

P378
.G85



BILLINGS LOGAN
INTERNATIONAL AIRPORT

STATEMENT OF PERMISSION TO COPY

In presenting this thesis in partial fulfillment of the requirements for an advanced degree at Montana State University, I agree that the Library shall make it freely available for inspection. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by my major professor, or, in his absence, by the Director of Libraries. It is understood that any copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Signature Dennis Greene

Date June 20, 1984

BILLINGS LOGAN INTERNATIONAL AIRPORT

by

Dennis W. Greeno

A thesis submitted in partial fulfillment
of the requirements for the degree

of

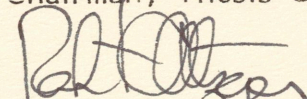
BACHELOR OF ARCHITECTURE

Approved:

Thesis Advisor



Chairman, Thesis Committee



Director, School of Architecture

MONTANA STATE UNIVERSITY
Bozeman, Montana

June 1984

ACKNOWLEDGEMENTS

To my wife and friend, Nola, a person of love, patience, and encouragement.

To my family, without whose love and support this goal in my life would not have been reached.

To my advisor, David Matthews, whose concern goes beyond architecture.

To Kellee, Randy, and Guy, friends who have made the journey brighter.

To Bruce Putnam, and the airport staff, who were so willing and eager to help.

To God, the great architect and builder of the universe, whom I thank for allowing me to be here.

ACKNOWLEDGEMENTS

If one is to make observations about airports, it is important at the onset to define what an airport is. Webster defines airport as a "place where aircraft can land and take off, usually with facilities for repair."¹ In simplest but not inclusive terms this does describe one aspect of an airport.

If we wish to define airport in more extensive words, it is first essential to set the parameters to establish what the term airport means. If Webster's definition were to be used, countless visual images surface. Does a gravel road constitute a runway or a toolbox in a pickup truck a repair facility?

For the purpose of this project airport should include the following within its definition. Airports are transitional spaces between one mode of transportation and another; airports, therefore, act as links between earth and sky. Airports communicate in a unique language usually in graphic form. This language continually directs users in specific paths to desired locations. In this sense airports are much like organisms with specific internal circulation strategies. Airports also are educational devices which introduce to people technology manifested in the form of aircraft. Airports do indeed include runways and other related support facilities, but these aspects will remain status quo and concentration

will be placed on the space where machine and man converge.

It is also important at this time to state a personal attitude. It is not the intention of this thesis project to redefine the mechanics of airport systems. Years have been expended by numerous professionals attempting to develop airport systems which work efficiently. It would be presumptuous and ignorant of one with so little hands-on experience to attempt this feat with so few tools. Rather, the goal of my involvement in the design of an airport terminal for Billings is to examine their relationship to man and offer suggestions via the final design which might enhance and establish a more positive personal environment, one which can be enjoyed rather than endured.

The strategy to develop the suggestions might best be achieved through an examination of airports in both positive and negative qualities.

Airports are incredible mechanisms for processing and manipulating people. Airports on a large scale are forced into dealing with catastrophic numbers of people, cars, aircraft, volumes of luggage, pounds of mail and freight all converging from different origins with specific and very rhythmic destinations.

INTRODUCTION



Often man is critical of a particular system when inconvenienced, which unfortunately frequently occurs at airports, but if for a moment we step back and view the entire situation, we might conclude that it is amazing it works as well as it does.

Airports also deal with time in a unique way. Because of the speed of aircraft, time has become far more important in units not commonly stressed in the everyday world. Flight patterns, approaches, taxi of aircraft all become important events measured in minutes and sometimes seconds. The entire scenario experienced endeavors to become as a fine tuned watch and for this reason airports should be applauded.

Is is perhaps from these efforts to maximize certain aspects of airport planning that other issues more directly related to the human experience have been neglected. The late Eero Saarinen, when asked to define in his opinion the purpose of architecture, stated "to shelter and enhance man's life on earth and to fulfill his belief in the nobility of his existence."² This statement offers to the architecture profession a challenge requiring an uncompromising sincerity to our fellow man. Because architecture should make a forceful effort to enhance man's life on earth, it should encourage, sympathize, reflect, with



him. Airports, while succeeding in pragmatic and functional concerns, contribute minimally to an architectural fabric.

"Airports are probably the ultimate of placelessness. The traveler parks his car, enters a vast funnel, walks through one tunnel into another, does not meet anyone, goes through a small doorway, sits down in a long tube, and perhaps does not even see the outside of the place in which he flies."³

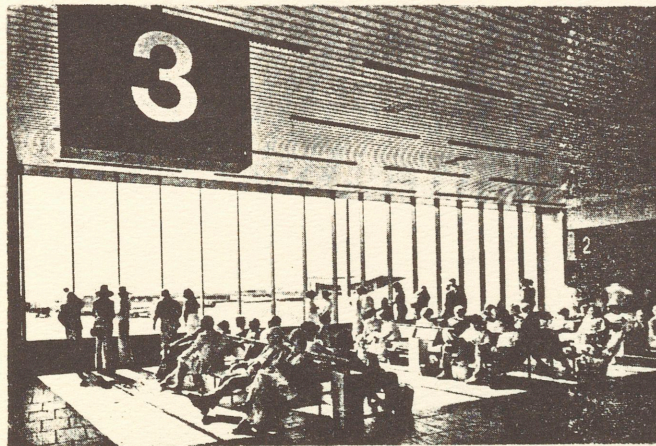
Although the above statement might unfairly generalize the airport experience, it does occur in a very real sense for countless thousands of people who experience airports enroute to their destination where the space is encountered alone and little or no provision is made to welcome, much less comfort or uplift, a weary traveler. This situation becomes much more alarming when it occurs in smaller airports which could more readily create a positive architectural environment. This situation occurs primarily because of the motivation in airport planning. "In the United States, we organize air transport around private, competitive airlines each striving for their own profit, and place more emphasis on economic efficiency than social amenities."⁴ Often the means to economic efficiency result in architecture that attempts to remain at the forefront of technological

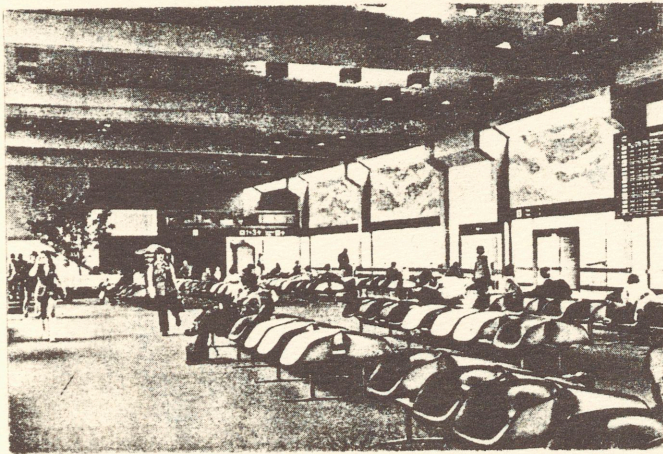
advancement and provides no recognizable language for the layman. The manifestation of this technology is often realized in materials, graphics and in a broad sense the entire airport system. "Geometric symmetry of the exterior shell is an abstraction prized mainly by designers; it is rarely even noticed by others who are too busy trying to find their way around."⁵

Airports are without a doubt complex circulation problems, but clearly defined circulation schemes present an incomplete architectural environment. Airports provide an excellent opportunity for cities or regions to inform and invite passengers to discover them. A goal of the design is to create an inviting atmosphere, one that does more than simply move people to and from aircraft.

Airports are very dynamic spaces; to some, this dynamic quality brings with it excitement, to others fear. A goal of the design is to introduce this movement to people in terms that they will enjoy.

In a very real sense it is easier to state one's desires than it is to accomplish them, and I am certain that the final product will carry with it some of the weaknesses inherent to existing solutions. This occurs because design is a conglomeration of parts which are generated from past experience and examples. Personally, the important issue is not





4

whether the product solves all the problems but that
it offers a direction to the ultimate solution.

Until only recently man has been held captive of the earth. But in the mere span of a lifetime man has not only been liberated from the earth but has soared higher and faster than would have been believed. Perhaps as long as man has walked upon the earth he has gazed heavenward at the birds and imagined floating on the invisible wings of air. Greek mythology tells us of a father, Daedulus, fashioning wings for his son, Icarus. Acting against his father's advice, Icarus flew too close to the sun melting the wax used to fasten the wings and plunging to his death.

"Leonardo da Vinci between the years of 1486 and 1490 sketched imaginative ideas of how man could fly. Replacing a traditional method of strapping wings to a man's arms, he envisioned a mechanical mechanism with wings powered by human energy."⁶ These mechanisms came to be called ornithopters, derived from the Greek word "ornitho" meaning of or related to birds. Because of the structural differences that inherently exist between man and birds, these mechanisms were destined to fail.

"It wasn't until November 21, 1783 that man first experienced a true but comparatively speaking rudimentary form of flight. Joseph and Etienne Montgolfier designed and constructed the first hot-air

balloon which carried Pilatre de Rosier and Marquis d'Arlandes five miles across Paris on a flight which lasted twenty-five minutes."⁷ Although the hot-air balloon offered no technical advancement to an understanding of heavier than air flight, it proved that man could fly and would provide the only method of flight for the next 100 years.

Although heavier than air flight would not occur until the dawn of the twentieth century, many advancements were necessary to bring this dream to fruition. "A British scientist, Sir George Cayley, was the first to conceptualize a flying device with a fixed wing used to generate lift and a separate mechanism for propulsion."⁸ In a sense Cayley discovered the essence of modern aircraft. In 1853 he accomplished a portion of the dream as he built and flew the world's first human carrying glider. Although the glider was yet uncontrollable, George Cayley's work in the development of aeronautics was perhaps the single greatest impetus in liberating man from the earth. Except for a few, the scientific world was not eager to carry the torch lit by Cayley because his work became obscure soon after his death in 1857 and would not be utilized until the end of the century.

The year of Cayley's death brought success to another aeronautic engineer, a Frenchman by the name of Felix du Temple. "In 1857 he flew the first successful model airplane in history, it had swept-forward wings and was powered by clockwork."⁹ In 1874 he then expanded his model version into a life-size aircraft powered by a steam engine. Although the aircraft left the ground momentarily, it did not achieve any form of sustained flight.

The interest in flight was worldwide. In July of 1884 in St. Petersburg, Russia, Alexander F. Mozhaiski was the second to attempt powered but assisted takeoff. It too did not accomplish sustained flight.

With all of the efforts to free man from earth in a heavier than air aircraft, it was not until 1891 that someone literally jumped into the air with wings and flew in a controlled fashion. "Otto Lilienthal, a German, developed and flew gliders based on extensive study, and in a five year span flew 2500 successful glider flights."¹⁰ On August 9, 1896 Otto Lilienthal would encounter a gust of wind stalling his glider and plunging him to the ground where he would suffer a broken spine resulting in his death. It has been speculated that, had he not died so untimely, he would have been the first to accomplish

flight due to his ongoing research with powered engines.

"Aeronautics finally came to America in 1896 as Octave Chaute, a naturalized Frenchman, developed and flew a biplane glider which introduced a Pratt truss that would greatly influence the design of the Wright brothers."¹¹

There exists one other noteworthy event prior to the success of the Wright brothers. "Samuel Pierpont Langley, an American, built a series of powered aircraft which culminated in two attempted piloted flights, both in 1903 just weeks before the Wrights' historical flight."¹²

"On December 17, 1903 Orville Wright, witnessed by his brother Wilbur and five others, was the first to voyage in a heavier than air aircraft. His maiden voyage encompassed a distance of 120 feet at an altitude of 10 feet and lasted a mere 12 seconds."¹³

The historical information concerning man's endeavors to fly is purely academic, but it does display the courage and desire man has exerted in the pursuit of a dream. The truly amazing realization is the speed in which events have occurred since the Wrights' maiden flight. For instance, in the early 1960's a rocket powered airplane, the X-15, flew at a speed of 4,100 mph at an altitude of 314,750 feet. It

is incredible to consider that the time lapsed between the Wright Flyer I and the X-15 was less than the lifespan of a man. Not only have aircraft soared higher and faster, but the weight of aircraft and the number of people able to fly per aircraft have increased manifold times.

Flying has certainly changed and challenged our concept of time and distance, perhaps more than any other single event. It is because of this fascination with flight that an airport terminal building was considered. As a child, no greater excitement was experienced than a visit to the airport. The immensity of the aircraft, the noise, the hustle and bustle of passengers carry with it an excitement experienced in few environments. No other building enjoys such a dynamic movement of people and machines. It offers a tremendous challenge both in function and atmosphere. The terminal is the interface between man and sky. Because it is a transition zone, special consideration must be given to the user. Due to the inherent qualities of the space, it becomes necessary to determine which aspects should be emphasized and which should be minimized. The airport terminal provides an intriguing environment which is perhaps not yet fully understood by the passenger or the architectural profession.

Since its founding in 1882 Billings has developed an intimate association with transportation. As in most western cities, the railroad initially played the single greatest role in establishing urban centers. Prior to the railroad, which began passenger service in August 1882, the Yellowstone River, located south of the city, boasted a fleet of river boat steamers.

Transportation has increased in importance since the city's inception. Billings has established itself as a transportation hub serving Montana, Wyoming, North and South Dakota via railroad, highway, and air facilities.

Although railroad passenger service is not available in the Billings area today, Burlington Northern Railroad has maintained an active role in the transportation of coal, grain and other goods to and from Billings. A major switching yard is located in neighboring Laurel, and Burlington Northern operates an industrial park in Billings to meet specific needs of rail users.

"Four interstate highways connect Billings directly with metropolitan areas in the west and midwest. Interstate 90 provides a direct route to Chicago, Spokane, and Seattle. Interstate 94 is a direct route to Minneapolis. Interstate 25, via Interstate 90, links Denver and Billings. Los Angeles and

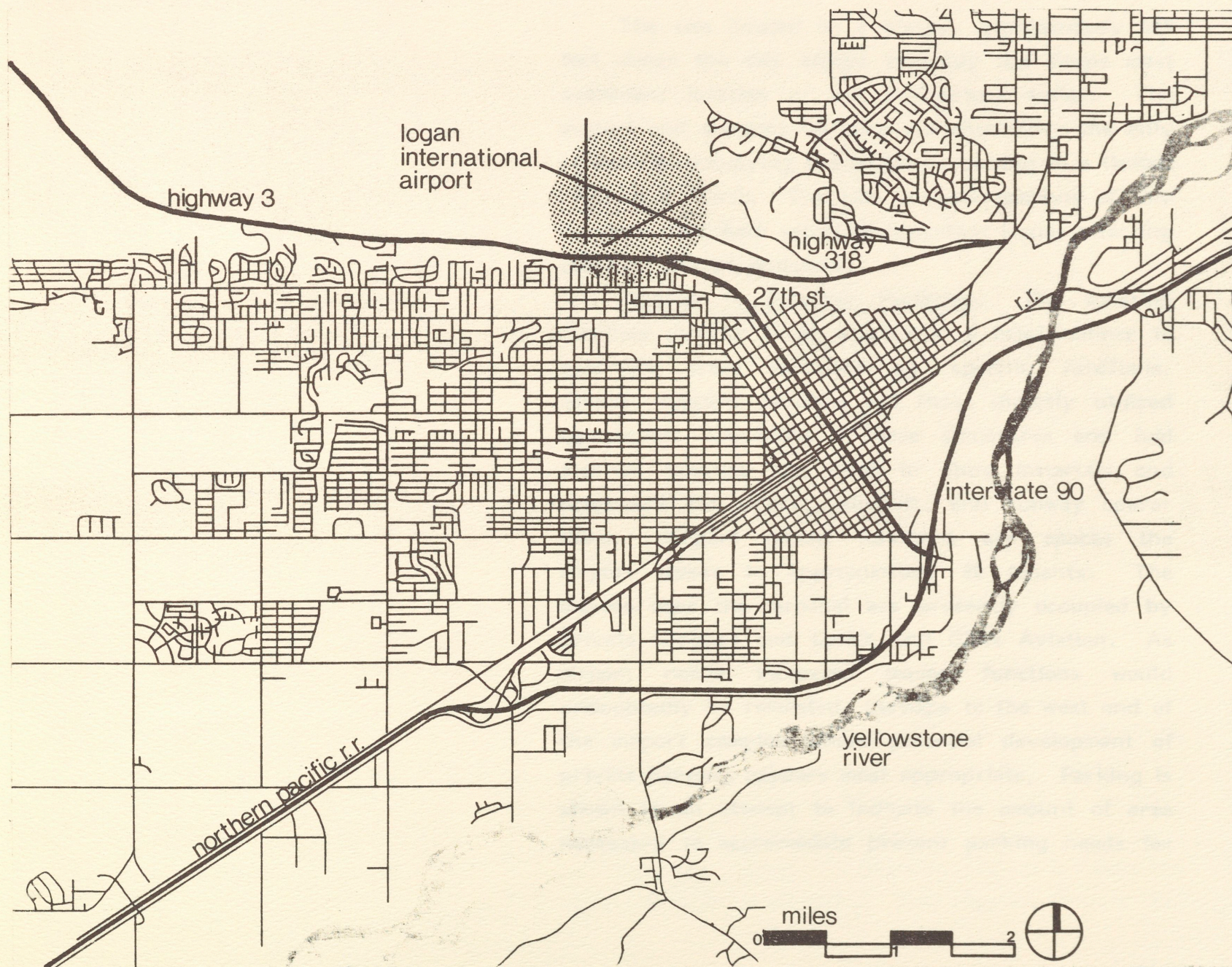
Salt Lake City can be easily reached by Interstate 15 and 90."¹⁴ The interstate system and central location of Billings has aided in the establishment of eight interstate and seven intrastate freight carriers.

Since the decline of railroad passenger service, the airport's role within the region has experienced consistent growth. With 342,000 enplaning passengers in 1983 Billings Logan International Airport accounted for nearly fifty percent of all air travel within the state. Billings is currently served by four commercial air carriers: Northwest Orient, Frontier, Western, and United. Big Sky Airlines, a Billings based commuter airline, serves cities in Montana, Wyoming, North Dakota, and Minnesota. In addition to airlines, three fixed based operators, Corporate Air, Gillis Aviation, and Lynch Flying Service, operate in Billings. Air freight carriers in addition to services provided by commercial carriers are: C&C Airfreight, Montana Air Cargo, Logan Air Freight, and recently added Federal Express, which serve in mail and cargo capacities.

Transportation has acted as a catalyst in providing growth in industrial, commercial, cultural, medical, and entertainment areas. Billings' trade area of nearly 300,000 square miles provides services in a four state region. This growth has enabled the local

economy to expand into numerous areas resulting in a diverse economic base.

Transportation has and will continue to be a significant force in the future development of Billings. As air traffic continues to grow, a substantial challenge is established. This challenge can be an opportunity for the city to address in architectural form an environment that is sensitive and informative of the regional qualities and attitudes. This environment will not only inform people, be they the people of Billings, potential business clients or visitors, but will offer to the city an image not removed from its residents but rather a reflection of its people.



BILLINGS

The site located on a plateau approximately 500 feet above the city enjoys probably the single most prominent location in the Yellowstone valley. The airport and support facilities are essentially the only structures occupying the plateau resulting in a limited contextual fabric. The site analysis consists of five diagrams that help establish important issues affecting potential design decisions.

Diagram - Existing Facilities. The existing facilities diagram is an attempt in a brief manner to establish areas occupied by specific functions. Airport support facilities are those directly utilized by airport operations. These structures and fuel storage facilities are used to store materials and equipment for airport, aircraft, and runway operations. Airport tenant functions are spaces the airport leases to approximately 90 tenants. The lessees near the terminal are presently occupied by private hangars and Lynch and Gillis Aviation. As airport needs increase, leased functions would undoubtedly be relocated, perhaps to the west end of the airport complex where potential development of private hangars appears most appropriate. Parking is shown in an attempt to indicate the amount of area necessary to accommodate present parking needs for

long- and short-term automobile, employee, and car rental.

Diagram - Runways and Vehicular Access. Air carrier runway shown in black is the runway utilized by commercial air carriers and general aircraft. The runway is 150 feet wide by 10,500 feet long and is capable of accommodating larger aircraft, i.e., 747's. Basic transport and general utility runways are used exclusively by general aircraft. Taxi is space required for aircraft to maneuver to and from the terminal and hangars, to runways. Aircraft land and takeoff in directions dictated by current weather conditions.

Vehicular access to the site is realized from three routes: Highway 318 from the east, Highway 3 from the west, and 27th Street from Interstate 90 south of the city. The point where the three converge has developed into a problem with serious potential and will therefore be considered in the design. Because of the expected increase in airport usage, the entrance issue becomes an important element within the airport design and should be addressed in a manner which will provide a positive solution to meet future demands.

Diagram - Noise.¹⁵ Noise is without a doubt an expected issue at airports. This diagram denotes the

severity of the problem, though the duration of noise is related to air traffic at specific times of the day. Through proper location of the building a buffer could be generated allowing the possibility of exterior space. Because noise is an inherent characteristic of airports, the building envelope must be given special care, especially in detail to insure appropriate control.

Diagram - Sun Path and Wind.¹⁶ The site, due to its vertical location and absence of surrounding structures, enjoys ample sunlight. This characteristic might support large areas of glazing or atrium space within the terminal. The site also is not buffered in any sense from winter storms and wind. Care, therefore, needs to be exerted to provide barriers via walls or plantings to protect passengers as they enter and leave the building envelope.

Diagram - Views to Surrounding Landscape. There exist views in two senses at the airport site, though only one, views to surrounding landscapes, is diagrammed. Views in close proximity to the site, particularly toward runways, provide site occupants a very dynamic visual involvement with the airport. The terminal should provide ample visual links toward runways, internally.

The site, due to its unique vantage point, provides views to distant landscapes perhaps not experienced from a less elevated location. From the control tower the city and entire valley unfold providing a unique experience. This can provide an excellent opportunity architecturally to provide an elevated observation space from the airport.

Views have been described as desirable, neutral, and undesirable. Neutral views are those which, apart from the aircraft activity, represent visual access toward unbroken plains or residential development. These views to the north are in no sense negative but assume a secondary position in relationship to views toward the south into the city.

legend EXISTING FACILITIES

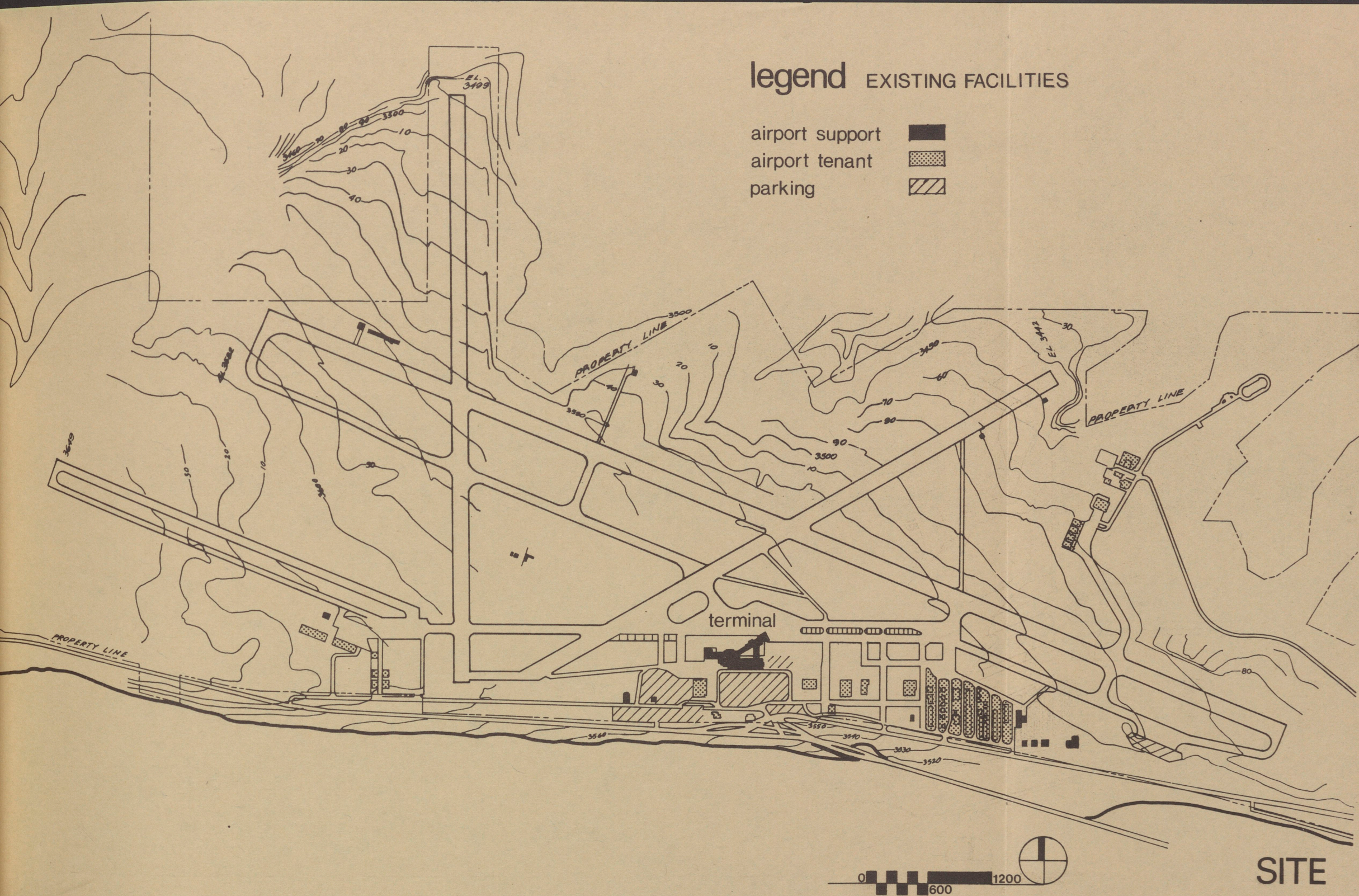
airport support



airport tenant



parking

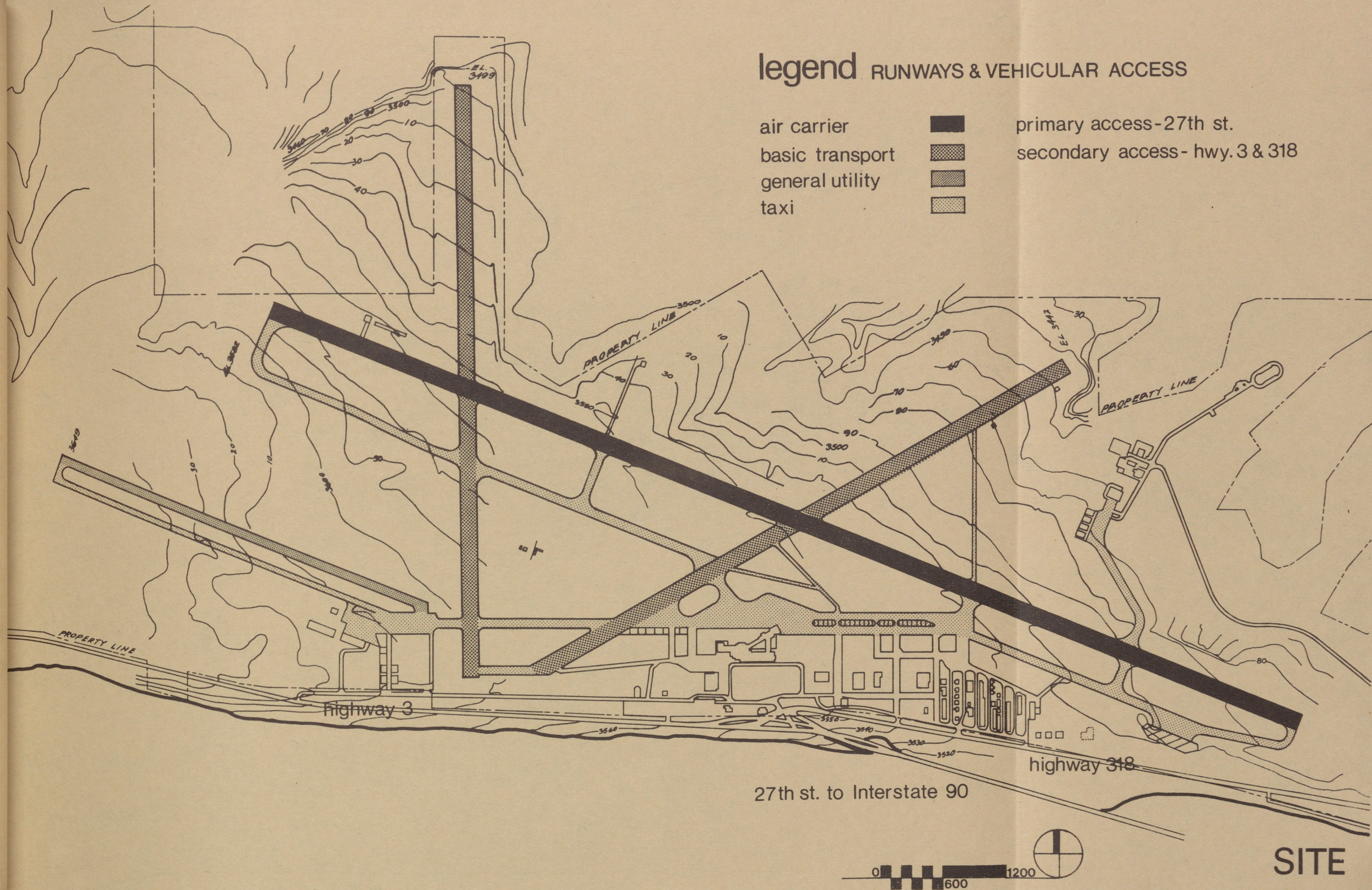


legend RUNWAYS & VEHICULAR ACCESS

air carrier
basic transport
general utility
taxi



primary access-27th st.
secondary access- hwy.3 & 318



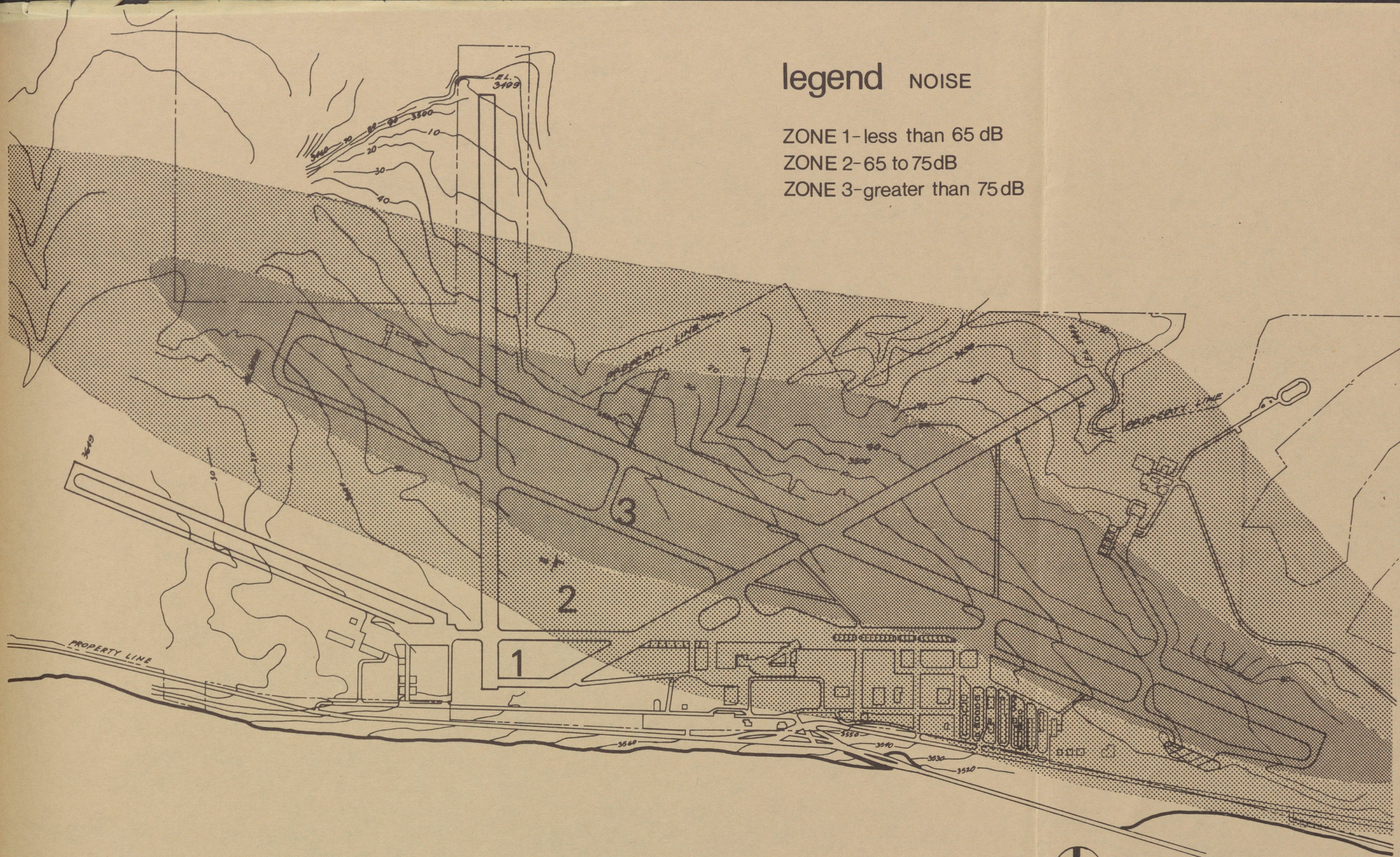
SITE

legend NOISE

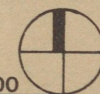
ZONE 1-less than 65 dB

ZONE 2-65 to 75dB

ZONE 3-greater than 75 dB

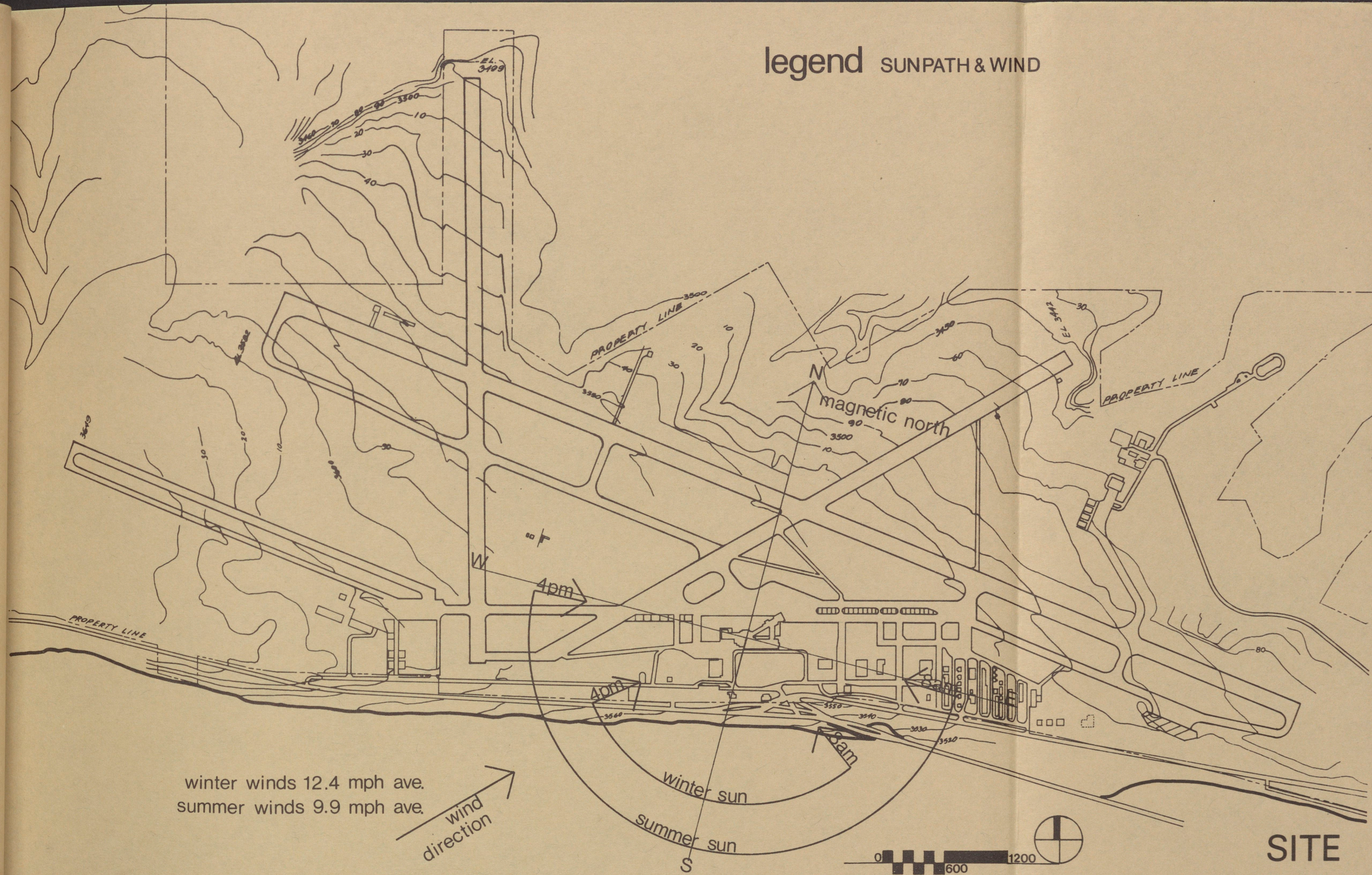


0 600 1200



SITE

legend SUNPATH & WIND



winter winds 12.4 mph ave.
summer winds 9.9 mph ave.

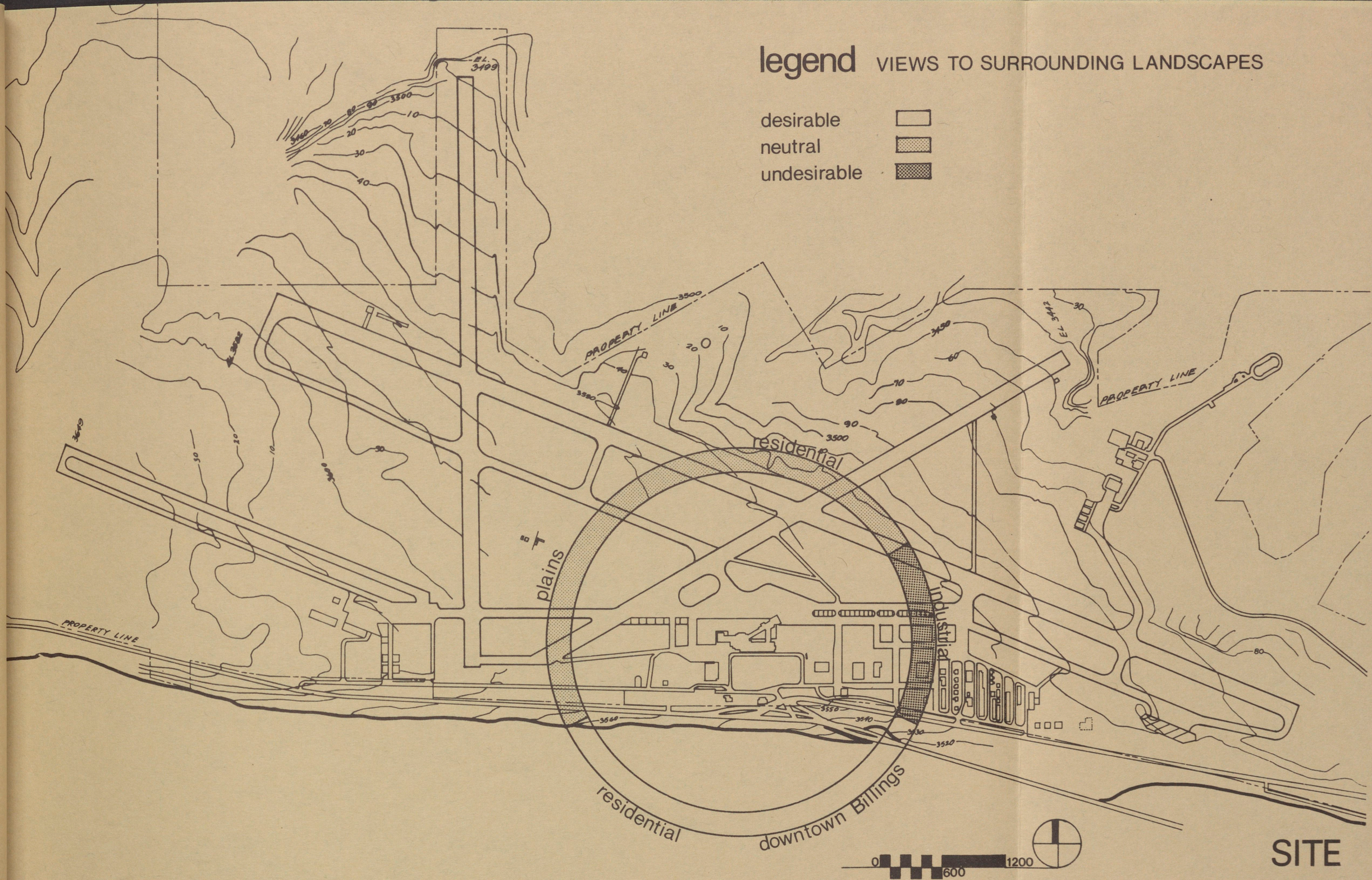
wind
direction

winter sun
summer sun
S

SITE

legend VIEWS TO SURROUNDING LANDSCAPES

desirable 
neutral 
undesirable 



Due to the elevated and rather obstruction-free location of the site, climatic characteristics might offer valuable information affecting design development.

"Billings, Montana, at an elevation of 3100-3600 feet above mean sea level, is situated in the borderline area between the great plains and the Rocky Mountains and has a climate which takes on some of the characteristics of both regions. Its climate may be classified as semiarid, but with irrigation and the favorable distribution of the precipitation during the spring and autumn months, it is possible to raise a variety of crops in the area."¹⁷

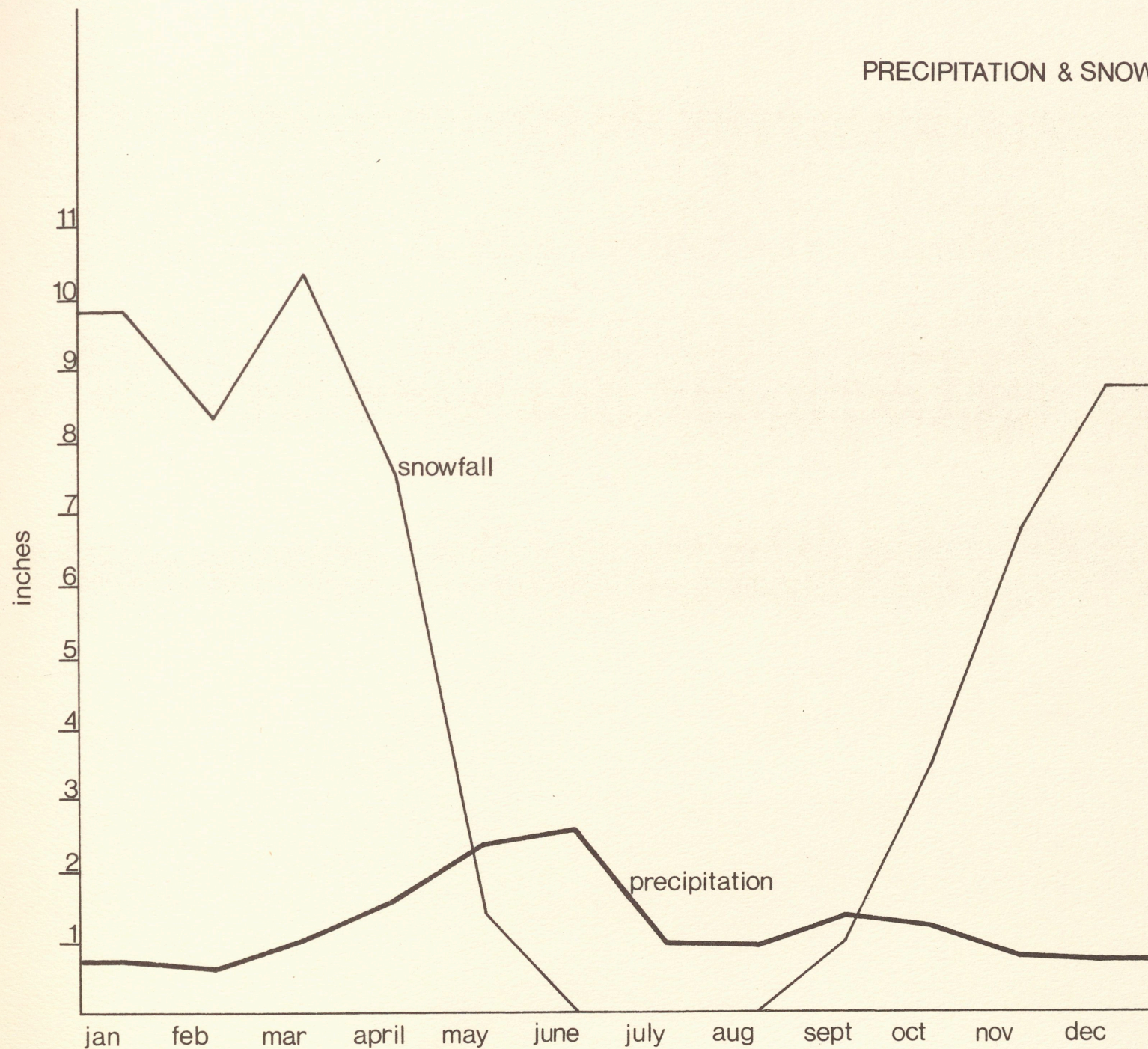
Diagram - Precipitation and Snowfall.¹⁸ Billings receives on the average a little more than 14 inches of precipitation a year with the majority of it falling in the spring and fall months. Although the amount of precipitation is low, there does exist the possibility of substantial snowfall in winter months. The winters are generally interrupted with mild periods resulting in thawing of snow accumulations, but adequate space should be considered for snow removal from parking and pedestrian paths.

Diagram - Temperature and Humidity.¹⁹ The temperature in Billings is uncommonly mild for the region, especially in winter, as it frequently enjoys a

"drainage wind moving down the Yellowstone Valley which transports warmer air of Pacific origin to the area."²⁰ Summer temperatures are comfortably warm with mild nighttime temperatures. Humidity does not pose as a detrimental condition of the site but rather helps maintain a comfortable environment, particularly during summer and early fall. In part due to temperature and site orientation, interior green space might be explored in an attempt to provide an inviting environment during winter months.

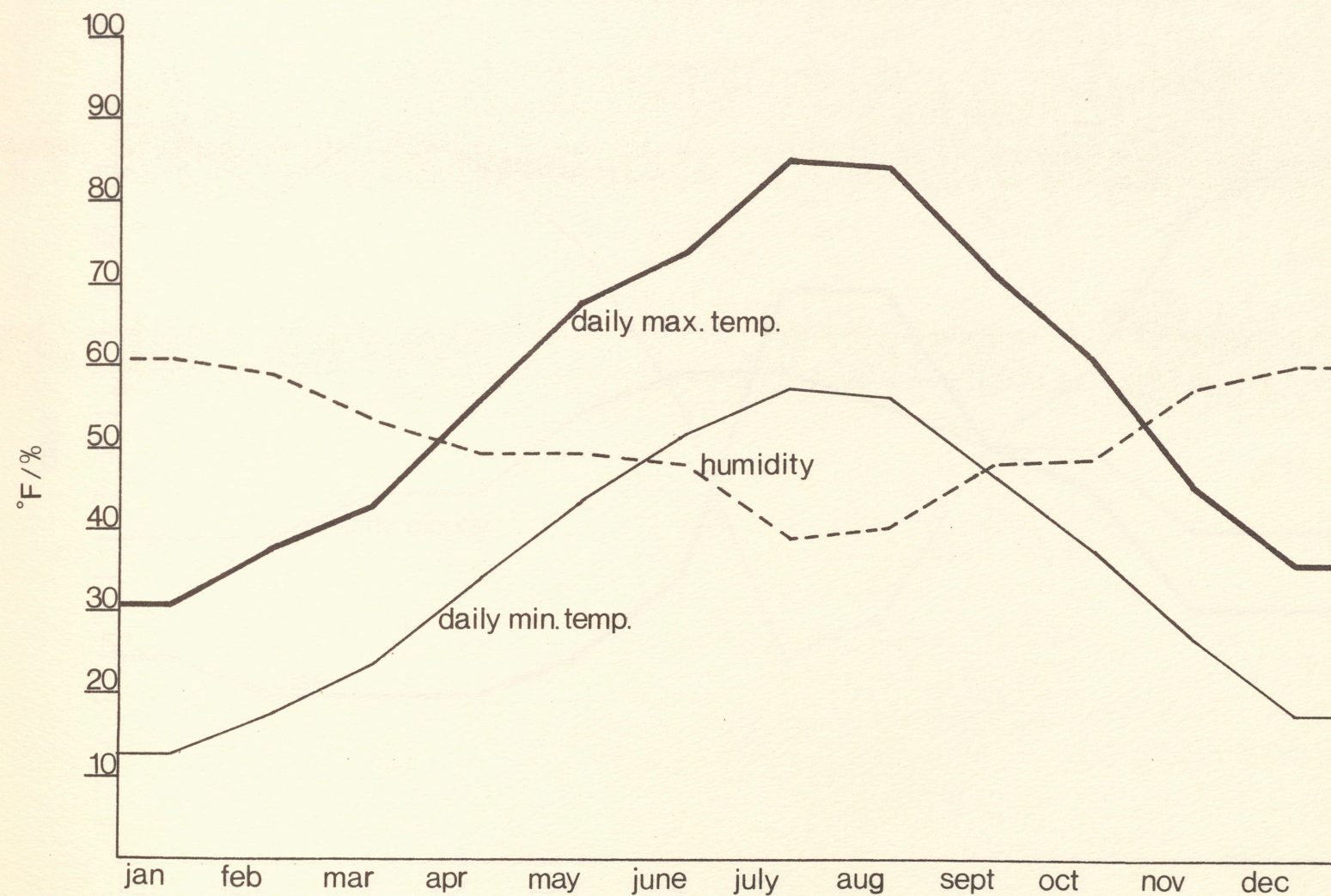
Diagram - Clear, Partly Cloudy, and Cloudy Days.²¹ This diagram reveals that the expected conditions for Billings skies is partly cloudy, although generally these clouds are not low lying. In the summer months Billings enjoys azure blue skies which provide a dynamic backdrop for a strong visual image architecturally displayed in the control tower. Sky conditions also give impetus to interior green space, though insulating thermal loss during winter months would be necessary.

PRECIPITATION & SNOWFALL



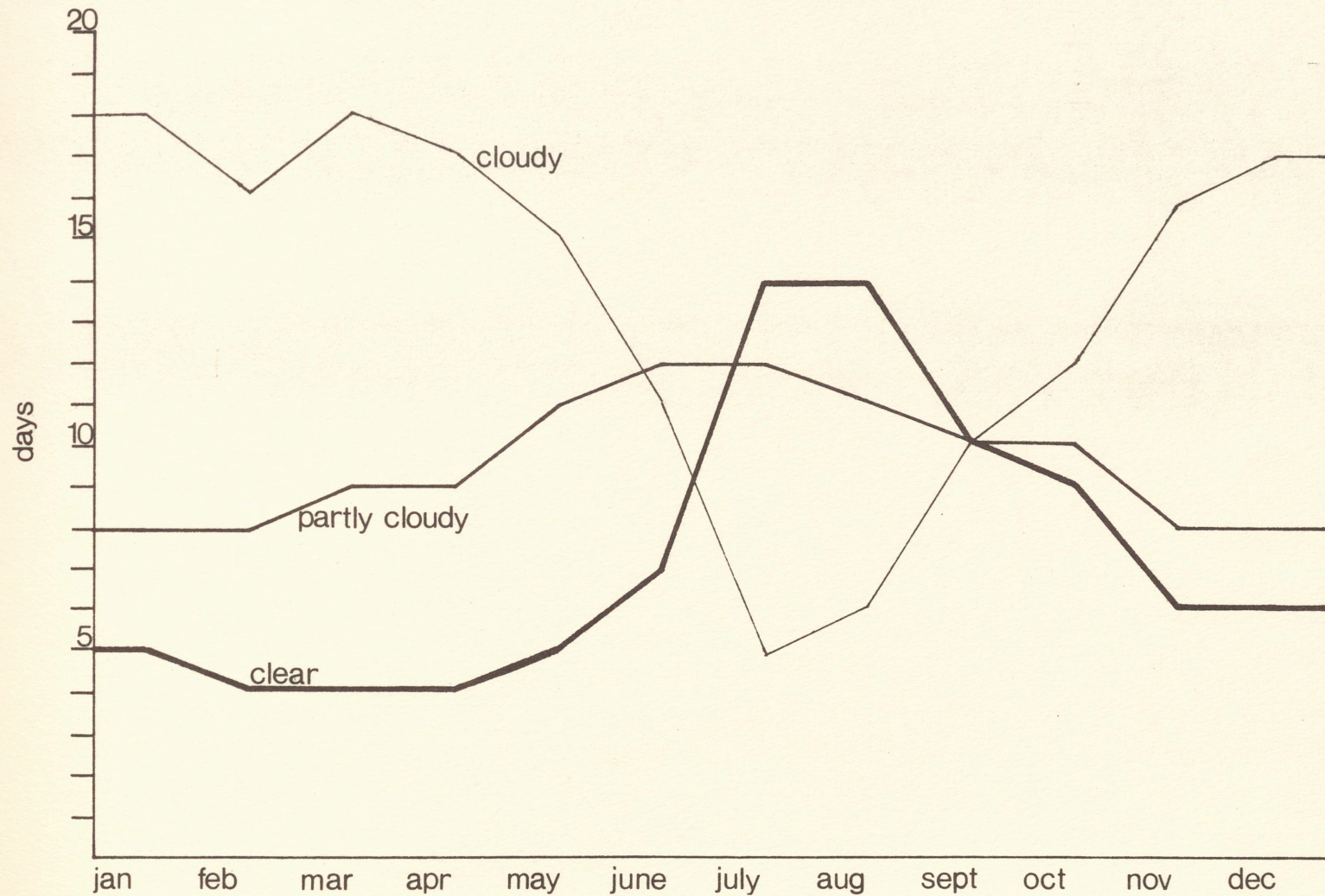
CLIMATE

TEMPERATURE & HUMIDITY



CLIMATE

CLEAR, PARTLY CLOUDY & CLOUDY DAYS



CLIMATE

Programming is much more than providing required square footage for specific areas; it allows a designer the opportunity to analyze information gathered to develop an appropriate attitude or course in which to respond architecturally. Because airports tend to exhibit anonymous space, there has been an attempt to first define the space and establish a quality desired to provide direction as the design process continues. Included within the program are conceptual sketches which provide initial direction for the airport's internal character. These sketches were an exercise to aid me in graphically expressing verbal intentions for a space; they are not intended to depict the final architectural form, but rather the mood or quality of space.

There does exist within the program assumptions which were made due to the extensive research necessary to address needs for specific airports. For instance, airline operation space was treated in a generic sense, and in actuality considerable time would need to be spent with each airline establishing an appropriate program which would most adequately serve specific airline needs. Also waiting and holding space were considered as lump sums of space and will be more directly influenced by the terminal concept adopted.

PROGRAM

The number of airlines now serving Billings is five. The addition of three more airlines with twelve gate positions was assumed so as to create a program which would be challenging and require innovation on my part to solve site issues resulting from increased spatial requirements.

It is important to address the means by which the program spaces were sized. According to the accompanying diagram, a conservative growth rate for the rest of this decade was assumed, which is considerably less than the Federal Aviation projection, which generally have proven to be generous and unreliable.²²

From the 4% growth rate assumed, a figure of 450,000 enplaning passengers was calculated for the year 1990. From this figure and information provided by the Federal Aviation Administration,²³ along with an inventory of the existing facility, a hybrid program was developed. Due to the relative instability of the airline industry, considerable effort would be necessary to project a usable document for a future airport facility, and the program to be utilized can in no reliable sense be validated.

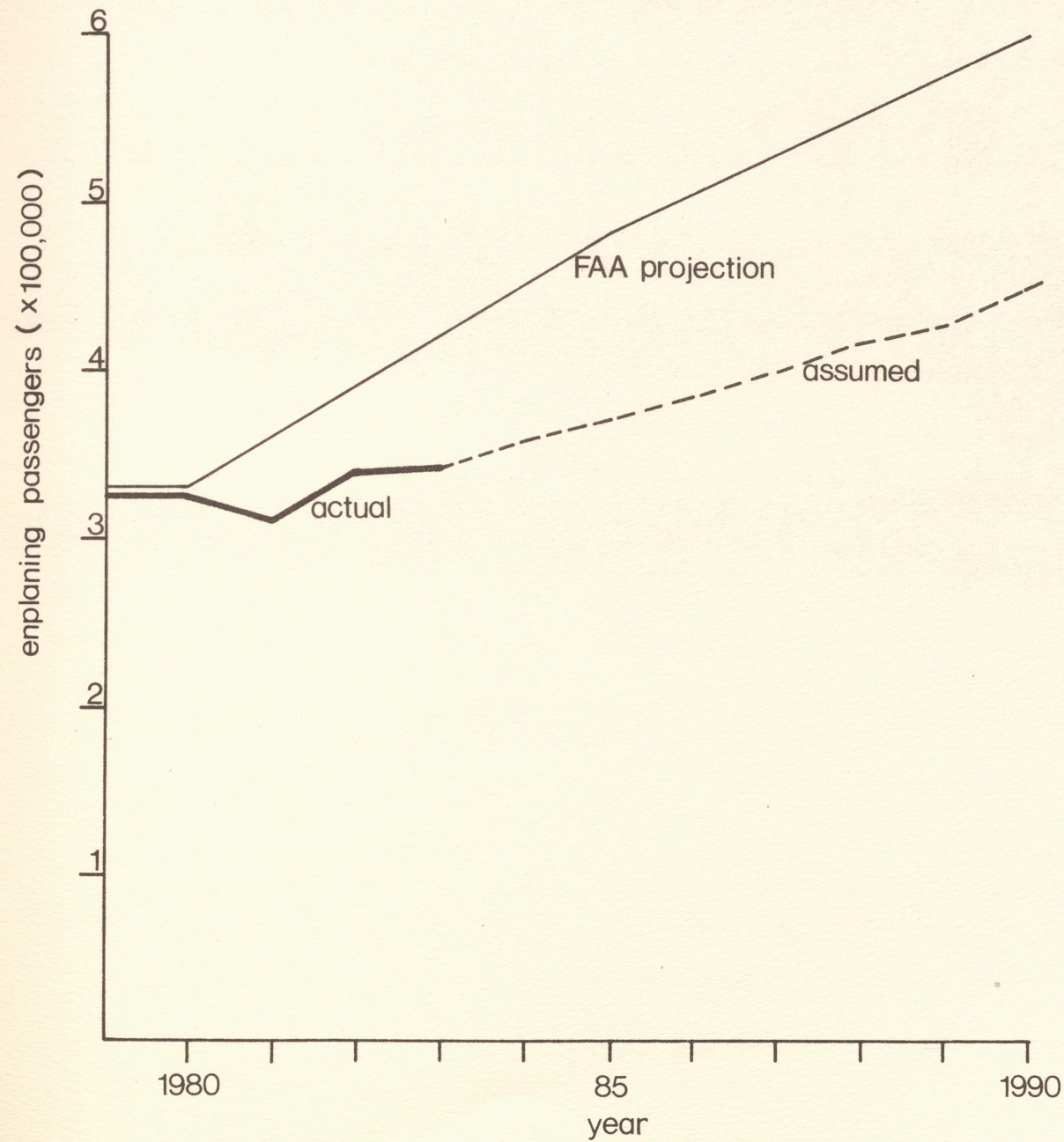
The program was in a personal sense a difficult area of the design to resolve. In part this was due to conflicting data and theories on sizing airports.

PROGRAM

Extrapolating the existing airport or utilizing a theory of airport planning carry with them problems and biases which are inherent. The most appropriate decisions can only be made by someone who invests much time and effort in understanding not only the problem but specific needs of the people involved. It is my hope that the final design reflects some understanding of the problems and provides a positive and inviting architectural environment.

PROGRAM

PASSENGER GROWTH PROJECTIONS



PROGRAM

PROGRAM SUMMARY

	Sq. Ft.
Lobby	5,400
Restaurant	
Dining	5,000
Kitchen	4,500
Coffee Shop	
Dining	3,000
Kitchen	2,500
Flight Kitchen	1,525
Pilot's Lounge	1,150
Lounge	925
Gift Shop	1,800
Retail Space	1,800
Ticket Lobby	7,800
Airline Operations (8 Airlines)	19,600
Baggage Claim	12,000
Car Rental	400
Customs	300
Airport Security	400
Office Space	3,000
Weather Bureau	2,000

PROGRAM

Flight Service Station	2,500
Airport Manager/Related Activities	1,800
Waiting	5,200
Departure Gates (12)	21,600
Concourse Circulation	27,230
Public Restrooms	3,000
Loading & Service	4,900
Mechanical	14,700
Total Square Footage	154,030

Parking	No. of Spaces
Short Term	225
Long Term	470
Handicapped	4
Restaurant	96
Employee	200
Car Rental	165
Total Parking Spaces	1,160

PROGRAM

SPACE DESCRIPTION LOBBY

MAJOR ENTRANCE AND DECISION SPACE. PROXIMITY TO OTHER PUBLIC AIRPORT FUNCTIONS SHOULD BE VISIBLE FROM THE LOBBY.

QUALITY LARGE VOLUME, INFORMATIVE, BRIGHT, WARM, INVITING, COLORFUL, LARGE GATHERING NODE.

USER PASSENGERS, GENERAL PUBLIC, AIRPORT AIRLINE PERSONNEL.

TIME OF USE ALL AIRPORT HOURS.

FUNCTIONAL CONCERNS INCLUDED WITHIN OR NEAR SHOULD BE PHONES, LOCKERS, BATHROOMS
VIEWS

in TICKETING, WAITING, COFFEE, GIFT
out DESIRABLE

ORIENTATION SOUTH

LIGHTING NATURAL OR INCANDESCENT

ACOUSTICS DUE TO LOBBY'S HIGH ACTIVITY ADJOINING SPACES WILL NEED TO BE BUFFERED

MATERIALS BRICK PAVERS, SKYLIT OR ATRIUM SPACE WOOD OR STEEL TRUSSES, WOOD CERAMIC TILE

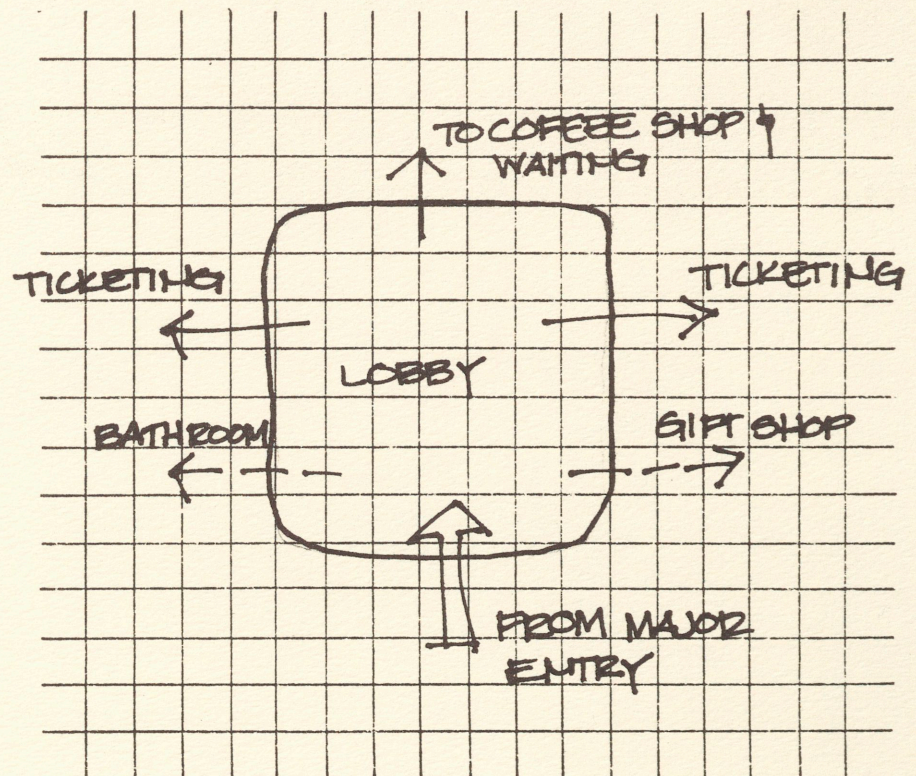
OCCUPANCY

450 / HR

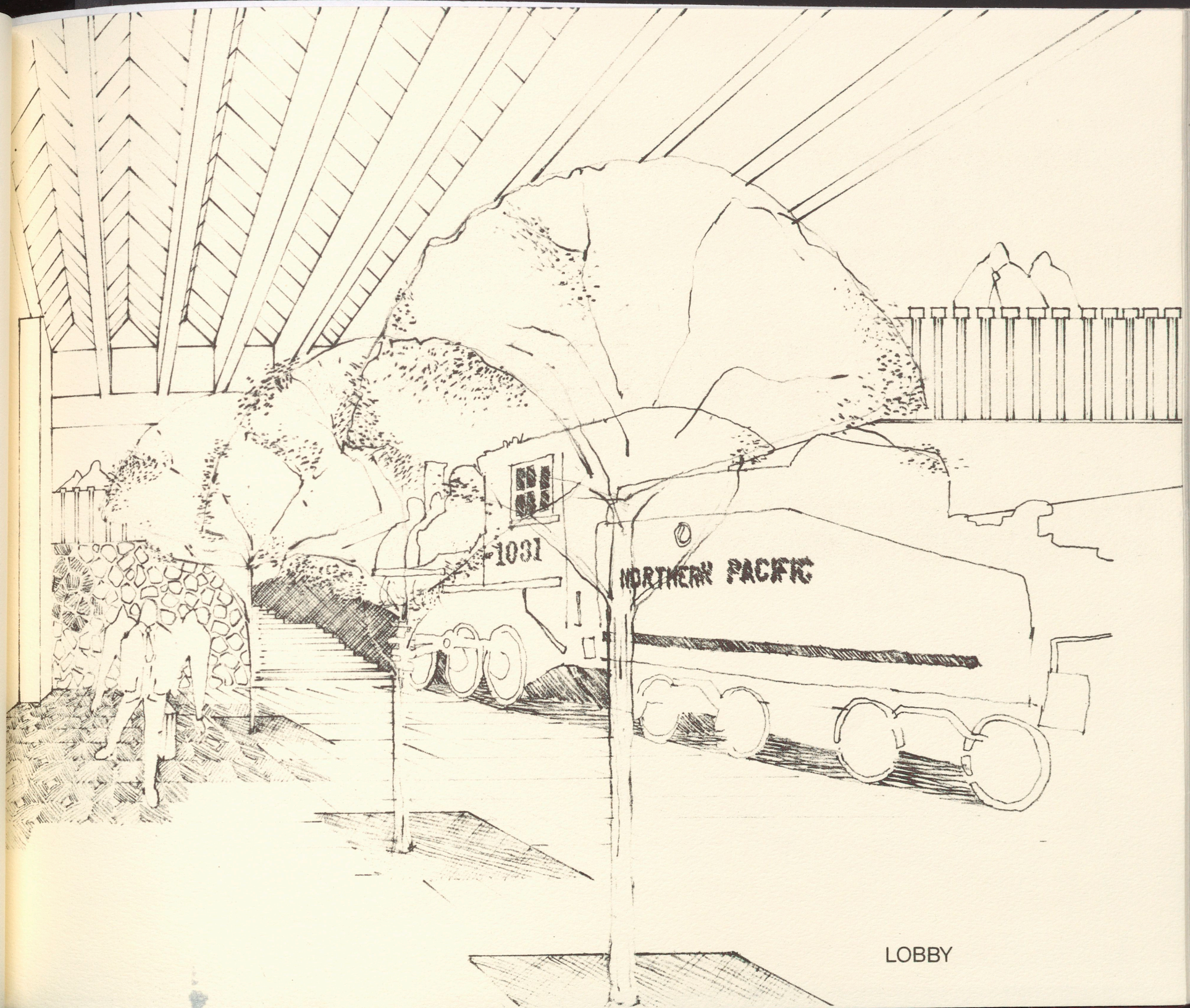
AREA REQUIRED

5,400 $\pm$

ADJACENCY



PROGRAM



LOBBY

SPACE DESCRIPTION RESTAURANT

RESTAURANT TO BE HOUSED IN CONTROL TOWER LINKED TO TERMINAL BUILDING. VIEWS TO CITY & AIRFIELD.

QUALITY RESTAURANT WHOSE INFLUENCE IS CITY & REGIONALLY KNOWN.
FORMAL, EXPENSIVE, UNIQUE, EXCITING (GOURMET FOOD)

USER GENERAL PUBLIC & PASSENGER

TIME OF USE 5 P.M. - 2.2.A.M.

FUNCTIONAL CONCERNS KITCHEN TO BE
LOCATED 1 FLOOR BELOW. SERVICE TO RESTAURANT
VIA DUMBWAITERS
ADJACENCY
VIEWS

in

out - TO CITY & AIRFIELD

ORIENTATION NORTH & SOUTH

LIGHTING NATURAL, INCANDESCENT

ACOUSTICS FAINT

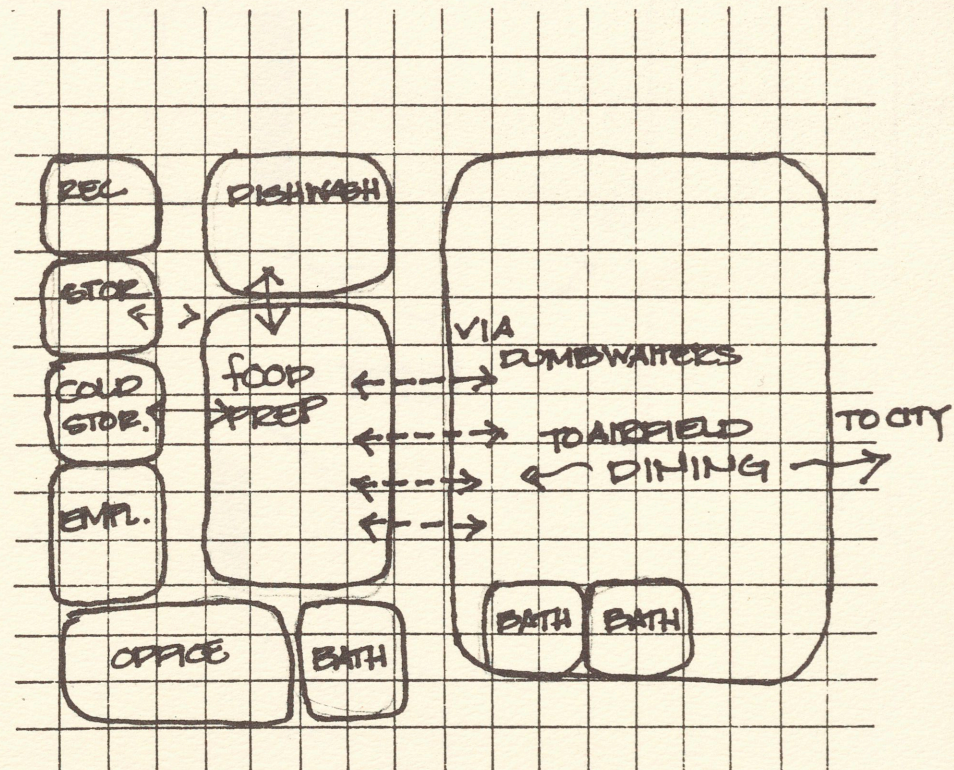
MATERIALS BRASS, WOOD, CARPET, BRUSHED
UPHOLSTERY, LATTICE SCREENS, METAL

OCCUPANCY 205 SEATS

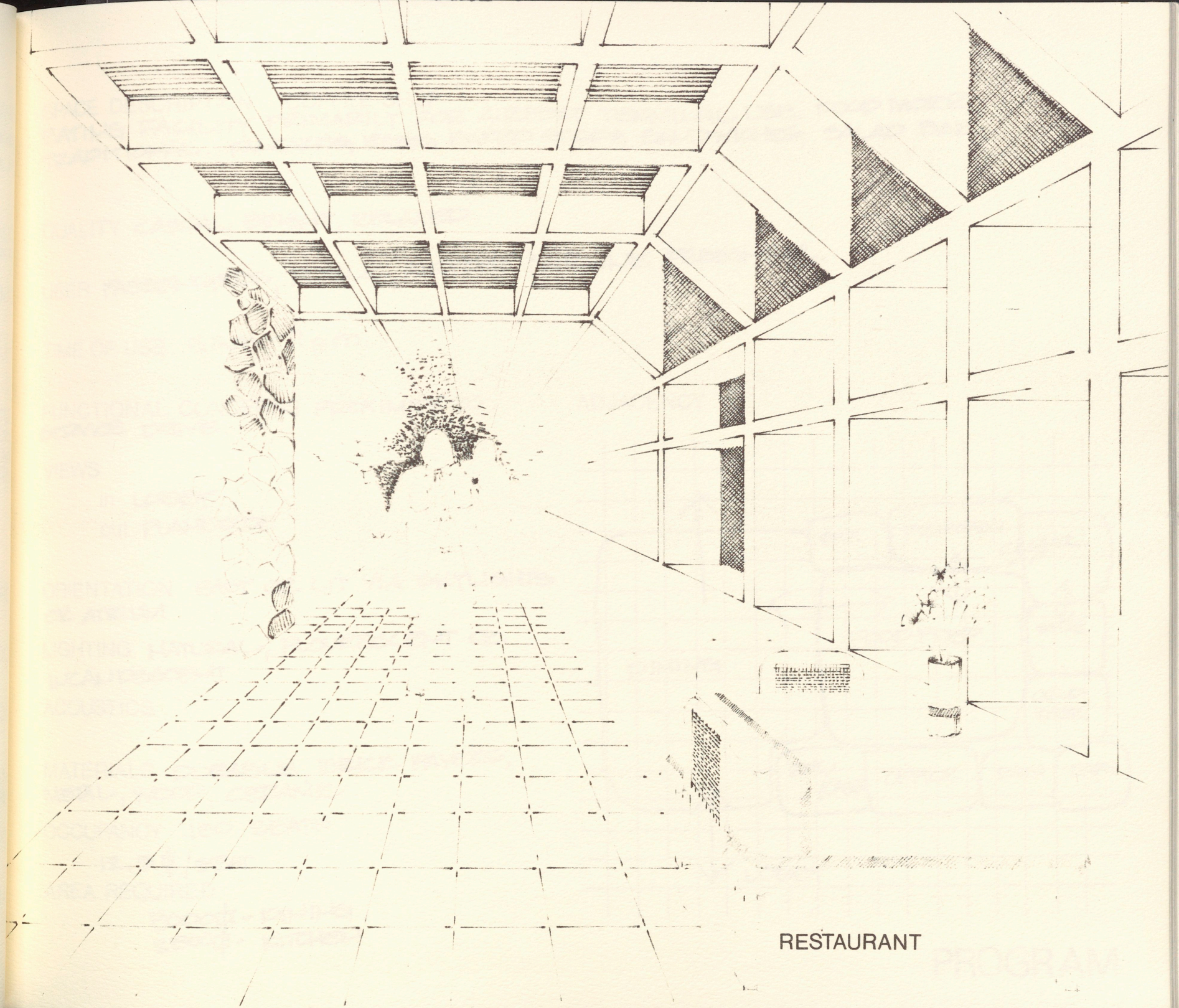
15 ϕ /SEAT

AREA REQUIRED

5,000 ϕ DINING
4,500 ϕ KITCHEN



PROGRAM



RESTAURANT

SPACE DESCRIPTION COFFEE SHOP
EATING FACILITY PRIMARILY FOR AIRPORT TERMINAL USE. FOOD MORE
TRADITIONAL. PANCAKES, EGGS, BAKED GOODS, SANDWICHES, SALAD BAR.

QUALITY CASUAL BRIGHT, RELAXED

USER PASSENGERS, PUBLIC, AIRPORT AIRLINE PERSONNEL.

TIME OF USE 5 a.m. - 11 p.m.

FUNCTIONAL CONCERNS PROXIMITY TO
SERVICE DRIVE.

VIEWS

in LOBBY
out PLANE SIDE

ORIENTATION EAST OR LIT VIA SKYLIGHTS
OR ATRIUM

LIGHTING NATURAL, FLOURESCENT OR
INCANDESCENT

ACOUSTICS

MATERIALS DURABLE, BRICK PAVERS,
METAL, WOOD, CERAMIC

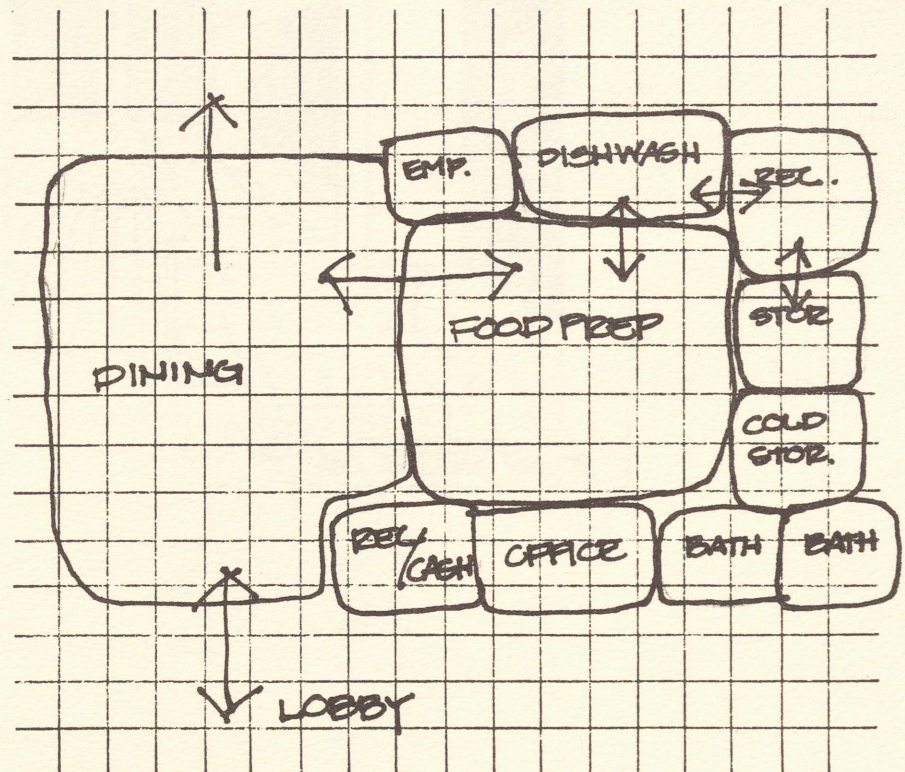
OCCUPANCY 150 SEATS

12.5¢ / SEAT

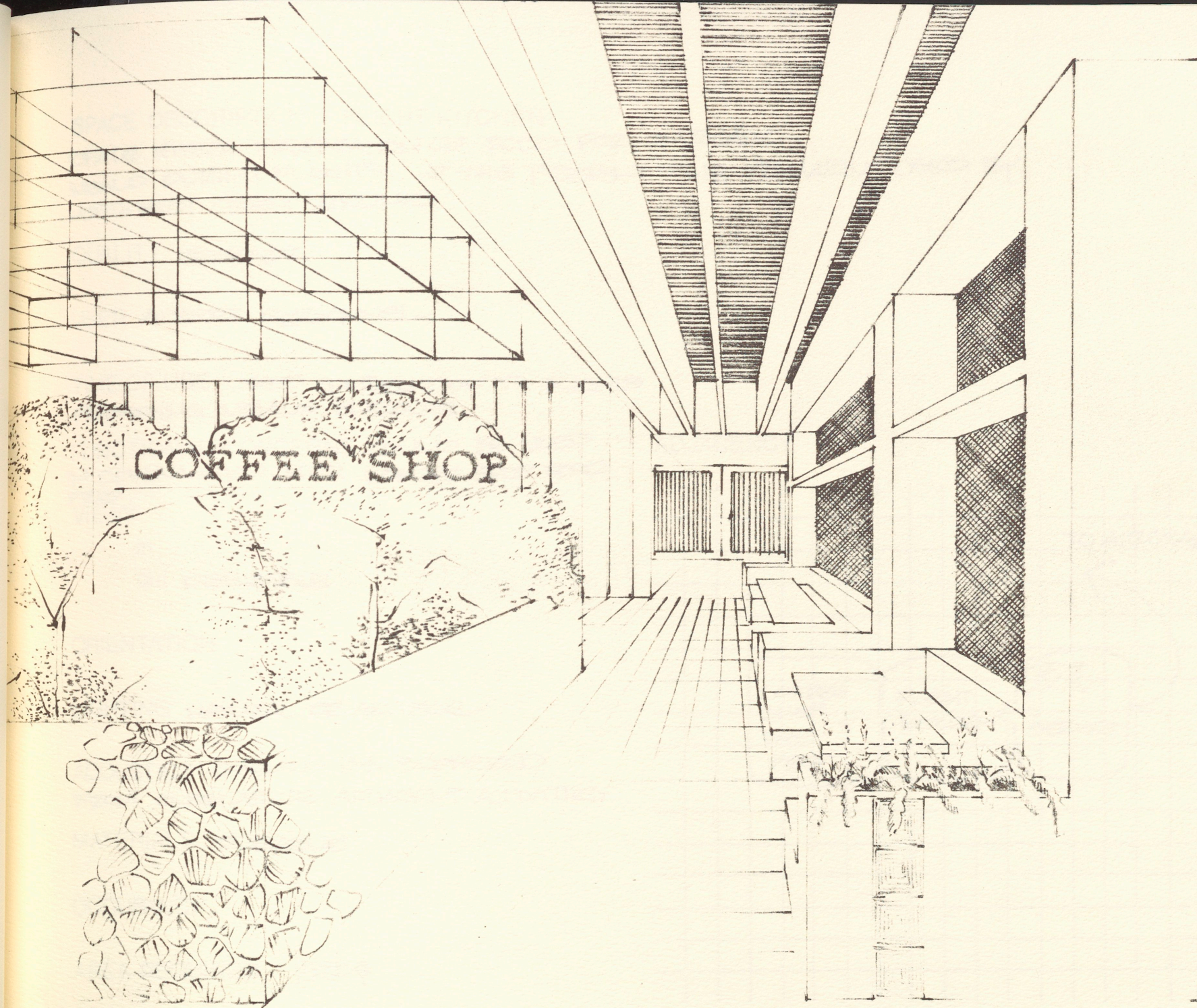
AREA REQUIRED

3000^{sq}ft - DINING
2500^{sq}ft - KITCHEN

ADJACENCY



PROGRAM



SPACE DESCRIPTION FLIGHT KITCHEN

SPACE WHERE PREPARATION OF FOOD FOR ON BOARD MEALS DURING FLIGHTS. AT THE PRESENT TIME PRIMARILY USED BY NORTHWEST ORIENT AIRLINES.

QUALITY EFFICIENT.

USER AIRPORT PERSONNEL

TIME OF USE USED IN RELATION TO FLIGHTS PROVIDING MEALS ENROUTE

FUNCTIONAL CONCERNS COULD BE USED IN CONJUNCTION WITH COFFEE SHOP FOOD PREP. VIEWS

in
out DESIRABLE

ORIENTATION

LIGHTING NATURAL OR ARTIFICIAL

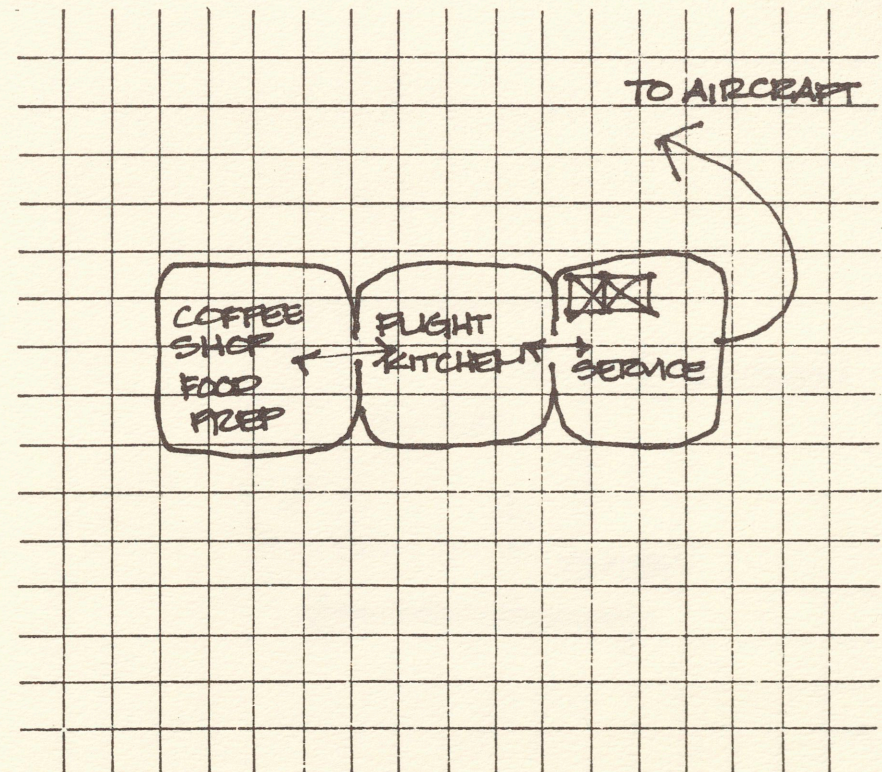
ACOUSTICS SHOULD BE BUFFERED FROM OUTSIDE OR ADJACENT ACTIVITIES

MATERIALS DURABLE

OCCUPANCY

AREA REQUIRED 1525 ϕ

ADJACENCY



PROGRAM

SPACE DESCRIPTION PILOTS LOUNGE
SPACE FOR PILOTS & FLIGHT CREW TO RELAX BETWEEN AIRCRAFT DEPARTURE.

QUALITY QUIET CASUAL, RELAXING, WARM.

USER PILOTS & FLIGHT CREW

TIME OF USE PRIOR TO AIRCRAFT DEPARTURE

FUNCTIONAL CONCERNS SPACE NEEDS TO BE ADJACENCY
ALLOCATED FOR RESTROOMS, PERHAPS A CONNECTION
TO KITCHEN OR NON ALCOHOLIC BEVERAGE
VIEWS

in
out DESIRABLE BUT NOT TO AIRFIELD

ORIENTATION SOUTH

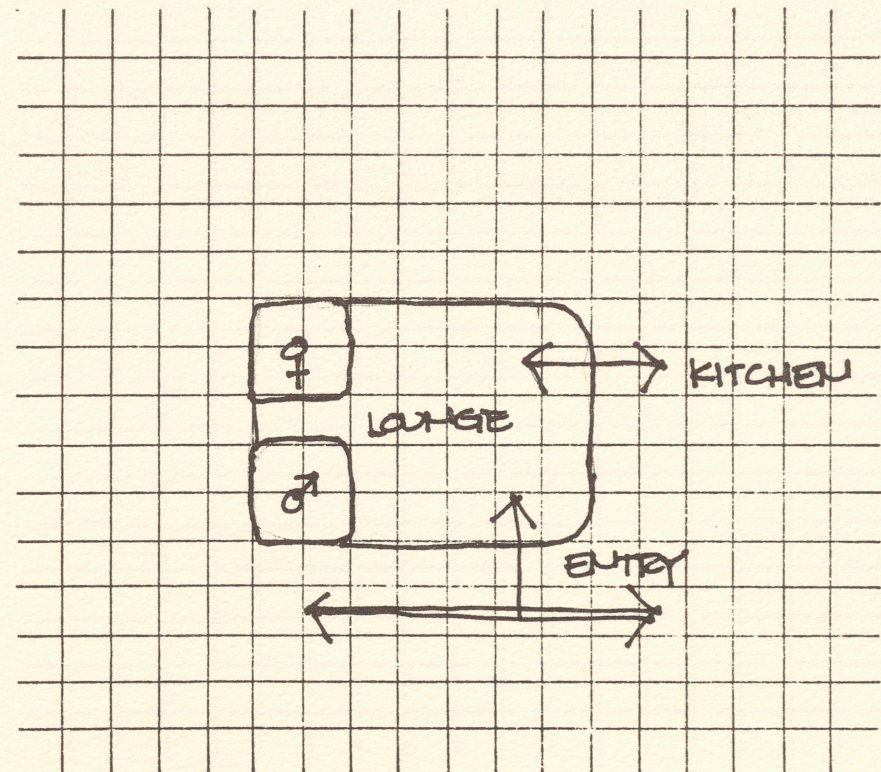
LIGHTING NATURAL & ARTIFICIAL

ACOUSTICS ALLOW QUIET CONVERSATION

MATERIALS WOOD, METAL CARPET
COMFORTABLE FURNITURE

OCCUPANCY
12-20

AREA REQUIRED
1150 sq ft



PROGRAM

SPACE DESCRIPTION LOUNGE
SPACE WHERE PASSENGER CAN RELAX BEFORE FLIGHT.
USUALLY SERVE ALCOHOLIC BEVERAGES

SPACE WHERE PUBLIC CAN RELAX BEFORE FLIGHT.
USUALLY SERVE ALCOHOLIC BEVERAGES

QUALITY RELAX, INVITING, CASUAL

USER **PUBLIC**

TIME OF USE 11 A.M. - 11 P.M.

FUNCTIONAL CONCERNS

VIEWS

in

out NOT DESIRABLE

ORIENTATION

LIGHTING ARTIFICAL

ACOUSTICS ALLOW QUIET CONVERSATION

MATERIALS DURABLE & EASILY MAINTAINED

OCCUPANCY 75 12.5¢/OCCUPANT

AREA REQUIRED 9250

ADJACENCY

This image shows a full page of blank graph paper. The grid consists of 20 columns and 15 rows of small squares, formed by thin black lines on a light cream-colored background. There are no margins, text, or other markings on the page.

PROGRAM

SPACE DESCRIPTION GIFT SHOP
SPACE FOR SELLING SOUVENIRS, NEWSPAPERS, MAGAZINES & OTHER
NOVELTIES, REGIONAL & INFORMATIVE PUBLICATIONS

QUALITY BRIGHT, INVITING.

USER PASSENGERS, GENERAL PUBLIC & AIRLINE
PERSONNEL

TIME OF USE 8 a.m.-9 p.m.

FUNCTIONAL CONCERNS SPACE FOR ADEQUATE
CIRCULATION TO PREVENT CROWDING
STORAGE
VIEWS

in

out NOT DESIRABLE

ORIENTATION

LIGHTING ARTIFICIAL

ACOUSTICS ALLOW NORMAL CONVERSATION

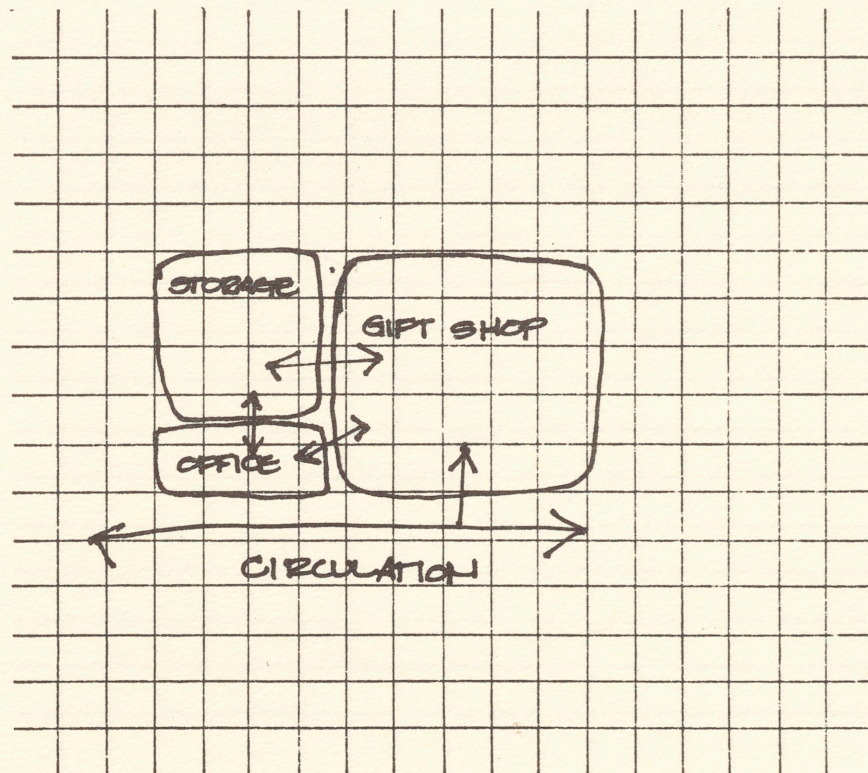
MATERIALS DURABLE & EASILY MAINTAINED

OCCUPANCY 20-30

AREA REQUIRED 1,800 sq ft

1,200 FLOOR AREA
600 STORAGE

ADJACENCY



PROGRAM

SPACE DESCRIPTION RETAIL
SPACE FOR OTHER RETAIL FUNCTIONS. SUCH AS: BANK, BARBER SHOP, CAMERA SHOP,
CANDY STORE, SHOE SHINE, FLOWER SHOP, INSURANCE VENDING, ETC.

USER ~~DETAIL~~ PERSONNEL

FUNCTIONAL CONCERNS

in

ORIENTATION

ACOUSTICS ALLOW NORMAL CONVERSATION

OCCUPANCY

ADJACENCY

A full-page view of a blank sheet of graph paper. The paper has a light cream or off-white color. It features a uniform grid of thin, dark gray lines. The grid consists of 20 vertical columns and 20 horizontal rows, creating a total of 400 small squares. The lines are evenly spaced across the entire page. There are no margins, text, or other markings on the paper.

PROGRAM

SPACE DESCRIPTION TICKET LOBBY

SPACE PRIOR TO TICKET COUNTER, ALLOWS DEPARTING & TRANSFER PASSENGERS ROOM TO PREPARE FOR TICKETING & BAGGAGE PROCESSING AT PARTICULAR AIRLINE.

QUALITY INVITING, BRIGHT, WARM, INFORMATIVE

USER DEPARTING PASSENGERS AND THOSE SEEKING FLIGHT INFORMATION

TIME OF USE PRIOR TO AIRLINE DEPARTURE

FUNCTIONAL CONCERNS ROOM MUST BE ALLOCATED FOR QUEUING, CIRCULATION AND SEATING
VIEWS

in TO WAITING, LOBBY
out - NOT NECESSARY

ORIENTATION - SOUTH FOR OPTIMUM LIGHTING

LIGHTING - NATURAL OR INCANDESCENT

ACOUSTICS - POTENTIALLY A VERY LOUD SPACE, CARE SHOULD BE TAKEN TO ALLOW CONVERSATION BETWEEN PASS. & AIRLINE MATERIALS
BRICK PAVERS, WOOD

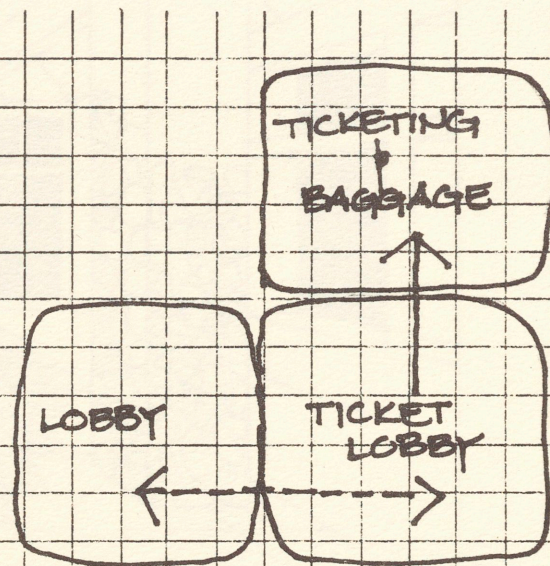
METAL, GLASS, DURABLE & CLEANABLE SURFACES.

OCCUPANCY TYPICAL PEAK HOUR EMPLOYING
FLOW. 450 PASSENGERS

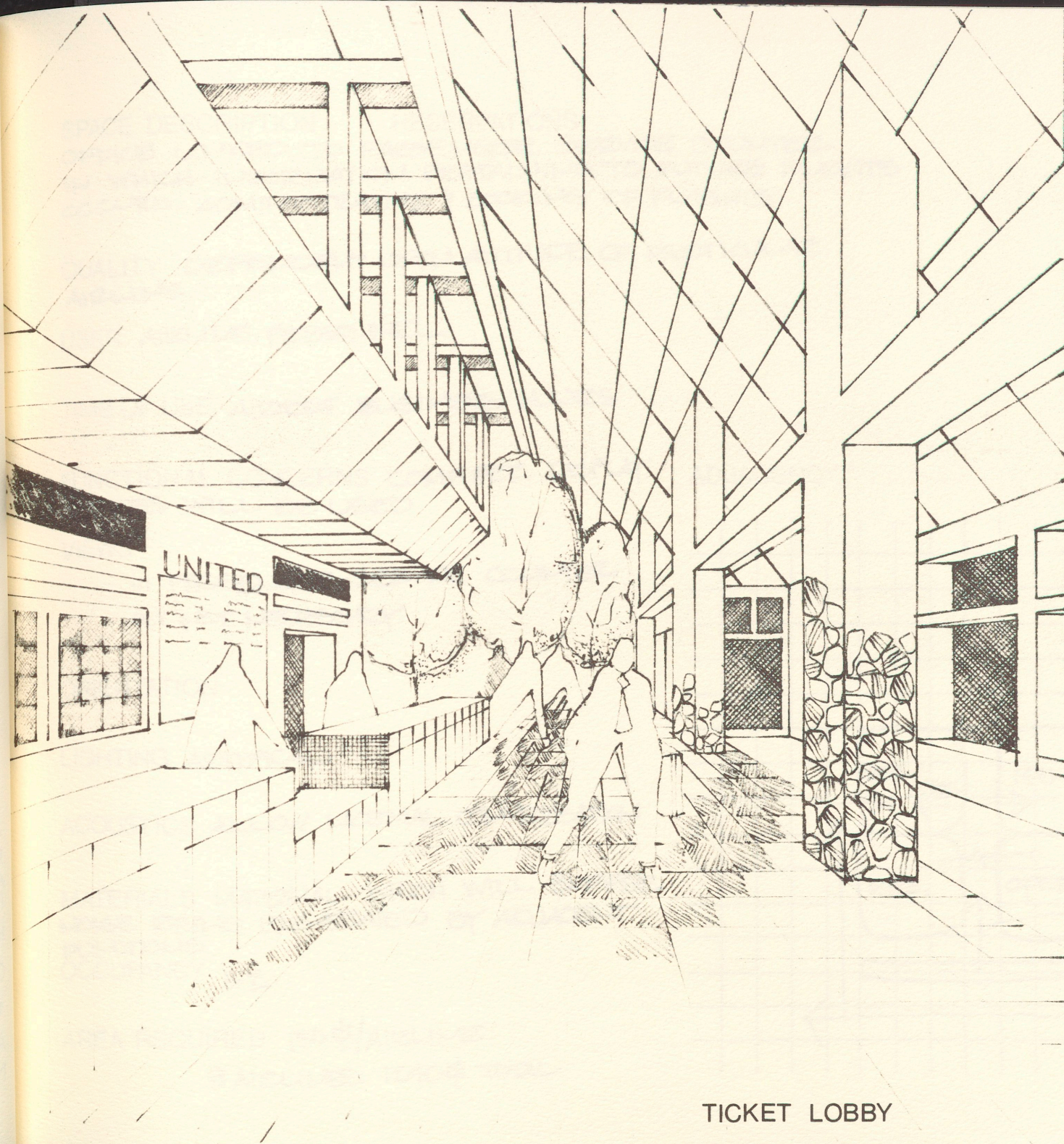
AREA REQUIRED

MINIMUM 5,000 ϕ (7,800 ϕ)

ADJACENCY



PROGRAM



TICKET LOBBY

SPACE DESCRIPTION RESERVATIONS
OFFICE LINKED TO PASSENGER SERVICE COUNTER
IN WHICH INFORMATION PERTAINING TO FUTURE FLIGHTS
OCCURS. ADMINISTRATIVE & BOOKING OF FLIGHTS.

QUALITY DEPENDENT UPON ATTITUDE OF PARTICULAR
AIRLINE.

USER AIRLINE PERSONNEL

TIME OF USE AIRPORT BUSINESS HOURS

FUNCTIONAL CONCERNS COMPUTER DISPLAY
DEVICES WILL BE USED

VIEWS

in PASSENGER SERVICE COUNTER
out NOT NECESSARY

ORIENTATION

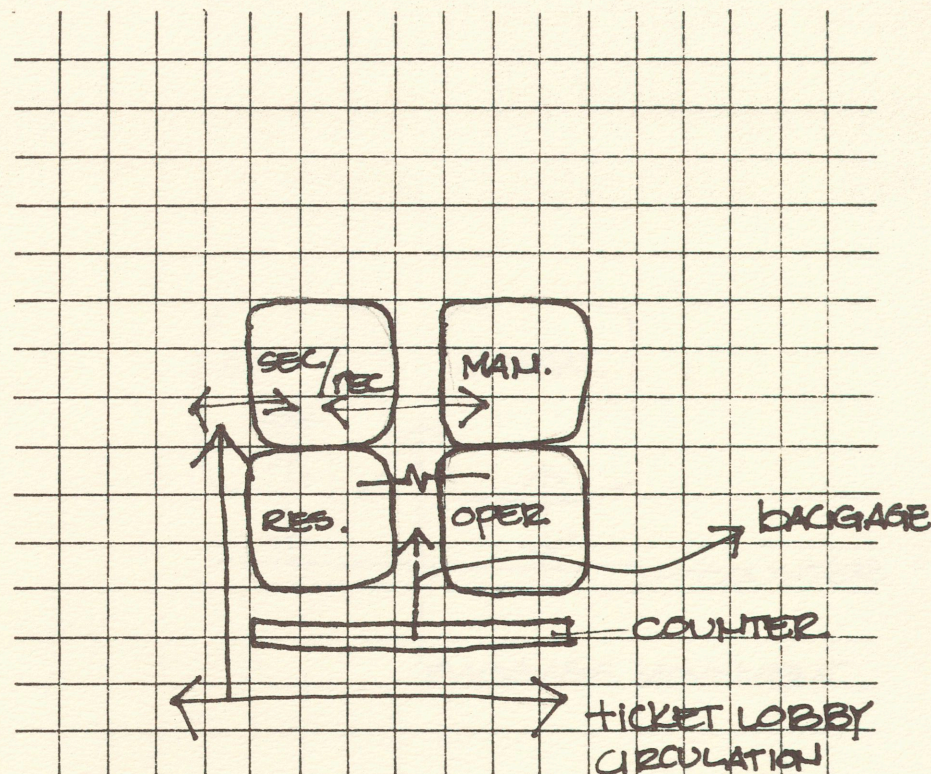
LIGHTING ARTIFICIAL

ACOUSTICS ALLOW NORMAL CONVERSATION

MATERIALS MATERIAL WHICH WILL BUFFER
NOISE BEING GENERATED BY ADJACENT
FUNCTIONS
OCCUPANCY 1-2

AREA REQUIRED 150 Φ /AIRLINE
8 AIRLINES 1240 Φ TOTAL

ADJACENCY



PROGRAM

SPACE DESCRIPTION OPERATIONS
OFFICE SPACE USED IN CONJUNCTION WITH BAGGAGE
PROCESSING AT COUNTER. ADMINISTRATIVE, STORAGE,
DATA PROCESSING

QUALITY EFFICIENT, FUNCTIONAL

USER AIRLINE PERSONNEL

TIME OF USE DEPENDENT UPON AIRLINE AND
FLIGHT FREQUENCY

FUNCTIONAL CONCERNS EASY ACCESS TO
BAGGAGE COUNTER

VIEWS

in - TO BAGGAGE COUNTER

out - NOT NECESSARY

ORIENTATION

LIGHTING FLOURESCENT

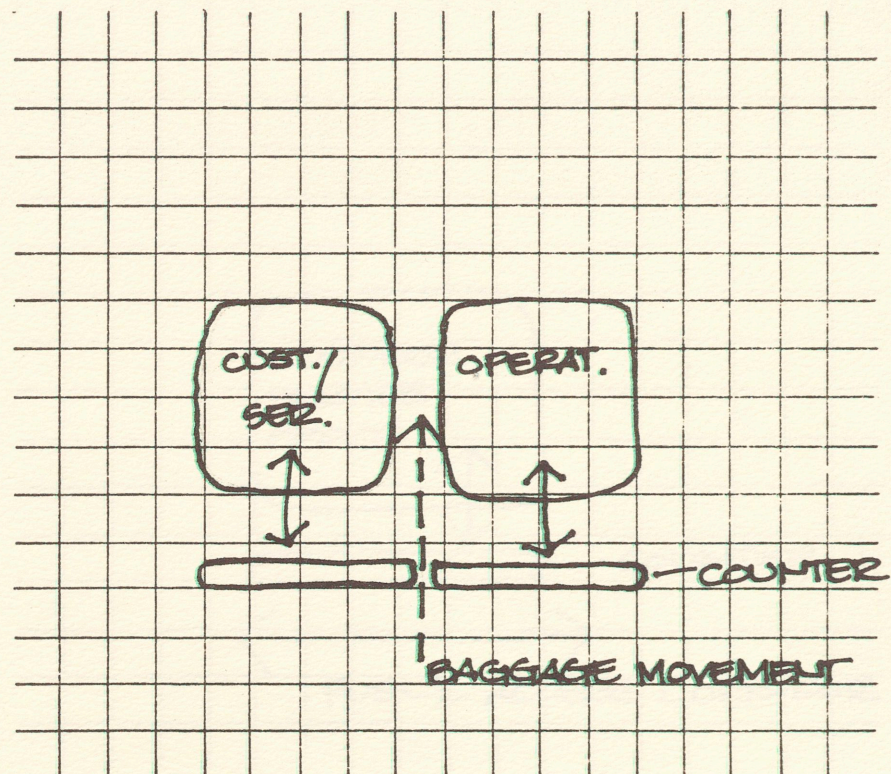
ACOUSTICS POTENTIAL TO BE A LOUD
ENVIRONMENT, BUFFER NECESSARY TO
ADJOINING SPACES.

MATERIALS DURABLE AND EASILY
CLEANED

OCCUPANCY 2-3

AREA REQUIRED 150 $\pm$ /AIRLINE
8 AIRLINES - 1240 $\pm$

ADJACENCY



PROGRAM

SPACE DESCRIPTION CUSTOMER SERVICE
OFFICE AND COUNTERSPACE WHERE INFORMATION AND GRIEVANCES
OCCUR.

QUALITY INFORMATIVE, INVITING, NOT INTIMIDATING

USER AIRLINE PERSONNEL, PUBLIC AIRLINE PASSENGER

TIME OF USE AIRPORT BUSINESS HOURS
8 a.m. - 5 p.m.

FUNCTIONAL CONCERNS

VIEWS

in TO PUBLIC SERVICE CORRIDOR
out NOT NECESSARY

ORIENTATION

LIGHTING FLUORESCENT

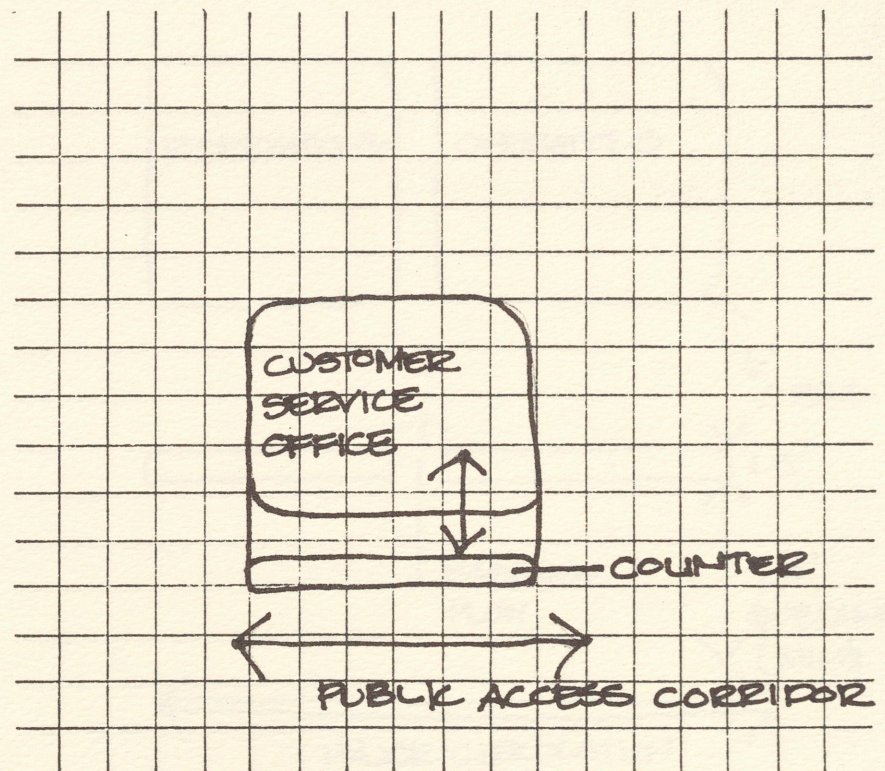
ACOUSTICS ALLOW NORMAL CONVERSATION
TO OCCUR.

MATERIALS DURABLE COUNTER MATERIALS

OCCUPANCY 3

AREA REQUIRED 130 sq ft / AIRLINE
8 AIRLINES
1040 sq ft

ADJACENCY



PROGRAM

SPACE DESCRIPTION PASSENGER SERVICE COUNTER
COUNTER SPACED USED BY RESERVATIONS, BAGGAGE PROCESSING
PERSONNEL. INCLUDES CIRCULATION SPACE BEHIND COUNTER AS
WELL AS QUEUING SPACE PRIOR TO COUNTER.

QUALITY

USER AIRLINE PERSONNEL, PASSENGERS

TIME OF USE PRIOR TO AIRCRAFT DEPARTURE
AS WELL AS AIRPORT BUSINESS HOURS

FUNCTIONAL CONCERNS SPACE (1') FOR
COMPUTER TERMINAL EQUIPMENT
MUST BE AVAILABLE
VIEWS

in LOBBY

out DESIRABLE

ORIENTATION

LIGHTING NATURAL OR INCANDESCENT

ACOUSTICS SPACE HAS POTENTIAL
TO BE VERY NOISY. MUST ALLOW NORMAL
CONVERSATION TO OCCUR.
MATERIALS DURABLE & EASILY MAINTAINED

OCCUPANCY 150 FT OF LINEAR COUNTER
REQUIRED (MINIMUM)

AREA REQUIRED 8 AIRLINES - 30 FT/AIRLINE

240 LINEAR FT.

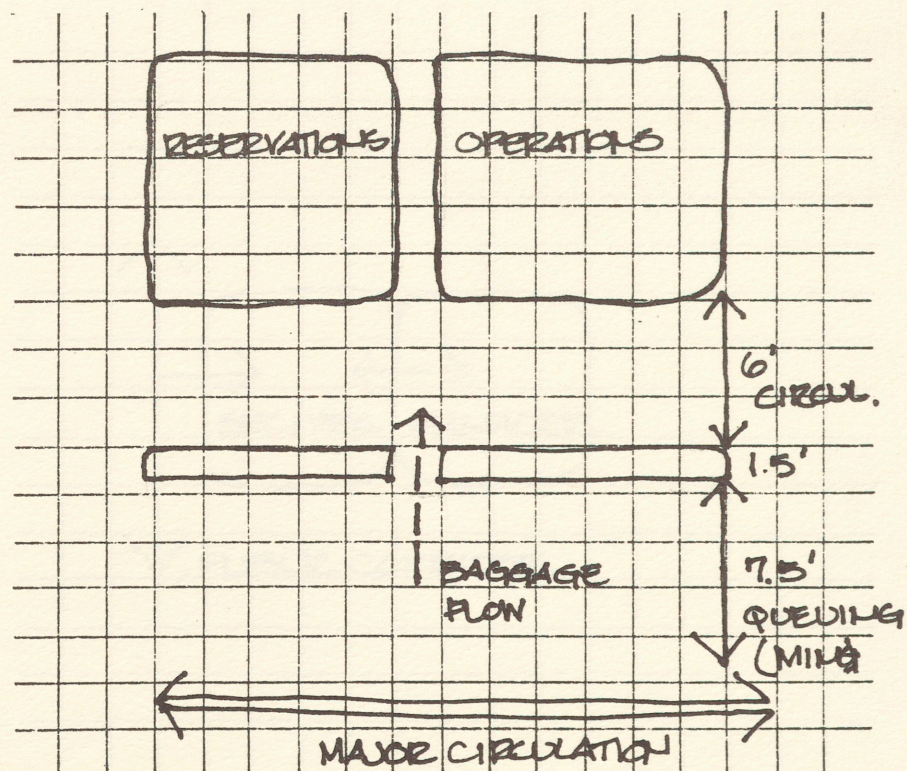
6' CIRCULATION

7.5' MINIMUM QUEUING

COUNTER & CIRCUL.

1800 FT - 8 AIRLINES

ADJACENCY



PROGRAM

SPACE DESCRIPTION AIRLINE MAN.
OFFICE FOR EACH AIRLINE MANAGER SPECIFICALLY
FOR ADMINISTRATIVE DUTIES

QUALITY DEPICT IMAGE APPROPRIATE
FOR THE PARTICULAR AIRLINE

USER AIRLINE PERSONNEL

TIME OF USE AIRPORT BUSINESS HOURS
8 a.m. - 5 p.m.

FUNCTIONAL CONCERNS

VIEWS

in TO SEC/REL
out DESIRABLE

ORIENTATION TO AIRFIELD (NORTH)

LIGHTING INCANDESCENT, NATURAL OR
WARM FLUORESCENT

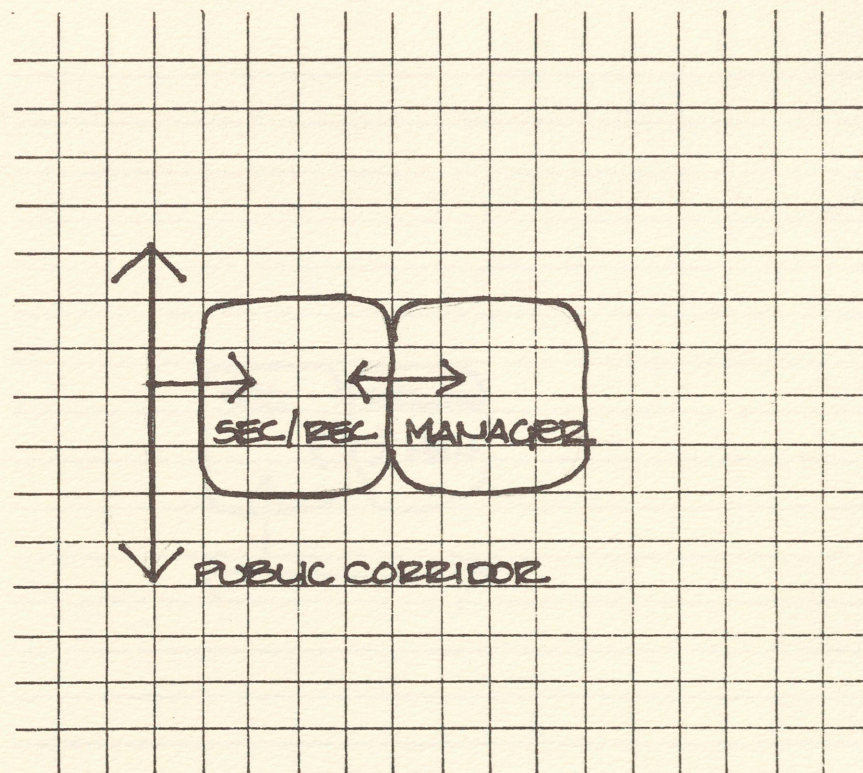
ACOUSTICS ALLOW NORMAL CONVERSATION

MATERIALS DEPENDENT UPON AIRLINE
PREFERENCE

OCCUPANCY MANAGER, PUBLIC (2)

AREA REQUIRED 150 ϕ /AIRLINE
8 AIRLINE - 1240 ϕ

ADJACENCY



PROGRAM

SPACE DESCRIPTION SECRETARY TO AIRLINE MAN.
PERFORM CLERICAL + RECEPTIVE DUTIES

QUALITY INVITING BUT MAINTAINING A
PRIVATE CHARACTER

USER SECRETARY + PUBLIC

TIME OF USE AIRPORT BUSINESS HOURS
8 a.m.-5 p.m.

FUNCTIONAL CONCERNS CLOSE PROXIMITY
TO PUBLIC CORRIDOR AND AIRLINE
MANAGER
VIEWS

in TO AIRLINE MANAGER
out DESIRABLE

ORIENTATION

LIGHTING NATURAL, INCANDESCENT, OR
WARM FLOURESCENT

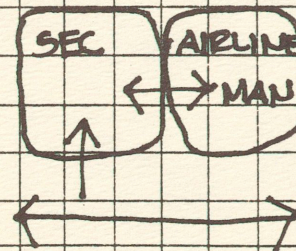
ACOUSTICS MUST ALLOW NORMAL
CONVERSATION

MATERIALS (DURABLE)

OCCUPANCY 1-2

AREA REQUIRED 150 sq ft / AIRLINE
8 AIRLINES - 1240 sq ft

ADJACENCY



PROGRAM

SPACE DESCRIPTION BAGGAGE PROCESSING
 SPACE USED FOR BAGGAGE HOLDING / SORTING PRIOR TO LOADING
 ONTO AIRCRAFT. IN THE MULTIPLE LEVEL SYSTEM TO BE ADOPTED
 BAGGAGE PROCESSING OCCURS ON THE APRON LEVEL. BAGGAGE AFTER
 CHECKING IN BY THE PASSENGER MUST BE LOWERED 1 LEVEL VIA AN ESCALATED
 BELT SYSTEM
 QUALITY FUNCTIONAL

USER AIRLINE PERSONNEL

TIME OF USE PRIOR TO AIRCRAFT DEPARTURE

FUNCTIONAL CONCERNS MUST BE A SPACE
 THAT ALLOWS EASY MANEUVERING OF BAGGAGE
 VEHICLES.

VIEWS

in
 out

ORIENTATION TO AIRCRAFT APRON
 (NORTH)

LIGHTING NATURAL OR ARTIFICIAL

ACOUSTICS LOUD ENVIRONMENT
 WOULD RESULT FROM VEHICLES MOVING
 IN AND OUT OF SPACE

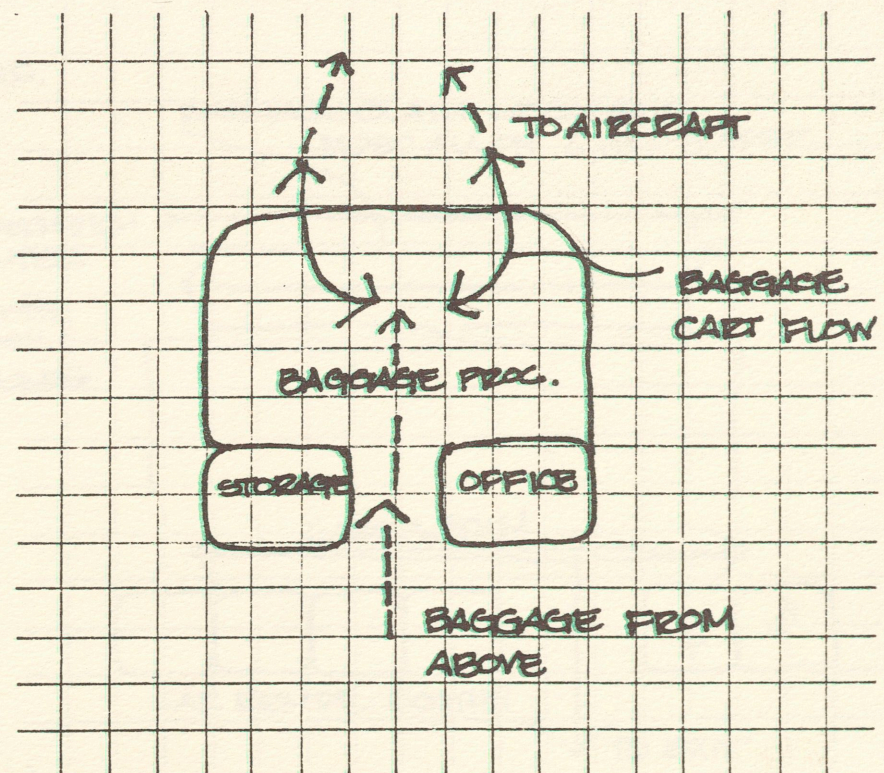
MATERIALS DURABLE AND EASILY CLEANED

SURFACES

OCCUPANCY

AREA REQUIRED 1500 m^2 / AIRLINE
 8 AIRLINES - 12,400 m^2 TOTAL

ADJACENCY



PROGRAM

SPACE DESCRIPTION BAGGAGE CLAIM
 SPACE WHERE DEPLANING PASSENGERS CLAIM BAGGAGE AND OFTEN
 MAKE ARRANGEMENTS FOR ACCOMMODATIONS & TRANSPORTATION.

QUALITY WELL ORGANIZED, INFORMATIVE, INVITING, BRIGHT, ALLOW
 CIRCULATION TO AND FROM BAGGAGE MECHANISM TO OCCUR EASILY.

USER DEPLANING PASSENGERS AS WELL AS THOSE COMING TO
 MEET AN ARRIVING PASSENGER.

TIME OF USE SOON AFTER ARRIVAL & DEPLANING OF AIRCRAFT.

FUNCTIONAL CONCERNS CARE MUST BE TAKEN ADJACENCY
 TO ALLOW CIRCULATION THROUGH THE SPACE.

VIEWS
 in FLOWER KIOSK, INFORMATION CENTER.
 CAR RENTAL, ACCOMMODATIONS, BATH, PHONES.
 out AIRPORT EXIT, PARKING

ORIENTATION

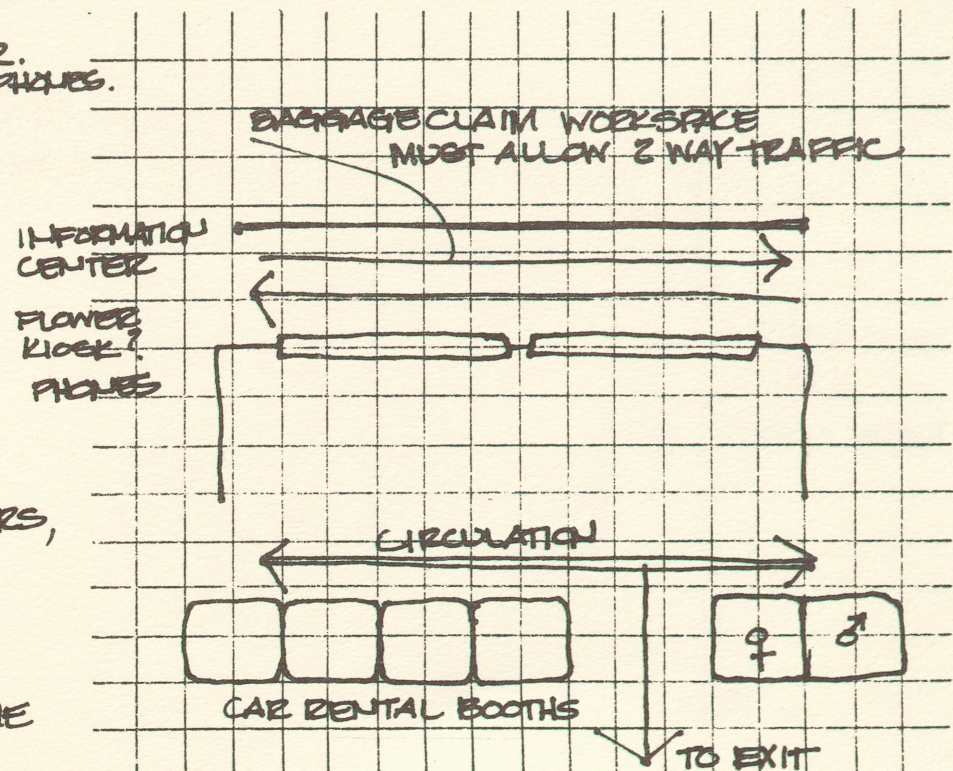
LIGHTING NATURAL & ARTIFICIAL

ACOUSTICS - SPACE WHICH WILL BE
 NOISY

MATERIALS DURABLE, BRICK OR TILE FLOORS,
 WOOD, METAL, PLANTING AREAS.

OCCUPANCY 450/HZ.

AREA REQUIRED DEPENDENT UPON SCHEME
 UTILIZED. FAA SUGGEST (2,600 $\pm$ MIN.)
 12,000 $\pm$ (5,600 $\pm$ EXISTING AIRPORT)



PROGRAM

SPACE DESCRIPTION CAR RENTAL

SPACE WHERE CAR RENTAL AGENCIES RENT AUTOMOBILE TRANSPORTATION
TO PASSENGERS & PUBLIC.

AVIS, HERTZ, NATIONAL, BUDGET.

QUALITY DEPENDENT UPON INDIVIDUAL AGENCY

USER CAR RENTAL PERSONNEL

TIME OF USE HOURS MAY VARY BUT SHOULD INCLUDE TIME
PRIOR TO & SOON AFTER FLIGHTS. UP TO DISCRETION OF SPECIFIC
AGENCY

FUNCTIONAL CONCERNS A BOOTH WITH AMPLE ADJACENCY
COUNTER SPACE NEAR BAGGAGE CLAIM.

VIEWS

in - TO BAGGAGE CLAIM

out EXIT

ORIENTATION

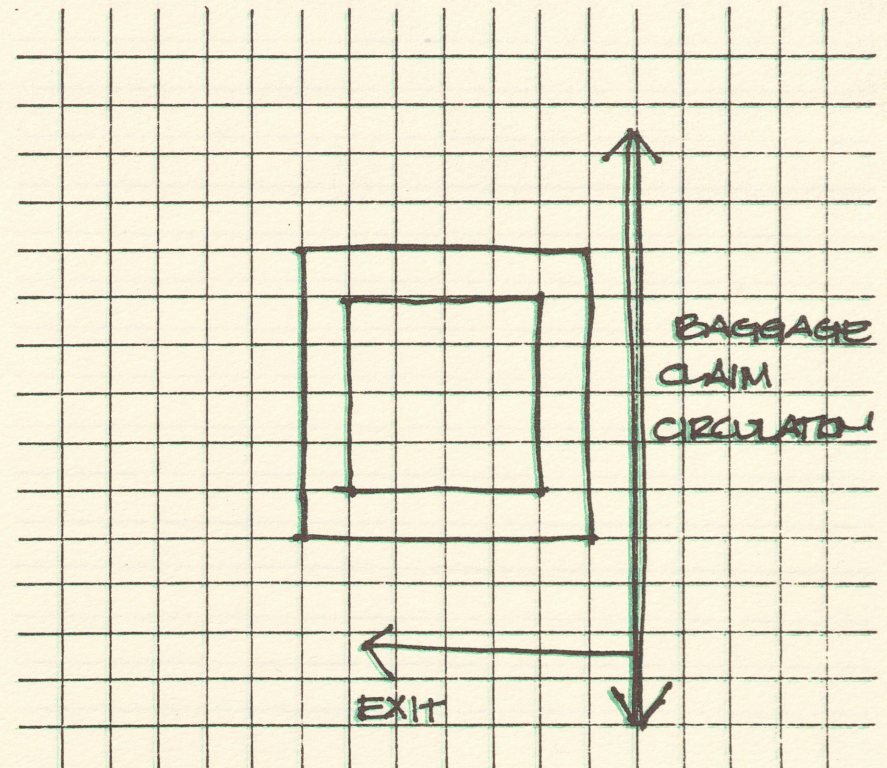
LIGHTING NATURAL OR ARTIFICIAL

ACOUSTICS - LOCATED IN BAGGAGE CLAIM
WHICH WILL BE A NOISY ENVIRONMENT.

MATERIALS DURABLE

OCCUPANCY

AREA REQUIRED 100 $\pm$ /AGENCY
4 AGENCY - 400 $\pm$



PROGRAM

SPACE DESCRIPTION HOTEL ACCOMADATION COUNTER
COUNTERSPACE WITH TELEPHONES WHERE PASSENGERS MAKE ARRANGEMENTS
FOR ACCOMODATIONS.

QUALITY INFORMATIVE

USER DEPLANING PASSENGER

TIME OF USE AFTER AIRCRAFT ARENAL

FUNCTIONAL CONCERNS SHOULD BE
CLEARLY VISIBLE WITH WALL SPACE FOR
HOTEL MOTEL ADVERTISEMENTS.
VIEWS

in
out

ORIENTATION

LIGHTING

ACOUSTICS CARE MUST BE TAKEN SO
PHONE CONVERSATION CAN OCCUR IN
THE BAGGAGE CLAIM AREA.
MATERIALS

OCCUPANCY

AREA REQUIRED 30 ft. of COUNTER
SPACE.

ADJACENCY

[illegible]

PROGRAM

SPACE DESCRIPTION CUSTOMS
OFFICE SPACE PROVIDED FOR CUSTOMS. AREA UNDER FEDERAL JURISDICTION
WHERE PASSENGERS FROM FOREIGN COUNTRIES DECLARE BAGGAGE AND
ARE INSPECTED (SEE FUNCTIONAL CONCERNS) ADMINISTRATIVE SPACE.

QUALITY

USER

TIME OF USE

FUNCTIONAL CONCERNS BILLINGS AIRPORT CAN INSPECT NO MORE THAN 20 PASS. AND IS NOT A PART OF ENTRY. CUSTOMS OCCUR IN THE AIRCRAFT AND NOT THE TERMINAL BUILDING. ADJACENCY

in

out

ORIENTATION

LIGHTING NATURAL OR ARTIFICIAL

ACOUSTICS ALLOW NORMAL CONVERSATION.

MATERIALS STANDARD OFFICE MATERIALS

OCCUPANCY 1-3

AREA REQUIRED

300¢

PROGRAM

SPACE DESCRIPTION SECURITY

OFFICE AND ADMINISTRATION SPACE FOR AIRPORT SECURITY.

PURPOSE IS TO ACT AS CENTRAL GATHER POINT OF INFORMATION, PERSONNEL
& SECURITY DISPATCHES

QUALITY EFFICIENT FUNCTIONAL SPACE

USER AIRPORT SECURITY PERSONNEL

TIME OF USE 24 HRS

FUNCTIONAL CONCERNS COMPUTER EQUIP,
DISPATCH & LOCKERS

VIEWS

in

out DESIRABLE

ORIENTATION

LIGHTING NATURAL OR ARTIFICIAL

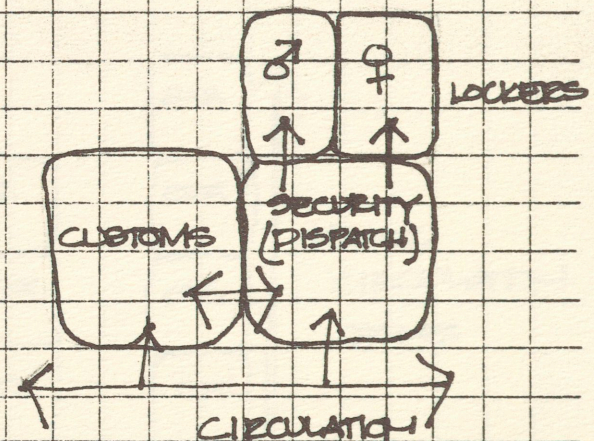
ACOUSTICS ALLOW NORMAL CONVERSATION

MATERIALS DURABLE

OCCUPANCY

AREA REQUIRED 4000

ADJACENCY



PROGRAM

SPACE DESCRIPTION OFFICE SPACE

OFFICE SPACE TO BE UTILIZED BY FUNCTIONS NOT SPECIFICALLY ADDRESSED.

QUALITY UP TO DISCRETION OF OFFICE OCCUPANT BUT MAINTAIN A COMPATIBLE ARCHITECTURAL ENVIRONMENT.

USER

TIME OF USE AIRPORT BUSINESS HOURS
8 a.m. - 5 p.m.

FUNCTIONAL CONCERNS OFFICE SPACES
SHOULD BE LOCATED IN CLOSE PROXIMITY
TO EACH OTHER
VIEWS

in - LOBBY (GARDEN)

out - DESIRABLE

ORIENTATION NORTH OR SOUTH

LIGHTING NATURAL OR ARTIFICIAL

ACOUSTICS STANDARD OFFICE ACOUSTIC
REQUIREMENT

MATERIALS UP TO DISCRETION OF USER.

OCCUPANCY

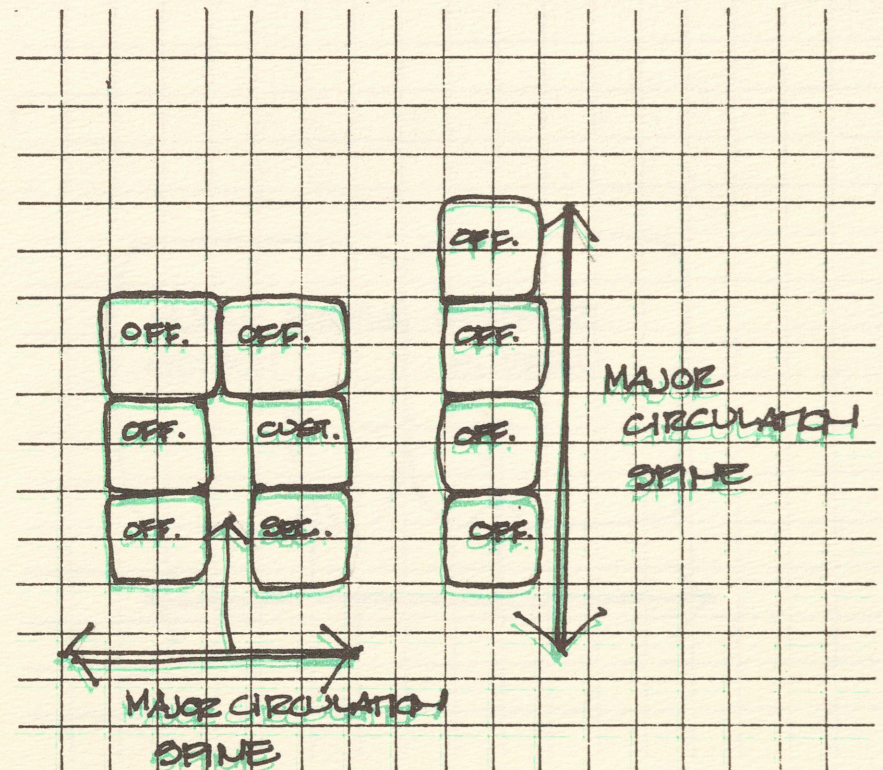
AREA REQUIRED 8 OFFICE SPACES

2-400 $\pm$ 4-375 $\pm$

2-350 $\pm$

3,000 $\pm$ TOTAL

ADJACENCY



PROGRAM

SPACE DESCRIPTION WEATHER BUREAU
SPACE WHERE INFORMATION ABOUT CURRENT WEATHER CONDITIONS ARE
CATALOGED AND MADE AVAILABLE TO PUBLIC MEDIA & FLIGHT SERVICE STATION.

QUALITY- DEPENDENT UPON EQUIPMENT AND FUNCTIONAL
CONSIDERATIONS

USER WEATHER BUREAU PERSONNEL

TIME OF USE 24 HRS

FUNCTIONAL CONCERNS SPACE FOR CURRENT ADJACENCY
STATE OF THE ART CLIMATOLOGICAL DEVICES SHOULD
BE PROVIDED FOR
VIEWS

in TO FLIGHT SERVICE STATION
out DESIRABLE

ORIENTATION NORTH OR SOUTH

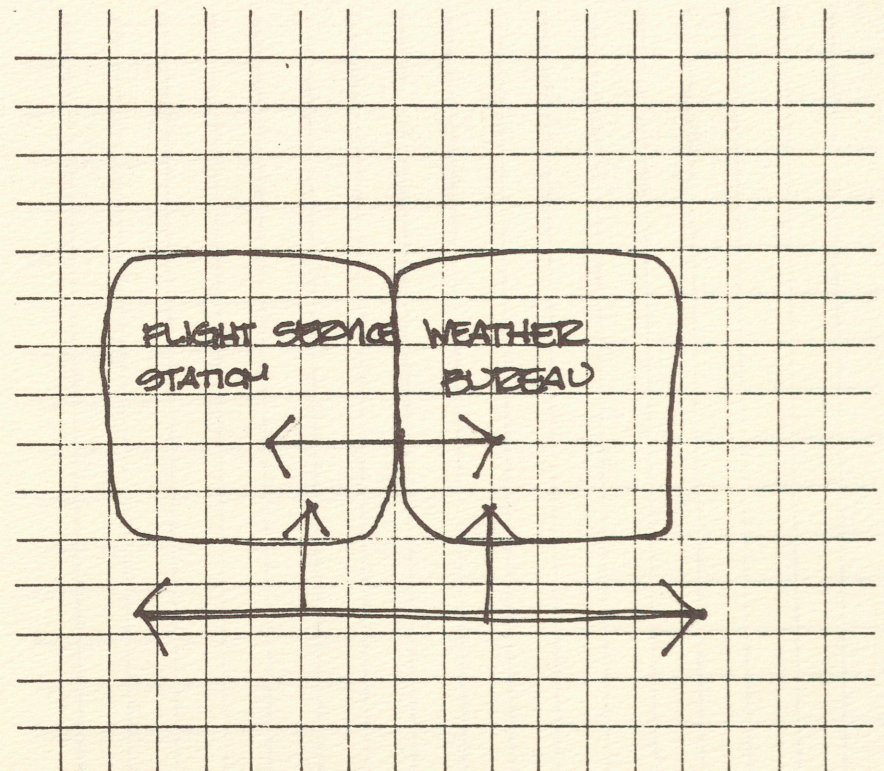
LIGHTING NATURAL OR ARTIFICIAL

ACOUSTICS ALLOW NORMAL CONVERSATION

MATERIALS DURABLE

OCCUPANCY

AREA REQUIRED 2000 sq ft



PROGRAM

SPACE DESCRIPTION FLIGHT SERVICE STATION
GOVERNMENT AGENCY THAT PROVIDES WEATHER AND FLIGHT INFORMATION
TO GENERAL AVIATION, AIR CARRIER OR MILITARY PILOTS. KEEPS RECORDS
OF FLIGHT PLANS INTO AND OUT OF BILLINGS.

QUALITY INFORMATIVE

USER AIRPORT PERSONNEL + PILOTS

TIME OF USE 24HRS

FUNCTIONAL CONCERNS CLOSE ADJACENCY
TO WEATHER. UTILIZES COMPUTER EQUIP.

VIEWS

in TO WEATHER BUREAU

out DESIRABLE

ORIENTATION NORTH OR SOUTH

LIGHTING NATURAL or ARTIFICIAL

ACOUSTICS ALLOW NORMAL CONVERSATION

MATERIALS DURABLE & EASILY MAINTAINED

OCCUPANCY

AREA REQUIRED 2500 ft²

ADJACENCY

A full page of blank graph paper. The grid consists of 20 vertical columns and 20 horizontal rows, creating a uniform square pattern across the entire page. The lines are thin and black, set against a light cream-colored background.

PROGRAM

SPACE DESCRIPTION AIRPORT MANAGER
ADMINISTRATIVE FUNCTIONS OF THE AIRPORT OCCUR HERE.

QUALITY INVITING, RELAXED, CONSERVATIVE, REMOVED FROM THE ACTIVITY OF THE AIRPORT.

USER AIRPORT MANAGER, PUBLIC

TIME OF USE AIRPORT BUSINESS HOURS
8 a.m. - 5 p.m.

FUNCTIONAL CONCERNS CLOSE PROXIMITY
TO CONFERENCE OTHER ADMINISTRATIVE OFFICES
AND SEC/REC
VIEWS

in SEC/REC
out DESIRABLE

ORIENTATION NORTH, TO AIRFIELD

LIGHTING NATURAL OR ARTIFICIAL

ACOUSTICS NORMAL CONVERSATION

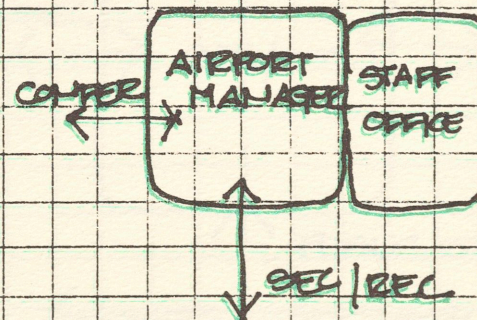
MATERIALS CARPET, WOOD, GYPSUM BOARD
WALL CONSTRUCT PAINT COMFORTABLE FURN.
WOOD DESK, PANEL.
OCCUPANCY

1-4

AREA REQUIRED

350 sq ft

ADJACENCY



PROGRAM

SPACE DESCRIPTION SEC./REC.

SPACE WHERE SECRETARY CAN PERFORM CLERICAL FUNCTIONS + RECEPTION
TO PUBLIC + BUSINESS CLIENTS

QUALITY RELAXED, INVITING.

USER SECRETARY, PUBLIC, BUSINESS CLIENTS

TIME OF USE AIRPORT BUSINESS HOURS
8 a.m. - 5 p.m.

FUNCTIONAL CONCERNS SPACE FOR SEATING
AS WELL AS COMPUTER EQUIP. + STORAGE
FILES
VIEWS

in AIRPORT MANAGER
out DESIRABLE

ORIENTATION

LIGHTING NATURAL OR ARTIFICIAL

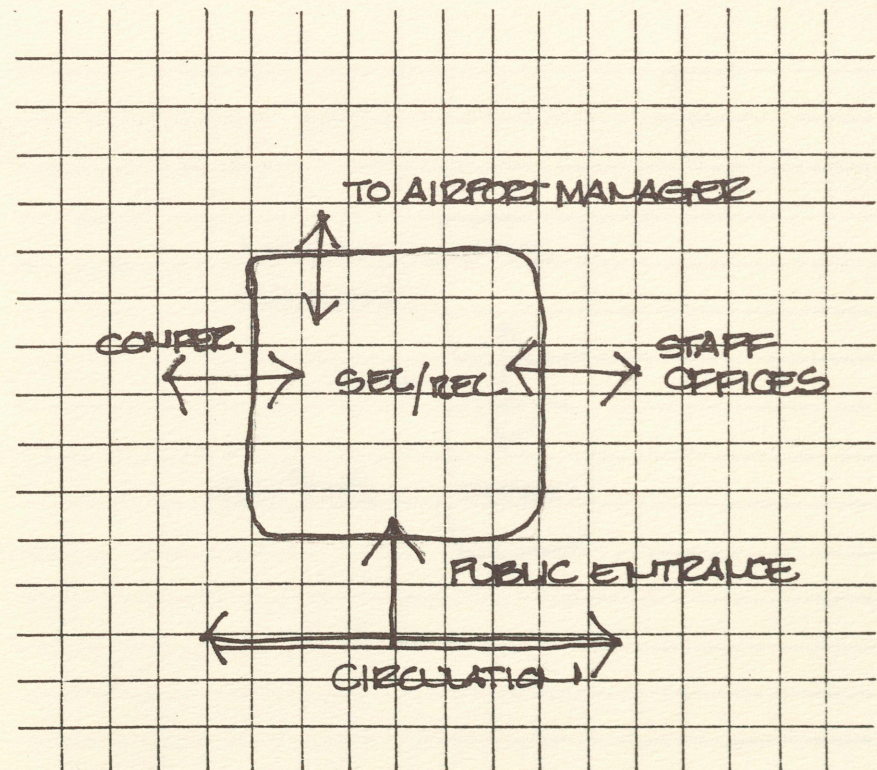
ACOUSTICS ALLOW NORMAL CONVERSATION

MATERIALS CARPET, WOOD, DURABLE +
EASILY MAINTAINED. PAINT

OCCUPANCY 1-10

AREA REQUIRED 600 sq ft

ADJACENCY



PROGRAM

SPACE DESCRIPTION OFFICES (ADMINISTRATIVE)
OFFICE SPACE FOR AIRPORT MANAGER ASSISTANT AND ONE OTHER
ADMINISTRATIVE PERSONNEL.

QUALITY - ESSENTIALLY SAME QUALITY AS AIRPORT MANAGERS
OFFICE

USER AIRPORT PERSONNEL & PUBLIC

TIME OF USE AIRPORT BUSINESS HOURS
8 a.m. - 5 p.m.

FUNCTIONAL CONCERNS

VIEWS

in REL/REL
out DESIRABLE

ORIENTATION

LIGHTING NATURAL OR ARTIFICIAL

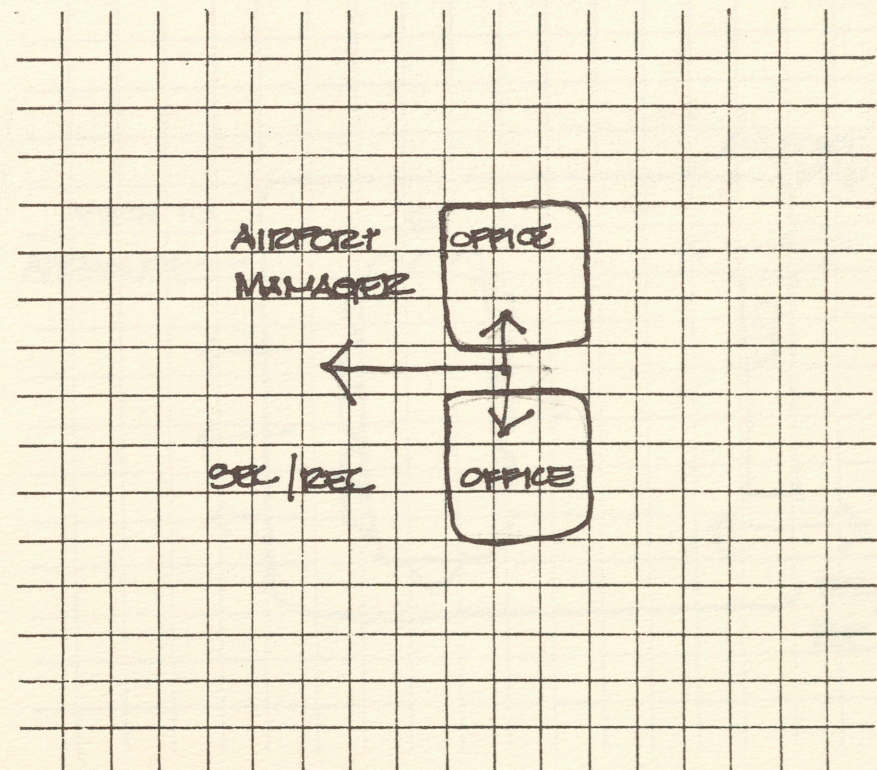
ACOUSTICS NORMAL CONVERSATION

MATERIALS CARPET, WOOD, PAINT,
COMFORTABLE FURNITURE

OCCUPANCY
1-3

AREA REQUIRED 2 OFFICES
200 $\pm$ / EACH

ADJACENCY



PROGRAM

SPACE DESCRIPTION CONFERENCE

LARGE SPACE TO ACCOMMODATE ADMINISTRATIVE MEETINGS & OTHER BUSINESS CONFERENCES.

QUALITY RELAXED, QUALITY FURNISHINGS, WOOD FLOOR
PAINTINGS, WELL DESIGNED INTERIOR.

USER AIRPORT PERSONNEL & CLIENTS

TIME OF USE AIRPORT BUSINESS HOURS.
8 a.m. - 5 p.m.

FUNCTIONAL CONCERNS SPACE FOR
BEVERAGE SERVING LARGE CONFERENCE
TABLE 5' X 12'
VIEWS

in UNDESIRABLE
out DESIRABLE

ORIENTATION NORTH TO AIRFIELD

LIGHTING NATURAL AND ARTIFICIAL

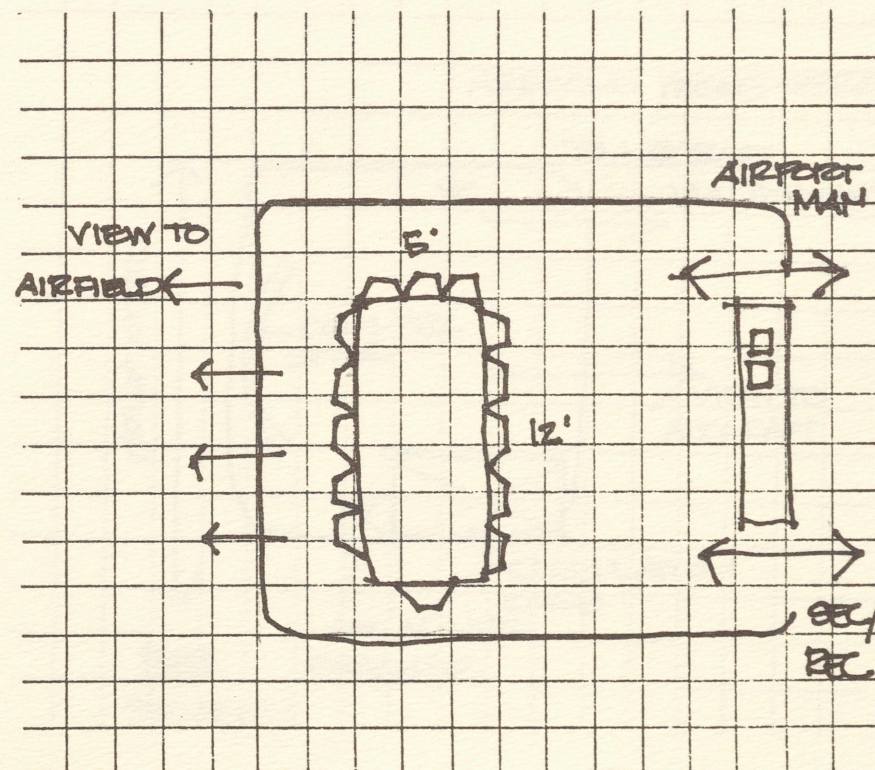
ACOUSTICS MUST ALLOW NORMAL TO
HEAR CONVERSATION.

MATERIALS WOOD, BRASS, PLUSH FURNITURE
GLASS, WOOD CONF. TABLE, PAINTINGS

OCCUPANCY 15

AREA REQUIRED 450 $\pm$

ADJACENCY



PROGRAM

SPACE DESCRIPTION HOLDING
SPACE POST SECURITY CHECK POINTS WHERE EMPLANING PASSENGERS WAIT
JUST PRIOR TO AIRPLANE DEPARTURE. TICKET CHECKING AND SEAT ASSIGNMENT
OCCUR HERE

QUALITY COMFORTABLE. BRIGHT, CASUAL

USER EMPLANING PASSENGER & AIRLINE PERSONNEL

TIME OF USE PRIOR TO AIRCRAFT DEPARTURE

FUNCTIONAL CONCERNS ELEVATOR SPACE FOR ADJACENCY
LAST MINUTE BAGGAGE DROP OFF & COUNTER SPACE
FOR TICKET CHECKING & SEAT ASSIGNMENT. SEPERATION
VIEWS OF ARRIVING & DEPARTING TRAFFIC

in
out TO PLANES

ORIENTATION NORTH

LIGHTING NATURAL & ARTIFICIAL

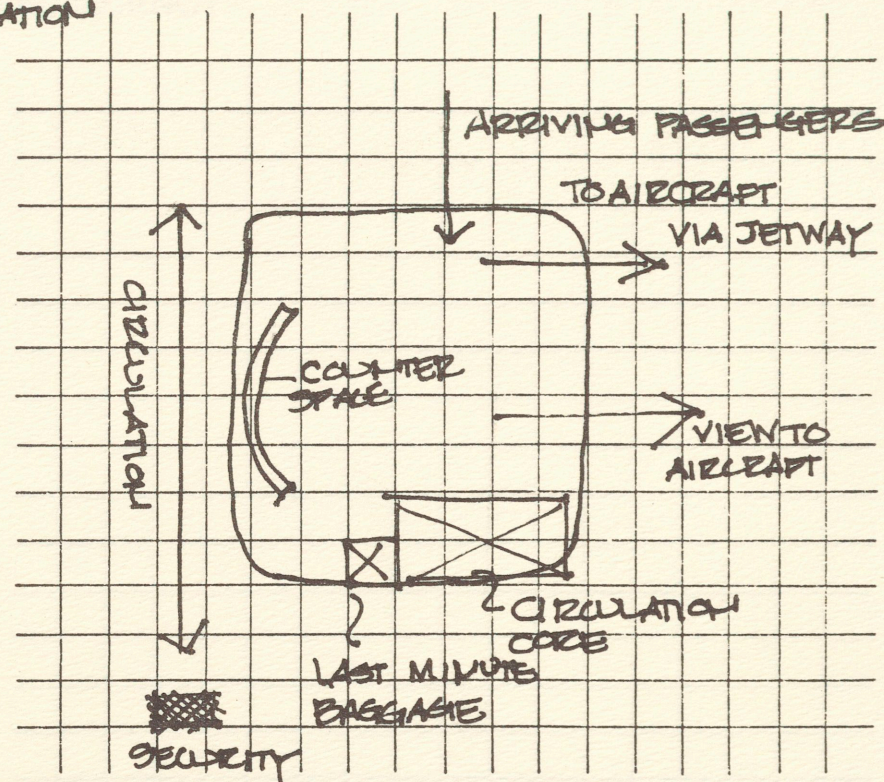
ACOUSTICS CLOSEST SPACE TO AIRCRAFT, NEEDS
TO BE WELL BUFFERED

MATERIALS DURABLE

OCCUPANCY 1/2 THE SEATS ON LARGEST
PLANE (60)

AREA REQUIRED $30\text{¢} / \text{SEAT} \times 60 = 1,800\text{¢}$
GATE LOUNGE

127 - 2,000¢
137 - 2000¢



PROGRAM

SPACE DESCRIPTION WAITING

SPACE DESCRIPTION WAITING
SPACE FOR EMPLOYING PASSENGERS | PUBLIC TO WAIT PRIOR TO SECURITY
| HOLDING AREAS

QUALITY RELAXING, CASUAL, INFORMATIVE, BRIGHT, COMFORTABLE
SOFT, PLAYFUL

USER ~~PASSENGERS~~ PUBLIC

TIME OF USE 1-1/2 PRIOR TO AIRCRAFT DEPARTURE

FUNCTIONAL CONCERNS SHOULD BE WELL ORGANIZED
BUT WITH THE POSSIBILITY OF CREATIVE RESPONSE
FROM USER VIEWS

in TO HOLDING AREAS
out TO AIRCRAFT

ORIENTATION NORTH

LIGHTING NATURAL OR INCANDESCENT.

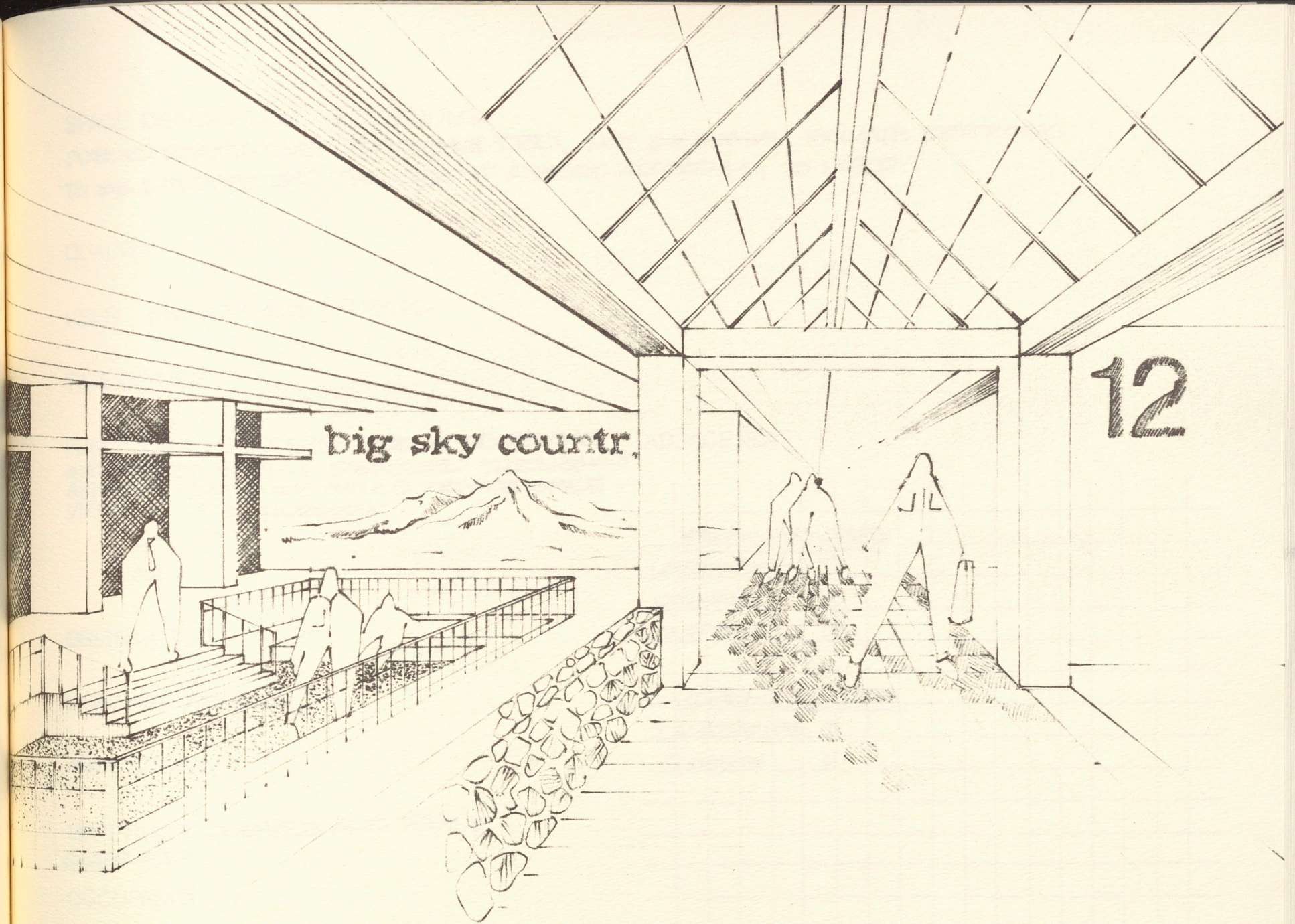
ACOUSTICS ALLOW NORMAL CONVERSATION!

MATERIALS WOOD, CARPET, COMFORTABLE
FURNISHINGS, METAL

OCCUPANCY 2 170 304 / OCCUPANT

AREA REQUIRED 5200 ϕ

PROGRAM



WAITING

SPACE DESCRIPTION	RESTROOMS
1.000	1.000
2.000	2.000
3.000	3.000
4.000	4.000
5.000	5.000
6.000	6.000
7.000	7.000
8.000	8.000
9.000	9.000
10.000	10.000
11.000	11.000
12.000	12.000
13.000	13.000
14.000	14.000
15.000	15.000
16.000	16.000
17.000	17.000
18.000	18.000
19.000	19.000
20.000	20.000
21.000	21.000
22.000	22.000
23.000	23.000
24.000	24.000
25.000	25.000
26.000	26.000
27.000	27.000
28.000	28.000
29.000	29.000
30.000	30.000
31.000	31.000
32.000	32.000
33.000	33.000
34.000	34.000
35.000	35.000
36.000	36.000
37.000	37.000
38.000	38.000
39.000	39.000
40.000	40.000
41.000	41.000
42.000	42.000
43.000	43.000
44.000	44.000
45.000	45.000
46.000	46.000
47.000	47.000
48.000	48.000
49.000	49.000
50.000	50.000
51.000	51.000
52.000	52.000
53.000	53.000
54.000	54.000
55.000	55.000
56.000	56.000
57.000	57.000
58.000	58.000
59.000	59.000
60.000	60.000
61.000	61.000
62.000	62.000
63.000	63.000
64.000	64.000
65.000	65.000
66.000	66.000
67.000	67.000
68.000	68.000
69.000	69.000
70.000	70.000
71.000	71.000
72.000	72.000
73.000	73.000
74.000	74.000
75.000	75.000
76.000	76.000
77.000	77.000
78.000	78.000
79.000	79.000
80.000	80.000
81.000	81.000
82.000	82.000
83.000	83.000
84.000	84.000
85.000	85.000
86.000	86.000
87.000	87.000
88.000	88.000
89.000	89.000
90.000	90.000
91.000	91.000
92.000	92.000
93.000	93.000
94.000	94.000
95.000	95.000
96.000	96.000
97.000	97.000
98.000	98.000
99.000	99.000
100.000	100.000

PUBLIC RESTROOMS RECOMMENDED. NOT INCLUSIVE, PRIVATE RESTROOMS TO BE INTERSPERSED THROUGHOUT AIRPORT ACCORDING TO NEED.

QUALITY

USER PASSENGER + PUBLIC

TIME OF USE

FUNCTIONAL CONCERNS PUBLIC RESTROOMS
SHOULD BE EVENLY DISPERSED THROUGHOUT
AIRPORT. 1 BATH/FLOOR SHOULD PROVIDE SPACE
VIEWS FOR NURSERY

in
out

ORIENTATION

LIGHTING ARTIFICIAL

ACOUSTICS

MATERIALS DURABLE AND EASILY
CLEANED

OCCUPANCY

AREA REQUIRED 6000 ϕ MIN REQ- MEN
6000 ϕ MIN REQ- WOMEN

ADJACENCY

MEN'S FIXTURES

LAVATORIES 15

ORIGINALS 13

CLOOTS 13

WOMEN'S FIXTURES

LAVATORZES II

CLOSETS 11

PROGRAM

GATE-ARRIVAL

Gate arrival is the simplest terminal concept. It is an attempt to consolidate all airline functions into one building while minimizing walking distances for passengers. In major airport systems multiple drive to gate terminals are utilized resulting in a decentralized airport system.

PIER FINGER

The pier finger concept is the most frequently used presently. Processing occurs in a centralized building with aircraft gate positions located along a corridor. The pier finger concept allows easy expansion without disruption to the processing area by the addition of another pier finger. This concept provides large passenger-processing capacity without excessive land requirements.

PIER SATELLITE

The pier satellite concept is a modification of the pier finger concept with the finger terminated in a rotunda structure with aircraft gate positions encircling. The advantage of this system is that more space is available for easy assembly of passengers and is an attempt to reduce horizontal distances traveled by passengers.

TERMINAL CONCEPTS

REMOTE SATELLITE

In the remote satellite concept allowance for aircraft to park around units separate from the main terminal occurs. Some processing (ticketing, passenger assembly, aircraft loading and unloading) are performed at these units while the rest of the activities (baggage check-in, baggage claim, etc.) occur at the main terminal. This concept allows partial decentralization of processing activities. It permits flexible aircraft movement. Conveyance of passengers occurs below grade.

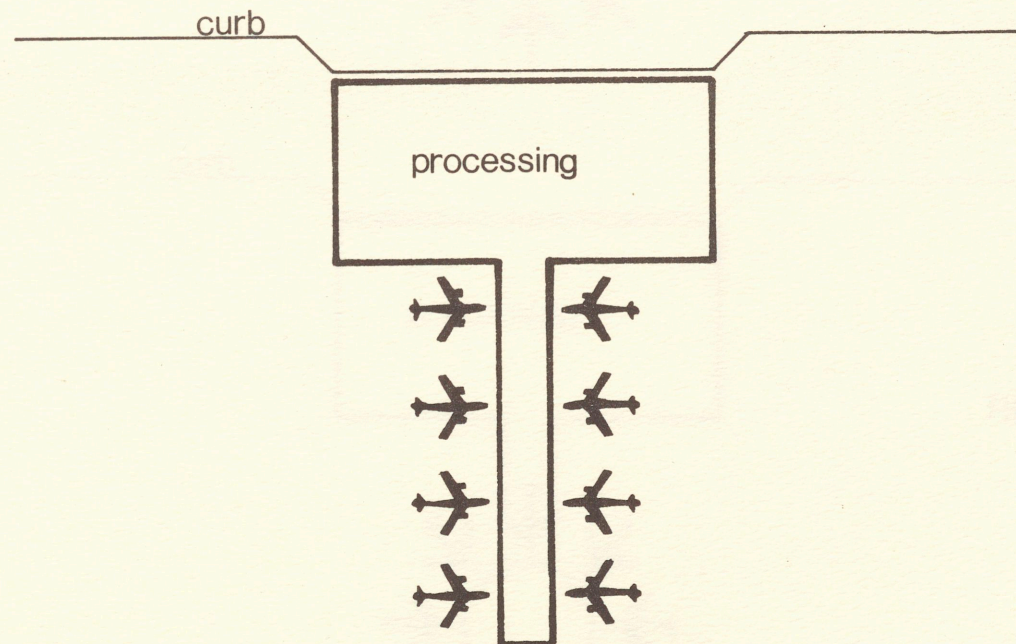
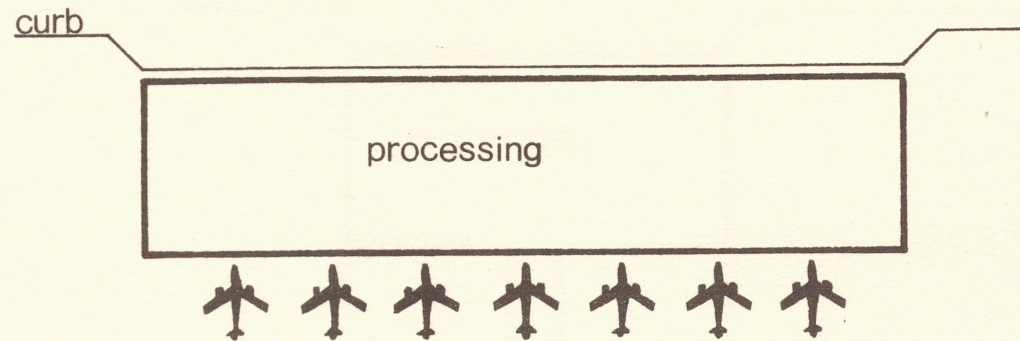
MOBILE CONVEYANCE

Mobile conveyance systems allow aircraft to be parked at remote stations away from the main terminal. A mobile conveyance system utilizing special buses or mobile lounges is used to take passengers to and from aircraft. The main feature of this system is independence between aircraft operations and terminal, and it allows flexibility in future aircraft modifications.

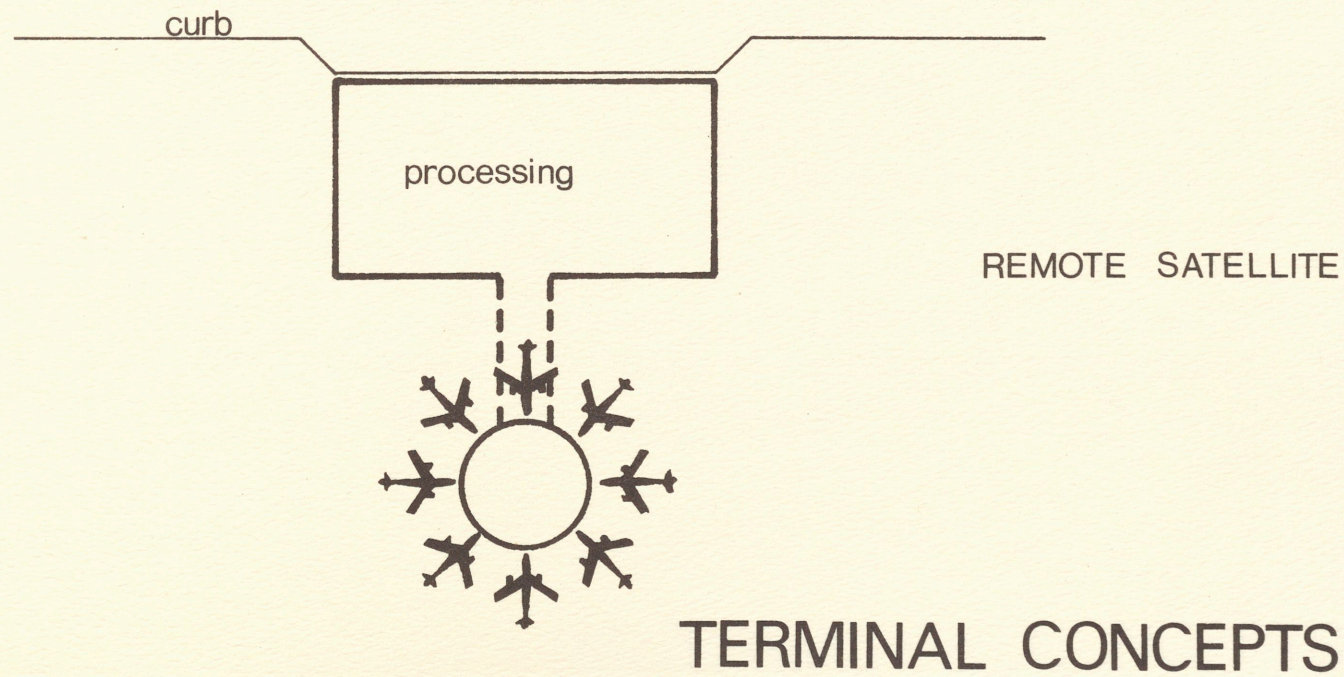
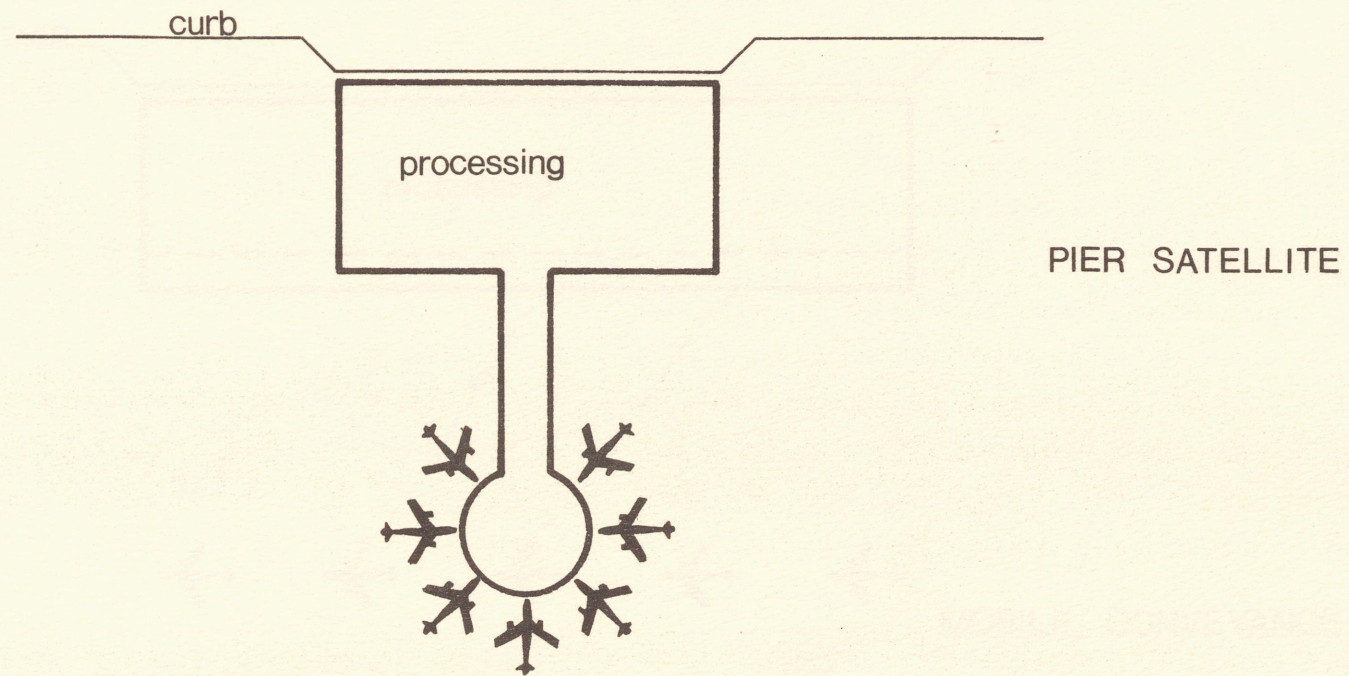
COMMENTS

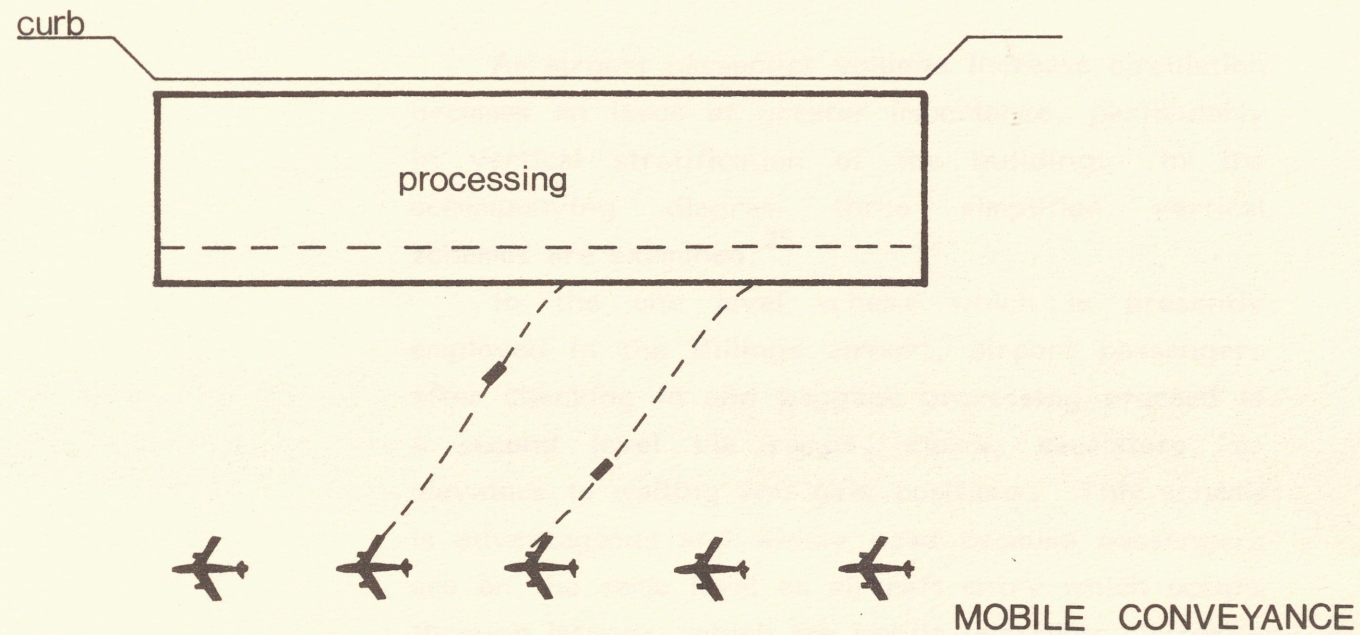
These concepts, while simplistic, define in essence contemporary airport schemes.²⁴ Most airports incorporate a number of systems or utilize one in multiples, resulting in terminology such as consolidated, decentralized, etc. There does not exist, though, much information about appropriateness of these schemes for specific airport needs.

TERMINAL CONCEPTS



TERMINAL CONCEPTS





TERMINAL CONCEPTS

As airport passenger volumes increase circulation becomes an issue of greater importance, particularly in vertical stratification of the building. In the accompanying diagram three simplified vertical schemes are examined.²⁵

In the one level scheme which is presently employed in the Billings airport, airport passengers after checking in and baggage processing proceed to a second level via ramps, stairs, escalators, or elevators to waiting and gate positions. This scheme is advantageous and widely used because passengers are on the same level as aircraft entry which occurs through jetways, which are mobile telescopic circulation devices. Baggage remains on the apron level to and from aircraft.

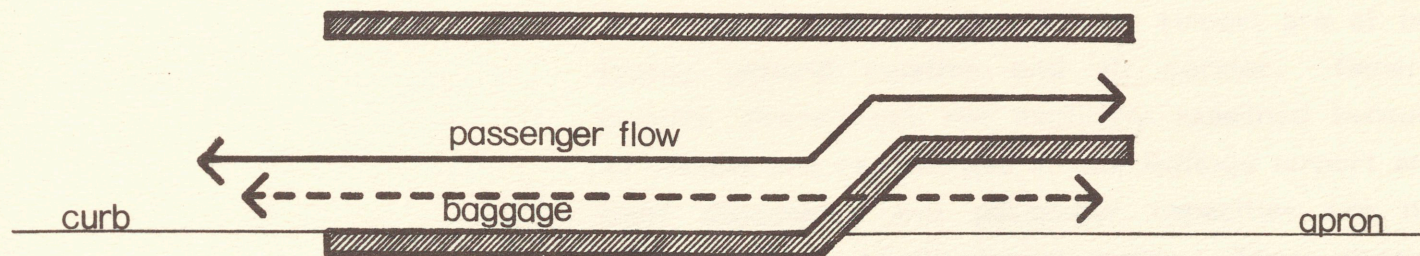
The multiple level system A is a scheme which provides minimum vertical movement for passengers as they enter the terminal at the same level as aircraft entry. Baggage after processing must be brought to the apron level. This scheme is useful if inherent to the site is a grade change of sufficient slope to help alleviate unnecessary site excavation. The site at the Billings airport is relatively flat and would not adapt to this scheme readily.

VERTICAL CIRCULATION

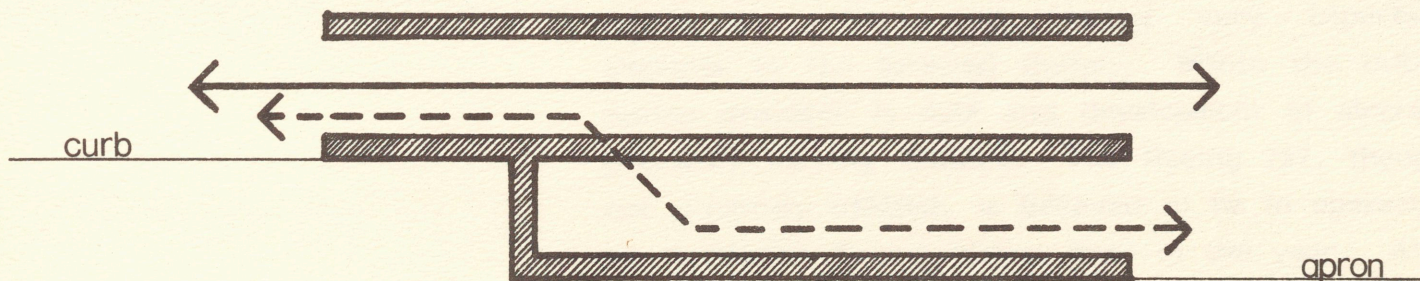
Multiple level system B is an attempt to separate arriving and departing passengers. This scheme separates opposing streams of traffic. Enplaning passengers arrive via an automobile ramp-up system to the same level as aircraft loading. Baggage as in the previous scheme must be lowered one level to the apron. Deplaning passengers entering on aircraft level proceed one level down to baggage claim and parking, which can occur on grade or underground. The advantage of this scheme is the separation of traffic flow.

VERTICAL CIRCULATION

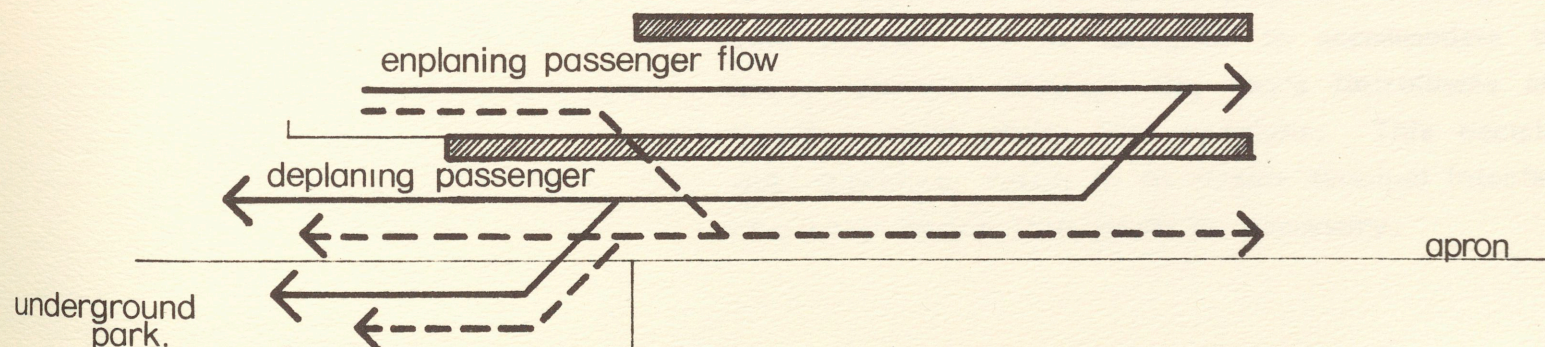
ONE LEVEL SYSTEM



MULTIPLE LEVEL SYSTEM A



MULTIPLE LEVEL SYSTEM B



VERTICAL CIRCULATION

Aircraft utilizing the Billings airport are of two types; general aviation and air carrier. General aviation aircraft are not explicitly examined because all classes are represented at the Billings airport and their dimensions and passenger capacities are not crucial elements to the airport design. These aircraft do not dock at the terminal, though they account for a substantial amount of traffic; 400 aircraft operations per day. Air carrier aircraft are those flown by commercial airlines and become very important elements in the terminal design. Within the information provided is data and development of aircraft presently serving Billings. The Boeing 757, though not presently utilized, is believed to be in operation by Northwest Orient Airline later in the year. Also included is a brief synopsis of the major airlines serving Billings.²⁶

Aircraft directly influence the terminal in regard to gate positions. For the purpose of the design the gate position will be designed to accommodate the larger aircraft, although Big Sky's Metrofiners and Cessnas would utilize gate positions. This decision will, therefore, result in an airside terminal interface of greater length than would be necessary.

Fairchild-Swearingen Metro

USA

The following specification refers to the Metro III.

Power Plant: Two Garrett AiResearch TPE 331-11U-601G turboprops each rated at 1,100shp for take-off, using alcohol/water injection.

Performance: Design operating speed, 285mph (459km/h) CAS/Mach = 0.52, max speed, 345mph (555km/h); max cruising speed, 319mph (513km/h) at 10,000ft (3050m); initial rate of climb, 2,440ft/min (12.4 m/sec); range, 19 passengers, baggage and 45-min reserve, 714mls (1149km).

Weights: Typical operating weight empty (with two crew, avionics and unusable fuel), 8,737lb (3963kg); max useful load, 5,463lb (2478kg); max take-off and landing weight, 14,000lb (6350kg); max zero fuel weight, 12,500lb (5670kg).

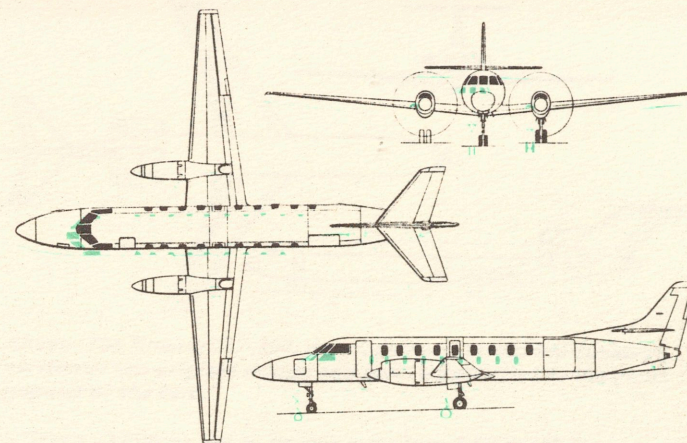
Dimensions: Span, 57ft 0in (17.37m); length 59ft 4½in (18.09m); height 16ft 8in (5.08m); wing area, 309sq ft (28.71m²).

The Metro was designed by Ed Swearingen to meet the needs of the third level airlines, and was the first product of wholly original concept produced by the Swearingen company, which had taken the Beechcraft Queen Air to provide the basis for a series of business aircraft named the Merlin I, IIA and IIB. When the Metro was developed, as a 19-passenger transport, a version was also offered for business use, with up to 12 seats in an executive interior. Swearingen was acquired by Fairchild Industries as a subsidiary in November 1971 and the company name has subsequently changed to Fairchild Swearingen.

The Metro first flew on 26 August 1969 and entered service early in 1971, the first major operator being Air Wisconsin, which had a fleet of 10 by 1977. Progressive improvements have kept the Metro in the forefront of the US commuter market and more than 200 had been sold by 1981.

During 1974, the Metro 2 was introduced, with square windows and some internal refinements, plus optional installation of a small rocket unit in the tail to improve take-off performance in hot and high conditions. Like the original model, however, this was confined by the provisions of FAA regulations (SFAR 23) that restricted to 12,500lb (5670kg) the gross weight of aircraft to be operated by US commuter airlines.

This weight restriction was relaxed by Special Federal Aviation Regulation (SFAR) 41, and, on 23 June 1980, the Metro became the first aircraft to be approved by the FAA under the provision of SFAR 41. As the Metro IIA, with a number of additional safety features as prescribed by the FAA, a maximum weight of 13,100lb (5941kg) was approved, but to obtain full benefit from the new regulations for commuter operations, a more extensive

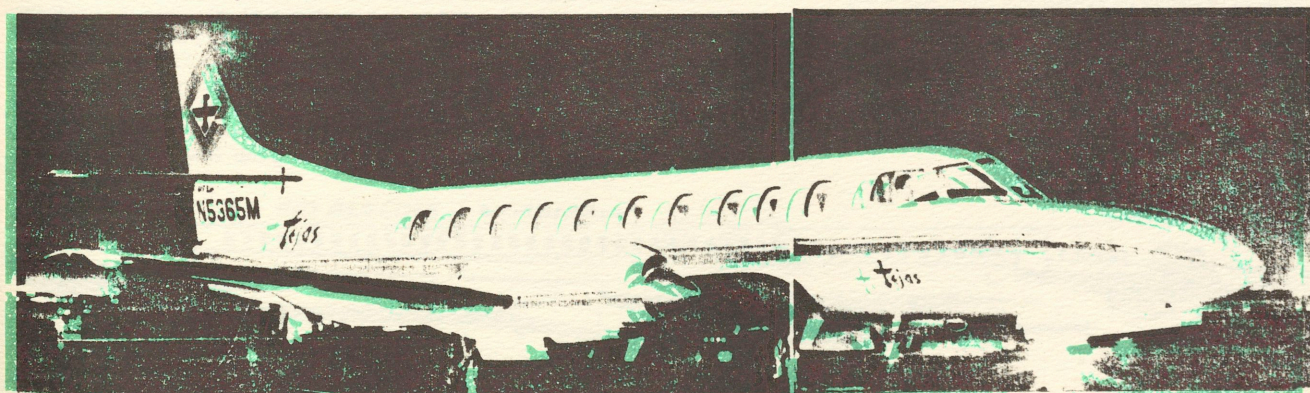


Above: Three-view drawing of the Metro III, which introduces a wing of greater span than that of the Metro II previously built.

modification of the aircraft was required. This led to introduction of the Metro III, the major new features of which were uprated engines and a longer, stronger wing, associated with a gross weight of 14,000lb (6350kg). There was no change in fuselage size or passenger accommodation; as before, the aircraft was approved for up to 20 passengers, but in US operations the effective limit is 19, since a cabin attendant has to be carried if 20 or more passengers are enplaned.

The new wing of the Metro III was 10ft (3.05m) longer than that of the original Merlin, with conical-cambered wing tips to reduce drag and structural strengthening matched to the new weights and flight loads. The engines were Garrett AiResearch TPE 331-11U-601G turboprops, with an optional continuous alcohol/water injection (CAWI) system for those operators requiring the best field performance in hot and high conditions; respective dry and wet ratings of 1,000 and 1,100shp were each 160shp higher than those of the TPE 331-3UW-304G engines in the Metro II.

New Dowty-Rotol supercritical four-bladed propellers were adopted and the nacelle lines were refined to reduce drag and to improve accessibility for rapid engine changes. Another drag-reducing modification concerned the main landing gear doors, which now close after gear extension, as well as retraction. As a further development of the basic Metro III, the company announced during 1981, for 1983 delivery, the Metro IIIA with Pratt & Whitney PT6A-45R engines and gross weight increased to 14,500lb (6576kg).



Left: A Metro II in the markings of Tejas Airlines, a Texas-based local airline that was among the first to use this commuter airliner. Progressive development led to the Metro III in 1981, with extended wing span, and to the Metro IIIA (first flown on 31 December 1981).

Boeing 727

USA

The following specification relates to the Advanced 727-200:

Power Plant: Three 15,000lb st (6804kcp) Pratt & Whitney JT8D-11 or 15,500 lb st (7030kcp) JT8D-15 or 16,000lb st (7257kcp) JT8D-17 turbo-fans.

Performance: Max cruising speed, 599mph (964km/h) at 24,700ft (7530m); economy cruise, 570mph (917km/h) at 30,000ft (9145m); initial rate of climb, 2,600ft/min (13.2m/sec); service ceiling, 33,500ft (10,210m); range with max payload over 2,800mils (4500km).

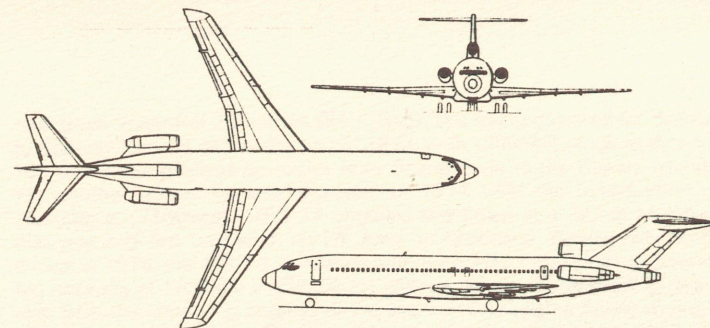
Weights: Operating weight empty, 100,000lb (45,360kg); max payload, 42,800lb (19,414kg); max take-off, 209,500lb (95,027kg).

Dimensions: Span, 108ft 0in (32.92m); length, 153ft 2in (46.69m); height, 34ft 0in (10.36m); wing area, 1,700sq ft (157.9m²).

Design studies to evolve a medium-to-short range partner for the Model 707 were begun by Boeing as early as February 1956, two years before the first 707 entered service. Many configurations were studied, with nearly 70 alternatives actually reaching the stage of wind-tunnel testing, but maximum commonality with the 707 was one of the major design objectives, in order to achieve economy in first cost and operating cost. Boeing designers eventually concluded that a three-engined configuration best suited the size and performance requirements, and the new type therefore evolved along lines closely resembling those of the de Havilland 121 Trident which was intended for the same segment of the airline market.

After three years in Preliminary Design, during which time the designation 727 was adopted to continue the family series begun with the 707, the new transport became an active project early in 1959 and all major design decisions had been finalized by 18 September in that year. For another twelve months or so the favoured engine was the Allison-built version of the Rolls-Royce Spey, but the Pratt & Whitney JT8D was eventually chosen, and in this form the Boeing 727 moved from project to production on 5 December 1960 when United Airlines and Eastern Air Lines each ordered 40 examples. Boeing expressed its confidence in the future market for medium-sized aircraft of the 727 type with an estimate of sales totalling at least 300; by late 1981, however, the sales total stood at 1,815, making the 727 the world's best-selling jet airliner by a substantial margin. More than 100 airlines had by then purchased examples of the 727 from Boeing, three of these each having acquired fleets of more than 100, and many other operators had acquired examples on lease or through second-hand purchases.

Commonality with the Boeing 707 included the entire upper lobe of the fuselage, based on a cabin floor of identical width and therefore permitting the use of the same interior arrangements, and similar flight decks. Special attention was paid to the field performance, and the wing design incorporated the most advanced high lift devices ever adopted for a commercial transport at the time the 727 was launched. With a sweepback of 32 deg, the 727's wing had leading-edge slats and flaps, triple-slotted trailing edge flaps, inboard (high-speed) and outboard (low-speed) ailerons and flight and ground spoilers. With accommodation for up to 125 passengers (high-density) the 727 was designed to operate over stage lengths of up to



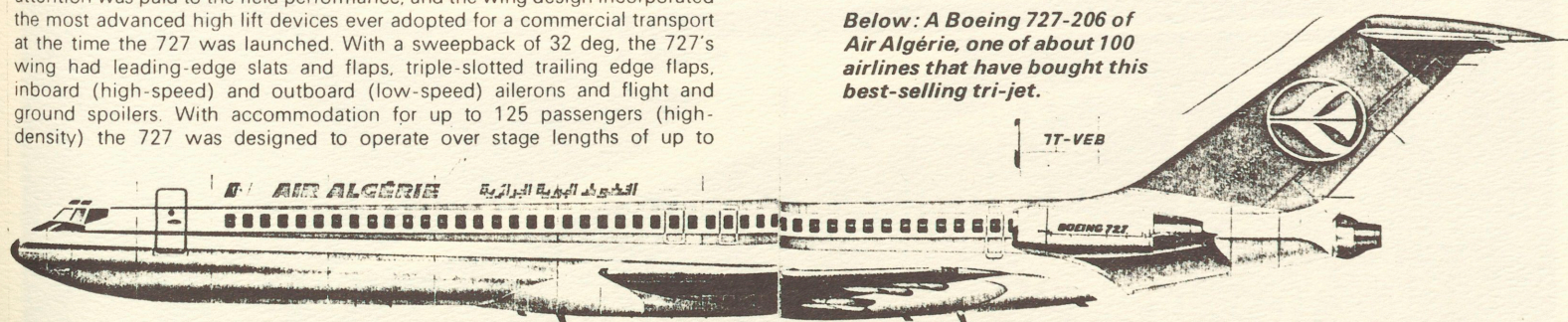
Above: The Boeing 727-200, developed as a stretched-fuselage version of the original design and soon established as the most popular of the two.

1,700mils (2736km) and to be able to fly from 5,000ft (1524m) runways.

The first Boeing 727, in United colours, flew on 9 February 1963 from Seattle, followed by a company demonstrator in Boeing's canary yellow and brown house colours on 12 March. With two more production aircraft soon joining the flight test programme, FAA Type Approval was obtained on 24 December 1963 and the first commercial service was operated on 1 February 1964 by Eastern between Miami, Washington and Philadelphia, followed by United's first service on 6 February. Later in the same month, the first export delivery was made, to Lufthansa, and the German airline flew its first service with the type on 16 April. Thus, the Boeing 727 completely eroded the lead that the D.H.121 Trident had gained with its go-ahead in 1958, and was quickly to achieve ascendance in the sales battles that were to follow, not least because of the larger capacity and greater range offered by Boeing from the outset.

Following the precedent set with the 707, Boeing offered the 727 in a number of variants. At first, these were concerned primarily with fuel capacity and operating weights, the original certificated gross weight of 152,000lb (68,950kg) soon being increased to 160,000lb (72,575kg) and then, in the 727C version, to 169,000lb (76,655kg). Progressive increases in engine thrust also became available, starting with the 14,000lb st (6350kcp) JT8D-1 or -7, followed by the 14,500lb st (6577kcp) JT8D-9. The 727C was announced in July 1964 as a convertible passenger/cargo version, with the same side-loading freight door and cargo handling systems already developed for the Boeing 707-320C. Northwest Orient was the first to order the 727C; the first example flew on 30 December 1965, Type Approval was obtained on 13 January 1966 and Northwest flew the first service with the type on 23 April. A further refinement of the convertible idea was to mount passenger seats and galleys on pallets to achieve fast conversions, allowing ►

Below: A Boeing 727-206 of Air Algérie, one of about 100 airlines that have bought this best-selling tri-jet.



AIRCRAFT

the same aircraft to fly passengers by day and freight by night, although there was a weight penalty. This became known as the QC (Quick Change) version and was in service by May 1966, with United.

Meanwhile, in August 1965, Boeing had announced a "stretched" version as the 727-200 (the original production version then becoming the 727-100, or 727-100C or QC in convertible form). The "stretch" comprised exactly 20ft (6.10m) in two equal sections fore and aft of the wing, which remained unchanged, and maximum accommodation increased to 189. The JT8D-7 or -9 engines were specified at first, the gross weight being 169,000lb (76,655kg), but 15,000lb st (6804kkg) JT8D-11s became available in 1972 and the 15,500lb st (7030kkg) JT8D-15 was offered as a further alternative in later models. The first customer for the Boeing 727-200, which was to become the most important variant, was Northeast Airlines, with an order placed on 10 August 1965; the first example flew on 27 July 1967. Type Approval was obtained on 29 November and the first service was flown on 14 December 1967.

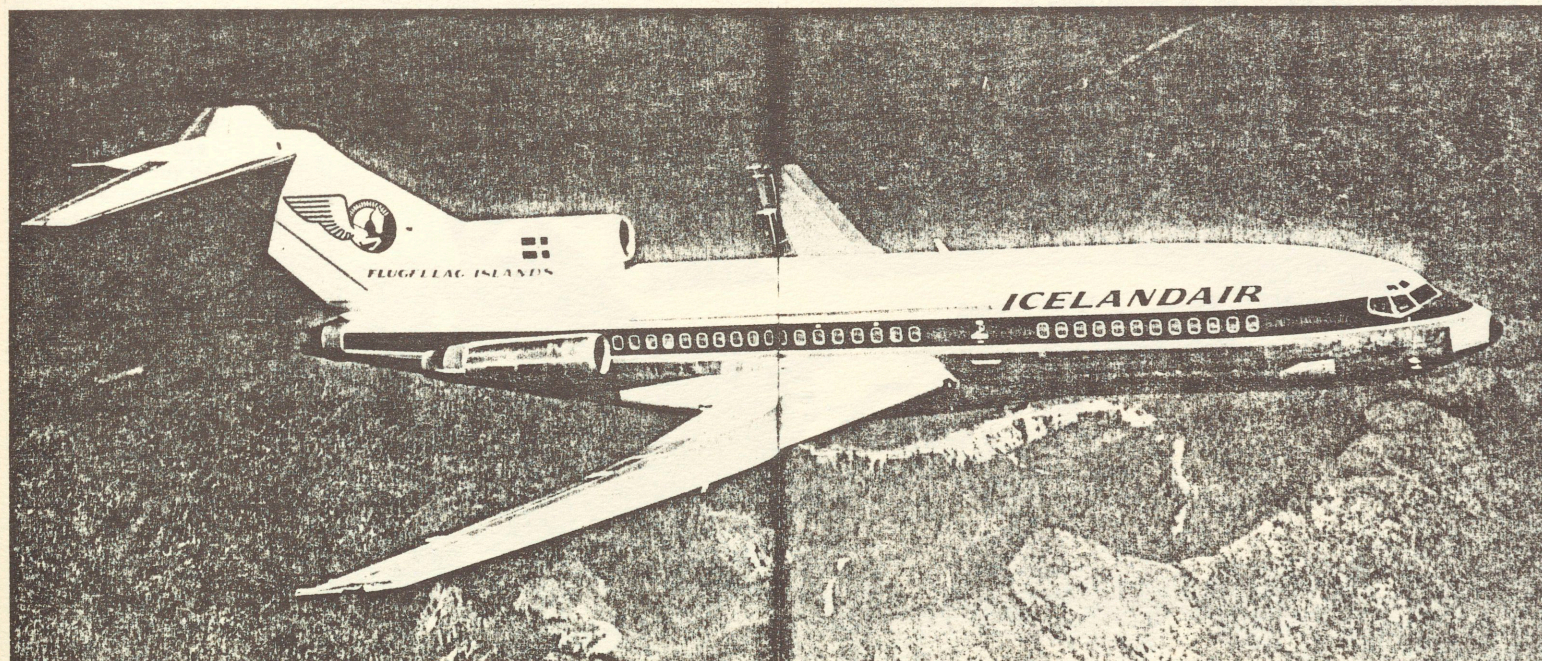
During 1970, when sales of the 727 were temporarily at a low ebb, Boeing began to plan a series of additional improvements, which led to introduction of the Advanced 727 with a wide option of gross weights, fuel capacities, engine powers and other features. Basic to the Advanced model were an increase in fuel capacity, new and improved aircraft systems, a "wide-body look" interior modelled on that of the Boeing 747 and additional noise reduction features to comply with new FAA regulations. First orders for the Advanced 727 were placed in December 1970 by TAA and Ansett of Australia, and the first example, destined for All-Nippon Airways, flew on 3 March 1972, with JT8D-15 engines and a gross weight of 191,000lb (86,636kkg). Type Approval was obtained on 14 June and All-Nippon flew the first service in July 1972.

On 26 July 1973, Boeing made the first flight of an Advanced 727 at a

new gross weight of 207,500lb (94,120kg), this being destined for delivery to Sterling Airways before the end of 1973, with sufficient range to fly a full 189-passenger payload on routes from Scandinavia to the Canary Islands. Yet another option became available in 1974 with the introduction of 16,000lb st (7260kkg) JT8D-17 engines, first flown in a 727 in March of that year and first delivered, on 24 June, to Mexicana. Boeing also introduced, in 1976, the JT8D-17R engine with automatic thrust reserve, operating normally at 16,400lb st (7440kkg) with an extra 1,000lb (454kg) available from the remaining engines in the event of one engine failing during a critical stage of the flight. The first 727 with ATR flew on 27 May 1976 and was later delivered to Hughes Airwest. Another variant emerged in 1981 when Federal Express ordered the Boeing 727F, a pure cargo version with cabin windows blanked off, side-loading freight door, cargo restraint and handling systems and a maximum cargo payload of 62,000lb (28,118kg).

Between 1974 and 1978, Boeing studied a number of possible "stretched" versions of the 727, initially as the 727-300A and 727-300B with 18ft 4in (5.59m) more fuselage length and either JT8D-17R or JT8D-217 engines. These projects were eventually superseded by the decision to develop the Boeing 7N7, which was launched as the Boeing 757. During 1981, however, Boeing was actively considering launching a programme to convert 727-200s to the new 727RE configuration, in which two Pratt & Whitney PW2037 or Rolls-Royce RB.211-535 turbofans (the engines selected to power the Boeing 757) would replace the three JT8Ds. Conversion would require structural modification of the rear fuselage and would provide a 150-seat airliner with modern fuel and noise characteristics at relatively low cost.

Below: Icelandair's Boeing 727-108C, a passenger/cargo convertible version of the original short-fuselage model.



AIRCRAFT

Boeing 737

USA

The following specification relates to the Advanced 737-200:

Power plant: Two 14,000lb st (6350kqp) Pratt & Whitney JT8D-7 or 14,500lb st (6577kqp) JT8D-9 or 15,500lb st (7030kqp) JT8D-15 or 16,000lb st (7257kqp) JT8D-17 turbofans.

Performance: Max cruising speed, 576mph (927km/h) at 22,600ft (6890m); best economy cruise, 553mph (890km/h); initial rate of climb, 3,760ft/min (19.1m/sec); range with max payload, 2,370mils (3815km); range with max fuel, 2,530mils (4075km).

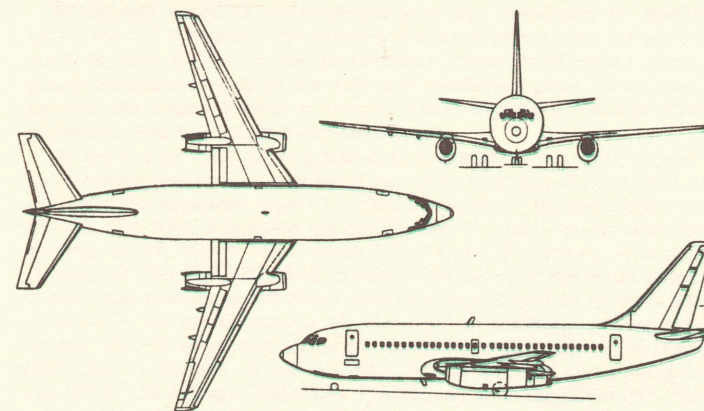
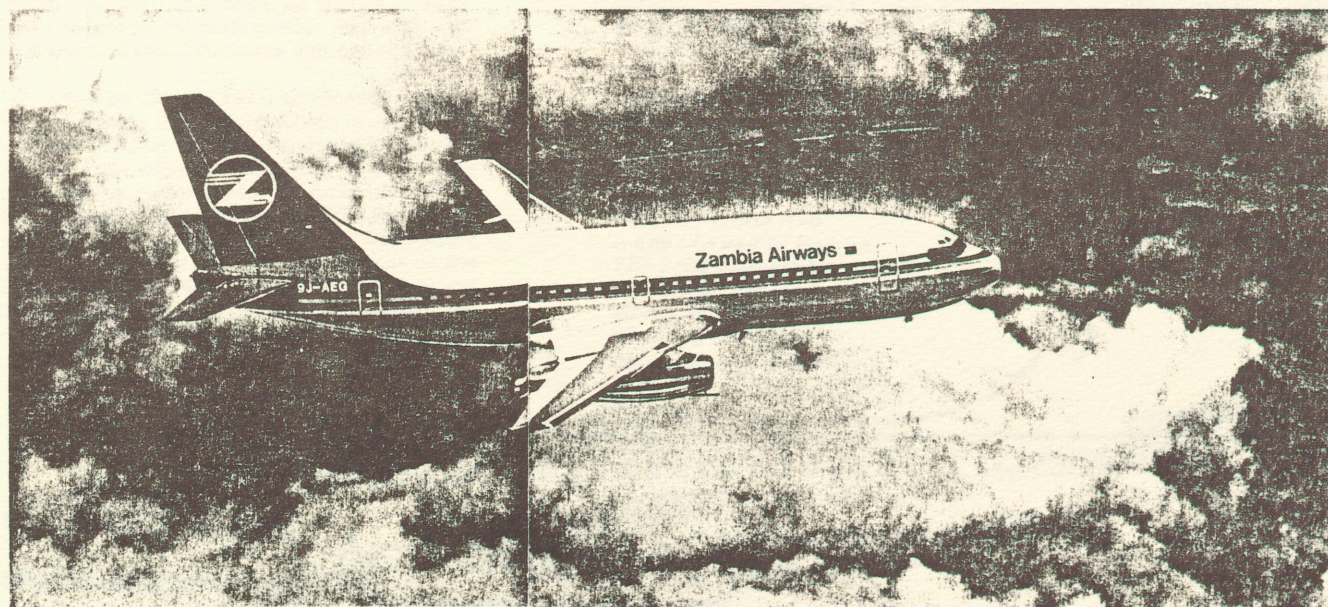
Weights: Operating weight empty, 59,300lb (26,898kg); max payload, 35,700lb (16,193kg); max take-off, 119,500lb (54,195kg).

Dimensions: Span, 93ft 0in (28.35m); length, 100ft 0in (30.48m); height, 37ft 0in (11.28m); wing area, 980sq ft (91.05m²).

Boeing's decision to add a short-haul airliner to its family of jet transports including the various models of 707 and 727 was taken in November 1964, by which time the BAC One-Eleven was already in flight test and the DC-9 was nearing first flight. With what became known as the Model 737, Boeing was competing for, broadly, the same portion of the airline market as that covered by the One-Eleven and DC-9, but the design approach was quite different. Whereas both BAC and Douglas had chosen a rear-engined, T-tail layout, Boeing decided to keep an underwing engine location and a conventional tail unit; not only did this keep the 737 clear of the aerodynamic problems associated with T-tails, but it also helped to achieve maximum commonality between the "baby" Boeing and its big brother. Most importantly, Boeing decided to retain the same overall fuselage width as that used in the 707/727; this resulted in a somewhat stubby appearance for the aircraft when the cabin length was sized to carry about 100 passengers, but provided for relatively spacious seating arrangements and permitted airlines already using the 707 or 727 to standardize on seats, galleys, etc.

The "launching order" for the Boeing 737, announced on 19 February

Right: A Boeing 737-2M9 of Zambia Airways. The 737 is the smallest of the extensive family of Boeing jetliners available in 1982, and is the second best-seller, exceeded in sales total only by the 727. The "M9" in the designation indicates Zambia Airways configuration: Boeing originally used two digits for its customer designers but was forced to introduce letter/number combinations as the customer list grew. The "2" indicates that this is a -200 model of the 737.



Above: Three-view drawing of the Boeing 737-200. The Advanced 737, incorporating numerous new features, is externally the same as the basic -200; the original -100 has a shorter fuselage.

1965, came from Lufthansa in Germany, marking the first occasion on which an airline outside the USA had ever been the initial customer for a new airliner put into production in the USA. Although passenger capacities of 60-85 had been projected for the 737 during most of the early stages of design, the size was increased to allow for 100 seats in the final stages of negotiation with Lufthansa; powered by Pratt & Whitney JT8D-1s at 14,000lb st (6350 kqp) each, the Model 737 was to have a gross weight of 85,000lb (38,535kg) and a full-payload range of 700mils (1,126km).

This aircraft was to emerge in due course as the Boeing 737 Srs 100, with an initial gross weight of 97,800lb (44,360kg) and up to 111,000lb (50,350kg) eventually in a special model produced for Malaysia-Singapore Airlines. The JT8D-7, with the same power as the -1 but flat rated for higher temperatures, was also introduced instead of the initial engine variant, and the ▶

14,500lb st (6577kgp) JT8D-9 was offered for use in later versions of the 737-100. Boeing soon discovered, however, that there was a strong demand for slightly larger passenger capacity, and to meet this need the 737-200 was announced on 5 April 1965 when United Air Lines ordered 40, this also being the first order from a US airline for the type. The fuselage was lengthened by 6ft (1.82m) to provide two more seat rows, which, with some internal redesign, increased accommodation to 119 or eventually, in high-density layouts, 130. With JT8D-7 engines, the 737-200 began its life at a gross weight of 97,000lb (43,998kg) with two centre-section fuel tanks, which were optional. Subsequent developments have taken the gross weight of the standard 737-200 to 117,000lb (53,070kg), with either the JT8D-9, JT8D-15 or JT8D-17 turbofans also being available.

First flight of the Boeing 737 was made at Seattle on 9 April 1967, this aircraft being a company demonstrator, followed about a month later by the first of Lufthansa's 737-100s. The first 737-200 in United configuration was the fifth 737 to fly, on 8 August 1967. Full FAA Type Approval was obtained for the 737-100 on 15 December 1967, and for the 737-200 on 21 December 1967, services being inaugurated with the two models, respectively, by Lufthansa on 10 February and by United on 28 April 1968.

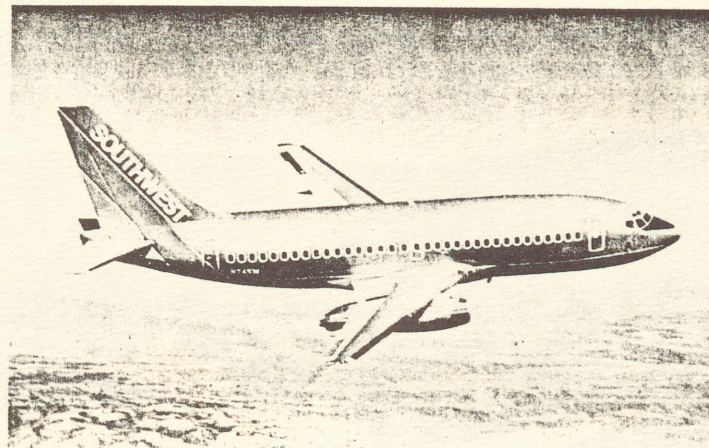
Sales of the Boeing 737 proceeded somewhat more slowly than those of the earlier Boeing jetliners, but the company pursued a concentrated programme of improvement and refinement to keep abreast of the competition. A passenger/cargo convertible version of the 737-200 was soon offered, with side-loading freight door and other features similar to those in the 727C. The first 737-200C was flown in August 1968 and after certification in October entered service with Wien Consolidated before the end of the year.

Because of some deficiencies in the specific range of the 737 as first delivered, plus poor efficiency of the thrust reversers on the JT8D engines, Boeing introduced a series of modifications commencing with aircraft No 135 delivered (to United) in March 1969, and offered conversion kits for earlier customers who wished to update their aircraft. The changes included target-type thrust reversers instead of clamshell design, with redesign of the aft engine nacelle; some drag-reduction modifications to the wing and changes in the flap settings and structure. Another series of changes was offered by Boeing later in 1969, and these were combined in the specification of what became the Advanced 737-200, with deliveries starting in 1971. The new features comprised changes to the leading edge flaps and slats, wider nacelle struts, optional use of JT8D-15 engines and optional nose-wheel brakes.

The first Advanced 737-200 flew on 15 April 1971; certification was obtained on 3 May and All Nippon Airways inaugurated service in June 1971. Later that year, a "wide-body look" interior was also developed for the 737, the first example being delivered to Air Algerie in December 1971, and this eventually became widely adopted by customers for the Advanced 737. A "Quiet Nacelle" modification was added to the Advanced 737 specification in 1973, to allow compliance with latest FAA regulations, the first delivery being made in October to Eastern Provincial Airways. Later options on the Advanced 737 introduced the JT8D-17 engine at 16,000lb st (7264kgp) and a gross weight of 117,000lb (53,070kg) or 119,500lb (54,253kg), the first example at the latter weight going to Braathens SAFE in Norway in late 1977.

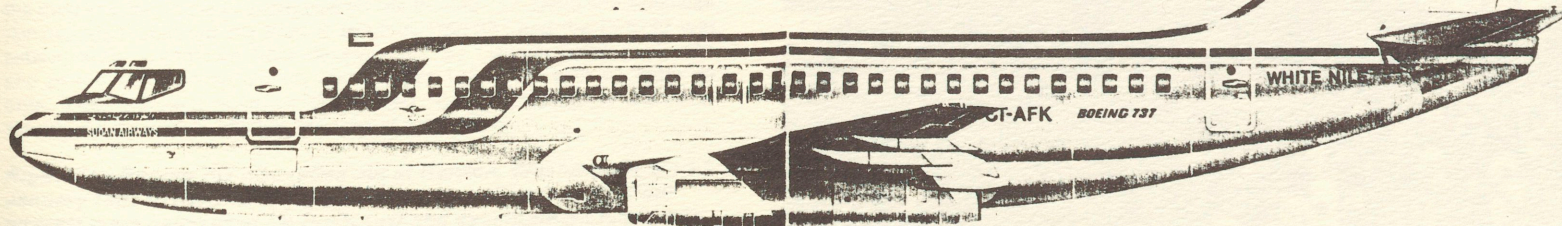
A separate series of modifications was also developed by Boeing to permit the 737 to operate from gravel and dirt runways, so that full advantage could be taken of its short field performance. These modifications comprised gravel deflection shields on the main and nosewheel gears, blow-away jets beneath the engine intakes to prevent debris ingestion, fuselage abrasion protection, flap protection and other features.

By the end of 1981, Boeing had sold over 950 Boeing 737s, including a few for military and non-commercial use; of the total, only 30 were 737-100s, and 64 of the remainder were 737-200Cs. Included in the sales total were 20 Boeing 737-300s, this being the designation of a new variant launched by Boeing on 26 March 1981 when US Air and Southwest Airlines each ordered 10. The 737-300, to fly in April 1984 with first deliveries at the end of that year, features an 8ft 8in (2.64m) fuselage stretch to increase seating capacity by up to 20 seats; a 1ft 10in (56cm) increase in wing span; a revised leading edge and extended dorsal fin and a pair of 20,000lb st (9072kgp) turbofans in revised nacelles. Variants at gross weights of 124,500lb (56,473kg), 130,000lb (58,968kg) and 135,000lb (61,236kg) are on offer, with varying fuel capacities.



Above: A Boeing 737-2H4 in the very striking orange, red and ochre livery of Texas-based Southwest Airlines.

Below: "White Nile" is one of a pair of Boeing 737-2J8C convertible passenger/cargo versions used by Sudan Airways, the other being named "Blue Nile".



AIRCRAFT

Boeing 757

USA

Power Plants: Two Rolls-Royce RB.211-535C turbofans each rated at 37,400lb st (16,980kgp).

Performance: Max cruising speed, 569mph (915km/h) at 29,000ft (8840m); long-range cruise, 528mph (850km/h) at 37,000ft (11,280m); range with max payload, no reserves, 1,380mils (2220km); range with max fuel, no reserves, 5,600mils (8631km).

Weights: Typical operating weight empty, 130,670lb (59,270kg), max take-off weight, 220,000lb (99,880kg); max zero fuel weight, 184,000lb (83,536kg); max landing weight, 148,000lb (67,120kg).

Dimensions: Span, 124ft 6in (37.95m); overall length, 155ft 3in (47.32m); overall height, 44ft 6in (13.56m); wing area, 1,951sq ft (181.25m²).

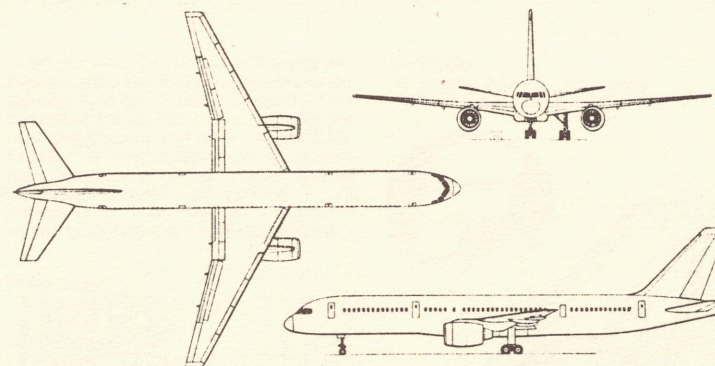
After several years during which various "stretched" versions of the Boeing 727 were studied and attempts were made to obtain sufficient airline orders to launch production, Boeing finally was able to launch the Boeing 757 in mid-1978. This new airliner retains the fuselage width of the 707/727/737 series and therefore maintains commonality with the 727, but it has a new wing, with two engines in underwing pods, and a low-mounted tailplane. After it had been launched, the Boeing 757 design was further revised to incorporate the same nose and flight deck as the Boeing 767, with the result that it ended up having greater commonality with the latter than with the 727 on which it was originally based.

As finally launched, the Boeing 757 was designed to carry a maximum of 233 passengers six-abreast in a high-density layout at 29-in (73.7-cm) seat pitch, or, more typically, 196 in all-tourist or 178 in two-class layouts, and to have a maximum range of 2,300mils (3700km) with a full passenger load. With some 13,200lb (6000kg) of cargo, the maximum payload was 64,000lb (29,025kg). The 757 was designed primarily as a replacement for the Boeing 727 tri-jet and with the Rolls-Royce RB.211-535C engines initially specified was claimed to offer the best fuel efficiency per passenger carried of any aeroplane in its class.

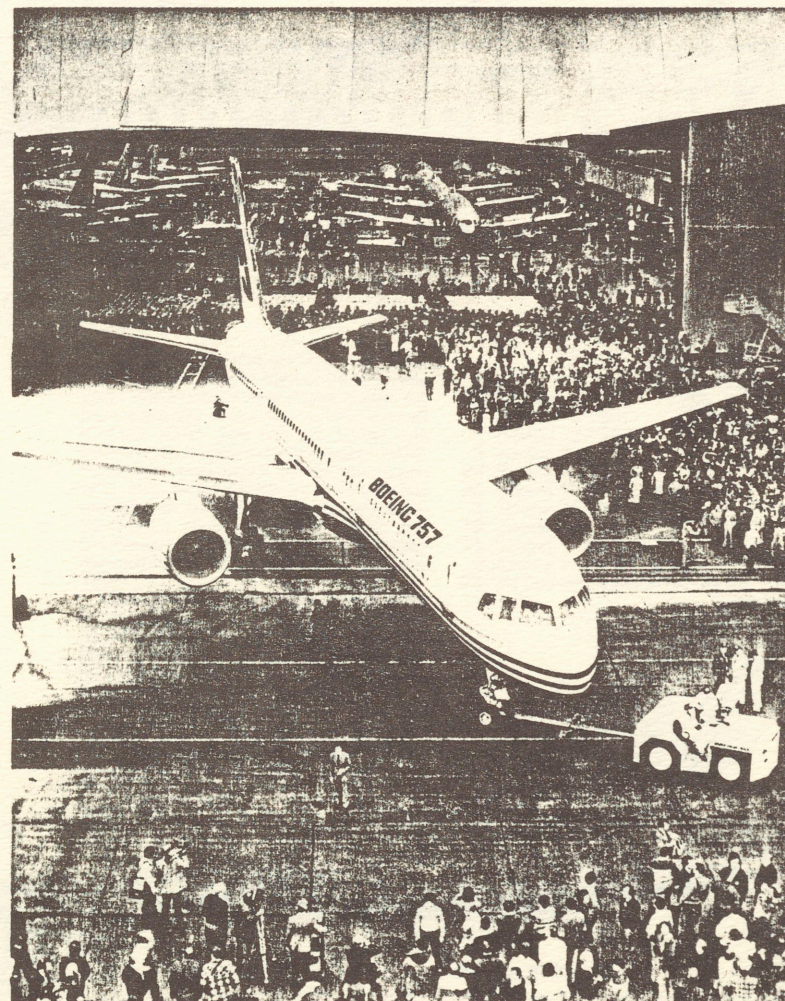
The two launching airlines, British Airways and Eastern Air Lines, announced their intention of ordering Boeing 757s in August 1978, at which time Boeing confirmed its decision to offer the new aircraft with the Rolls-Royce engines, these being smaller-fan derivatives of the RB.211 already in production for the Lockheed TriStar and the Boeing 747.

British Airways signed a definitive order for 19 Boeing 757s on 2 March, valued at some £300m, later taking an option on 18 more, and the Eastern Air Lines contract was signed on 23 March, covering 21 aircraft with an option on 24. Although Boeing had been proceeding with preliminary activities for production of the 757, the formal decision to initiate full-scale production was not taken until the Eastern contract had been signed. Subsequent to the launch, Boeing offered increased gross weight options of 230,000lb (104,328kg) and 240,000lb (108,863kg), and the 36,330lb st (16,480kgp) CF6-32C was nominated as an alternative engine. However, the third and fourth major customers for the Boeing 757, Delta and American Airlines, both selected the Pratt & Whitney PW2037 and the CF6-32 was subsequently withdrawn from development by General Electric. By the end of the 1981, seven airlines had ordered 136 757s, with 61 more on order. First flight was made on 19 February 1982, with customer deliveries starting on December 1982 at the time of certification.

Right: The Boeing 757 was rolled out at Renton, Washington, on 13 January 1982 to become Boeing's sixth major jet transport. Four aircraft were being used for flight test and development leading to certification and entry into service before the end of 1982.



Above: Three-view drawing of the Boeing 757-200, which is the basic version as launched in mid-1978; the projected 757-100 was shorter.



AIRCRAFT

Frontier Airlines

The Denver-based carrier has its roots in Monarch Airlines, which was formed early in 1946 and inaugurated local service from Denver on 27 November of that year. In December 1949 Monarch absorbed Challenger Airlines, and Arizona Airways, an intra-state operator, was taken over in April 1950. Monarch formally became Frontier Airlines on 1 June of that year. The effect of the mergers was to give Frontier an extensive north-south operation between Montana and Mexico, serving 40 points in 7 states. During the subsequent decade the carrier expanded its route system throughout the states between the Rocky Mountains and the midwest. DC-3 aircraft were supplemented by former United Convair 340s in 1959. Frontier undertook a re-engining programme involving the installation of Allison 501 turboprop engines in the Convair 340 aircraft, which were redesignated Convair 580s. The first of the Convair turboprops

entered service on 1 June 1964, and eventually Frontier operated a total of 32 Convair 580s.

Jet operations were inaugurated with the first of 5 Boeing 727-191 aircraft in September 1966 and Boeing 727-291s were acquired in February 1968. These aircraft, however, did not entirely suit the carrier's route network and were replaced with Boeing 737 aircraft, the first of which (a 737-2C0) was acquired in May 1969. Another major phase of expansion was accomplished when Fort Worth-based Central Airlines merged with Frontier on 1 October 1967. Central had been formed in March 1944 and operated services in Texas and surrounding states with DC-3 and Convair 600 equipment. By 1974 Frontier was carrying in excess of 3 million passengers annually and serving some 100 destinations (more than United), though many of these were small communities.

Frontier Airlines currently provides flights

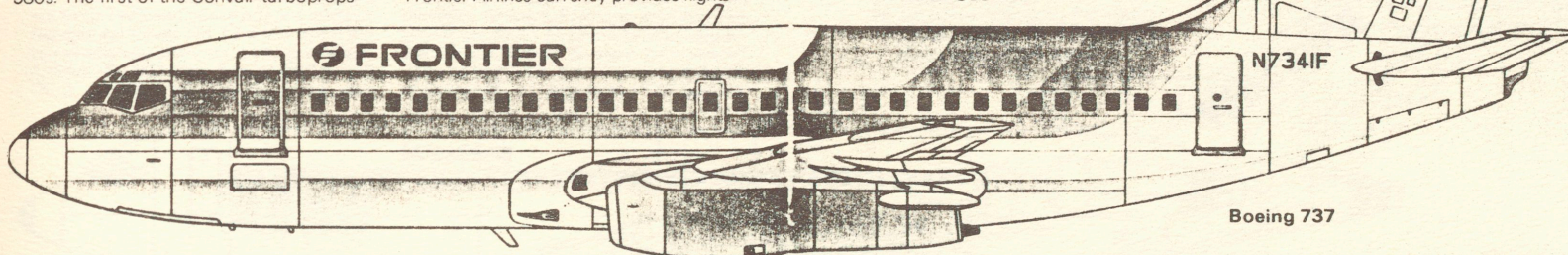
to 86 points in 27 US states, Canada and Mexico. RKO General (a subsidiary of the General Tyre and Rubber Company) took control of the carrier in 1964. Under the new designations laid down by the CAB, Frontier is now defined as a national carrier (ie a carrier with an annual revenue of 75-1,000 million US dollars). 5,893 personnel work for Frontier and over 5 million passengers are carried annually.

On Order

- 6 Boeing 737-291 Advanced
- 3 McDonnell Douglas DC-9-82

Fleet Data

- 4 Boeing 737-214
- 3 Boeing 737-222
- 2 Boeing 737-247
- 5 Boeing 737-291
- 5 Boeing 737-2C0
- 1 Boeing 737-2H4
- 1 Boeing 737-212 Advanced
- 22 Boeing 737-291 Advanced
- 2 Boeing 737-2A1 Advanced
- 16 Convair 580



Boeing 737

Northwest Orient Airlines

Northwest Airlines (Northwest Orient Airlines) is the second oldest airline in the USA with a continuous identification and was formed on 1 August 1926 as Northwest Airways. The airline commenced operations on 1 October 1926 providing air mail service between Minneapolis/St Paul and Chicago, and passenger services were started in July of the following year. On 16 April 1933 the airline adopted its present title and acquired Northern Air Transport. Lockheed 10A Electras entered service in August 1934 and in March 1939 the DC-3 commenced operations with Northwest. On 1 June 1945 Northwest became the fourth US transcontinental airline when service was extended eastward from Minneapolis/St Paul to Newark and New York City via Milwaukee and Detroit. Northwest began to expand its routes through Canada, Alaska and the Aleutian Islands, and on 15 July 1947 a new Great Circle route through Anchorage to Tokyo, Seoul, Shanghai and Manila was inaugu-

rated with DC-4 aircraft. Services to Washington D.C. from Detroit via Cleveland and Pittsburgh began on 15 March 1948, and to Honolulu from Seattle/Tacoma and Portland on 2 December, making Northwest the first airline certified to link Hawaii with the Pacific North-West. The airline initiated service to Taiwan on 30 June 1950 and began operations with Boeing Strato-cruisers. Northwest subsequently introduced DC-6A/B aircraft and by 1957 had also acquired Super Constellations and DC-7C aircraft. Services to Florida started in 1958 and Atlanta was added to the route system on 27 September 1959.

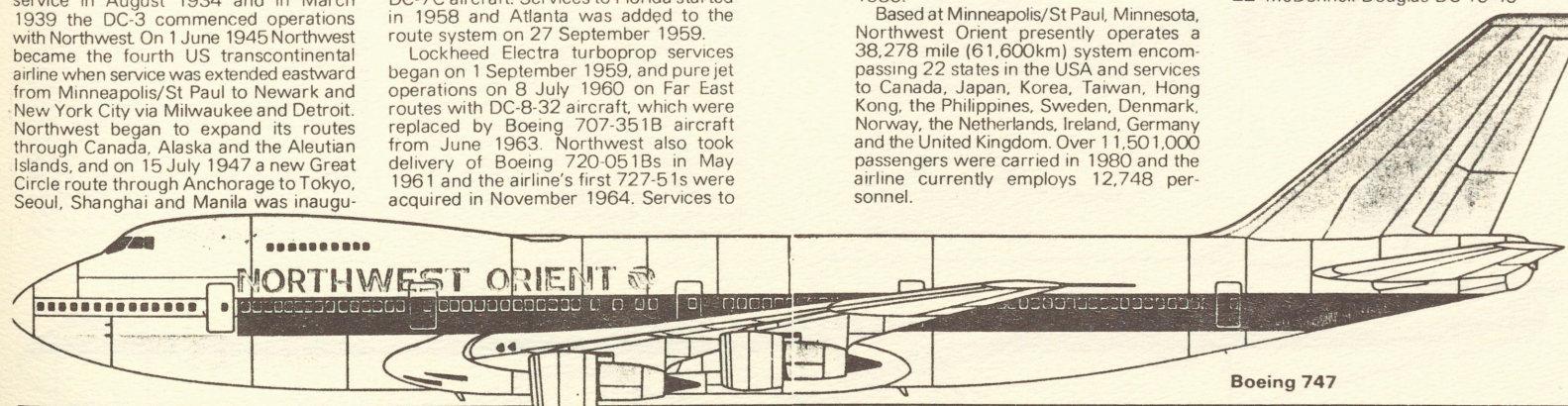
Lockheed Electra turboprop services began on 1 September 1959, and pure jet operations on 8 July 1960 on Far East routes with DC-8-32 aircraft, which were replaced by Boeing 707-351B aircraft from June 1963. Northwest also took delivery of Boeing 720-051Bs in May 1961 and the airline's first 727-51s were acquired in November 1964. Services to

Hong Kong were inaugurated in October 1966 and to Osaka in April of the following year. Wide-bodied operations began following delivery of Boeing 747-151 aircraft in April 1970. The first DC-10-40 was delivered to Northwest at the end of 1972. Passenger operations to Europe began with the inauguration of transatlantic services on the New York-Copenhagen-Stockholm route in March 1979 and Northwest commenced services from Minneapolis/St Paul to London on 2 June 1980.

Based at Minneapolis/St Paul, Minnesota, Northwest Orient presently operates a 38,278 mile (61,600km) system encompassing 22 states in the USA and services to Canada, Japan, Korea, Taiwan, Hong Kong, the Philippines, Sweden, Denmark, Norway, the Netherlands, Ireland, Germany and the United Kingdom. Over 11,501,000 passengers were carried in 1980 and the airline currently employs 12,748 personnel.

Fleet Data

- 3 Boeing 727-51C
- 1 Boeing 727-151C
- 4 Boeing 727-51
- 23 Boeing 727-251
- 29 Boeing 727-251 Advanced
- 2 Boeing 747-135
- 10 Boeing 747-151
- 12 Boeing 747-251B
- 5 Boeing 747-251F (SCD)
- 22 McDonnell Douglas DC-10-40



Boeing 747

Western Airlines

Western Airlines (WAL) was incorporated on 13 July 1925 as Western Air Express (WAE) and is the oldest US carrier. Operations began with air mail services between Los Angeles and Salt Lake City via Las Vegas on 17 April 1926 using Douglas M-2 aircraft. Passenger services on the route began on 23 May of that year, and this represented the first scheduled passenger service in the USA. By early 1930 WAE had taken over Colorado Airways, Pacific Marine Airways, West Coast Air Transport and Standard Air Lines. On 16 July of that year, under pressure from the Postmaster General, WAE merged with Transcontinental Air Transport to form TWA in order to gain the mail contract for the Los Angeles-Kansas City section of the transcontinental route which had previously been flown by both airlines. In 1934 WAE was bought out from TWA and operated for a while as General Air Lines. On 17 April 1941 the carrier officially changed its title to Western Airlines. By this time Boeing 247-D and DC-3 aircraft had been acquired, and

National Parks Airways been absorbed. Services on the carrier's old Los Angeles-San Francisco route were restarted in 1944 and extended to Portland and Seattle in 1947. DC-4 aircraft entered service in January 1946 and Convair 240s commenced operations in September 1948. Western became the first operator of the DC-6B on 11 April 1951.

The first of twelve Lockheed Electra turboprops flew on the Los Angeles-Seattle route in August 1959, and jet services were inaugurated on 1 June 1960 with Boeing 707-139 aircraft leased from the manufacturer prior to delivery of the carrier's first Boeing 720-047Bs in April 1961. Western received its Boeing 727-247 aircraft from October 1969 to replace the Electras. On 1 July 1967 Seattle-based Pacific Northern Airlines (PNA) was merged into Western. Founded in 1932 as Woodley Airways, PNA operated services linking southern Alaska with Washington State and Oregon. Western commenced wide-bodied operations following delivery of its first DC-10-10 in April 1973. Service

between London and Honolulu via Anchorage was inaugurated in October 1980 but was terminated a year later. However, Western inaugurated a Denver-London service on 24 April 1981 with a former Air New Zealand DC-10-30.

Western, headquartered in Los Angeles, currently operates scheduled passenger and cargo services to 33 destinations in the USA (including Honolulu and Anchorage), to several points in Canada, Mexico and to London. 9,130,000 passengers flew with Western in 1980 and the carrier employs 10,657 personnel.

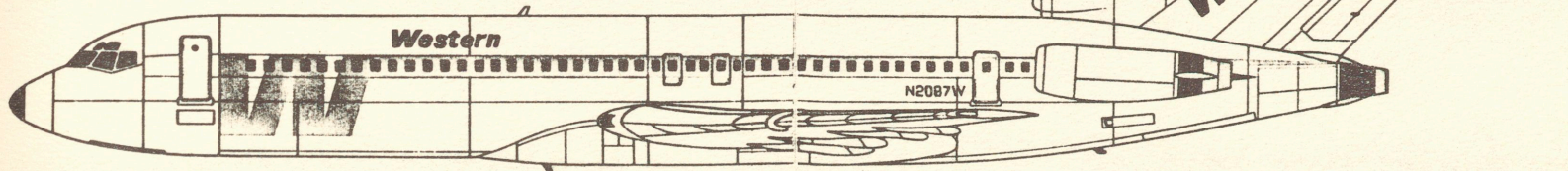
On Order
6 Boeing 767-247



Fleet Data

- 6 Boeing 727-247
- 40 Boeing 727-247 Advanced
- 1 Boeing 727-208 Advanced
(leased from Interlease)
- 11 Boeing 737-247
- 10 McDonnell Douglas DC-10-10
- 1 McDonnell Douglas DC-10-30
(leased from Interlease)

Boeing 727



United Airlines

United traces its origin to Varney Air Lines which began air mail services between Paso, Washington and Elko, Nevada on 6 April 1926. Varney Air Lines was later merged with Pacific Air Transport and National Air Transport, both of whom were air mail carriers, into Boeing Air Transport which was part of a combine that included the Boeing Airplane Company and Pratt and Whitney, the engine manufacturer. United was organised on 1 July 1931 as the management company for the airline division. Three years later the combine broke up and the corporate divisions became separate entities. By this time United was operating the Boeing 247 which had entered service in March 1933 and established regular coast-to-coast operations. DC-3 operations began in 1937 and DC-4 aircraft entered United service on the New York-Chicago route in March 1946 with the DC-6 following in April 1947. By May 1947 the route network had been expanded to include Boston,

Denver, Washington D.C. and Hawaii. DC-6B services began in 1951 and the Convair 340 was introduced on short haul routes in 1952. Transcontinental services with the DC-7 began in April 1954 and jet operations with DC-8 aircraft were inaugurated on 18 September 1959. Boeing 720 aircraft were introduced in July 1960 initially between Chicago, Denver and Los Angeles. United made its first purchase of a foreign aircraft when a fleet of twenty Caravelle VI-R aircraft was ordered. The type commenced services between New York and Chicago on 14 July 1961.

United's size increased significantly on 1 June 1961 when the carrier took over Capital Airlines, founded in November 1936 as Pennsylvania Central Airlines. As a result of the merger United's route system was increased by 7,200 miles (11,600km) and the carrier became the world's largest privately-owned airline in terms of annual passengers carried and passenger miles flown. The Caravelles and

former Capital Viscount 745 aircraft were progressively replaced by Boeing 727 and 737 aircraft from 1964 and 1967 respectively. Wide-bodied services were introduced by the carrier following delivery of Boeing 747 aircraft in June 1970 and DC-10-10 aircraft in July 1971. In keeping with its tradition of being among the launch customers for new aircraft, United was the first airline to order the Boeing 767 (pictured below).

United now operates an extensive scheduled passenger and cargo route network linking well over 100 points in the USA alone. United currently employs 46,440 personnel and operates an all-jet fleet of 315 aircraft.

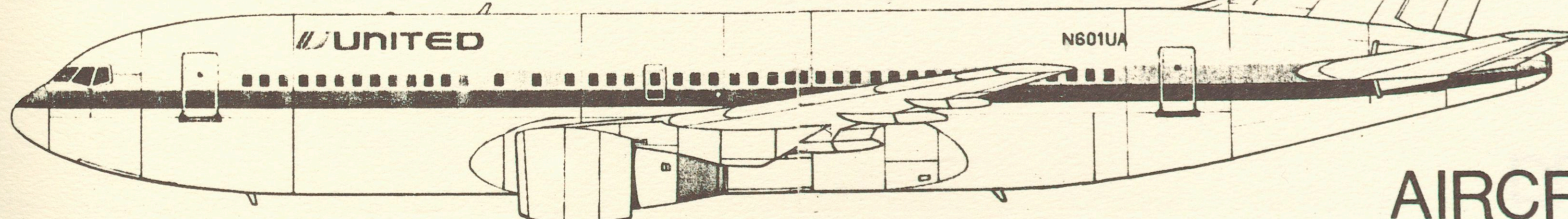
- 14 McDonnell Douglas DC-8-54F
- 29 McDonnell Douglas DC-8-61
- 47 McDonnell Douglas DC-10-10

On Order
39 Boeing 767-222



Fleet Data

- 54 Boeing 727-22
- 28 Boeing 727-222
- 76 Boeing 727-222 Advanced
- 49 Boeing 737-222
- 18 Boeing 747-122

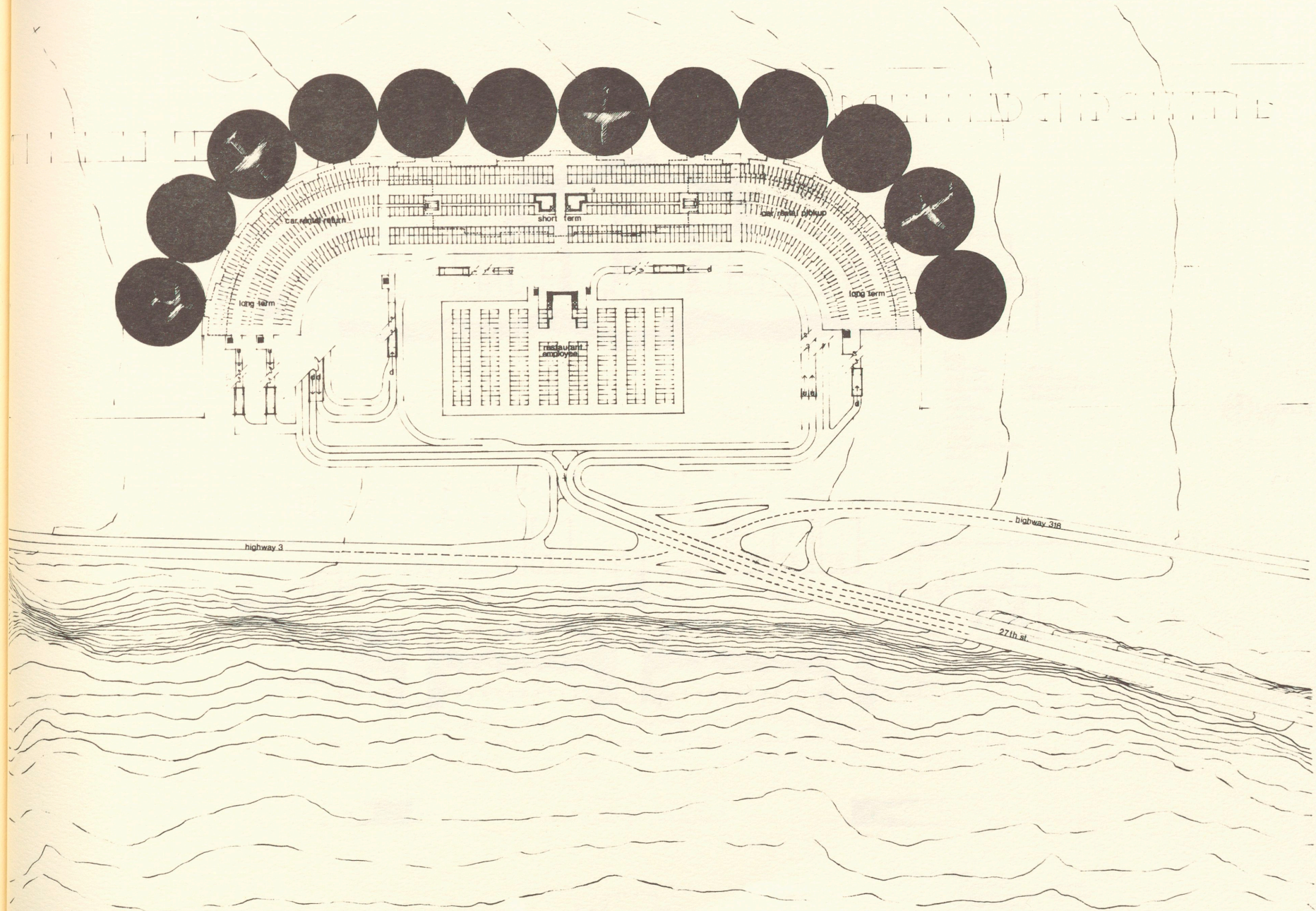


AIRCRAFT

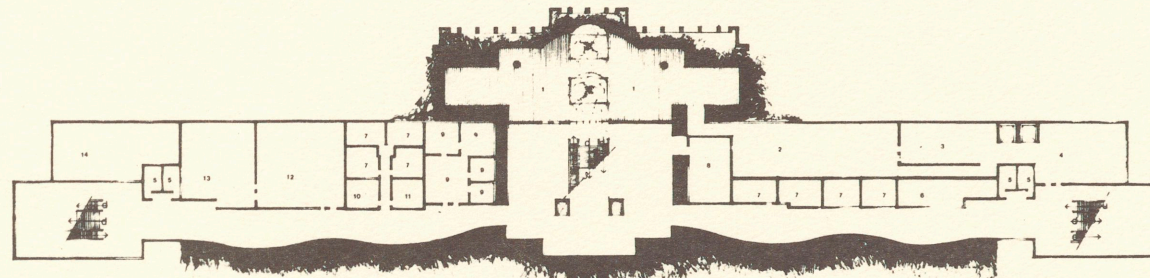


INTERNATIONAL DESIGN

DESIGN

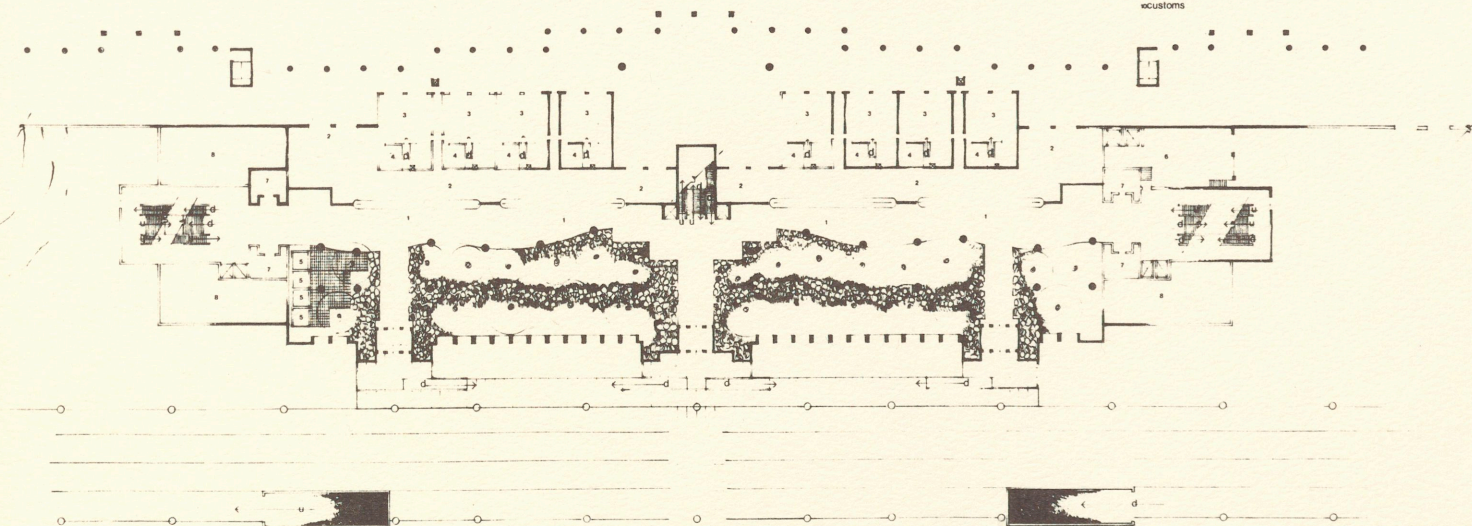


BILLINGS
LOGAN INTERNATIONAL AIRPORT



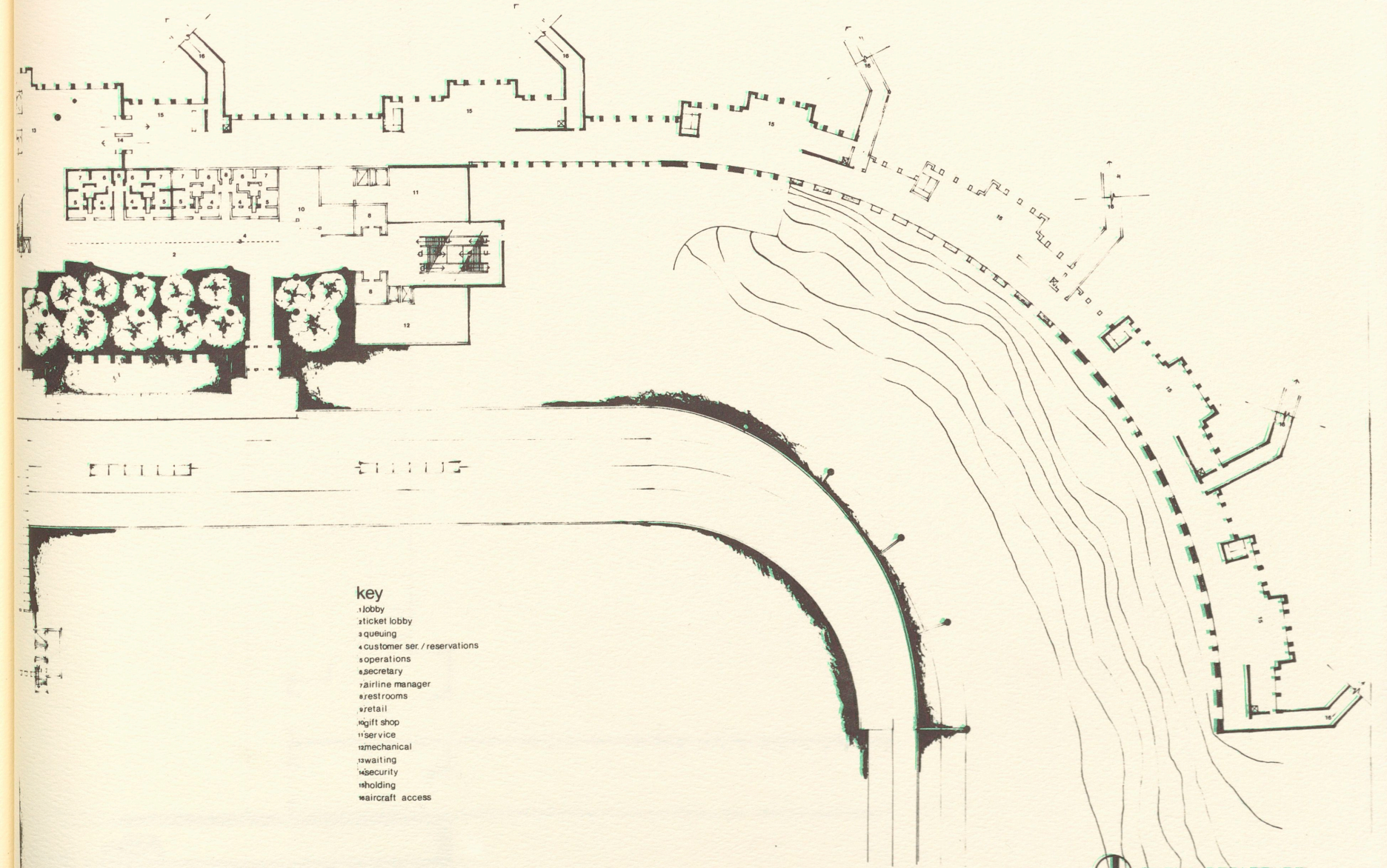
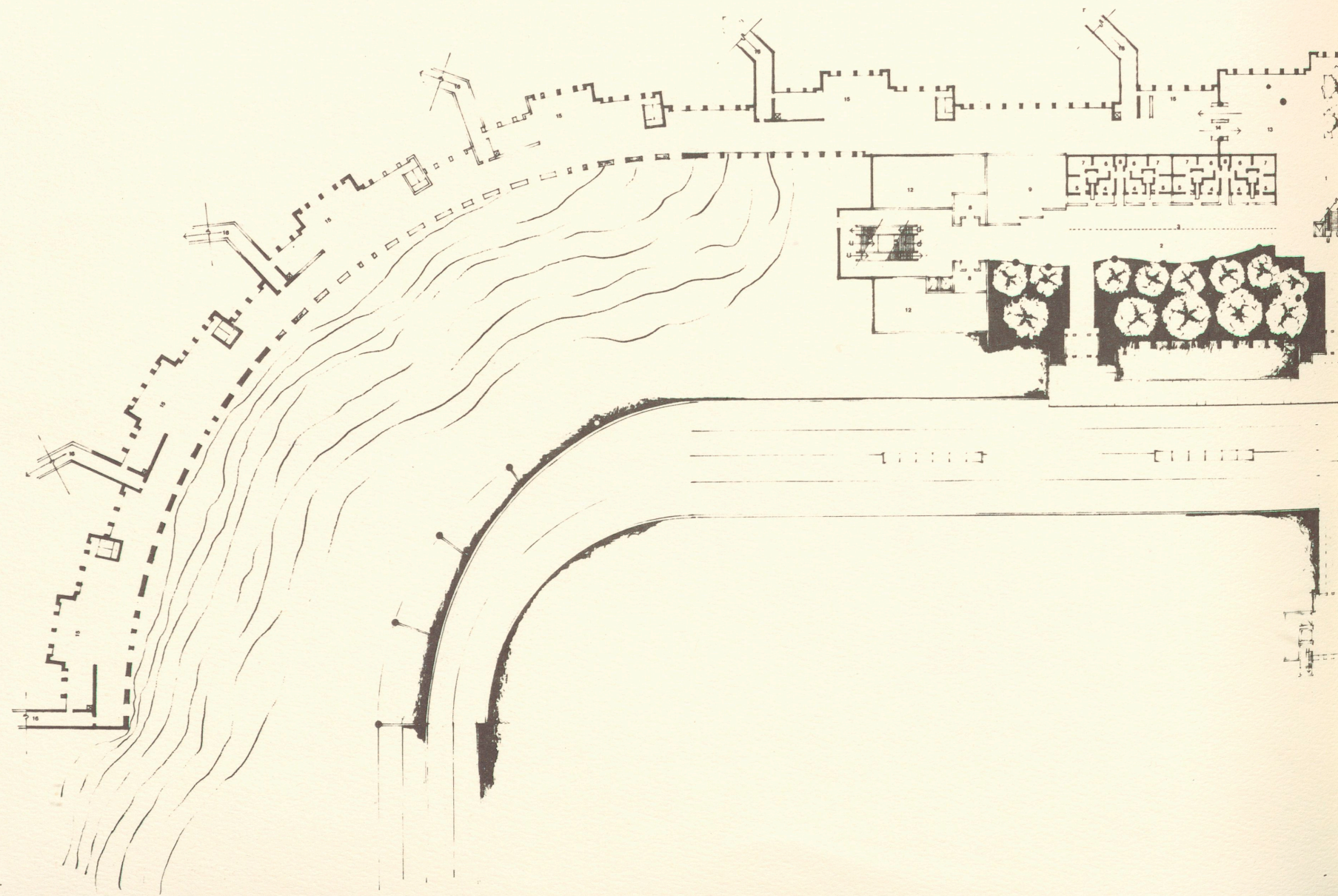
- key**
- 1 coffee shop
 - 2 food prep
 - 3 flight kitchen
 - 4 service
 - 5 restrooms
 - 6 pilots lounge
 - 7 offices
 - 8 lounge
 - 9 airport administration
 - 10 customs
 - 11 security
 - 12 weather bureau
 - 13 flight service station
 - 14 mechanical

⊕ LEVEL 3
1" = 30'



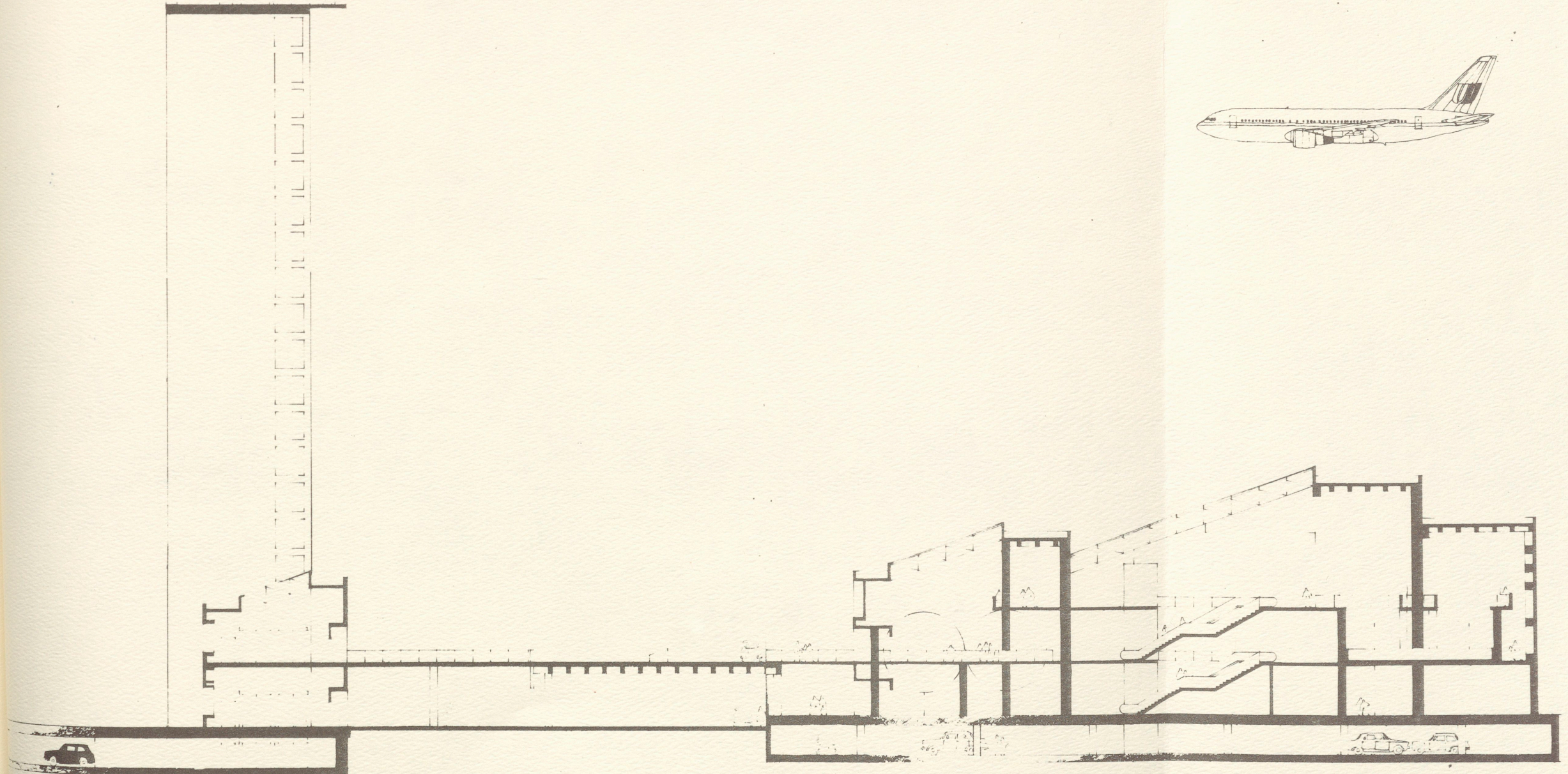
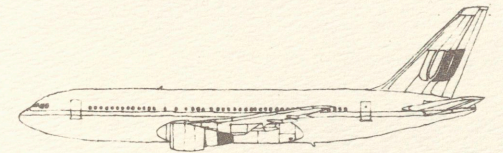
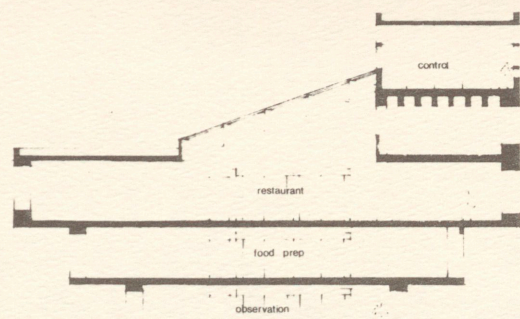
- key**
- 1 baggage claim
 - 2 baggage cart circulation
 - 3 baggage processing
 - 4 office
 - 5 car rental
 - 6 service
 - 7 restrooms
 - 8 mechanical

⊕ LEVEL 1 - ARRIVAL, BAGGAGE CLAIM
1" = 30'

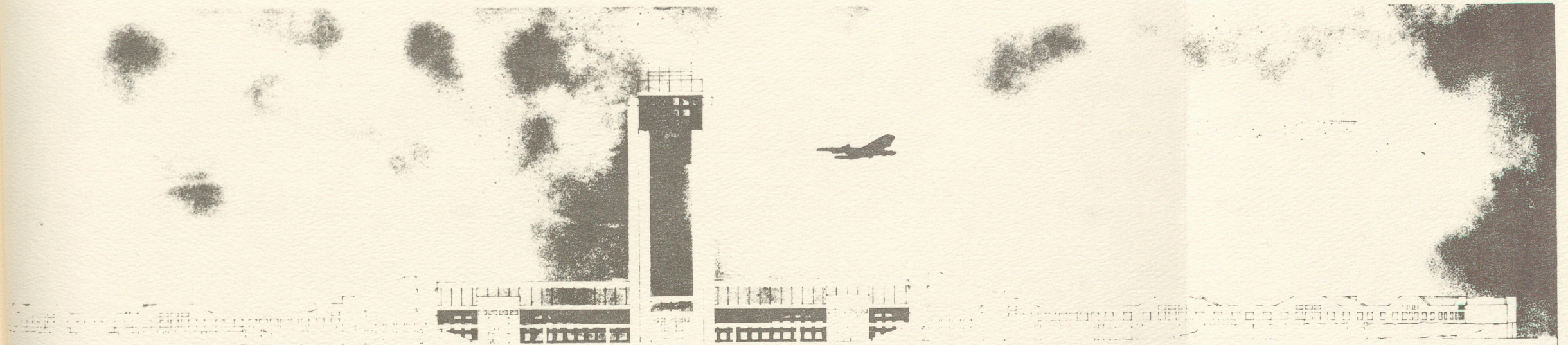


key

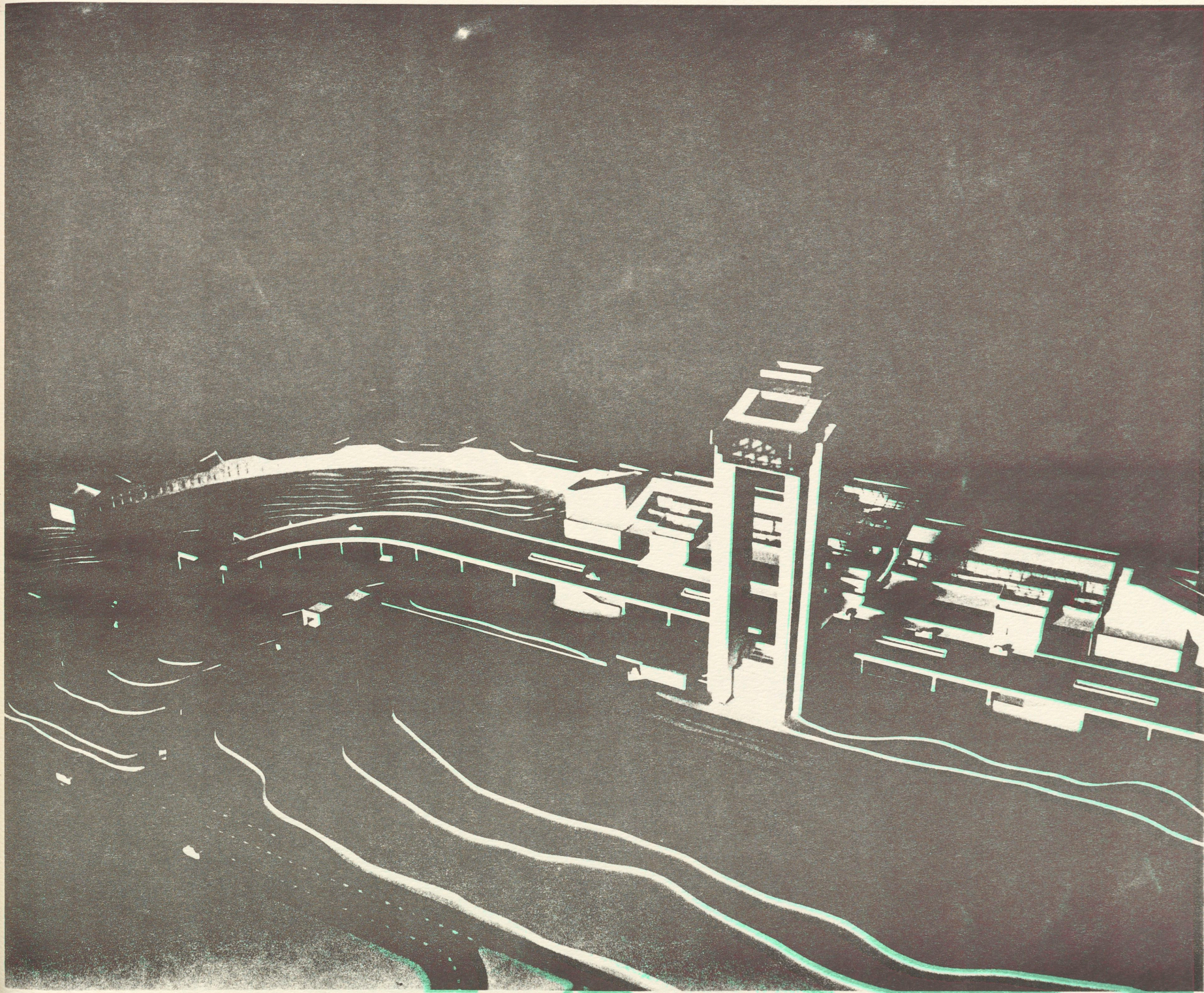
- 1 lobby
- 2 ticket lobby
- 3 queuing
- 4 customer ser. / reservations
- 5 operations
- 6 secretary
- 7 airline manager
- 8 restrooms
- 9 retail
- 10 gift shop
- 11 service
- 12 mechanical
- 13 waiting
- 14 security
- 15 holding
- 16 aircraft access

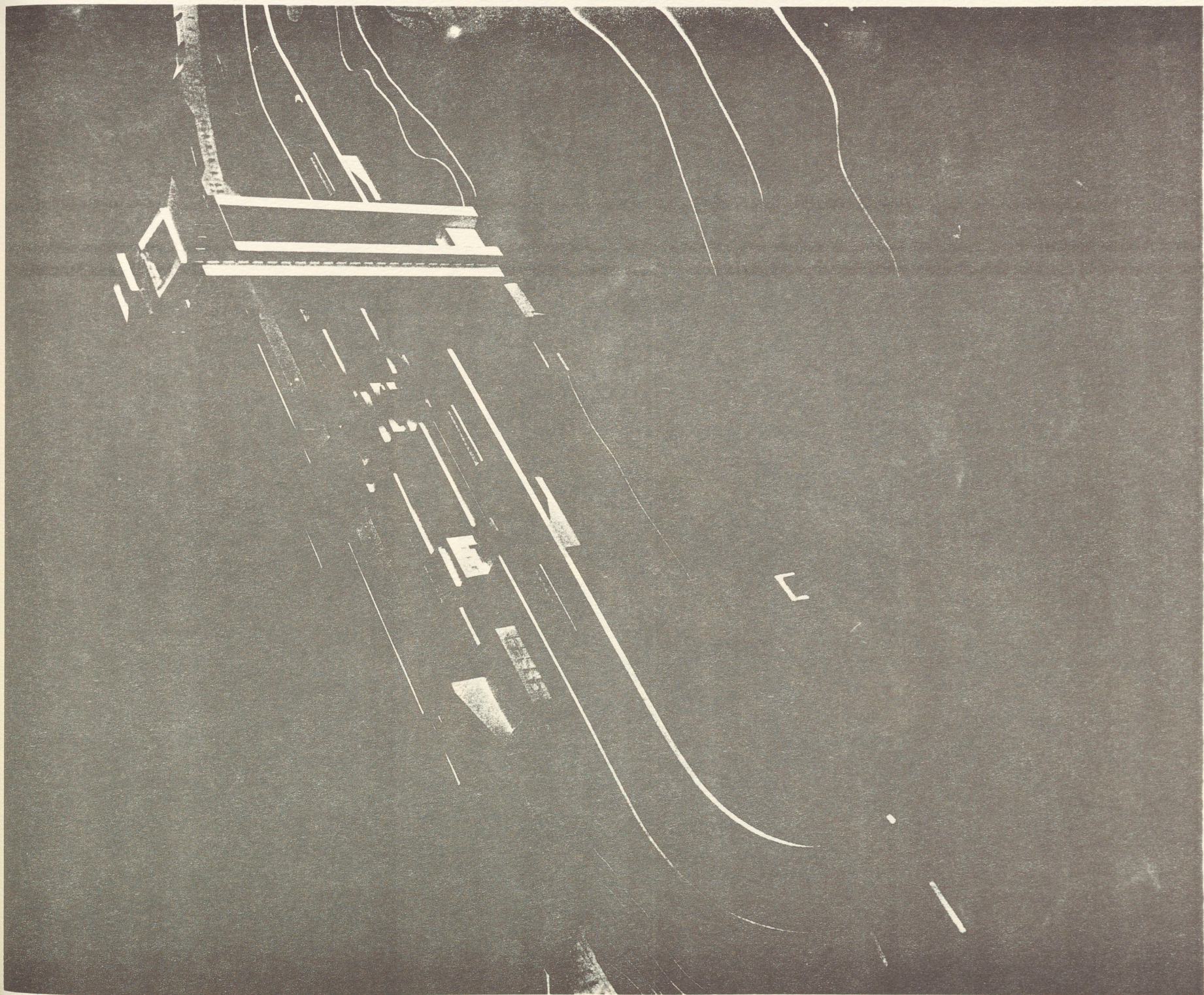


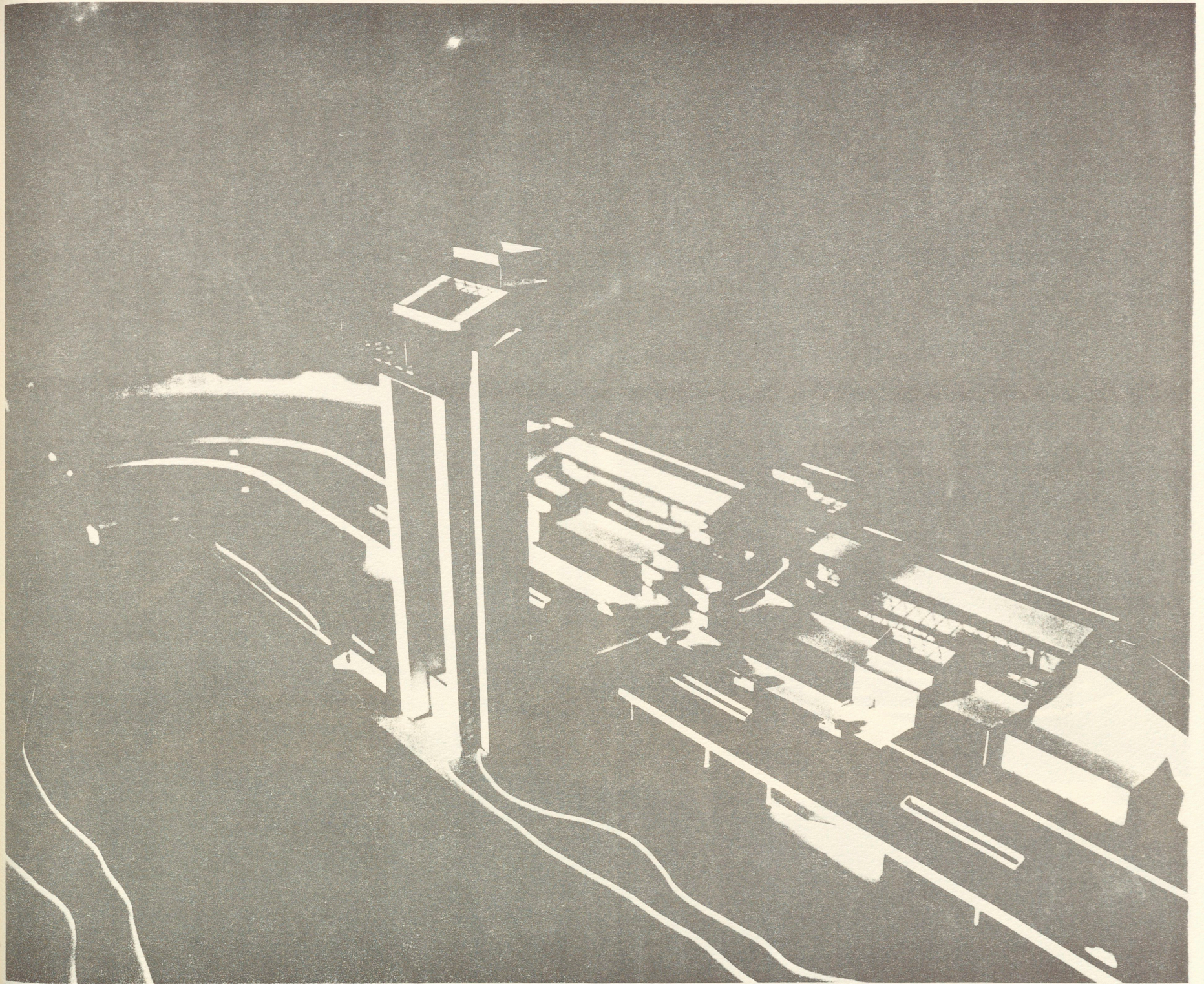
SECTION, TOWER-LOBBY
1" = 10'

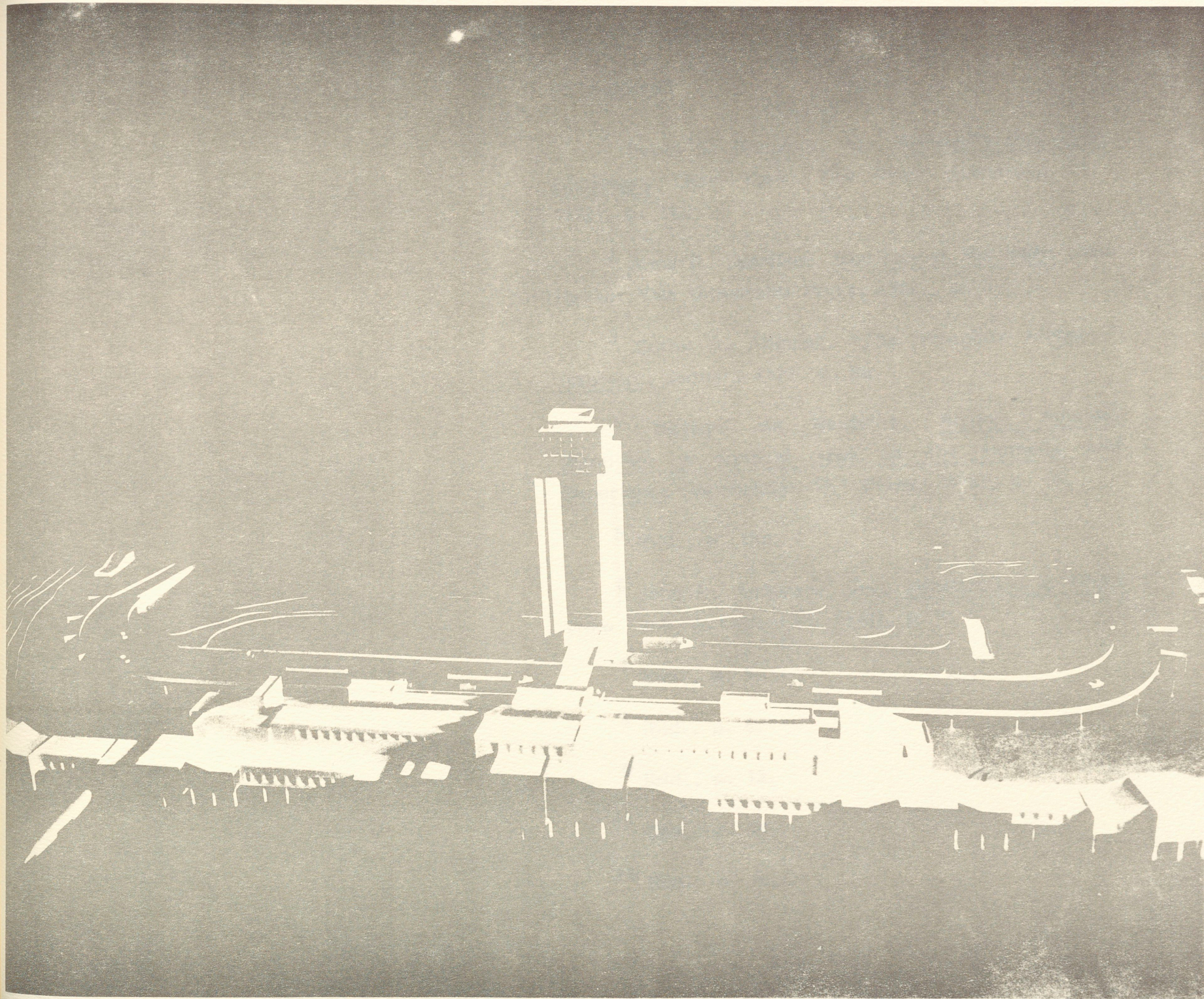


SOUTH ELEVATION
1" = 30'









FOOTNOTES

¹ David B. Guralnik, ed., Webster's New World Dictionary (New York: The World Publishing Co., 1978), p. 14.

² Aline B. Saarinen, Saarinen on His Work (New Haven: Yale University Press, 1962), p. 5.

³ Cathy B. Ailgeier, "The Someplace Airport," Interiors, January 1977, p. 86.

⁴ Richard de Neufville, Airport Systems Planning; A Critical Look at the Methods and Experience (Cambridge: MIT Press, 1976), p. 16.

⁵ Ibid., p. 103.

⁶ John D. Anderson, Jr., Introduction to Flight (New York: McGraw-Hill, 1978), p. 4.

⁷ Ibid., p. 5.

⁸ Ibid., p. 6.

⁹ Ibid., p. 13.

¹⁰ Ibid., p. 18.

¹¹ Ibid., p. 19.

¹² Ibid., p. 20.

¹³ Ibid., p. 1.

¹⁴ Billings (Montana), Information About Billings, Compiled by Billings Chamber of Commerce, 1983.

¹⁵ Billings Logan International Airport, Airport Influence Area Zoning Maps, Exhibit B, Day-Night Noise Level Zones.

¹⁶ Edward Mazria, The Passive Solar Energy Book (Emmaus, Pa.: Rodale Press, 1979), p. 284.

¹⁷ Billings (Montana), Information About Billings, Compiled by Billings Chamber of Commerce.

¹⁸ U.S. Department of Commerce, Local Climatological Data, Annual Survey with Comparative Data 1982, Billings, Montana (Washington, D.C.: Government Printing Office, 1982).

¹⁹ Ibid.

²⁰ Ibid.

²¹ Ibid.

²² U.S. Department of Transportation, National Airport Systems Plan, Revised Statistics 1980-1989 (Washington, D.C.: Government Printing Office, 1980), p. 240.

²³ U.S. Department of Transportation, F.A.A., Airport Terminal Buildings (Washington, D.C.: Government Printing Office, 1960), p. 1-86.

²⁴ Robert Hornjeff, Planning & Design of Airports, 2nd ed. (New York: McGraw-Hill, 1975), p. 247-248.

²⁵ U.S. Department of Transportation, F.A.A., Airport Terminal Buildings (Washington, D.C.: Government Printing Office, 1960), p. 6.

²⁶ William Green and Gordon Swanborough, The World's Airlines (New York: Arco Publishing Inc., 1982), p. 46-53, 58-59, 108-109, 232-233, 254-55, 275-275, 278-279.

LIST OF ILLUSTRATIONS

¹ Cathy B. Ailgeier, "The Someplace Airport," Interiors, January 1977, p. 89.

² Ibid., p. 88.

³ John Morris Dixon, "Passenger Haven," Progressive Architecture, February 1976, p. 79.

⁴ Cathy B. Ailgeier, "The Someplace Airport," Interiors, January 1977, p. 87.

⁵ U.S. Department of Transportation, National Airport Systems Plan, Revised Statistics 1980-1989 (Washington, D.C.: Government Printing Office, 1980), p. 239.

BIBLIOGRAPHY

- Ailgeier, Cathy. "The Someplace Airport," Interiors, January 1977, pp. 86-89.
- Anderson, John D., Jr. Introduction to Flight. New York: McGraw-Hill, Inc. 1978.
- Billings Logan International Airport, Influence Area Zoning Maps, Exhibit B, Day-Night Noise Level Zones.
- Callender, John, ed. Time Saver Standards for Architectural Design. New York: McGraw-Hill, 1982.
- Canty, Donald. "The Confusion in Airport Planning," Architectural Forum, July 1962, pp. 68-83.
- De Neufville, Richard. Airport Systems Planning: A Critical Look at Methods and Experience. Cambridge: MIT Press, 1976.
- Dixon, John Morris. "Passenger Haven," Progressive Architecture, February 1976, pp. 76-79.
- Foxhall, William B. "Airport Building Types Study," Architectural Record, August 1970, pp. 117-132.

Green, William, and Swanborough, Gordon. The World Airlines. New York: Arco Publishing, Inc., 1982.

Guralnik, David B., ed. Webster's New World Dictionary. New York: The World Publishing Co., 1978.

Hornjeff, Robert. Planning & Design of Airports, 2nd ed. New York: McGraw-Hill, 1975.

Hoyt, Charles. "Airport Building Types Study," Architectural Record, October 1976, pp. 125-140.

Information About Billings, Montana. Compiled by Billings Chamber of Commerce, 1983.

Mazria, Edward. The Passive Solar Energy Book. Emmaus, Pa: Rodale Press, 1979.

Ramsey, Charles and Sleeper, Harold. Architectural Graphic Standard, 6th edition. New York: John Wiley and Sons, 1970.

Saarinen, Aline B. Saarinen on His Work. New Haven: Yale University Press, 1962.

U.S. Department of Transportation, F.A.A. Airport Terminal Buildings. Washington, D.C.: Government Printing Office, 1960.

U.S. Department of Transportation, F.A.A. National Airport Systems Plan, Revised Statistics, 1980-1989. Washington, D.C.: Government Printing Office, 1980.

U.S. Department of Commerce, Local Climatological Data Annual Summary with Comparative Data 1982, Billings, Montana. Washington, D.C.: Government Printing Office, 1982.

MONTANA STATE UNIVERSITY LIBRARIES
stks 720.6.M76G85
Billings Logan International Airport / CA



3 1762 00186365 1

~~NA 2540~~

~~720.6~~
~~M76~~
G85

