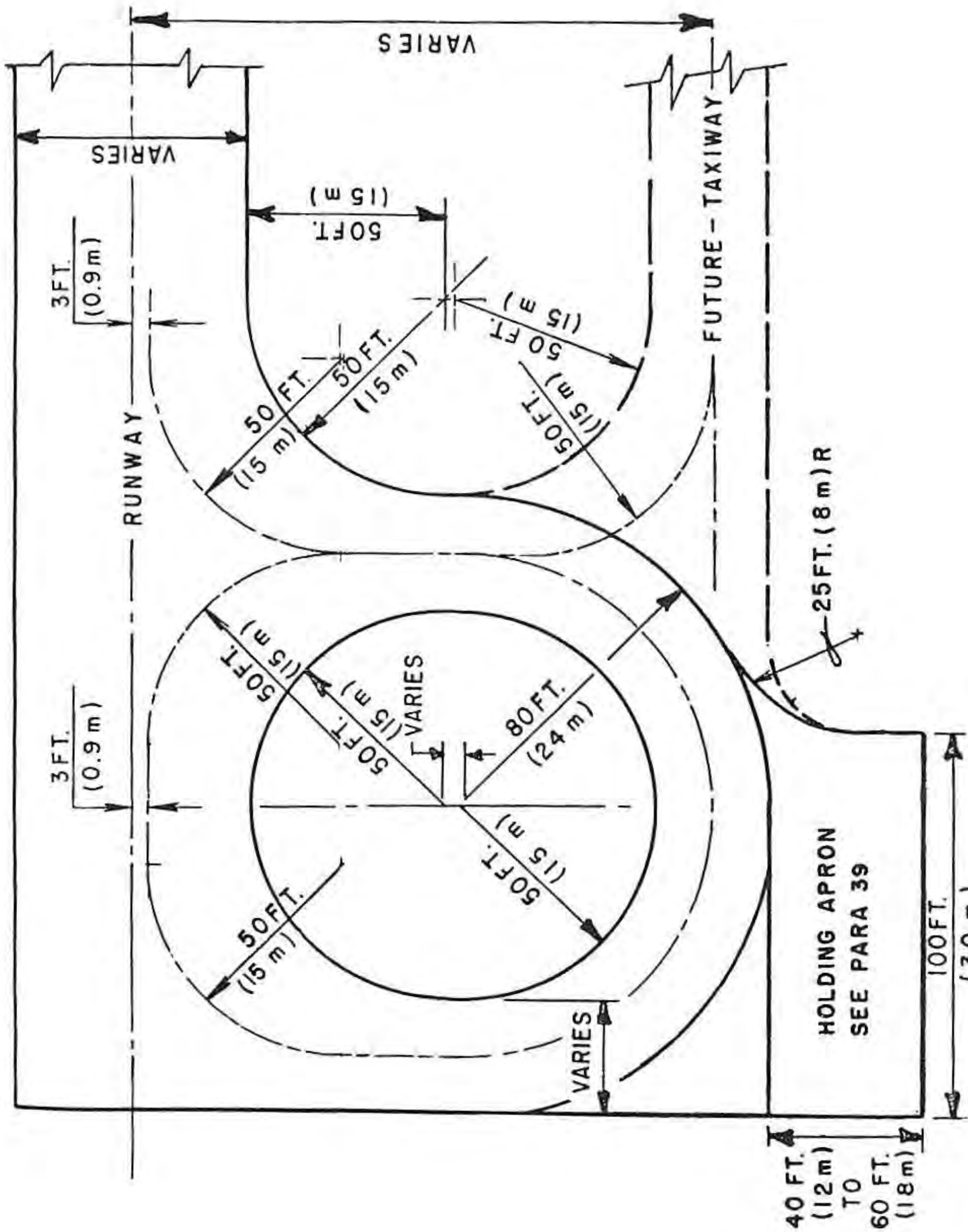


FIGURE 8-3. TURNAROUND--CIRCULAR

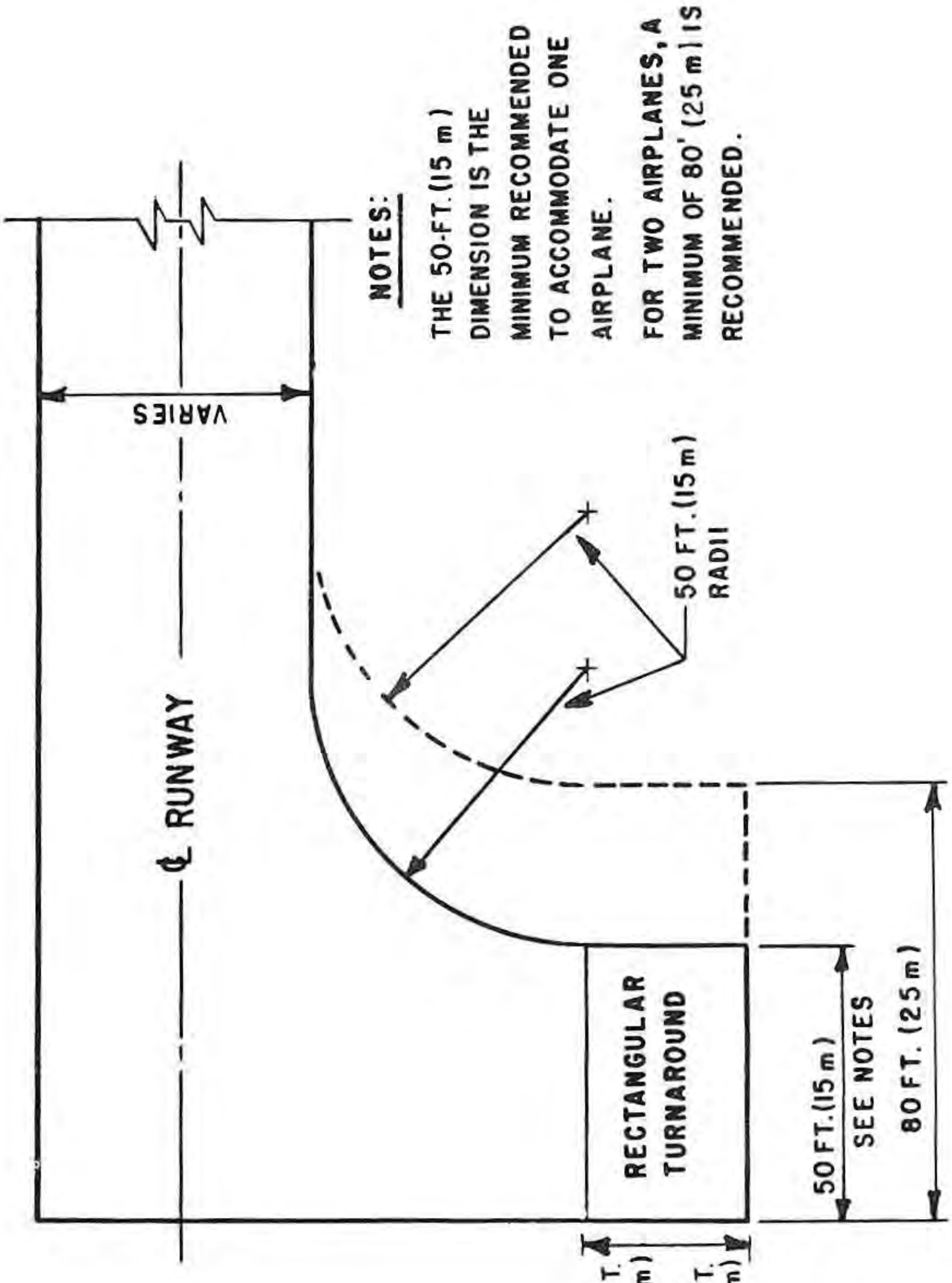


FIGURE 8-4. TURNAROUND--RECTANGULAR

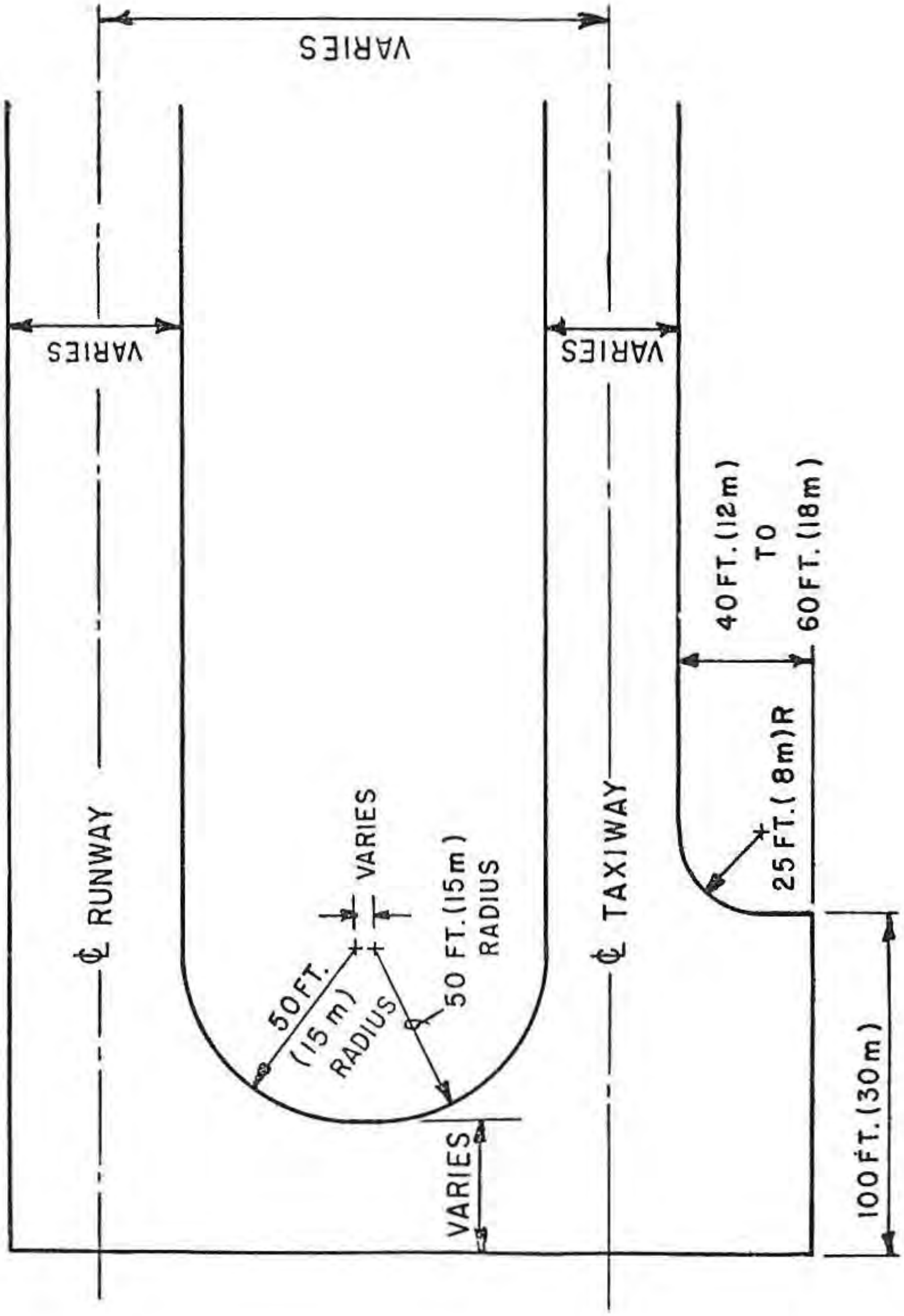


FIGURE 8-5. HOLDING APRON

CHAPTER 9. AIRPLANE PARKING AND TIEDOWN

40. GENERAL. During the airport master planning study, determine the number of based and transient airplanes expected to utilize the airport. Using these figures, the layout and design of the airplane parking apron and tiedown area can be accomplished.

a. Figure 9-1 shows an example of the design of a parking apron for small airplanes related to operation functions. There are five elements that should be considered: the fixed base operator (FBO), the itinerant airplanes, the based airplanes, short-term loading and unloading (terminal), and fueling.

b. The FBO will require space adjacent to his facility to park his own airplanes being serviced. Room must be provided for future expansion.

41. ITINERANT APRON. Provide parking facilities for itinerant or transient airplanes which give easy access to the terminal facilities, fueling, and surface transportation. It is difficult to determine the total amount of apron area needed to accommodate itinerant airplanes by formula or empirical relationship. Local conditions often vary significantly from one airport to another. The ideal solution is to conduct an on-site survey during typical busy days and to count the itinerant airplanes on the ground periodically during the day. However, this is impossible for new airports and impractical for many airports that have no manager. Recognizing this situation, it is worthwhile to state a method which includes factors that affect the determination of the area needed for itinerant parking. With this method, the engineer/planner can analyze and estimate the demand for the itinerant airplane apron. The suggested method is as follows:

a. Calculate the total annual itinerant operations from the best available source. This may be as described in Figure 9-2.

b. Obtain the record of aviation gas sales for the year for the airport.

c. Correlate gas sales with annual itinerant operations on a monthly basis.

d. Calculate the average daily itinerant operations for the most active month.

e. Assume the busy itinerant day is 10 percent more active than the average day. This is based on data from FAA surveys.

f. Assume that a certain portion of the itinerant airplanes will be on the apron during the busy day. Fifty percent is considered a reasonable figure, but if used, it must be applied with caution.

g. Calculate the area needed on the basis of 360 square yards per itinerant airplane.

h. Increase the above by a specific percentage to accommodate expansion for at least the next 2-year period. A minimum increase of 10 percent is suggested.

42. APRON FOR BASED AIRPLANES. Locate the apron for based airplanes in an area separate from the itinerant airplanes. The area needed for parking based airplanes is smaller per airplane than for itinerants. This is due to knowledge of the specific type of based airplanes and closer clearance allowed between airplanes. In determining the total apron area required for local airplanes, consider the following factors:

a. The total number of based airplanes.

b. The number of airplanes now hangared or expected to be hangared within two years.

c. The number of airplane owners who will continue to tie down their airplane in a turfed (unpaved) area. At many general aviation airports a certain percentage of airplane owners will prefer to tie down in the most inexpensive area.

d. An area of 300 square yards per airplane. This should be adequate for all single engine and light twin engine airplanes, such as the Cessna 310, which has a wingspan of 37 feet and a length of 27 feet.

e. An increase in total area to accommodate expansion for at least the next 2-year period. A minimum increase of 10 percent is suggested.

43. TIEDOWNS. Using the above, a total apron area needed for based airplanes can be computed. The location of tiedowns in this area will vary with local preference. However, the purpose for laying out the tiedowns is to park the maximum number of airplanes and to maintain ease of ingress and egress. Figure 9-3 illustrates two layouts of such tiedowns for small airplanes. Information on general tiedown techniques and procedures is given in Advisory Circular 20-35, Tie-down Sense.

44. OTHER CONSIDERATIONS.

a. As activity at the airport increases, the demand for an area to load and unload airplanes will increase. This activity may be in the form of charter, air taxi, business, or personal airplane operations. Generally, the area should be large enough to accommodate two airplanes in front of the terminal building. Also, investigate requirements for possible local air mail service.

b. At Basic Utility airports, a gas pump facility is usually the most economical method of airplane fueling. For such an operation, locate the fueling area near the terminal building. Application of a fuel-resistant seal coat to the pavement may be desirable in these areas.

c. At General Utility airports, a fuel truck operation is sometimes used. Such an operation eliminates the need for gas pump areas and allows more area for airplane parking.

d. In summary, carefully design the apron to maintain its flexibility and expandability. Use empirical relationships for design only when field data are not available. Install the tiedowns so that the apron area can be altered as needed. Also, it is ideal to keep both ends of the apron free of structures and thus to allow for future expansion.

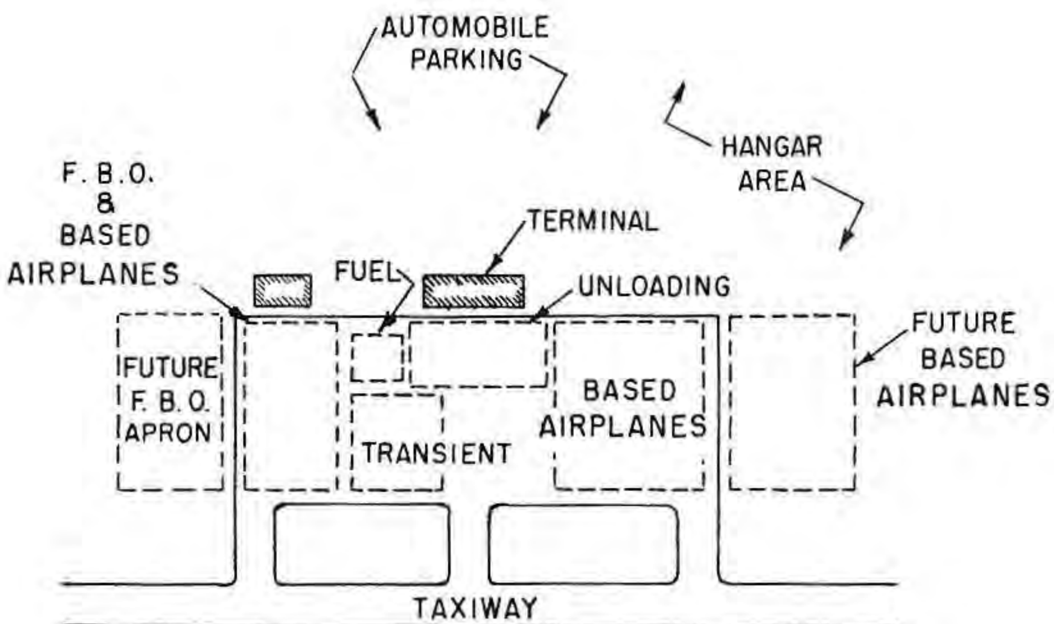
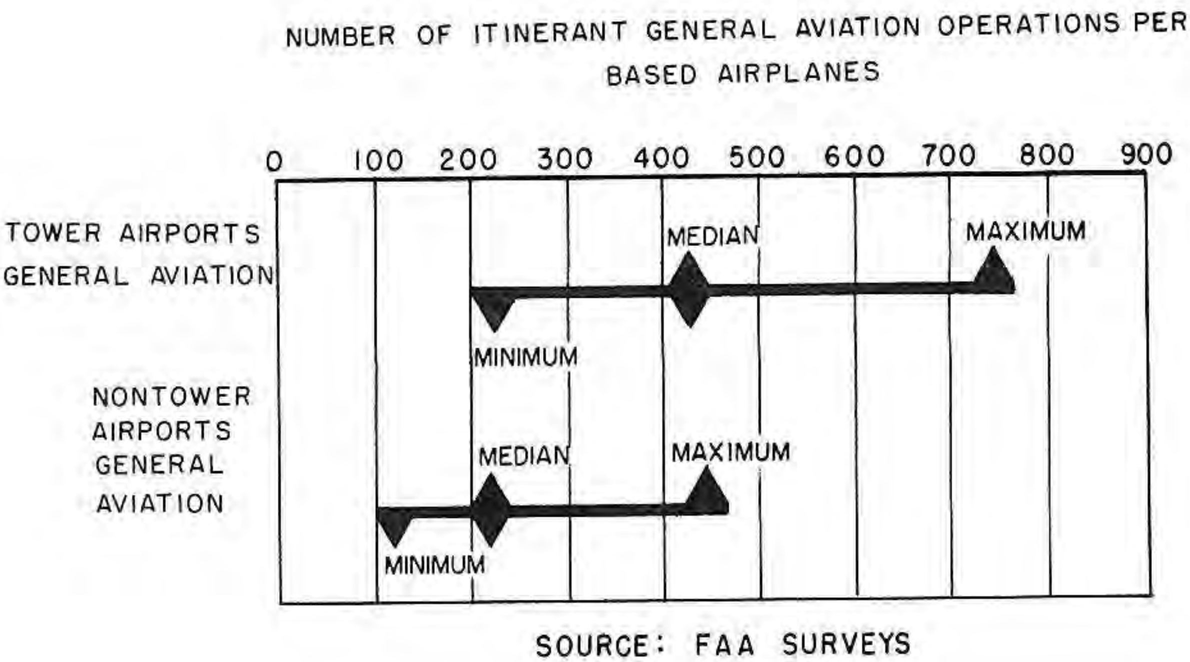


FIGURE 9-1. PARKING APRON AREA



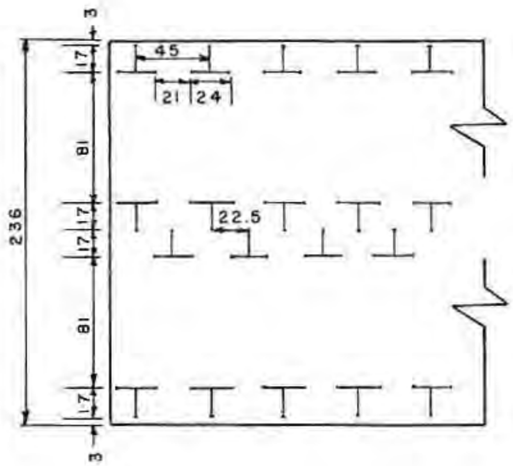
Example of Use:

Most utility airports will not have an air traffic control tower. Therefore, the engineer will be concerned with the volume of itinerant operations at nontower airports.

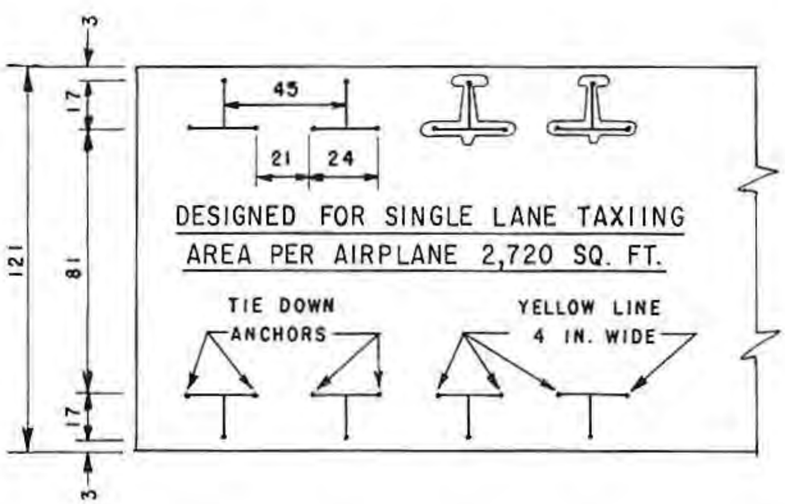
The above Figure 9-2, provides a guide for estimating the number of annual itinerant operations per based airplanes. The chart indicates a range from 120 to 450 operations at nontower airports, the normal is 210.

The design engineer may determine, for example, that an above average activity is expected at the proposed airport and 250 is selected as the estimated number of itinerant operations. Assuming the number of airplanes forecast to be based at the airport within two years is 20, the total estimated annual itinerant operations would be 250 x 20, or 5,000.

FIGURE 9-2. AIRPLANE ITINERANT OPERATIONS



TYPICAL LAYOUT FOR
GENERAL UTILITY AIRPORT



TYPICAL LAYOUT FOR
BASIC UTILITY AIRPORT

FIGURE 9-3. TIEDOWN LAYOUTS

CHAPTER 10. BUILDINGS AND HANGARS

45. GENERAL. Airport buildings are constructed to fulfill the needs of specific aviation activities. The fixed base operator's (FBO) building usually provides space for the commercial activities - maintenance and repair of aircraft, air charter, etc. The administration building accommodates the public - pilots, passengers, and visitors. It may also house the airport manager's office. Small airplane hangars generally are constructed only for storage of the airplanes.

a. In order that the airport functions efficiently and in an orderly manner now and in the future, carefully consider the layout of all building areas. This, of course, should be done when the airport layout Plan is being developed.

b. Figure 10-1 illustrates a typical layout for the building area of a General Utility airport. The FBO building is sited adjacent to the airplane parking apron. This is convenient for both local and transient pilots. The administration building is near the FBO but sufficiently separated to preclude conflict between airplanes operating from these areas. The storage hangars often are T-hangars and grouped in multiunits in a separate area.

c. Other aviation-oriented buildings may be established on the airport. The functions of these buildings in relation to other activities will determine the optimum location of each.

46. HANGARS. Figure 10-2 illustrates typical layouts of hangar areas for different types of hangars. As noted, the recommended clearance between T-hangars is 75 feet for one-way traffic and 125 feet for two-way traffic. These clearances will accommodate most twin engine general aviation airplanes.

a. Prefabricated T-hangars are available in various sizes and lengths. Details on their erection and cost may be obtained from any of several manufacturers throughout the country.

b. The number of T-hangars depends upon local demand. However, a greater demand can be expected in the more severe climate areas for protection from weather.

47. ADMINISTRATION BUILDING. Whether an administration building is required at an airport is a question for management to answer after it has weighed at least two factors. Operationally, the chief factor is whether the airport can take care of present and anticipated airplane activity. Economically, the chief factor is the kind of community the airport serves and how well this community can support general aviation activity. It should be noted here that lower activity airports may not initially justify the construction of either an FBO or administration

building. In many cases, the initial airport building is a small maintenance hangar with attached office. Consider the following basic criteria prior to construction of an administrative type of building on a general aviation airport:

a. A minimum traffic volume of 10 airplane departures and arrivals, not including touch and go, during the peak hours of a typically busy day during the year.

b. One or more active fixed base operators on the airport.

c. Airplane fuel available on the airport.

d. A hangar with repair facilities in operation on the airport.

e. A full-time airport manager on duty during the normal day.

f. Public waiting area and restrooms, if they are not already available in hangars or other buildings on the airport. A public telephone should be available 24 hours a day for closing flight plans or requesting fuel or transportation to town.

48. AIRPORT SURVEY. A survey of airport aviation activity should be made before the building is planned. For survey purpose, "airport aviation activity" includes the number of active-based airplanes, the number of airplane operations (local and itinerant), the number of pilots and passengers, and the number of visitors at the airport on a typically busy day.

a. The number and type of facilities the administration building requires calls for a survey of current activity at the airport. In addition, it is usually possible to obtain valuable information from other airports with similar aviation activity characteristics and which already have administration buildings.

b. The survey is rather simple to make. Data can be gathered by the hour and recorded as shown on sample Evaluation Sheet 1 (Figure 10-3). The airport manager or a fixed base operator can gather this information on several typically busy days over a period of several weeks, preferably during the most active season. At many small airports, weekends are usually the busiest days and are a good time to measure peak activity. A Pilots Register is also useful in making a traffic count.

c. Evaluation Sheet 2 (Figure 10-4) is an example of the kind of data that can be gathered in a survey of present facilities to help determine what new or improved facilities are needed.

d. In this discussion, the term "peak-hour passengers" means the greatest number of passengers and pilots enplaning and deplaning during the busiest hour of a busy day of a typical week. The term "typical peak-hour passengers" means a level of high activity, although not necessarily the absolute peak level that can be expected in an abnormally busy day of the year.

e. For example, an airport manager selects two or three days of the week in the season he knows is historically the busiest. On the evaluation sheet he records the activity for these days in several weeks of the selected busy season. From this record he can determine for his airport a plateau of high activity in terms of peak-hour operations and peak-hour passengers for the typically busy hour by averaging the hourly activity for three or four of the busiest hours.

f. FAA activity surveys made of representative general aviation airports show relationships between the number of airplane operations and the number of airplane occupants handled there during typically busy or peak hours. This relationship is illustrated graphically in Figure 10-5.

g. From this graph aircraft operations can be converted to occupants where accurate aircraft operations records have been maintained. Following the previously discussed survey procedure, peak-hour passengers may be determined from past airport operations activity.

49. BUILDING PLAN. The specialized interior requirements of the small administration building are few, and all well-planned structures should reflect this basic simplicity by providing direct functional relationships among rooms and facilities.

a. The arrangement of elements within the building should be planned with due regard to the airfield configuration, future building expansion, and the passenger and service driveways. Figure 10-6 shows the basic relationships that usually apply in planning an administration building.

b. In determining the details of space relations and requirements, take advantage of the know-how of an experienced general aviation airport manager. A working airport manager knows the specific requirements of his airport. He knows the "good and bad" from experience and knows what can be done to relieve congestion and overcrowding. The experienced manager is in the best position to assist in tailoring detailed building needs to actual aviation activity. Consequently, the sponsor should encourage the architect to include the airport manager in the early planning conferences.

c. Arrange the building components to provide:

(1) Short and direct pedestrian routes from parking areas to public waiting areas or airport offices, and to the loading apron or tiedown areas.

(2) A view of the airfield operations from the manager's office, the waiting room, and the eating facilities, if any.

50. EXPANSION.

a. Future expansion of the administration building must be planned from the start. This is very important at the general aviation airport where, because it is difficult to make accurate forecasts, initial construction has to be based on actual measurable activity.

b. When the field side of the building is fixed, as it usually is, there can be expansion only on the off-field side and the two ends. When drives and walks resist expansion on the off-field side, plan all major expansion at the building ends.

51. CIRCULATION. The waiting room is the hub from which circulation routes radiate. Usually, an open plan with only the most essential partitioning allows better circulation as well as a more spacious building interior. Consider the following important items to assure satisfactory circulation of traffic through the building:

a. Short and direct routes from the entrance of the off-field side of the building to the exit on the field side.

b. Wide doorways at the main entry and exits.

c. Public corridors, when necessary, wide enough for comfortable traffic flow, but not excessive to raise initial and maintenance costs.

d. Adequate circulation aisles within the waiting area to assure free movement and comfort for the room occupants.

52. WAITING ROOM. The waiting room is the focal point of the building (Figure 10-7). It is the central meeting and waiting space for passengers, visitors, pilots, and airport employees. It should merge with such other required spaces as the manager's office, eating facilities, and public restrooms. The closer this relationship, the more economical is the building. In addition, it would be well to incorporate the following user conveniences:

a. A view of airfield activities. The public likes to see the airplanes and their operations. Do not put utility rooms, restrooms, and other service facilities on the field side of the building if it can be avoided.

b. A comfortable seating arrangement. This need not be fixed or stereotyped. At a small airport such an arrangement is especially good to promote the waiting room informality usually associated with small airport operations.

c. Such concession items as coin-operated parcel lockers and small-item dispensing machines.

d. A bulletin board for information of interest to private pilots and the aviation public; for example, weather reports, notices to airmen, and FAA information.

e. Space for the mounting of aeronautical charts.

f. A folding partition to provide dual space use. This flexible arrangement conserves building space and makes it possible to hold meetings in the administration building without disturbing the essential business routine.

53. MANAGER'S OFFICE.

a. Variation in the room space for management use at a particular airport is to be expected. The local management's space requirements should be determined after an analysis of the management equipment, furnishings, and personnel space needs.

b. As a general planning guide, the minimum office size should be about 180 square feet, an average of management operations office areas sufficient for the furnishings and functions of an office manned by a manager and one secretary.

54. EATING FACILITIES. Some provision for food services is usually planned in the administration building for the comfort and convenience of airport users. The scope of the eating facilities in the building varies with local and itinerant aviation activity; there may be dispenser items, a snack bar, a coffee shop, a dining room, or any combination of these. Quite often, the airport eating facility attracts additional patrons because of its convenient location, its unusual cuisine, or the interest the patrons take in aviation activity.

a. Food and drink dispensers are usually enough to satisfy initial needs at general aviation airports. Dispenser service requires little attention to operate. The dispensers should be grouped so they can be seen from the main circulation route between the waiting area and the operation/management office.

b. If the coffee shop or dining room is contemplated, it will usually be operated by a concessionaire. It is important to select this concessionaire early enough for him to help in planning his part of the administration building. He should compute the size of his space in terms of seated patrons and the kind and amount of food service and preparation equipment. The following planning considerations are important:

(1) Direct relation with the waiting room.

(2) Convenient route from public entrances.

(3) Direct access from the food preparation area to the outside service drive.

(4) View of the airfield activity from the seating area.

(5) Compliance with public health agency requirements.

55. PUBLIC RESTROOMS. Plan restrooms to be immediately accessible from the waiting room.

56. ROADS AND AUTO PARKING. Roads and parking areas directly related to the administration building may be established after the configuration of the building, including passenger entrances and exits and service entries, has been arranged. The important considerations are as follows:

a. Locate short-limit parking or stopping spaces close to the main off-field public entrance, enough distance being left between building and parking spaces for any future building expansion planned toward these parking spaces.

b. Consolidate public and employee parking spaces into one centrally located parking area when both an administration building and a hangar area are contemplated. This plan is feasible when a convenient relation is established from the first between the administration building and the hangars.

c. For special events, provide one or more well-drained turfed areas, located beside the airport access roads, for overflow parking.

d. If the administration building contains eating facilities that are regularly patronized by outside customers, plan additional parking spaces for them.

e. Separate service drives for kitchens from public drives and parking. The service drive may often be combined with the apron access drive (see Figure 10-6). However, where this is done, the restaurant vehicles should be prevented from inadvertantly driving out onto the apron.

f. Locate the apron access drive in the vicinity of the building to serve the apron from the passenger drive.

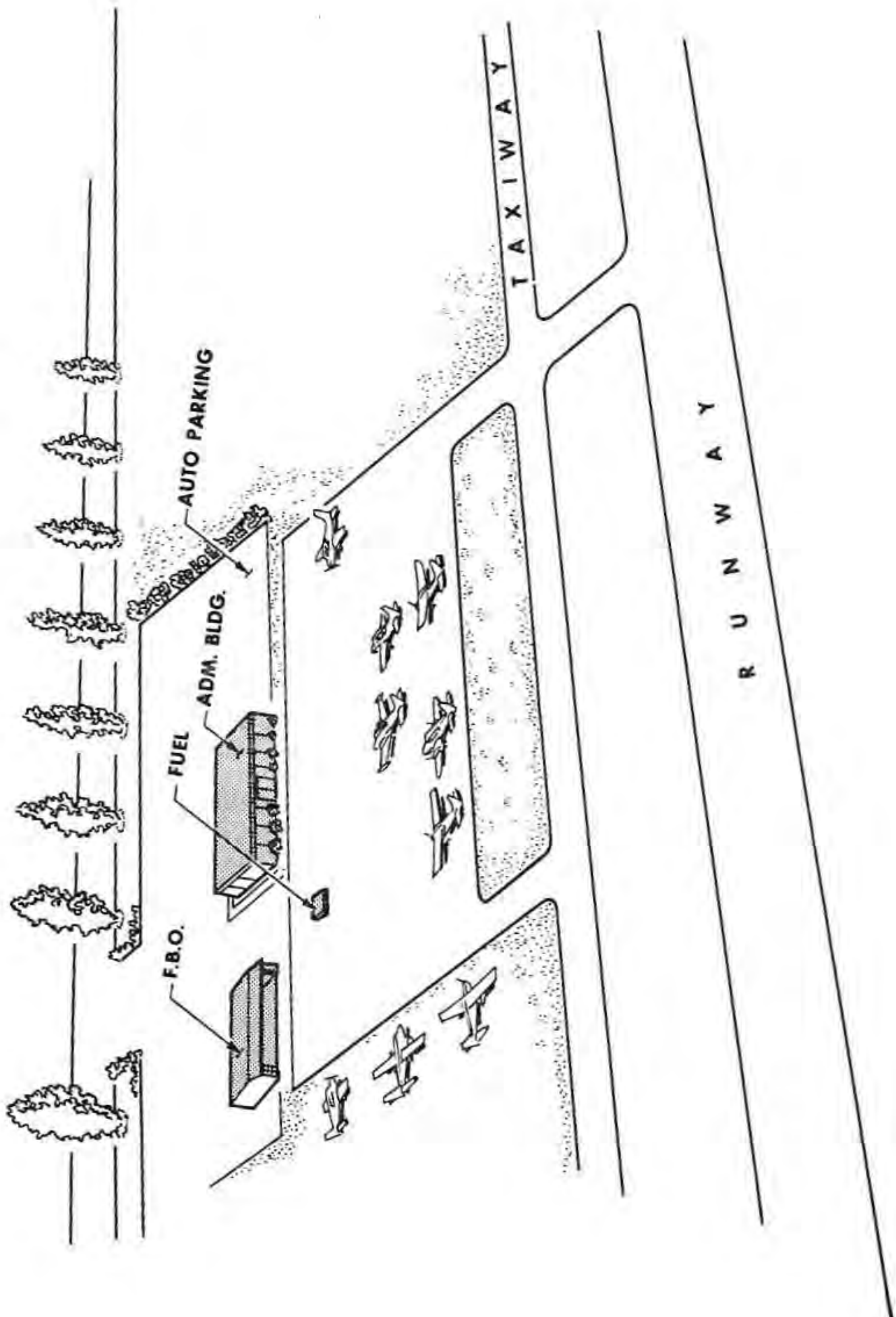


FIGURE 10-1. PARKING APRON AREA

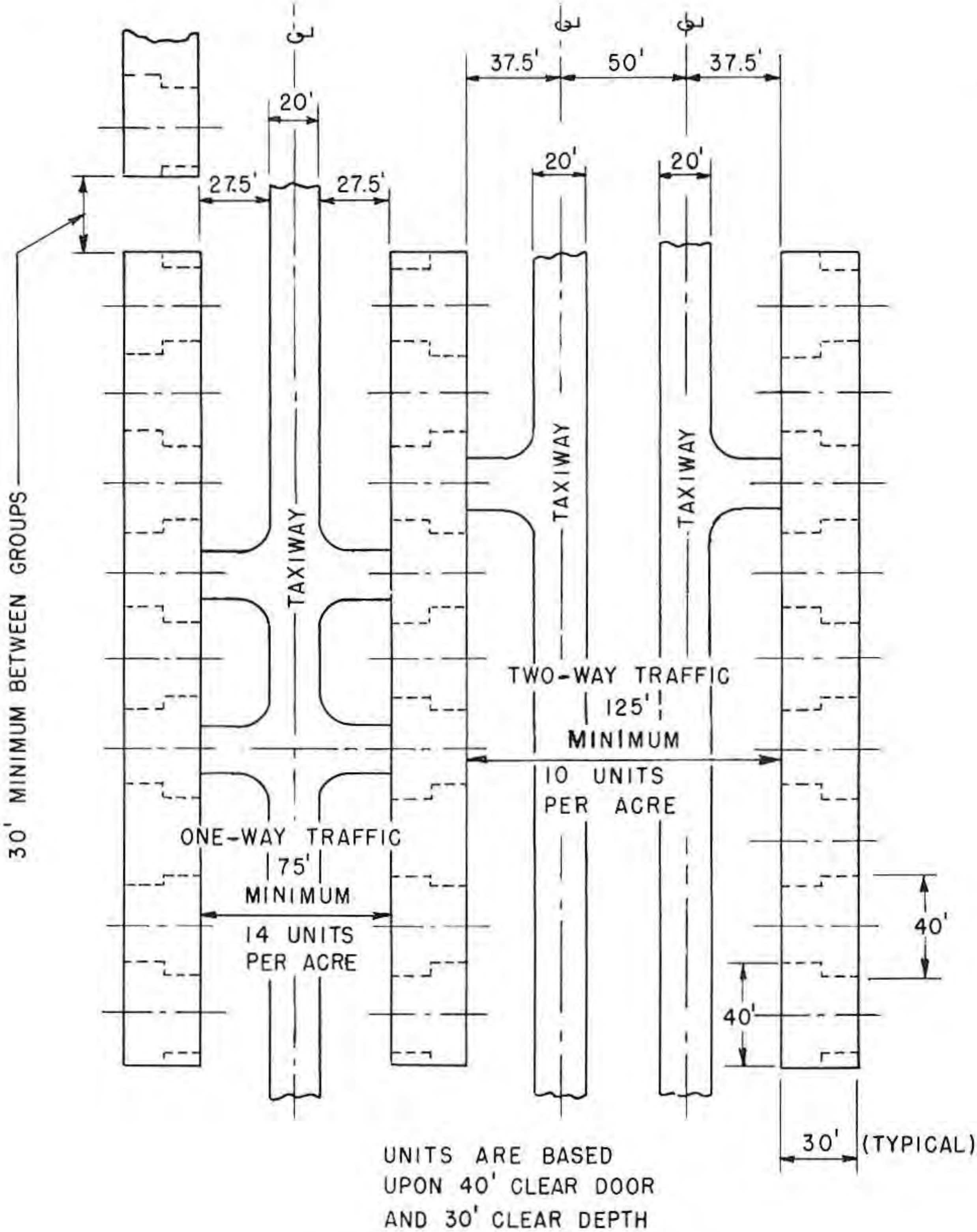


FIGURE 10-2. T-HANGER LAYOUT

Evaluation Sheet 1 Prepared by: ____________

Airport ____________ City ____________ State ____________ Survey Date ____________

Number of Active Based Aircraft ____________

Hour	Hourly Local and Itinerant Activities		Persons Entering Building Per Hour		Number of Occupants or Customers			
	No. of A/C Departures and Arrivals	No. Passengers (Including Pilot)	Visitors	Airport Employees	Waiting Room	Eating Facility	News or Gift Shop	Other Con-cession
6 - 7 a.m.								
7 - 8								
8 - 9								
9 - 10								
10 - 11								
11 - 12 p.m.								
12 - 1 p.m.								
1 - 2								
2 - 3								
3 - 4								
4 - 5								
5 - 6								
6 - 7								
7 - 8								

FIGURE 10-3. GENERAL AVIATION ACTIVITY SURVEY FORM

Evaluation Sheet 2

Prepared by:

Kind of Building, Check one:

Name: ______________________

Administration ________

Title: ______________________

Hangar Lean-to ________

Survey Date: ______________________

Airport ______________________ City ______________ State ________

Evaluation Code: 1 - Excessively Large
2 - Adequate
3 - Inadequate

Item	Area In Square Feet	Evaluation Code Number	Remarks
Waiting Room			
Seats, No.			
Pilots' Lounge			
Eating Facility			
Kitchen and Storage			
Newsstand and Gifts			
Manager			
Men's Restroom (WC-lav-ur; No.)			
Women's Restroom (WC-lav; No.)			

AUTO PARKING

Public Spaces, No. ________________ Peak No. Occupied ____________

Employee Spaces, No. ______________ Peak No. Occupied ____________

Approx. Total Area, SF ____________

FIGURE 10-4. GENERAL AVIATION SPACE INVENTORY FORM

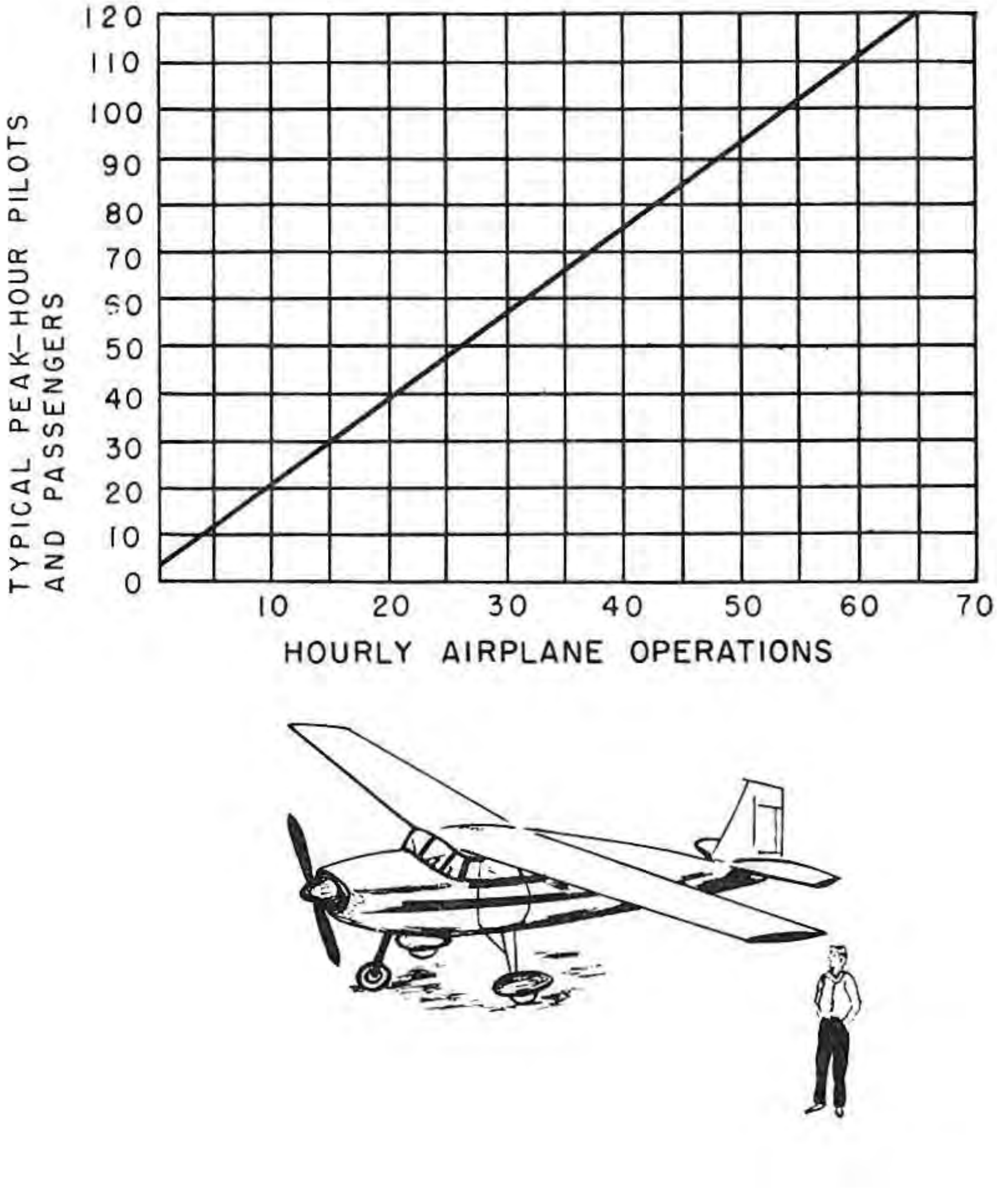
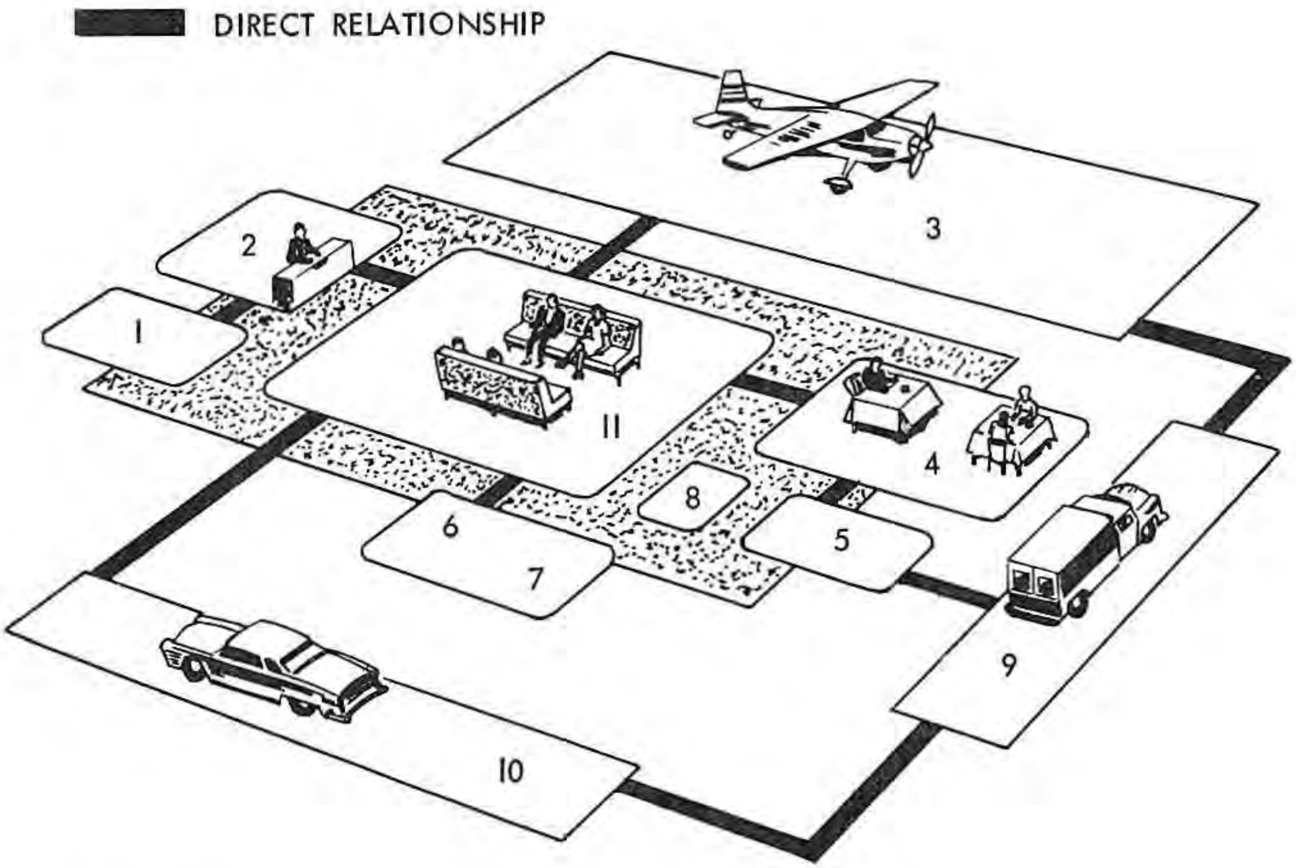


FIGURE 10-5. TYPICAL PEAK-HOUR PASSENGERS



1. STORAGE
2. OPERATION MANAGEMENT
3. AIRPLANE LOADING APRON
4. DINING AREA
5. KITCHEN
6. REST ROOMS
7. JANITOR CLOSET
8. UTILITIES
9. SERVICE AND APRON ACCESS DRIVE
10. ADMINISTRATION BUILDING DRIVE
11. WAITING AREA

FIGURE 10-6. SCHEMATIC FLOW IN AN ADMINISTRATION BUILDING

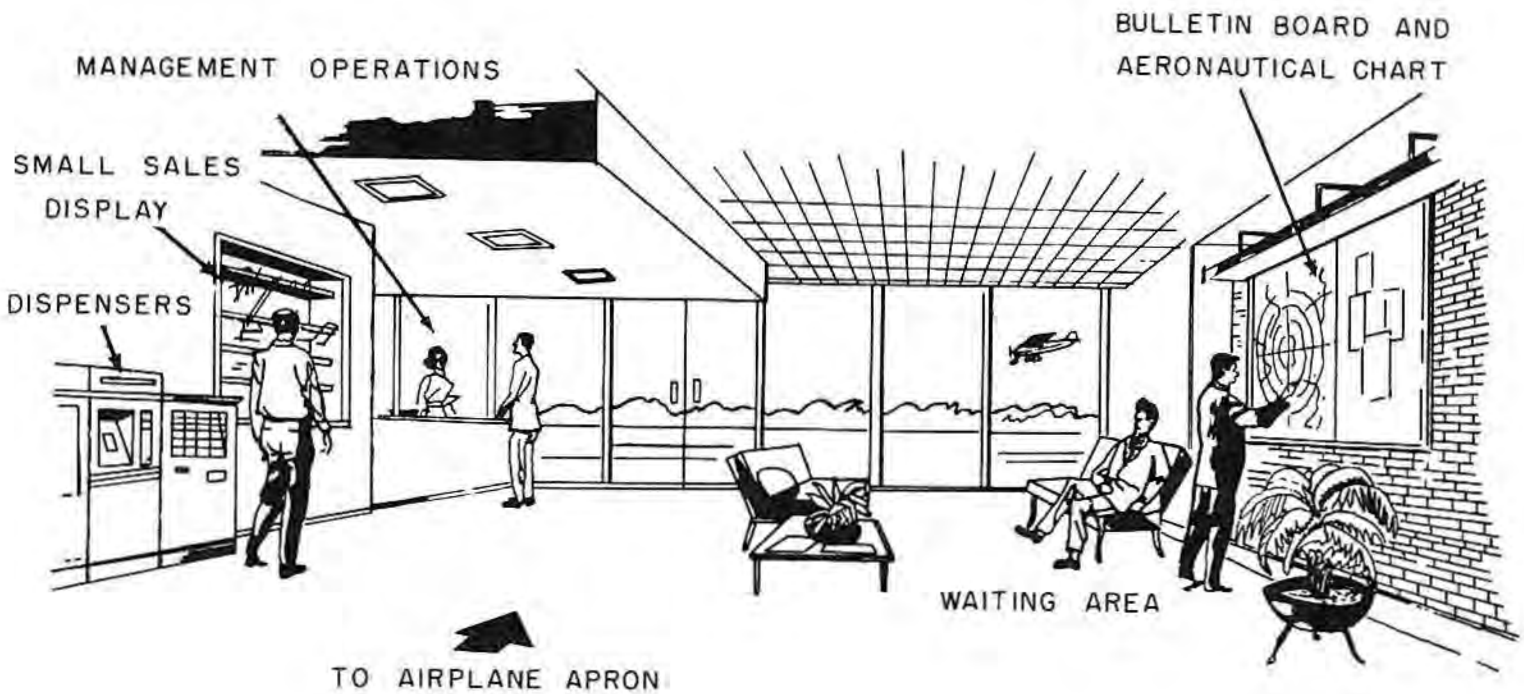


FIGURE 10-7. WAITING AREA

CHAPTER 11. MARKING, LIGHTING, AND VISUAL AIDS

57. GENERAL. A pilot intending to land at an airport must be able to determine readily the physical limits of the landing surface, the direction of the surface wind, and whether a nonstandard traffic pattern is in use. This chapter highlights the marking and lighting recommended to provide such information to the pilot. The chapter also identifies visual aids which will improve operations at night or during periods of reduced visibility at a utility airport. More detailed guidance for marking and lighting is found in the advisory circulars referenced in this chapter.

58. AIRPORT MARKING. The following paragraphs discuss the airport markings which should be provided as part of the initial airport development. Retroreflective beads may be added to the painted runway and taxiway markings to increase their prominence for operations at night or during periods of reduced visibility. Figure 11-1 illustrates airport marking. More detailed guidance on this subject is found in current editions of AC 150/5340-1, Marking of Paved Areas on Airports; AC 150/5340-5, Segmented Circle Airport Marker System, and AC 150/5340-18, Taxiway Guidance Sign System. FAA Airport offices may be contacted for advice concerning specific marking problems.

a. Runway Marking. Two methods are employed to mark airport runways, depending on whether the runway is unpaved or paved.

(1) Unpaved Runways. Transient pilots in particular often find it difficult to identify the physical limits of an unpaved runway. To overcome this difficulty, markers are placed at the corners of the runway and at intervals of 400 feet (120 m), or less, along its length to
* delineate the limits of the runway. While figure 11-1 illustrates one *
type of marker, ingenuity may be used to construct markers of locally obtainable materials. The color of the markers is not critical. Markers should be readily discernable from both the air and from the ground.

(2) Paved Runways. The physical limits of an asphalt or concrete surfaced runway are well discernable. Runway numbers and a centerline stripe are adequate for visual runways (see AC 150/5340-1). Additional markings are required for precision and nonprecision instrument runways. White runway markings identify usable runway areas. Yellow chevron markings identify unusable runway areas.

b. Taxiway Marking. All taxiway markings are yellow and consist of a centerline stripe with transverse stripes to indicate the "holding position" (see AC 150/5340-1 and 150/5340-18). The holding position is located so that holding aircraft are outside of the runway safety area and OFZ and do not interfere with the operation of NAVAIDs.

c. Segmented Circle Marking System. A 100-foot (30 m) diameter circle with at least 18 segments is constructed around the airport's wind direction indicator. The circle helps the visiting pilot to locate the wind indicator. It also serves as another visual identification of an airport. Segments are similar to those used to mark unpaved runways. Airports having nonstandard traffic patterns are able to convey this information with traffic pattern indicators located adjacent to the segmented circle. (See AC 150/5340-5.) The circle should be readily discernable from the air as well as the ground. The color(s) used should provide the best possible contrast with the surroundings.

59. AIRPORT LIGHTING. Installation of a lighting system will increase an airport's use. An airport lighting system--consisting of runway lights, rotating beacon, * and a lighted wind direction indicator--is recommended if the airport is to be * operated at night. Figure 11-2 illustrates a typical airport lighting system. Current editions of the following provide detailed guidance: AC 150/5340-20, Installation Details and Maintenance Standards for Reflective Markers for Airport Runway and Taxiway Centerlines; AC 150/5340-21, Airport Miscellaneous Lighting Visual Aids; AC 150/5340-24, Runway and Taxiway Edge Lighting System; and AC 150/5340-27, Air-to-Ground Radio Control of Airport Lighting Systems. FAA Airport offices should be contacted prior to undertaking the design or installation of any airport lighting system.

a. Runway Lighting. The runway lighting system consists of runway edge lights and runway end/threshold lights. Light fixtures, electrical cable, and operating controls conforming to the FAA specifications for medium intensity systems are recommended for most utility airport installations. Airports that are not attended 24 hours per day should consider installing photo-electric or air-to-ground radio controls for operating the airport's lighting systems.

(1) Runway Edge Lights. Edge lights are elevated, omni-directional, steady burning lights with clear lenses. They are spaced at a uniform interval of 200 feet (60 m) or less along both edges of the usable surface.

(2) Runway End/Threshold Lights. End/threshold lights are identical to edge lights except that a two-color (red/green) lens is used. The green half of the lens faces the approaching airplane, indicating the beginning of the usable runway. The red half of the lens faces the airplane on roll-out or take-off, indicating the end of the usable runway. End/threshold lights consist of a minimum of six lights, in two groups of three, and are located at each end of the runway. An instrument runway requires eight end/threshold lights in two groups of four.

b. Rotating Beacon. The beacon emits two rotating beams of light spaced 180 degrees apart to indicate the location of an airport. At a lighted, civil airport, one of the beams is white and the other is green. Beacons are installed on or close to the airport. (See AC 150/5345-12, Specification for L-801 Beacons, current edition.)

c. Lighted Wind Direction Indicator. The surface wind direction indicator, installed at the center of the segmented circle, is lighted so that it is visible for night operations. The lighting should adequately illuminate any traffic pattern indicators.

60. AIRPORT VISUAL AIDS. A number of visual aids are available to assist a pilot in locating the runway at night or during periods of reduced visibility. The visual aids covered in this paragraph are considered appropriate for utility airports. The selection of a particular visual aid should be based on an operational requirement for a light signal that is more pronounced than that provided by the existing medium intensity runway lighting system. An evaluation of each site must be made to determine which aid will best serve to reduce any deficiency in a particular approach. Current editions of AC 150/5300-2, Airport Design Standards--Site Requirements for Terminal Navigational Facilities, AC 150/5340-14, Economy Approach Lighting Aids, and * AC 150/5340-25, Visual Approach Slope Indicator (VASI) Systems, provide additional guidance on siting and installing these visual aids.

a. Runway End Identification Lights (REIL). The REIL consist of two flashing lights located at the end of the runway. Figure 11-3 illustrates a typical REIL installation. The intense white flashing uni- or omni-directional lights provide positive runway end identification as well as a degree of circling guidance. REIL are beneficial in areas having a preponderance of background lighting or where featureless terrain exists. NOTE: REIL are not to be installed on the same runway end as an approach light system.

b. Omnidirectional Approach Lighting System (ODALS). The ODALS consists of seven omnidirectional flashing lights. Two are located in accordance with criteria for locating REIL and five are located along the centerline extended into the approach. Figure 11-4 illustrates a typical ODALS installation. The ODALS may be used to provide circling, offset, and straight-in visual guidance for nonprecision instrument approaches to a runway.

c. Medium Intensity Approach Lighting System (MALS). The MALS is a configuration of steady-burning lights arranged symmetrically about and along the extended runway centerline. MALS may also be installed with sequenced flashers. In this case the system is referred to as MALSF. A MALS may be installed with a line of five sequentially flashing lights located outbound of the steady-burning lights. This system is referred to as MALSR. MALSR installations meet FAA requirements for ILS Category I operations. Figure 11-5 illustrates typical MALSF and MALSR installations. All lights in the system emit a white light. The steady-burning lights have variable controlled intensities, while the flashing lights have only three intensity steps. The system provides early runway lineup and lead-in guidance, runway end identification, and, to a degree, roll guidance. These are beneficial where:

(1) extraneous lighting prevents the pilot from lining up with the runway centerline, or

(2) surrounding terrain is devoid of lighting and does not provide the cues necessary for proper aircraft altitude control.

d. Visual Approach Slope Indicator (VASI). A VASI consists of light units which are normally located along the left runway edge as viewed on approach. Figure 11-2 illustrates a typical VASI installation. Each light unit emits a two-color (red and white) light beam which enables the pilot to determine whether the approach is being made above, on, or below the projected course signal. A VASI may be installed with the REIL, ODALS, or MALS systems. VASI's are especially beneficial where:

(1) visual references are lacking or are deceptive, or

(2) a hazardous object must be cleared, or

(3) noise relief is desired.

61. OTHER MARKING PRACTICES. Airport owners and aviation-minded organizations frequently carry out additional marking programs to aid pilots in identifying the airport, the community, the direction-location of the nearest airport, and tall objects which could impinge upon flight safety.

a. Off-Airport Marking. The name of the community and/or an arrow pointing toward the nearest airport is frequently painted on the roof of a prominent building in the community. This type of air marking is carried out by aviation organizations such as the "99's" - an organization of women pilots.

b. On-Airport Marking. While no specific standard exists, a number of airport owners have painted the airport name, field elevation, etc., on the roof of a prominemt airport building or, in some instances, on the airport apron. When this type of marking is used, routine maintenance is necessary, because an unintelligible marking is worse than no marking at all.

c. Objects To Be Marked and Lighted. When any object either temporary or permanent, exceeds any standard for determining obstructions to air navigation set forth in FAR Part 77 or is a height of 200 feet (60 m) or more above site level, that object should be marked and lighted in accordance with the applicable standards in AC 70/7460-1, Obstruction Marking and Lighting, current edition, unless an FAA aeronautical study has determined that such marking and/or lighting is not necessary for safety.

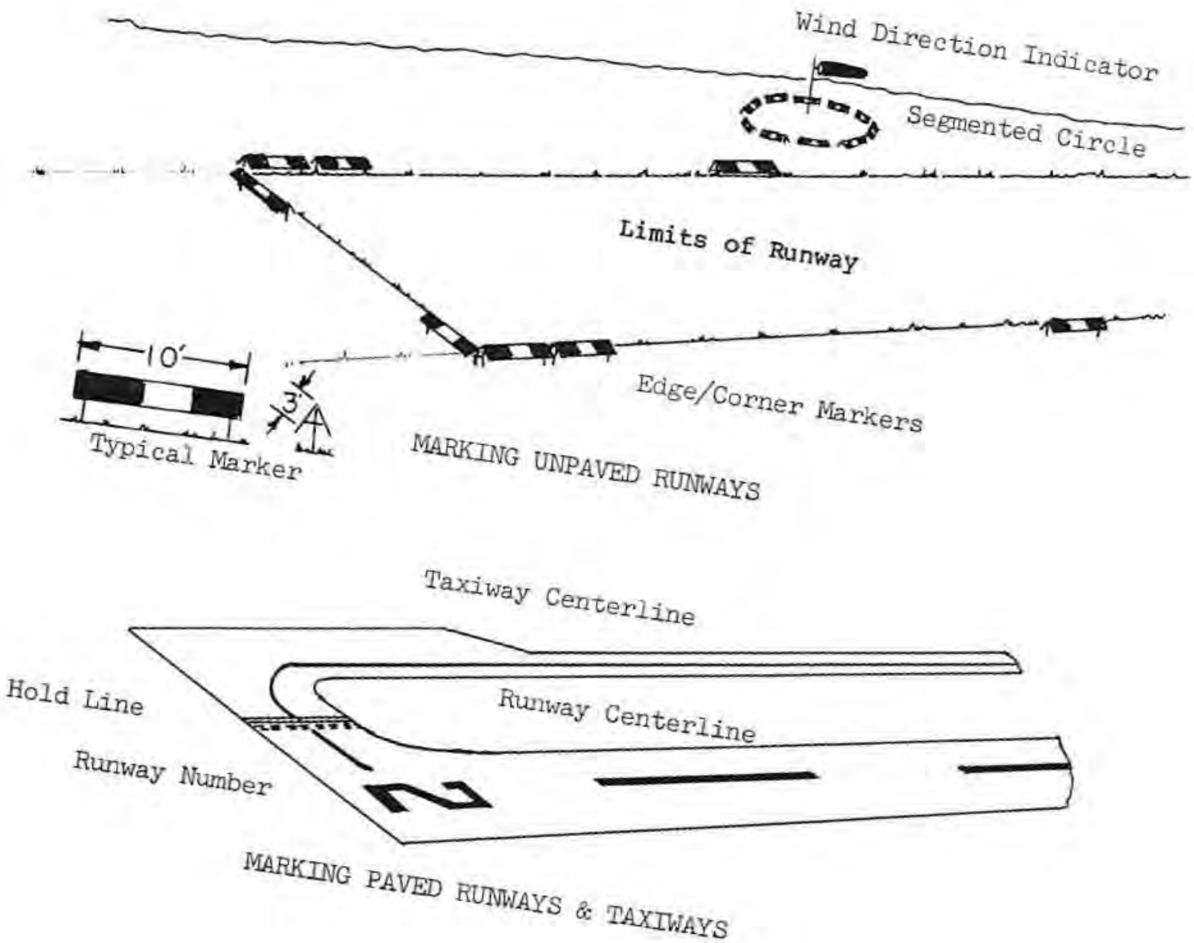


FIGURE 11-1. AIRPORT MARKING

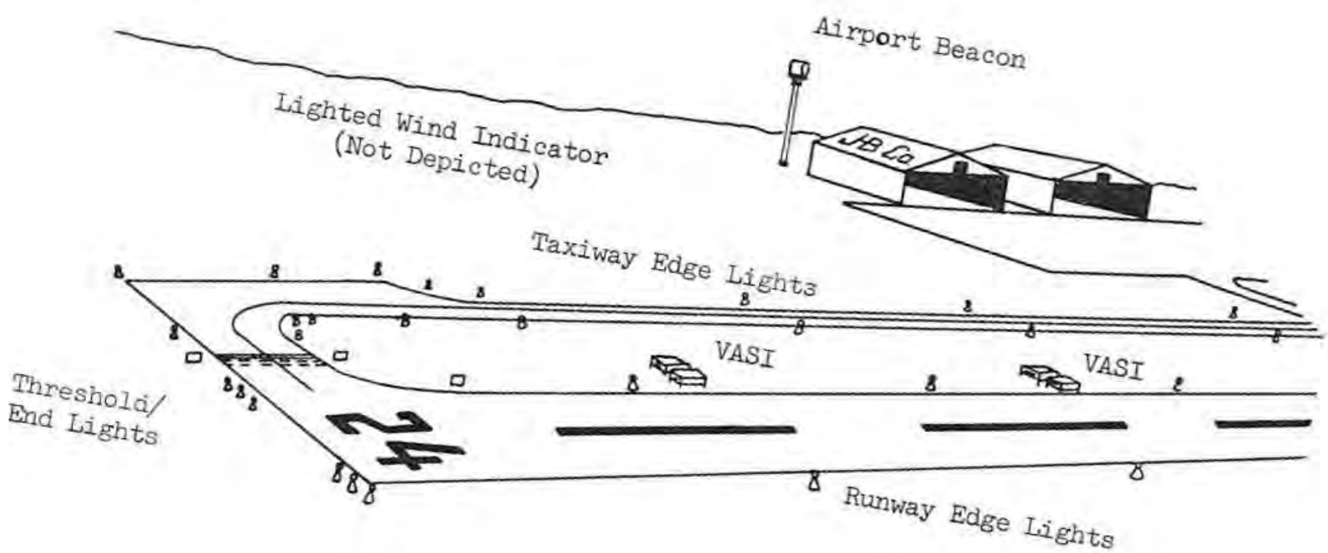


FIGURE 11-2. TYPICAL AIRPORT LIGHTING SYSTEM

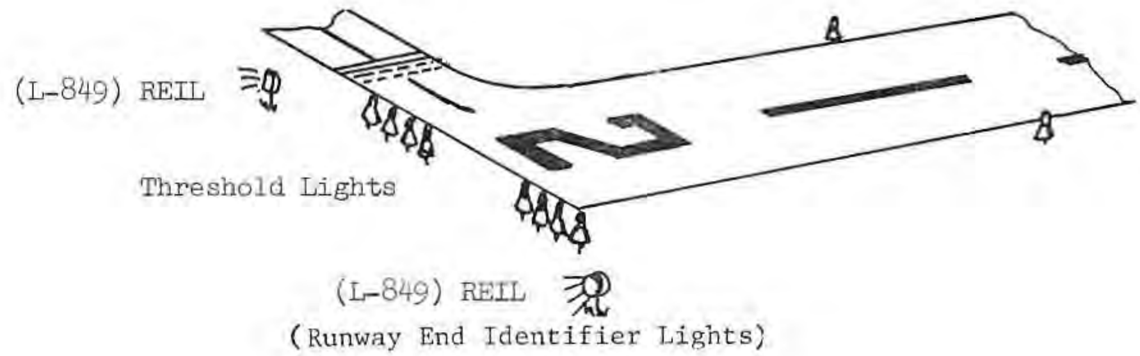


FIGURE 11-3. TYPICAL REIL INSTALLATION

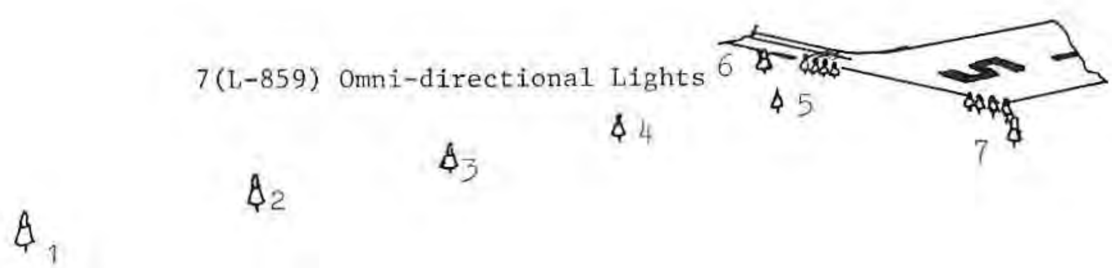


FIGURE 11-4. TYPICAL ODALS INSTALLATION

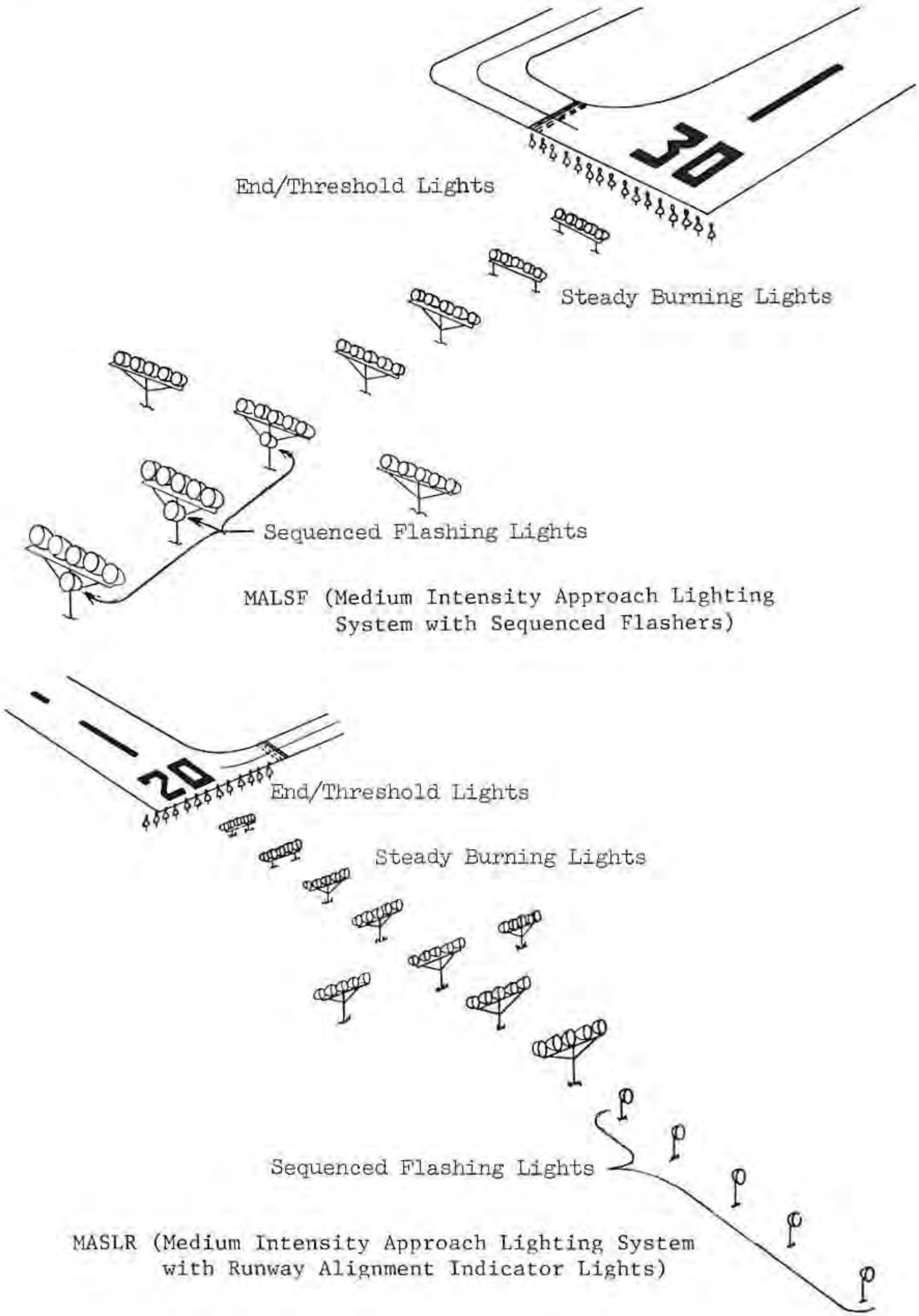


FIGURE 11-5. TYPICAL MALSF & MALSR INSTALLATIONS