AC 150/5335-3

AIRPORT DESIGN STANDARDS

AIRPORTS SERVED BY AIR CARRIERS
-BRIDGES AND TUNNELS ON AIRPORTS-

19 APRIL 1971

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION
Airports Service

CHANGE

AC NO: 150/5335-3 CHG-1

DATE: March 30, 1973

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: CHANGE 1 TO ADVISORY CIRCULAR 150/5335-3; AIRPORT DESIGN STANDARDS - AIRPORTS SERVED BY AIR CARRIERS - BRIDGES AND TUNNELS ON AIRPORTS

1. PURPOSE. This change transmits revised pages incorporating the changes cited in paragraph 2.

2. EXPLANATION OF CHANGES. In addition to the substantive changes listed below, the references in Appendix 1 have been updated.

   a. Paragraph 5b(2) has been reworded to remove the inference that less than full width taxiway bridges were to be considered only if "space is limited." The revised wording of "operationally acceptable" does permit lesser widths to be considered on a case-by-case basis after due study by all interested parties per paragraph 5b(3).

   b. Paragraph 5b(4) has also been modified to stress that continuous full strength structures are good engineering and operational practice.

   c. Paragraph 7a has been reworded to include consideration of taxiway centerline lights on the taxiway bridge and bridge approaches to aid the pilot in aligning the aircraft for crossing.

3. PAGE CONTROL CHART.

Remove Page	Dated	Insert Page	Dated
1	4/19/71	1	4/19/71
2	4/19/71	2	3/30/73
3	4/19/71	3	3/30/73
4	4/19/71	4	4/19/71
Appendix 1		Appendix 1	
1 and 2	4/19/71	1 and 2	3/30/73

Initiated by: AAS-560

4. HOW TO OBTAIN ADDITIONAL COPIES OF THIS PUBLICATION. Additional copies of this Change 1 to AC 150/5335-3, Airport Design Standards - Airports Served by Air Carriers - Bridges and Tunnels on Airports, may be obtained from the Department of Transportation, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

Clyde W. Pace Jr.

CLYDE W. PACE, JR.
Director, Airports Service

AC NO: 150/5335-3

DATE: 19 Apr 71

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: AIRPORT DESIGN STANDARDS - AIRPORTS SERVED BY AIR CARRIERS - BRIDGES AND TUNNELS ON AIRPORTS

1. PURPOSE. This advisory circular provides general guidance to those contemplating the construction of a bridge type structure to allow aircraft to cross over an essential surface transportation mode.

2. REFERENCES. Federal Aviation Administration (FAA) publications providing additional guidance and information are listed in Appendix 1.

3. HOW TO GET THIS PUBLICATION. You can obtain additional copies of this advisory circular from the Department of Transportation, Federal Aviation Administration, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

4. APPLICABILITY. The recommendations contained in this advisory circular apply to new bridges and tunnels at airports served by air carriers. Airports serving general aviation are to be encouraged to adhere to this criteria. Existing bridge/tunnel structures are not obligated to comply with the recommendations contained herein; however, to the extent reasonable, they should be brought into conformance at the earliest practical date.

Chester G. Bowers

CHESTER G. BOWERS
Director, Airports Service

Initiated by: AS-560

TABLE OF CONTENTS

1. BACKGROUND. The runway length which was adequate for the airlines "prop" fleet is frequently too short now that the airlines have converted to "jets". The airport owners' efforts to extend a short runway were sometimes blocked by a street, highway, or railroad essential to the economic well being of the locality. The FAA encourages airport owners to close or relocate these surface hindrances to the runway extension project whenever possible. In some instances, abandonment or rerouting of the surface route is impossible. When this situation occurs, the only practical solution may be to have the airport's runway/taxiway bridge-over the surface mode. A number of airports have had to construct bridges already, others are contemplating the need for one, and a few have included bridges in their initial development plans. Photographs of some of these are included in Appendix 3.

2. ADVANCE PLANNING. An airport owner needs to know if, when, and where a bridge/tunnel may be required. He needs to know so that he is able to arrange for the financing and to schedule construction to be least disruptive on airport operations. Generally, construction of the runway/taxiway bridge or tunnel is carried out in conjunction with the airport improvement project which may or may not coincide with the surface mode need. Only by being alert to the activities beyond his boundary fence will the airport owner be able to anticipate the need for a bridge/tunnel.

3. COORDINATION. In addition to the FAA, local, state and Federal highway departments; railroad and utility companies; scheduled air carriers and general aviation users all have special interests in any proposed runway/taxiway bridge. Each of these interests must be coordinated, evaluated, and resolved. To avoid/minimize costly redesign or construction delays, the FAA should be consulted very early in the planning process.

4. SITING PRECEPTS. When the bridging of a surface transportation mode is unavoidable, the number of structures required and problems related therewith can be minimized by applying these precepts:

   a. Route or reroute the surface modes so that the least number of runways or taxiways will be affected.

   b. Co-align the surface modes so that all can be bridged with a single structure.

   c. Locate bridges on straight portions of taxiways and away from taxiway intersections or high speed taxiway exits.

   d. When two intersecting runways must be crossed, locate the bridge at or near the intersecting point, PROVIDED, a third runway is available to insure continuity of airport operations.

   e. Avoid bridge locations that have an adverse effect upon the airport's

drainage system, utility service lines, runway/taxiway lighting circuits, instrument landing system (ILS), or the approach lighting system (ALS).

5. DIMENSIONAL CRITERIA. While the final design of the bridge/tunnel structure is an engineering matter and beyond the scope of this circular, airport owners/planners need to recognize that the cost of the structure will depend upon the structure's physical dimensions and load carrying requirements. Physical dimensions are covered in this paragraph; load capabilities are discussed in paragraph 6.

a. Bridge length is measured along the runway/taxiway centerline. Bridges should be designed so that they cross all surface transport modes existing or contemplated in the future. The designer of the span should obtain the surface mode right-of-way widths and clearance requirements from the surface users. While minimum lengths are realized when the airport and surface modes cross at right angles, overriding factors may cause the airport/surface modes to cross on a skewed or curved alignment.

b. Bridge width is measured perpendicularly to the runway/taxiway centerline. Design the bridge width so that it is equal to or greater than the width of the runway/taxiway safety areas (formerly landing strip).

(1) It is recommended that the runway bridge extend at least 350 feet on each side of the runway centerline on any runway which is used or anticipates use by aircraft weighing 700,000 pounds or more.

(2) If operationally acceptable, taxiway bridge widths equal to the width of the taxiway plus shoulders may be considered provided positive edge protection and adequate blast protection is incorporated in the bridge design.

(3) Minimum width taxiway bridges cited in (2) above are special situations to be considered on a case-by-case basis and are not to be adopted as a recommended design practice.

(4) It is considered good engineering and operational practice to design an airport bridge as a continuous full strength structure to the full width of the combined runway and parallel taxiway safety areas. Figures 1 and 2 show two continuous width structures. Figures 3 and 4 illustrate dimensional clearances.

c. Bridge height is measured from the finished grade of the surface mode (road centerline/rail top elevation) vertically to the underside of

the bridge structural deck. Bridge height, essentially, is the vertical clearance provided for the surface mode. Contact the highway department or railroad company for their required vertical clearances. When conditions permit, the bridge should be designed to incorporate an intervening layer of select earth cover between the bridge structural surface and the airport pavement. Advisory Circular 150/5320-6A recommends this earth cover. In any event, the bridge designer must consider the runway/taxiway grades as being inviolate, making up any shortcoming in airport-surface elevation differential by one or both of the following techniques:

(1) Use the bridge structural deck as the airport runway or taxiway surface; i.e., exposed deck.

(2) Depress the surface mode sufficiently to obtain the required vertical clearances.

Figure 5 shows an airport exposed deck taxiway bridge with the roadway depressed to obtain the required vertical clearances.

6. LOAD CONSIDERATIONS. Design airport bridge/tunnel to support the static and dynamic loads imposed by the heaviest aircraft expected to use the structure. Aircraft weighing 750,000 pounds are in use today. Aircraft weighing 1,500,000 pounds or more are being projected to be in use by 1985. Prudent airport owners will evaluate their potential to attract these heavier aircraft and design the original bridge accordingly as the cost and operational penalties of "beefing up" an under-designed structure is high.

7. LIGHTING AND MARKING. FAA recommended standards for lighting airport pavements can be found in advisory circulars in the 150/5340 series. These standards apply to lighting all airport pavements and should be augmented as follows:

a. To improve visual guidance, light spacings of 50 feet (or less) are recommended on taxiway bridges and bridge approaches. Consider installing taxiway centerline lights on the taxiway bridge and its approaches to aid the pilot in aligning the aircraft for the crossing.

b. Mark bridge edges/tunnel portals with three equally-spaced L-810 obstruction lights (Advisory Circular 150/5345-2).

c. Retroflective markers may be added to the painted centerline/edge markings of the taxiway to make them more discernable to aircraft taxiing under adverse visibility conditions (Advisory Circular 150/5345-39A).

d. To aid in keeping taxiing aircraft from straying onto the shoulder area of exposed deck taxiway bridges, it is suggested that the spacing between the taxiway shoulder marking be reduced to 25 feet. Figure 6

illustrates this reduced marking.

e. Continuous width exposed deck bridges or tunnels may be mistaken for a runway by a disoriented pilot. To prevent aircraft from landing crosswise, it is suggested that the standard closed runway "X" marking be painted on the extreme edges of the exposed deck and midway between the runway-taxiway, runway-runway, or taxiway-taxiway pavements.

8. ADDITIONAL DESIGN CONSIDERATIONS. The preceding paragraphs have covered material applicable to any airport bridge or tunnel structure. This paragraph will introduce in brief form, additional design features which may or may not apply to a specific airport bridge project.

a. Guard rails or safety curbs may be necessary on minimum width taxiway bridges. Whatever type of rail or curb is selected, it should not violate the taxiway obstacle-free area as defined in AC 150/5335-1A. Figure 7 shows a double-curb installation. Figures 8 and 9 show vertical and horizontal guard rail installations.

b. Security fences are recommended at bridge/tunnel abutments to restrain persons, vehicles, and/or animals from entering onto the aircraft operational areas. Figure 8 shows a typical fence installation.

c. Heating elements may be a wise investment on any exposed deck pavement section area where snow and sleet are a problem. When used, design the drainage system to accept the melted snow without freezing or causing flooding of the surface mode tunnel.

d. Service roads for the express movement of an airport's emergency, maintenance, and service vehicles are permitted to cross nonairport surface modes via the runway/taxiway bridge provided:

(1) Adequate horizontal clearances are available, or

(2) Their use is subservient to the airport aeronautical use.

Figure 10 shows this latter situation with service vehicles being held short of the service road while an aircraft is being towed on the taxiway. Airports with an excessive volume of internal ground vehicle traffic may find it expedient to construct a separate bridge specifically for this traffic.

e. Cautionary signs alerting pilots of the bridge/tunnel are not mandatory. When used, the wording and placement should be coordinated with the airport owner and users with FAA review.

f. Additional blast protection should not be necessary on bridges/tunnels built to the recommended safety area width. Minimum width taxiway bridges/tunnels may need additional protective devices which do not penetrate the FAR Part 77 surface. In some locations, a nonload

bearing bridge deck may be the most practical solution for blast protection.

g. Approach aprons, similar to those used in highway bridges, may be used to minimize the effects of differential settlement in the approaches to the bridge and the bridge proper.

h. Mechanical ventilation may or may not be necessary depending on the width of the structure. When ventilation is required, locate the above ground components so that they will not interfere with the airport operation or violate the protective surfaces of FAR Part 77 or Advisory Circular 150/5335-1A.

i. If artifical lighting is necessary, consider provisions for emergency lighting, lane control, etc. on a case-by-case basis. The American Association of State Highway Officials have a section on lighting tunnels and underpasses in their publication "Informational Guide for Roadway Lighting" dated March 1969. Copies of this publication are available in most state highway offices.

j. Lighting of the approaches to the underpass/tunnel present special problems. Light support masts cannot violate FAR Part 77 criteria and the light fixture must not cause glare or be distracting to the pilot of the landing aircraft or to the control tower operator. Figures 5, 8 and 9 show some existing roadway lighting techniques.

k. Do not ignore the special drainage requirements of the surface modes, particularly when the surface mode grade is depressed to meet vertical clearance requirements. There is no advantage to bridging a surface mode if it is going to be incapacited whenever there is a moderate rainfall.

l. Since utility companies use highway or street rights-of-way for their distribution system,it is suggested that the bridge designer contact each of the utility systems operating in the area to determine if they will need additional capacity in any line using the surface mode right-of-way.

9. PASSENGER/BAGGAGE TUNNELS. Passenger/baggage tunnels normally are located in the terminal area connecting main and satellite terminals. In essence, they are merely smaller versions of highway/railroad bridges/tunnels and the designing process and considerations are similar.

10. APPLICATION TO EXISTING STRUCTURES. While existing bridges/tunnels are exempt from conforming to the recommendations of this advisory circular, whenever possible, they should be brought into conformance at the earliest possible date. Generally, existing deficiencies will fit into one of these categories: structural, lighting/marking, or blast protection.

a. Structural problems may be due to insufficient support capability

or inability to physically enlarge the structure to accomodate:

(1) Larger and heavier aircraft.

(2) Increased runway-taxiway separation.

(3) Widened runway-taxiway safety areas.

First priority should be given to strengthening bridges on the operationally critical runways and taxiways. Do not limit the project to just bringing the bridge up to current loading requirements but consider weights of aircraft projected for the future. To the extent funds permit, consider lengthening or widening anytime a strengthening project is contemplated.

b. Lighting/marking changes on an existing bridge to meet the standards recommended by this advisory circular are probably the easiest and least expensive to accomplish and should be scheduled to be least disruptive to continuing airport operations.

c. Additional blast protection of existing bridges should be evaluated on the blast patterns of current jet engines. When the existing bridge structure is structurally and dimensionally adequate to support current and future aircraft loadings, a nonload bearing structural canopy may suffice. However, there should be no degradation in the level of safety provided to the airport's aeronautical users or to the surface mode users.

APPENDIX 1. BIBLIOGRAPHY

1. The following Federal Aviation Regulations (FAR's) 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. Federal Aviation Regulations, Volume XI, $5.00

      (1) Part 77, Objects Affecting Navigable Airspace

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

   b. Federal Aviation Regulations, Volume X, $7.00, Part 152, Airport Aid Program

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

   d. AC 150/5320-5B, Airport Drainage ($1.00)

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

2. The following advisory circulars may be obtained from the Department of Transportation, Distribution Unit, TAD 484.3, Washington, D.C. 20590, at no cost:

   a. AC 150/5300-2B, Airport Design Standards - Site Requirements for Terminal Navigational Facilities

   b. AC 150/5300-6, Airport Design Standards - General Aviation Airports - Basic and General Transport (include Change 1)

   c. AC 150/5320-6A, Airport Paving (including Changes 1 thru 3)

   d. AC 150/5325-2B, Airport Design Standards - Air Carrier Airports - Surface Gradient and Line of Sight

   e. AC 150/5325-6A, Airport Design Standards - Effects and Treatment of Jet Blast

   f. AC 150/5330-2A, Runway/Taxiway Widths and Clearance for Airline Airports

   g. AC 150/5335-1A, Airport Design Standards - Airports Served by Air Carriers - Taxiways

   h. AC 150/5340-1D, Marking of Paved Areas on Airports

i. AC 150/5340-13A, High Intensity Runway Lighting Systems

j. AC 150/5340-15B, Taxiway Edge Lighting System

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

l. AC 150/5340-19, Taxiway Centerline Lighting System

m. AC 150/5345-2, Specification for L-810 Obstruction Light (include CHG 1)

n. AC 150/5345-39A, FAA Specification L-853, Runway and Taxiway Centerline Retroreflective Markers

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Washington, D.C. 20591

Official Business

PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
FEDERAL AVIATION
ADMINISTRATION
DOT 515

APPENDIX 2. SURVEY RESULTS OF EXISTING STRUCTURES

AIRPORT/STRUCTURE	PURPOSE	DIMENSIONS/REMARKS
Allegheny County (AGC)		
Taxiway-Runway Tunnel	Railroad	70x800-foot (continuous)
Taxiway-Runway Tunnel	Highway	70x800-foot (continuous)
Buffalo (BUF)		
Taxiway-Runway Tunnel	Railroad	50x750-foot (continuous)
Taxiway-Runway Tunnel	Highway	60x750-foot (continuous)
Chicago (ORD)		
Taxiway Overpass	Access Road	125x228-foot (exposed deck)
Taxiway-Runway Tunnel	Future Road	63x1,580-foot (continuous)
Denver (DEN)		
Taxiway-Runway Tunnel	Highway	100x756-foot (continuous)
Taxiway-Runway Tunnel	Railroad	36x752-foot (continuous)
Fort Worth (GSW)		
Taxiway-Runway Tunnel	Highway	100x813-foot (continuous)
Long Beach (LGB)		
Taxiway-Runway Tunnel	Highway	60x1,100-foot (continuous)
Taxiway-Runway Tunnel	Highway	60x900-foot (continuous)
Los Angeles (LAX)		
Taxiway-Runway Tunnel	Highway	80x2,000-foot (continuous)
Taxiway-Runway Tunnel	Future Road	118x720-foot (continuous)
Apron Tunnels	Passenger	(See Note 1.)
Memphis (MEM)		
Taxiway-Runway Tunnel	Highway	75x790-foot (continuous)
Taxiway Overpass	Highway	150x185-foot (exposed deck)
Milwaukee (MKE)		
Taxiway-Runway Tunnel	Highway	91x800-foot (continuous)
Minneapolis-St. Paul (MSP)		
Taxiway-Runway Tunnel	Service Road	60x1,170-foot (continuous) Under construction
New York (JFK)		
Taxiway Overpasses	Access Roads	115x140-foot (exposed deck)
Pittsburgh (PIT)		
Taxiway Overpass	Service Road	40x125-foot (exposed deck)

AIRPORT/STRUCTURE	PURPOSE	DIMENSIONS/REMARKS
Seattle (SEA)		
Taxiway-Runway Tunnel	Highway	73x1,060-foot (continuous)
Apron Tunnels	Passenger	Under construction (See Note 2.)
Tampa (TPA)		
Taxiway Overpass	Access Road	138x140-foot (exposed deck)

SPECIAL NOTES ON APRON TUNNELS

NOTE 1. APRON TUNNEL DATA--LOS ANGELES INTERNATIONAL. Tunnels of the following cross section extend from terminal building to satellites and between satellites as noted below. Earth cover between the apron pavement and tunnel roof will vary from 1 to 7 feet. Baggage section is structurally partitioned from passenger section for tunnels #2, 3, 5, 6, and 7. The most extensive network of apron tunnels exists at this airport.

CONCRETE TUNNEL	INTERIOR CROSS SECTION SIZE (WIDTH X HEIGHT)	
Number/Type	Passenger Section	Baggage Section
Tunnel #2 (Triple Box)	(1) - 20x10.25 Feet	(2) - 11x11.83 Feet
Tunnels #3, 5, and 6 (All Triple Box)	(1) - 20x10.25 Feet	(2) - 8x11.83 Feet
Tunnel #4 (2 Separate Boxes)	(1) - 23x10.25 Feet	(1) - 16x11.5 Feet
Tunnel #7 (Double Box)	(1) - 20x10.5 Feet	(1) - 16x11.5 Feet
Satellite/Satellite Connecting Tunnels	(1) - 10x10.25 Feet	None

NOTE 2. APRON TUNNEL DATA--SEATTLE-TACOMA INTERNATIONAL. Tunnels extend from terminal building to satellites and will contain a mechanical "people mover". Cross section is irregular shaped concrete box with maximum structural width of 21 feet and maximum height of 29 feet. Earth cover between the apron pavement and tunnel roof will vary from 5 to 8 feet.

FIGURE 1. AERIAL PHOTOGRAPH - HIGHWAY TUNNEL (GREATER SOUTHWEST INTERNATIONAL AIRPORT, FORT WORTH, TEXAS)

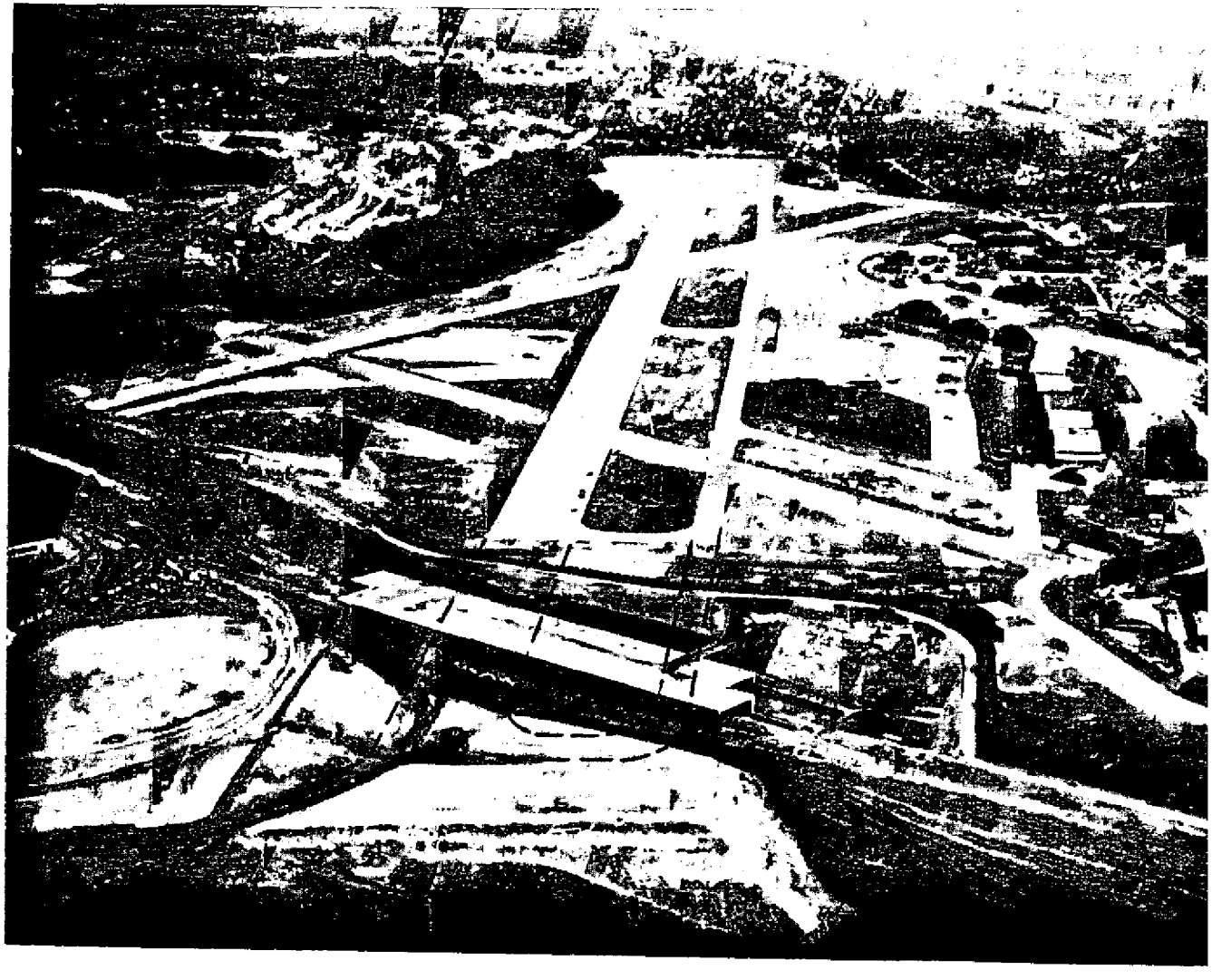
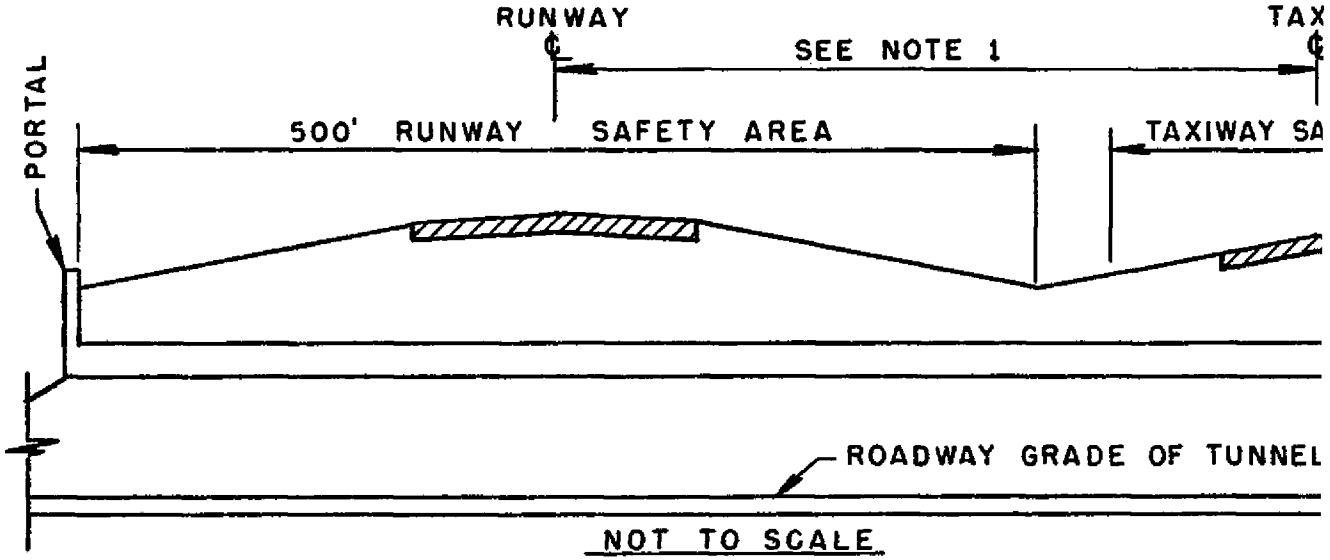


FIGURE 2. HIGHWAY/RAILROAD TUNNEL UNDER CONSTRUCTION AS PART OF RUNWAY EXTENSION, ALLEGHENY COUNTY AIRPORT, PENNSYLVANIA



NOTES:

1. WIDTH OF TAXIWAY SAFETY AREA AND RUNWAY / TAXIWAY SEPARATION VARY DEPENDING ON AIRPLANE / TAXIWAY DESIGN GROUP. (SEE AC 150/5
2. ROADWAY TUNNEL NORMALLY HAS SLIGHT LONGITUDINAL GRADIENT AI TYPE OF RETAINING WALL AT PORTALS
3. UNIFORM TUNNEL CROSS SECTION IS NORMALLY USED; AND A CONTINU STRUCTURE WITHOUT OPEN SECTION IN INFIELD AREA IS PREFERRED A RECOMMENDED WHEREVER FEASIBLE

FIGURE 3. DIMENSIONAL CLEARANCES FOR RUNWAY STRUCTURES

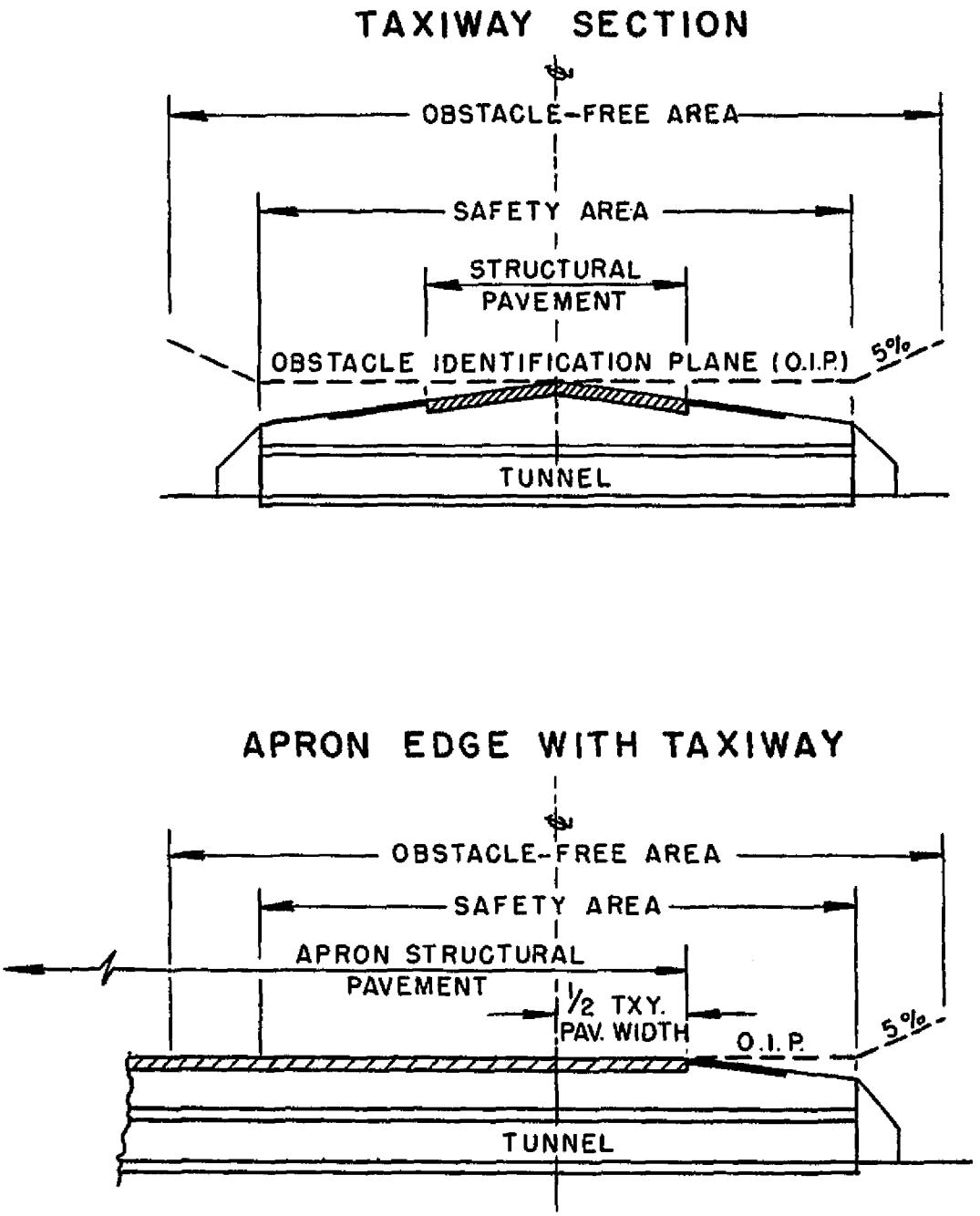


FIGURE 4. EDGE CLEARANCES FOR TAXIWAY AND APRON STRUCTURES

FIGURE 5. EXAMPLE OF ROADWAY GRADE LOWERING TO OBTAIN BRIDGE CLEARANCE (O'HARE AIRPORT, CHICAGO, ILLINOIS)

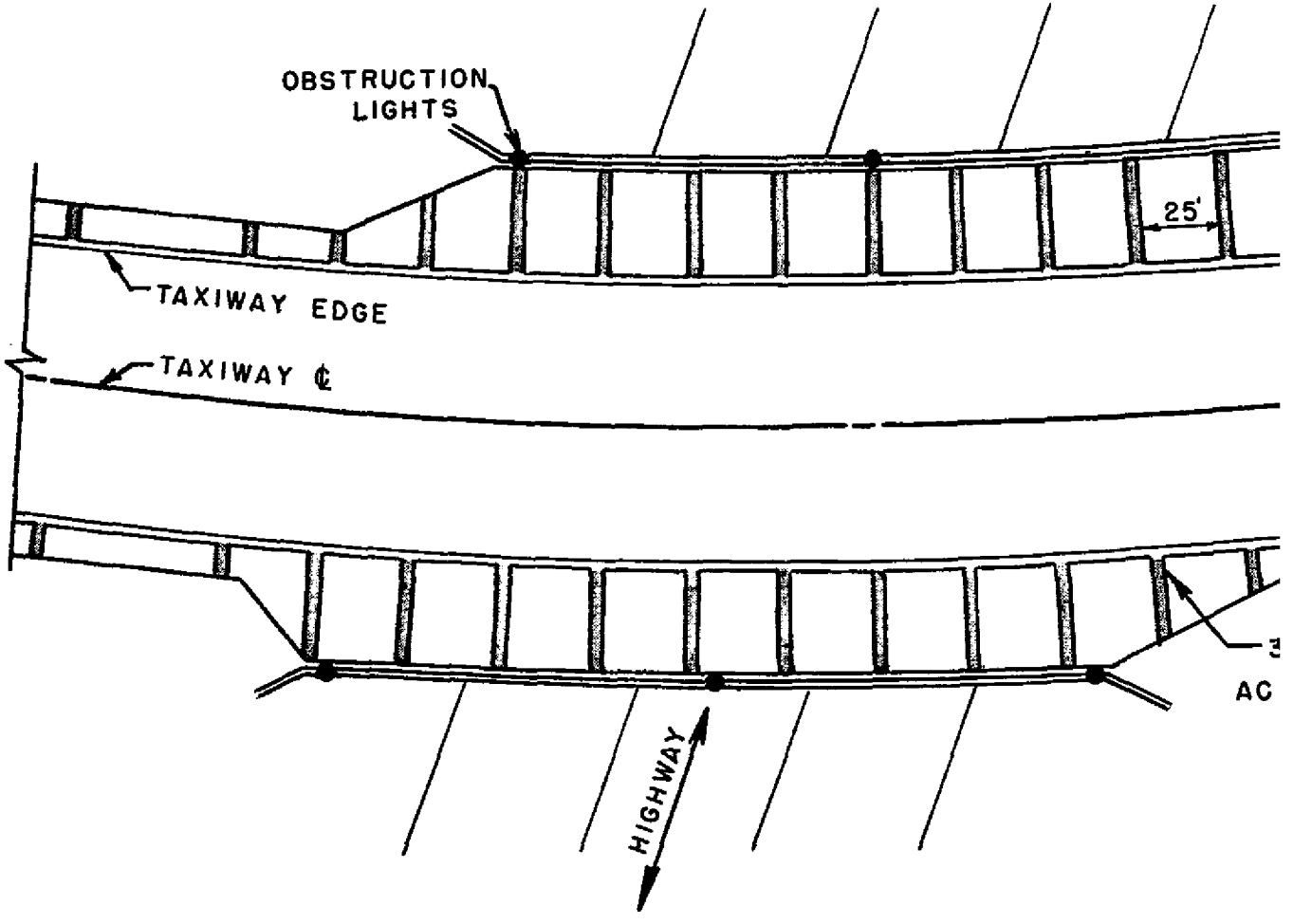


FIGURE 6. REDUCED SEPARATION OF TAXIWAY SHOULDER MARKING OVER A MINIMUM WIDTH BRIDGE

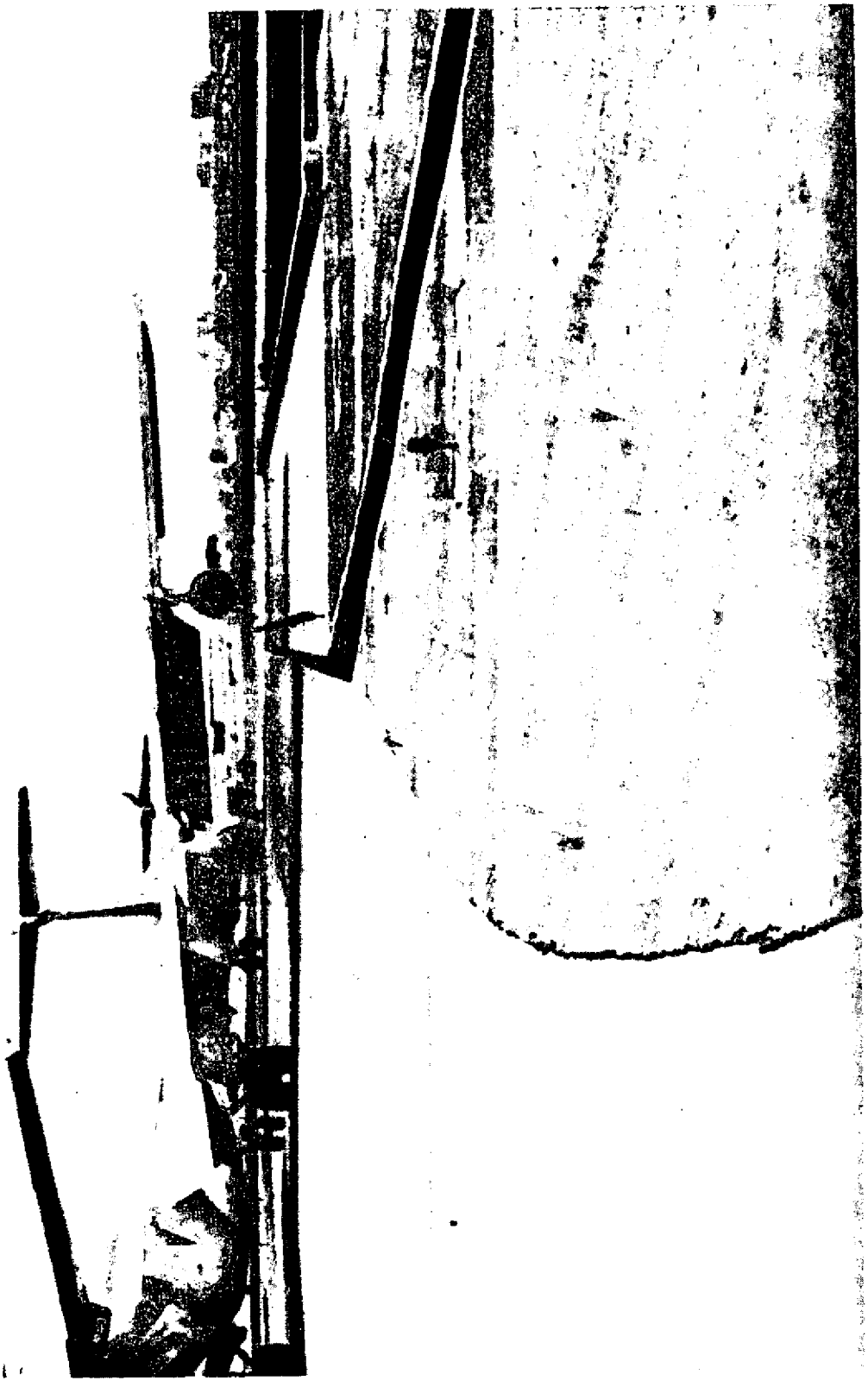


FIGURE 7. TAXIWAY BRIDGE SHOULDER TRANSITION AND DETAILS
(O'HARE AIRPORT, CHICAGO, ILLINOIS)

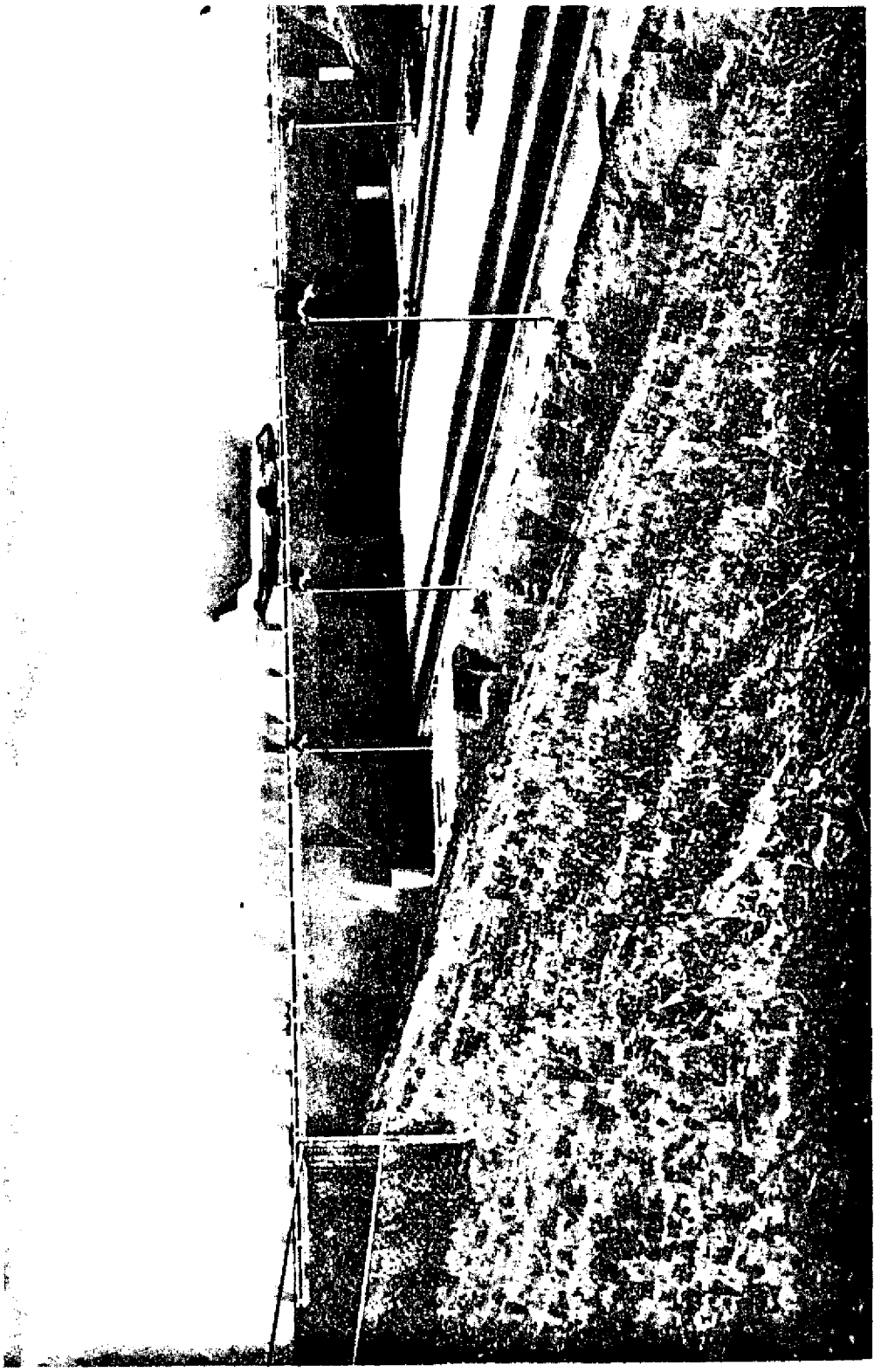


FIGURE 8. GUARD RAIL, SECURITY FENCING, AND ROADWAY LIGHTING INSTALLATIONS (GREATER SOUTHWEST INTERNATIONAL AIRPORT, FORT WORTH, TEXAS)

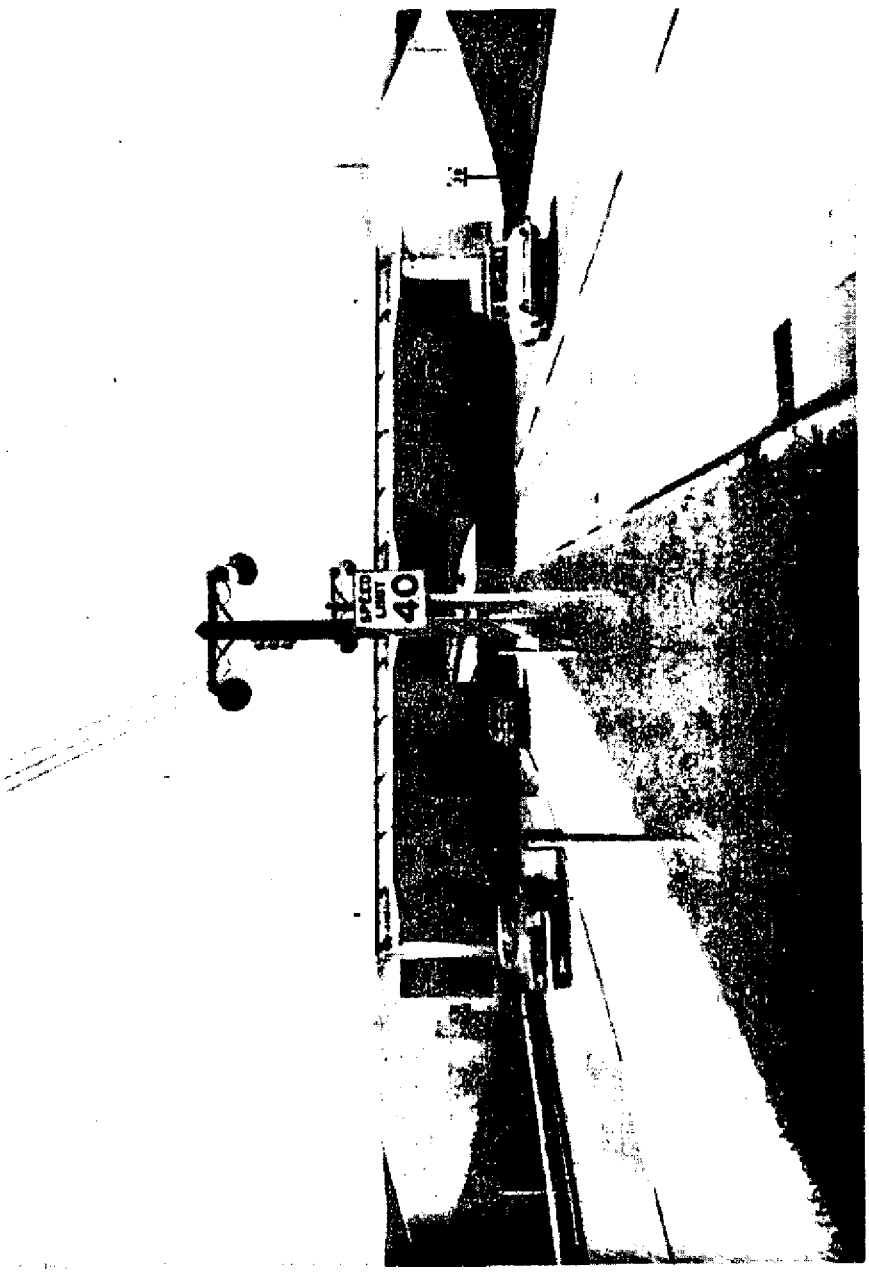


FIGURE 9. HORIZONTAL GUARD RAIL (GENERAL MITCHELL FIELD, MILWAUKEE, WISCONSIN)

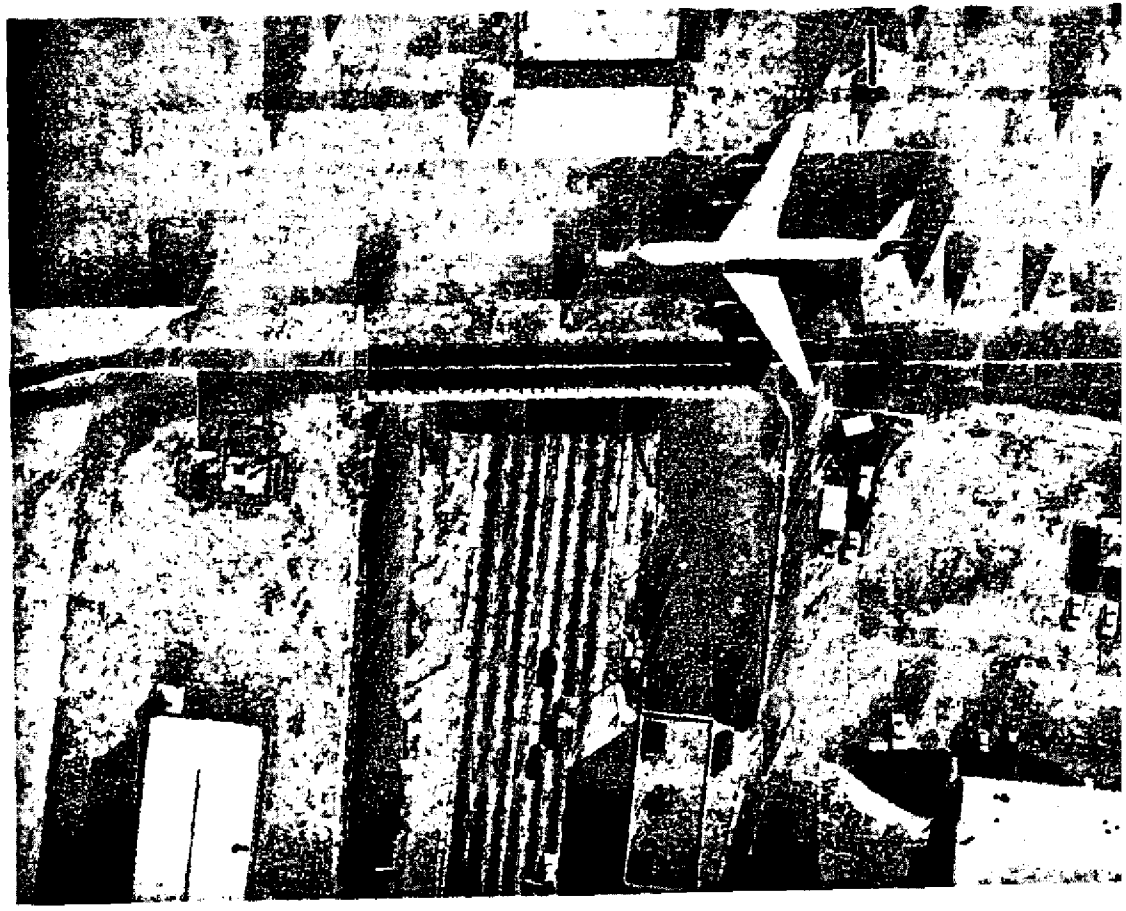


FIGURE 10. SERVICE ROAD TRAFFIC OVER TUNNEL PERMITTED ONLY WHEN TAXIWAY IS CI
(LOS ANGELES INTERNATIONAL AIRPORT, LOS ANGELES, CALIFORNIA)

U. S. GOVERNMENT PRINTING OFFICE: 1970 O - 424-679

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Washington, D.C. 20590