Federal Aviation Agency

ADVISORY CIRCULAR

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SUBJECT: AIRPORT SERVICE EQUIPMENT BUILDINGS

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1. PURPOSE. This advisory circular contains guidance material on the design of buildings for housing equipment used in maintaining and repairing runways, taxiways, aprons, and ground operational areas. It has been developed to provide assistance in planning suitable facilities which will contribute toward greater safety of aircraft operation on airports. The guidance material described is acceptable in accomplishing a project meeting the eligibility requirements of the Federal-aid Airport Program.

2. REFERENCES.

   a. "Airport Design", 1961; Supplement No. 1, 1962.

   b. Airport Engineering Data Sheet No. 32, "Airport Fire and Rescue Equipment Buildings Guide", July 1961.

3. HOW TO GET THIS CIRCULAR. Obtain additional copies of this circular, AC 150/5360-1, "Airport Service Equipment Buildings", from the Federal Aviation Agency, Distribution Section, HQ-438, Washington, D. C. 20553.

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TABLE OF CONTENTS

		Page No.
CHAPTER 1.	INTRODUCTION	1
1.	Background.	1
2.	Function of the Building.	1
3.	Maintenance and Service Equipment.	1
CHAPTER 2.	THE NEED FOR THE FACILITY	3
4.	Major Factors.	3
5.	Snowfall.	3
6.	Icing Conditions	4
7.	Maintenance and Services Affecting the Need.	5
	Figure 1. Mean Monthly Total Snowfall.	6
	Figure 2. Average Annual Days Snow Cover.	7
	Figure 3. Mean Annual Snowfall.	8
CHAPTER 3.	THE BUILDING AND ITS SURROUNDINGS	9
8.	Factors Affecting Space Requirements.	9
9.	Space Requirements.	9
	Figure 4. Representative Number Stalls and Employees.	10
10.	Combination Facilities.	10
11.	Space Relationships.	11
12.	Utilities.	12
	Figure 5. Suggested Illumination.	13
13.	Building Construction.	13
14.	Storage Adjacent to the Building.	14
	Figure 6. Combination Equipment Buildings.	15
	Figure 7. Service Equipment Buildings.	16
CHAPTER 4.	BUILDING SITING	17
15.	Importance of Site Planning.	17
16.	Location on the Airport.	17
17.	Planning Considerations.	18
	Figure 8. Service Equipment Building Siting.	19

CHAPTER 1. INTRODUCTION

1. BACKGROUND. Expanding operation of large scheduled jets and private aircraft has resulted in expanded airport landing facilities. Improvements of airport and aircraft instrumentation are leading to the development of all-weather operations. A heavier burden is thus placed upon airport management to maintain the airport in such condition as to encourage safe operations at peak efficiency. Takeoff and landing areas, as well as other operational areas, must be kept in good repair and be maintained clear of hazardous accumulations. Grass and other natural growth must be trimmed and snow, ice, and debris removed. Effective airport operation depends in part on having available, at the right time and place, the equipment needed to accomplish these tasks. Possession of the equipment is not enough, it should be properly housed and serviced if it is to be operational at all times.

2. FUNCTION OF THE BUILDING. An airport service equipment building is recommended for storage and maintenance of equipment used to service operational areas. This building is to be distinguished from other maintenance and service facilities necessary for utilities operation and for building maintenance, such as carpenter, paint, plumbing, and electrical shops. Minimum essential facilities for personnel engaged in airport maintenance and service will normally be included. This advisory circular defines the purpose and scope of a service equipment building in keeping with the specific requirements of various types of airports and the climatic conditions in which they are located. Therefore, factors relating to weather are discussed as well as physical characteristics peculiar to the service equipment building and its location.

3. MAINTENANCE AND SERVICE EQUIPMENT. Architect-engineers generally have knowledge of the types and sizes of equipment that may have to be housed and serviced. Others faced with the problem of determining building requirements should become familiar with the various types of the more common equipment used at a number of airports in their area of the country. The architect-engineer should work closely with the airport management who has responsibility for developing specific facility requirements.

CHAPTER 2. THE NEED FOR THE FACILITY

4. MAJOR FACTORS. Landing area maintenance and servicing functions at airports will vary dependent upon a number of factors.

   a. Types of aircraft using the airport, particularly turbine engine aircraft, and the number of operations of the predominant types are determinants. The characteristics of the airport landing and operational areas including runway, taxiway, and apron configuration are also determinants. The types of paved surfaces and soil and the amount of turfing and shrubbery adjacent to operating areas also affect the type and amount of maintenance and service equipment.

   b. In some areas, the principal determinant will be the weather conditions. Inclement weather characterized by large amounts of precipitation and extended periods of low temperatures is the most important single consideration. For this reason, yearly snowfall and the number of cold months when paved surfaces may become icy are the parameters selected as a basis for establishment of the general need for maintenance and service equipment. A mean daily minimum temperature of 0° F. and below for 20 or more days annually is significant as an indication of those areas where special consideration should be given to providing this facility. The emphasis on snow removal and sand spreading is consistent with the emergency nature of this type of servicing operations and with the importance of housing this automotive equipment at these locations.

5. SNOWFALL. How much snow is necessary to establish a need for snow removal equipment on an airport? Climatological data for a number of communities throughout the country with a mean snowfall from 0 inches to 111.8 inches indicate certain factors to be important.

   a. The maximum snowfall in a 24-hour period has little relationship to the mean annual snowfall. For example, a community having a mean annual snowfall of 111.8 inches may experience a maximum snowfall of 18.3 inches in a 24-hour period. Another location recording 17.8 inches in a 24-hour period may have an annual mean snowfall of only 7.2 inches.

   b. There is illustrated in Figure 1 on page 6 record data on the mean monthly total snowfall for selected locations in the contiguous United States. Although this type of data gives an indication of total snowfall and the number of months in which it occurs, several correlations are possible which also provide significant parameters. Normally, it would not be economically practical to provide large amounts of expensive snow removal equipment which may be needed for a very short period of the year. Arrangements can often be made to use equipment from nearby communities on a priority basis during emergencies.

c. The average number of days during the winter season that snow can be expected serves as an indicator of the number of times snow removal may be a problem. Figure 2 on page 7 illustrates the average number of days of snow cover each year for the contiguous United States. This data used in conjunction with that on total snowfall provides guidance on snow removal requirements influencing the amount of equipment and hence, the need for the facility.

d. Weather data indicate that communities having a mean annual snowfall of 15 inches or more have an average snowfall during a storm ranging from 2 inches to 6 inches. Average snowstorms in areas having less than a mean annual snowfall of 15 inches generally deposit less than 2 inches of snow. A correlation has been found to exist between the mean annual snowfall and the number of months during which more than 2 inches of snow fall. Research on the effects of snow and slush on aircraft takeoff operations has indicated that a 2-inch depth is critical in the relationship of retarding forces and available thrust. Thus, a mean annual snowfall of 15 inches or more has significance as an indicator of amounts of major equipment that may be needed for snow removal. Illustrated in Figure 3 on page 8 is the approximate dividing line in the contiguous United States between areas having more than and less than 15 inches mean annual snowfall.

e. Accumulated piles of snow remaining in operating areas can be hazardous to ground maneuvering of aircraft. Snow should therefore be removed from operating areas as quickly as possible for safety of aircraft and to avoid curtailment of service. This is particularly important in geographic areas where snowfall is quite heavy and where snow remains for long periods due to low temperatures.

6. ICING CONDITIONS.

a. The frequency with which runways and other paved operational areas are covered with ice affecting aircraft operations is relatively small. In the northern sections of our country, the use of sanding equipment may be required as many as 12 times during the winter season. Icy conditions at airports with weather similar to that of Washington, D. C., where only 15 inches of snow has been recorded as an annual mean, require the use of sanding equipment considerably fewer times during the cold months. There is a reasonably close correlation between the mean annual snowfall and the number of times during the year when icing causes hazardous conditions. Figure 3, showing the approximate dividing line for 15 inches mean annual snowfall, may be used as an indicator of the northern area where icing requires special consideration.

b. Ice formed by freezing rain is generally rare. The greatest problem arises from the alternate melting and freezing of snow during the cold months of the year. The periods when snows are of insufficient depth to warrant snow removal combined with

temperatures alternating above and below freezing present the greatest possibility of ice formation. Icy conditions on hard surface operational areas can occur with little warning during these periods.

c. The most common method of combatting icy surfaces lies in the application of sand. It has been found that reasonably nonskid surfaces can be obtained by the spreading of warm, dry sand. Dry sand can be spread most effectively, and any retained heat will set the sand in the ice to provide a nonskid surface texture.

7. MAINTENANCE AND SERVICES AFFECTING THE NEED.

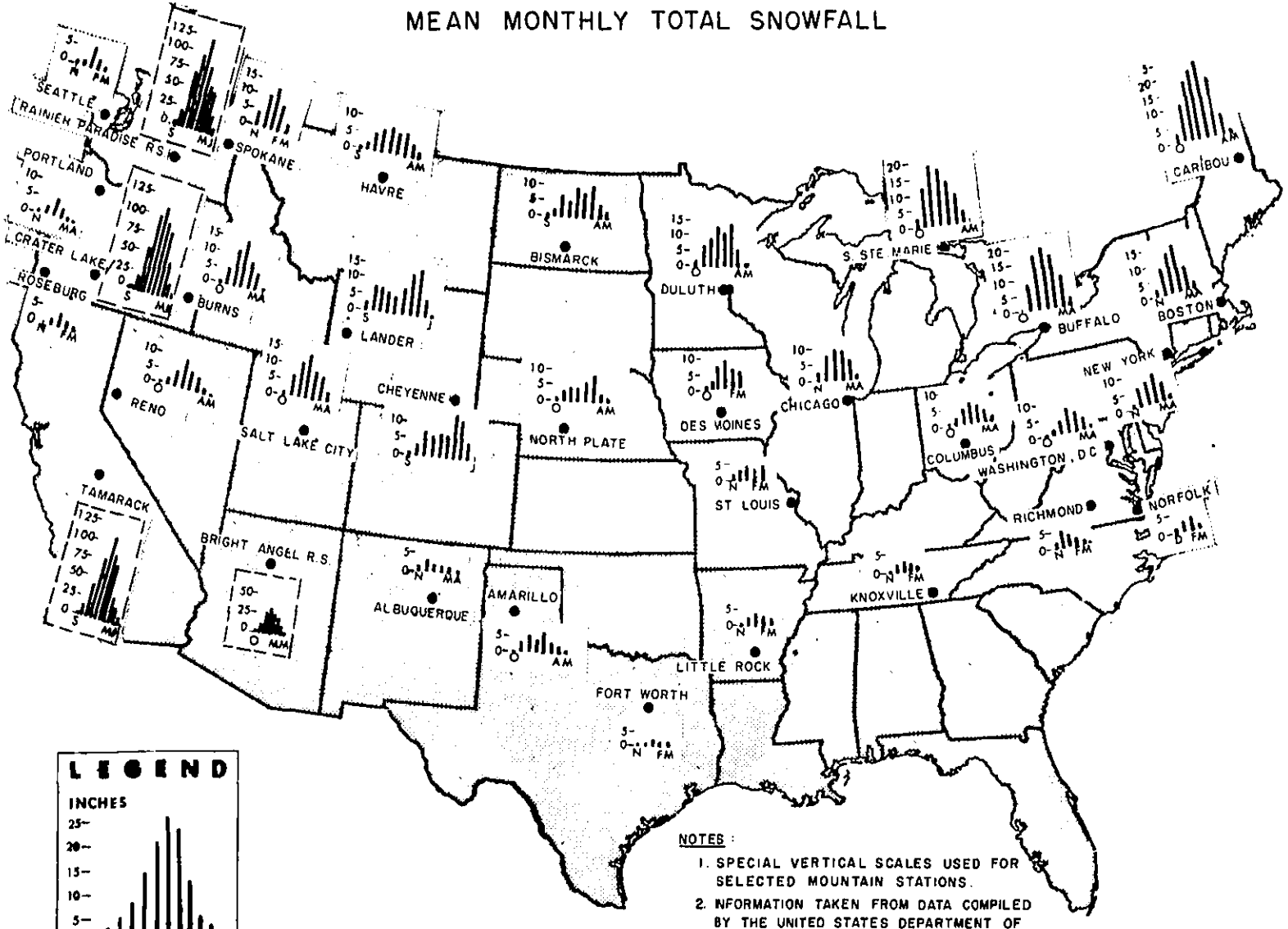
a. Debris Removal.

(1) The introduction of jet aircraft into service brought increased concern over the foreign matter that might collect on runways and other aircraft operating areas. Removal of debris from these areas is a matter of cleanliness and of maintaining conditions that encourage safe airport operation. The ingestion of debris of various kinds by the turbine engines of aircraft can cause damage to their working parts with consequent hazard to the safe operations of such aircraft; therefore, diligence is required on the part of airport management in keeping operational areas free of foreign matter.

(2) Even where jets do not operate, good housekeeping dictates that airport surfaces should be kept free of debris. Periodic inspection and sweeping, sufficient to keep the runways, taxiways, and aprons clear of undesirable accumulations, is recommended.

b. Other Airport Service Operations. Grass mowing, maintenance of marking, servicing of field lighting, patching of pavements, and other routine landing area maintenance work require a variety of equipment. Maintenance includes any recurring work necessary to preserve existing facilities in safe condition. Pavement maintenance of greater scope than crackfilling, refilling joints, and isolated patching can normally be expected to be accomplished by contract. It has been found that even where more than minimal pavement repair is accomplished, the very small amount of equipment for this operation will not be significant. Although the requirements for all equipment determined to be necessary to total maintenance and service operations must be considered, the factors discussed in this Chapter provide general guidance for most situations.

MEAN MONTHLY TOTAL SNOWFALL



NOTES:

1. SPECIAL VERTICAL SCALES USED FOR SELECTED MOUNTAIN STATIONS.
2. INFORMATION TAKEN FROM DATA COMPILED BY THE UNITED STATES DEPARTMENT OF COMMERCE WEATHER BUREAU.

FIGURE 1

AVERAGE ANNUAL DAYS
SNOW COVER OF AT LEAST 1 INCH

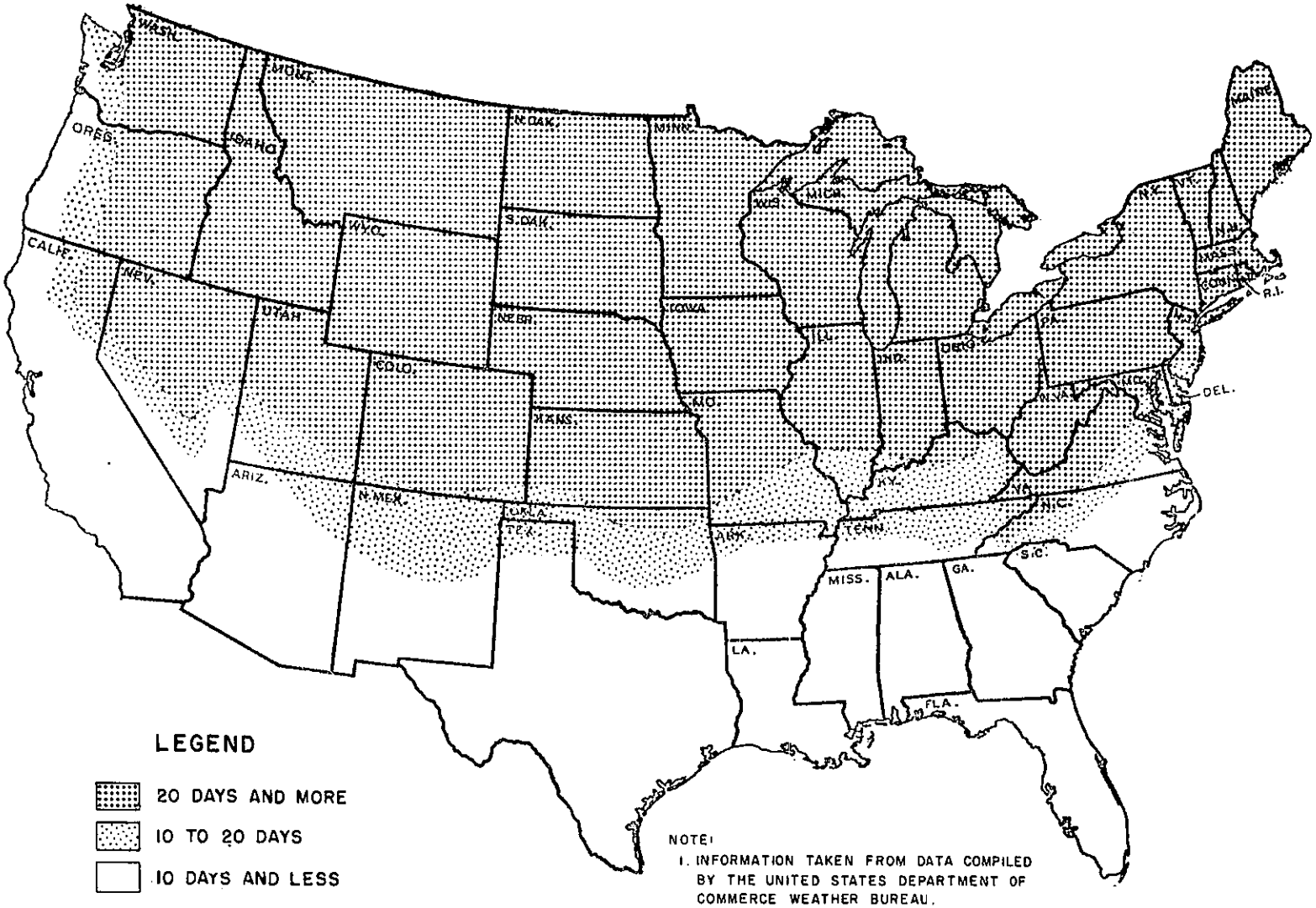


FIGURE 2

MEAN ANNUAL SNOWFALL

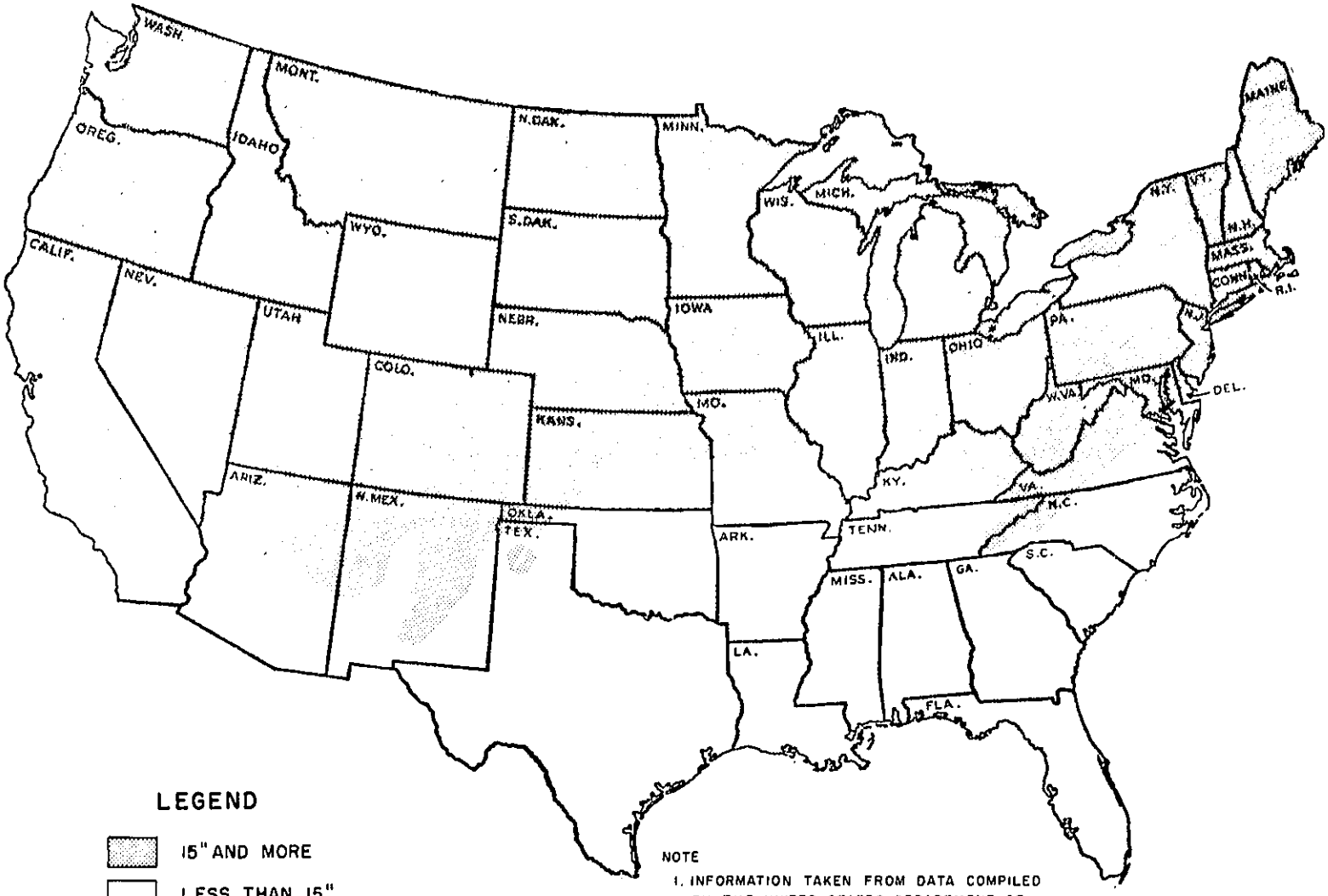


FIGURE 3

CHAPTER 3. THE BUILDING AND ITS SURROUNDINGS

8. FACTORS AFFECTING SPACE REQUIREMENTS.

a. The need for the facility having been clearly established, the next step is the design of the building and provision for required support items in the immediate surroundings. A review of the major factors affecting the need for a facility and a review of existing or contemplated airport maintenance procedures should provide an indication of what would constitute an adequate number of garage stalls for the equipment. No two airports can be expected to need exactly the same equipment or facilities. At some airports, a number of facilities may already be furnished in another building.

b. Some maintenance equipment, similar to construction equipment, will not require storage in a building of the type discussed herein. Also, some types of equipment, if adequately serviced and maintained, will not require shelter at all. At some airports, all servicing of vehicles may be done off the premises.

c. Office space is also an essential element to be considered in the functional design of the building. Storage for hand tools and parts, although not discussed in relationship to the various types of equipment, should not be forgotten in the analysis of space requirements. In addition, consideration should be given to the space required for personnel needs such as lockers, toilet and shower facilities, multipurpose rooms, and personnel equipment storage. At airports where few personnel are employed, separate locker rooms and storage facilities may not be needed.

9. SPACE REQUIREMENTS. It has been found that there exists a closer relationship between the number of vehicles used for maintenance and the amount of airport pavement than between the amount of equipment and the number of operations or passengers using the airport. Figure 4 is a tabular listing of runway lengths and the number of vehicle stalls found to be satisfactory at a representative group of airports. It is based on current usage figures. The application of these figures will provide general guidance where other data are not available. They must be carefully considered because every airport with a 10,000-foot runway in a cold climate does not need an 18-stall equipment building.

FIGURE 4 - REPRESENTATIVE NUMBER STALLS AND EMPLOYEES

Runway Length	Airport Mean Annual Snowfall			
	At least 15 inches		Less than 15 inches	
	Stalls	Employees	Stalls	Employees
10,000' or over	18	20	5	6
9,000' to 10,000'	16	18	5	6
8,000' to 9,000'	14	16	4	5
7,000' to 8,000'	12	13	4	5
6,000' to 7,000'	11	12	3	4
5,000' to 6,000'	10	11	3	3
4,000' to 5,000'	5	3	2	3
Less than 4,000'	4	2	2	2

10. COMBINATION FACILITIES.

a. A consideration affecting space requirements and space relationships is the advantages offered by combining facilities designed to meet a number of airport operational needs. At some airports, it may be desirable to consolidate the housing for fire and rescue apparatus and maintenance and service equipment into a single building. Airport management at an airport adjacent to large bodies of water may want to consider combined facilities at a site that would permit incorporating a facility to house a rescue boat. In every case, however, there are certain overriding factors, such as siting and accessibility for example, that must be considered in evaluating the advantages and disadvantages of combining different facilities.

b. There is an advantage in combining fire and rescue and service equipment facilities when personnel utilized as volunteer firefighters are maintenance personnel. This is particularly true when the airport management has undertaken the training of these men to operate fire and rescue apparatus. Even where this is not contemplated, combined facilities may be economical and satisfactory provided facilities can be made available for total needs and other requirements can be met. The requirements peculiar to the fire and rescue operation as indicated in the FAA publication, "Airport Fire and Rescue Equipment Buildings Guide", July 1961, must receive just consideration. The building site location on the airport should be in accordance with this publication.

c. A certain degree of isolation of facilities in combination buildings is essential for security purposes as well as for functional reasons. A full partition separating the two functional areas and isolating fire department activities and equipment is a requirement. Apparatus room requirements are such that tandem parking of vehicles is not recommended for emergency equipment. Office and storage space to satisfy the needs of the fire department should be separate from similar facilities provided for service equipment operations.

d. At airports where a 24-hour crew coverage requires living facilities including a dormitory for firefighters, the disadvantages associated with combining facilities override all other considerations. All of these factors must be evaluated. They are mentioned here preparatory to the detailed discussion of space relationships and other building elements that follow. Included in Figure 6 on page 15 is a typical layout showing space relationships which may be considered for a combined equipment building.

11. SPACE RELATIONSHIPS. Suggested space relationships for airports having varying equipment requirements are shown in Figures 6 and 7 on pages 15 and 16.

a. Equipment and servicing stalls should normally be between 12 feet to 14 feet wide and 40 feet long for typical equipment in order to allow a reasonable amount of space for circulation around each vehicle. Door openings of stalls should normally be 12 feet wide and 15 feet high for typical equipment. While most service equipment will conform to highway clearances and vehicular standards, the trend is toward larger units for special equipment developed to meet the needs of airport operation. Where stalls may be arranged to provide tandem storage of vehicles, the allowance for each vehicle space may be reduced to 35 feet with the over-all interior depth of the building being 70 feet. An example of this is indicated on Figure 7 on page 16. The ceiling height should be a minimum of 17 feet.

b. Office space sufficient to accommodate a desk, a few chairs, and a file cabinet should be provided for the maintenance superintendent. A room having an area of 100 square feet would be adequate to fulfill this need at most airports.

c. Storage space for tools and equipment should be provided adjacent to the stall area in which servicing of equipment is performed. A storage area of 60 to 80 square feet would provide reasonably adequate space for this purpose. The space may be provided along one wall of the service area in a group of secured shelves or cabinets, in a separate storage room, or both. Smaller equipment and hand tools needed in addition to those used for servicing may also be stored in the space provided.

d. Personnel Accommodations.

(1) Locker room facilities may be provided at airports where five or more persons are employed for maintenance and service work. These facilities may be combined with a multi-purpose room or other personnel accommodations. When the number of maintenance personnel approaches 14, completely separate locker room facilities should be considered. One locker, 15 inches wide, 22 inches deep, and 72 inches high, should be provided for each maintenance and service employee regularly employed at the airport. At small airports, where only a few maintenance personnel are employed, facilities for clothes storage and personnel needs may be more conveniently provided elsewhere than in the equipment building.

(2) Toilet, lavatory, and shower facilities allowances should be based on the total number of maintenance and service operations personnel. Toilet and shower facilities should be located adjacent to the locker room, and provision should be made for reasonable access from all working areas of the building.

(3) A multi-purpose room may, under some circumstances, be considered desirable for employee lunch room space when other eating facilities are not available on the airport. An allowance of approximately 10 square feet per employee would be adequate.

12. UTILITIES.

a. Lighting at the levels indicated in Figure 5 is recommended for the various areas of the building. The equipment storage area intensity level is based on the necessity of providing temporary auxiliary lighting when this space is needed for servicing and repair.

FIGURE 5 - SUGGESTED ILLUMINATION

Space	Foot Candles
Garage	5
Equipment Storage	100
Equipment Service and Repairs	30
Office	20
Storage Room	20
Locker and Lunch Rooms	20
Toilet and Shower Room	20
Heater Room	10
Exterior Surrounding	1

b. Normally, equipment storage facilities need not be heated. However, heating should be provided for spaces used for storage of snow removal and sanding equipment in cold climates. A minimum of 50° F. is desirable when outside temperatures are below 0° F. to assure starting of the equipment. Where practicable, the equipment servicing area should be heated to a minimum of 60° F. to provide sufficient comfort for working conditions. Other spaces in the building should be heated to about 70° F.

c. In addition to normal support utilities required for facilities discussed heretofore, consideration should be given to the special requirements of the operations to be accomplished in the building. A floor drainage system, equipped with oil intercept, sand trap and cleanout, is essential if this facility provides the only means for washing and removal of snow, ice, and debris. The need for an exhaust system to remove engine fumes from equipment should also be investigated as this factor will affect heat load discussed above.

13. BUILDING CONSTRUCTION.

a. The building design should be consistent with its functional requirements, and inexpensive utility type construction is encouraged. Consideration should be given to prefabricated metal structures which have proven economical and suitable under certain conditions. It should be kept in mind that equipment housed in the building is automotive, and engine fuel is highly combustible. The structure, especially one in which more than two vehicles are stored, should be built of incombustible materials. The insurance premium is one consideration that should be checked before selecting materials for the construction of the building. In some areas where a decision to erect a building of fire resistant, incombustible construction depends upon cost, it may be found that the savings in insurance premiums may more than offset the higher cost of a better class of construction.

b. Local building codes must be checked for structural and fire protection requirements as well as features affecting utilities and other matters. Although local codes may not be mandatory, these and the several national and area codes provide excellent guidance.

c. Finishes in the building will depend upon local factors, but they should be selected from the standpoint of low maintenance costs balanced against initial cost. In the garage, the floor should be smooth-finished concrete, the walls painted masonry block, and the ceiling structural units left exposed. The office, locker room, and multi-purpose room may be finished with asphalt tile on the floor or other flooring materials which can be applied to a concrete finished base. Walls may be painted masonry or plaster, and ceilings may be finished with plaster or other material having a suitable fire resistant rating. The toilet and shower room floors and wainscot should be of a hard impervious material for ease of cleaning. The walls and ceilings may be of a painted plaster.

14. STORAGE ADJACENT TO THE BUILDING.

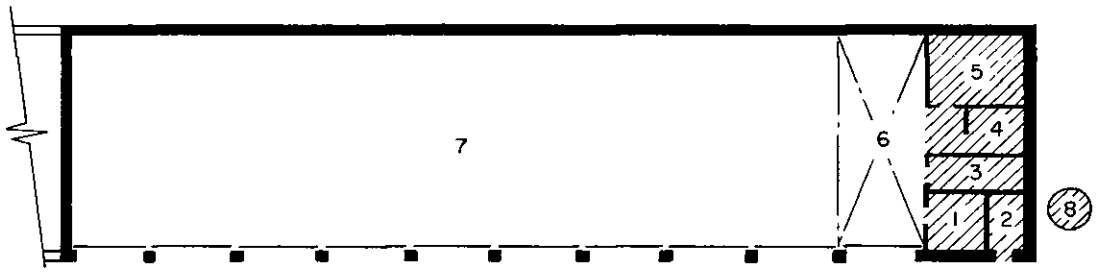
a. At airports where icy conditions are experienced and sanding is used as a method of maintaining safe operating surfaces under such conditions, availability of sand is often a problem. Where airports are not located sufficiently close to a quarry from which hot, dry sand can be procured readily, an adequate amount of sand should be stored in a dry condition on the airport.

b. At most airports where it is necessary to store sand, it has been found that between 250 and 300 tons should be readily available on the site. Since a problem arises when sand is stored in the open, various methods of providing for sand storage should be considered. Hot, dry sand is most desirable for spreading on icy surfaces. The dryness allows the sand to be spread effectively, and the heat sets the sand in the ice to provide a reasonably good abrasive surface.

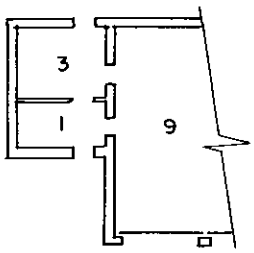
c. Where practicable, it is recommended that sand storage be provided adjacent to the building. One of the most effective methods of storing sand is in an elevated silo or hopper. Where this can be located adjacent to the building, access for trucks loading beneath it and problems of providing heating can be simplified. Other methods of storage at grade may be satisfactory provided mechanical loading equipment is available.

LEGEND

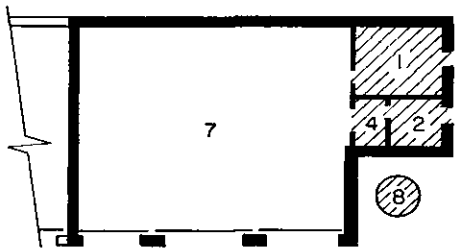
1. OFFICE
2. HEATING ROOM
3. STORAGE
4. TOILET & SHOWER ROOM
5. LOCKERS & MULTI-PURPOSE ROOM
6. VEHICULAR SERVICE
7. EQUIPMENT GARAGE
8. SAND STORAGE
9. FIRE APPARATUS ROOM



TEN STALL SERVICE EQUIPMENT BUILDING



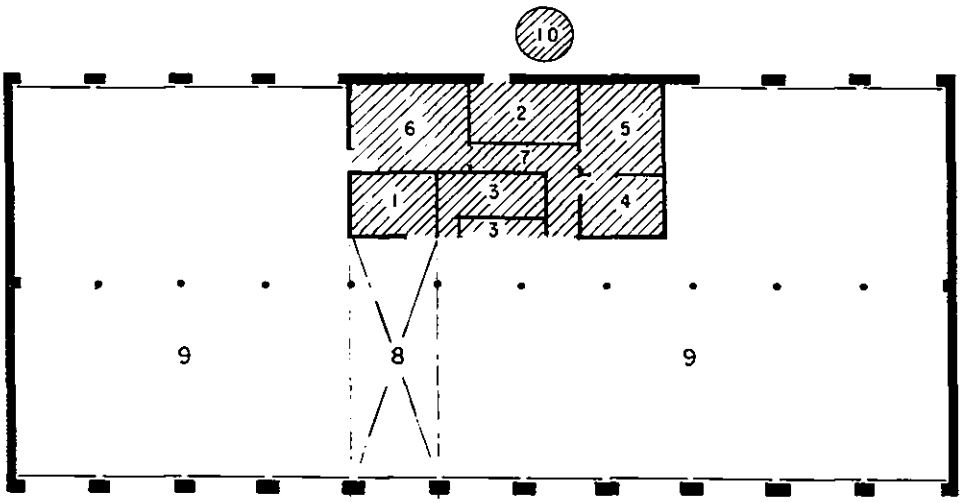
FIRE AND RESCUE
EQUIPMENT UNIT



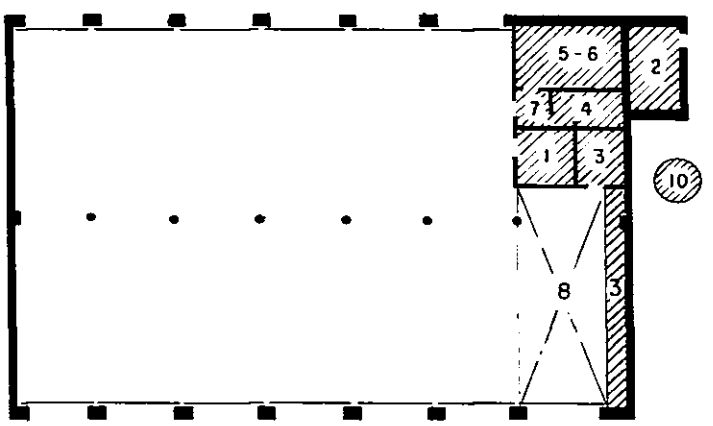
THREE STALL SERVICE
EQUIPMENT BUILDING

NO SCALE

FIGURE 6 COMBINATION EQUIPMENT BUILDINGS



EIGHTEEN STALL BUILDING



THIRTEEN STALL BUILDING

LEGEND

1. OFFICE
2. HEATING ROOM
3. STORAGE
4. TOILET & SHOWER ROOM
5. LOCKER ROOM
6. MULTI-PURPOSE ROOM
7. PASSAGE
8. VEHICULAR SERVICE
9. EQUIPMENT GARAGE
10. SAND STORAGE

NO SCALE

FIGURE 7 SERVICE EQUIPMENT BUILDINGS

CHAPTER 4 - BUILDING SITING

15. IMPORTANCE OF SITE PLANNING. The service equipment building must be sited in a location that will contribute to the efficient operation and performance of equipment and personnel. The analysis and study to determine the location of the building is the most important single consideration presented in this discussion. The efforts expended toward an effectively planned operation and an efficiently designed functional building will be nullified should the facility be sited in an ineffectual location on the airport.

16. LOCATION ON THE AIRPORT.

a. The study to determine the location for the service equipment building should consider the proper relationships of each of the essential airport building categories identified by activities related to the terminal and to administration, to commercial aircraft facilities, to other airport oriented operations, and to aviation oriented industry which may be located on the airport. Operational activities in addition to administrative functions are generally grouped according to the relationship to the services provided by governmental agencies, air traffic control, communications, and weather; to the services provided by airport management; to the aircraft sales, storage, maintenance, and flight training; and to air cargo, express, and air mail movements. The service equipment building and fire and crash rescue building are associated with a group of operational services provided by airport management for planning purposes. It is this relationship which led to the discussion of combining facilities under Paragraph 10 on page 10.

b. There are three principal considerations that should determine the location of this functional group of operation buildings including the service equipment building. It must be close to the heart of airport operations for control of maintenance and service activities. It must be accessible to airport service roads, particularly the airport perimeter road. This will permit the equipment to reach all operational areas of the airport without having to cross active runways. It must be centrally located with respect to airport pavement areas particularly air carrier aircraft passenger loading aprons, to other public loading and servicing aprons, and to landing area facilities. Examples of specific locations which have been selected after reasonable consideration of factors discussed in this Chapter are shown on Figure 8 on page 19. Site locations are indicated by order of preference.

17. PLANNING CONSIDERATIONS. The location of the operational activity having been established and the preliminary design concept of the building selected, a number of other factors should be studied prior to adoption of a siting plan.

    a. The arrangement of buildings and associated support facilities is important to satisfactory and efficient use, and it also affects future extensibility of the equipment building to accommodate additional garage stalls. Important in this regard is consideration of spacing of buildings for access, vehicular circulation, and fire and safety clearances. The proper orientation of the building, with respect to these factors, and the prevailing winds is essential to the functional operation of the building. In any climate, an attempt should be made to orient the building so that the large door openings will be least exposed to prevailing winds. In snow country, an effort should be made to take advantage of wind movements to reduce drifting against the building and, where possible, to remove snow away from vehicular entrance doors.

    b. Since, under most circumstances, it will not be considered practicable to site the building adjacent to aircraft operational aprons, provision should be made for adequate circulation and unobstructed access. Economical design dictates the need for balance of requirements for paved areas with other considerations discussed heretofore. Good drainage consistent with driveway, parking, and pedestrian access requirements is also important.

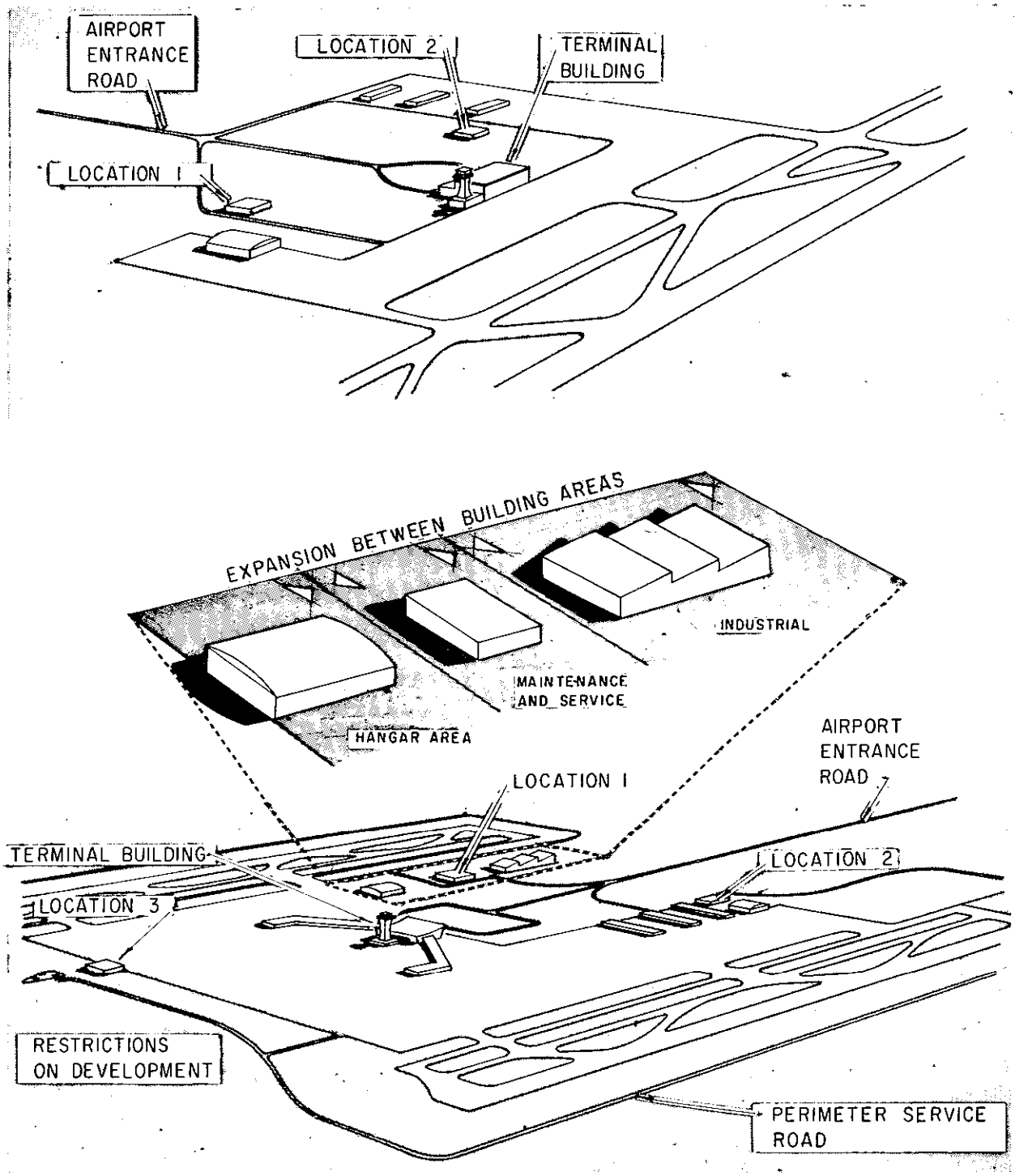


FIGURE 8 SERVICE EQUIPMENT BUILDING SITING

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