AC NO: 150/5300-2B

DATE: 22 NOV 71

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: AIRPORT DESIGN STANDARDS - SITE REQUIREMENTS FOR TERMINAL NAVIGATIONAL FACILITIES

1. PURPOSE. Airport designers need an understanding of the relative location and siting requirements for the terminal navigation facilities that may be established on an airport. This advisory circular provides that information. It is not intended that this circular be used for the design and installation of terminal navigation facilities.

2. BACKGROUND. To facilitate the proper and economic design and/or development of an airport it is necessary to relate, in general terms, the spatial and operational requirements of terminal navigational facilities to other airport located facilities. This advisory circular extracts and combines siting and operational information of terminal NAVAIDS from a number of FAA orders, handbooks, etc. Specific guidance applicable to the design, installation or operation of a particular NAVAID is found in publications cited in the text. The bibliography identifies sources/locations for obtaining/viewing these publications.

3. CANCELLATION. AC 150/5300-2A, Airport Design Standards - Site Requirements for Terminal Navigational Facilities, dated 8 October 1969 is cancelled.

4. EXPLANATION OF CHANGES. In addition to the editorial changes required to clarify material and to correct dimensional errors or ommissions, or to recognize changes in program titles, FAR references and field reorganization, the following technical changes have been made:

   a. References to Precision Approach Radars (PARs) have been deleted. PARs are no longer funded by the FAA and with few exceptions have been removed from civil airports.

   b. Material on Instrument Landing System (ILS) installations has been reworked to indicate current agency preferences of equipment types, approved changes in siting and grading criteria for the glide slope facility, and the recent agency adoption of 3 degree glide slopes.

c. Material on Non-Directional Beacon (NDB) has been revised to show the agency's position on this installation.

d. Material on Visual Approach Slope Indicators (VASI) has been revised to reflect current agency policies.

e. A new chapter has been added to cover the protection of airport-located NAVAIDS.

5. HOW TO OBTAIN THIS PUBLICATION. Obtain additional copies of this circular AC 150/5300-2B, Airport Design Standards - Site Requirements for Terminal Navigational Facilities, from the Department of Transportation, Federal Aviation Administration, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

Clyde W. Pace Jr.

CLYDE W. PACE JR.
DEPUTY DIRECTOR, AIRPORTS SERVICE

TABLE OF CONTENTS

ILLUSTRATIONS

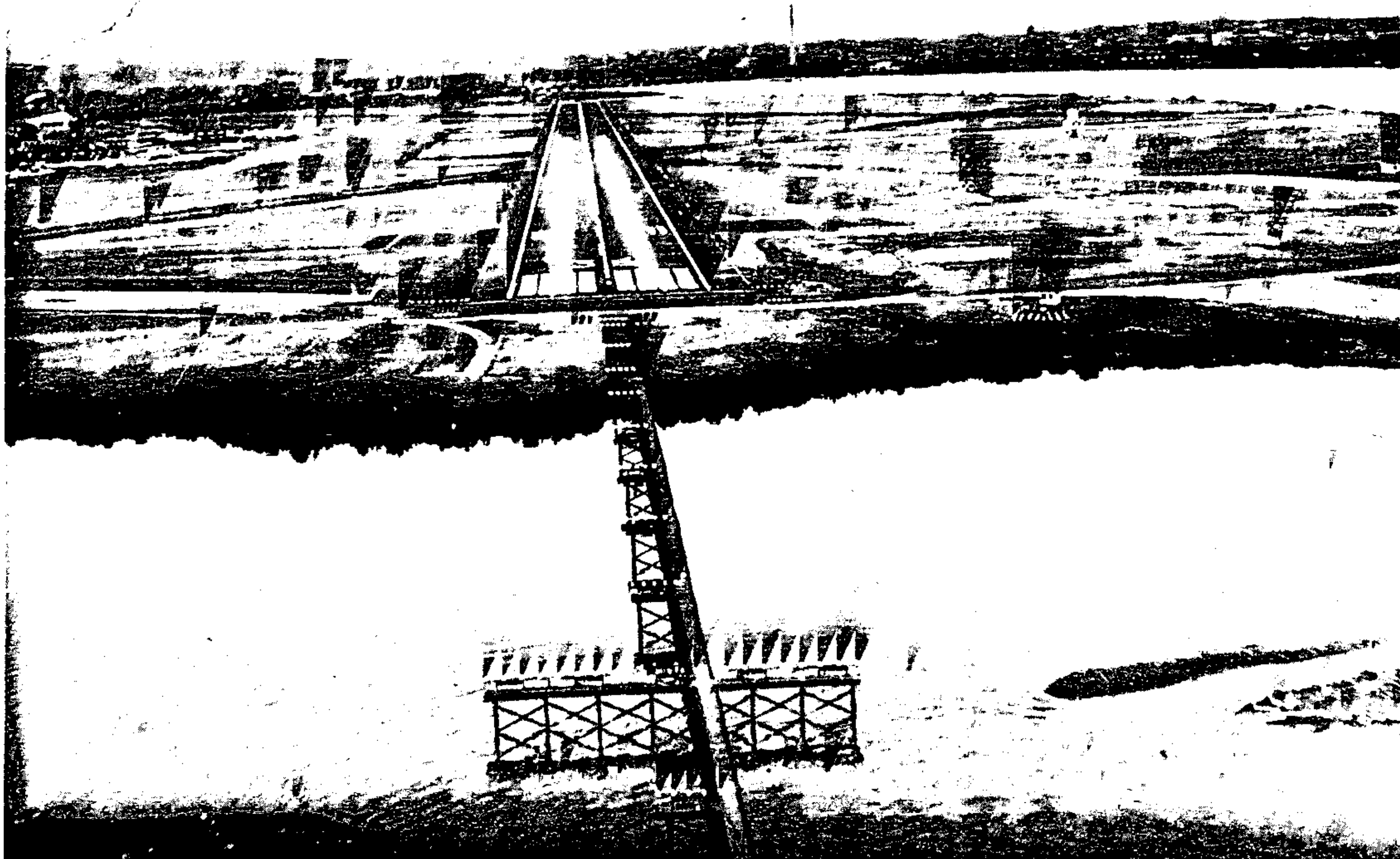


FIGURE 1. AERIAL PHOTOGRAPH - ILS RUNWAY 36 AND TERMINAL NAVAIDS AT WASHINGTON NATIONAL AIRPORT

CHAPTER 1. INTRODUCTION

1. GENERAL SCOPE.

a. This advisory circular describes in general terms the different types and primary functions of air traffic control and air navigational (ATC & N) facilities that may be established on or in the immediate vicinity of airports.

b. It summarizes the principal siting criteria regarding typical location, layout, clearance, and area requirements that should be considered by airport sponsors and their engineers to facilitate the early designation, reservation, and establishment of suitable ATC & N sites for use by the Federal Aviation Administration (FAA).

c. Current FAA policies and programs for establishment of ATC & N facilities on airports are briefly outlined, and Appendix 1 provides a bibliography of pertinent FAA publications and Federal Aviation Regulations (FARs).

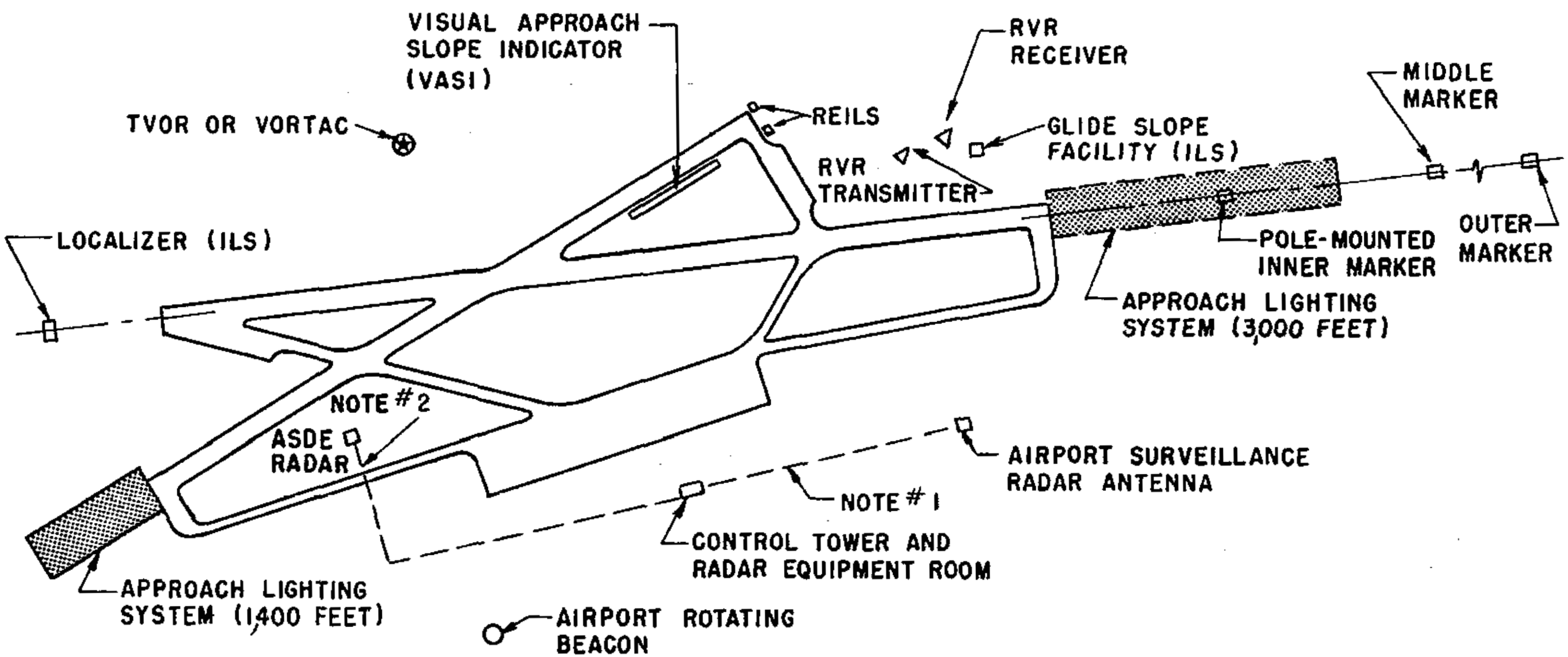
d. There are included applicable drawings and layout plans of various ATC & N facilities with Figure 2 depicting an overall schematic plan showing such facilities and their desirable locations on an airport.

e. The special siting criteria for and discussion of those ATC & N facilities that may be utilized at heliports and STOL ports are not included or covered in this publication.

2. APPLICATION.

a. The siting criteria presented in this circular have been extracted and condensed from existing FAA internal directives and instructions for establishment of ATC & N facilities with the objective of providing basic guidance to airport sponsors and their engineers for planning and design purposes.

b. The presentation of the detailed FAA standards and instructions on installation, hardware, electrical design, operational performance, etc., is outside the scope of this circular. Refer to the appropriate FAA handbooks and directives as the current, authoritative sources of such information (including comprehensive siting criteria) for all ATC & N facilities.



NOTES:

1. CABLE DISTANCE FROM ASR ANTENNA TO THE RADAR EQUIPMENT ROOM SHALL NOT EXCEED 12,000 FEET.
2. DUCTS SHOULD BE INSTALLED UNDER PAVED AREAS TO FACILITATE INSTALLATION OF POWER AND CONTROL CABLE TO ATC & N FACILITIES.
3. DISTANCE MEASURING EQUIPMENT (DME) MAY BE COLLOCATED AT THE ILS GLIDE SLOPE SITE WHERE OPERATIONALLY REQUIRED.

FIGURE 2. TYPICAL LOCATION PLAN FOR TERMINAL ATC & N FACILITIES.

c. The proper siting and installation of terminal ATC & N facilities are distinct and specialized phases of airport development which requires the services of engineers and aviation specialists trained and experienced in ATC & N facility establishment. Accordingly, it is recommended that such specialists be consulted in the early stages of airport planning and design wherever ATC & N facilities may be involved.

3. DEFINITIONS OF TERMS APPLICABLE TO THIS ADVISORY CIRCULAR.

a. Instrument Flight Rules (IFR). The FARs that govern the procedures for conducting instrument flight operations.

b. Visual Air Navigational Aids. Facilities and/or equipment such as lighting, signs symbols, markings, and other devices for the purpose of providing airmen with visual reference for guidance purposes when operating an aircraft in the air or on the ground.

c. Terminal Navigational Aids (NAVAIDS). The electronic facilities established on or in the immediate vicinity of an airport which enable a pilot when using compatible airborne equipment to execute the instrument approach or approaches authorized for the airport by FAA.

d. Instrument Approach Procedure. An instrument approach procedure is one that is prescribed and approved for a specific airport by competent authority. U.S. civil standard instrument approach procedures are approved by the FAA as prescribed under FAR Part 97 and are published in the Federal Register. For the convenience of the user, the aeronautical data prescribed in standard instrument approach procedures are portrayed on instrument procedure charts. Refer to Advisory Circular 90-1A, Civil Use of U.S. Government Produced Instrument Approach Charts, for additional information on this subject.

e. Precision Approach. A recognized instrument approach procedure utilizing electronic azimuth (localizer) and descent (glide slope) guidance.

f. Non-Precision Approach. A recognized instrument approach procedure without electronic descent (glide slope) guidance.

g. Noninstrument or Visual Runway. A runway having no existing or planned instrument approach procedure of any kind, and intended for operation of aircraft using visual flight rules (VFR).

h. Decision Height. With respect to the operation of aircraft, is the height at which a decision must be made during a precision instrument approach to either continue the approach or to execute a missed approach. This height is expressed in feet above mean sea level (MSL) and for Category II ILS operation the decision height is additionally expressed as a radio altimeter setting.

i. Operational Performance Category I. Operations down to minima of 200 feet decision height and 2,400 feet runway visual range (RVR), with a high probability of approach success. When RVR is not available, one-half mile visibility is intended.

j. Operational Performance Category II. Operations down to minima below 200 feet decision height and 2,400 feet RVR, and to as low as 100 feet decision height and RVR 1,200 feet, with a high probability of approach success.

k. Aircraft Approach Categories. FAA establishment of terminal NAVAIDS and standard instrument approaches are based on definite aircraft approach categories relating to certain aircraft characteristics and performance. As defined in FAR Part 97, "aircraft approach category" means a grouping of aircraft based on a speed of 1.3 V_{so} (at maximum certificated landing weight) or on maximum certificated landing weight. V_{so} (stalling speed) and the maximum certificated landing weight are those values as established by the certificating authority of the country of registry. The categories are as follows:

(1) Category A: Speed less than 91 knots; weight less than 30,001 pounds.

(2) Category B: Speed 91 knots or more but less than 121 knots; weight 30,001 pounds or more but less than 60,001 pounds.

(3) Category C: Speed 121 knots or more but less than 141 knots; weight 60,001 pounds or more but less than 150,001 pounds.

(4) Category D: Speed 141 knots or more but less than 166 knots; weight 150,001 pounds or more.

(5) Category E: Speed 166 knots or more; any weight.

If an aircraft falls into two categories, it is placed in the higher of the two. For example, a 30,000-pound landing weight aircraft with a computed speed of 130 knots would place the aircraft into Category C.

4. FAA ESTABLISHMENT PROGRAM FOR AIRPORT ATC & N FACILITIES.

a. Airport air traffic control and navigation facilities are determined and scheduled for establishment by the FAA under its Facilities and Equipment (F&E) Program in accordance with current agency policies and authorized funding. Operation and maintenance of such facilities are the responsibility of the FAA.

b. The F&E program identifies airport located navigational aid facilities at airports serving scheduled air carriers and/or general aviation. Refer to Airways Planning Standard (APS) No. 1, as modified, and related FAA directives regarding criteria for present and future ATC & N facilities that may be planned for establishment at particular airports.

c. FAR Part 171 and related directives are recommended references for current FAA policy regarding non-Federally owned air traffic control and navigation facilities and any nonstandard installations.

5. AIRPORT DEVELOPMENT AID PROGRAM (ADAP) ASSISTANCE.

a. In accordance with and subject to the requirements and criteria set forth in FAR Part 152, ADAP financial assistance may be made available to eligible airport sponsors to cover some of the costs for the following.

(1) Land acquisition, clearing, grading, and related site preparation for certain airport navigational aids.

(2) Installation of certain airport navigational aids used by aircraft landing at or taking off from a public airport, as designated in FAR Part 152.

b. The appropriate Airports District Office should be consulted regarding possible ADAP assistance in establishing desired navigation facilities on a particular airport by an eligible airport sponsor. It is advisable that airport sponsors properly anticipate and plan for the future need for enhancing the IFR capability of the airport or for lowering of operational minimums by proper establishment of terminal navigational aids (NAVAIDS).

6. FLIGHT EVALUATION OF NAVAID SITES. As a general rule, the proper siting and establishment of certain FAA NAVAIDS usually require the coordinated teamwork of several different FAA specialists and engineers working on the ground and in aircraft. In some cases, it is necessary to perform a flight evaluation of a particular site or location before final approval can be given for installation of such NAVAIDS. This is done by actually installing a portable NAVAID test unit on the proposed site and flight checking the test facility to determine adequacy of electromagnetic performance, signal coverage, and any possible interference sources under actual site environmental conditions. This flight checking usually applies to the siting of Instrument Landing System (ILS) components and those NAVAIDS associated with providing nonprecision instrument approaches for runways. Normally, visual approach aids require flight checking only after installation is completed.

7. COMPATIBILITY OF FUTURE AIRPORT DEVELOPMENT AND ATC & N FACILITIES.

a. The following are examples of items that may have an effect on ATC & N facility establishment, effectiveness, and performance:

(1) Expansion or development of runways, taxiways, aprons, roadways, etc., with respect to location, configuration, and spacing.

(2) Drainage ditches, embankments, borrow pits, or similar earthwork significantly affecting the existing terrain near air traffic control and navigation facilities.

(3) Existing or future erection of any above-ground objects or structures on or near the airport, including terminals hangars, towers, overhead powerlines, liquid storage tanks, warehouses, etc.

(4) Size and dimensions of future aircraft, particularly with respect to heights and wing tip clearance from ATC & N facilities when operating on runways, taxiways, aprons, etc.

b. It is recommended that appropriate airport layout plan(s) be prepared at the earliest practicable date to accurately depict existing and future planned airport facilities and airport land uses. Existing and proposed construction shown on the airport layout plan(s) can then be reviewed by FAA for possible conflict or interference with ATC & N facilities, existing or planned. Advisory Circular 150/5070-6 contains guidance on the preparation of an Airport Layout Plan and the designation of the instrument runway.

c. In this connection, FAA regulations set forth certain requirements and procedures to be followed.

(1) FAR Part 157 requires a notice to be submitted by the construction proponent 90 days before work is to begin on certain prescribed airport changes.

(2) Paragraphs 77.31 (a) and 77.35 (a) of FAR Part 77 permits the FAA to consider and study the effect of any proposed airport construction or alteration on the operation of air navigation facilities.

d. In summary, airport sponsors and their engineers are urged to obtain authoritative guidance and appropriate approvals from the FAA regional office regarding the planning, siting, and establishment details of any major ATC & N facility prior to proceeding with the final preparation of plans, specification, and contracts for any construction work which may affect or pertain to ATC & N facility sites.

CHAPTER 2. INSTRUMENT LANDING SYSTEM FOR PRECISION INSTRUMENT APPROACHES

8. GENERAL. The instrument Landing System (ILS) is designed to provide electronic instrument guidance to the pilot to permit exact alignment and angle of descent of a properly equipped aircraft on final approach for landing. The ILS consists of a localizer, glide slope, and outer and middle marker beacons. Other facilities normally associated and used in conjunction with the ILS are a compass locator (COMLO), located at the outer marker site; and approach lighting system; and other visual aids. (Refer to Figure 2.) Some middle marker sites may also have a compass locator installation. Additionally, at certain airports, distance measuring equipment (DME) is installed where operational or other benefits may be derived. Other general factors to be considered with respect to ILS establishment and the data presented in this chapter are as follows:

   a. The siting criteria herein are applicable for both Category I and Category II ILS; and where special or different requirements exist for Category II installation, these are appropriately noted or designated.

   b. It is strongly recommended that ILS facilities be located at sites which will not be affected by future runway, taxiway, buildings, or similiar construction.

   c. FAA planning envisions the ultimate establishment of precision instrument approach service based on the ILS at all airports serving scheduled air carriers and at certain selected airports serving general aviation that meet agency criteria.

9. DESCRIPTION OF ILS COMPONENTS AND RELATED FACILITIES.

   a. There are several different ILS Localizer antenna systems which are in use to provide alignment or lateral course guidance for landing an aircraft on the ILS runway. The principal types commonly used are the 8-loop and V-ring antenna arrays. The V-ring array has replaced the 8-loop array as the FAA standard localizer antenna installation since it is less sensitive to site irregularities.

b. As with the localizer, there are several types of ILS glide slope systems presently in use; these are the null-reference, side-band reference and capture effect. While the radiation patterns of these systems differ considerably, all provide electronic angle of descent (slope) information to properly equipped aircraft. The null-reference system is the simplest but most sensitive to terrain conditions. The capture effect system is the most complicated but least sensitive to terrain conditions.

c. ILS outer and middle marker beacons are installed on the front course sector of the localizer using the localizer course line as the reference line. They provide definite "Over-the-Station" information aurally and on instruments to the pilot with respect to distance from the ILS landing threshold. For Category II locations, an inner marker may also be required approximately halfway between the landing threshold and the middle marker facility with its exact location and need determined by criteria given in Figure 13.

d. A compass locator (COMLO) may be installed at either the middle marker or outer marker sites to facilitate the approach procedure and for providing a navigational fix. This facility is a low-powered nondirectional beacon of the conventional type.

e. Distance measuring equipment (DME) may be installed at certain airports to provide the pilot with continuous distance information with respect to the runway touchdown zone. In some instances, it may be used with the localizer to provide a navigational fix in lieu of outer marker, e.g., if the final approach is over water.

f. The principal siting criteria and layout requirements for each of these facilities are described in the following paragraphs.

10. ILS LOCALIZER.

a. General. The major components of the ILS localizer facility are the antenna array, transmitting equipment, monitor field detectors, and the transmitting equipment shelter. The following siting criteria generally apply to both the V-ring array and the 8-loop array systems, except as otherwise noted. The current FAA standard V-ring array is illustrated in Figure 3, while Figure 4 is a photograph of the 8-loop array.

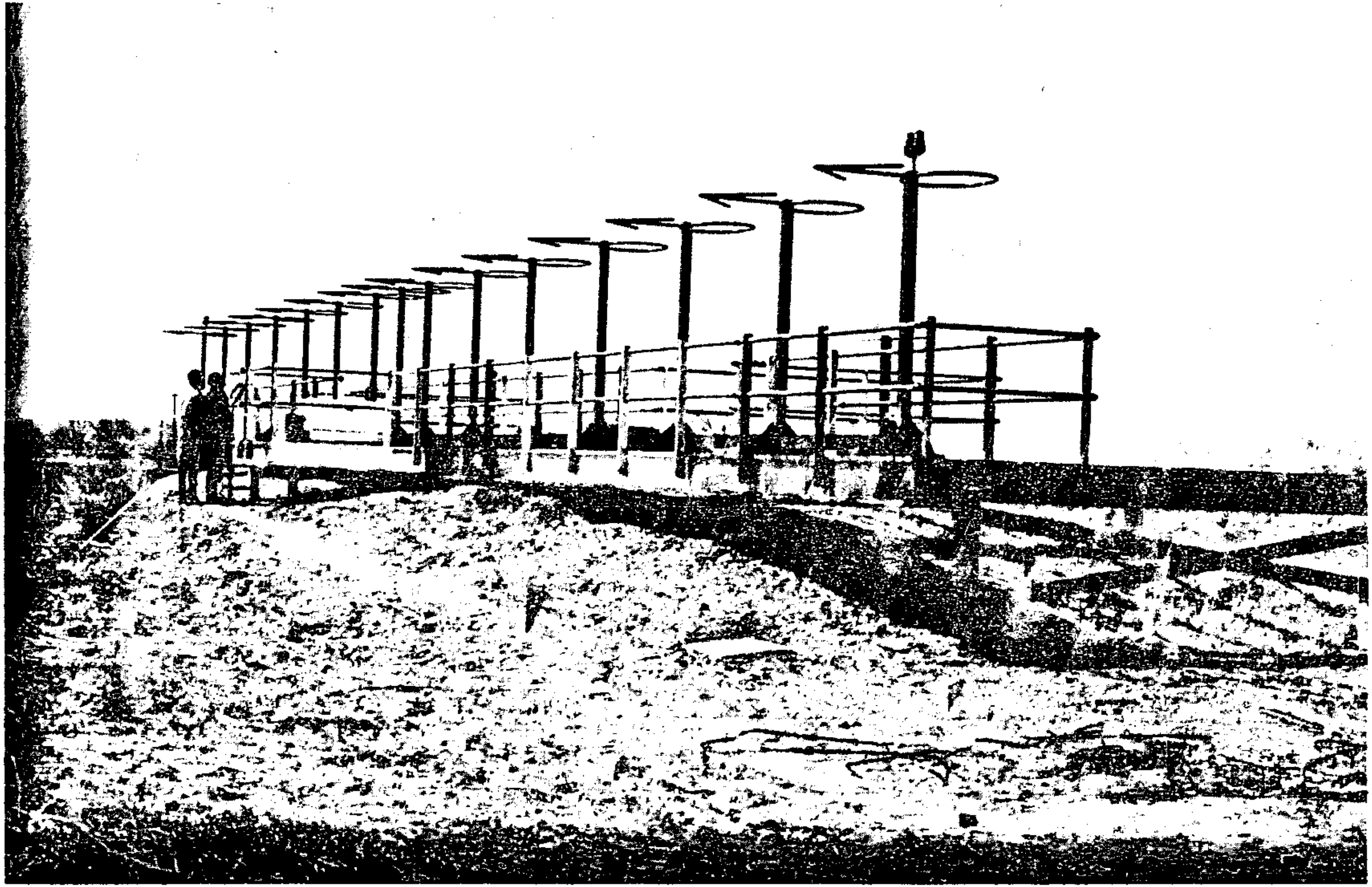


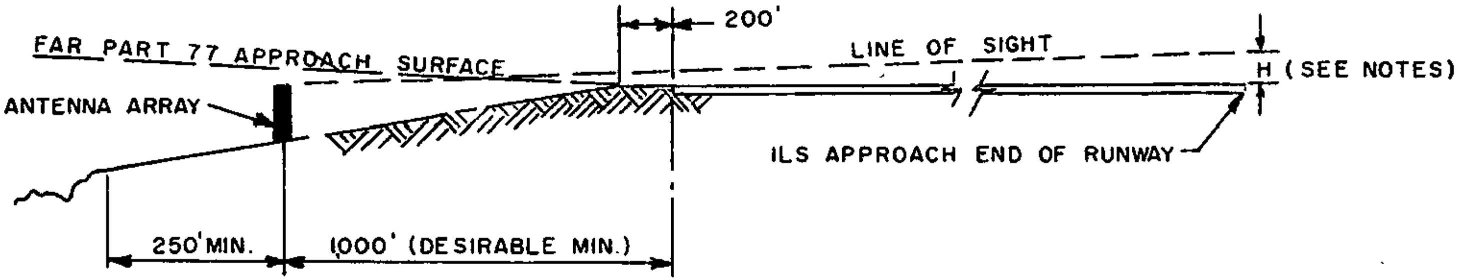
FIGURE 3. PHOTOGRAPH OF ILS LOCALIZER WITH V-RING ANTENNA ARRAY.

FIGURE 4. PHOTOGRAPH OF ILS LOCALIZER WITH 8-LOOP ANTENNA ARRAY.

b. Location. The location of the antenna array is the prime consideration and will fix the location of the equipment shelter and field detectors. Except for the offset configuration as subsequently discussed, the antenna array is located on the extended centerline of the runway, opposite the desired runway approach end, as shown in Figure 5. The localizer antenna array is located sufficiently beyond the runway end so that no portion of the array or its monitor detectors will penetrate the applicable imaginary approach surface of FAR Part 77. This requirement establishes the minimum distance that the antenna array can be from the runway end. The maximum distance is limited to 2,000 feet, unless additional distance is approved to accomodate a definitely programmed runway extension. Depending on existing terrain, required grading, and other site factors, the location selected for the antenna array (within these limits) will usually be that which economizes on establishment costs and still provides required signal quality and coverage. Where a graded runway safety area exists or site conditions otherwise permit, the antenna array is located at a distance not closer than 1,000 feet from the runway end. Location criteria for the transmitter shelter is shown in Figure 5. The transmitter shelter may be situated on either side of the antenna array, depending on local terrain conditions, access roads, or clearance requirements from other existing facilites.

c. Special Criteria. Special analysis and electronic techniques may be used in estimating the usable coverage or distance over which the VHF localizer signals can be received at any given site and antenna height. At locations where the existing terrain between the antenna array and the runway end is generally level, a ground-mounted array normally provides adequate coverage. Rough terrain or signal reflecting objects in the vicinity may require the antenna array to be put on the highest terrain or on an elevated platform. Where RVR minimums of less than 2,400 feet will be authorized or where upgrading the installation to Category II standards is contemplated, the localizer facility is established so that the antenna array is no closer than 1,000 feet from runway end, and there is clear line of sight between the antenna and a point 20 feet or less above the ILS landing threshold.

d. Obstacle Clearance. The minimum requirements for clearing above-ground objects in the vicintiy of the localizer antenna are given in Figure 5. At some locations, certain reflecting objects (power lines, buildings, or some structures) can cause harmful reflections



GRADING REQUIREMENTS FOR 8-LOOP ANTENNA ARRAY.

1. LONGITUDINAL GRADE IN AREA A (FIGURE 5) SHALL BE UNIFORM SLOPE NOT EXCEEDING +1 PERCENT OR -1½ PERCENT WITH REFERENCE TO THE RUNWAY END ELEVATION.

2. THE TRANVERSE GRADE IN AREA A SHALL BE UNIFORM SECTION WITH SLOPES NOT EXCEEDING +1 PERCENT OR -3 PERCENT WITH REFERENCE TO THE EXTENDED RUNWAY CENTERLINE. TRANSITIONS BETWEEN AREA A, AREA B, AND OTHER AREAS SHALL BE WARPED SMOOTHLY.

GRADING REQUIREMENTS FOR V-RING ANTENNA ARRAY (CURRENT FAA STANDARD SYSTEM).

1. THE CLOSE GRADING TOLERANCES GIVEN ABOVE ARE NOT REQUIRED FOR THE INSTALLATION OF THE V-RING ANTENNA SYSTEM, AS ONLY THE MINIMUM OF SITE GRADING AND PREPARATION ARE REQUIRED.

2. A CLEAR LINE OF SIGHT IS DESIRABLE BETWEEN THE ANTENNA AND A POINT 20 FEET OR LESS ABOVE THE ILS APPROACH END OF RUNWAY.

3. GRADING MAY BE LIMITED ONLY TO THE REMOVAL OF TERRAIN IRREGULARITIES IN AREA A (FIGURE 5) THAT MAY BE SOURCES OF INTERFERENCE TO THE LOCALIZER PERFORMANCE. OTHERWISE, TERRAIN IRREGULARITIES USUALLY HAVE LITTLE OR NO EFFECT ON SIGNAL QUALITY OR PERFORMANCE OF THE V-RING SYSTEM.

4. REFER TO CHAPTER 8 FOR ADDITIONAL GRADING REQUIREMENTS WHERE A RUNWAY EXTENDED SAFETY AREA WILL BE ESTABLISHED.

FIGURE 6. ILS LOCALIZER SITE GRADING CRITERIA.

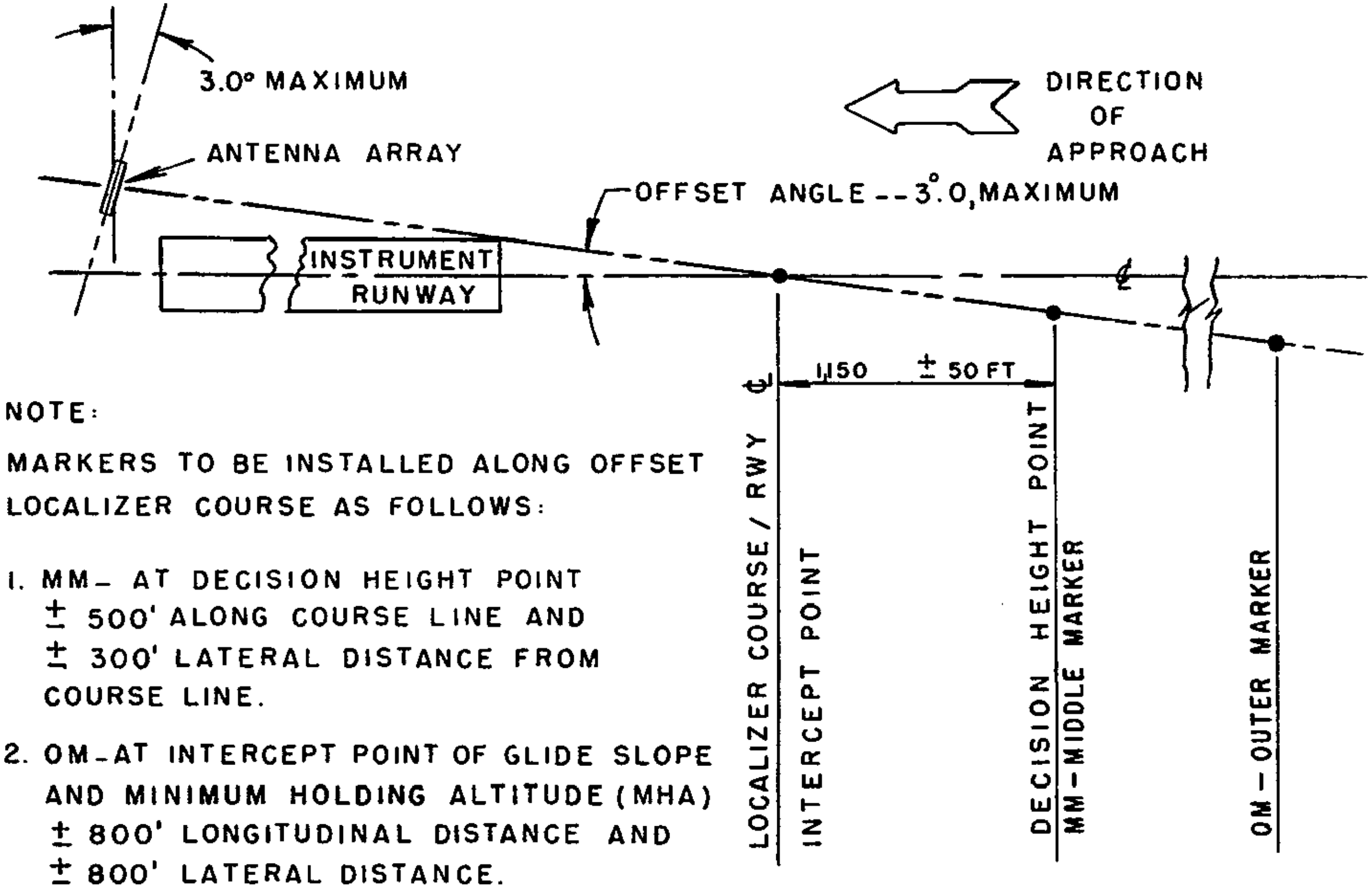


FIGURE 7. OFFSET LOCALIZER CONFIGURATION.

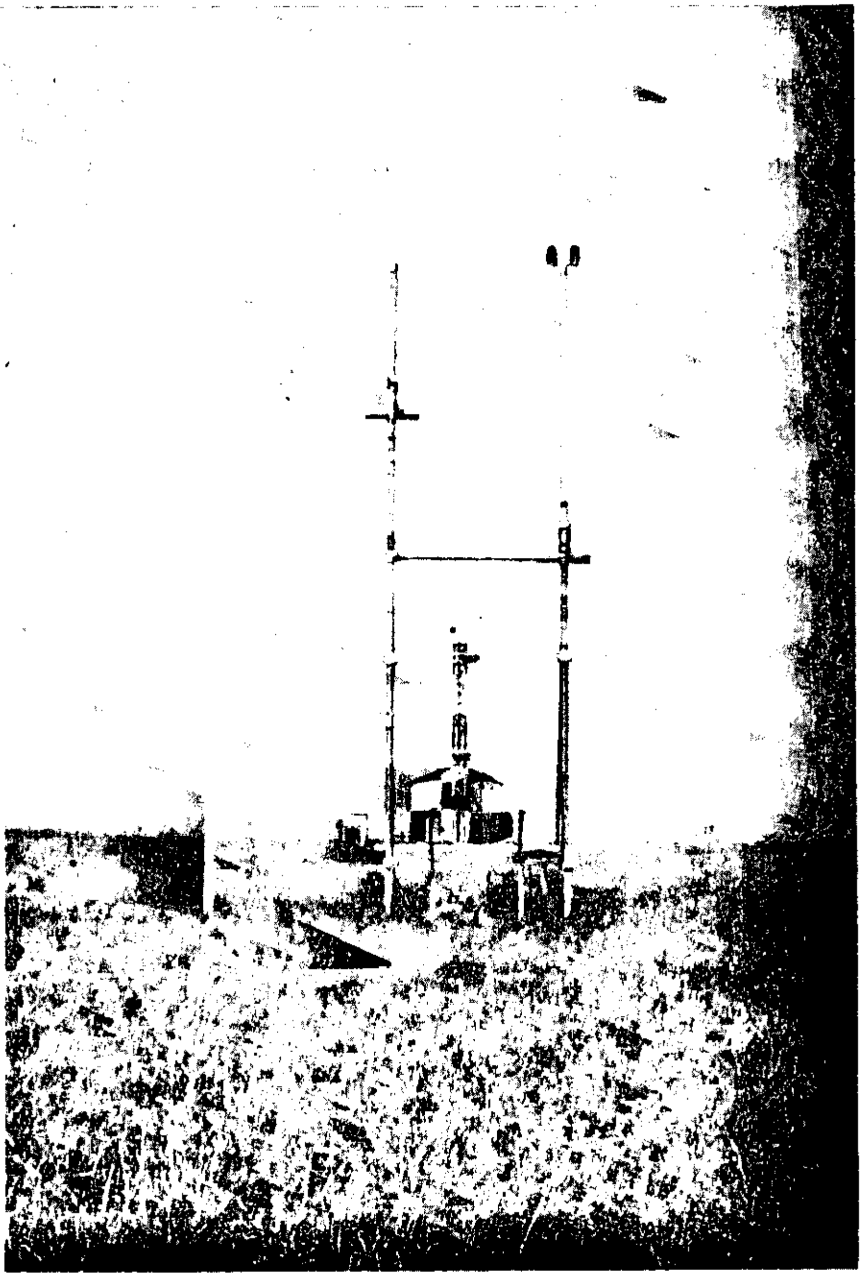


FIGURE 8. PHOTOGRAPH OF ILS GLIDE SLOPE FACILITY.

Figures 9 and 10. It is necessary that the glide slope facility be planned for installation on the runway side which will result in the least conflict with taxiway-runway-apron facilities (existing or planned) and least possibility of electronic reflection interference from nearby objects and/or adverse terrain conditions. To preclude serious siting conflicts and/or future electronic operational problems with the glide slope facility, it is recommended that the FAA Regional Office be consulted in the early stages of airport planning and design whenever establishment of a glide slope facility is contemplated. This is necessary because ILS glide slope criteria, in particular, are under constant review and subject to periodic revision by the FAA to keep abreast with more demanding performance requirements, the operational needs of aircraft operators, and growth of airport traffic.

b. Obstacle Clearance. As a minimum, the designated areas shown and explained in Figure 10 need to be cleared of all above-ground objects or possible sources of interference which may reflect glide slope antenna signals such as buildings, metallic fences, overhead utility lines, and trees.

c. Site Grading Requirements. A site conforming to the minimum grading criteria, as shown in Figure 11, will generally provide for a satisfactory installation for the various types of glide slope systems. These are minimum grading requirements and represent a compromise between theoretical requirements and practical, economic considerations. If terrain irregularities in front of the proposed glide slope facility are extremely severe and the required grading to tolerances or the extent of earthwork is too costly or otherwise not feasible, the use of either a sideband reference system or capture effect system may need to be considered. The sideband reference system provides a satisfactory glide slope facility at locations where the extent of generally level terrain is limited to a distance of 1,500 feet or less, followed by down sloping terrain and/or irregular terrain. The capture effect glide slope is used at locations where terrain discontinuities are severe throughout the approach zone area and penetrate a level plane; such as, rising terrain, slight knolls, etc. Figure 12 summarizes information on the use and applicability of the three types of glide slope systems in different site terrain conditions.

SITING ITEM	IDEAL OPTIMUM SITING	NORMAL TOLERANCES (NOTE NO. 1)		
		ITEM	CAT-I ILS	CAT-II ILS
LATERAL OFFSET FROM RUNWAY CENTERLINE (NOTE NO. 2)	500 FEET	MINIMUM MAXIMUM	250 FEET 650 FEET	400 FEET 650 FEET
LONGITUDINAL DISTANCE FROM RUNWAY THRESHOLD (NOTE NO. 2)	NOTE NO. 2	MINIMUM MAXIMUM	NOTE NO. 2	NOTES NO. 2 & 3
GLIDE SLOPE (GS) ANGLE (θ)	NOTE NO. 4	MINIMUM MAXIMUM	NOTE NO. 4	NOTE NO. 4
HEIGHT OF GS PLANE ABOVE RUNWAY THRESHOLD	50 FEET	MINIMUM MAXIMUM	47 FEET 60 FEET	50 FEET 60 FEET

NOTES:

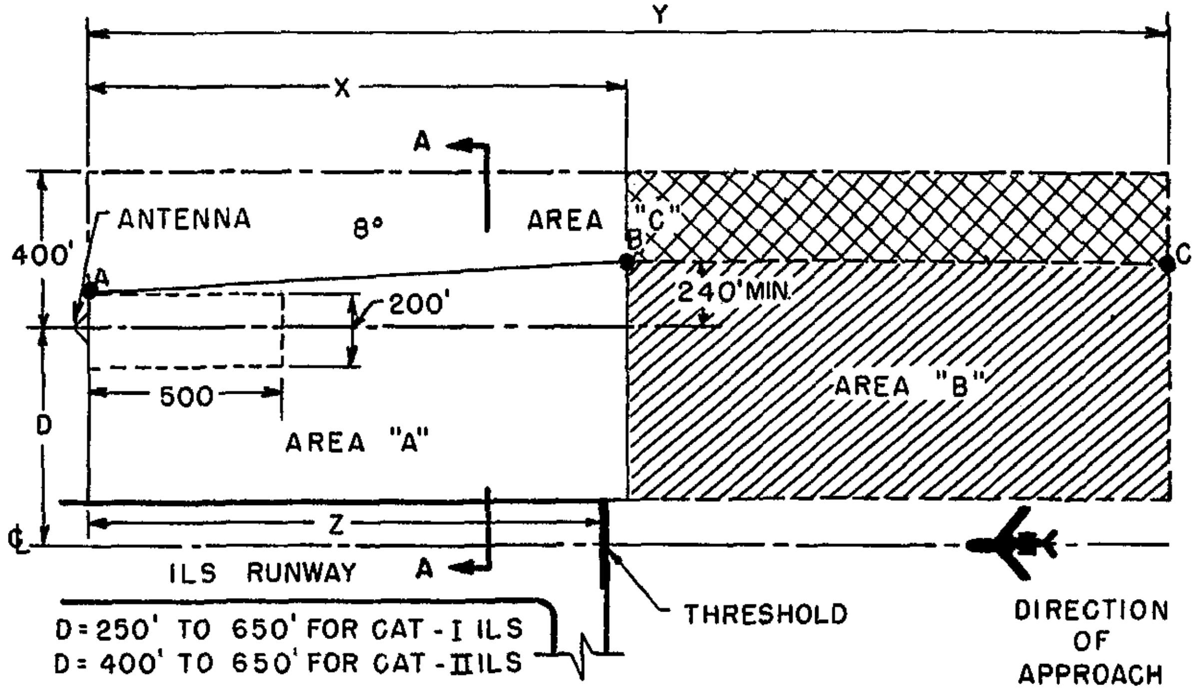
1. DEVIATIONS FROM THE IDEAL OPTIMUM ARE USUALLY REQUIRED BY TERRAIN, OBSTRUCTIONS, TAXIWAY CONFIGURATION AND SPACING, AIRCRAFT (LARGE) WINGSPAN CLEARANCE REQUIREMENTS, AND REQUIRED OBSTACLE CLEARANCE (ROC) CONSIDERATIONS BASED ON TERPS. ALSO, LIMITATIONS ON THE HEIGHT OF THE GS ANTENNA MAST MAY AFFECT LATERAL OFFSET LOCATION (Par 12e).

2. EXACT LATERAL OFFSET AND LONGITUDINAL DISTANCE ARE DETERMINED AFTER A SPECIAL STUDY BY ILS INSTALLATION ENGINEERS AND FLIGHT PROCEDURES SPECIALISTS.

3. REFER TO CHAPTER 7 FOR FURTHER DISCUSSION OF CATEGORY II REQUIREMENTS AND TOLERANCES.

4. ALL NEW ILS GLIDE SLOPES INSTALLED WITH 3° ANGLE.

FIGURE 9. ILS GUIDE SLOPE SITING CRITERIA



NOTES:

1. Locate glide slope installation on runway side which is freest of surface traffic or other interference sources.

2. All interferences sources (metallic structures, fences, etc.) shall be removed from areas "A", "B", and "C".

3. Distance "X" shall be the greater of:

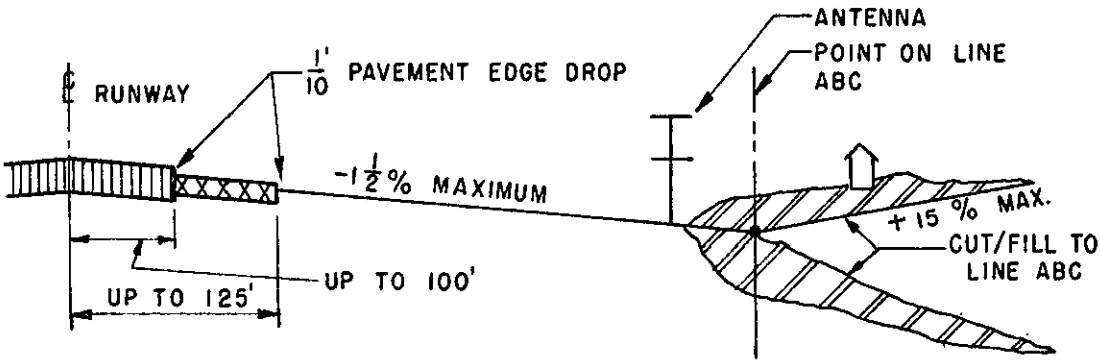
   a. 1,000 feet.
   b. Distance to the end of the runway safety area.

4. Distance "Y" shall be the least of:

   a. 3,000 feet.
   b. Distance to the airport property line.
   c. Distance to feasible limits of electronically smooth terrain.

5. Distance "Z" is determined by the glide slope operational requirements.

FIGURE 10. ILS GLIDE SLOPE LAYOUT PLAN



TRANSVERSE SECTION A-A

NOTES:

1. Area "A" of Figure 10 shall be uniformly graded so that longitudinal grades are identical to the runway centerline grade and transverse grades shall not exceed the design criteria depicted above.

   a. The 500' x 200' moniter field shall be protected from extensive vegêtation growth and shall be graded to assure drainage.

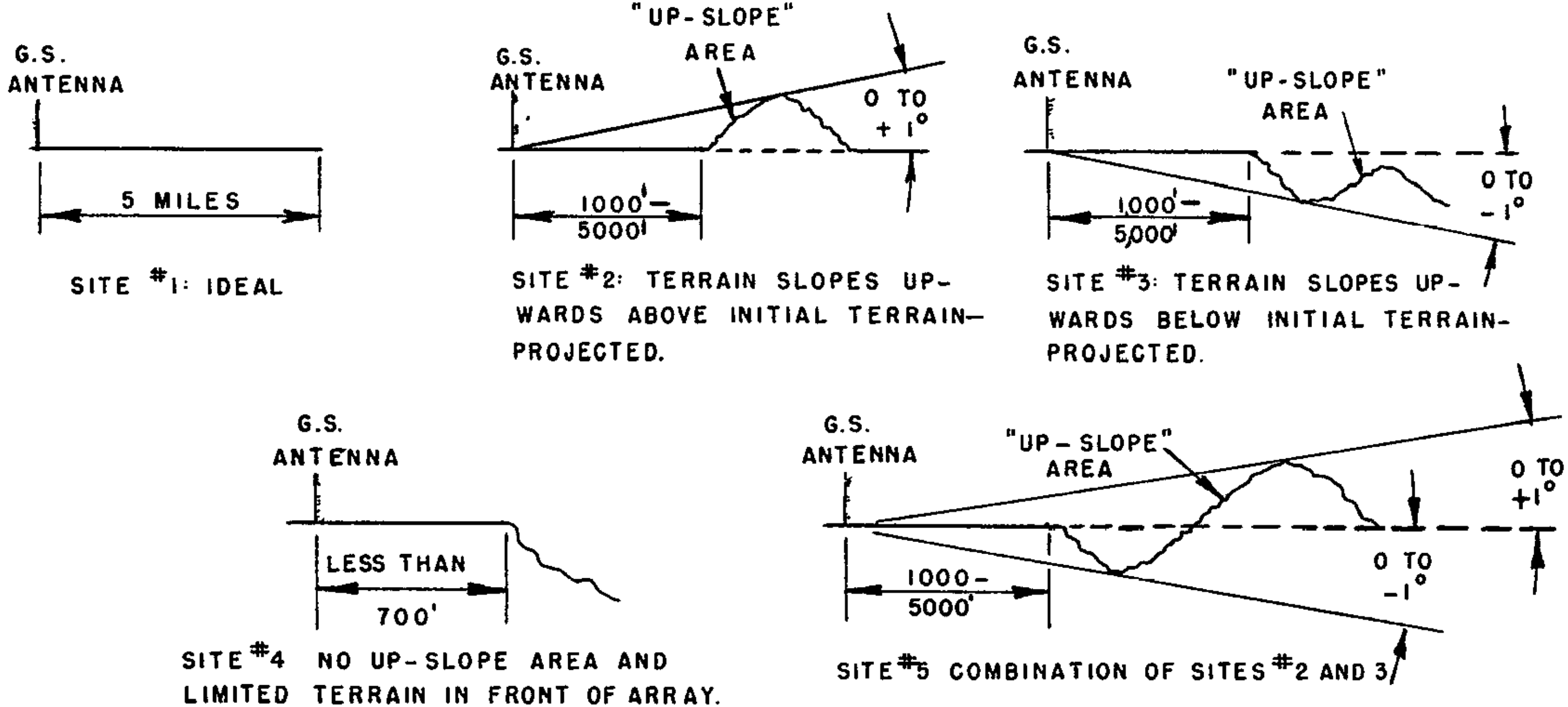
   b. Finished grades of Area "A" shall not exceed design grades by more than ± 1/10 foot per specification P-152 of AC 150/5370-1A.

2. Area "B" of Figure 10 shall be graded to remove any severe irregularities in the terrain as specified by the FAA.

3. Area "C" of Figure 10 shall be graded to eliminate signal interference sources. Slope of cut section may not exceed the 15% limitation but may be further restricted by application of the transitional surface criteria of FAR Part 77.

4. When required, drainage ditches adequate to handle the expected runoff shall be located beyond line ABC.

FIGURE 11. ILS GLIDE SLOPE GRADING DETAILS



APPROXIMATE PERCENT OF TOTAL SITES	SITE #1 5%	SITE #2 20%	SITE #3 15%	SITE #4 15%	SITE #5 45%
NULL REFERENCE	ALL	VERY FEW	FEW	NONE	VERY FEW
SIDEBAND REFERENCE	ALL	FEW	MANY	VERY FEW	FEW
CAPTURE EFFECT	ALL	MOST	MOST	NONE	MOST

FIGURE 12. EXPECTED APPLICABILITY OF VARIOUS TYPES OF GLIDE SLOPE SYSTEMS TO DIFFERENT SITING CONDITIONS.

d. Special Considerations. An important factor in establishing a glide slope facility and which also may require a departure from optimum conditions is the Required Obstruction Clearance (ROC) criteria, as given in U.S. Standard for Terminal Instrument Procedures (TERPS). This applies to the minimum vertical separation required between the glide slope plane and a physical obstruction at a given location in the final approach zone. The glide slope angle may need to be adjusted and/or glide slope facility relocated longitudinally along the runway to conform to the ROC criteria given in TERPS for the site conditions at a particular airport. This determination usually results after a special study conducted by FAA flight procedures specialists and ILS installation engineers.

e. Allowable Height of Glide Slope Antenna Mast. The height of the glide slope antenna mast is tailored to accommodate the upper antenna plus 2 feet for obstruction lights and shall not exceed the following:

(1) The maximum allowable height (Hm1) of a glide slope antenna mast at a lateral distance (LD) between 250 and 400 feet from runway centerline, as measured above runway centerline abeam, the glide slope mast, is determined by:

$$Hm1 = 55' - .2\ (400' - LD)$$

(2) The maximum allowable height (Hm2) of a glide slope antenna mast at a lateral distance (LD) between 400 and 650 feet from runway centerline, as measured above runway centerline abeam the glide slope mast, is determined by:

$$Hm2 = 55' + .1\ (LD - 400')$$

(3) Waivers from FAA headquarters and a reevaluation of allowable ILS minimums are required when there are deviations from these limitations on glide slope antenna mast height. This may occur at glide slope locations where adequate lateral distance from runway centerline cannot be provided without extremely costly grading or earthmoving to obtain suitable glide slope site conditions.

(4) It should be noted that the capture effect system usually requires a glide slope antenna mast height of approximately

38 to 60 feet; the null reference system, approximately 24 to 40 feet; and the sideband reference system, approximately 18 to 32 feet.

13. ILS MARKER BEACONS. Figure 13 summarizes criteria on the various ILS marker beacons for Category I and Category II locations. Previously, the standard marker facility consisted of an 8 x 12-foot equipment building with an antenna and 20 x 20-foot counterpoise, either on top of or adjacent to the buildings. Recently, a simplified and compact marker beacon has been developed which includes a solid-state transmitter, antenna, and power supply, all mounted on a single pole, as shown in Figure 14. Except as noted, clearance criteria given in Figure 15 are identical for both types of marker beacons.

14. COMPASS LOCATORS. As an auxiliary aid to the ILS, a Nondirectional Radio Beacon may be collocated at the outer marker to establish a final navigational fix and, where operationally required, at the middle marker. Such facilities are classified as compass locators (COMLOS) and designated either as LOM (Locator Outer Marker) or LMM (Locator Middle Marker). Figure 15 provides site area requirements and layout planning data for compass locators collocated with marker beacons, while Figure 16 is a photograph of an ILS Marker/COMLO facility.

15. DISTANCE MEASURING EQUIPMENT (DME). Although the DME is not presently considered as an integral component of an ILS, it may be installed in conjunction with the ILS to provide distance information to the runway touchdown point. Where so used, the DME is normally located at the glide slope site and may be used as a substitute for the outer marker. This is sometimes necessary where the ILS approach path is over water or at locations where no feasible site is available for the outer marker. The DME is usually housed in a separate shelter; its power and control circuits are provided by the glide slope facility. The DME antenna is mounted on a mast which may be fixed to the shelter or ground mounted. No special site clearance requirements need be observed where the DME is located at the glide slope site other than that the DME antenna may not be located in front of the glide slope antennas.

TYPE	FUNCTION	NOMINAL LOCATION	LOCATION TOLERANCES	OPERATIONAL REQUIREMENT
OUTER MARKER	MARKS INTERCEPT POINT OF GLIDE SLOPE AND MINIMUM HOLDING ALTITUDE	THE INTERCEPT POINT	±800 FEET LATERAL AND LONGITUDINAL	REQUIRED FOR CAT-I & CAT-II ILS LOCATIONS
MIDDLE MARKER	MARKS DECISION HEIGHT POINT FOR CAT-I OPERATIONS	THE DECISION HEIGHT POINT	±300 FEET LATERAL AND ±500 FEET LONGITUDINAL	REQUIRED FOR CAT-I & CAT-II ILS LOCATIONS
INNER MARKER (POLE-MOUNTED)	MARKS DECISION HEIGHT POINT FOR CAT-II OPERATIONS	SEE NOTE NO. 1	±25 FEET LATERAL AND LOGITUDINAL	REQUIRED ONLY FOR CAT-II ILS LOCATIONS

NOTES:

1. ILS INNER MARKER ANTENNA IS LOCATED AT THE POINT WHERE GLIDE SLOPE ELEVATION IS 100 FEET ABOVE THE ELEVATION OF THE HIGHEST POINT IN 3,000-FOOT RUNWAY TOUCHDOWN ZONE.

2. ILS INNER MARKER ANTENNA CAN PENETRATE AND EXTEND ABOVE THE APPROACH LIGHT PLANE, BUT NOT ABOVE THE 50:1 APPROACH SURFACE OF FAR PART 77.

3. RADAR (ASR AND PAR) AND DME MAY BE USED AS A SUBSTITUTE FOR OUTER MARKER UNDER CERTAIN CIRCUMSTANCES.

4. THE OUTER MARKER MAY BE APPROXIMATELY 4 TO 7 MILES FROM THE ILS LANDING THRESHOLD, WHILE THE MIDDLE MARKER MAY BE APPROXIMATELY 3,500 FEET FROM THE SAME THRESHOLD.

FIGURE 13. ILS MARKER BEACON DATA AND LOCATION CRITERIA.

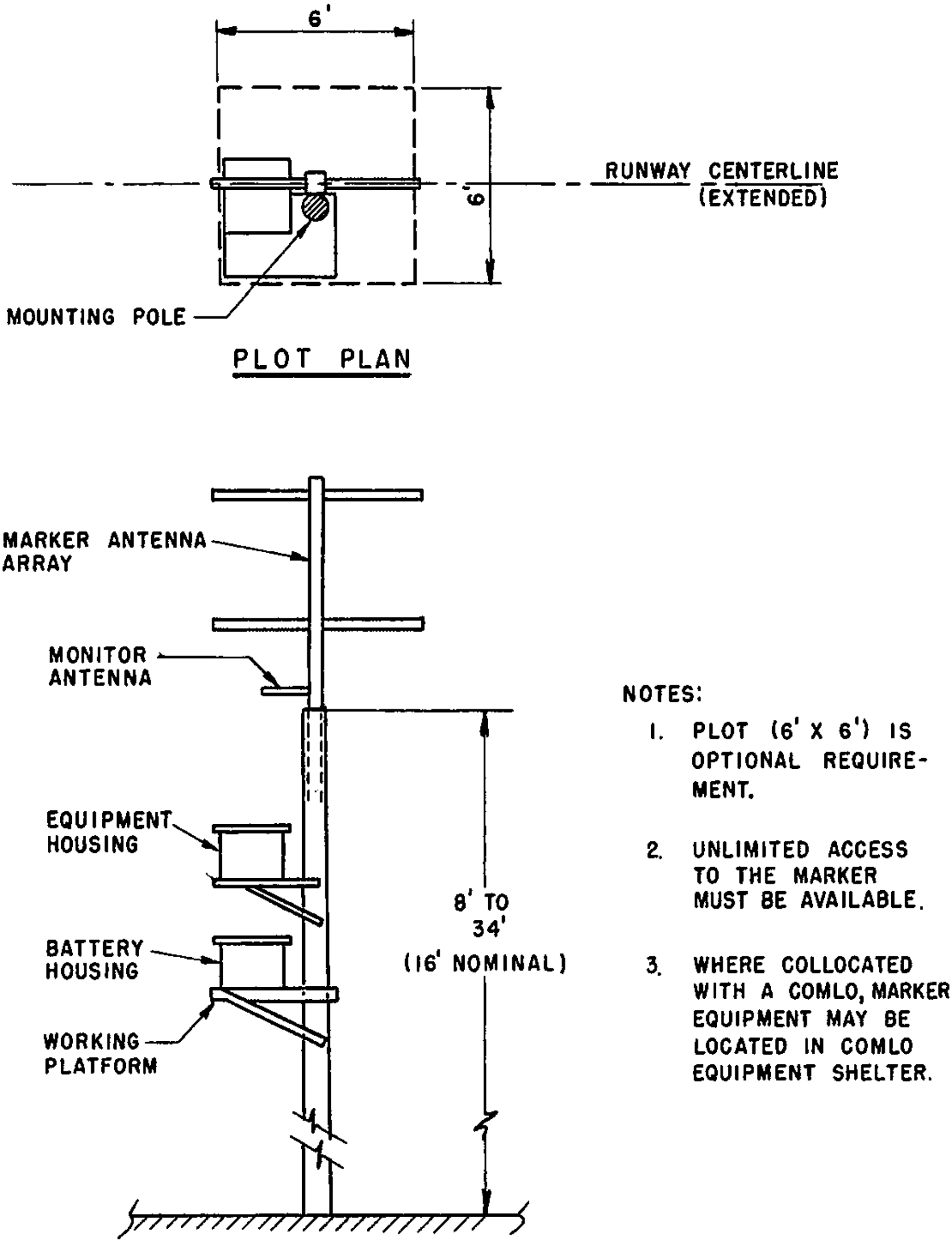
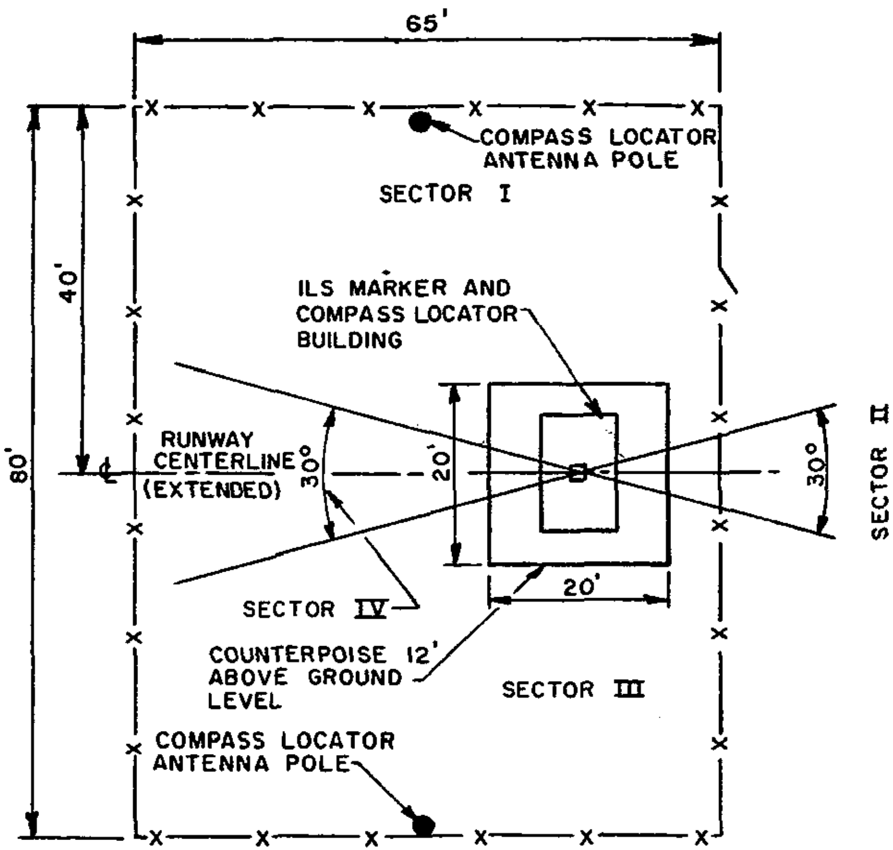


FIGURE 14. POLE-MOUNTED ILS MARKER BEACON.



NOTES:

1. NO OBSTACLES PERMITTED WITHIN 50 FEET OF MARKER COUNTERPOISE EDGE.

2. IN SECTORS I AND III NO OBSTACLES ARE PERMITTED WITHIN 150 FEET OF THE COUNTERPOISE EDGE WHICH PENETRATES A 20° ANGLE ABOVE THE LEVEL OF THE COUNTERPOISE AND EMANATING FROM THE CENTER OF THE COUNTERPOISE.

3. WHERE A COMPASS LOCATOR IS COLLOCATED WITH THE MARKER, THE ANTENNA POLE HEIGHT WILL NORMALLY BE 24 FEET HIGH. IF THE COMLO IS TO BE A MEDIUM OR HIGH COVERAGE NDB FACILITY, THE ANTENNA HEIGHT MUST BE INCREASED TO 50 FEET, AND THE POLE SPACING TO 250 FEET. THE SITE MUST, ACCORDINGLY, BE ENLARGED.

4. IF THERE IS NO COLLOCATED COMLO, THE MARKER PLOT MAY BE REDUCED IN SIZE TO ACCOMMODATE ONLY THE BUILDING AND NECESSARY ACCESS AREA.

5. OBSTACLE CRITERIA FOR THE POLE-MOUNTED MARKER BEACON IS IDENTICAL TO THAT SHOWN FOR THE PREVIOUS STANDARD MARKER BEACON WITH BUILDING. THE ONLY EXCEPTION IS THAT THE ANTENNA MAST AND A LINE 40 INCHES BELOW THE LOWER ANTENNA ARE USED AS THE REFERENCE PLANES.

FIGURE 15. ILS MARKER/COMLO PLOT LAYOUT AND CLEARANCE CRITERIA.

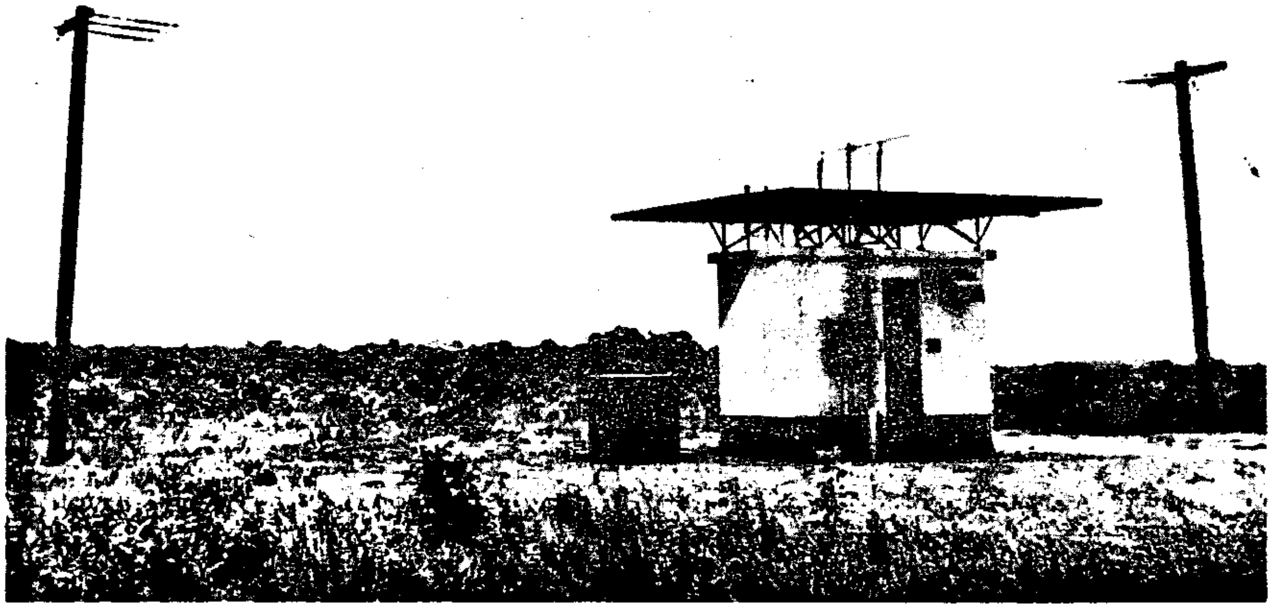


FIGURE 16. PHOTOGRAPH OF ILS MARKER/COMLO FACILITY

CHAPTER 3. NAVIGATIONAL AIDS FOR NONPRECISION INSTRUMENT APPROACHES

16. GENERAL. This chapter provides information on siting requirements for the following navigational aids associated with runways to provide for nonprecision instrument approaches:

    a. Terminal VHF Omnirange (TVOR)

    b. VORTAC and VOR/DME

    c. Doppler VOR

    d. Localizer Type Directional Aid (LDA) System

    e. Nondirectional Beacon (NDB)

17. TERMINAL VHF OMNIRANGE (TVOR).

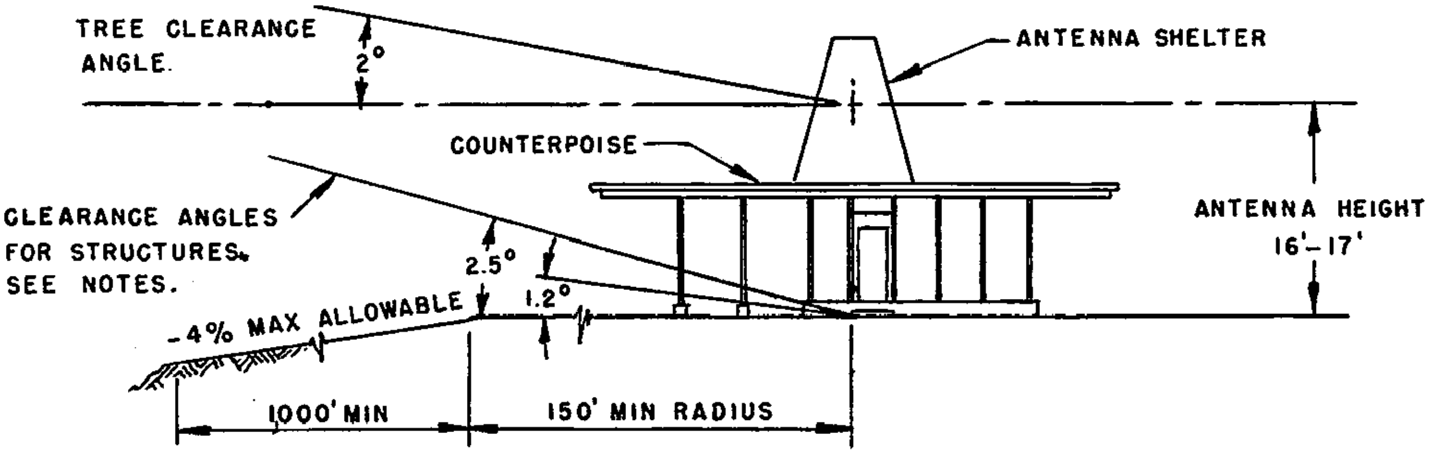
    a. General. The very high frequency omnirange (VOR) is the standard electronic navigational aid used throughout the airway system to provide azimuth (magnetic bearing) guidance. When installed in the immediate vicinity or within the physical limits of the airport and used as an approach aid, it is commonly referred to as a TVOR. The TVOR is usually installed to establish a new nonprecision instrument approach procedure or otherwise enhance the existing IFR capability of the airport. The TVOR is usually the conventional VOR used throughout the airway system; however, in a few cases it may be a low-powered VOR designed especially for use as a terminal aid within the vicinity of an airport.

    b. Location. The TVOR site preferably is located so that the facility will provide guidance to the approach ends of the runway(s). This requirement may best be met by selecting a location adjacent to the intersection of principal runways; however, the facility is not located closer than 500 feet from a runway centerline or 250 feet from a taxiway centerline. When the TVOR is required to be slightly outside the normal airport boundaries, a site is selected so that one of the course radials will provide for a let-down procedure to the desired IFR runway(s). In such a case, the site is located from 1,200 feet to 7 miles from the desired runway end and preferably on the extended runway centerline. However, where the TVOR cannot be located on the extended runway centerline, the TVOR is preferably located where it would permit a straight-in landing approach procedure to be established in accordance with TERPS. Ideally, the TVOR site is the highest ground in the vicinity and without any conflicting objects within a radius of 3,000 feet of the TVOR antenna; however, certain siting tolerances are permitted as outlined below. The minimum plot desired for the TVOR installation is approximately 70 feet by 80 feet of rectangular area.

c. Obstacle Clearance Criteria. The broad reflective surfaces of terminal buildings, hangars, and other structures on the airport sometimes cause interference to the TVOR signal, particularly when the antenna and these structures are in close proximity. It is desirable that a minimum separation of 750 feet be provided between above-ground structures and the antenna. (See Figure 17 for height limitations of structures in the vicinity of the TVOR installation.) It is also desirable that no metallic fences be located closer than 500 feet from the antenna, and no overhead metallic conductors (power, control, telephone lines, etc.) be permitted within 1,200 feet of the antenna. The site must be cleared of all trees within 1,000 feet of the TVOR antenna. Isolated trees of less than 30 feet in height may be tolerated if they are more than 500 feet from the TVOR antenna. Figure 17 illustrates these and other typical siting requirements, including height limitations of all above-ground objects which may affect electronic performace of the TVOR. At some TVOR sites with obstacle clearance problems, a special study is necessary to determine the corrective measures required.

d. Special Terrain Considerations. The terrain adjacent to the TVOR antenna should be generally uniform without major terrain irregularities, such as ravines, ditches, rock outcroppings, dikes, embankments, etc. Such irregularities, which are above or below average ground line, should not exceed a height or depth greater than 1 percent of their distance from the antenna. It is desirable that a graded, level pad with a minimum radius of 150 feet from the antenna be provided. Beyound this 150-foot pad, a downward slope, not to exceed 4 percent, may be tolerated as illustrated in Figure 17. After site grading is completed, the TVOR plot may be treated with soil sterilizer and covered with a minimum 3-inch layer of crushed stone or gravel where soil conditions require such treatment to minimize future ground maintenance of the area.

18. VOR/DME AND VORTAC. Distance Measuring Equipment (DME) is collocated or installed with a VOR facility on or off airport sites where distance guidance information is operationally required in addition to azimuth guidance for enhancing the airport's IFR capability or approach procedure(s). This distance information is provided on an aircraft instru-



NOTES:

1. A GRADED, LEVEL, AND CIRCULAR PAD WITH MINIMUM RADIUS OF 150 FEET IS RECOMMENDED.

2. A DOWNWARD SLOPE MAY BE TOLERATED BEYOND THE 150-FOOT PAD, BUT SHOULD NOT EXCEED -4% FOR AT LEAST 1,000 FEET. IN THIS AREA THE CONTOURS SHOULD BE CIRCULAR AROUND THE ANTENNA.

3. BEYOND 1000 FEET FROM THE ANTENNA, TREES SHOULD NOT SUBTEND A VERTICAL ANGLE MORE THAN 2°, AS MEASURED FROM THE TOP OF THE ANTENNA. TREES ARE NOT DESIRABLE WITHIN 1,000 FEET OF THE ANTENNA.

4. BEYOND 750 FEET, METAL STRUCTURES, SHOULD NOT SUBTEND A VERTICAL ANGLE OF MORE THAN 1.2°; AND WOODEN STRUCTURES, OVER 2.5° AS MEASURED FROM THE GROUND ELEVATION OF THE ANTENNA SITE. ABOVE-GROUND STRUCTURES ARE NOT PERMITTED WITHIN 750 FEET OF THE ANTENNA.

FIGURE 17. TYPICAL TVOR PROFILE AND GRADING REQUIREMENTS.

ment in terms of nautical miles in relation to the facility. A VORTAC facility is a combination of both VOR and TACAN, which provides essentially the same information as VOR/DME. (Military aircraft utilize TACAN for both azimuth and distance guidance.) For on-site airport installations, siting requirements and clearances for VOR/DME and VORTAC facilities are generally similar to those for the TVOR, detailed in Figure 17. A typical terminal VORTAC installation is shown in Figure 18.

19. DOPPLER VOR (DVOR). The Doppler VOR utilizes a different antenna system, which is designed to obtain more satisfactory electronic performance at locations which present siting problems for a conventional VOR. The same siting criteria generally apply to the Doppler VOR as to a conventional VOR. However, a much larger land plot is needed since a 150-foot diameter counterpoise is used for the Doppler facility, as compared to the 52-foot diameter counterpoise for conventional VOR. (See Figure 19.)

20. LOCALIZER TYPE DIRECTIONAL AID SYSTEM (LDA). An LDA is defined as a localizer whose course alignment is more than 3 degrees from the runway alignment. It is a basic IFR approach system consisting of an ILS localizer and outer marker beacon. It may be established when an existing VOR can be used for transition to the localizer. Siting requirements for the localizer and marker beacon of the LDA system are the same as those given for the ILS localizer and outer marker, except as otherwise provided in TERPS.

21. NON-DIRECTIONAL BEACON (NDB). NDBs are no longer installed as an FAA navigational aid except in the case of a COMLO installed as part of an ILS system. (See paragraph 14). Commercially obtained NDBs transmit a nondirectional signal on which a pilot may "home" using automatic direction finder (ADF) equipment installed in the aircraft. The NDB facility may include a small transmitter building with either a wire antenna strung between two poles spaced approximately 250 feet apart or a vertical antenna mounted on a building or pole. Installation requirements for these commercially obtained NDBs would be provided by the manufacturer/supplier.

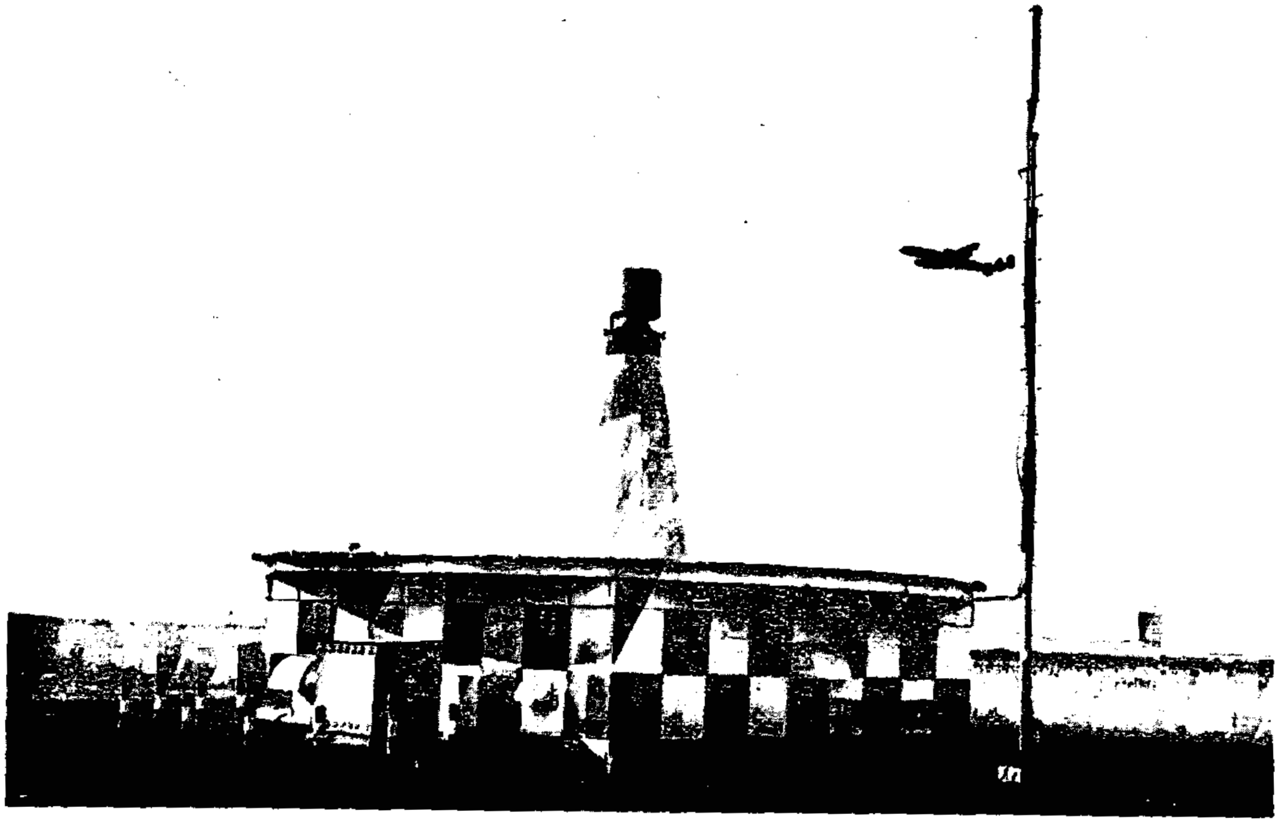


FIGURE 18. PHOTOGRAPH OF VORTAC FACILITY.

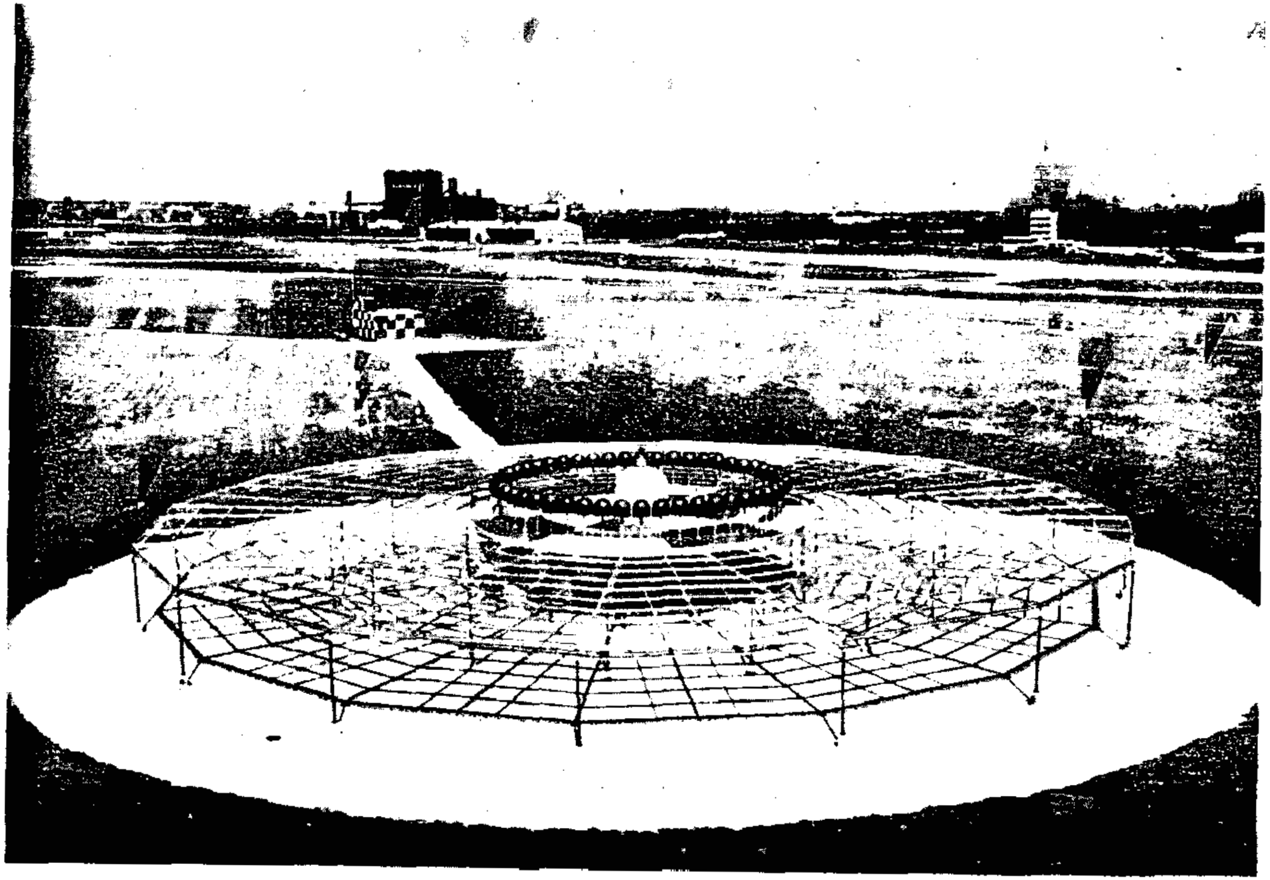


FIGURE 19. PHOTOGRAPH OF DOPPLER VOR FACILITY

CHAPTER 4. APPROACH LIGHTING SYSTEMS

22. GENERAL. This chapter provides some of the basic siting criteria and clearance requirements applicable for the following FAA approach lighting systems (ALS) which are high intensity, except as otherwise noted:

a. ALSF-2 (CAT II Configuration) - Approach Lighting System (3,000 Feet).

b. ALSF-1 (CAT I Configuration) - Approach Lighting System (3,000 Feet).

c. SSALS - Simplified Short Approach Lighting System (1,400 Feet).

d. SSALF - Simplified Short Approach Lighting System with Sequenced Flashers (1,400 Feet).

e. SSALR - Simplified Short Approach Lighting System with Runway Alignment Indicator Lights (3,000 Feet).

f. MALS - Medium Intensity Approach Lighting System (1,400 Feet).

g. MALSF - Medium Intensity Approach Lighting System with Sequenced Flashers (1,400 Feet).

h. MALSR - Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (3,000 Feet).

Illustrations at the end of this chapter depict the layout and configuration of each of the above lighting systems with pertinent details, and Figure 20 indicates the principal use and application of each of these lighting systems. Refer to Chapter 8 for special grading and frangibility requirements of approach lighting systems where an extended runway safety area will be established. For detailed ALS criteria, refer to FAA Handbook, "Visual Guidance Lighting Systems."

23. APPROACH LIGHT PLANE AND CLEARANCE REQUIREMENTS.

a. Approach Light Plane. The approach light plane is a single, imaginary horizontal plane at the elevation of the runway end centerline. This plane passes through the beam centers of all steady burning lights in the system. The plane is rectangular in shape, 400 feet wide, and centered on the ALS centerline. It originates at the landing threshold and extends 200 feet beyond the last steady-burning light bar at the approach end of the ALS.

b. Visibility. There shall be a clear line of sight to all lights of the system from any point on an imaginary plane, inclined one-half degree below the ILS glide path, extending 250 feet each side of the centerline in width and up to 1,600 feet in advance of the outermost light in the system. Procedures for determining clear line of site are given in Figures 28 and 29. A table in each of the figures gives calculated horizontal distances (for selected ALS slopes and glide slope settings) from the last light in the system to the point of intersection of the line of sight with the appropriate FAR Part 77 approach surface. Thus, in the profile views of Figures 28 and 29, objects within the triangular areas ABC, A'BC', AB'D, etc., will obstruct the pilot's view of lights when on final landing approach for the example conditions shown. For nonprecison systems installed where there is no ILS, a 3-degree glide path, intersecting the runway 1,000 feet from the landing threshold, is assumed for determining visibility requirements.

c. Clearance. No object protrudes above the approach light plane. For approach light plane clearance purposes, all roads, highways, vehicle parking areas, and railroads are considered as vertical solid objects. Refer to FAR Part 77 for current clearance dimensional requirements above such facilities used by surface traffic. The clearance above roads and highways is measured from the crown of the road; above railroads, it is measured from the top of the rails; and above vehicle parking areas, clearance is measured from the average grade in the vicinity of the highest point. Airport service roads, where vehicle traffic is controlled in any manner which would preclude blocking the view of approach lights to landing aircraft, are not considered as obstructions for approach light plane purposes.

d. Permissible Deviations.

(1) Where necessary to insure optimum performance of the Instrument Landing System, the antennas and their associated supports for the Inner Marker Beacon and the Localizer may penetrate the approach light plane. These antennas or their supports shall not, however, obscure any light. This exception applies only to penetration of the approach light plane and not to penetration of the applicable imaginary approach surface as defined in FAR Part 77.

(2) The position of light bars along the centerline may be adjusted, where necessary, to avoid roads, buildings, railroads, etc. Where a light bar must be displaced longitudinally from its ideal or normal position, the adjacent bars, where practicable, are displaced by appropriate amounts in order to maintain essentially equal longitudinal spacing in the system. When respacing is necessary, the spaces are kept as near the optimum as possible and within the applicable tolerances for each ALS configuration. Lateral displacement of light bars is not permitted.

(3) With the exception of the frangible lights at stations 0+00, 1+00, and 2+00, no other ALS components may penetrate the applicable airport imaginary approach surface, as defined for civil use in FAR Part 77.

(4) The clearance requirements of Paragraph 23(c) do not apply to the RAIL portion of the SSALR or MALSR, except where required to meet the visibility criteria of Paragraph 23(b).

24. MINIMUM ALS LAND REQUIREMENTS. The following are recommended minimum ALS land requirements, as measured from the landing threshold and located symmetrically about the runway centerline extended.

a. ALSF-1 and ALSF-2 - 3,200 feet in length by 400 feet wide.

b. MALS, MALSF, SSALS, SSALF - 1,600 feet in length by 400 feet wide.

c. MALSR and SSALR - 1,600 feet in length by 400 feet wide for the MALS and SSALS portion, plus an additional 1,600 feet in length by 25 feet wide for the RAIL portion, unless a greater minimum width is necessary because of site conditions, accessibility, or other requirements.

TYPE	APPLICATION AND SELECTION CRITERIA
ALSF-2 (Category II) (White/Red/Green Lights -- 3,000-foot	Airport has scheduled service and the airport meets FAA requirement for CAT-II ILS.
ALSF-1 (Category I) (White/Red/Green Lights -- 3,000-foot)	Airport has scheduled service by Category D/larger aircraft or such service is forecast within 3 years and the airport meets FAA requirements for CAT-I ILS.
SSALR (All White Lights -- 3,000-foot)	Airport has scheduled service with Category D/larger aircraft forecast in 3 to 5 years, and the airport meets FAA requirements for CAT-I ILS.
MALSR (All White Lights -- 3,000-foot)	Airport has scheduled service with Category D/larger aircraft not forecast within 5 years, or the airport serves general aviation with the required number of annual instrument approaches, and the airport meets FAA requirements for CAT-I ILS.
SSALF and SSALS (All White Lights --	Airport forecast to qualify for ILS within 2 years with scheduled service by Category D/larger aircraft within 5 years. Airport must have a non-precision instrument approach system installed or programmed, and the SSALS will reduce landing minimums.
MALSF and MALS (All White Lights -- 1,400-foot)	Airport has a non-precision instrument approach system installed or programmed. Also, the airport meets FAA requirements for annual instrument approaches by general aviation or annual passenger originations for airports with scheduled service.

FIGURE 20. APPROACH LIGHTING SYSTEMS SELECTION CRITERIA.

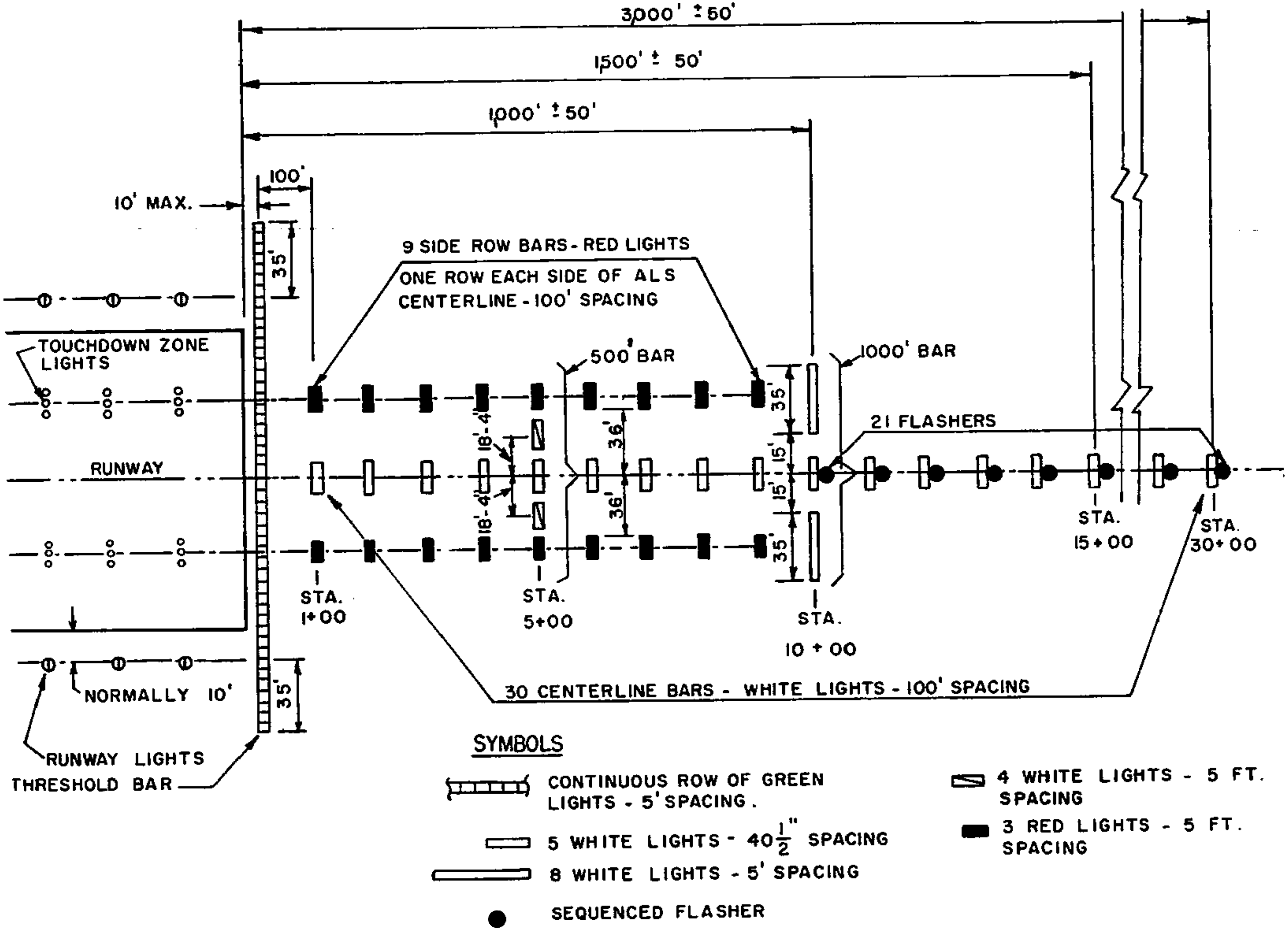


FIGURE 21. ALSF-2 CONFIGURATION.

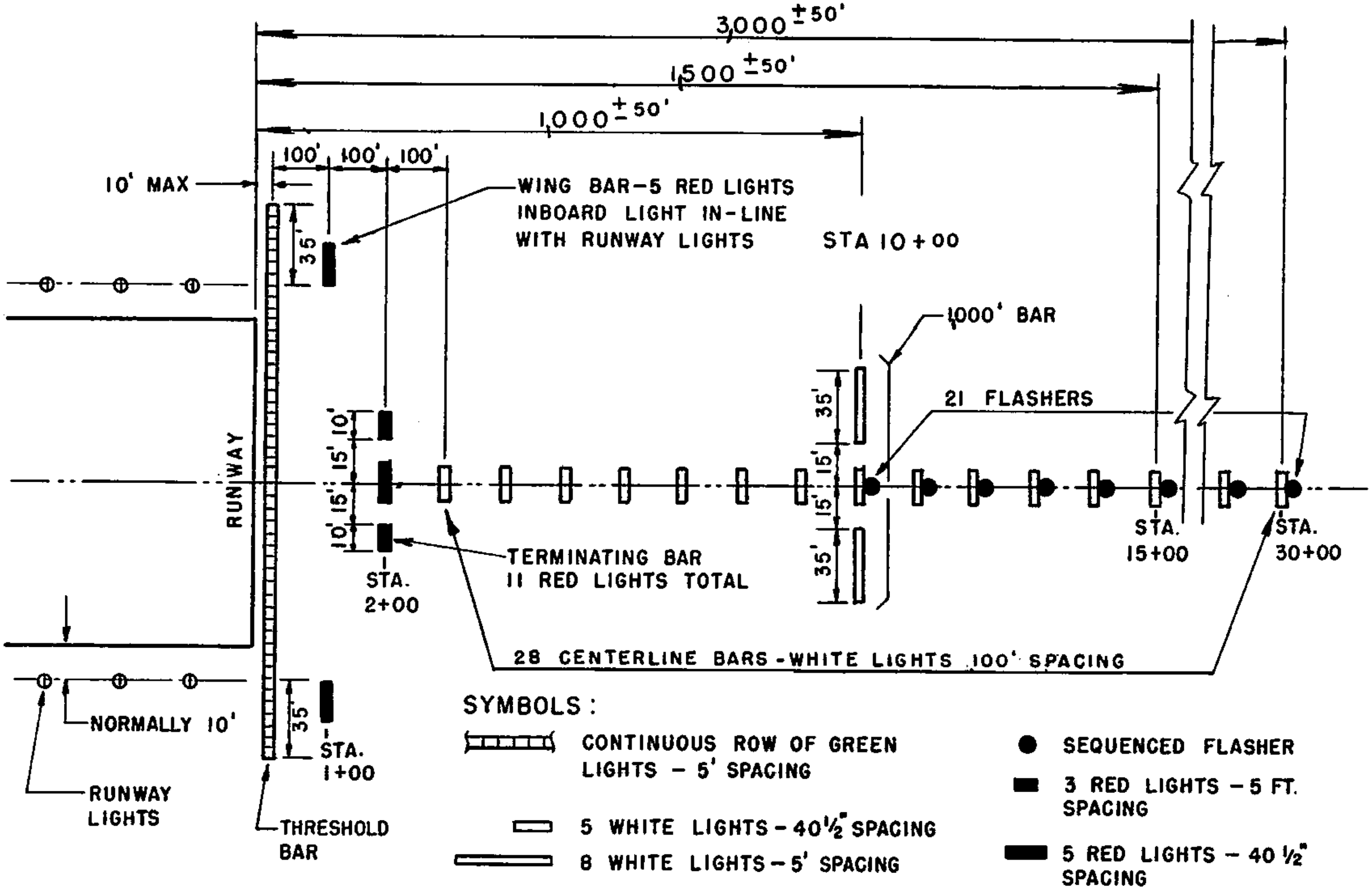
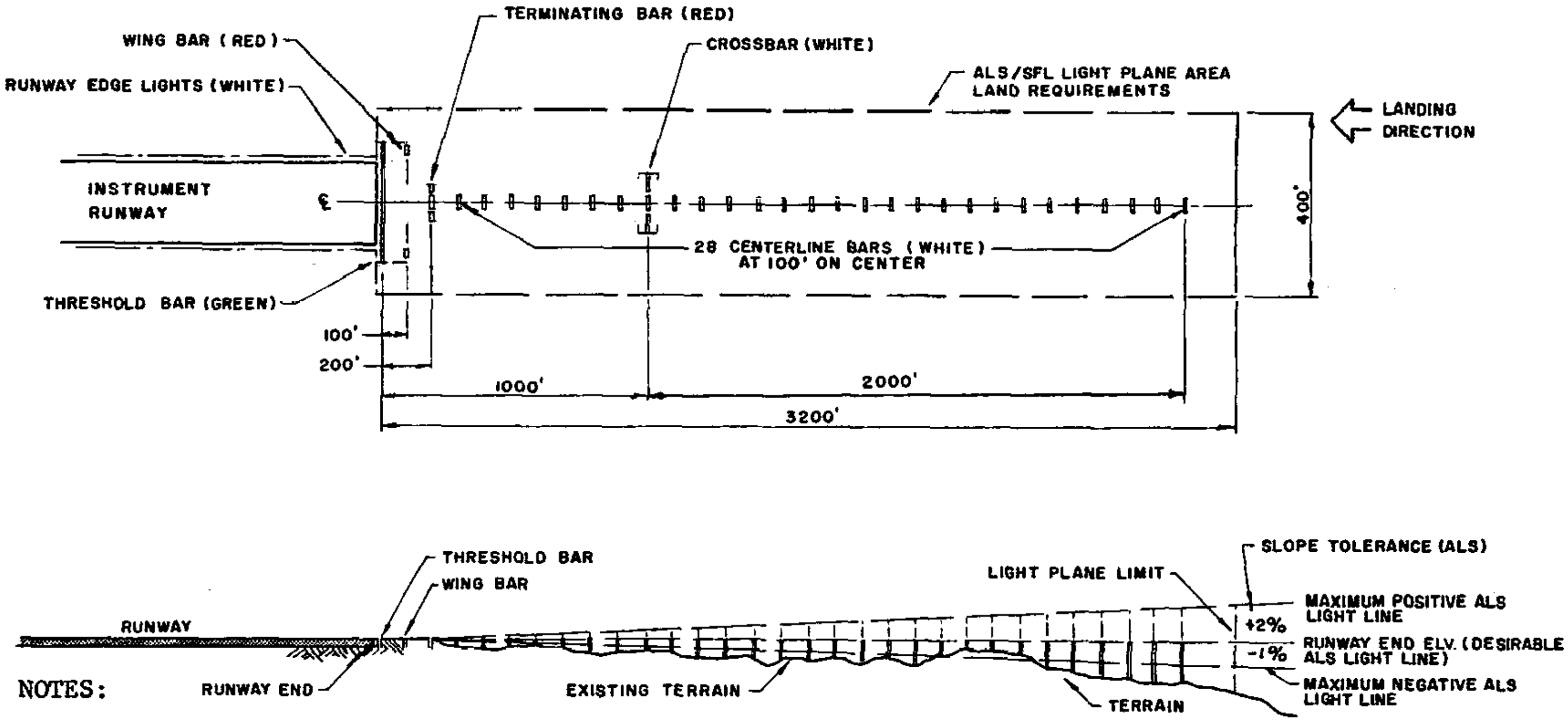


FIGURE 22. ALSF-1 CONFIGURATION.



NOTES:

1. THE OPTIMUM LOCATION OF THE APPROACH LIGHTS IS IN A HORIZONTAL PLANE AT RUNWAY END ELEVATION.

2. A MAXIMUM 2% UPWARD LONGITUDINAL SLOPE TOLERANCE MAY BE USED TO RAISE THE LIGHT PATTERN ABOVE OBJECTS WITHIN ITS AREA.

3. A MAXIMUM 1% DOWNWARD LONGITUDINAL SLOPE TOLERANCE MAY BE USED TO REDUCE THE HEIGHT OF SUPPORTING STRUCTURES.

4. NO OBJECTS SHALL BE PERMITTED TO PROTRUDE ABOVE THE APPROACH LIGHT PLANE, EXCEPT FOR COMPONENTS OF THE ILS SYSTEM.

5. REFER TO CHAPTER 8 FOR ADDITIONAL GRADING REQUIREMENTS WHERE A RUNWAY EXTENDED SAFETY AREA WILL BE ESTABLISHED.

FIGURE 23. TYPICAL APPROACH LIGHTING PLAN LAYOUT AND PROFILE (CAT-1 ALSF-1).

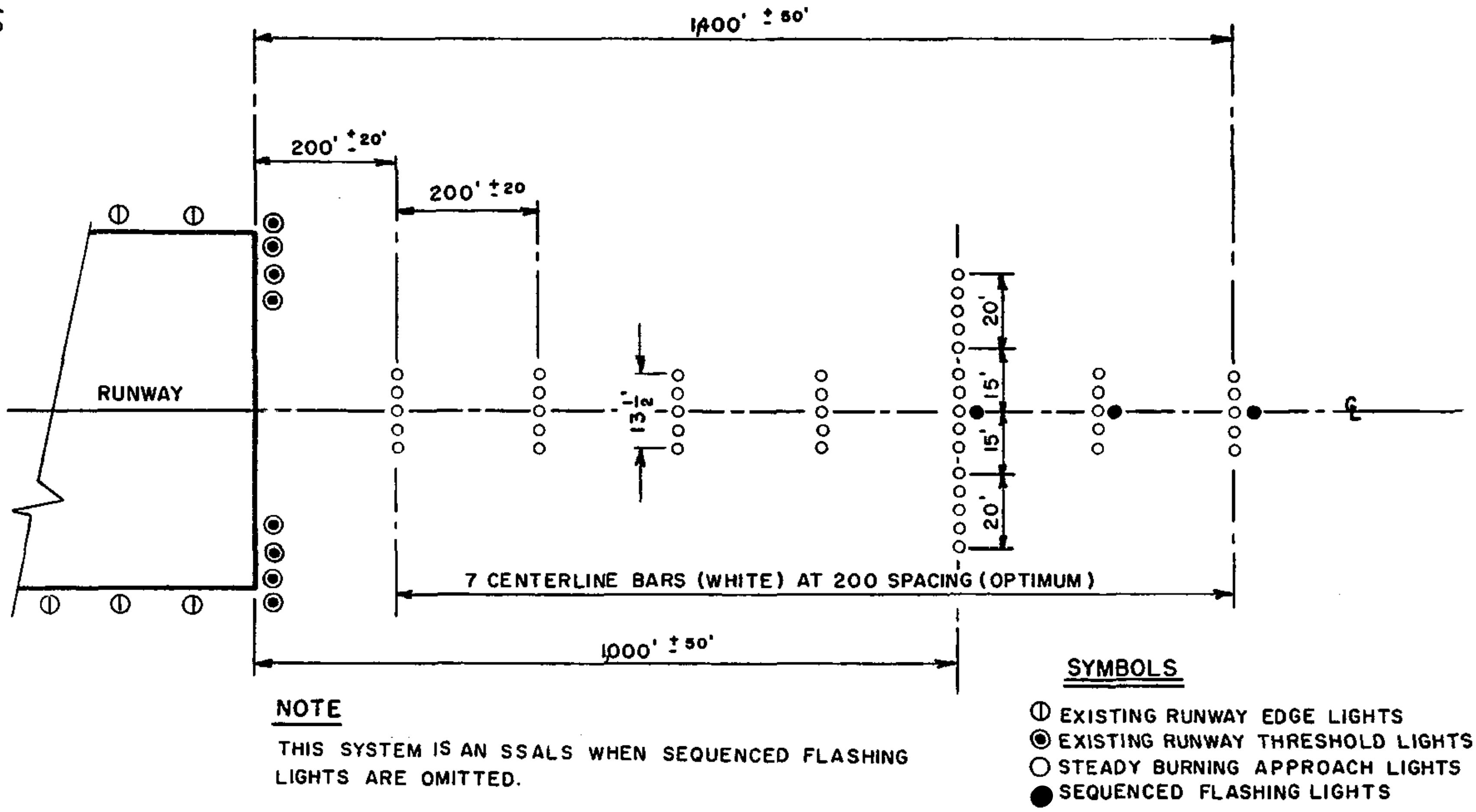


FIGURE 24, SSALS AND SSALF CONFIGURATION.

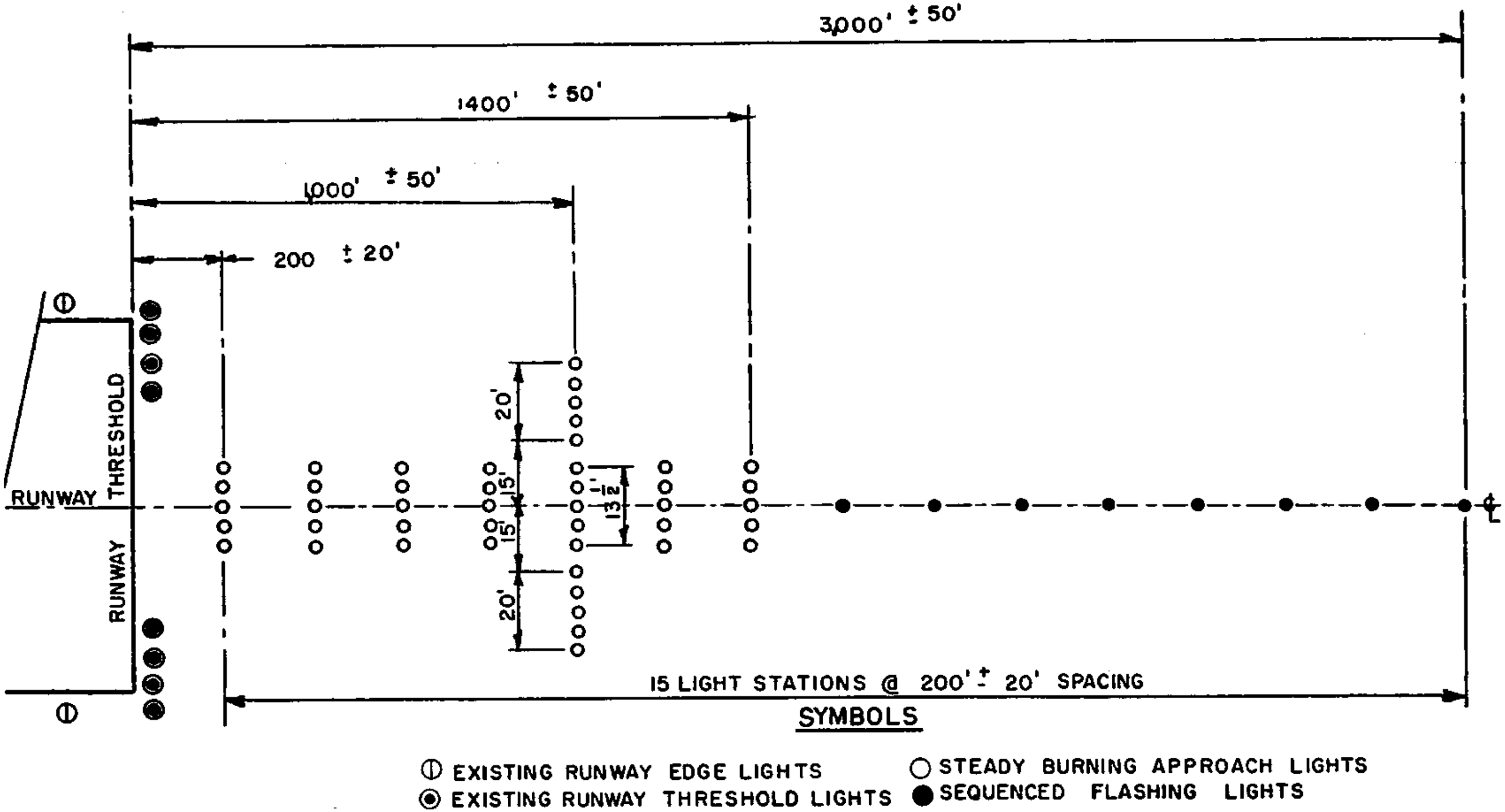
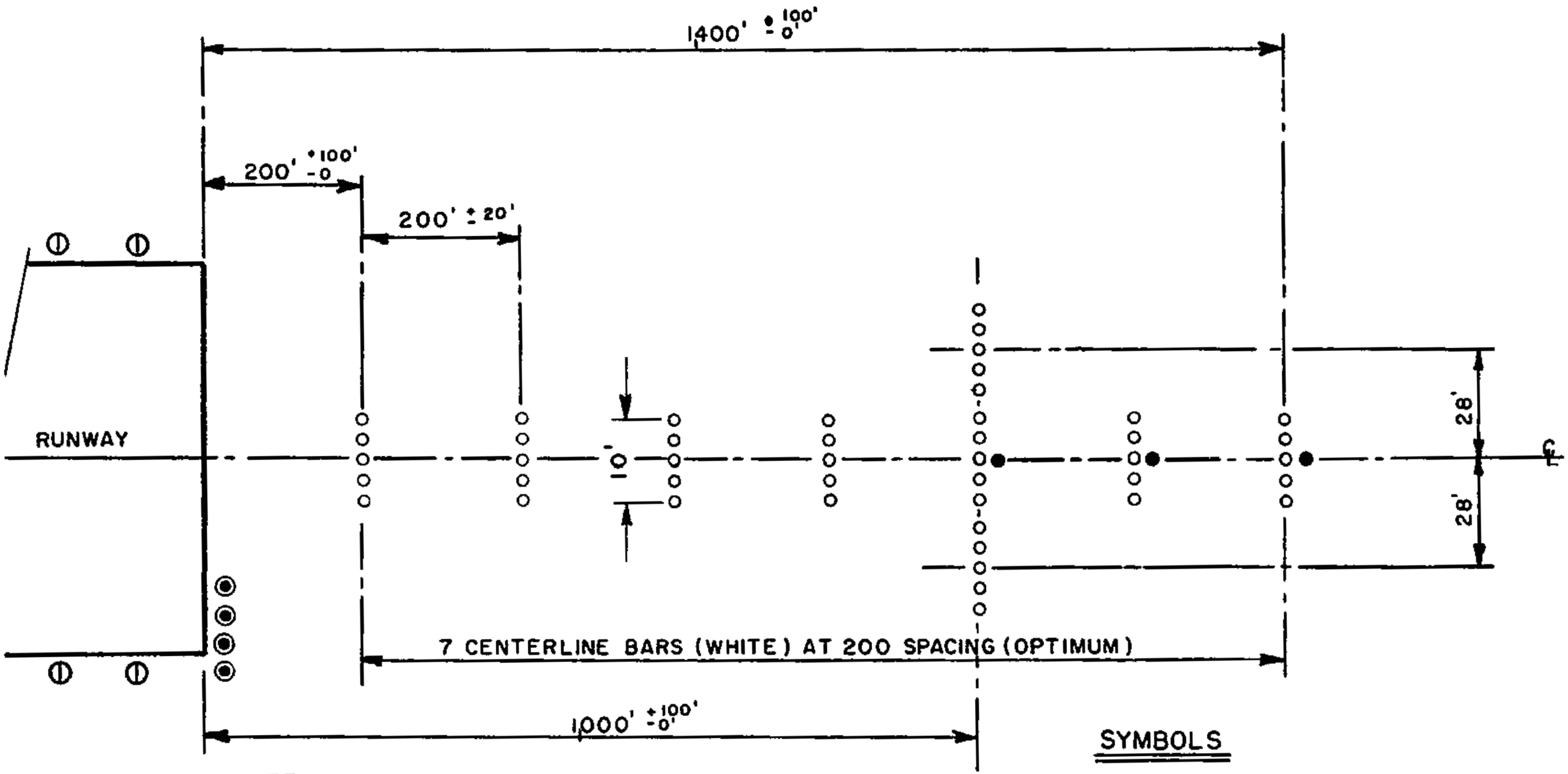


FIGURE 25, SSALR CONFIGURATION.



NOTE

THIS SYSTEM IS A MALS WHEN SEQUENCED FLASHING LIGHTS ARE OMITTED.

SYMBOLS

- EXISTING RUNWAY EDGE LIGHTS
- EXISTING RUNWAY THRESHOLD LIGHTS
- STEADY BURNING APPROACH LIGHTS
- SEQUENCED FLASHING LIGHTS

FIGURE 26. MALS AND MALSF CONFIGURATION.

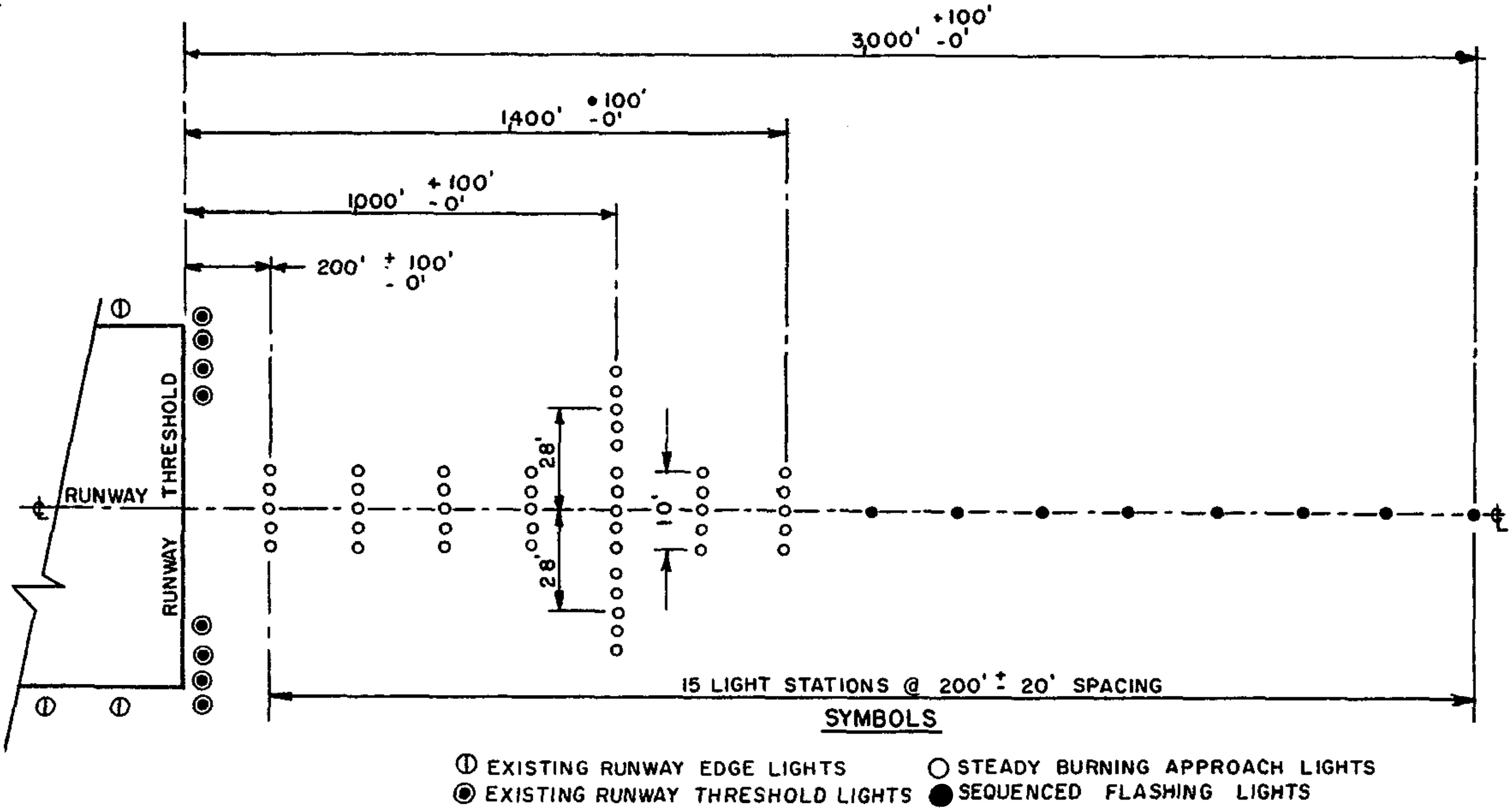
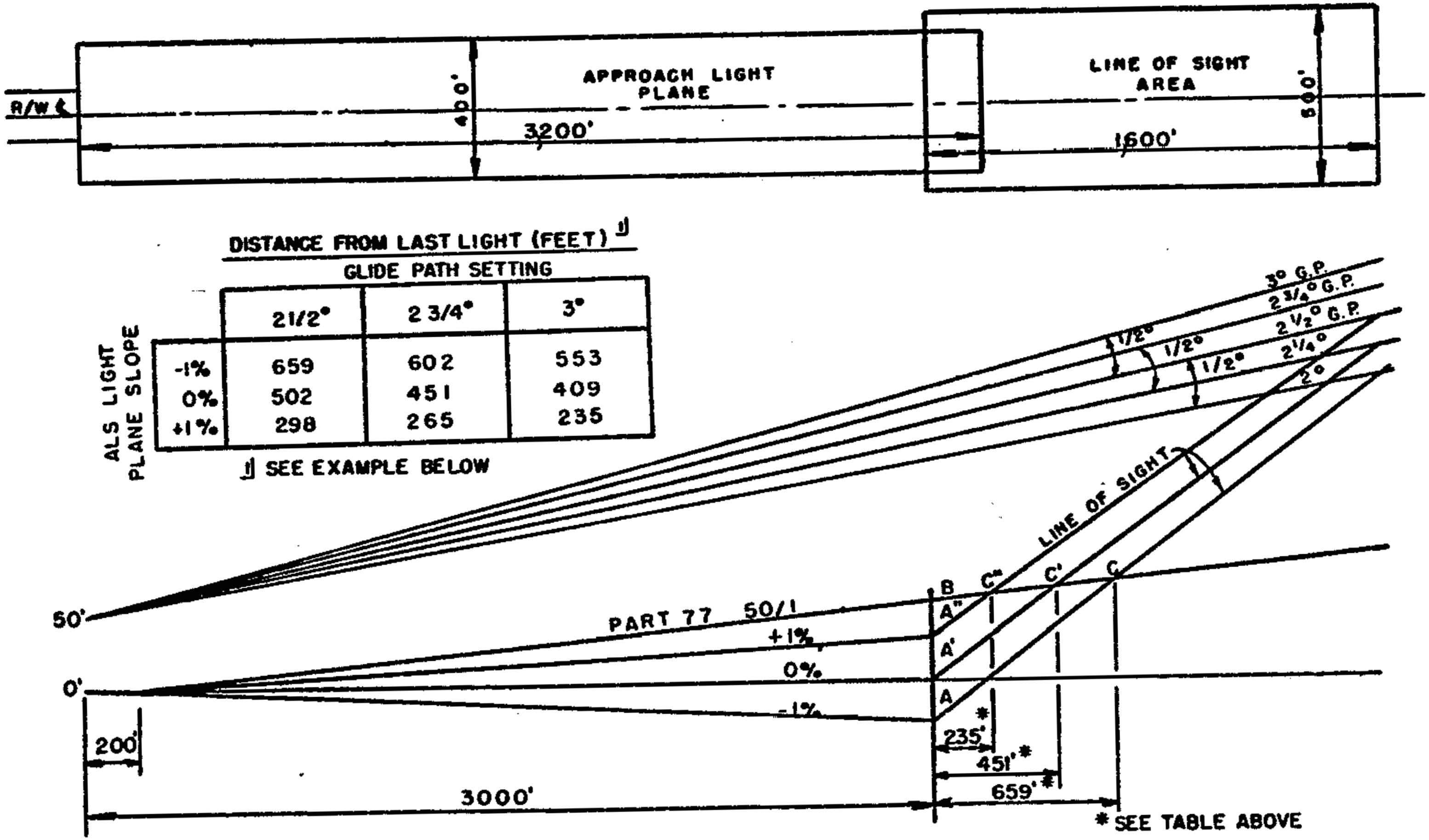


FIGURE 27. MALSR CONFIGURATION.



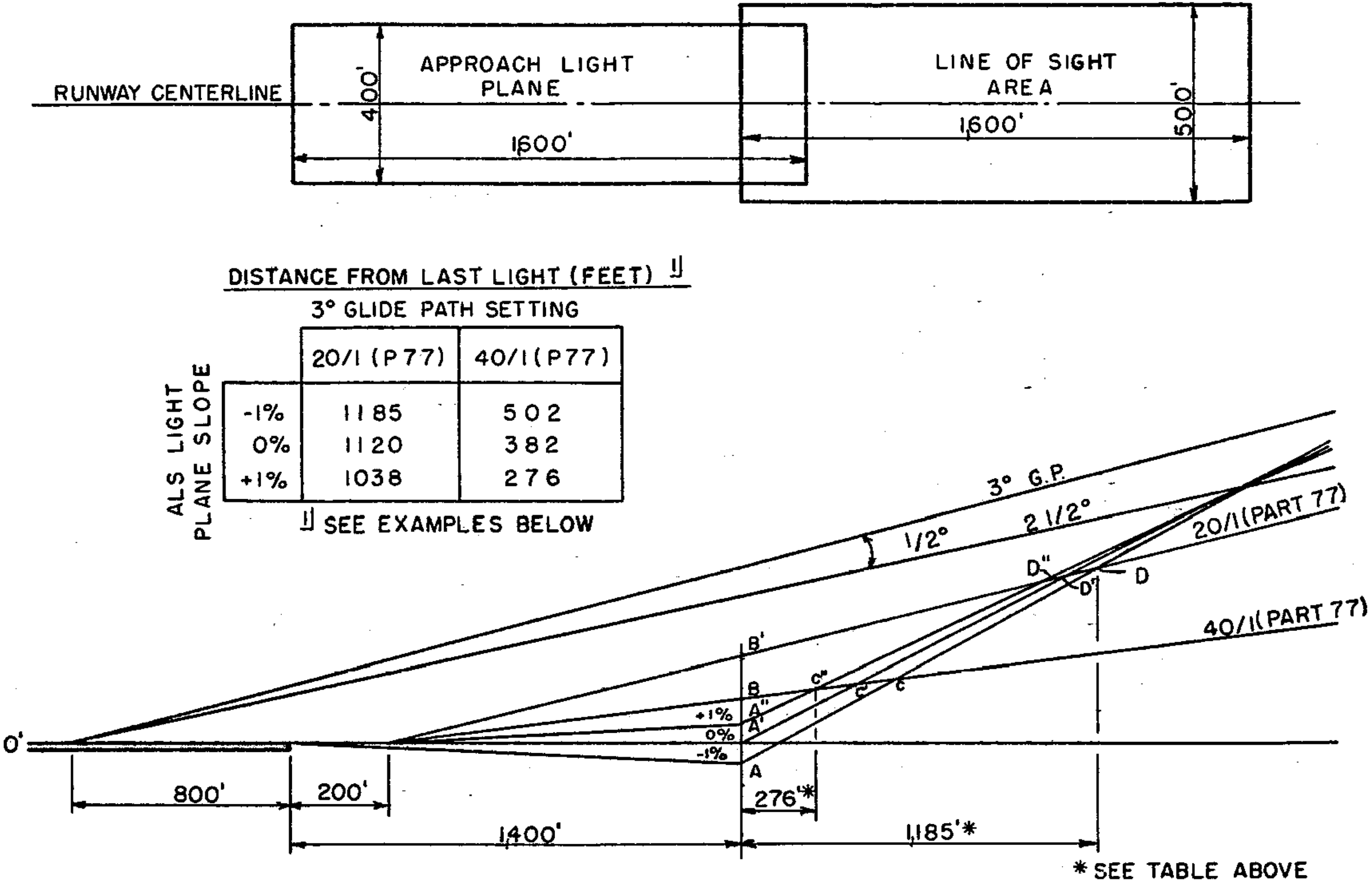
DISTANCE FROM LAST LIGHT (FEET) [1]

ALS LIGHT PLANE SLOPE	GLIDE PATH SETTING 2 1/2°	2 3/4°	3°
-1%	659	602	553
0%	502	451	409
+1%	298	265	235

[1] SEE EXAMPLE BELOW

NOTE: FOR SSALR AND MALSR, USE DATA IN FAA HANDBOOK, "VISUAL GUIDANCE LIGHTING SYSTEMS." ALL NEW GLIDE SLOPES TO BE INSTALLED AT THE 3° SETTING.

FIGURE 28. LINE-OF-SIGHT CLEARANCE FOR 3000-FOOT ALSF-1 AND ALSF-2.



DISTANCE FROM LAST LIGHT (FEET) 1/

3° GLIDE PATH SETTING

ALS LIGHT PLANE SLOPE	20/1 (P77)	40/1 (P77)
-1%	1185	502
0%	1120	382
+1%	1038	276

1/ SEE EXAMPLES BELOW

NOTE: ALL NEW GLIDE SLOPES TO BE INSTALLED AT THE 3° SETTING.

FIGURE 29. LINE-OF-SIGHT CLEARANCE FOR 1400-FOOT ALS.

CHAPTER 5. MISCELLANEOUS VISUAL APPROACH AIDS AND AIRPORT BEACONS

25. SCOPE. This chapter covers the following miscellaneous visual approach aids and airport beacons that may be installed on airports:

a. Rotating Airport Beacons

b. VASI - Visual Approach Slope Indicator Systems

c. REIL - Runway End Identifier Lights

d. LDIN - Lead-In Lighting System

26. ROTATING AIRPORT BEACONS.

a. General. A rotating beacon with alternating white and green flashes is installed to indicate a lighted airport. A beacon with only white flashes may be installed to indicate an unlighted airport or an airport which does not qualify as a lighted airport.

b. Location.

(1) For utility airports (general aviation), the beacon is normally not located closer than 350 feet to the centerline or extended centerline of the main runway. For other than utility airports, the beacon is not located closer than 750 feet to the centerline or extended centerline of the nearest runway.

(2) For all airports, the beacon is not located more than 5,000 feet from the nearest point of the usable landing area, except in cases where surrounding terrain will unduly restrict the visibility of the beacon. In this case, this distance may be increased to a maximum of 2 miles, provided certain FAA recommendations are met, as specified in AC 170/6850-1.

(3) The beacon must be located to minimize dazzle to pilots in aircraft approaching to land and any distraction to air traffic control personnel in the control tower.

c. Special Considerations. For airports with medium intensity runway lighting, a 10-inch rotating beacon conforming to FAA Specification L-801 is acceptable for use. For airports with high intensity runway lighting, a 36-inch beacon conforming to Specification CAA-291 is usually installed.

27. VISUAL APPROACH SCOPE INDICATOR (VASI) SYSTEMS.

a. General. VASI systems provide visual approach slope (descent) information and are intended for day or night use during VFR weather conditions. The light units, usually on the left side of the runway, are designed to project a split beam of light having a white upper segment and a red lower segment and on course descent will have the near or downwind light bar appear white while the far or upwind light bar appears red. On a high approach both light bars appear white and on a low approach both light bars appear red. To accommodate aircraft of 747, C5-A size, the FAA is installing two visual approach paths, the lower (downwind zone) path for use by existing aircraft (including jets) with the upper (upwind zone) path for use by the long/large bodied jet aircraft now entering airline service. Airways Planning Standard No. 1 contains VASI establishment criteria. Figure 30 illustrates the standard VASI-4 installation; Figure 31 identifies other VASI configurations".

b. Siting Criteria. Layout and siting criteria for the FAA standard VASI-4 and VASI-6 (3-bar) system are given in Figures 32 and 33. Additional special criteria for VASI installations follows:

(1) Where turbojet aircraft operations are conducted on a runway without ILS, the two VASI-4 light bars are positioned to provide a visual approach slope intercept point with the runway at a distance of 1,000 feet from the threshold. On the VASI-6 installation, the downwind zone intercept point conforms to the VASI-4 installation with the upwind zone intercept point located so that it shall not be greater than 1,800 feet from the landing threshold. A VASI system is not normally installed on a runway with an ILS. At locations where VASI is requested, obtain special guidance from the FAA Regional Office.

(2) The standard VASI-4 system is installed so that the visual approach slope angle is not less than 2.5 degrees nor more than 3 degrees if turbojet operations are involved. For runways used exclusively by propeller driven aircraft, angles greater than 3 degrees, but not more than 4 degrees, may be used provided the commissioned angle is specified in a NOTAM and is published in the Airman's Information Manual. The preferred visual approach slopes for the VASI-6 system is an angle of 2.5 degrees for the downwind zone and 3 degrees for the upwind zone.

(3) It is important not to locate other lights, which may confuse the pilot or otherwise conflict with the VASI operation in the immediate vicinity of the VASI installation.

c. Obstacle Clearance. The downwind bar is the critical bar insofar as physical location, aiming, and obstacle clearance are concerned. The downwind bar is positioned to obtain a 20-foot minimum clearance over the highest or most critical object which exists within the runway approach area and/or penetrates the airport imaginary surfaces as defined in FAR Part 77 plus 3/4 degree. Figures 32 and 33 illustrate VASI installation and aiming criteria.

d. Guidance. Technical guidance on the installation of VASI systems is found in Handbook 6850.2. Guidance for VASI and SAVASI installations at Utility Airports is found in AC 150/5340-14B and AC 150/5340-16B respectively.

28. RUNWAY END IDENTIFIER LIGHTS (REIL). The primary function of the REIL is to provide the pilot with rapid and positive visual identification of the approach end of the runway. The system consists of a pair of synchronized white flashing lights, one of which is located on each side and abeam of the runway landing threshold facing the approach area. REILS are primarily intended for VFR use during both daytime and nighttime operations. REILS may be placed on the same runway end as the VASI system; however, REILS are not installed on the same runway end with an approach lighting system. Figure 34 illustrates basic layout details and configuration of the REIL system.

29. LEAD-IN LIGHTING SYSTEM (LDIN). The lead-in lighting system (LDIN) consists of series of flashing lights installed at or near ground level to describe the desired course to a runway or final approach. Each group of lights is positioned and aimed so as to be conveniently sighted and followed by the approaching aircraft under conditions at or above authorized approach minimums. The system may be curved, straight, or a combination thereof. The LDIN system may be terminated at any approved approach lighting system, or at a distance from the landing threshold which is compatible with authorized visibility minimums permitting visual reference to the runway environment. Each LDIN system configuration must be specially designed to suit local conditions and to provide the visual guidance intended, such as for noise abatement or other purposes.

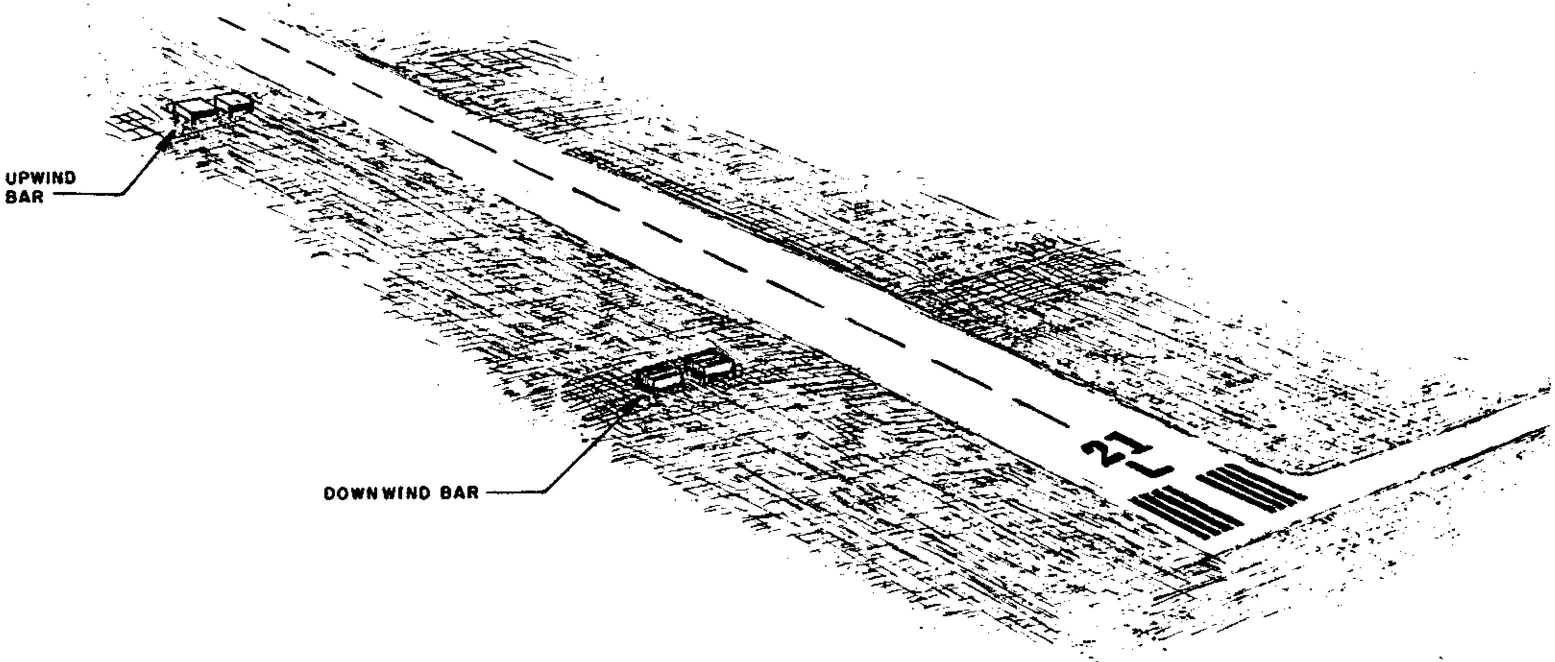


FIGURE 30. FAA STANDARD (VASI-4) VISUAL APPROACH SLOPE INDICATOR INSTALLATION.

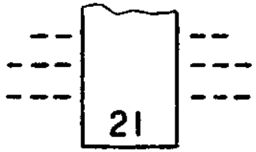
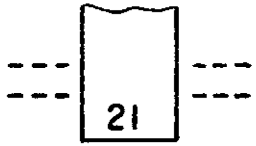
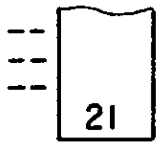
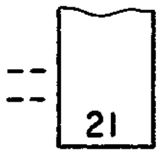
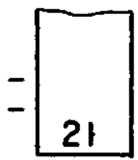
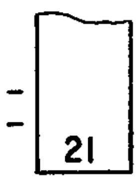
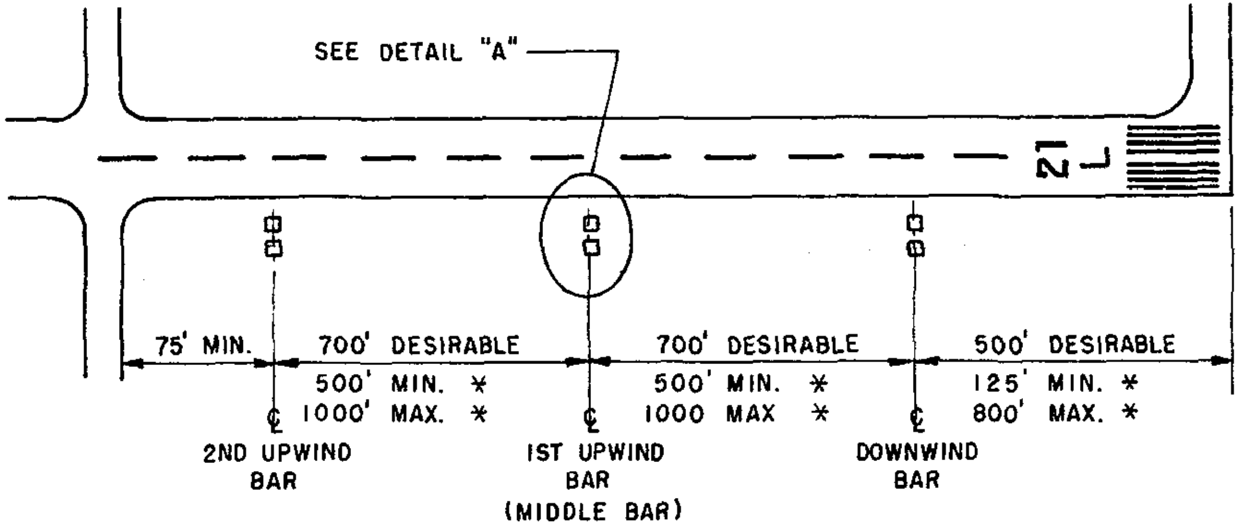
TYPE	SCHEMATIC	DAY VFR RANGE	COMMENTS
VASI-16		5 NAUT. MILES	ALL AIRCRAFT INCLUDING LONG/LARGE BODIED TURBOJET. USED AT MAJOR AIRPORTS REQUIRING MAXIMUM BOLDNESS OF SIGNAL.
VASI-12		5 NAUT. MILES	ALL AIRCRAFT EXCEPT LONG/LARGE BODIED TURBOJET. USE AT MAJOR AIRPORTS REQUIRING MAXIMUM BOLDNESS OF SIGNAL.
VASI-6		4 NAUT. MILES	ALL AIRCRAFT INCLUDING LONG/LARGE BODIED TURBOJET. THE FAA STANDARD 3-BAR INSTALLATION.
VASI-4		4 NAUT. MILES	ALL AIRCRAFT EXCEPT LONG/LARGE BODIED TURBOJET. THE FAA STANDARD 2-BAR INSTALLATION.
VASI-2		3 NAUT. MILES	ALL PROPELLER AIRCRAFT. CAN BE PROGRAMMED UNDER ADAP
SAVASI		$1\frac{1}{2}$ NAUT. MILES	SMALL PROPELLER AIRCRAFT. CAN BE PROGRAMMED UNDER ADAP UTILITY AIRPORTS WITH ELECTRICAL LOAD LIMITATIONS.

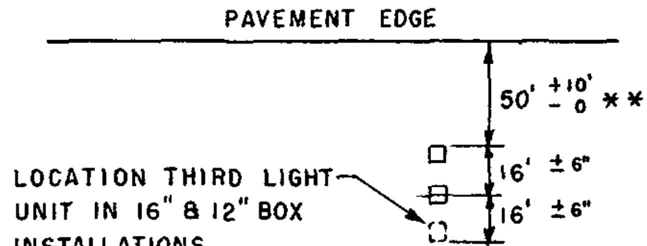
FIGURE 31. VASI SELECTION CRITERIA



NOTES:

1. THE UPWIND AND DOWNWIND LIGHT UNITS ARE LOCATED AT THE SAME DISTANCE FROM THE RUNWAY EDGE.

2. THE CENTER OF THE OPTICAL APERTURE OF ALL LIGHT UNITS IS WITHIN ±1 FOOT OF RUNWAY CENTERLINE GRADE.

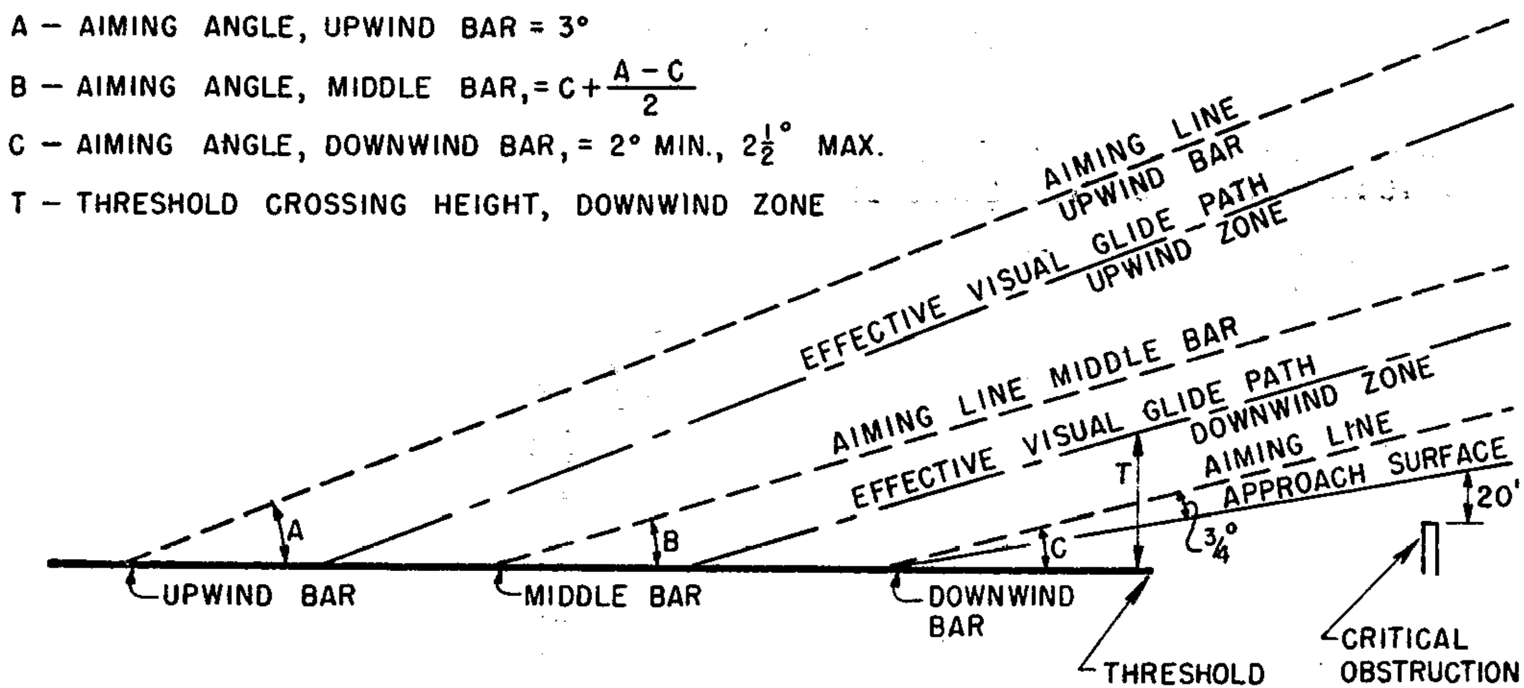


DETAIL "A"

* LONGITUDINAL TOLERANCES TO BE USED ONLY TO AVOID TAXIWAYS, CROSS RUNWAYS, ETC. OR TO ACHEIVE A DESIRABLE HEIGHT DUE TO TERRAIN.

** LATERAL TOLERANCES TO BE USED TO AVOID DITCHES, CATCH BASINS, MANHOLES, ETC.

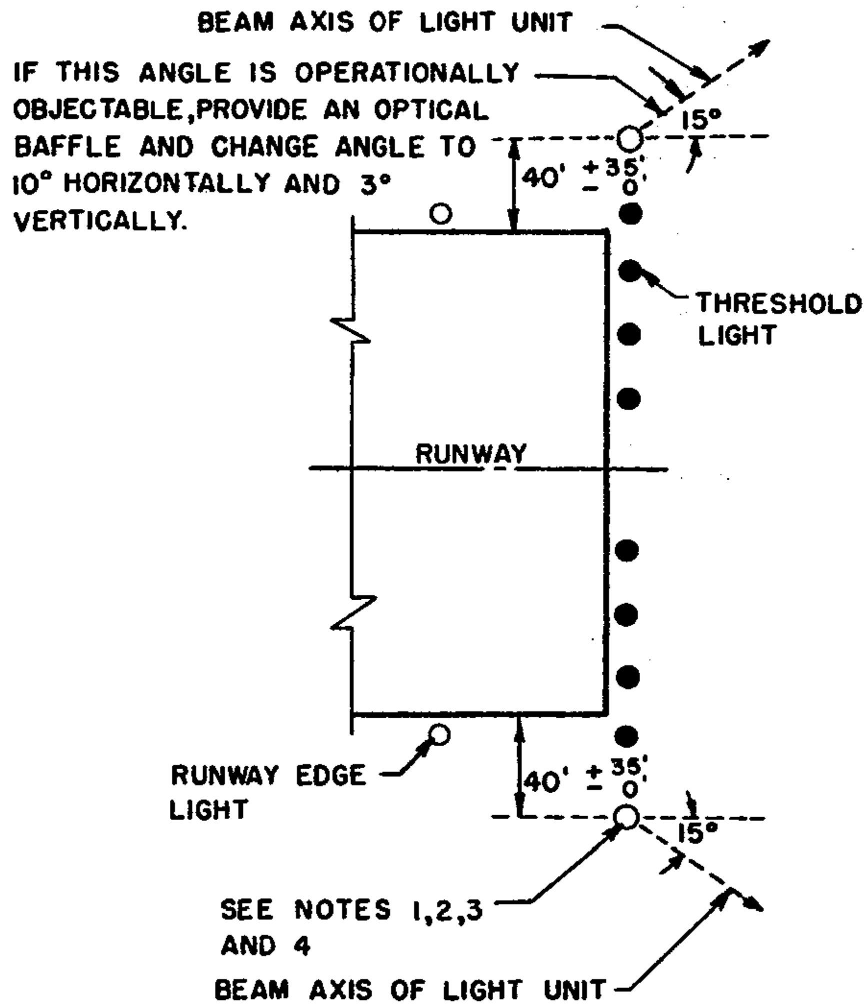
FIGURE 32. TYPICAL VASI PLAN LAYOUT



NOTES:

1. Use a plot of the approach area showing the location and height of all significant objects in the approach to determine the critical obstruction.
2. Locate and aim the downwind bar so that the effective visual glide path of the downwind zone will provide a threshold crossing height (T) of 25-foot minimum to 60-foot maximum.
3. Locate and aim the middle and upwind bars in accordance with the criteria of Figure 32 and letters (A) and (B) above.
4. Where terrain drops off rapidly near the approach threshold and severe turbulence may be experienced, the effective approach slope should be established at its maximum elevation and the downwind bar located at its maximum distance from the landing threshold in order to keep aircraft as high as feasible over the landing threshold.
5. SAVASI location details contained in AC 150/5340-16B.

FIGURE 33. VASI INSTALLATION AND AIMING CRITERIA



NOTES

1. THE OPTIMUM LOCATION FOR EACH LIGHT UNIT IS IN LINE WITH THE RUNWAY THRESHOLD AT 40 FEET FROM THE RUNWAY EDGE.
2. A PLUS OR MINUS 200-FOOT TOLERANCE IS PERMITTED IN LOCATING THE LIGHT UNITS IN LINE WITH THE RUNWAY THRESHOLD
3. THE LIGHT UNITS ARE EQUALLY SPACED WITH RESPECT TO EACH OTHER, FROM THE RUNWAY THRESHOLD.
4. THE BEAM CENTERLINE OF EACH LIGHT UNIT IS AIMED 15° OUTWARD FROM A LINE PARALLEL TO THE RUNWAY CENTERLINE AND INCLINED AT AN ANGLE 10° ABOVE THE HORIZONTAL.
5. LOCATE THE REIL EQUIPMENT NOT LESS 10 FEET FROM TAXIWAYS.
6. IF REILS ARE USED WITH VASI-2, INSTALL REILS AT 75' LOCATION.

FIGURE 34. TYPICAL REIL PLAN LAYOUT

CHAPTER 6. AIR TRAFFIC CONTROL AND OTHER RELATED FACILITIES

30. AIR TRAFFIC CONTROL TOWER. The air traffic control (ATC) tower is the. focal point for the safe control of aircraft operating in the designated airspace area and within the surface maneuvering area of the airport. Airports can present different and complex problems in the selection of suitable control tower sites. Accordingly, it is recommended that airport planning and design engineers consult with the FAA regional office before final selection is made of a control tower site, or before any land is reserved for it. Basic siting requirements for determing optimum location of an airport control tower are found in FAA Handbook AFP 6510.16. They include but are not limited to the following items:

a. General Requirements. Siting and height determination of towers require consideration of several basic engineering factors such as accessibility to utilities, subsoil and ground water conditions, expansion possibilities, and the existing and future development of the airport, including proposed runway (s) extensions.

b. Specific Requirements.

(1) Maximum visibility from the tower of airborne traffic patterns is required.

(2) A clear, unobstructed and direct view of the approach to the ends of the primary instrument runway and all other active runways and landing areas is also a basic requirement.

(3) Complete visibility and adequate depth perception by ATC personnel of all airport surface areas utilized in aircraft ground movement are necessary.

(4) Refer to current FAA standards for ATC tower siting regarding orientation, positioning, and layout requirements for the cab portion of the control tower and other details.

c. Special Considerations.

(1) A site plot of sufficient area is needed to accommodate the initial and planned future tower building area, including an adequate vehicle parking area for ATC personnel.

(2) Tower locations must minimize conflict and/or interference with the operation of other ATC & N facilities.

(3) The standards for determining obstructions on airports (FAR Part 77) must be complied with unless deviations are absolutely necessary to meet the siting requirements given herein.

31. AIRPORT SURVEILLANCE RADAR (ASR).

a. General. The Airport Surveillance Radar (ASR) is used for the control of air traffic within predetermined airspace areas, normally within approximately 40 nautical miles of the airport at which the ASR is located. The ASR scans through 360 degrees of azimuth and presents target information on radar display equipment located in the ATC facility. This information is used by ATC personnel independently or in conjunction with other NAVAIDS to control terminal traffic. Figure 35 depicts an ASR installation.

b. Location. The radar antenna tower site normally is located no closer than 1,000 feet from the radar display equipment location (IFR room) nor more than 12,000 feet from it. It is desirable that a minimum separation of 1,000 feet be provided between the ASR antenna site and any above-ground objects that may interfere or cause reflections in radar operation. This clearance requirement can be depicted on airport layout plans by a circle of 1,000-foot radius (minimum) centered on the ASR antenna location. Normally, the ASR antenna is not located closer than one-half mile from a runway end.

c. Obstruction Criteria. The ASR antenna tower installation and siting are governed by the standards for determining obstruction on airports, as contained in FAR Part 77.

d. Special Considerations. To assure acceptable operation, performance, and coverage of the ASR, it is necessary that airport authorities consult with the FAA regional office in the final site selection or planning for ASR establishment.

32. AIRPORT SURFACE DETECTION EQUIPMENT (ASDE).

a. General. The airport surface detection system (radar) is installed to permit the observation and control of aircraft and vehicular ground traffic on the airport by ATC personnel. Figure 36 depicts an ASDE installation.

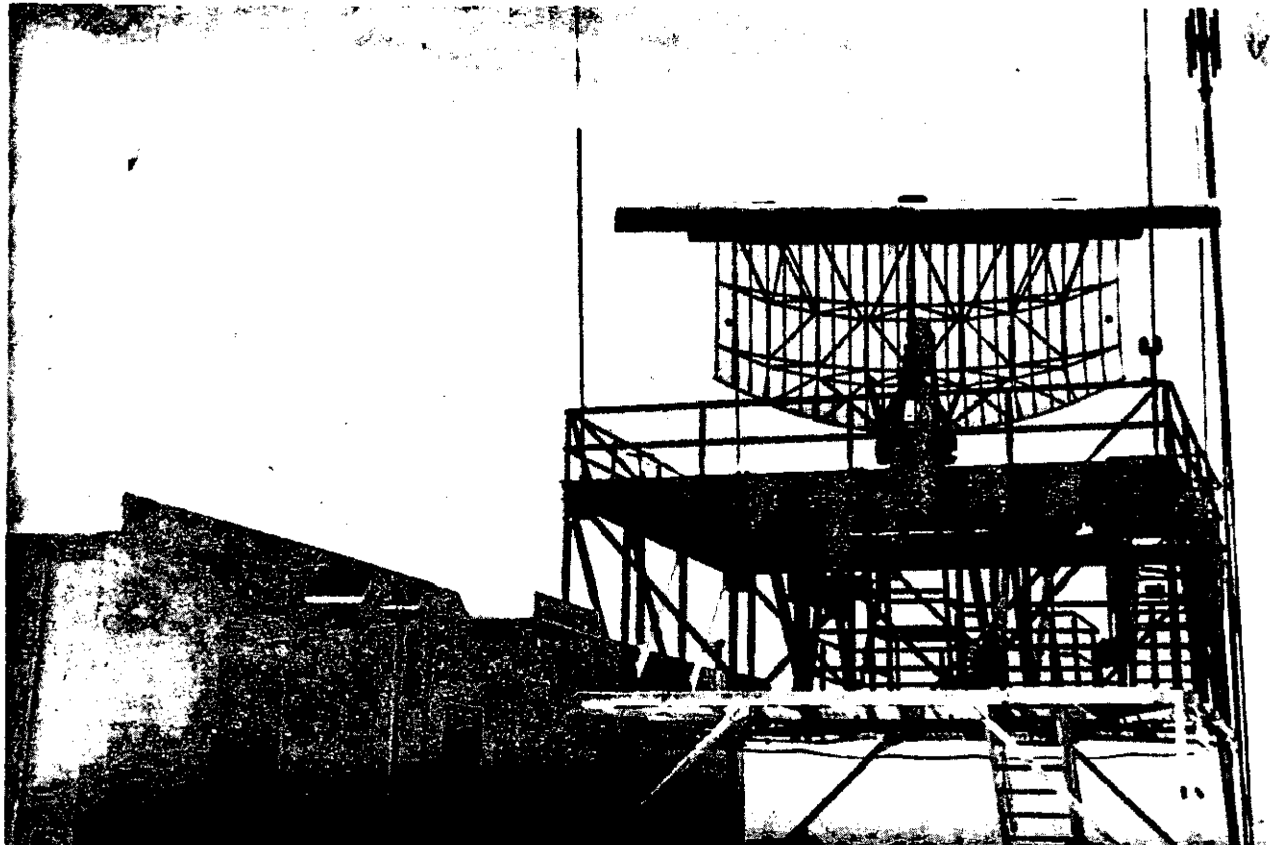


FIGURE 35. PHOTOGRAPH OF ASR INSTALLATION.

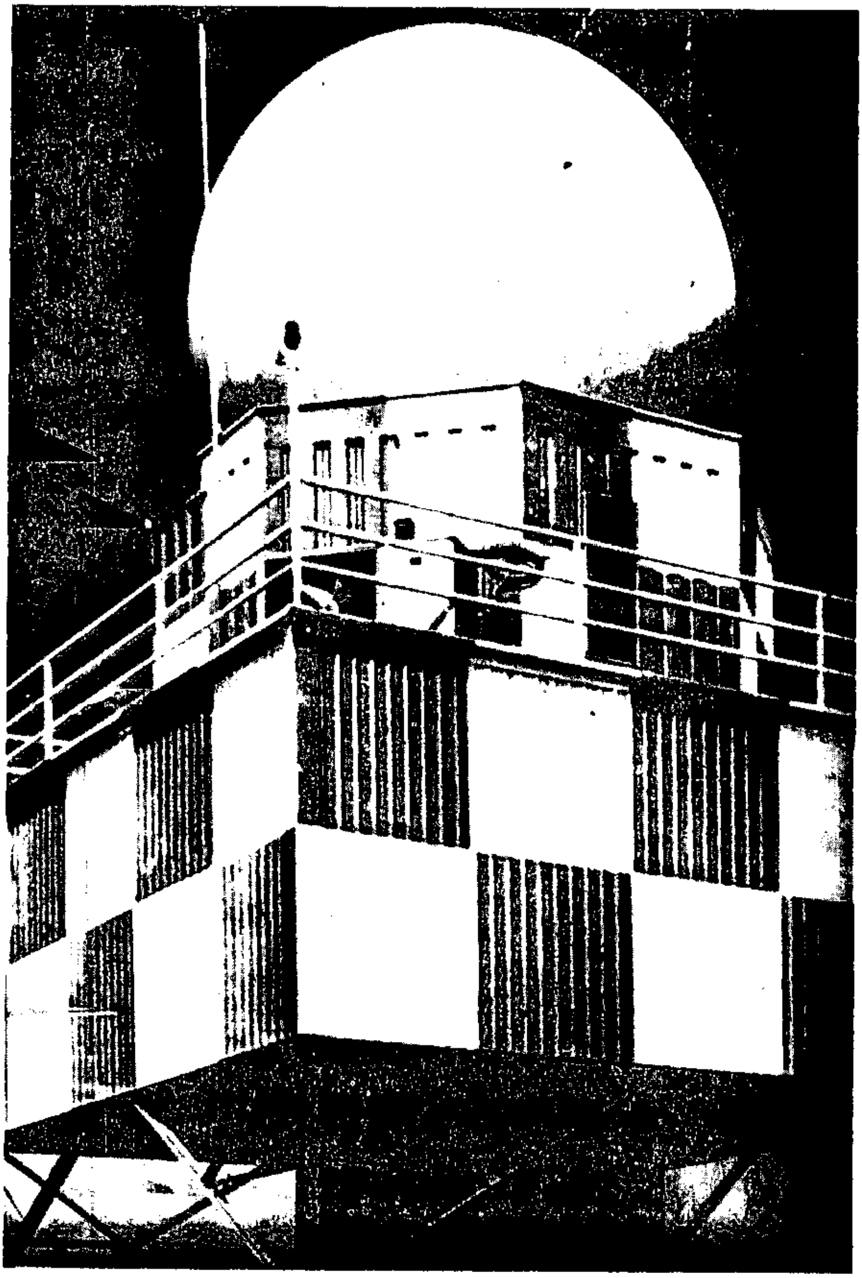


FIGURE 36. PHOTOGRAPH OF ASDE TOWER INSTALLATION.

b. Location. The ASDE equipment site is preferably located in the airport terminal area and may be located atop an existing building, or on a free-standing structure. Site selection is dependent upon obtaining satisfactory surveillance of the airport operational area.

c. Obstruction Criteria. ASDE installation and siting are governed by the standards for determining obstructions on airports, as contained in FAR Part 77. In general, the height of ASDE free-standing towers is approximately 20 to 120 feet, depending on airport layout configuration and terrain conditions.

d. Special Considerations. It is possible that future ASDE installations may be limited to only a few locations.

33. TRANSMISSOMETER FACILITIES FOR RUNWAY VISUAL RANGE (RVR).

a. General. Placement of a transmissometer system near the touchdown area of the ILS runway provides for the measurement of visibility in the runway touchdown zone area in terms of feet of Runway Visual Range (RVR). The RVR value indicates to the pilot the horizontal distance down the runway that may be seen upon landing. RVR is directly related to the sighting or visibility of the runway edge lights (high intensity) by the pilot. For example, 2,400 RVR indicates approximately 2,400 feet of runway edge lights would be visible. For CAT I ILS runways, RVR is not required unless justified by a special operational study. However, RVR is required for CAT II ILS runways (Chapter 7.).

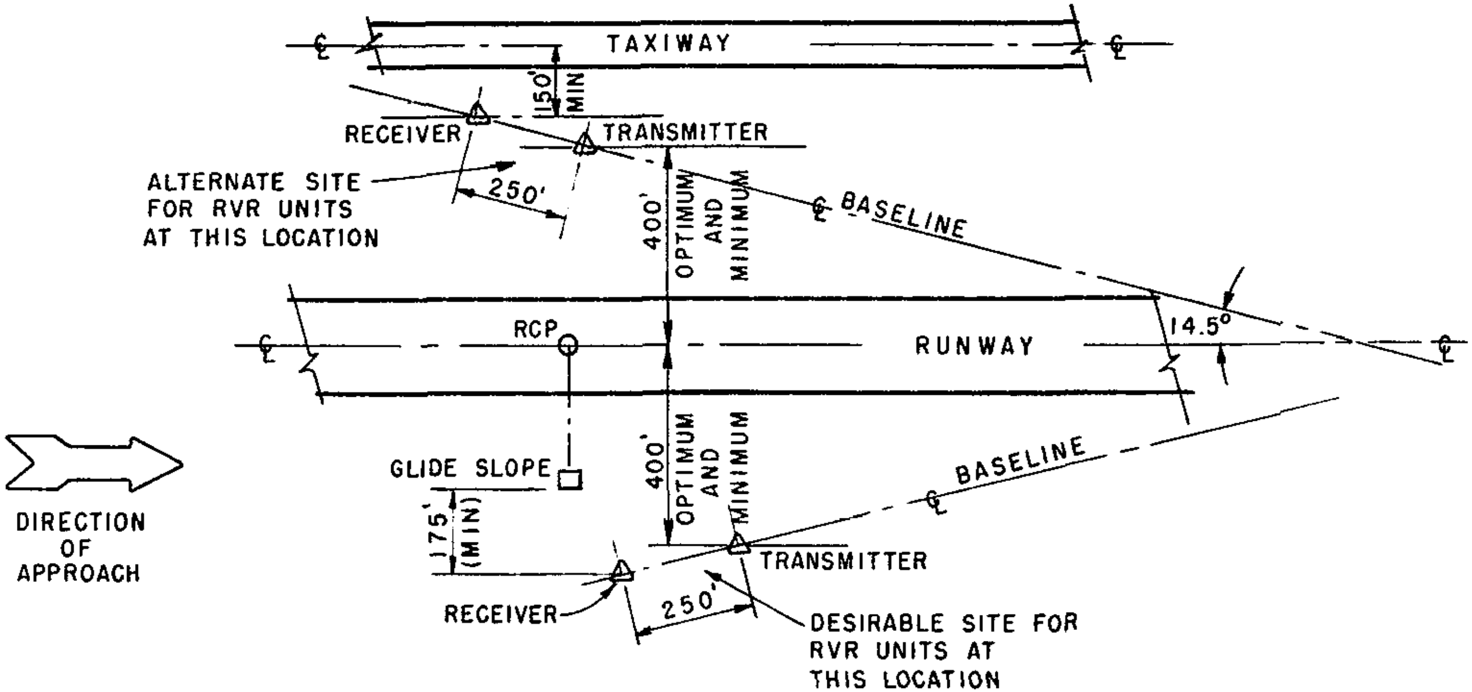
b. Components. Basically, the transmissometer system consists of a transmitter, receiver, and recording instruments. The transmitter directs a beam of light to the receiver instrument located 250 or 500 feet away near the ILS glide slope building. The receiver unit then sends an electronic signal by cable to "read-out" and recording instruments in the control tower. The control tower operators can then inform approaching pilots of the actual visibility conditions on the runway in terms of RVR in feet.

c. Siting Criteria. The transmitter and receiver units are mounted on individual platforms (approximately 14 feet in height), spaced on either a 500-foot or 250-foot base line, with the latter now the preferred standard. An angle of 14.5 degrees is provided between the runway centerline and this base line. A clear line of sight at least 10 feet above the ground at all points between the transmitter and receiver units and within 0.1 degree of the horizontal plane is a basic requirement. However, maximum platform height may not exceed 15 feet above the elevation of the corresponding runway centerline point nearest them. Both units must be placed outside the glide slope facility restricted area so that glide slope operation is not affected. The optimum location of the transmitter unit is 400 feet from the runway centerline. Neither the transmitter nor receiver units can be located closer than 400 feet to the runway centerline or 150 feet to a taxiway centerline. Figure 37 illustrates layout of the transmissometer system and applicable siting tolerances.

34. ROTATING BEAM CEILOMETER SYSTEM.

a. General. A rotating beam ceilometer (RBC) system is installed to obtain vertical measurements of the cloud heights in the vicinity of the ILS middle marker site. Basically, this system includes a light beam projector unit and one or two detector units for determining the representative ceiling height which can be reported to pilots.

b. Siting Criteria. Typical configuration and siting layouts of an RBC system are shown in Figure 38 with Site "A" being the preferred and recommended location wherever possible. The two detector system is provided for an ILS runway, while only a single detector system on a 800-foot baseline may be provided for a runway without an ILS installed or programmed. However, choose a location for a single detector system which can permit a second detector unit to be installed in the future. Although desirable, the projector and detector units need not be at the same elevation. However, the difference in elevation of the units must not exceed 50 feet, and the first detector is always installed on the line of sight between the projector and the second detector. Approval of the FAA and the appropriate airport authority must be secured for the final siting and layout of the RBC system.



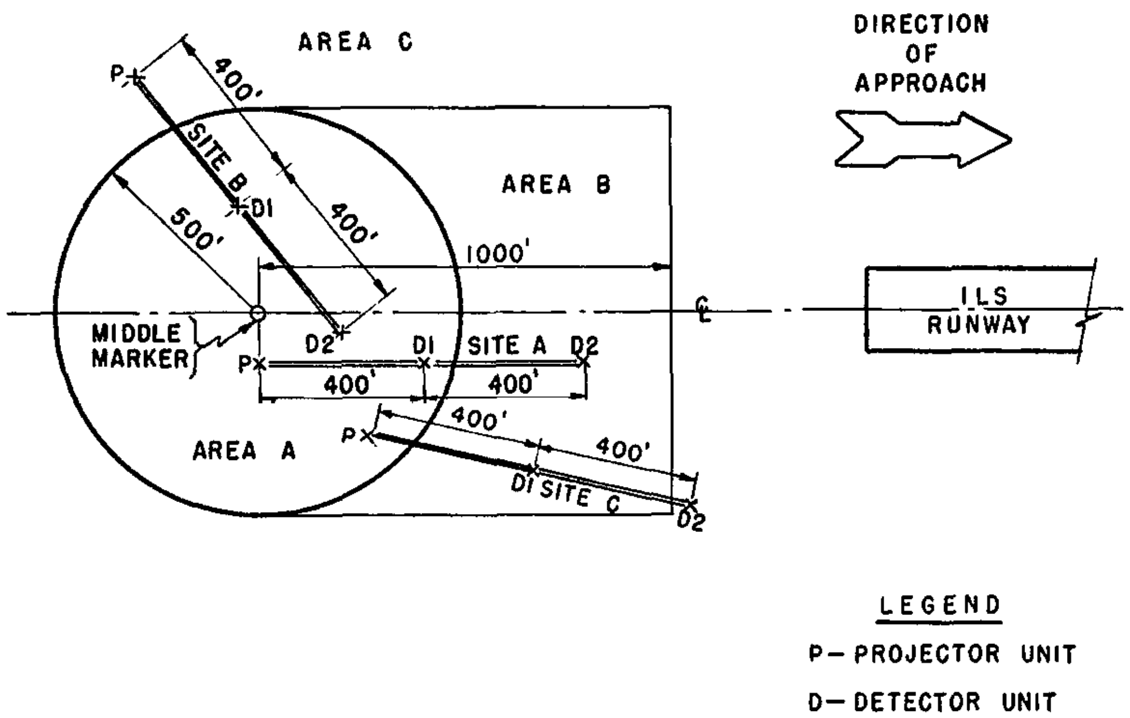
NOTES

1. TRANSMITTER SHALL NOT BE LOCATED MORE THAN 500 FEET FROM RUNWAY CENTERLINE, UNLESS APPROVED.

2. THE REFERENCE CONTROL POINT (RCP) IS THE INTERSECTION POINT OF THE RUNWAY CENTERLINE WITH THE PERPENDICULAR INTERCEPT THROUGH THE GS BUILDING OR TRAILER.

3. THE RVR UNITS SHALL BE WITHIN 1500 FEET OF THE RCP WHEN LOCATED DOWN THE RUNWAY FROM THE ILS APPROACH END.

FIGURE 37. SITING CRITERIA FOR TRANSMISSOMETER SYSTEM (RVR).



NOTES;

1. ALL SITES REQUIRE FAA AND AIRPORT AUTHORITY APPROVAL.
2. SYSTEM MAY BE LOCATED ON EITHER SIDE OF APPROACH LANE.
3. SITE "A" IS PREFERRED SITE.
4. ALL-WEATHER ACCESS WAYS (DRIVES AND WALKS) REQUIRED TO ALL COMPONENTS. FENCING MAY BE REQUIRED.

FIGURE 38. SITING CRITERIA FOR ROTATING BEAM CEILOMETER SYSTEM.

CHAPTER 7. SPECIAL FACILITY REQUIREMENTS FOR CATEGORY II OPERATIONS

35. GENERAL. It is beyond the scope of this advisory circular to do other than briefly cite and summarize some of the special ATC & N facility requirements for Category II operations. Refer to the appropriate advisory circulars and internal FAA directives covering the Category II program requirements as the authoritative sources of information. However, certain essential data are presented for the guidance and benefit of airport sponsors and their engineers who may be unfamiliar with the fundamentals of the Category II program of the FAA. As FAA policy, the improvements or modifications necessary for the sole purpose of Category II operations will not commence until each of the system requirements have been examined, technical difficulties resolved, and probability of success assured.

36. PLANNING REQUIREMENTS. Category II locations are currently selected to meet the following requirements:

a. Candidacy will generally conform to FAA Airways Planning Standard No. 1 or justification for exception to these criteria are presented.

b. In-runway lighting is presently available, an ADAP grant has been authorized, or the sponsor has expressed a willingness to participate in the program.

c. No known deficiency exists which will prevent the facility from meeting Category II criteria. Site tests for the glide slope and localizer assure that electronic performance can be obtained.

d. Long range airport development plans will not prevent early Category II implementation.

37. FACILITY REQUIREMENTS.

a. The airport surface area gradients conform to FAA airport design standards for gradients.

b. High Intensity Runway Edge Lights will be limited to a maximum spacing of 200 feet and a maximum height of 14 inches for each unit.

c. In-Runway Touchdown Zone Lights are 3,000 feet in length.

d. In-runway centerline lighting extends 75 feet from the runway end to a similar point on the opposite runway end, with a maximum spacing of 50 feet between light units. Runway-remaining visual guidance is recommended for the last 3,000 feet.

e. The approach lighting system may be 3,000-foot Category I ALSF-1 or Category II ALSF-2. However, new or modified installations at Category II locations will conform to the Category II systems.

f. Standard FAA all-weather runway markings are required.

g. Runway visual range (RVR) operations down to and including 1600 RVR require an RVR system near the landing threshold. These systems may be on a 250- or 500- foot base line, except that all new RVR installations near the landing threshold will be on a 250-foot base line. Operations below 1600 RVR also require another RVR system on a 250-foot line placed near the rollout area of the runway. Where transmissometers from other runways are used to provide RVR information at the rollout area of the Category II runway, the transmissometer is located within a radius of 2,000 feet of the end of the Category II runway and provides a minimum of 2,000 feet coverage of the rollout area measured from the Category II runway end.

h. All new ILS glide slope facilities will be installed with a glide slope angle of 3.0 degrees (formerly the optimal glide slope angle was set at 2.5 degrees). Optimal glide slope threshold crossing height is 50 feet, with an allowable maximum of 60 feet. The glide slope antenna mast for CAT-II installations can not be located closer than 400 feet from the CAT-II runway centerline.

i. The ILS localizer must perform within tolerances specified in the U.S. Standard Flight Inspection Manual and meet current FAA requirements for Category II operations. The ILS localizer antenna array is not located closer than 1,000 feet from the Category II runway end and is on the extended centerline of the runway. An offset localizer installation is not acceptable for Category II operations.

j. ILS outer and middle markers will be provided prior to Category II commissioning. The inner marker, which provides a means for the pilot to identify the 100-foot decision height, will be installed either prior to commissioning or as early as practicable following authorization for 100-foot decision height, 1200 RVR. The 150-foot DH, 1600 RVR (day and night authorization) does not require an inner marker. Radio altimeter setting heights will be provided, and all marker beacons will be monitored.

k. System components for Category II facilities will be provided with the appropriate electrical power configuration as required by FAA.

l. Taxiway turnoff lighting when installed and used during Category II operations conforms to FAA specifications.

m. Critical areas for Category II ILS glide slope, localizer, and touchdown zone are marked and lighted in accordance with current FAA standards to insure that ground traffic does not violate these areas during Category II operations. Additionally, it is advisable to keep the areas in the vicinity of the ILS glide slope and localizer facilities free of large structures or other objects which may improperly reflect or reradiate the ILS antenna signals.

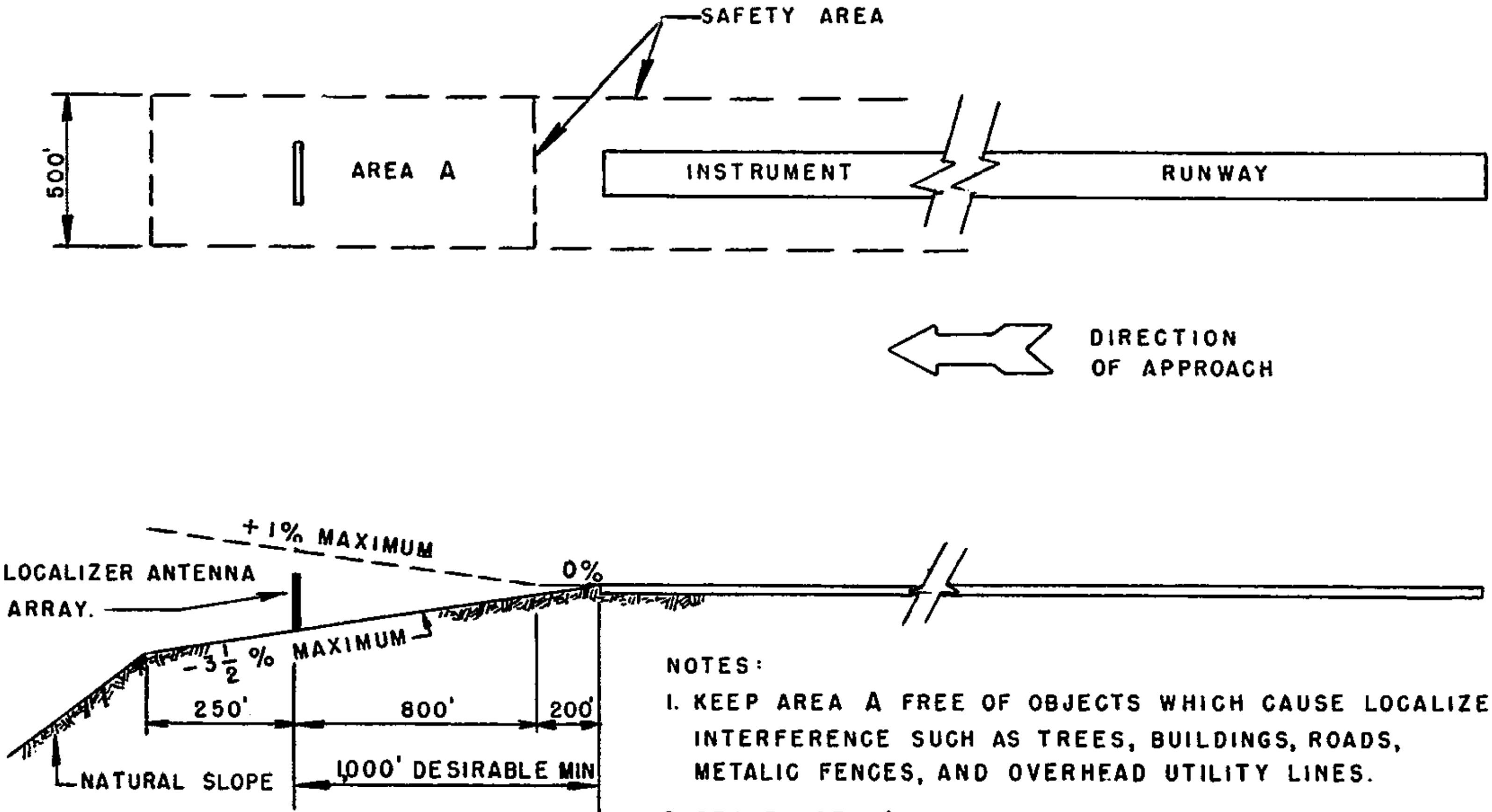
n. Obstacle clearance in the final approach, touchdown, transitional surfaces, and missed approach areas are in accordance with current FAA requirements for Category II operations.

CHAPTER 8. EXTENDED RUNWAY SAFETY AREA REQUIREMENTS FOR ALS AND ILS LOCALIZER SITE GRADING

38. GENERAL. An extended runway safety area is a cleared, drained, and graded area, symmetrical about the extended runway centerline and adjacent to the end of the runway safety area. It is designed to enhance the safety for aircraft that undershoot or overrun the runway as well as providing improved accessibility for fire crash and rescue vehicles responding to an overrun or undershoot incident. Extended runway safety must be developed at new airports on those runways intended to accommodate air carrier operations of transport category airplanes. When feasible, extended runway safety areas are to be encouraged on any runway accommodating air carrier operations in conjunction with other runway (lengthening, widening, strengthening) or clear zone developments. However, establishment of an extended runway safety area normally will not be required at existing runway locations where no new construction is contemplated. Where an extended runway safety area will be established, additional requirements are imposed for grading proposed sites for the ILS localizer (V-ring) and approach lighting system, as discussed below.

39. ILS LOCALIZER FACILITY. Where an ILS localizer (V-ring) is planned for installation, site grading shall be in accordance with Figure 39, when an extended runway safety area exists or will be established. For ILS localizer with 8-loop antenna, grading criteria given in Chapter 2 are adequate.

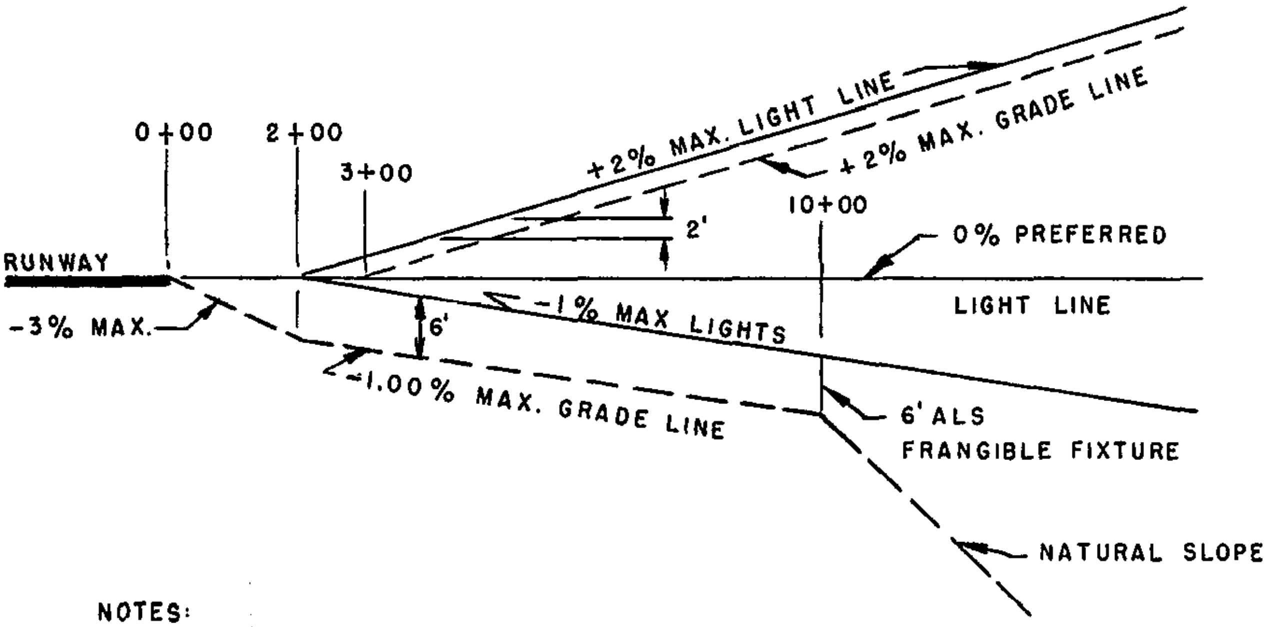
40. APPROACH LIGHTING SYSTEMS. Where any of the approach lighting systems discussed in Chapter 4 are planned for installation, site grading for the center 50-foot width shall be in accordance with Figure 41 when an extended runway safety area exists or will be established. These grading requirements will permit the use of frangible fixtures for the inner 1,000 feet of the approach lighting system, and thus fulfill the intent of the extended runway safety area.



NOTES:

1. KEEP AREA A FREE OF OBJECTS WHICH CAUSE LOCALIZER INTERFERENCE SUCH AS TREES, BUILDINGS, ROADS, METALIC FENCES, AND OVERHEAD UTILITY LINES.
2. GRADE AREA A UNIFORMLY AND PROVIDE SMOOTH TRANSITIONS TO ADJACENT AREAS.
3. GRADE AREA A TRANSVERSELY WITHIN +3% TO −5% MAXIMUM.

FIGURE 39. ILS LOCALIZER (V-RING) SITE GRADING FOR RUNWAY EXTENDED SAFETY AREA ESTABLISHMENT.



NOTES:

1. THE GRADIENTS SHOWN APPLY TO THE CENTER 50-FOOT WIDTH FROM ALS STATIONS 0+00 TO 10+00

2. BEYOND THE CENTER 50-FOOT WIDTH LIMITS, THE TRANSVERSE GRADE SHALL BE LIMITED TO SLOPES NOT EXCEEDING +3% OR -5% FROM ALS STATIONS 0+00 TO 10+00

3. THE TRANSITIONS BETWEEN DIFFERENT GRADIENTS SHALL BE WARPED SMOOTHLY, AS REQUIRED.

4. FOR CAT-II ALS, A NEGATIVE LONGITUDINAL GRADE IS NOT PERMITTED IN THE INNER 1,500 FEET OF THE SYSTEM.

FIGURE 40. ALS SITE GRADING FOR RUNWAY EXTENDED SAFETY AREA ESTABLISHMENT

CHAPTER 9. NAVIGATIONAL AID PROTECTION

41. GENERAL. The navigational aids discussed in this circular are associated with and are physically located on or in close proximity to the airport. Unauthorized persons must be denied access to these navigational aids for their own safety as well as for the safety of the persons who must rely on the integrity of the installation.

42. OFF-AIRPORT INSTALLATIONS. Normally, the navigational aids located off of the airport are provided with the extent of protection deemed appropriate. The type of protection provided (warning sign, security fence, etc.) will depend upon whether the protection would interfere with the generated signal, whether the aid is located in a rural or urban environment, and whether the aid could be dangerous to persons or animals approaching it.

43. ON-AIRPORT INSTATLLATIONS. Navigational aids located on the airport present different problems in providing necessary/desired protection. To the extent possible, protective devices/facilities will be provided in the original installation. Fencing, which is the usual form of barrier provided, cannot be used in all cases as it may adversely affect the operation of the navigational aid signal or may constitute a hazard to the users of the airport. In these instances, it is necessary to rely on the general protection provided by the airport to restrict/prohibit/police access to operational areas of the airport.

44. GUIDANCE. General guidance on providing protection for the airport is contained in Advisory Circular 150/5200-10 "Airport Emergency Operations Planning." The FAA Regional Office should be contacted for guidance on specific problem items.

APPENDIX 1. BIBLIOGRAPHY

1. The following Federal Aviation Regulations (FARs) and advisory circulars may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. No c.o.d. orders are accepted. Make your check or money order payable to the Superintendent of Documents.

   a. FAR Volume VI, ($5.50)

   b. FAR Volume X, ($4.50)

   c. FAR Volume XI, ($2.75)

      (1) Part 77, Objects Affecting Navigable Airspace

      (2) Part 97, Standard Instrument Apporach Procedures

      (3) Part 157, Notice of Construction, Alteration, Activation, and Deactivation of Airports

      (4) Part 171, Non-Federal Navigation Facilities

   d. AC 150/5300-4A, Utility Airports ($1.75)

   e. AC 150/5370-1A, Standard Specifications for Construction of Airports ($3.50)

   f. AC 150/5370-6, Airport Master Plans ($1.25)

2. The following FAA publications are available for examination upon request at either FAA Regional or Airports District Offices:

   a. U.S. Standard for Terminal Instrument Approach Procedures (TERPS).

   b. Airways Planning Standard No. 1

   c. Visual Guidance Lighting Systems

   d. Planning Grant Program (PGP), Order 5900.1

   e. Air Traffic Control Tower Siting Criteria AF P 6510.16

   f. Protection of Agency Property OA P 1600.6

   g. Siting Criteria for Instrument Landing Systems Order 6750.16

3. The following advisory circulars may be obtained from the Department of Transportation, Distribution Unit, TAD 484.3, Washington, D.C. 20591 at no cost:

a. AC 70/7460-2B, Proposed Construction or Alteration of Objects That May Affect the Navigable Airspace

b. AC 90-1A, Civil Use of U.S. Government Produced Instrument Approach Charts

c. AC 120-29, Criteria for Approving Category I and Category II Landing Weather Minima for FAR-121 Operators

d. AC 150/5200-10, Airport Emergency Operations Planning

e. AC 150/5340-14B, Economy Approach Lighting Aids

f. AC 150/5340-16B, Medium Intensity Runway Lighting System and Visual Approach Slope Indicators for Utility Airports

g. AC 150/5370-4, Procedures Guide for Using the Standard Specifications for Construction of Airports

h. AC 170/6850-1, Aeronautical Beacons and True Lights

☆U.S. GOVERNMENT PRINTING OFFICE: 1971-720-342/642-R-1