Chapter 2

AVIATION FACILITIES PLANNING

2.1. Applicability. Much of the criteria in this chapter apply to Aviation Facilities Planning for the Army only and are intended for use together with the design criteria presented elsewhere in this manual. Use of these criteria produces the right facilities, in the right place, at the right time. Navy aviation planning is covered in NAVFAC P-80, *Facility Planning Factor Criteria for Navy and Marine Corps Shore Installations*, and NAVFAC P 80.3, Appendix E, *Airfield Safety Clearances*. Aviation facilities planning for the Air Force is discussed in Air Force Instruction (AFI) 32-1024, *Standard Facility Requirements*, and Air Force Handbook (AFH) 32-1084, *Standard Facility Requirements Handbook.* In some cases, Air Force and Navy agencies and documents have been noted.

2.1.1. Manual Usage. Integration of aviation facilities planning with other Department of Defense (DoD) planning processes entails broad considerations. For example, the National Environmental Policy Act of 1969 (NEPA) has significantly affected aviation facilities planning by requiring that environmental impacts be considered early and throughout the planning process. In using this manual, planners should recognize that planning an aviation facility not only requires planning for runways, taxiways, aprons, and buildings, but must also consider environmental factors, land use considerations, airspace constraints, and surrounding infrastructure.

2.1.2. Terms. The following terms, for the purpose of this manual, define cumulative areas of consideration when planning aviation facilities. These terms are defined in attachment 1.

2.1.2.1. Aviation facility

2.1.2.2. Airside facilities

2.1.2.3. Landside facilities

2.1.2.4. Aviation movement or action

2.1.3. Planning Process. Aviation facilities planning involves collecting data, forecasting demand, determining facility requirements, analyzing alternatives, and preparing plans and schedules for facility development. The aviation facilities planning process must consider the mission and use of the aviation facility and its effect on the general public. The planning process cannot be completed without knowing the facility's primary mission and assigned organization and types of aircraft. Figure 2.1 provides general steps in the aviation facilities planning process.

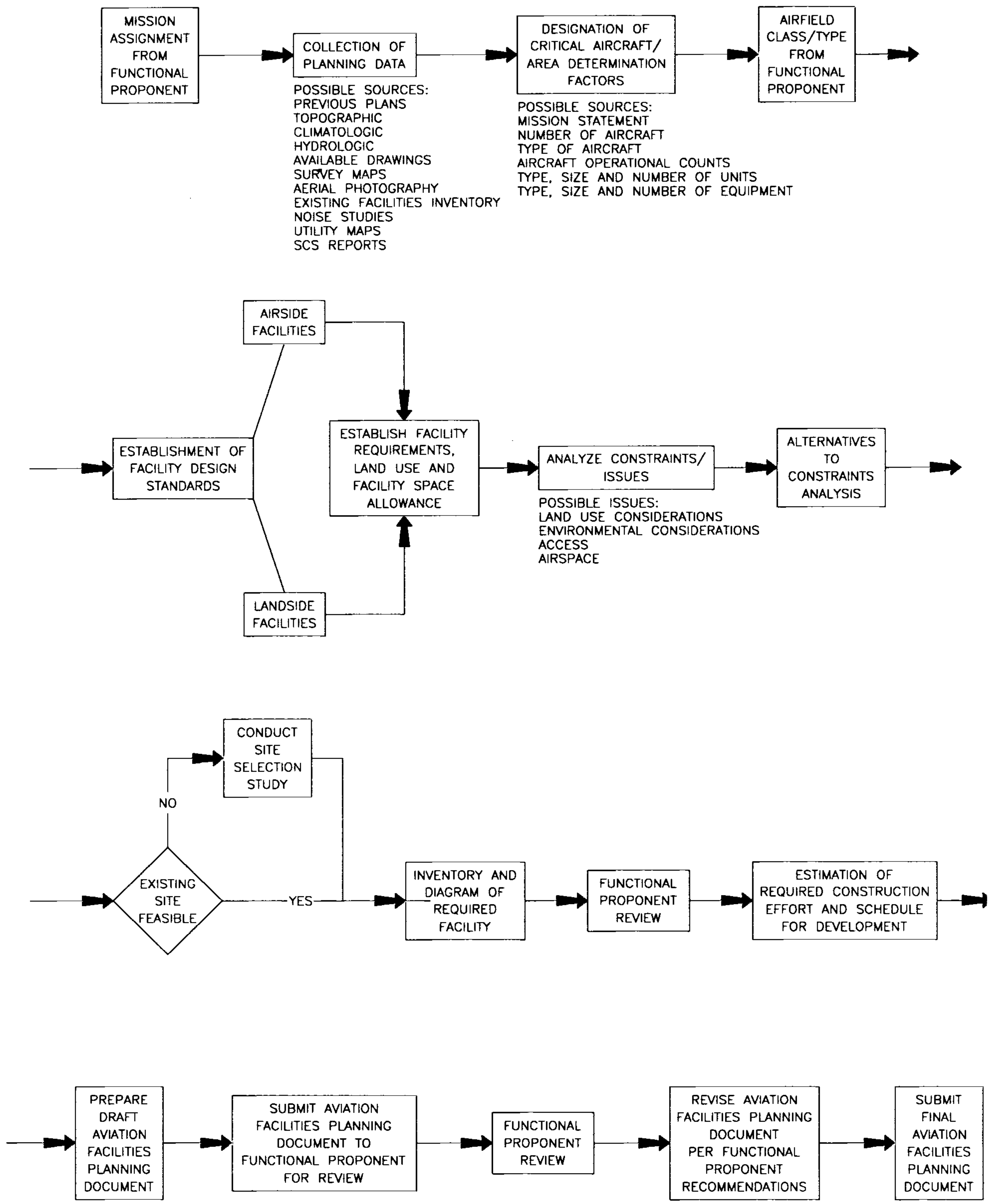
2.1.4. Planning Elements. The elements of an aviation facility's planning process will vary in complexity and degree of application, depending on the size, function, and problems of the facility. The technical steps described in this manual should be undertaken only to the extent necessary to produce a well-planned aviation facility.

2.1.5. Guidance. This chapter is structured and organized to provide guidance to planners intending to plan, design, or modify an aviation facility to comply with standardized criteria.

2.1.6. Additional Planning Factors. As discussed in Chapter 1, there are additional planning factors such as pavement design, airfield marking, and Terminal Instrument Procedures (TERPS) that must be considered when planning aviation facilities.

2.1.7. Space Allowances. Space allowances, presented in attachment 3, should be used when planning Army aviation facilities. Space allowances are presented in NAVFAC P-80 for Navy facilities and AFH 32-1084, *Facility Requirements Handbook*, for Air Force facilities.

Figure 2.1. Aviation Facilities Planning Process.



2.2. Justification:

2.2.1. Aviation Facilities Planning. Aviation facilities must be planned, programmed, and constructed in accordance with the Airfield Master Plan process. An Airfield Master Plan is developed and approved through an established planning process as discussed in paragraph 2.4. During the Master Plan process, alternatives must be assessed to determine the best, or a combination of, alternative(s) which overcome deficiencies at an aviation facility. Consideration must be given to construction alternatives (to construct new, modify, or upgrade a substandard facility) combined with operational alternatives (rescheduling and sharing facilities, changing training or mission) to determine the best plan for meeting facility requirements. As a minimum, each alternative considered must identify the changes to the mission, personnel, weapons systems and equipment, and any other impact to the facility. Construction of a new aviation facility is authorized when: (1) operational alternatives considered have been assessed and it has been concluded that the alternatives are not viable or executable options; or (2) existing facilities have been assessed as inadequate to meet the mission and new airside and/or landside facilities are not feasible.

2.2.2. Number of Aircraft. The construction and operating cost of an airfield for a few miscellaneous aircraft usually cannot be justified from the standpoint of military necessity or economy when those aircraft can be accommodated at an existing airfield within 32 kilometers (20 miles). Planning efforts must consider the number of aircraft assigned to the mission and review alternatives for using existing airfields which have capacity to satisfy mission requirements.

2.2.3. Joint Use Facilities. Use of existing facilities on a civil airfield, or the airfield of another service, should be considered when feasible.

2.3. General Planning Considerations:

2.3.1. Goals and Objectives. The goals and objectives of planning an aviation facility, as set forth in this manual, are to ensure sustained, safe, economical and efficient aircraft operations and aviation support activities. Planners must consider both the present and potential uses of the aviation facility during peacetime, mobilization, and emergency operations.

2.3.2. Functional Proponent. The functional proponent responsible to justify the need, scope (size), and utilization of an aviation facility is discussed below. Engineers/planners should assist operations personnel with the planning and programming, definition and scope, site selection, and design of the facility.

2.3.2.1. Army. The functional proponent for developing the scope and requirements for Army aviation facilities is usually assigned to the Aviation Division, Directorate of Plans, Training and Mobilization (DPTM) of the installation staff or the Operations Section (G/S-3) of the senior aviation organization. At locations where there is no DPTM or G/S-3 office, facility planners must coordinate with the commander of the aviation units to be supported. The DPTM, as the primary functional proponent, is responsible for determining mission support requirements for aviation facilities, operations, safety, and air traffic.

2.3.2.2. Air Force. The functional proponent for the Air Force is the Major Command (MAJCOM).

2.3.2.3. Navy. The functional proponent for the Navy is the Activity Commanding Officer.

2.3.3. Requirements. Each functional proponent is responsible for providing the appropriate operational information to be used in the planning of an aviation facility. In addition, planning should be coordinated with all users (operations, air traffic control, safety) of the aviation facility, including the FAA, to determine immediate and long range uses of the aviation facility.

2.3.3.1. Operational Information. Functional proponents will provide, at a minimum, existing and projected operational information needed for planning aviation facilities:

2.3.3.1.1. Mission statements.

2.3.3.1.2. Aircraft operational counts, traffic levels, and traffic density.

2.3.3.1.3. Type, size, and number of units/organizations and personnel.

2.3.3.1.4. Type, size, and number of equipment (aircraft, weapons systems, vehicles, etc.).

2.3.3.1.5. Once the above items are established, land requirements to support the aircraft mission can be established.

2.3.3.2. Engineering Information. Engineering information provided will include, as a minimum: graphical maps and plans, facility condition assessments, and tabulation of existing facilities.

2.3.4. Safety. The planning and design of an aviation facility will emphasize safety for aircraft operations. This includes unobstructed airspace and safe and efficient ground movements. Protect air space by promoting conscientious land use planning, such as compatible zoning and land easement acquisition.

2.3.5. Design Aircraft. Aviation facilities typically are designed for a specific aircraft known as the "critical" or "design" aircraft, which is the most operationally and/or physically demanding aircraft to make substantial use of the facility. The critical or design aircraft is used to establish the dimensional requirements for safety parameters such as approach protection zones, lateral clearance for runways, taxiways and parking positions, and obstacle clearance. In many cases, the "geometric" design aircraft may not be the same aircraft as the "pavement" design aircraft.

2.3.6. Airspace and Land Area. Aviation facilities need substantial air space and land area for safe and efficient operations and to accommodate future growth or changes in mission support.

2.3.6.1. Ownership of Clear Zones and Accident Potential Zones. When planning a new aviation facility or expanding an existing one, clear zones should be either owned or protected under a long term lease, and Accident Potential Zones (APZ) should be zoned in accordance with DoD Instruction 4165.57, *Air Installation Compatible Use Zone (AICUZ)*. Ownership of the APZ is desirable but not required.

2.3.6.2. Land Use Within the Clear Zone and Accident Potential Zones. Requirements for land use below approach-departure surfaces are provided in DoD Instruction 4165.57 and are summarized in Attachment 4.

2.3.6.3. Explosives. Where explosives or hazardous materials are handled at or near aircraft, safety and separation clearances are required. The clearances are based on quantity-distance criteria as discussed in Attachment 10.

2.3.6.4. Landside Safety Clearances. Horizontal and vertical operational safety clearances must be applied to landside facilities and will dictate the general arrangement and sizing of facilities and their relationship to airside facilities. Landside facilities will vary in accordance with the role of the mission. There are, however, general considerations which apply in most cases, such as:

2.3.6.4.1. Adherence to standards in support of safety in aircraft operations.

2.3.6.4.2. Non-interference with line of sight or other operational restrictions.

2.3.6.4.3. Use of existing facilities.

2.3.6.4.4. Flexibility in being able to accommodate changes in aircraft types or missions.

2.3.6.4.5. Efficiency in ground access.

2.3.6.4.6. Priority accorded aeronautical activities where available land is limited.

2.3.6.5. Helipads. Helipads are authorized at locations where aircraft are not permanently assigned but have a need for access based upon supporting a continuing and recurrent aviation mission. For example, hospitals, depot facilities, and headquarters buildings are authorized one or more helipads. These facilities must be included in the approved Airfield Master Plan.

2.3.6.6. Facilities Used by Multiple Services. At airfields used by multiple services, the planning and design of facilities will be coordinated between the appropriate services. The lead for coordination is the appropriate facilities/engineering echelon of the service which owns the facilities.

2.4. Planning Studies:

2.4.1. Master Plan. Knowledge of existing facilities, mission, and aircraft, combined with a realistic assumption of future requirements, is essential to the development of Master Plans. Principles and guidelines for development of Master Plans at an aviation facility are contained in the following publications:

2.4.1.1. Army: AR 210-20, *Master Planning for Army Installation.*

2.4.1.2. Air Force: AFI 32-7062, *Air Force Comprehensive Planning.*

2.4.1.3. Navy/Marines: E-I, *Installation Planning, Design and Management Guide* (Draft).

2.4.2. Land Use Studies. Long-range land use planning is a primary strategy for protecting a facility from problems which arise from aviation-generated noise and incompatible land uses. Aircraft noise can adversely affect the quality of the human environment. Federal agencies are required to work with local, regional, state, and other Federal agencies to foster compatible land uses, both on and off the boundaries of the aviation facility. The Air Installation Compatible Use Zone (AICUZ) and Installation Compatible Use Zone (ICUZ) programs promote land use compatibility through active land use planning.

2.4.3. Environmental Studies. Development of an aviation facility including expansion of an existing aviation facility requires compliance with a variety of environmental policies and regulations. NEPA requires all Federal agencies to consider the potential environmental impacts of certain proposed projects and activities, as directed by DoD Directives 6050.1, *Environmental Effects in the United States of DoD Actions*, and 6050.7, *Environmental Effects Abroad of Major Department of Defense Actions*. Implementation of these regulations is defined for each service in the following documents: Army: AR 200-2, *Environmental Effects of Army Actions*; Air Force: AFI 32-7061, *Environmental Impact Analysis Process*; and Navy and Marine Corps: OPNAVINST 5090.1B (MCO 5090.2), *Environmental and Natural Resources Program Manual*. Four broad categories of environmental review for a proposed action exist. The decision to conduct one study or another depends on the type of project and the potential consequences the project has to various environmental categories. Criteria for determining which type of study should be undertaken are defined in the environmental directives for each branch of service. Environmental studies should be prepared and reviewed locally. When additional assistance or guidance appears necessary, this support may be obtained through various agencies such as USAATCA, COE TSMCX (U.S. Army Corps of Engineers Transportation Systems Center) and the U.S. Army Corps of Engineers District Offices, Naval Facilities Engineering Command Headquarters and Engineering Field Divisions, and the Air Force Center for Environmental Excellence (HQ AFCEE).

2.4.3.1. Environmental Assessment (EA). The EA serves to analyze and document the extent of environmental consequences of a proposed construction project. It evaluates issues such as existing and future noise, land use, water quality, air quality, cultural resources, fish and wildlife. The conclusion of the assessment will result in either: (1) a Finding of No Significant Impact (FONSI), or if the consequences are significant, (2) the decision to conduct an Environmental Impact Statement (EIS). This decision is typically made by the authority approving the study.

2.4.3.2. Environmental Impact Statement (EIS). An EIS is the document which identifies the type and extent of environmental consequences created if the proposed project is undertaken. The EIS' primary purpose is to ensure that NEPA policies and goals are incorporated into the actions of the Federal government. The EIS defines the impact, and details what measures will be taken to minimize, offset, mitigate, or avoid any adverse effects on the existing environmental condition. Upon completion of an EIS, the decision maker will file a Record Of Decision (ROD), which finalizes the environmental investigation and establishes consent to either abandon or complete the project within the scope of measures outlined in the EIS.

2.4.3.3. Categorical Exclusion (CX). A CX is used for projects that do not require an EA or EIS because it has been determined that the projects do not have an individual or cumulative impact on the environment, and present no environmentally controversial change to existing environmental conditions. A list of actions which are categorically excluded is contained in the regulatory directives for each service.

2.4.3.4. Exemption By Law and Emergencies. Situations where laws applicable to the DoD prohibit, exempt, or make full compliance with NEPA impossible, or where immediate actions to promote national defense and security do not allow for environmental planning, are exempt from environmental studies.

2.4.4. Aircraft Noise Studies. AICUZ and ICUZ are programs initiated to implement Federal laws concerning land compatibility from the perspective of environmental noise impacts. The ICUZ program is the Army's extension of the AICUZ which was initiated by DoD and undertaken primarily by Air Force and Navy aviation facilities. Studies under these programs establish noise abatement measures which help to eliminate or reduce the intensity of noise from its sources, and provide land use management measures for areas nearby the noise source.

2.4.4.1. Analysis. Due to the widely varied aircraft, aircraft power plants, airfield traffic volume, and airfield traffic patterns, aviation noise at installations depends upon both aircraft types and operational procedures. Aircraft noise studies should be prepared for aviation facilities to quantify noise levels and possible adverse environmental effects, ensure that noise reduction procedures are investigated, and plan land for uses which are compatible with higher levels of noise. While many areas of an aviation facility tolerate higher noise levels, many aviation landside facilities and adjoining properties do not. Noise contours developed under the AICUZ and ICUZ studies are used to graphically illustrate noise levels and provide a basis for land use management and impact mitigation. The primary means of noise assessment is mathematical modeling and computer simulation. Guidance regarding when to conduct noise studies is contained in the environmental directive for each service.

2.4.4.1.1. Fixed-Wing Aircraft Noise. Fixed-wing aircraft noise levels generated at aviation facilities are modeled using the current version of the NOISEMAP computer model. Of particular interest to facility planning for fixed-wing aircraft facilities is the land near areas used for engine run-up and testing and those land areas below the extended approach-departure path of runways.

2.4.4.1.2. Rotary-Wing Noise. Rotary-wing aircraft create a different class of noise which is described as having high-level, low-frequency energy. These noise levels create vibrations which vary greatly from that generated by fixed-wing aircraft. Helicopter noise measurement and modeling is primarily an Army initiative, and the latest modeling techniques for assessing rotary-wing aircraft noise is contained in NOISEMAP or the Helicopter Noise Model (HNM) computer noise program.

2.4.4.1.3. Noise Contour Maps. Noise levels generated from the activities of fixed- and rotary-wing operations are identified using contours which delineate areas of equal sound pressure impact on the areas surrounding the source of the noise. Noise levels are expressed in Ldn and noise contours provide a quantified diagram of the noise levels. Noise contours are illustrated on airfield general site plans, Installation Land Use Compatibility Plans, and/or Base Comprehensive Plans. Noise contours from other sources, such as firing ranges, should also be shown on the noise contour map. In addition, the noise contour maps should show the imaginary airspace such as the runway primary surface, clear zone, APZ 1, and APZ 2. Through the establishment of noise contour maps, potential noise sensitive areas on and off the aviation facility will be identified.

2.4.4.3. Requirement For Analysis of Noise Impact. An Environmental Impact Statement is required to analyze a noise impact. An EA is required when: (1) a project or facility is proposed within a noise sensitive area; (2) there is a change in flight operational procedures; or (3) the quality of the human environment is significantly affected by a change in aircraft noise.

2.4.5. Instrumented Runway Studies. The requirement to conduct an instrumented runway study is issued by the functional proponent. It is important to recognize that instrument landing capability provides for aircraft approaches at very low altitude ceilings or visibility distance minimums. Consequently, these lower approach minimums demand greater safety clearances, larger approach surfaces, and greater separation from potential obstacles or obstructions to air navigation.

2.5. Siting Aviation Facilities:

NOTE: While the general siting principles below are applicable to Navy aviation facilities, see MIL-HDBK-1021/1, *General Concepts for Airfield Pavement Design*, and NAVFAC P-80 for Navy-specific data and contacts.

2.5.1. Location. The general location of an aviation facility is governed by many factors, including base conversions, overall defense strategies, geographic advantages, mission realignment, security, and personnel recruitment. These large-scale considerations are beyond the scope of this manual. The information in this chapter provides guidelines for siting aviation facilities where the general location has been previously defined.

2.5.2. Site Selection:

2.5.2.1. Site Conditions. Site conditions must be considered when selecting a site for an aviation facility. The site considerations include, but are not limited to: topography, vegetative cover, existing construction, weather elements, wind direction, soil conditions, flood hazard, natural and man-made obstructions, adjacent land use, availability of usable airspace, accessibility of roads and utilities, and future expansion capability.

2.5.2.2. Future Development. Adequate land for future aviation growth must be considered when planning an aviation facility. An urgent requirement for immediate construction should not compromise the plan for future development merely because a usable, but not completely satisfactory, site is available. Hasty acceptance of an inferior site can preclude the orderly expansion and development of permanent facilities. Initial land acquisition (fee or lease) or an aviation easement of adequate area will prove to be the greatest asset in protecting the valuable airfield investment.

2.5.2.3. Sites not on DoD Property. Site selection for a new airfield or heliport not located on DoD or service controlled property must follow FAA planning criteria and each service's established planning processes and procedures for master planning as previously discussed in paragraph 2.4.1. Siting the aviation facility requires an investigation into the types of ground transportation that will be required, are presently available, or are capable of being implemented. All modes of access and transportation should be considered, including other airports/airfields, highways, railroads, local roadways, and internal roads. The facility's internal circulation plan should be examined to determine linear routes of movement by vehicles and pedestrians to ensure that an adequate access plan is achievable.

2.5.3. Airspace Approval. Construction of new airfields, heliports, helipad or hoverpoints, or modifications to existing facilities affecting the use of airspace or changes in aircraft densities will require notification to the Administrator, FAA, in conformance with AR 95-2, *Air Traffic Control, Air Space, Airfield Flight Facilities and Navigational Aids*. Copies of FAA airspace approval actions should normally accompany any construction projects when forwarded to Department of the Army (DA) for approval.

2.5.4. Airfield Safety Clearances:

2.5.4.1. Dimensional Criteria. The dimensions for airfield facilities, airfield lateral safety clearances, and airspace imaginary surfaces are provided in Chapters 3 and 4 of this manual.

2.5.4.2. Air Force Missions at Army Facilities. Airfield flight safety clearances applicable to Army airfields which support Air Force cargo aircraft missions will be based upon an Army Class B airfield. This will be coordinated between the Army and the Air Force.

2.5.4.3. Prohibited Land Uses. Airfield airspace criteria prohibit certain land uses within the clear zone and Accident Potential Zones (APZ 1 and APZ 2). These activities include the storage and handling of munitions and hazardous materials, and live-fire weapons ranges. See AICUZ DoD Instruction 4165.57 for more information.

2.5.4.4. Wake Turbulence. The problem of wake turbulence may be expected at airfields where there is a mix of light and heavy aircraft. At these airfields, some taxiway and holding apron design modifications may help to alleviate the hazards. Although research is underway to improve detection and elimination of the wake, at the present time, the most effective means of avoiding turbulent conditions is provided by air traffic control personnel monitoring and regulating both air and ground movement of aircraft. Planners can assist this effort by providing the controllers line-of-site observation to all critical aircraft operational areas and making allowances for aircraft spacing and clearances in turbulence prone areas. Additional information on this subject is available in FAA AC 90-230, *Wake Turbulence*.

2.6. Airside and Landside Facilities. An aviation facility consists of four land use areas. They are:

2.6.1. Airside Facilities:

2.6.1.1. Landing and take-off area.

2.6.1.2. Aircraft ground movement and parking areas.

2.6.2. Landside Facilities:

2.6.2.1. Aircraft maintenance areas.

2.6.2.2. Aviation operations support areas.

2.7. Landing and Takeoff Area:

2.7.1. Runways and Helipads. Take-off and landing areas are based on either a runway or helipad. The landing/take-off area consists not only of the runway and helipad surface, shoulders, and overruns, but also approach slope surfaces, safety clearances and other imaginary airspace surfaces.

2.7.2. Number of Runways. Aviation facilities normally have only one runway. Additional runways may be necessary to accommodate operational demands, minimize adverse wind conditions or overcome environmental impacts. A parallel runway may be provided based on operational requirements. Methodologies for calculating runway capacity in terms of annual service volume (ASV) and hourly instrument flight rules (IFR) or visual flight rules (VFR) capacity are provided in FAA AC 150/5060-5, *Airport Capacity and Delay*. Planning efforts to analyze the need for more than one runway should be initiated when it is determined that traffic demand for the primary runway will reach 60 percent of its established capacity (FAA guidance).

2.7.3. Number of Helipads. The number of helipads authorized is discussed in Attachment 3. At times there are situations at airfields or heliports when a large number of helicopters are parked on mass aprons or are in the process of take-off and landing. When this occurs, there is usually a requirement to provide landing and take-off facilities that permit more rapid launch and recovery operations than can otherwise be provided by a single runway or helipad. This increased efficiency can be obtained by providing one or more of the following, but is not necessarily limited to:

2.7.3.1. Multiple helipads, hoverpoints, or runways.

2.7.3.2. Rotary-wing runways in excess of 240 meters (800 feet) long.

2.7.3.3. Landing lane(s).

2.7.4. Runway Location. Runway location and orientation are paramount to airport safety, efficiency, economics, practicality, and environmental impact. The degree of concern given to each factor influencing runway location depends greatly on meteorological conditions, adjacent land use and land availability, airspace availability, runway type/instrumentation, environmental factors, terrain features/topography, and obstructions to air navigation.

2.7.4.1. Obstructions to Air Navigation. The runway must have approaches which are free and clear of obstructions. Runways must be planned so that the ultimate development of the airport provides unobstructed navigation. A survey of obstructions should be undertaken to identify those objects which may affect aircraft operations. Protection of airspace can be accomplished through purchase, easement, zoning coordination, and application of appropriate military directives.

2.7.4.2. Airspace Availability. Existing and planned instrument approach procedures, control zones, and special use airspace and traffic patterns influence airfield layouts and runway locations. Construction projects for new airfields and heliports or construction projects on existing airfields have potential to affect airspace. These projects require notification to the FAA to examine feasibility for conformance with and acceptability into the national airspace system.

2.7.4.3. Runway Orientation. Wind direction and velocity is a major consideration for siting runways. To be functional, efficient, and safe, the runway should be oriented in alignment with the prevailing winds, to the greatest extent practical, to provide favorable wind coverage. Wind data, obtained from local sources, for a period of not less than five years, should be used as a basis for development of the windrose to be shown on the airfield general site plan. Attachment 5 provides guidance for the research, assessment, and application of wind data.

2.7.5. Runway and Helipad Separation. The lateral separation of a runway from a parallel runway, parallel taxiway, or helipad/hoverpoint is based on the type of aircraft the runway serves. Runway and helipad separation criteria are presented in Chapters 3 and 4 of this manual.

2.7.6. Runway Instrumentation. Navigational aids require land areas of specific size, shape, and grade to function properly and remain clear of safety areas.

2.7.6.1. Navigational Aids (NAVAIDS), Vault, and Buildings. NAVAIDS assist the pilot in flight and during landing. Technical guidance for flight control between airfields may be obtained from the U.S. Army Aeronautical Services Agency. The type of air navigational aids which are installed at an aviation facility are based on the instrumented runway studies, as previously discussed. A lighting equipment vault is provided for airfields and heliport facilities with navigational aids, and may be required at remote or stand-alone landing sites. A (NAVAID) building will be provided for airfields with navigational aids. Each type of NAVAID equipment is usually housed in a separate facility. Technical advice and guidance for air navigational aids should be obtained from the support and siting agencies listed in Attachment 17.

2.8. Aircraft Ground Movement and Parking Areas. Aircraft ground movement and parking areas consist of taxiways and aircraft parking aprons.

2.8.1. Taxiways. Taxiways provide for free ground movement to and from the runways, helipads, maintenance, cargo/passenger, and other areas of the aviation facility. The objective of taxiway system planning is to create a smooth traffic flow. This system allows unobstructed ground visibility; a minimum number of changes in the aircraft's taxiing speed; and, ideally, the shortest distance between the runways or helipads and apron areas.

2.8.1.1. Taxiway System. The taxiway system is comprised of entrance and exit taxiways; bypass, crossover taxiways; apron taxiways and taxilanes; hangar access taxiways; and partial-parallel, full-parallel, and dual-parallel taxiways. The design and layout dimensions for various taxiways are provided in Chapter 5.

2.8.1.2. Taxiway Capacity. At airfields with high levels of activity, the capacity of the taxiway system can become the limiting operational factor. Runway capacity and access efficiency can be enhanced or improved by the installation of parallel taxiways. A full length parallel taxiway may be provided for a single runway with appropriate connecting lateral taxiways to permit rapid entrance and exit of traffic between the apron and the runway. At facilities with low air traffic density, a partial parallel taxiway or mid length exit taxiway may suit local requirements. However, develop plans so that a full parallel taxiway may be constructed in the future when it can be justified.

2.8.1.3. Runway Exit Criteria. The number, type, and location of exit taxiways is a function of the required runway capacity. Exit taxiways are typically provided at the ends and in the center and mid-point on the runway. Additional locations may be provided as necessary to allow landing aircraft to exit the runway quickly. Additional information on exit taxiways may be found in Chapter 5.

2.8.1.4. Dual-Use Facility Taxiways. For taxiways at airfields supporting both fixed-wing and rotary-wing operations, the appropriate fixed-wing criteria should be applied.

2.8.1.5. Paved Taxiway Shoulders. Paved taxiway shoulders are provided to reduce the effects of jet blast on areas adjacent the taxiway. Paved taxiway shoulders help reduce ingestion of foreign objects debris (FOD) into jet intakes. Paved shoulders will be provided on taxiways in accordance with the requirements set forth in Chapter 5 and Attachment 3.

2.8.2. Aircraft Parking Aprons. Aircraft parking aprons are the paved areas required for aircraft parking, loading, unloading, and servicing. They include the necessary maneuvering area for access and exit to parking positions. Aprons will be designed to permit safe and controlled movement of aircraft under their own power. Aircraft apron dimensions and size are based on mission requirements. Additional information concerning Air Force aprons is found in AFH 32-1084, Section D, *Apron Criteria.*

2.8.2.1. Requirement. Aprons are individually designed to support specific aircraft and missions at specific facilities. The size of a parking apron is dependent upon the type and number of aircraft authorized. Chapter 6 provides additional information on apron requirements.

2.8.2.2. Location. Aircraft parking aprons typically are located between the parallel taxiway and the hangar line. Apron location with regard to airfield layout will adhere to operations and safety clearances provided in Chapter 6 of this manual.

2.8.2.3. Capacity. Aircraft parking capacity for the Army is discussed in Attachment 3 of this manual; in NAVFAC P-80 for the Navy; and AFH 32-1084 for the Air Force.

2.8.2.4. Clearances. Lateral clearances for parking aprons are provided from all sides of aprons to fixed and/or mobile objects. Additional information on lateral clearances for aprons is discussed in Chapter 6.

2.8.2.5. Access Taxilanes, Entrances, and Exits. The dimensions for access taxilanes on aircraft parking aprons are provided in Chapter 6. The minimum number of exit/entrance taxiways provided for any parking apron should be two (2).

2.8.2.6. Aircraft Parking Schemes. On a typical mass parking apron, aircraft should be parked in rows. The recommended tactical/fighter aircraft parking arrangement is to park aircraft at a 45-degree angle. This is the most economical parking method for achieving the clearance needed to dissipate jet blast temperatures and velocities to levels that will not endanger aircraft or personnel. (For Navy, these are 38 °C (100 °F) and 56 kmh (35 mph) at break-away (intermediate power)). Typical parking arrangements and associated clearances are provided in Chapter 6.

2.8.2.7. Departure Sequencing. Formal aircraft egress patterns from aircraft parking positions to the apron exit taxiways should be established to prevent congestion at the apron exits. For example, aircraft departing from one row of parking positions should taxi to one exit taxiway, allowing other rows to simultaneously taxi to a different exit.

2.8.2.8. Army and Navy Aprons. Army aircraft parking aprons are divided into three categories: unit, general purpose, and special purpose. The category to be provided is based on the mission support requirement of the facility.

2.8.2.8.1. Unit Parking Apron. The unit parking category supports fixed- and rotary-wing aircraft assigned to the facility.

2.8.2.8.2. General Purpose Apron. When no tenant units are assigned to an aviation facility, and transient aircraft parking is anticipated, a personnel loading apron or aircraft general purpose apron should be provided in lieu of a mass parking apron.

2.8.2.8.3. Special Purpose Apron. Special purpose aprons are provided for specific operations such as providing safe areas for arming/disarming aircraft and other specific mission requirements that demand separation of or distinct handling procedures for aircraft.

2.8.2.9. Apron/Other Pavement Types. Special use aprons may exist on an aviation facility. Further information on these aprons/pavements may be found in Chapter 6.

2.9. Aircraft Maintenance Area (Other than Pavements). An aircraft maintenance area is required when aircraft maintenance must be performed regularly at an aviation facility. Space requirements for maintenance facilities are based on aircraft type.

2.9.1. Aircraft Maintenance Facilities. The aircraft maintenance facility includes, but is not limited to: aircraft maintenance hangars, special purpose hangars, hangar access aprons, weapons system support shops, aircraft system testing and repair shops, aircraft parts storage, corrosion control facilities, and special purpose maintenance pads. The aircraft maintenance area includes utilities, roadways, fencing, and security facilities and lighting.

2.9.2. Aviation Maintenance Buildings (Air Force and Navy). For aviation maintenance building information for the Air Force, see AFH 32-1084; for the Navy, see MIL HDBK 1028/1, *Aircraft Maintenance Facilities*.

2.9.3. Aviation Maintenance Buildings (Army):

2.9.3.1. Maintenance Hangars. Maintenance hangars are required to support those aircraft maintenance, repair, and inspection activities which can be more effectively accomplished while the aircraft is under complete cover. The size requirement for maintenance hangars is determined by the number of aircraft assigned.

2.9.3.2. Security and Storage Hangars. These hangars are limited in use and do not require the features normally found in maintenance hangars.

2.9.3.3. Avionics Maintenance Shop. Avionics maintenance space should normally be provided within the maintenance hangar. However, a separate building for consolidated avionics repair may be provided at aviation facilities with multiple units.

2.9.3.4. Engine Repair and Engine Test Facilities. Engine repair and test facilities are provided at air bases with aircraft engine removal, repair, and testing requirements. Siting of engine test facilities should consider the impacts of jet blast, jet blast protection, and noise suppression.

2.9.3.5. Parts Storage. Covered storage of aircraft parts should be provided at all aviation facilities and located close enough to the maintenance area to allow easy access to end-users.

2.9.4. Maintenance Aprons. These aprons should be sized according to the dimensions discussed in Chapter 6.

2.9.5. Apron Lighting. Apron area lighting (floodlights) is provided where aircraft movement, maintenance, and security are required at night, and during poor visibility. Type of lighting is based on the amount of apron space or number of aircraft positions which receive active use during nighttime operations.

2.9.6. Security. The hangar line typically represents the boundary of the airfield operations area. Maintenance buildings should be closely collocated to discourage unauthorized access and enhance facility security.

2.10. Aviation Operations Support Area:

2.10.1. Aviation Operations Support Facilities. Aviation operations support facilities include those facilities that directly support the flying mission. Operations support includes air traffic control, aircraft rescue and firefighting, fueling facilities, airfield operations center (airfield management facility), squadron operations/aircraft maintenance units, and air mobility operations groups.

2.10.2. Location. Aviation operations support facilities should be located along the hangar line with the central area typically being allocated to airfield operations (airfield management facility), air traffic control, aircraft rescue and firefighting, and flight simulation. Aircraft maintenance facilities should be located on one side of the runway to allow simplified access among maintenance areas, aircraft, and support areas.

2.10.3. Orientation of Facilities. Facilities located either parallel or perpendicular to the runway make the most efficient use of space. Diagonal and curved areas tend to chop up the area and result in awkward or unusable spaces.

2.10.4. Multiple Supporting Facilities. When multiple aviation units are located at one facility, their integrity may be retained by locating such units adjacent to each other.

2.10.5. Transient Facilities. Provisions should be made for transient and VIP aprons and buildings. These facilities should be located near the supporting facilities discussed above.

2.10.6. Other Support Facilities. When required, other support facilities, such as aviation fuel storage and dispensing, heating plants, water storage, consolidated parts storage, and motor pool facilities should be sited on the far side of an access road paralleling the hangar line.

2.10.6.1. Air Traffic Control Facilities. The siting and height of the ATC tower cab is determined by an operational assessment conducted by USAATCA and ATZQ-ATC-A (U.S. Army Air Traffic Control Activity), and in accordance with MIL-HDBK 1024/1, *Aviation Operational and Support Facilities* (Navy and Marine Corps). Air Force ATC towers are sited in accordance with Attachment 18.

2.10.6.2. Radar Buildings. Some airfields are equipped with radar capability. When the functional proponent determines the need for radar capability, space for radar equipment will be provided. Space for radar equipment should be provided in the flight control tower building.

2.10.6.3. Aircraft Rescue and Fire Facilities. Airfield facilities and flight operations will be supported by fire and rescue equipment. The aircraft rescue and fire facilities must be located strategically to allow aircraft firefighting vehicles to meet response time requirements to all areas of the airfield. Coordinate the airfield fire and rescue facility and special rescue equipment with the facility protection mission and Master Plan. It may be economically sound to develop a consolidated or expanded facility to support both airside and landside facilities. The site of the fire and rescue station must permit ready access of equipment to the aircraft operational areas and the road system serving the airfield facilities. A site centrally located, close to the midpoint of the runway, and near the airfield operations area (airfield management and base operations building (Air Force)) and air traffic control tower is preferred.

2.10.6.4. Rescue and Ambulance Helicopters. With the increasing use of helicopters for emergency rescue and air ambulance service, consideration should be given to providing an alert helicopter parking space near the fire and rescue station. This space may be located as part of the fire and rescue station or in a designated area on an adjacent aircraft parking apron.

2.10.6.5. Hospital Helipad. A helipad should normally be sited in close proximity to each hospital to permit helicopter access for emergency use. Subject to necessary flight clearances and other hospital site factors, the hospital helipad should permit reasonably direct access to and from the hospital emergency entrance.

2.10.6.6. Miscellaneous Buildings. The following buildings should be provided as part of an aviation facility. Authorization and space allowances should be determined in accordance with directives for each branch of service.

2.10.6.6.1. Airfield operations building (airfield management facility).

2.10.6.6.2. Aviation unit operations building (Army); squadron operations building (Air Force).

2.10.6.6.3. Representative weather observation stations (RWOS).

2.10.7. Aircraft Fuel Storage and Dispensing:

2.10.7.1. Location. Aircraft fuel storage and dispensing facilities will be provided at all aviation facilities. Operating fuel storage tanks will be provided wherever dispensing facilities are remote from bulk storage. Bulk fuel storage areas require locations which are accessible by tanker-truck, tanker-rail car, or by waterfront. Both bulk storage and operating storage areas must provide for the loading and parking of fuel vehicles to service aircraft. Where hydrant fueling systems are authorized, bulk fuel storage locations must take into account systems design requirements (e.g., the distance from the fueling apron to the storage tanks).

2.10.7.2. Safety. Fuel storage and operating areas have requirements for minimum clearances from buildings, aircraft parking, roadways, radar, and other structures/areas, as established in service directives. Aviation fuel storage and operating areas also require lighting, fencing, and security alarms. All liquid fuel storage facility sitings must address spill containment and leak protection/detection.

2.10.8. Roadways to Support Airfield Activities:

2.10.8.1. General. Vehicular roads on airfields should not cross or be within the lateral clearance distance for runways, high-speed taxiways, and dedicated taxiways for alert pads. This will prevent normal vehicular traffic from obstructing aircraft in transit. Roads should be located so that surface vehicles will not be hazards to air navigation and air navigation equipment.

2.10.8.2. Rescue and Firefighting Roadways. Rescue and firefighting access roads are usually needed to provide unimpeded two-way access for rescue and firefighting equipment to potential accident areas. Connecting these access roads to the extent practical with airfield operational surfaces and other airfield roads will enhance fire and rescue operations. Dedicated rescue and firefighting access roads are all-weather roads designed to support vehicles traveling at normal response speeds.

2.10.8.3. Fuel Truck Access. Fuel truck access points to aircraft parking aprons should be located to provide minimal disruptions and hazards to active aircraft movement areas. Fuel truck access from the facility boundary to the fuel storage areas should be separate from other vehicular traffic. Fuel trucks should be parked as close to the flight line as reasonably possible.

2.10.8.4. Explosives and Munitions Transfer to Arm/Disarm Pads. Transfer of explosives and munitions from storage areas to arm/disarm pads should occur on dedicated transfer roads. Transfer roads should be used exclusively for explosives and munitions transfer vehicles.