TAD-494.4

CHANGE

AC NO: 150/5325-2C CHG 1

DATE: April 21, 1975

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: CHANGE 1 TO ADVISORY CIRCULAR 150/5325-2C, AIRPORT DESIGN STANDARDS - AIRPORTS SERVED BY AIR CARRIERS - SURFACE GRADIENT AND LINE-OF-SIGHT

1. PURPOSE. This change transmits revised criteria for unobstructed line-of-sight along individual runways and between intersecting runways.

2. EXPLANATION OF CHANGE.

   a. The requirements for an unobstructed line-of-sight along individual runways have been relaxed for runways that have a full length parallel taxiway.

   b. The requirements for an unobstructed line-of-sight between intersecting runways have been increased for certain runway configurations.

   c. The use of asterisks denotes changed, added, or deleted portion of the text.

3. HOW TO OBTAIN ADDITIONAL COPIES OF THIS PUBLICATION. Additional copies of this change may be obtained free of charge from the Department of Transportation, Publications and Forms Section, TAD-443.1, Washington, D.C. 20590.

Initiated by: AAS-560

4. PAGE CONTROL CHART.

Remove Page	Dated	Insert Pages	Dated
9 thru 12	2/6/75	9	2/6/75
		10 thru 13	4/21/75

William V. Vitale

WILLIAM V. VITALE
Director, Airports Service

AC NO: 150/5325-2C

DATE: February 6, 1975

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: AIRPORT DESIGN STANDARDS - AIRPORTS SERVED BY AIR CARRIERS - SURFACE GRADIENT AND LINE-OF-SIGHT

1. PURPOSE. This advisory circular establishes design standards for airports served by certificated air carriers to assist engineers in designing the gradients of airport surface areas used to accommodate the landing, takeoff, and other ground requirements of airplanes, while providing adequate line-of-sight between airplanes operating on the airports.

2. CANCELLATION. Advisory Circular 150/5325-2B, Airport Design Standards - Air Carrier Airports - Surface Gradient and Line-of-Sight, dated February 18, 1970, is cancelled.

3. REFERENCES. Advisory Circular 00-2, updated triannually, contains a listing of the current issuances of the following publications and changes thereto.

   a. The latest issuance of the following publications may be purchased from the Superintendent of Documents, United States Government Printing Office, Washington, D.C. 20402. Enclose with your request a check or money order made payable to the Superintendent of Documents; include an additional 25 percent for foreign mailing. No c.o.d. orders are accepted.

      (1) Federal Aviation Regulations (FAR) Part 1, Definitions and Abbreviations ($3.00).

      (2) Advisory Circular 150/5300-4, Utility Airports - Air Access to National Transportation ($3.15).

      (3) Advisory Circular 150/5320-5, Airport Drainage ($1.30).

   b. The latest issuance of the following publications may be obtained from the Department of Transportation, Publications and Forms Section, TAD-443.1, Washington, D.C. 20590.

Initiated by: AAS-560

(1) Advisory Circular 00-2, Federal Register Advisory Circular Checklist and Status of Regulations.

(2) Advisory Circular 90-42, Traffic Advisory Practices at Nontower Airports.

(3) Advisory Circular 150/5300-2, Airport Design Standards - Site Requirements for Terminal Navigational Facilities.

(4) Advisory Circular 150/5300-6, Airport Design Standards - General Aviation Airports - Basic and General Transport.

(5) Advisory Circular 150/5320-6, Airport Pavement Design and Evaluation.

(6) Advisory Circular 150/5335-1, Airport Design Standards - Airports Served by Air Carriers - Taxiways.

4. EXPLANATION OF REVISION.

a. Grading requirements for extended runway safety areas, clearways, and runway blast pads have been included in this advisory circular.

b. For informational purposes, metric units have been included in parentheses next to the English units throughout the text. The metric values are based upon the International Civil Aviation Organization's standard English/metric equivalents and therefore do not represent exact conversions of the English values. The English values should be used in applying the standards contained in this advisory circular.

c. Editorial changes.

5. BACKGROUND.

a. Surface Gradient.

(1) For the purpose of airport design, surface gradient is the rate of ascent or descent of an airport surface. Surface gradients are an important consideration in airport design since they have both an operational and economic significance. For this reason, it is necessary to develop standards for surface gradients that will allow design flexibility without affecting operational safety.

(2) In selecting design grades for a stage construction project, consideration must also be given to the grades that will be required by the ultimate airport development plans. Failure to consider these plans may lead to costly grade adjustments for the later stages of development.

b. Line-of-Sight.

(1) Since runways are designed for bidirectional operations and are also used or crossed by taxiing aircraft, it is important that a pilot using the runway be able to see anything on the runway that may interfere with his aircraft's operation. It is also important that the pilot be able to see an aircraft using an intersecting runway.

(2) At airports with control towers, positive control of aircraft traffic in the air and on the ground is maintained. Therefore, the standards for an unobstructed line-of-sight along individual runways and between intersecting runways do not need to be as restrictive as the line-of-sight standards for uncontrolled airports.

(3) Line-of-sight standards impose additional restraints on the determination of surface gradients.

6. APPLICATION. These standards are to be used in the planning, design and construction of facilities at airports served by air carriers. The ultimate airport development must be considered in applying the standards.

a. In the design and construction of facilities for exclusive use of smaller airplanes at airports served by air carriers, the applicable general aviation standards may be applied. These standards are contained in Advisory Circular 150/5300-4.

b. In many cases, the grading requirements for terminal navigational aids are more restrictive than the surface gradient standards contained in this advisory circular. Grading requirements for terminal navigational aids are contained in Advisory Circular 150/5300-2.

7. SURFACE GRADIENT.

a. Aprons. To ease aircraft towing and taxiing, apron grades should be kept to a minimum, consistent with local drainage requirements. The maximum allowable grade in any direction is 1 percent. However, in aircraft fueling areas the apron grade should not exceed 0.5 percent. Where possible, apron grades should be established to direct drainage away from the building areas. This is particularly important in fueling areas.

b. Runways and Stopways.

(1) Longitudinal Grade. The maximum longitudinal grade is 1.5 percent; however, the longitudinal grade may not exceed 0.5 percent in the first and last quarters of the runway length. (See Figure 1.) It is desirable to keep longitudinal grades to a minimum.

(2) Longitudinal Grade Changes. Whenever possible, longitudinal grade changes should be avoided. The maximum allowable grade change of 1.5 percent should only be used when it is absolutely necessary.

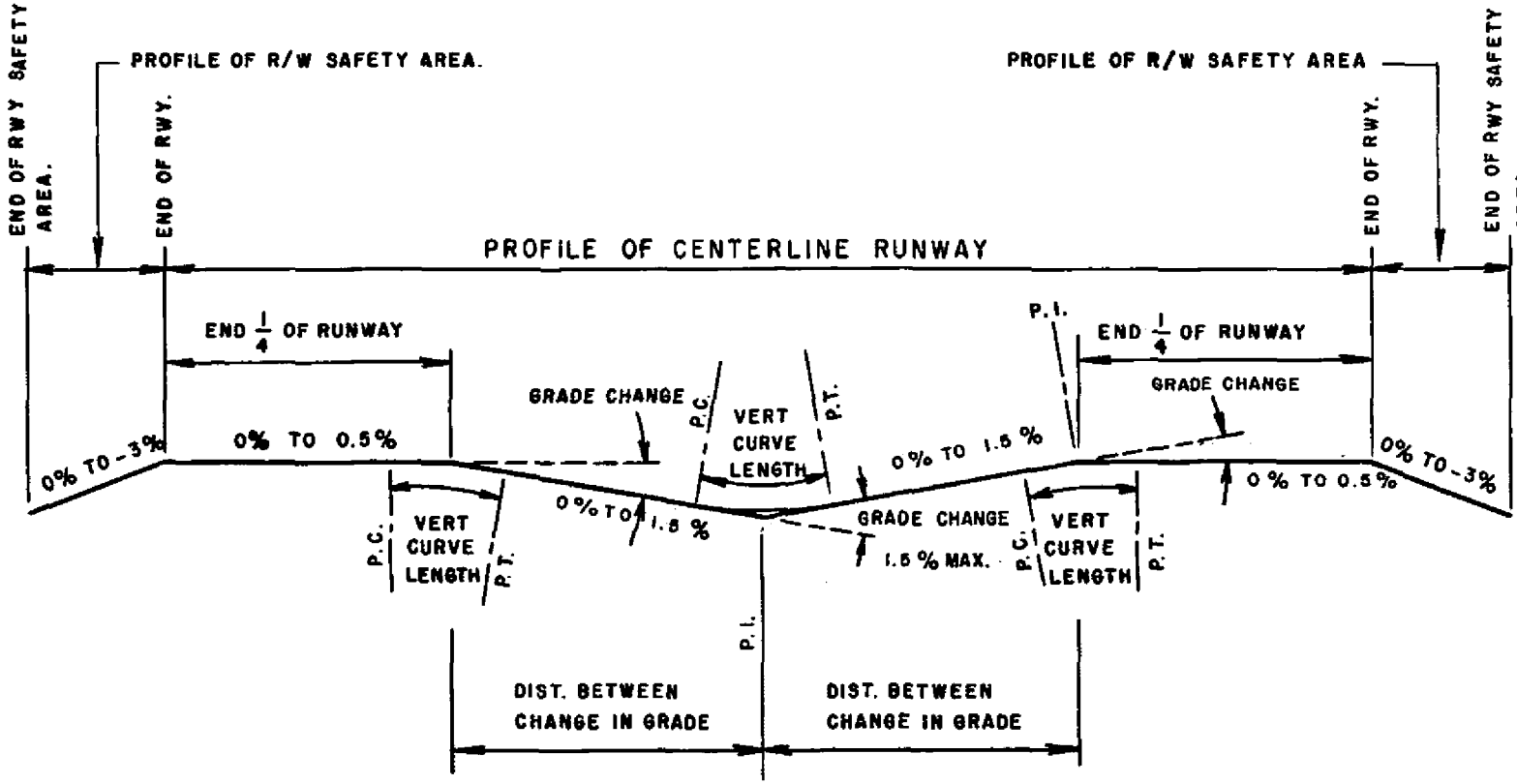
(3) Vertical Curves. When longitudinal grade changes are necessary, parabolic vertical curves should be used. The length of the vertical curve should be a minimum of 1,000 feet (300 meters) for each 1 percent change. (See Figure 1.)

(4) Distances Between Changes in Grade. The distance between the points of intersection of vertical curves should be a minimum of 1,000 feet (300 meters) multiplied by the sum of the grade changes (in percent) associated with the two vertical curves. (See Figure 1.)

(5) Maximum Difference of Centerline Elevation. The maximum allowable difference in runway centerline elevation is 1 percent of the runway length. For stopways, there is no maximum difference. However, if a clearway is to be provided, the stopway cannot penetrate the clearway plane.

(6) Transverse Grade. For runways and stopways, the maximum transverse grade is 1.5 percent. However, the transverse grade should never be less than 1 percent. (See Figure 2.)

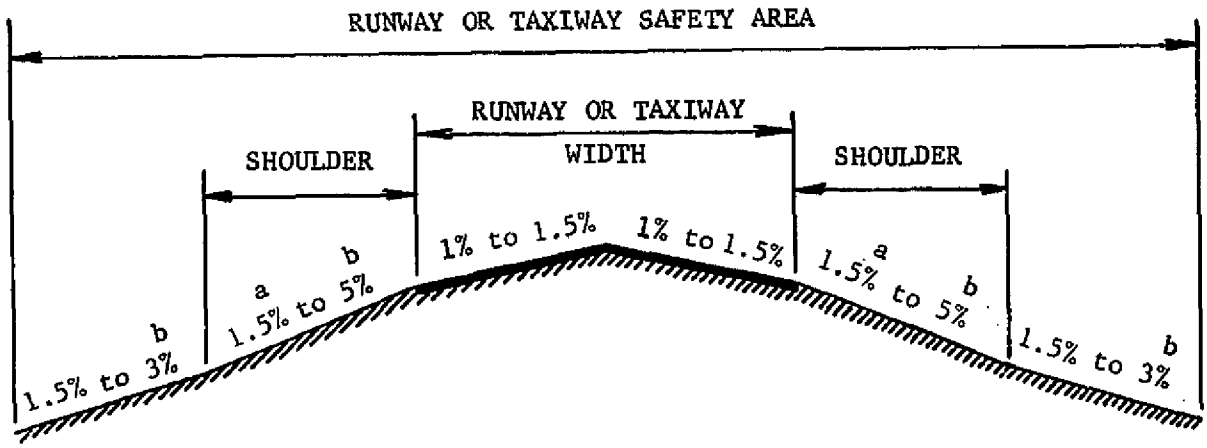
(7) Runway Intersections. Intersections should be designed to provide for a smooth transition between the runways and/or taxiways as well as for adequate drainage of the intersection.



MINIMUM DISTANCE BETWEEN CHANGE IN GRADE = 1000' (300m) x SUM OF GRADE CHANGES (IN PERCENT).

MINIMUM LENGTH OF VERTICAL CURVES = 1000' (300m) x GRADE CHANGE (IN PERCENT).

FIGURE 1. LONGITUDINAL GRADE.



a. 3% MINIMUM REQUIRED FOR TURF

b. A slope of 5% is recommended for a 10-foot (3 meter) width adjacent to the pavement edges to facilitate drainage.

GENERAL NOTES:

1. A 1.5-inch drop from paved surface to unpaved surface is recommended.

2. Drainage ditches and swales shall be located outside the limits of the safety area.

FIGURE 2. TRANSVERSE GRADE

c. Runway Safety Area.

(1) Longitudinal Grade, Longitudinal Grade Changes, Vertical Curves, and Distance Between Changes in Grade. Standards for that part of the runway safety area between the runway ends are the same as the comparable standards for the runway and stopways, except where deviations are required by the presence of taxiways or other runways within the area. In such cases, the longitudinal grades of the runway safety area should be modified by the use of smooth curves. For that part of the runway safety area beyond the runway ends, the longitudinal grade should be between 0 percent and 3 percent with any slope being downward from the ends.

(2) Transverse Grade. Maximum and minimum transverse grades for shoulders and the remainder of the runway safety area are shown in Figure 2. In all cases, keep transverse grades to a minimum, consistent with local drainage requirements.

d. Extended Runway Safety Areas.

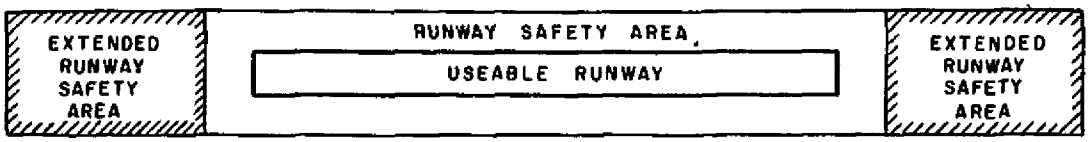
(1) Longitudinal Grade. The maximum longitudinal grade must be such that no part of the extended runway safety area penetrates the approach surface. A negative grade of more than 5 percent is not permitted. (See Figure 3.)

(2) Longitudinal Grade Changes. Longitudinal grade changes are limited to plus/minus 2 percent per 100 feet (30 meters). Parabolic vertical curves should be used where practical.

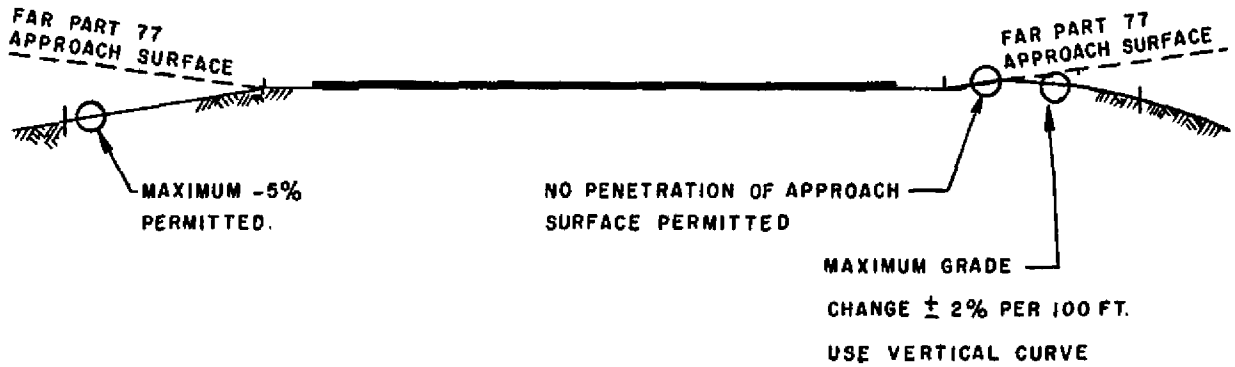
(3) Transverse Grade. The transverse grade is limited to plus/minus 5 percent. (See Figure 3.)

(4) Other Considerations. Grading requirements for navigational aids in the extended runway safety area are, in most cases, more stringent than those stated in (1), (2), and (3) above. Those requirements are found in Advisory Circular 150/5300-2. In the same respect, the requirement to establish a clearway (see paragraph 7e) is more stringent than the longitudinal grading requirements for extended runway safety areas.

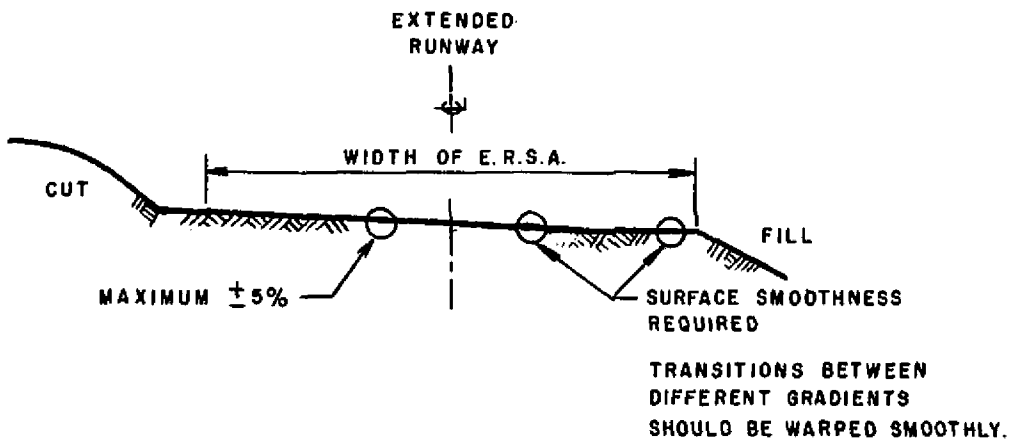
e. Clearways. There are no surface gradient requirements for the clearway. However, terrain which penetrates the clearway plane (defined in FAR Part 1) must be graded to eliminate the penetration. If it is intended to establish an extended runway safety area in conjunction with the clearway, then the transverse and minimum longitudinal grading requirements for the extended runway safety area must be applied in addition to the clearway plane requirements.



PLAN



LONGITUDINAL GRADE



TRANSVERSE GRADE

FIGURE 3. EXTENDED RUNWAY SAFETY AREA

f. Runway Blast Pad.

(1) Longitudinal Grade. The longitudinal grade of the blast pad should be the same as the longitudinal grades for the runway safety area and extended runway safety area in which the blast pad is located. However, the longitudinal grade of the blast pad shall always be level with or downward from the runway end.

(2) Transverse Grade. The transverse grading requirements for the blast pad should be the same as the transverse grades for the runway safety area and extended runway safety area in which the blast pad is located.

g. Taxiways and Taxiway Safety Areas.

(1) Longitudinal Grade. The maximum longitudinal grade is 1.5 percent. It is desirable to keep longitudinal grades to a minimum.

(2) Longitudinal Grade Changes. Whenever possible, longitudinal grade changes should be avoided. The maximum longitudinal grade change of 3 percent should only be used when it is absolutely necessary.

(3) Vertical Curves. When longitudinal grade changes are necessary, vertical parabolic curves should be used. The length of the vertical curve should be a minimum of 100 feet (30 meters) for each 1 percent change.

(4) Distance Between Changes in Grade. The distance between points of intersection of vertical curves should be a minimum of 100 feet (30 meters) multiplied by the sum of the grade changes (in percent) associated with the two vertical curves.

(5) Elevation Differential to Parallel Runway, Taxiways, and Aprons. At any point on a taxiway centerline, the difference in elevation between the taxiway and associated parallel runway, taxiways, or apron edges should not exceed 1-1/2 percent of the shortest distance from that point to the parallel runway, taxiway, or apron. For the purposes of this item, a parallel taxiway is any taxiway functioning as a parallel taxiway whether it is exactly parallel or not. This standard allows for ultimate placement of stub taxiways at any point where capacity requirements dictate. Although it is

desirable, it is not necessary to maintain the aforementioned elevation differential for the entire length of the taxiway when the location of all future stub taxiways is known. In these cases, the elevation differential should be maintained at the locations of the future stub taxiways.

(6) Transverse Grade. Maximum and minimum transverse grades for taxiways and taxiway safety areas are shown in Figure 2. In all cases, keep transverse grades to a minimum, consistent with local drainage requirements.

*8. LINE-OF-SIGHT. Line-of-sight standards impose an additional restraint on the determination of 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 which should be met as a minimum.

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 meters) 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 meters) above the runway centerline to all other points 5 feet (1.5 meters) 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 unobstructed line-of-sight for the entire runway length, adherence to longitudinal gradient standards will provide an adequate line-of-sight at these airports. However, before applying these criteria, a careful analysis must be made of the control tower's operation to assure that it will remain a 24-hour tower. Visibility requirements from the air traffic control tower to airport surface areas utilized 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 meters) above one runway centerline to any point 5 feet (1.5 meters) 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 4. The location of each runway's visibility points is determined in the following manner:

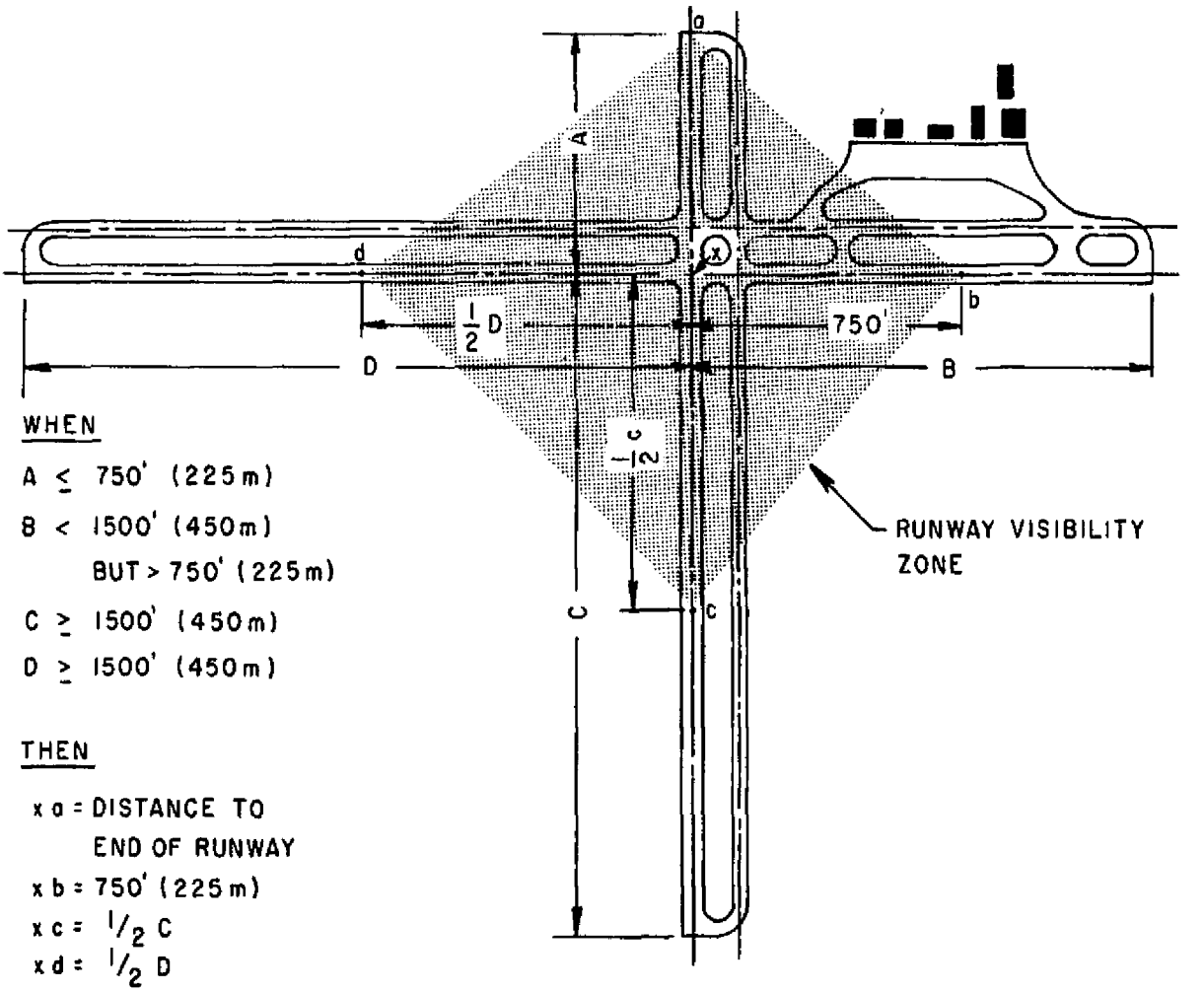
(a) When distance from the intersection of two runway centerlines to a runway end is 750 feet (225 meters) or less, the visibility point is located on the centerline at that runway end.

(b) When the distance from the intersection of two runway centerlines to a runway end is greater than 750 feet (225 meters) but less than 1,500 feet (450 meters), the visibility point is located on the centerline, 750 feet (225 meters) from the intersection of the runway centerlines.

(c) When the distance from the intersection of two runway centerlines to a runway end is equal to or greater than 1,500 feet (450 meters), the visibility point is located on the centerline, equidistantly from the runway end and the intersection of the centerlines.

(2) Airports Having 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, an analysis must be made of the control tower's operation to assure that it will remain a 24-hour tower.

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 safely enter or cross the runway. *



WHEN

A ≤ 750' (225 m)

B < 1500' (450 m)
BUT > 750' (225 m)

C ≥ 1500' (450 m)

D ≥ 1500' (450 m)

THEN

x a = DISTANCE TO END OF RUNWAY

x b = 750' (225 m)

x c = $^1/_2$ C

x d = $^1/_2$ D

FIGURE 4. RUNWAY VISIBILITY ZONE. *

9. HOW TO OBTAIN ADDITIONAL COPIES OF THIS PUBLICATION. Obtain additional copies of this advisory circular from the Department of Transportation, Publications and Forms Section, TAD-443.1, Washington, D.C. 20590.

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