RUNWAYS (FIXED-WING) AND IMAGINARY SURFACES

3.1. Contents. This chapter presents design standards and considerations for fixed-wing runways and associated imaginary surfaces.

3.2. Requirements. The landing and take-off design considerations for an airfield include mission requirements, expected type and volume of air traffic, traffic patterns such as the arrangement of multidirectional approaches and takeoffs, ultimate runway length, runway orientation required by local wind conditions, local terrain, restrictions due to airspace obstacles or surrounding community, noise impact, and aircraft accident potential.

3.3. Runway Classification. Runways are classified as either Class A or Class B, based on aircraft type as shown in Table 3.1. This table uses the same runway classification system established by the Office of the Secretary of Defense as a means of defining accident potential areas (zones) for the Air Installations Compatible Use Zones (AICUZ) Program. These runway classes are not to be confused with aircraft approach categories and aircraft wingspan in other DoD or FAA documents, aircraft weight classifications, or pavement traffic areas. The aircraft listed provide examples of aircraft which fall into these classifications and may not be all inclusive.

Table 3.1. Runway Classification by Aircraft Type.

Class A Runways		Class B Runways		
C-1	OV-1	A-6	C-141	P-3
C-2	T-3A	A-10	E-3	S-3
C-12	T-28	AV-8	E-4	SR-71
C-20	T-34	B-1	E-6	T-1
C-21	T-44	B-2	R/F-4	T-2
C-23	U-21	B-52	F-5	T-37
C-26	UV-18	C-5	F-14	T-38
E-1	DASH-7	C-9	F-15	T-39
E-2	DASH-8	KC-10	F-16	T-42
		C-17	F/A-18	T-45
		C-130	F-22	TR-1
		C-135	FB-111	U-2
		C-137	F-117	

Notes:

1. Only symbols for basic mission aircraft or basic mission aircraft plus type are used. Designations represent entire series. Runway classes in this table are not related to aircraft approach categories, aircraft weight, aircraft wingspan, or to pavement design classes or types.
2. These are examples of aircraft which fall into these classifications, and may not be all inclusive.
3. Rotary aircraft are not addressed in this table.
4. V-22 aircraft is a rotary aircraft which operates as a rotary-wing aircraft on a Class A runway and operates as either a fixed-wing or rotary-wing aircraft on taxiways associated with Class A runways.

3.3.1. Class A Runways. Class A runways are primarily intended for small light aircraft. These runways do not have the potential or foreseeable requirement for development for use by high performance and large heavy aircraft. Ordinarily, these runways are less than 2,440 meters [8,000 feet] long and have less than 10 percent of their operations that involve aircraft in the Class B category.

3.3.2. Class B Runways. Class B runways are primarily intended for high performance and large heavy aircraft, as shown in Table 3.1.

3.3.3. Rotary-Wing and V-STOL Aircraft. Runways for Rotary-wing and Vertical Take-Off and Landing (V-STOL) (V-22) aircraft are not addressed in this chapter. Design standards and considerations for rotary-wing aircraft runways and landing lanes are found in Chapter 4 of this manual. Information on the design standards and considerations for the V-STOL aircraft may be obtained from:

Department of the Navy
LANTDIV Code 15C
1510 Gilbert St.
Norfolk, VA 23511-2699

3.3.4. Army Airfields Class A and Class B Criteria. For Army airfields where Air Force aircraft may not normally operate, the runway will be designed with Class A criteria. For Army airfields where Air Force transport aircraft may operate, the runway will be designed with Class B criteria, except for lateral clearances and some other selected primary surface criteria, as noted in the tables. These dimensional changes are to provide the installation with Air Force support, while not jeopardizing the mission.

3.3.5. Short Fields and Training Assault Landing Zones. Short Fields and Training Assault Landing Zones are special use fields. Design criteria are found in Air Force Engineering Technical Letter (ETL) 98-5, *C-130 and C-17 Contingency and Training Airfield Criteria*. When fully developed and approved, criteria for training airfields will be provided in Chapter 7 of this manual.

3.4. Runway Systems. As discussed in Chapter 2, an airfield normally has only one runway.

3.4.1. Single Runway. A single runway is the least flexible and lowest capacity system. The capacity of a single runway system will vary from approximately 40 to 50 operations per hour under IFR conditions, up to 75 operations per hour under VFR conditions.

3.4.2. Parallel Runways. Parallel runways are the most commonly used system for increased capacity. In some cases, parallel runways may be staggered with the runway ends offset from each other and with terminal or service facilities located between the runways. When parallel runways are separated by less than the distance shown in Item 15 of Table 3.2, the second runway will increase capacity at the airfield under VFR conditions, but due to the close distance, capacity at the airfield will not be increased under IFR conditions.

3.4.3. Crosswind Runways. Crosswind runways may be either the open-V or the intersecting type of runway. The crosswind system is adaptable to a wider variety of wind conditions than the parallel system. When winds are calm, both runways may be used simultaneously. An open-V system has a greater capacity than the intersecting system.

3.5. Runway Orientation/Wind Data. Runway orientation is the key to a safe, efficient, and usable aviation facility. Orientation is based on an analysis of wind data, terrain, local development,

operational procedures and other pertinent data. Procedures for analysis of wind data to determine runway orientation are further discussed in attachment 4.

NOTE: Metric units apply to new airfield construction, and where practical, to modifications to existing airfields and heliports, as discussed in paragraph 1.4.4.

Table 3.2. Runways.

Item No.	Item Description	Class A Runway	Class B Runway	Remarks
		Requirement		
1	Length	See Table 3.3	See Remarks	For Army airfields. For Army Class B runways, runway length will be determined by the Air Force MAJCOM for the most critical aircraft in support of the mission.
		See Remarks	See Remarks	For Air Force airfields, runway length will be determined by the MAJCOM for the most critical aircraft in support of the mission.
		See Remarks	See Remarks	For Navy and Marine Corps airfields, see NAVFAC P-80 for computation of runway lengths.
2	Width	30 m [100 ft]	46 m [150 ft]	Army airfields and Air Force airfields, not otherwise specified.
		NA	90 m [300 ft]	B-52 aircraft.
		23 m [75 ft]	N/A	Navy and Marine Corps class A runways. Runway width for T-34 and T-44 will be 45 m [150 ft].
		NA	60 m [200 ft]	Navy and Marine Corps airfields.
3	Total width of shoulders (paved and unpaved)	15 m [50 ft]	60 m [200 ft]	Army and Air Force airfields.
		7.5 m [25 ft]	46 m [150 ft]	Navy and Marine Corps airfields.
4	Paved shoulder width	7.5 m [25 ft]	7.5 m [25 ft]	Army airfields, and Air Force airfields not otherwise specified below.
		NA	3 m [10 ft]	Air Force airfields designed for Trainer, Fighter and B-52 aircraft.
		3 m [10 ft]	3 m [10 ft]	Navy and Marine Corps airfields.

5	Longitudinal grades of runway and shoulders	Maximum 1.0%		Grades may be both positive and negative but must not exceed the limit specified. Exception for shoulders: a 3.0 percent maximum is permitted where arresting barriers are installed.
6	Longitudinal runway grade changes	No grade change is to occur less than 300 m [1,000 ft] from the runway end	No grade change is to occur less than 900 m [3,000 ft] from the runway end	Where economically feasible, the runway will have a constant centerline gradient from end to end. Where terrain dictates the need for centerline grade changes, the distance between two successive point of intersection (PI) will be not less than 300 m [1,000 ft] and two successive distances between PIs will not be the same.
7	Rate of longitudinal runway grade changes	Max 0.167% per 30 linear meters [100 linear feet]of runway		For Army and Air Force. Maximum rate of longitudinal grade change is produced by vertical curves having 180 meters [600 foot] lengths for each percent of algebraic difference between the two grades.
		Max 0.10% per 30 linear meters [100 linear feet] of runway		For Navy and Marine Corps. Maximum rate of longitudinal grade change is produced by vertical curves having 300 meters [1,000 foot] lengths for each percent of algebraic difference between the two grades.
		See Remarks		Exceptions: 0.4 percent for edge of runways at runway intersections.
8	Longitudinal sight distance	Min 1,500 m [5,000 ft]		Any two points 2.4 m [8 ft] above the pavement must be mutually visible (visible by each other) for the distance indicated. For runways shorter than 1,500 meters [5,000 ft], height above runway will be reduced proportionally.
9	Transverse grade of runway	Min 1.0% Max 1.5%		New runway pavements will be centerline crowned. Existing runway pavements with insufficient transverse gradients for rapid drainage should provide increasing gradients when overlaid or reconstructed.
				Slope pavement downwards from centerline of runway. 1.5% slope is optimum transverse grade of runway. Selected transverse grade is to remain constant for length of runway, except at or adjacent to

				runway intersections where pavement surfaces must be warped to match abutting pavements.
10	Transverse grade of paved shoulder	2% min 3% max		Paved Portion of Shoulder. Slope downward from runway pavement.
11	Transverse grade of unpaved shoulder	(a) 40 mm [1-1/2"] drop off at edge of paved shoulder (b) 5% slope first 3 m [10 ft] from paved shoulder and edge of runway without paved shoulder (c) beyond 3 m [10 ft] from paved shoulder and edge of runway without paved shoulder - 2% min, 4% max.		Unpaved Portion of Shoulder. Slope downward from shoulder pavement. For additional information, see Figure 3.1.
12	Runway lateral clearance zone	152.40 m [500 ft]	152.40 m [500 ft]	Army airfields.
		152.40 m [500 ft]	304.80 m [1,000 ft]	Air Force, Navy, and Marine Corps.
				The runway lateral clearance zone's lateral limits coincide with the limits of the primary surface. The ends of the lateral clearance zone coincide with the runway ends. The ground surface within this area must be clear of fixed or mobile objects, and graded to the requirements of Table 3.2, items 13 and 14. The zone width is measured perpendicularly from the centerline of the runway and begins at the runway centerline. In addition to the lateral clearance criterion, the vertical height restriction on structures and parked aircraft as a result of the 7 to 1 transitional slope must be taken into account. See Table 3.7, item 30. (1) Fixed obstacles include manmade or natural features such as buildings (including air traffic control towers), trees, rocks, terrain irregular-ities and any other features constituting possible hazards to moving aircraft. Navigational aids and meteorological equipment will be sited within these clearances where essential for their proper functioning to fulfill flight operation requirements. For Army and Air Force, this area to be clear of all obstacles except for the permissible deviations

				noted in Attachment 14. For Navy and Marine Corps, certain items that are listed in NAVFAC P-80.3 are exempted. (2) Mobile obstacles include parked aircraft, parked and moving vehicles, railroad cars, and similar equipment. Taxiing aircraft and emergency vehicles are exempt from this restriction. (3) For Army and Air Force airfields, parallel taxiway (exclusive of shoulder width) will be located in excess of the lateral clearance distances (Primary Surface). For Navy and Marine Corps airfields, the centerline of a parallel taxiway may be located at the lateral clearance distance (thus allowing a portion of the taxiway pavement to be within the primary surface). (4) For Class A runways, except at Navy and Marine Corps airfields, above ground drainage structures, including head wall, are not permitted within 76.2 meters [250 feet] of the runway edge. For Class B runways, except at Navy and Marine Corps airfields, above ground drainage structures, including head walls are not permitted within 91.44 meters [300 feet] from the runway edge. At Navy and Marine Corps airfields, above ground drainage structures will be individually reviewed. Drainage slopes of up to a 10 to 1 ratio are permitted for all runway classes, but swales with more gentle slopes are preferred. (5) Distance from runway centerline to helipads is discussed in Table 4.1. For Military installations overseas (other than bases located in the United States, its territories, trusts, and possessions), apply to the maximum practical extent.
		152.4 m (500 ft)	228.6 m (750 ft)	Navy airfields constructed prior to 1997.
13	Longitudinal grades within runway lateral clearance zone	Max 10.0%		Exclusive of pavement, shoulders, and cover over drainage structures. Slopes are to be as gradual as practicable. Avoid abrupt changes or sudden reversals. Rough grade to the extent necessary to minimize damage to aircraft. Grades must not penetrate the elevation of the

				primary surface. The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline.
14	Transverse grades within runway lateral clearance zone (in direction of surface drainage)	Minimum of 2.0% prior to channelization* Max 10.0%		Exclusive of pavement, shoulders, and cover over drainage structures. Slopes are to be as gradual as practicable. Avoid abrupt changes or sudden reversals. Rough grade to the extent necessary to minimize damage to aircraft. Grades must not penetrate the elevation of the primary surface. The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline.
15	Distance between centerlines of parallel runways	213.36 m [700 ft]	304.80 m [1,000 ft]	Visual flight rules (VFR) without intervening parallel taxiway between the parallel runways. One of the parallel runways must be a VFR only runway.
		632.46 m [2,075 ft]		VFR with intervening parallel taxiway.
		762.00 m [2,500 ft]		IFR using simultaneous operation (Depart-Depart) (Depart-Arrival).
		1,310.64 m [4,300 ft]		Instrument flight rules (IFR) using simultaneous approaches.
				For separation distance between fixed wing runways and rotary wing facilities, see Table 4.1.

* Bed of channel may be flat.

Notes:

1. Geometric design criteria in this manual are based on aircraft-specific requirements and are not direct conversions from inch-pound (English) dimensions. Inch-pound units are included only to permit reference to the previous standard.
2. Airfield and heliport imaginary surfaces and safe wingtip clearance dimensions are direct conversions from inch-pound to SI units.

3.6. Additional Considerations for Runway Orientation. In addition to meteorological and wind conditions, the following factors must be considered:

3.6.1. Obstructions. A specific airfield site and the proposed runway orientation must be known before a detailed survey can be made of obstructions which affect aircraft operations. Runways should be so oriented that approaches necessary for the ultimate development of the airfield are free of all obstructions.

3.6.2. Restricted Airspace. Airspace through which aircraft operations are restricted, and possibly prohibited, are shown on sectional and local aeronautical charts. Runways should be so oriented that their approach and departure patterns do not encroach on the restricted areas.

3.6.3. Built-Up Areas. Airfield sites and runway alignment will be selected and the operational procedures adopted which will least impact local inhabitants. Additional guidance for facilities is found in DoD Instruction 4165.57, *Air Installations Compatible Use Zone (AICUZ) Program.*

3.6.4. Neighboring Airports. Existing aircraft traffic patterns of airfields in the area may affect runway alignment.

3.6.5. Topography. Avoid sites which require excessive cuts and fills. Evaluate the effects of topographical features on: airspace zones, grading, drainage, and possible future runway extensions.

3.6.6. Soil Conditions. Evaluate soil conditions at potential sites to minimize settlement problems, heaving from highly expansive soils, high groundwater problems, and construction costs.

3.6.7. Noise Analysis. Noise analyses should be conducted to determine noise impacts to local communities and identify noise sensitive areas.

3.7. Runway Designation. Runways are identified by the whole number nearest one-tenth (1/10) the magnetic azimuth of the runway centerline. The magnetic azimuth of the runway centerline is measured clockwise from magnetic north when viewed from the direction of approach. For example, where the magnetic azimuth is 183 degrees, the runway designation marking would be 18; and for a magnetic azimuth of 117 degrees, the runway designation marking would be 12. For a magnetic azimuth ending in the number 5, such as 185 degrees, the runway designation marking can be either 18 or 19. Supplemental letters, where required for differentiation of parallel runways, are placed between the designation numbers and the threshold or threshold marking. For parallel runways, the supplemental letter is based on the runway location, left-to-right, when viewed from the direction of approach: for two parallel runways — "L", "R"; for three parallel runways — "L", "C", "R."

3.8. Runway Dimensions. The following paragraphs and tables present the design criteria for runway dimensions at all aviation facilities except Short Fields and Training Assault Landing Zones. The criteria presented in the tables are for all DoD components (Army, Air Force, Navy and Marine Corps) except where deviations are noted.

3.8.1. Runway Dimension Criteria, Except Runway Length. Table 3.2 presents all dimensional criteria, except runway length, for the layout and design of runways used primarily to support fixed-wing aircraft operation.

3.8.2. Runway Length Criteria:

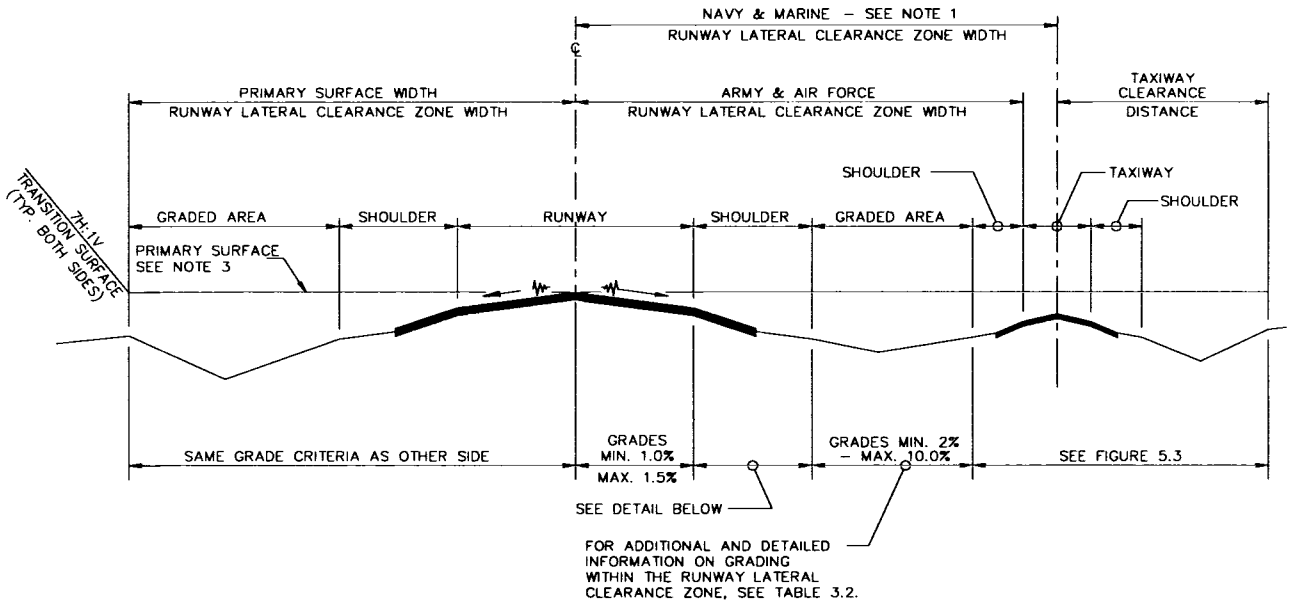
3.8.2.1. Army. For Army Class A runways, the runway length will be determined in accordance with Table 3.3. Army Class B runways are used by Air Force aircraft, and therefore will have the runway length determined by the Air Force MAJCOM.

3.8.2.2. Air Force. For Air Force Class A and Class B runways, the length will be determined by the MAJCOM.

3.8.2.3. Navy and Marine Corps. Runway length computation for Navy and Marine Corps Class A and Class B runways is presented in NAVFAC P-80.

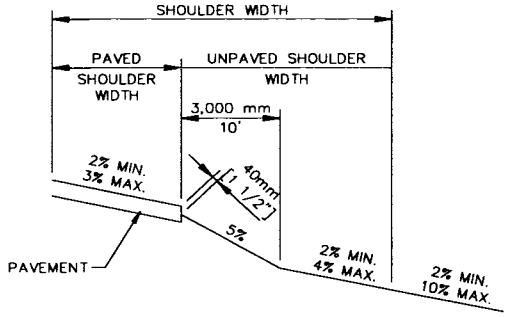
3.8.3. Layout. Typical sections and profiles for Army, Air Force, Navy and Marine Corps airfield runways, including clear zones, are shown in Figures 3.1 through 3.19.

Figure 3.1. Runway Transverse Sections.



RUNWAY TRANSVERSE SECTION

N.T.S.



SHOULDER GRADE DETAIL

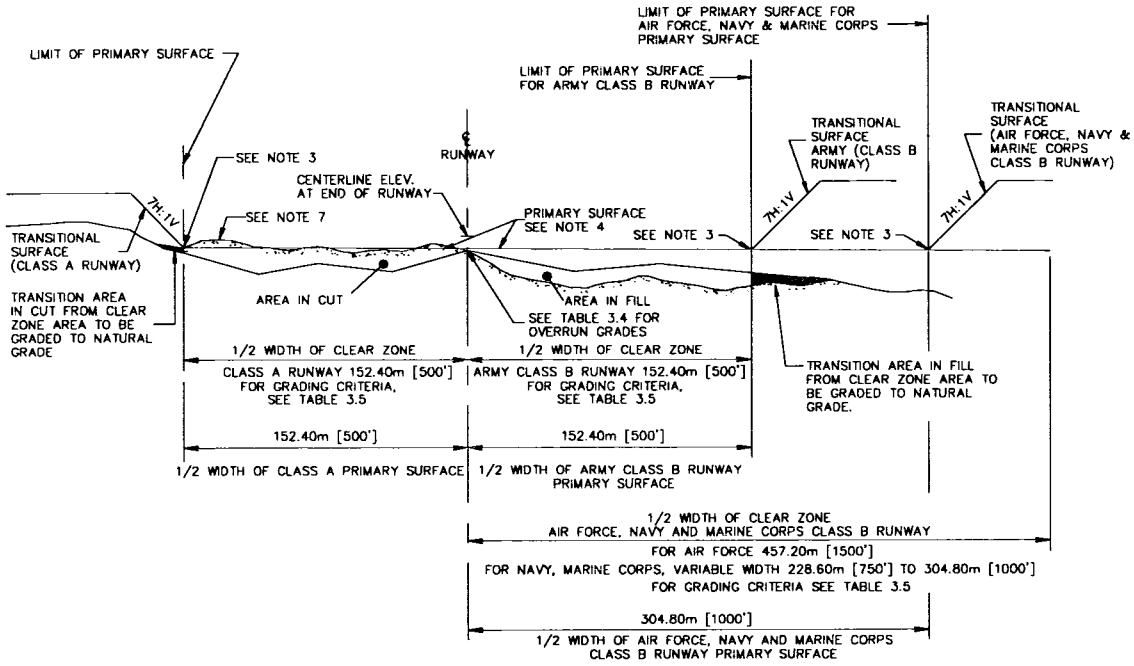
N.T.S.

NOTES

1. AT NAVY AND MARINE CORPS AIRFIELDS, ONE HALF OF THE PARALLEL TAXIWAY MAY BE LOCATED WITHIN THE RUNWAY LATERAL CLEARANCE ZONE. SEE TABLE 3.2.
2. WHEN PAVED SHOULDERS ARE REQUIRED, GRADE SHOULDER WITH A 40mm [1–1/2"] DROPOFF NEXT TO PAVED SHOULDER, FOLLOWED BY 5% SLOPE FOR FIRST 3,000 mm [10'] NEXT TO PAVED SHOULDER.
3. THE PRIMARY SURFACE WIDTH IS COINCIDENT WITH THE LATERAL CLEARANCE ZONE WIDTH. THE ELEVATION OF ANY POINT ON THE PRIMARY SURFACE IS THE SAME AS THE ELEVATION OF THE NEAREST POINT ON THE RUNWAY CENTERLINE. NO GROUND SURFACE OR OBJECT SHOULD PENETRATE THE PRIMARY SURFACE EXCEPT FOR THE RUNWAY LANDING SURFACE, INCLUDING SHOULDERS AND OVERRUNS.

CLASS A AND CLASS B RUNWAYS

Figure 3.2. Clear Zone Transverse Section Detail.



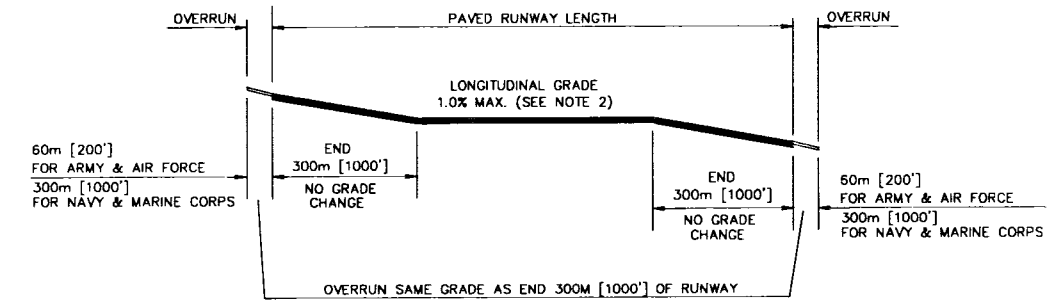
NOTES

1. TAKEN BEYOND END OF RUNWAY.
2. PRIMARY SURFACE APPLY ONLY TO FIRST 60.96m [200'] BEYOND END OF RUNWAY.
3. THE STARTING ELEVATION FOR THE 7:1 TRANSITIONAL SLOPE IS THE ELEVATION OF THE PRIMARY SURFACE ELEVATION. REFER TO TABLE 3.7.
4. ELEVATION OF ANY POINT ON THE PRIMARY SURFACE IS THE SAME AS THE ELEVATION OF THE NEAREST POINT ON THE RUNWAY CENTERLINE.
5. AT NAVY AND MARINE CORPS FACILITIES, THE PRIMARY SURFACE MAY BE 228.60m [750']
6. DISTANCES ARE SYMMETRICAL ABOUT CENTER OF RUNWAY.
7. NO GROUND SURFACE OR OBJECT CAN PENETRATE THE PRIMARY SURFACE OR THE TRANSITIONAL SURFACE.

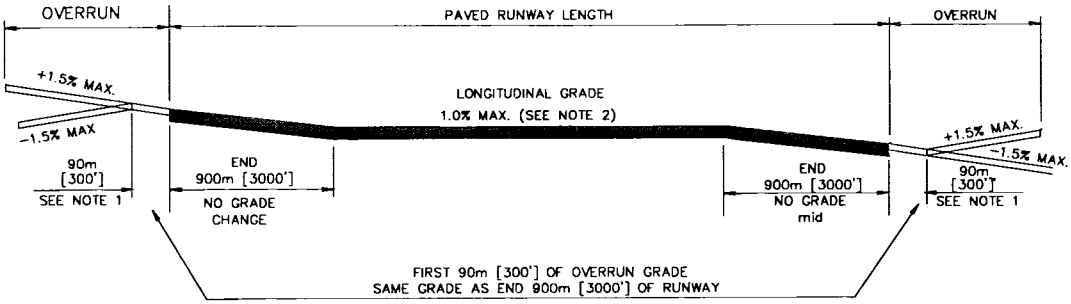
HALF SECTION IN CUT

HALF SECTION IN FILL

Figure 3.3. Runway and Overrun Longitudinal Profile.



CLASS A RUNWAY
N.T.S.

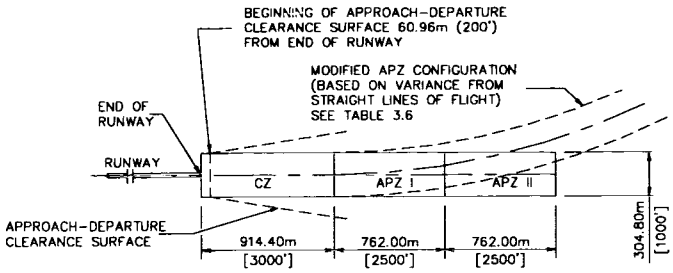


CLASS B RUNWAY
N.T.S.

NOTES

1. TO AVOID ABRUPT CHANGES IN GRADE BETWEEN THE FIRST 90m [300'] OF THE OVERRUN AND THE REMAINDER OF THE OVERRUN, THE MAXIMUM CHANGE OF GRADE IS 2.0% PER 30m [100 L.F.].
2. GRADE MAY BE POSITIVE OR NEGATIVE BUT MUST NOT EXCEED THE LIMIT SPECIFIED.

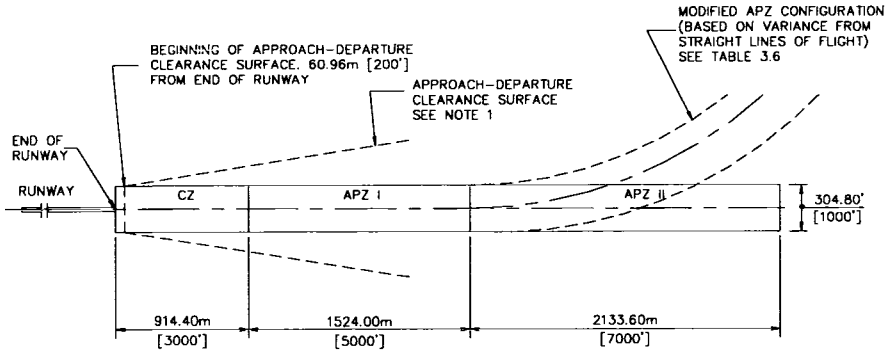
Figure 3.4. Army Clear Zone and Accident Potential Zone Guidelines.



ARMY CLASS A RUNWAY
N.T.S.

NOTES

1. THE WIDTH AND CONFIGURATION OF AN APPROACH-DEPARTURE CLEARANCE SURFACE ARE BASED ON THE CLASS OF RUNWAY, NOT THE WIDTH OF THE CLEAR ZONE.
2. FOR ADDITIONAL INFORMATION ON CLEAR ZONES, SEE TABLE 3.5.
3. FOR ADDITIONAL INFORMATION ON ACCIDENT POTENTIAL ZONES, SEE TABLE 3.6.

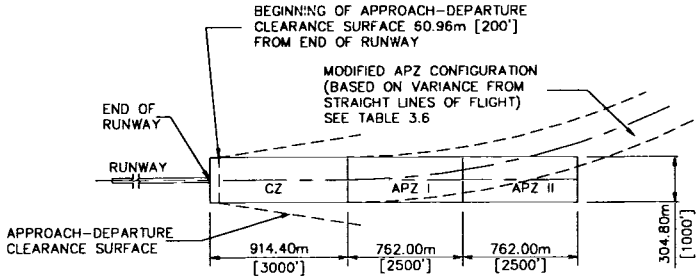


LEGEND

CZ	CLEAR ZONE
APZ I	ACCIDENT POTENTIAL ZONE I
APZ II	ACCIDENT POTENTIAL ZONE II

ARMY CLASS B RUNWAY
N.T.S.

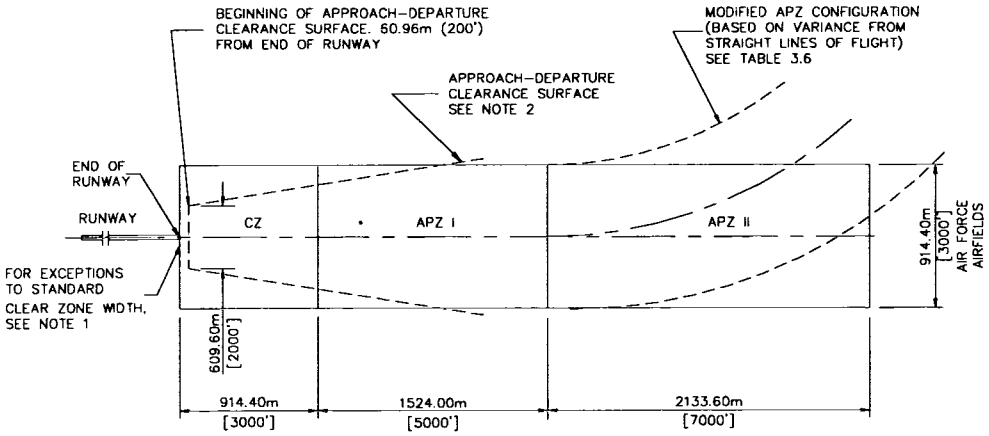
Figure 3.5. Air Force Clear Zone and Accident Potential Zone Guidelines.



AIR FORCE CLASS A RUNWAY
N.T.S.

NOTES

1. STANDARD WIDTH OF CLEAR ZONE MAY BE VARIED BASED ON INDIVIDUAL SERVICE ANALYSIS OF HIGHEST ACCIDENT POTENTIAL AREA AND LAND ACQUISITION CONSTRAINTS. HOWEVER, FOR NEW AIR FORCE CONSTRUCTION, A 914.40m [3000'] WIDE CLEAR ZONE IS DESIRABLE.
2. THE WIDTH AND CONFIGURATION OF AN APPROACH–DEPARTURE CLEARANCE SURFACE ARE BASED ON THE CLASS OF RUNWAY, NOT THE WIDTH OF THE CLEAR ZONE.
3. FOR ADDITIONAL INFORMATION ON CLEAR ZONES, SEE TABLE 3.5
4. FOR ADDITIONAL INFORMATION ON ACCIDENT POTENTIAL ZONES, SEE TABLE 3.6

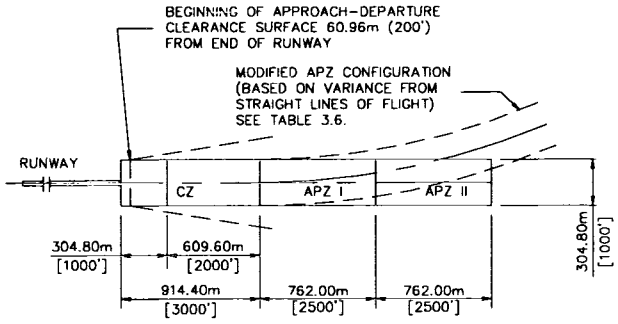


AIR FORCE CLASS B RUNWAY
N.T.S.

LEGEND

CZ	CLEAR ZONE
APZ I	ACCIDENT POTENTIAL ZONE I
APZ II	ACCIDENT POTENTIAL ZONE II

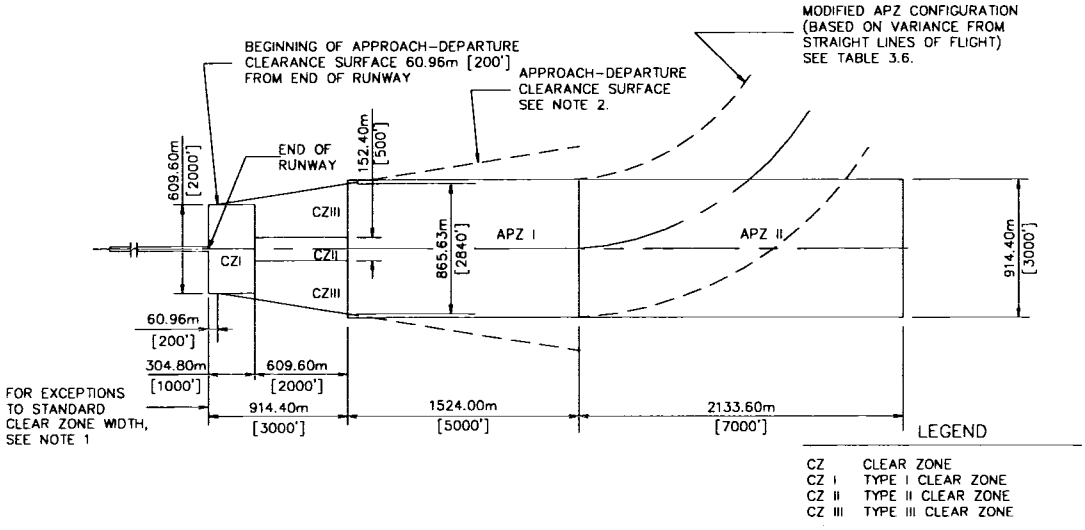
Figure 3.6. Navy and Marine Corps Clear Zone and Accident Potential Zone Guidelines.



NAVY AND MARINE CORPS CLASS A RUNWAY
N.T.S.

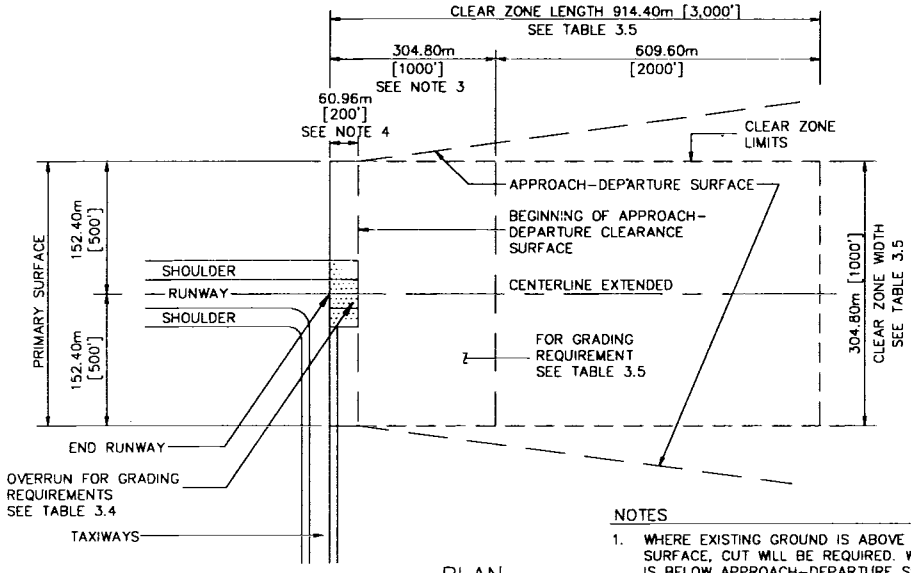
NOTES

1. STANDARD WIDTH OF CLEAR ZONE MAY BE VARIED BASED ON INDIVIDUAL SERVICE ANALYSIS OF HIGHEST ACCIDENT POTENTIAL AREA AND LAND ACQUISITION CONSTRAINTS. HOWEVER, FOR NEW NAVY AND MARINE CORPS CONSTRUCTION, A 914.40m [3000'] WIDE CLEAR ZONE IS DESIRABLE.
2. THE WIDTH AND CONFIGURATION OF AN APPROACH-DEPARTURE CLEARANCE SURFACE ARE BASED ON THE CLASS OF RUNWAY, NOT THE WIDTH OF THE CLEAR ZONE.
3. FOR ADDITIONAL INFORMATION ON CLEAR ZONES, SEE TABLE 3.5.
4. FOR ADDITIONAL INFORMATION ON ACCIDENT POTENTIAL ZONES, SEE TABLE 3.6.



NAVY AND MARINE CORPS CLASS B RUNWAY
N.T.S.

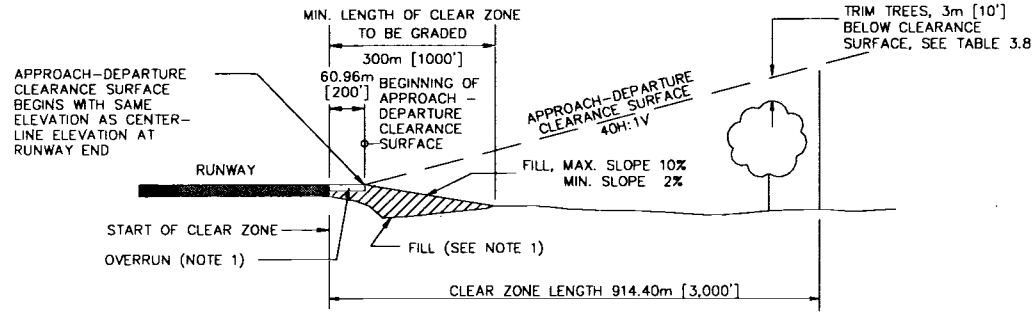
Figure 3.7. Class A VFR Runway Primary Surface End Details.



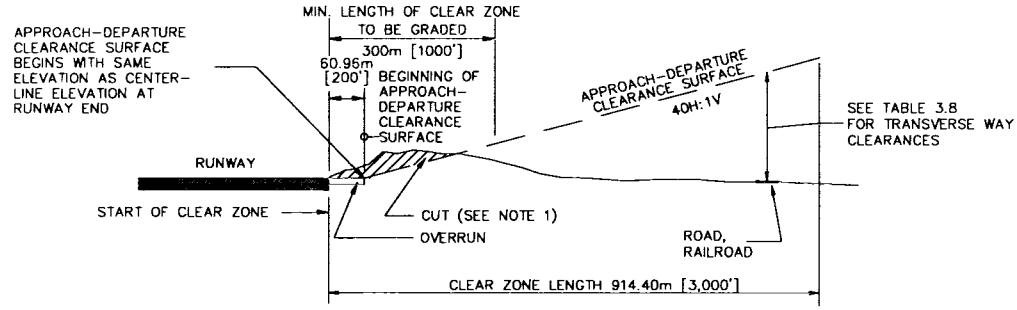
PLAN
N.T.S.

NOTES

1. WHERE EXISTING GROUND IS ABOVE THE APPROACH-DEPARTURE SURFACE, CUT WILL BE REQUIRED. WHERE THE EXISTING GROUND IS BELOW APPROACH-DEPARTURE SURFACE, FILL AS NECESSARY TO MEET MAX. GRADE REQUIREMENTS.
2. FOR TRANSVERSE SECTION OF CLEAR ZONE AND AREA TO BE GRADED, SEE FIGURE 3.2.
3. MINIMUM AREA OF CLEAR ZONE TO BE GRADED, SEE TABLE 3.5
4. FOR NAVY AND MARINE CORPS, OVERRUN LENGTH IS 300m [1000'].

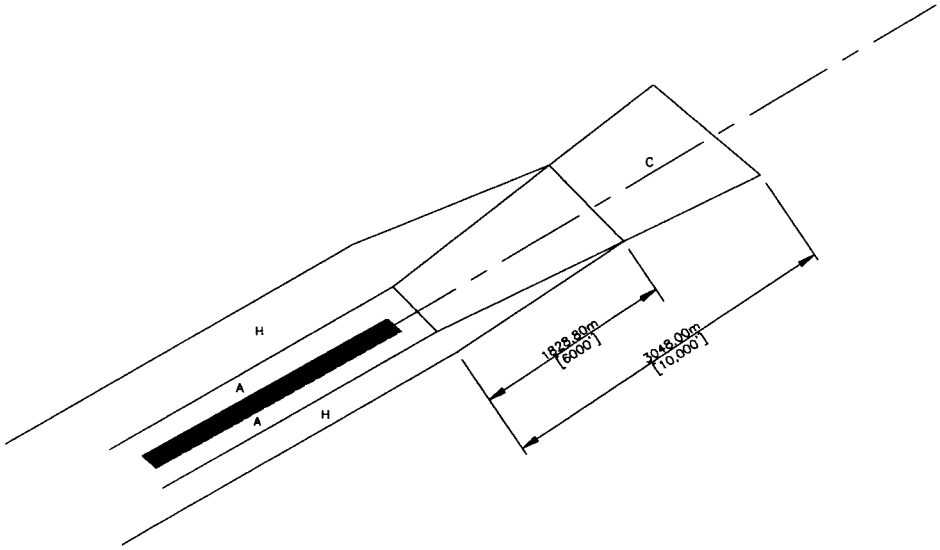


OVERRUN FILL PROFILE
N.T.S.



OVERRUN CUT PROFILE
N.T.S.

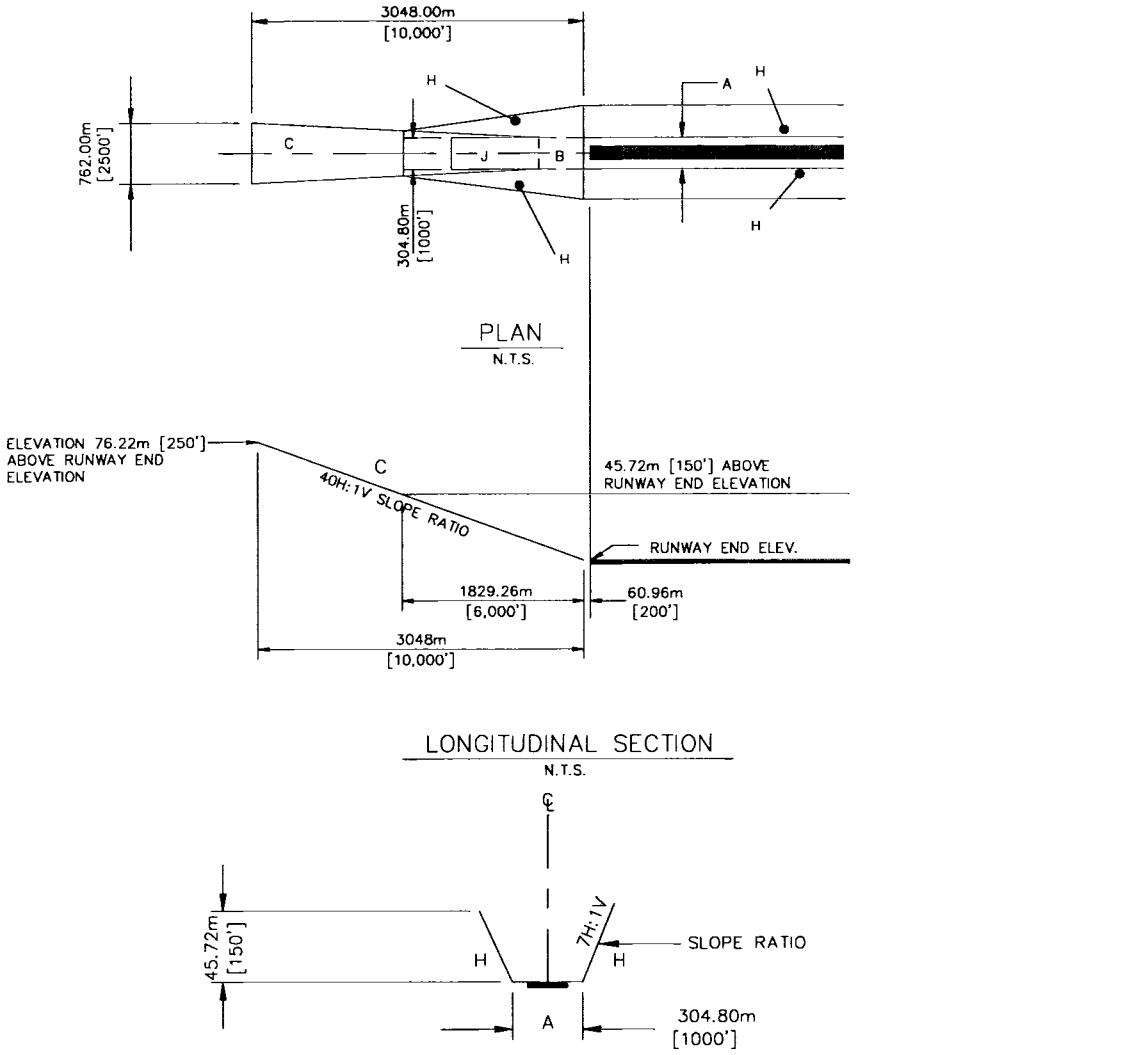
Figure 3.8. Class A VFR Runway Isometric Airspace Imaginary Surfaces.



LEGEND

A	PRIMARY SURFACE
B	CLEAR ZONE SURFACE (NOT SHOWN)
C	APPROACH–DEPARTURE CLEARANCE SURFACE (40H:1V SLOPE RATIO)
D	APPROACH–DEPARTURE CLEARANCE SURFACE (HORIZONTAL)(NOT REQUIRED)
E	INNER HORIZONTAL SURFACE (NOT REQUIRED)
F	CONICAL SURFACE (NOT REQUIRED)
G	OUTER HORIZONTAL SURFACE (NOT REQUIRED)
H	TRANSITIONAL SURFACE (7H:1V SLOPE RATIO)
I	NOT USED
J	ACCIDENT POTENTIAL ZONE (APZ) (NOT SHOWN)

Figure 3.9. Class A VFR Runway Plan and Profile Airspace Imaginary Surfaces.



LEGEND

- A PRIMARY SURFACE
- B CLEAR ZONE SURFACE
- C APPROACH-DEPARTURE CLEARANCE SURFACE (SLOPE)
- D APPROACH-DEPARTURE CLEARANCE SURFACE (HORIZONTAL) (NOT REQUIRED)
- E INNER HORIZONTAL SURFACE (NOT REQUIRED)
- F CONICAL SURFACE (NOT REQUIRED)
- G OUTER HORIZONTAL SURFACE (NOT REQUIRED)
- H TRANSITIONAL SURFACE
- I NOT USED
- J ACCIDENT POTENTIAL ZONE (APZ)

NOTES

1. DATUM ELEVATION FOR:
   a. SURFACES D, E, F AND G ARE THE ESTABLISHED AIRFIELD ELEVATION.
   b. SURFACE C IS THE RUNWAY CENTERLINE ELEVATION AT THE THRESHOLD.
   c. SURFACE H VARIES AT EACH POINT ALONG THE RUNWAY CENTERLINE. SEE TABLE 3.7
2. THE SURFACES SHOWN ON THE PLAN ARE FOR THE CASE OF A LEVEL RUNWAY.

Figure 3.10. Class A IFR Runway Primary Surface End Details.

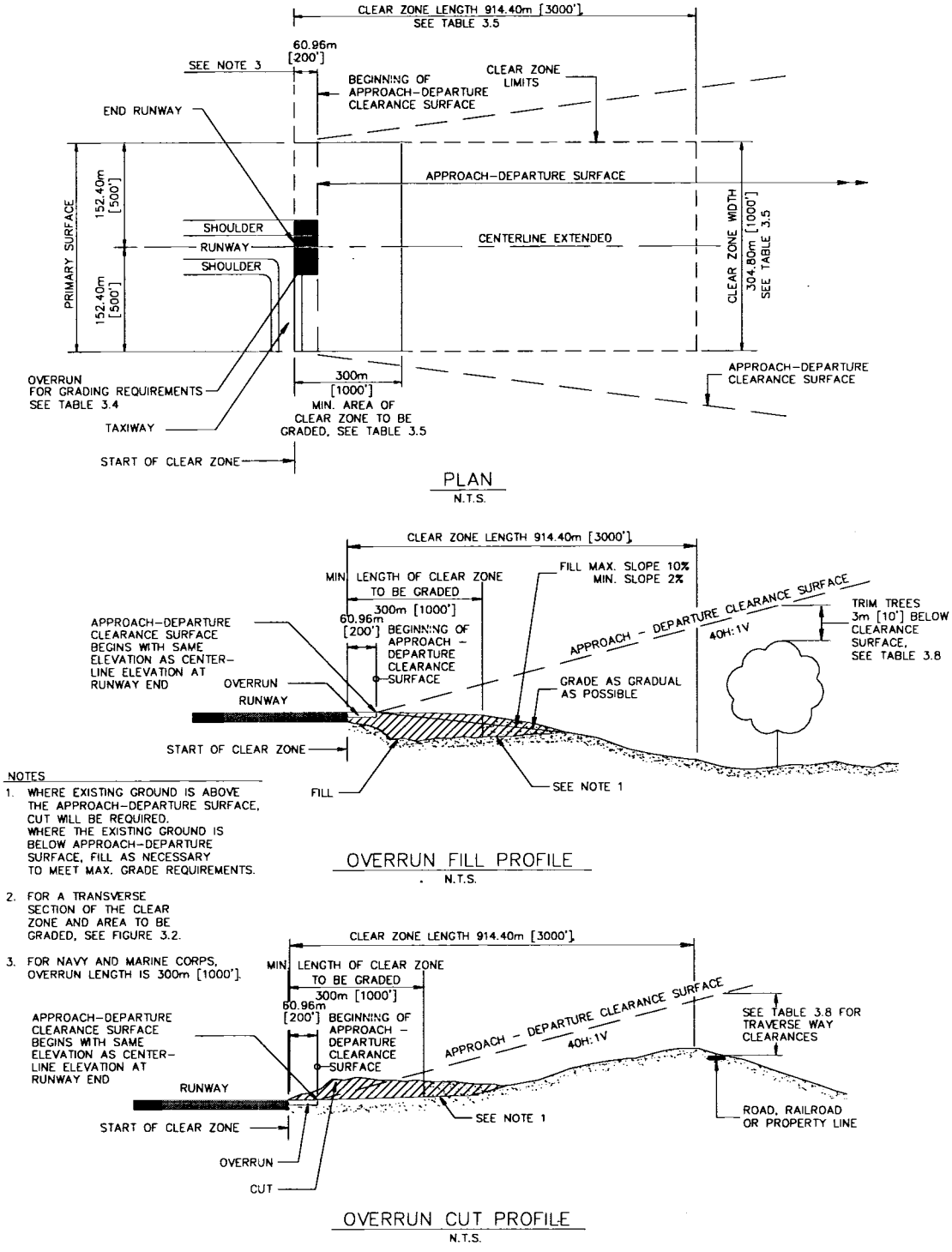
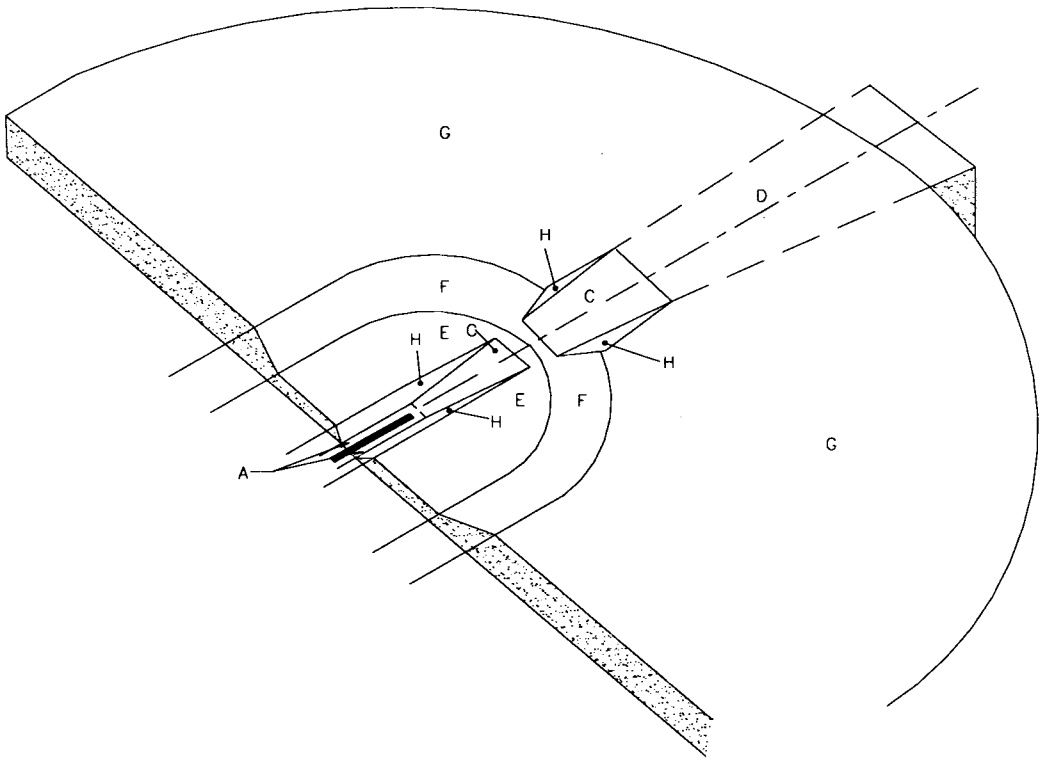


Figure 3.11. Class A IFR Runway Airspace Imaginary Surfaces.

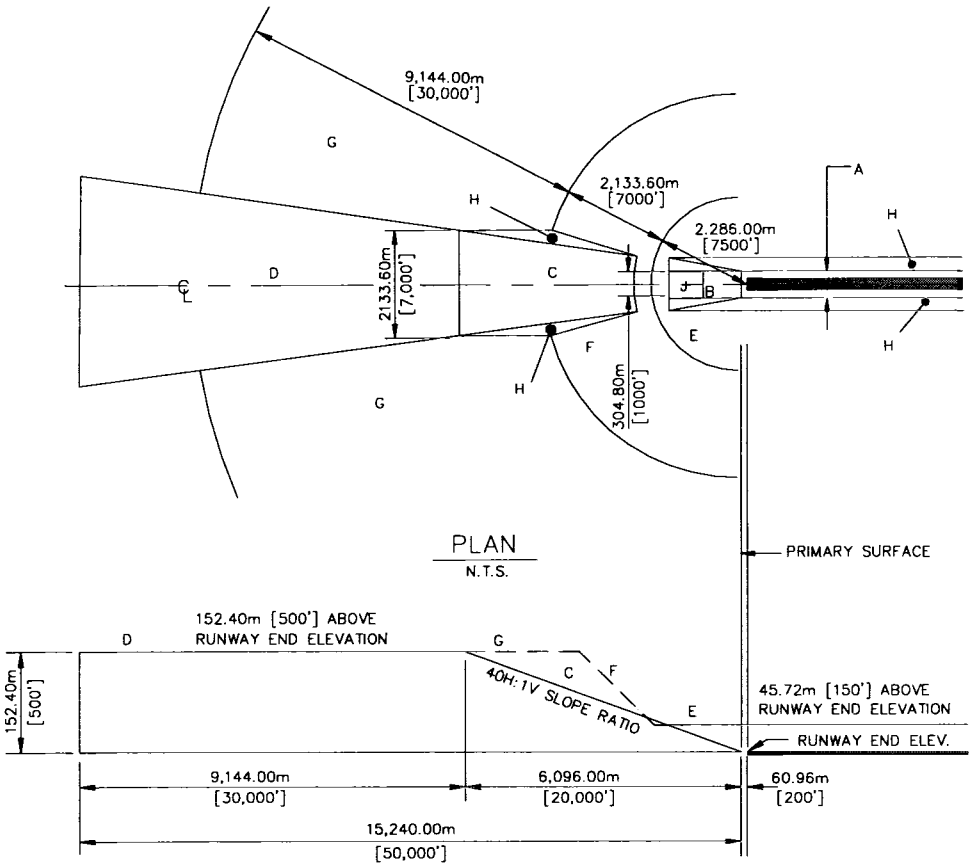


LEGEND

- A PRIMARY SURFACE
- B CLEAR ZONE SURFACE (NOT SHOWN)
- C APPROACH–DEPARTURE CLEARANCE SURFACE (SLOPE) (40H:1V RATIO)
- D APPROACH–DEPARTURE CLEARANCE SURFACE (HORIZONTAL)
- E INNER HORIZONTAL SURFACE (45.72m [150'] ELEVATION)
- F CONICAL SURFACE (20H:1V)
- G OUTER HORIZONTAL SURFACE (152.40m [500'] ELEVATION)
- H TRANSITIONAL SURFACE (7H:1V)
- I NOT USED
- J ACCIDENT POTENTIAL ZONE (APZ) (NOT SHOWN)

ISOMETRIC

Figure 3.12. Class A IFR Runway Plan and Profile Airspace Imaginary Surfaces.



LEGEND

- A PRIMARY SURFACE
- B CLEAR ZONE SURFACE
- C APPROACH–DEPARTURE CLEARANCE SURFACE (SLOPE)
- D APPROACH–DEPARTURE CLEARANCE SURFACE (HORIZONTAL)
- E INNER HORIZONTAL SURFACE
- F CONICAL SURFACE
- G OUTER HORIZONTAL SURFACE
- H TRANSITIONAL SURFACE
- I NOT USED
- J ACCIDENT POTENTIAL ZONE (APZ)

NOTES

1. DATUM ELEVATION FOR:
   a. SURFACES D, E, F AND G ARE THE ESTABLISHED AIRFIELD ELEVATION.
   b. SURFACE C IS THE RUNWAY CENTERLINE ELEVATION AT THE THRESHOLD.
   c. SURFACE H VARIES AT EACH POINT ALONG THE RUNWAY CENTERLINE. SEE TABLE 3.7
2. THE SURFACES SHOWN ON THE PLAN ARE FOR THE CASE OF A LEVEL RUNWAY.

Figure 3.13. Class B Army and Air Force Runway End and Clear Zone Details.

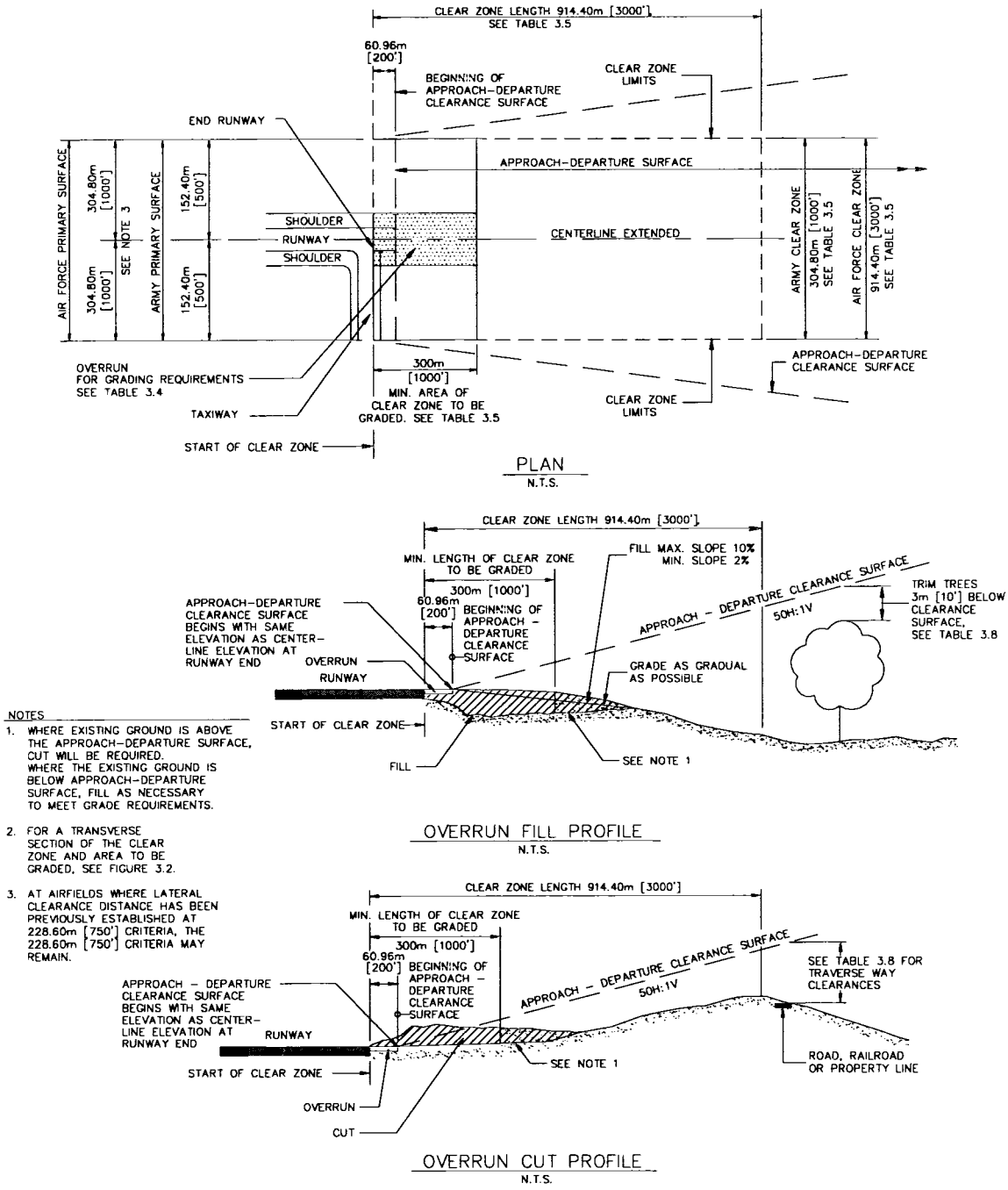
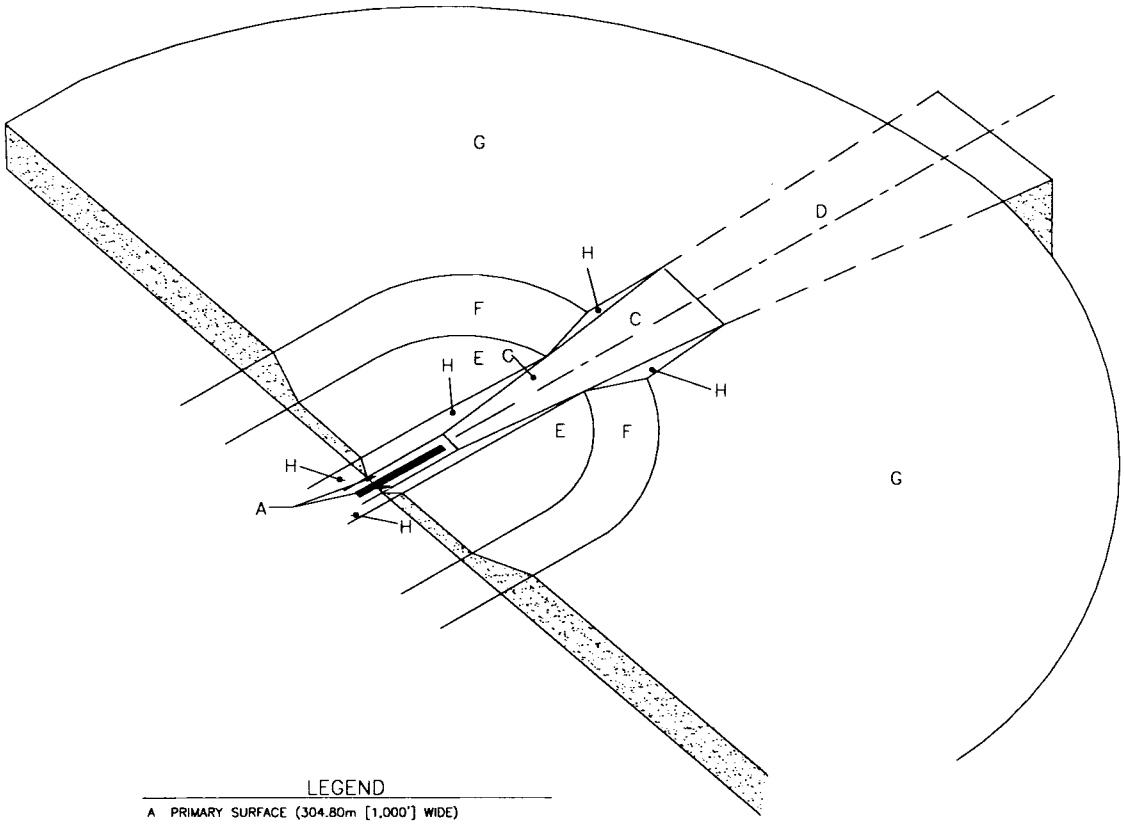


Figure 3.14. Class B Army Runway Airspace Imaginary Surfaces.

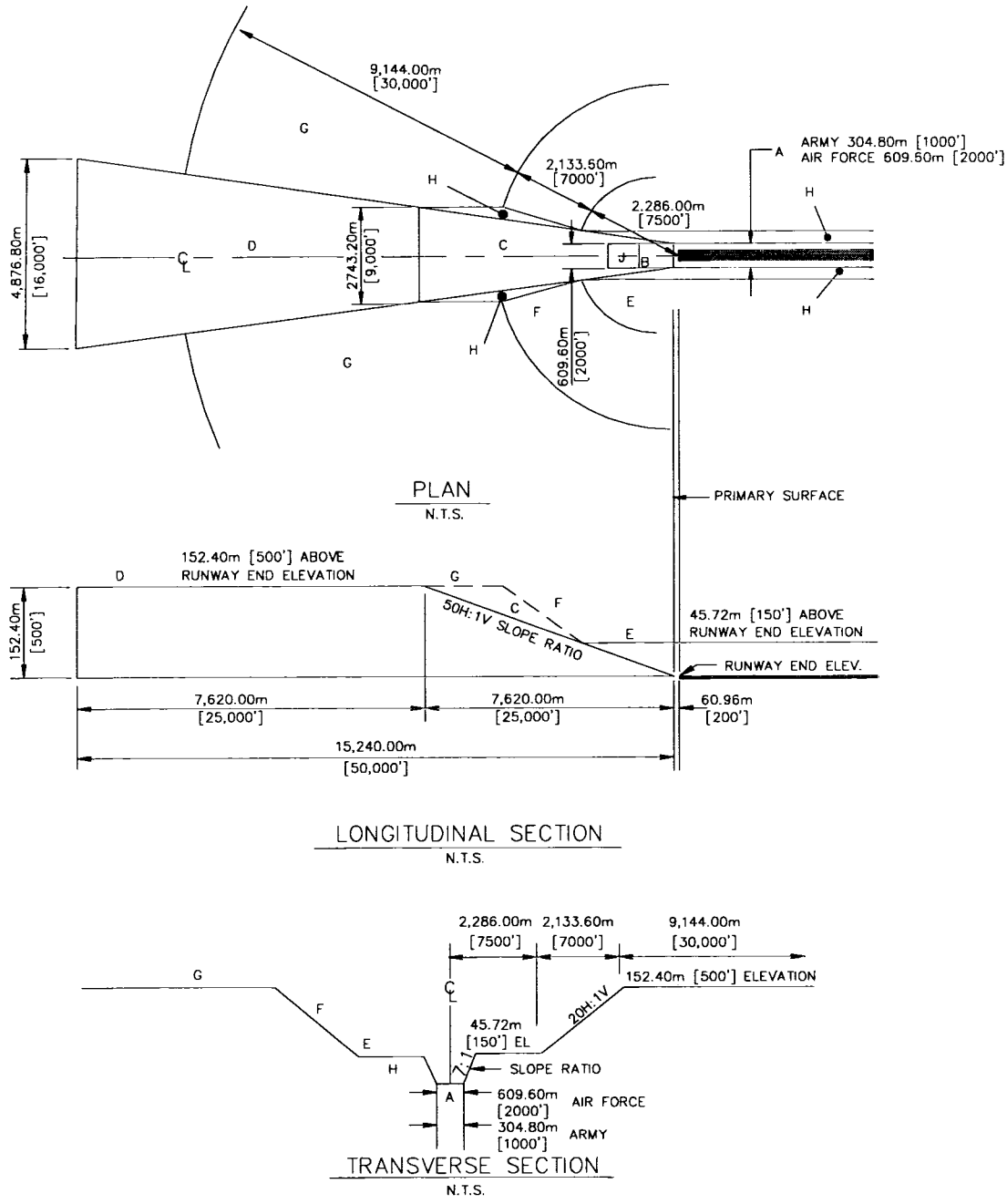


LEGEND

A PRIMARY SURFACE (304.80m [1,000'] WIDE)
B CLEAR ZONE SURFACE (NOT SHOWN)
C APPROACH-DEPARTURE CLEARANCE SURFACE (SLOPE) (50H:1V RATIO)
D APPROACH-DEPARTURE CLEARANCE SURFACE (HORIZONTAL)
E INNER HORIZONTAL SURFACE (45.72m [150'] ELEVATION)
F CONICAL SURFACE (20H:1V)
G OUTER HORIZONTAL SURFACE (152.40m [500'] ELEVATION)
H TRANSITIONAL SURFACE (7H:1V)
I NOT USED
J ACCIDENT POTENTIAL ZONE (APZ) (NOT SHOWN)

ISOMETRIC

Figure 3.15. Class B Army and Air Force Runway Airspace Plan and Profile Runway Imaginary Surfaces.



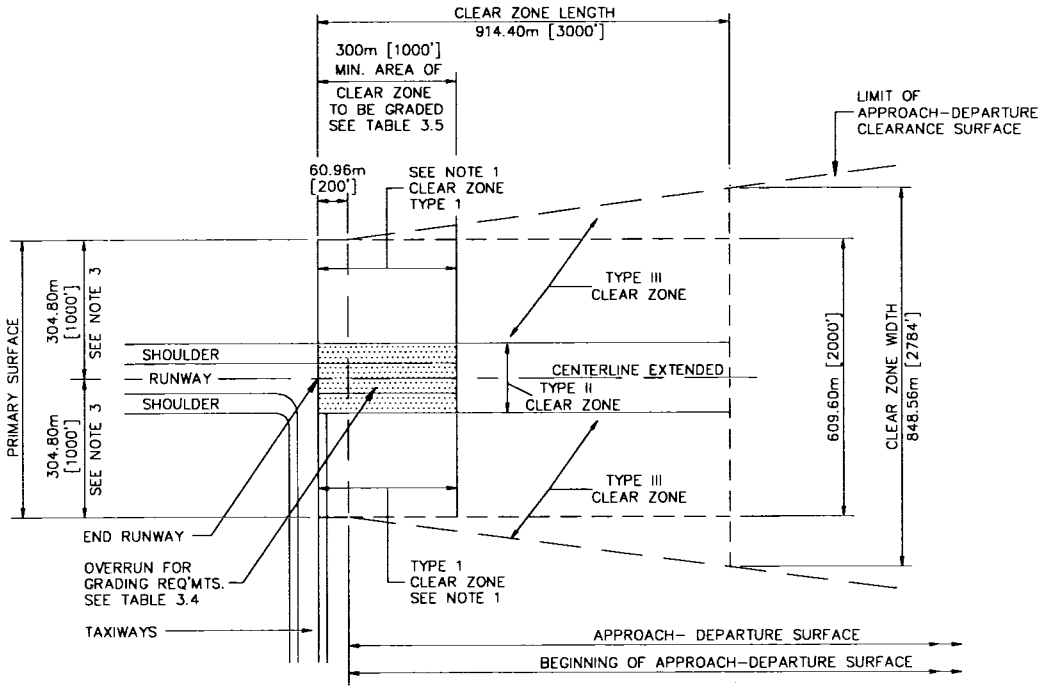
LEGEND

- A PRIMARY SURFACE
- B CLEAR ZONE SURFACE
- C APPROACH–DEPARTURE CLEARANCE SURFACE (SLOPE)
- D APPROACH–DEPARTURE CLEARANCE SURFACE (HORIZONTAL)
- E INNER HORIZONTAL SURFACE
- F CONICAL SURFACE
- G OUTER HORIZONTAL SURFACE
- H TRANSITIONAL SURFACE
- I NOT USED
- J ACCIDENT POTENTIAL ZONE (APZ)

NOTES

1. DATUM ELEVATION FOR:
   a. SURFACES D, E, F AND G ARE THE ESTABLISHED AIRFIELD ELEVATION.
   b. SURFACE C IS THE RUNWAY CENTERLINE ELEVATION AT THE THRESHOLD.
   c. SURFACE H VARIES AT EACH POINT ALONG THE RUNWAY CENTERLINE. SEE TABLE 3.7
2. THE SURFACES SHOWN ON THE PLAN ARE FOR THE CASE OF A LEVEL RUNWAY.

Figure 3.16. Class B Navy Runway Primary Surface End Details.



NOTES

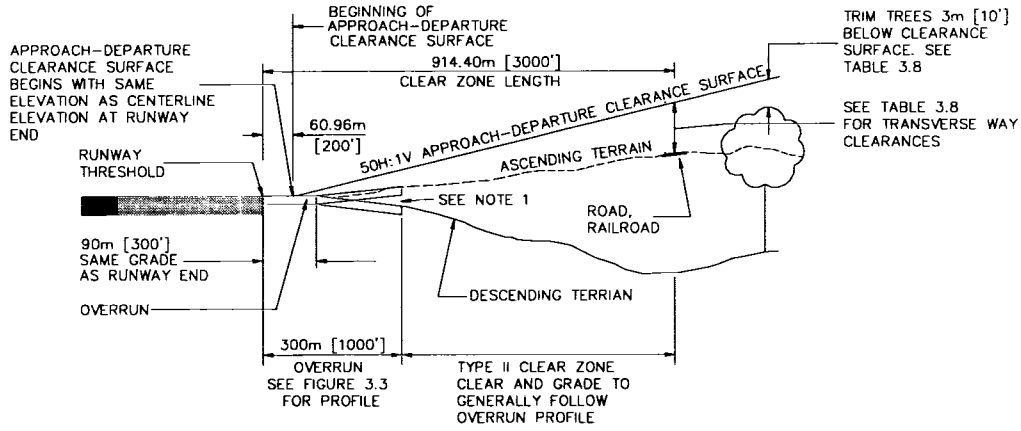
1. WHERE EXISTING GROUND IS ABOVE THE APPROACH-DEPARTURE SURFACE, CUT WILL BE REQUIRED.
2. WHERE THE EXISTING GROUND IS BELOW APPROACH-DEPARTURE SURFACE, FILL AS NECESSARY TO MEET MAX. GRADE REQUIREMENTS.
   TYPE I CLEAR ZONE IS TO BE CLEARED, GRADED AND FREE OF ABOVE GROUND OBJECTS.
   GRADES: LONGITUDINAL MAX. 10%, MAX. GRADE CHANGE ± 2.0% PER 30m [100']
   TRANSVERSE MAX. 10%, MIN. 2%

   OVERRUN: LONGITUDINAL GRADE, FIRST 90m [300'] SAME AS LAST 900m [3000'] OF RUNWAY. REMAINDER 1.5% MAX.
   MAX. LONG GRADE CHANGE 2% PER 30m[100']

   TYPE II CLEAR ZONE CLEAR AND GRADE TO GENERALLY FOLLOW OVERRUN PROFILE.

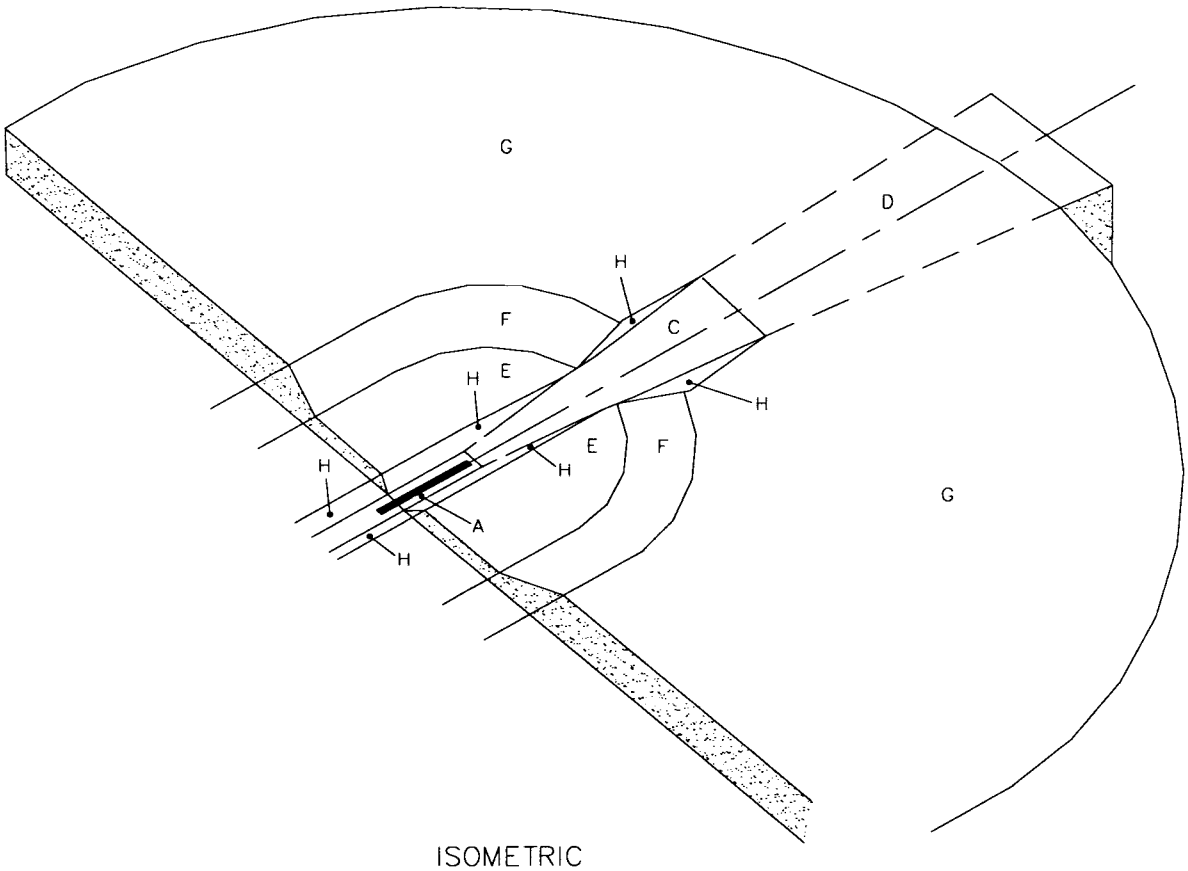
   TYPE III CLEAR ZONE NOT GRADED.
3. AT AIRFIELDS WHERE LATERAL CLEARANCE DISTANCE HAS BEEN PREVIOUSLY ESTABLISHED AT 228.60m [750'] CRITERIA, THE 228.60m [750'] CRITERIA MAY REMAIN.

PLAN
N.T.S.



PROFILE
N.T.S.

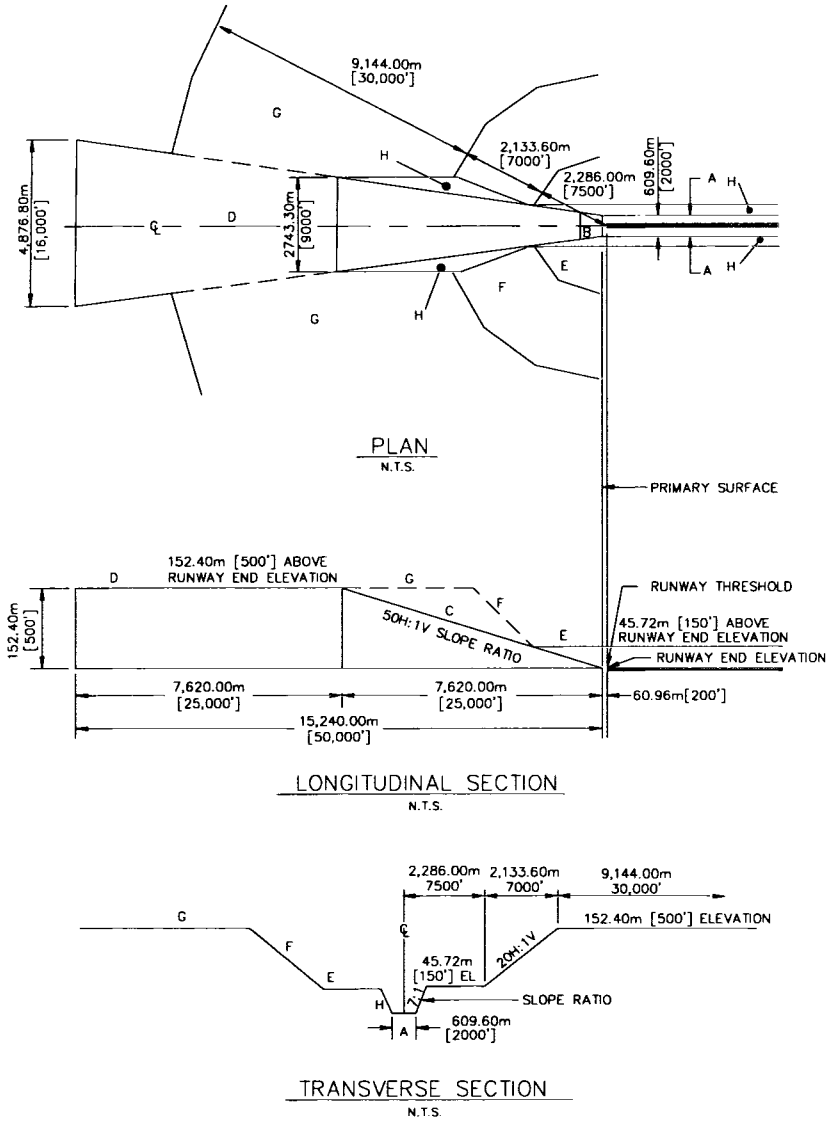
Figure 3.17. Class B Air Force and Navy Runway Airspace Imaginary Surfaces.



LEGEND

A	PRIMARY SURFACE
B	CLEAR ZONE SURFACE (NOT SHOWN)
C	APPROACH–DEPARTURE CLEARANCE SURFACE (50:1 SLOPE RATIO)
D	APPROACH–DEPARTURE CLEARANCE SURFACE (HORIZONTAL)
E	INNER HORIZONTAL SURFACE (45.72m [150'] ELEVATION)
F	CONICAL SURFACE (20:1 SLOPE RATIO)
G	OUTER HORIZONTAL SURFACE (152.40m [500'] ELEVATION)
H	TRANSITIONAL SURFACE (7:1 SLOPE RATIO)
I	NOT USED
J	ACCIDENT POTENTIAL ZONE (APZ) (NOT SHOWN)

Figure 3.18. Class B Navy Runway Airspace Plan and Profile Runway Imaginary Surfaces.



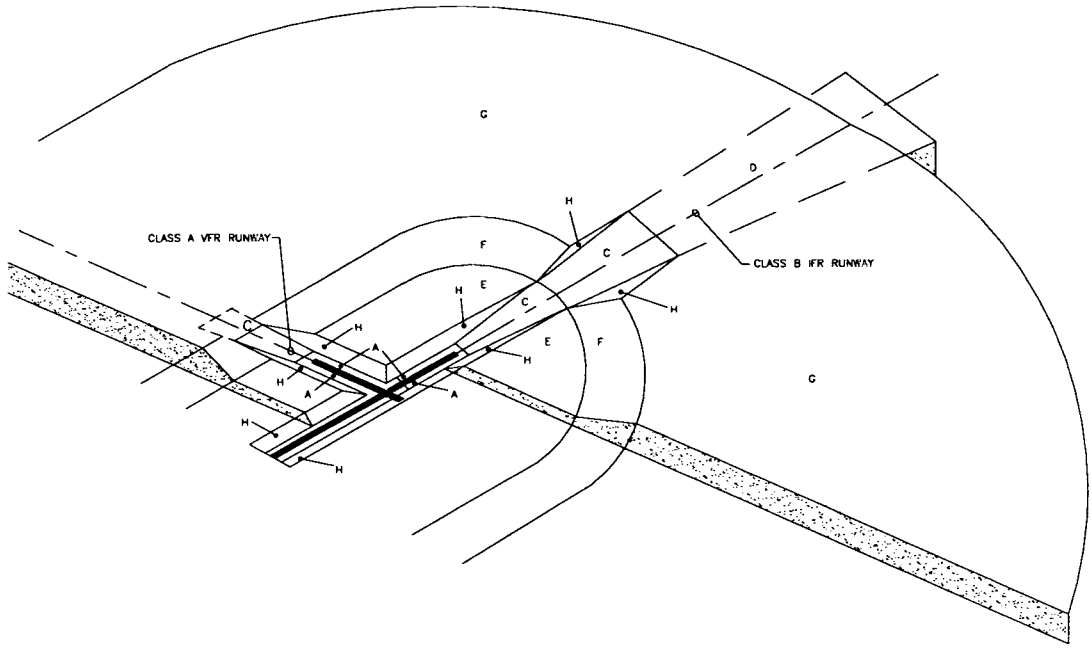
LEGEND

- A PRIMARY SURFACE
- B CLEAR ZONE SURFACE
- C APPROACH-DEPARTURE CLEARANCE SURFACE (SLOPE)
- D APPROACH-DEPARTURE CLEARANCE SURFACE (HORIZONTAL)
- E INNER HORIZONTAL SURFACE
- F CONICAL SURFACE
- G OUTER HORIZONTAL SURFACE
- H TRANSITIONAL SURFACE
- I NOT USED
- J ACCIDENT POTENTIAL ZONE (APZ) (NOT SHOWN)

NOTES

1. DATUM ELEVATION FOR:
   a. SURFACES D, E, F AND G ARE THE ESTABLISHED AIRFIELD ELEVATION.
   b. SURFACE C IS THE RUNWAY CENTERLINE ELEVATION AT THE THRESHOLD.
   c. SURFACE H VARIES AT EACH POINT ALONG THE RUNWAY CENTERLINE. SEE TABLE 3.7
2. THE SURFACES SHOWN ON THE PLAN ARE FOR THE CASE OF A LEVEL RUNWAY.

Figure 3.19. VFR and IFR Crosswind Runways Isometric Airspace Imaginary Surfaces.



3.9. Shoulders. Unprotected areas adjacent to runways and overruns are susceptible to erosion caused by jet blast. Shoulders reduce the probability of serious damage to an aircraft to a minimum in the event the aircraft runs off the runway pavement. The shoulder width, shown in Item 3 of Table 3.2, includes both paved and unpaved shoulders. Paved shoulders are required adjacent to all runways. The minimum paved shoulder width, shown in Table 3.2, allows the runway edge lights to be placed within the paved portion of the shoulder and to reduce foreign object damage (FOD) to aircraft. The unpaved shoulder should be graded to prevent water from ponding on the adjacent paved area (shoulder and runway). The drop-off next to the paved area prevents turf (which may build up over the years) from ponding water.

3.10. Runway Overruns. Runway overruns keep the probability of serious damage to an aircraft to a minimum in the event the aircraft runs off the runway during a take-off or lands short during a landing. Overruns are required for the landing and take-off area. Table 3.4 shows the dimensional requirements for overruns. Overrun profiles are shown in Figure 3.3, and an overrun layout is shown in Figures 3.7, 3.10, 3.13, and 3.16.

Table 3.3. Army Class A Runway Lengths.

Temperature	Elevation				
	Sea Level	304 m [1,000 ft]	610 m [2,000 ft]	1,524 m [5,000 ft]	1,828 m [6,000 ft]
15°C [60°F]	1,615 m [5,300 ft]	1,676 m [5,500 ft]	1,768 m [5,800 ft]	2,042 m [6,700 ft]	2,164 m [7,100 ft]
30°C [85°F]	1,707 m [5,600 ft]	1,798 m [5,900 ft]	1,890 m [6,200 ft]	2,286 m [7,500 ft]	2,438 m [8,000 ft]
40°C [105°F]	1,798 m [5,900 ft]	1,890 m [6,200 ft]	2,042 m [6,700 ft]	2,469 m [8,100 ft]	2,682 m [8,800 ft]

Notes:

1. Based on zero runway gradient and a clean dry runway surface for the most critical aircraft in the Army's inventory to date (RC-12N).
2. Metric units apply to new airfield construction, and where practical, to modifications to existing airfields and heliports, as discussed in Paragraph 1.4.4.

Table 3.4. Overruns.

Item No.	Item Description	Class A Runway	Class B Runway	Remarks
		Requirement		
1	Length	60 m [200 ft]	300 m [1,000 ft]	For Army and Air Force airfields
		300 m [1,000 ft]		For Navy and Marine Corps airfields At outlying fields for T-34 aircraft, the required overrun length is 150 m [500 ft].
		See Remarks.		Length of stabilized or paved area to conform to criteria of the individual DoD Service component.
2	Total Width of Overrun (Paved and Unpaved)	Sum of runway and shoulders		
3	Paved Overrun Width	Same as width of runway		Center on runway centerline extended
4	Unpaved Width of Overrun	Same width as runway shoulder		The outside edges of the overrun equal in width to the runway shoulder, is graded as overrun, but not paved.

5	Longitudinal Centerline Grade	Same as last 300 m [1,000 ft] of runway	First 90 m [300 ft] same as last 900 m [3,000 ft] of runway. Remainder: 1.5% Max	To avoid abrupt changes in grade between the first 90 m [300 feet] and remainder of overrun of a Class B runway, the maximum change of grade is 2.0 percent per 30 linear meters [100 linear feet].
6	Transverse Grade	Min 2.0% Max 3.0% 40 mm [1-½ in.] dropoff at edge of paved overrun		From centerline of overrun. Transition from the runway and runway shoulder grades to the overrun grades to be made within the first 45 meters [150 feet] of overrun.

NOTE: Geometric design criteria in this manual are based on aircraft-specific requirements and are not direct conversions from inch-pound (English) dimensions. Inch-pound units are included only to permit reference to the previous standard.

3.11. Runway Clear Zones. Runway Clear Zones are areas on the ground, located at the ends of each runway. They possess a high potential for accidents and their use is restricted to be compatible with aircraft operations. Runway Clear Zones are required for the runway. Table 3.5 shows the dimensional requirements for runway clear zones. Layout of the clear zones is shown in Figures 3.4, 3.5, 3.6, 3.7, 3.10, 3.13 and 3.17. Land use within the clear zones are shown in Attachment 4.

3.12. Accident Potential Zones (APZ). APZs are areas on the ground located beyond the clear zone of each runway. They possess a potential for accidents and their use is restricted in accordance with DoD Instruction No. 4165.57. Table 3.6 shows the dimensional requirements for runway accident potential zones. Layout of the Accident Potential Zones is shown in Figure 3.4 for the Army, Figure 3.5 for the Air Force, and Figure 3.6 for the Navy. Navy planners will use OPNAVINST 11010.36A to determine specific AICUZ requirements. Land use within the APZ I and APZ II is shown in Attachment 3.

3.13. Airspace Imaginary Surfaces:

3.13.1. Types of Airspace Imaginary Surfaces. Airspace imaginary surfaces for Army and Air Force Class B IFR Runways are similar to those at fixed-wing DoD facilities, except that the Primary Surface and Clear Zone widths are narrower for Army Runways. At fixed-wing DoD facilities, the following types of airspace imaginary surfaces may be found:

3.13.1.1. Class A VFR Runway.

3.13.1.2. Class A IFR Runway.

3.13.1.3. Class B IFR Runway for Army Facilities.

3.13.1.4. Class B IFR Runway for Air Force Facilities.

3.13.1.5. Class B IFR Runway for Navy and Marine Corps Facilities.

3.13.2. Imaginary Surfaces. The area surrounding a runway that must be kept clear of objects that might damage an aircraft is bounded by imaginary surfaces that are defined in this manual. An object, either man-made or natural, which projects above an imaginary surface is an obstruction. Imaginary surfaces for fixed-wing airfields are shown in Figures 3.6 through 3.19 and are defined in

Attachment 1. The applicable dimensions and slopes are provided in Table 3.7. These imaginary surfaces include:

3.13.2.1. Primary Surface.

3.13.2.2. Approach-Departure Surface.

3.13.2.3. Inner Horizontal Surface.

3.13.2.4. Conical Surface.

3.13.2.5. Outer Horizontal Surface.

3.13.2.6. Transitional Surface.

NOTE: Metric units apply to new airfield construction, and where practical, to modifications to existing airfields and heliports, as discussed in Paragraph 1.4.4.

Table 3.5. Clear Zones. (See note 1.)

Item No.	Item Description	Class A Runway	Class B Runway	Remarks
		Requirement		
1	Length	914.40 m [3,000 ft]	914.40 m [3,000 ft]	Measured along the extended runway centerline beginning at the runway end (see note 2).
2	Width at start of Clear Zone (adjacent to the runway)	304.80 m [1,000 ft]	304.80 m [1,000 ft]	Army airfields
			914.80 m [3,000 ft]	Air Force airfields
			609.60 m [2,000 ft]	Navy and Marine Corps (See P-80.3)
		See Remarks		Width of the Clear Zone is centered on and measured at right angles to the extended runway centerline. Exceptions to these widths are permissible based on individual service analysis of highest accident potential area for specific runway use and acquisition constraints. Refer to Figures 3.4, 3.5 and 3.6 Accident Potential Zone Guidelines.
3	Width at end of Clear Zone	304.80 m [1,000 ft]	304.80 m [1,000 ft]	Army airfields
			914.40 m [3,000 ft]	Air Force airfields

		304.80 m [1,000 ft]	848.56 m [2,784 ft]	Navy and Marine Corps The clear zone has the same dimensions as the approach-departure surface, as shown in Table 3.7. The first 60.96 m [200 ft] of the clear zone is a uniform 609.60 m [2,000 ft] in width, and which point the variable width begins.
		See Remarks		Exception to these widths are permissible based on individual service analysis of highest accident potential area for specific runway use and acquisition constraints. Refer to Figures 3.4, 3.5 and 3.6 Accident Potential Zone Guidelines. Width of the Clear Zone is centered on and measured at right angles to the extended runway centerline.
4	Longitudinal grade of area to be graded	Max 10.0%		For Army and Air Force, the area to be graded is 300 meters [1,000 ft] in length by the established width of the primary surface. Grades are exclusive of the overrun, but are to be shaped into the overrun grade. The maximum longitudinal grade change cannot exceed ± 2.0 percent per 30 meters [100 feet]. For Navy and Marine Corps, the area to be graded will be based on the type of clear zone, as shown in Figure 3.16, and discussed in NAVFAC P-80.3 and MIL-HDBK-1021. For all services, the graded area is to be cleared and grubbed of stumps and free of abrupt surface irregularities, ditches, and ponding areas. No above-ground structures (see note 3), objects, or roadways are permitted in the area to be graded, but gentle swales, subsurface drainage, covered culverts and underground structures are permissible. The transition from the graded area to the remainder of the clear zone is to be as gradual as feasible. No part of either area must penetrate the approach-departure clearance surface. For policy regarding permissible facilities, geographical features, and land use in the remainder of the clear zone, refer to guidance furnished by each individual Service, and DoD Air Installations Compatible Use Zone (AICUZ) guidelines for Clear Zones and Accident Potential Zones (See Attachment 4).
5	Transverse grade of area to be graded (in direction of surface drain-age prior to channelization)	Min 2.0% Max 10.0%		

Notes:

1. Applicable to aviation facilities installations of the Military Departments in the United States, its territories, trusts, and possessions. For military facilities overseas, other than in locations designated, apply to the maximum practical extent.
2. For the definition of runway end refer to the glossary.
3. Essential NAVAID structure exceptions are discussed in Attachment 14.
4. Airfield and heliport imaginary surfaces and safe wingtip clearance dimensions are direct conversions from inch-pound to SI units.
5. Metric units apply to new airfield construction, and where practical, to modifications to existing airfields and heliports, as discussed in Paragraph 1.4.4.

Table 3.6. Accident Potential Zones (APZ).

Item No.	Item Description	Class A Runway	Class B Runway	Remarks
		Requirement		
1	APZ I Length	762.00 [2,500 ft]	1,524.00 m [5,000 ft]	APZ I starts at the end of the Clear Zone, and is centered and measured on the extended centerline extend. Modifications will be considered if: - The runway is infrequently used. - Prevailing wind conditions are such that a large percentage (that is, over 80 percent) of the operations are in one direction. - Local accident history indicates consideration of different areas. - Most aircraft do not overfly an APZ area as defined here during normal flight operations (modifications may be made to alter these zones and adjust them to conform to the line of flight). - Other unusual conditions exist.
2	APZ I Width	304.80 m [1,000 ft]	304.80 m [1,000 ft]	Army airfields.
			914.400 m [3,000 ft]	Air Force, Navy, and Marine Corps airfields.
3	APZ II Length	762.00 m [2,500 ft]	2,133.60 m [7,000 ft]	APZ II starts at the end of the APZ I, and is centered and measured on the runway centerline extend.
4	APZ II Width	304.80 m [1,000 ft]	304.80 m [1,000 ft]	Army airfields.
			914.40 m [3,000 ft]	Air Force, Navy and Marine Corps airfields.

Notes:

1. Applicable to aviation facilities of the Military Departments in the United States, its Territories, trusts, and possessions. For military facilities overseas, other than in locations designated, follow guidance of the individual service component.

2. For guidance on land use within the APZ's, see land use compatibility guidelines in DoD Air Installations Compatible Use Zone (AICUZ) guidelines, Attachment 4.
3. Metric units apply to new airfield construction, and where practical, to modifications to existing airfields and heliports, as discussed in Paragraph 1.4.4.
4. Airfield and heliport imaginary surfaces and safe wingtip clearance dimensions are shown as a direct conversion from inch-pound to SI units.

Table 3.7. Airspace Imaginary Surfaces (Approach-Departure Clearance Surface). (See note 1)

Item No.	Item Description	Legend	Class A Runway Requirement		Class B Runway Requirement	Remarks
			VFR	IFR	VFR & IFR	
1	Primary surface width	A	304.80 m [1,000 ft]	304.80 m [1,000 ft]	304.80 m [1,000 ft]	Army airfields
					609.60 m [2,000 ft]	Air Force, Navy, and Marine Corps airfields
			See Remarks			Centered on the runway centerline. At airfields where the lateral clearance was established according to the previous 750 ft [228.60 m] from centerline criterion, the 1500 ft [228.60 m] distance may remain.
2	Primary surface length	A	Runway Length + 60.96 m [200 ft] at each end			Primary surface extends 60.96 m [200 ft] beyond each end of the runway.
3	Primary surface elevation	A	The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline.			
4	Clear Zone Surface	B	See Table 3.5			
5	Start of Appr.-Dept Surface	C	60.96 m [200 ft]			Measured from the end of the runway.
6	Length of sloped portion of Appr.-Dept Surface	C	3,048.00 m [10,000 ft]	6,096.00 m [20,000 ft]	7,620.00 m [25,000 ft]	Measured horizontally.

7	Slope of Appr.-Dept Surface	C	40:1	40:1	50:1	Slope ratio is horizontal: vertical. Example: 40:1 is 40 m [ft] horizontal to 1 m [ft] vertical. For clearances over highway and railroads, see Table 3.8.
8	Width of Appr.-Dept. Surface at start of sloped portion	C	304.80 m [1,000 ft]	304.80 m [1,000 ft]	NA	
					304.80 m [1,000 ft]	Army airfields.
					609.60 m [2,000 ft]	Air Force, Navy, and Marine Corps airfields.
			See Remarks			Centered on the extended runway centerline, and is the same width as the Primary Surface. At airfields where the lateral clearance distance has been established according to the previous 750 foot [228.60 m] from centerline criterion, the 1,500 foot [457.20 m] distance at the start of the Approach-Departure Clearance Surface may remain.
9	Width of Appr.-Dept Surface at end of sloped portion	C	762.00 m [2,500 ft]	2,133.60 m [7,000 ft]	2,743.20 m [9,000 ft]	Centered on the extended runway centerline.
10	Elevation of Appr.-Dept. Surface at start of sloped portion	C	0 m [0 ft]	0 m [0 ft]	0 m [0 ft]	Same as the runway centerline elevation at the threshold.
11	Elevation of Appr.-Dept. Surface at end of sloped portion	C	76.20 m [250 ft]	152.40 m [500 ft]	152.40 m [500 ft]	Above the established airfield elevation.

12	Start of horizontal portion of Appr.-Dept Surface	D	NA	6,096.00 m [20,000 ft]	7,620.00 m [25,000 ft]	Measured from the end of the primary surface. The end of the primary surface (start of the approach-departure surface) is 60.96 m [200 ft] from the end of the runway.
13	Length of horizontal portion of Appr.-Dept Surface	D	NA	9,144.00 m [30,000 ft]	7,620.00 m [25,000 ft]	Measured horizontally along the ground.
14	Width of Appr.-Dept Surface at start of horizontal portion	D	NA	2,133.60 m [7,000 ft]	2,743.20 m [9,000 ft]	Centered along the runway centerline extended.
15	Width of Appr.-Dept Surface at end of horizontal portion	D	NA	4,876.80 m [16,000 ft]	4,876.80 m [16,000 ft]	Centered along the runway centerline extended.
16	Elevation of horizontal portion of Appr.-Dept Surface	D	NA	152.40 m [500 ft]	152.40 m [500 ft]	Above the established airfield elevation.
17	Radius of inner horizontal surface	E	NA	2,286.00 m [7,500 ft]		An imaginary surface constructed by scribing an arc with a radius of 2,286 m [7,500 ft] about the centerline at each end of each runway and inter-connecting these arcs with tangents.
18	Width of inner horizontal surface	E	NA	4,572.00 m [15,000 ft]		
19	Elevation of inner horizont-al surface	E	NA	45.72 m [150 ft]		Above the established airfield elevation.
20	Horizontal width of conical surface	F	NA	2,133.60 m [7,000 ft]		Extends horizontally outward from the outer boundary of the inner horizontal surface.

21	Slope of conical surface	F	NA	20:1	Slope ratio is horizontal:vertical. Example: 20:1 is 20 meters [feet] horizontal to 1 meter [foot] vertical
22	Elevation of conical surface at start of slope	F	NA	45.72 m [150 ft]	Above the established airfield elevation.
23	Elevation of conical surface at end of slope	F	NA	152.40 m [500 ft]	Above the established airfield elevation.
24	Distance to outer edge of conical surface	G	NA	4,419.60 m [14,500 ft]	
25	Width of outer horizontal surface	G	NA	9,144.00 m [30,000 ft]	Extending horizontally outward from the outer periphery of the conical surface.
26	Elevation of outer horizontal surface	G	NA	152.40 m [500 ft]	Above the established airfield elevation.
27	Distance to outer edge of outer horizontal surface	G	NA	13,563.60 m [44,500 ft]	An imaginary surface formed by scribing an arc with a radius of 13,563.6m about the centerline at each end of each runway, and interconnecting the arcs with tangents.
28	Start of Transitional Surface	H	152.40 m [500 ft]	152.40 m [500 ft]	At Army airfields.
			304.8 m (1,000 ft)		Air Force, Navy, and Marine Corps.
29	End of Transitional Surface	H	See Remarks		The Transitional Surface ends at the Inner Horizontal Surface, Conical Surface, Outer Horizontal Surface, or at an elevation of 45.72 m [150 ft].

30	Slope of Transitional Surfaces	H	7:1	Slope ratio is horizontal:vertical. 7:1 is 7 meters [feet] horizontal to 1 meter [foot] vertical. Vertical height of vegetation and other fixed or mobile obstacles and/or structures will not penetrate the transitional surface. Taxiing aircraft are exempt from this requirement. For Navy and Marine Corps airfields, taxiway pavements are exempt from this requirement.

Notes:

1. Approach-Departure Surfaces are based on Instrument Approach-Departure procedures. Verify Instrument Approach-Departure procedures with Army Aeronautical Service Agency, Air Force Flight Standard Agency or Navy Flight Standard Group, as appropriate, prior to using this table.
2. NA = Not Applicable
3. Airfield and heliport imaginary surfaces and safe wingtip clearance dimensions are shown as a direct conversion from inch-pound to SI units.

3.14. Airspace for Airfields with Two or More Runways. Typical airspace requirements for an airfield with multiple runways, such as a VFR and an IFR runway are shown in Figure 3.19.

3.15. Obstructions to Air Navigation. An existing object (including a mobile object) is, and a future object would be, an obstruction to air navigation if it is higher than any of the the heights or surfaces listed in Federal Aviation Regulations Part 77, *Objects Affecting Navigable Airspace.*

3.15.1. Take-Off and Landing Area. No part of the takeoff or landing area itself will be considered an obstruction.

3.15.2. Determining Obstructions. For airfields located in the United States and trust territories, an obstruction to air navigation is determined in accordance with the standards contained in Federal Aviation Regulations Part 77, *Objects Affecting Navigable Airspace*. Paragraph 77.23, "Standards for Determining Obstruction," from Part 77, has been included in Attachment 5 of this manual. For airfields located elsewhere, an obstruction is determined in accordance with either the host county's standards, or the individual service's standards, whichever are more stringent.

3.15.3. Trees. Trees which project into the imaginary surfaces must be removed or lowered to a distance below the imaginary surface, as shown in Table 3.8.

NOTE: Metric units apply to new airfield construction, and where practical, to modifications to existing airfields and heliports, as discussed in Paragraph 1.4.4.

Table 3.8. Imaginary Surfaces Minimum Clearances over Highway, Railroad, Waterway and Trees.

Item No.	Item Description	Traverse Way/Objects	Class A and Class B Runways Dimensions
1	Minimum vertical clearance between established imaginary surfaces and traverse ways/objects (measured from the highest and nearest elevation of the traverse ways/ objects).	Interstate highway that is part of the National System of Military and Interstate Highways.	5.18 m [17 ft]
2		Other public highways not covered in item 1.	4.57 m [15 ft]
3		Private or military road.	3.05 m [10 ft] minimum, or height of highest mobile object that would usually traverse them, whichever is greater.
4		Railroad.	7.01 m [23 ft]
5		Waterway or traverse way, not previously covered.	A distance equal to the height of the highest mobile object that usually would traverse them.
6		Trees *	3 m [10 ft]

* Trees will be removed or topped the distance shown below the applicable imaginary surface.

3.16. Aircraft Arresting Systems. Aircraft arresting systems consist of engaging devices and energy absorbers. Engaging devices are net barriers, disc supported pendants (hook cables), and cable support systems which allow the pendant to be raised to the battery position or retracted below the runway surface. Energy absorbing devices are ships anchor chains, rotary friction brakes, such as the BAK-9 and BAK-12, or rotary hydraulic systems such as the BAK-13 and E-28. The systems designated "Barrier, Arresting Kit" (BAK) are numbered in the sequence of procurement of the system design. There is no connection between the Air Force designations of these systems and their function. The BAK equipment is government furnished equipment, as discussed in AFI 32-1043, *Managing Aircraft Arresting Systems*. Other designations such as E-5, E-28 and M-21 are US Navy designations. The systems in use today are as follows: MA-1A; E-5; BAK-9; BAK-12; Dual BAK-12 systems; BAK-13; BAK-14; 61QSII (BAK-15); E-28.

3.16.1. Navy and Marine Corps Requirements. This section does not apply to the Navy and Marine Corps other than to provide applicable Navy publications where additional information may be found.

3.16.2. Installation Design and Repair Considerations. Further information on the planning, installing and repairing of an arresting system or arresting system complex is found in AFI 32-1043, *Managing Aircraft Arresting Systems*. During the planning, installation and repair process, the following items will be given consideration.

3.16.2.1. Configuration and Location. The configuration and location of arresting system installations will be determined in accordance with AFI 32-1043. Design will conform with the criteria within Section 3 of the appropriate 35E8 series Technical Order and the typical installation drawings. Both may be obtained from:

SA-ALC/LDE
485 Quentin Roosevelt Road Suite 7
Kelly AFB TX 78241-5442

3.16.2.2. Runway Pavement. The 60 m [200 ft] of pavement on both the approach and departure sides of the arresting system pendant is a critical area. Protruding objects and undulating surfaces are detrimental to successful tailhook engagements and are not allowable. The maximum permissible longitudinal surface deviation in this area is plus or minus 3 mm [0.125 in] in 3.6 m [12 ft]. Changes in pavement type or an interface between rigid and flexible pavement are not permitted within this area.

3.16.2.3. Repair of Bituminous Pavements. Rigid inlays will not be used as a repair material beneath the cable in a flexible runway system. This type repair causes high hook skip potential when the flexible pavement consolidates, exposing the leading edge of the rigid pavement.

3.16.3. Joint-Use Airfields. Arresting systems installed on joint-use civil/military airfields to support military aircraft are sited in accordance with Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5220-9, *Aircraft Arresting Systems for Joint Civil/Military Airports*. It may be obtained, free of charge, from:

U.S. Department of Transportation
General Services Section
M-443.2
Washington D.C. 20590

3.16.3.1. Agreement to Install. When planning the installation of an arresting system at a joint-use facility, the installation commander must first notify the airport manager/authority of the need. If agreement is mutual, the installation commander submits the plan with sketches or drawings to the Air Force Liaison Officer within the appropriate FAA regional office. Disagreement between the responsible officials must be referred to the next higher level for resolution.

3.16.3.2. Disagreements. If a lease agreement is involved and does not allow placement of additional structures on the leased premises, the issue will be elevated to the MAJCOM for resolution.

3.16.3.3. Operating Agency. When an arresting system is installed at a joint-use civil airfield for the primary use of US military aircraft, the FAA acts for, and on behalf of, the DoD service component in operating this equipment.

3.16.3.4. Third Party Claims. Third-party claims presented for damage, injury, or death resulting from the FAA operation of the system for military aircraft or from DoD maintenance of the system is the responsibility of the DoD and must be processed under the appropriate DoD component's regulatory guidance.

3.16.3.5. DoD and FAA Agreements. Separate agreements between the DoD and the FAA are not required concerning liability for damage arising from the intentional operation of the system by FAA personnel for civil aircraft, because such claims are the responsibility of the FAA.

3.16.3.6. Operational Agreement. The MAJCOM is responsible to negotiate the operational agreement with FAA for a joint-use civil airport; however, authority may be delegated to the installation commander. The agreement will describe FAA functions and responsibilities concerning the remote control operation of arresting systems by FAA air traffic controllers.

3.16.4. Military Rights Agreements for Non-CONUS Locations. These systems are installed under the military rights agreement with the host government. If a separate agreement is specifically required for installation of a system, the installation commander coordinates with the local US diplomatic representative and negotiates the agreement with the host nation.