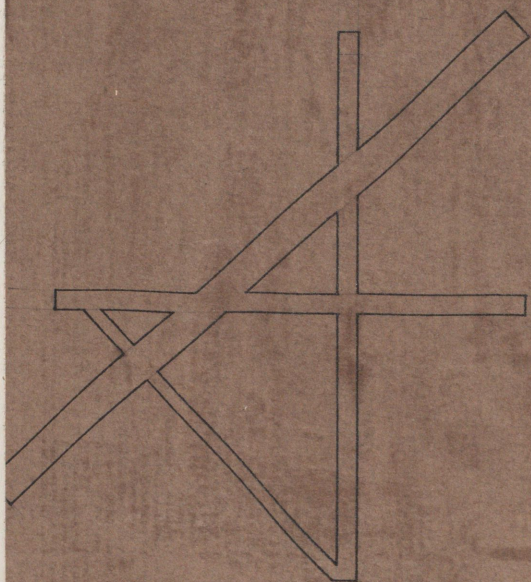


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AN AIRPORT TERMINAL FOR MISSOULA, MONTANA

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AN AIRPORT TERMINAL FOR MISSOULA, MONTANA

Part 1

Undergraduate Thesis in Architectural Design

By

Jack R. Alley

Submitted to the School of Architecture
as partial fulfillment of the requirements
for the degree of Bachelor of Architecture

at

Montana State University

Bozeman, Montana
March, 1968

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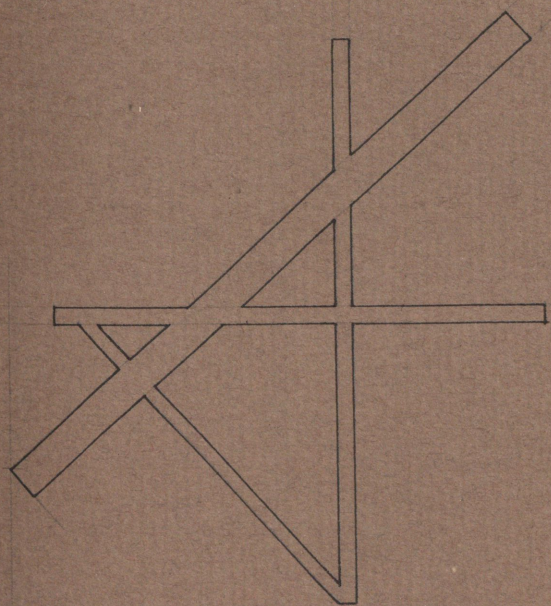
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INTRODUCTION

INTRODUCTION

Missoula's first airplane landing field was constructed in 1923. Its location was southwest of the University of Montana campus. In 1927, 80 acres of land east of the county fairgrounds were secured for a larger field. This field served Missoula until 1954, when the land was designated as the future site of Sentinel High School. From 1929 to the 1940s, the airport, known as Hale Field, became known nationally as the home of the U. S. Forest Service Aerial Fire Depot.

In 1940, the present Missoula County Airport was constructed at a cost of more than a million dollars. The airport, a Works Progress Administration (WPA) project, was situated on 1120 acres of land. It was rated a class four airport by the Civil Aeronautics Administration because it had runways 4500 feet and more in length. It safely handled the largest and fastest military and civil aircraft then in use. (11)

Since 1940, the Missoula County Airport has had almost 30 years of constant use. Since its beginning, the airport has not undergone any major construction programs. Little by little the facilities have grown to their present size which, shortly, will be considered almost obsolete by airport authorities.

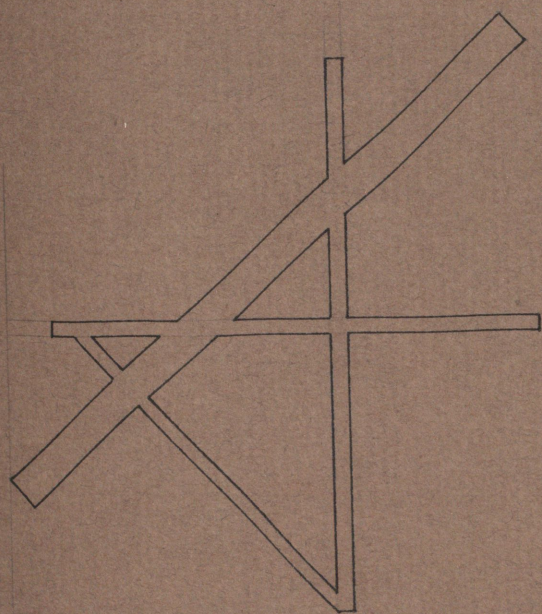
In February 1969, the two largest commercial airlines now serving Missoula (Frontier and Northwest) will begin operating larger and heavier Boeing 727 and 737 jets. However, under specifications established by the Federal Aviation

Agency (FAA), the airport's facilities are not sufficient to handle the nearly 180,000 pound aircraft. The board of directors, supplemented by the aviation committee of the Chamber of Commerce, intends this year to expand the facilities to meet modern needs. (12)

One of the major problems associated with the airport is a lack of adequate terminal facilities. The present terminal building is badly overcrowded and functionally outdated. Robert Jones, an airport board member, stated that the present terminal building should have been brought up to capacity five years ago. The building is twenty years old and not capable of handling the increased number of patrons using airport facilities.

Current plans suggest expanding the present terminal to its ultimate capability before constructing a new facility. However, a new terminal will eventually have to be built to relieve mounting pressure brought about by increased use of air transportation in the Missoula area.

The firm of Isbill Associates, Inc. released a comprehensive plan to the city of Missoula last July. This study, which took five months to complete, would, if carried out, elevate the Missoula County Airport to modern jet-age standards. The purpose of this report is to study in detail the type of terminal facilities which will be required by the jet-age traveler.



CONDITIONS CREATING A NEED

CONDITIONS CREATING A NEED

Missoula, with a population of 46,000, is western Montana's largest city. It is also one of the fastest growing urban areas in the state. From the turn of the century to 1960, the six county Missoula region grew from 26,000 to 83,000 people. In the succeeding years, the region increased by about eight percent annually for an estimated 90,300 persons by 1965. The 9,100 persons added to the population between 1950 and 1960 were all added within Missoula County, giving evidence of an increasing centralization of population. The county, containing less than 40 percent of the region's population in 1930, had grown to 44,663 by 1960, and held more than one-half of the region's population. In 1965, the county held an estimated 50,200 persons (fig. 1). (1)

The Missoula County Airport, located 5.8-miles northwest of Missoula, is beginning to feel the strain of the area's growth. Mounting pressure on existing facilities stems from increased number of passengers, increased use of private planes, increased air cargo volumes, and the increased size of planes landing. At the present time, there are eight flights per day serving the city. These flights are divided evenly between two airlines. Missoula, even with two airlines, is receiving only minimal service. For example, the city did not have direct north-south service until 1967. If flight scheduling and routes were provided that Missoula needs, use would expand even faster than at present (fig. 2). (2)

Figure 1

PLANNING AREA POPULATION

1930 - 1965

<u>Year</u>	<u>Number</u>	<u>% County</u>	<u>% State</u>
1930	16,368	75.1	3.0
1940	22,635	77.9	4.0
1950	31,147	87.7	5.2
1960	39,759	89.0	5.8
1965 ^a	46,430	90.0	6.4

a. estimated by Clark, Coleman and Rupeike, Inc.

Source: United States Census Population

These figures are from the Missoula Planning Area. This area includes the city of Missoula and the urbanizing fringe extending approximately 4.5 miles in each direction from the corporate limits.

Source: Northwest Airlines

Figure 2

PASSENGER TRAFFIC AT MISSOULA COUNTY AIRPORT

<u>Year</u>	<u>Enplaned Passengers</u>	<u>Yearly Increase (%)</u>
1966	20,941	+13.4
1965	18,462	+22.4
1964	15,080	+21.4
1963	12,418	+20.1
1962	10,340	+43.8
1961	7,190	-22.4
1960	9,260	+5.2
1959	8,803	- 0.2
1958	8,823	- 2.3
1957	9,034	+25.6
1956	7,193	+29.8
1955	5,540	+21.1
1954	4,575	+ 1.8
1953	4,492	+ 9.6
1952	4,097	+46.9
1951	2,789	

Source: Northwest Airlines

Air traffic is growing at a fantastic rate. According to a recent study, it will quadruple within the next decade. (2) Between 1965 and 1966, United States airline passenger totals increased from 95-million to 110-million. This is more than a 16-percent gain in a single year. From third place as recently as 1959, air travel now accounts for more inter-city passenger miles than rail roads and bus lines combined by a margin of three to two. In the past three years, the number of commercial planes has increased by 22-percent, passengers by 54-percent, landings and takeoffs by 49-percent, and airport grant requests by 90-percent. (9)

The new planning study of the Missoula County Airport cites many of the same type of statistics. The plan, recently completed by Isbill Associates, Inc., a Denver, Colorado planning firm, calls for a renovation of the present airport on a massive scale. The improvements, spread over a period of 19-years, will cost an estimated 8,714,000 dollars. This figure is the minimum amount Missoula needs to maintain a standard of service consistent with the area's growing demands (fig. 3).

Northwest Airlines, one of the two airlines presently serving Missoula, plans to offer jet service only beginning in 1969. Frontier Airlines, the other major carrier in the Missoula area, is also planning to bring jet service to Montana in the near future. At present, the Missoula County Airport does not have facilities capable of handling jets on a regular basis. Missoula County Airport Study, Isbill Associates, Inc.

Two flights which previously served Missoula, Northwest's

Figure 3

SUMMARY OF PROJECTED AIR TRADE FOR 1986

Enplaned Passengers	172,000
Total Passenger Volume	344,000
Flights Scheduled	6,250
Daily Flights	17
Maximum Stage Length (miles)	6600
Critical Aircraft Scheduled	727
Number of Scheduled Airlines	3-5

At the present time, plans call for remodeling and expanding the terminal building. However, with current growth

Source: Missoula County Airport Study, Isbill Associates, Inc.

flights 40 and 105 were discontinued on October 29, 1967. According to John Bower, district sales manager for the airline in Billings, it was primarily a space problem. More room was needed for passengers and cargo. In order to gain the necessary space, Northwest elected to make flights 40 and 105 jet service.

Missoula now has only one flight daily connecting with Minneapolis. Before October 29, 1967, it had three flights daily. The city might have been able to retain the flights if the airport were able to handle jets. Bower also noted that Montana is the only area remaining in this section of the United States where Northwest is still using non-jet equipment.

The arrival of Frontier Airlines in the Missoula area made it impossible to delay the improvements of auto parking and terminal facilities. Already the airport board has taken steps to cope with these problems. The passenger terminal is being remodeled to accommodate the increased passenger load created by Frontier (fig. 5). The parking lot is also being expanded (fig. 6). These improvements can only be considered a temporary or emergency measure. The arrival of 727 fan jets next year will make it impossible to delay lengthening and strengthening of runways and taxiways.

At the present time, plans call for remodeling and expanding the terminal building. However, with current growth trends, the terminal will ultimately have to be replaced. The new site will be on the west side of the airport where there

is sufficient space for expanded parking facilities, and a much larger and more complete terminal. The present terminal is stifled for space (fig. 7). It is crowded between U. S. Highway 10 on the northeast, and runways and taxiways on the southwest. Private aircraft facilities hamper its expansion to the southeast (fig. 8). To the northwest is a Forest Service installation (fig. 9).

The airport modernization program, proposed by the consulting firm of Isbill Associates, Inc., is designed in two phases. The first phase, to be completed by 1971 and costing an estimated 2,467,800 dollars, is shown in fig. 4. The second phase, which will be completed by 1986 and will cost an estimated 6,247,000 dollars, is also shown in fig. 4.

This section has shown the need for a vast modernization of present airport facilities. It is the purpose of this report to study in detail one of these facilities, a new terminal building. It is hoped, that as information is gathered and interpreted, insights can be made into the type of terminal facilities which will best suit Missoula's needs.

1. Provide emergency crash building	100,000
2. Provide air cargo building	75,000
3. Extend main runway	201,500
4. Complete parking and auto parking for existing terminal	40,000
5. Provide emergency crash building	100,000
6. Provide air cargo building	75,000
7. Construct sewage plant	30,000
8. Construct new terminal	1,200,000
9. Construct aircraft apron	1,420,000
10. Construct taxiways	1,226,000
11. Construct apron road	100,000
12. Construct parking lot	200,000
13. Provide utilities	150,000
Total	6,247,000

Figure 4

PROPOSED MODERNIZATION PROGRAM

Phase 1

1. Remodel existing terminal	\$ 65,000
2. Provide auto parking	58,000
3. Strengthen runways and taxiways	737,200
4. Additional aviation apron	308,300
5. Additional aircraft parking apron	125,000
6. Construct taxiways	254,500
7. Acquire land for runway extension	177,600
8. Extend main runway	66,700
9. Enlarge terminal and relocate electrical vault	<u>675,000</u>
Total	2,467,300

Phase 2

1. Provide additional apron and relocate transmitter site	917,500
2. Provide T-Hangar units	250,000
3. Extend main runway	201,500
4. Complete parkway and auto parking for existing terminal	40,000
5. Provide emergency crash building	100,000
6. Provide air cargo building	78,000
7. Construct sewage plant	50,000
8. Construct new terminal	1,500,000
9. Construct aircraft apron	1,529,000
10. Construct taxiways	1,226,000
11. Construct entrance road	105,000
12. Construct parking lot	100,000
13. provide utilities	<u>150,000</u>
Total	6,247,000

Figure 5



• View of terminal from
air carrier apron.

Aircraft tie-down
area north of ter-
minal



View of terminal from
automobile parking lot

Figure 6



View of parking lot

View of parking lot
from Johnson Flying
Service hangar



View of parking lot

Figure 7



View of Johnson Flying
Service hangar north of
the terminal

Present storage of
flightline equipment



Aircraft tie-down area

Figure 8



Missoula Sky-flite, Inc., south of terminal



Air carrier apron

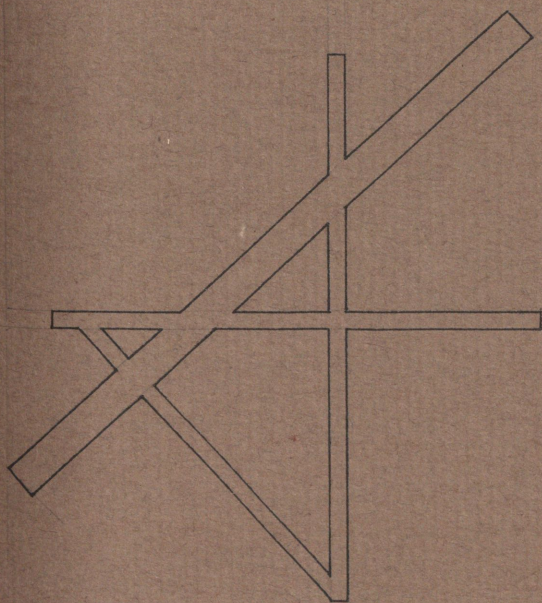
Figure 9



Aerial Fire Depot



Aerial Fire Depot



LOCAL CONDITIONS

LOCAL CONDITIONS

Geographic

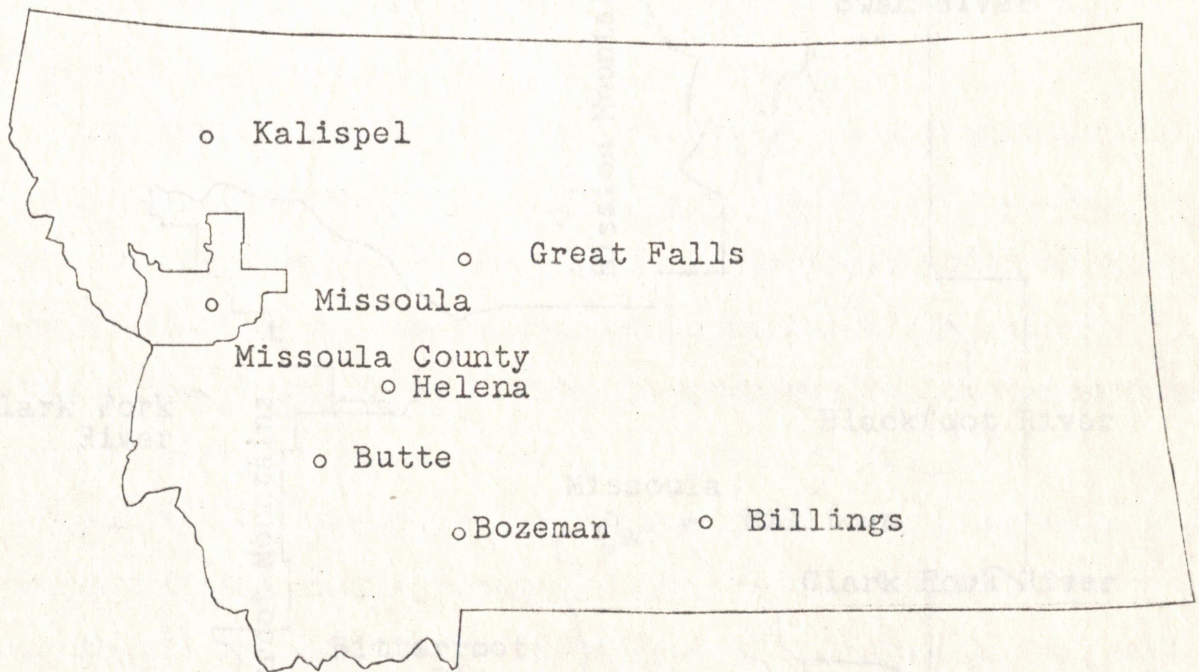
Missoula County is located in the rugged mountain country of west-central Montana (fig. 10). Four major river valleys are included within its boundaries. The Clark Fork of the Columbia River is the principal drainage. The Clark Fork flows through the county from southeast to northwest. The Bitterroot River flows north through the Bitterroot Valley and joins the Clark Fork at Missoula. The Blackfoot River flows southwest from the Continental Divide and joins the Clark Fork six miles east of Missoula at Milltown. The Swan River flows north through the northern part of the county and enters Flathead Lake at Big Fork, Montana. (fig. 11).

Missoula County is very mountainous. Elevations vary from 3,000 feet in the lower valleys to 10,000 feet in the higher mountains. The two principal mountain ranges within the county are the Bitterroots and the Missions. The Bitterroots, with a north-south orientation, form the county's western boundary. The Missions, also with a north-south orientation, are located in the northeastern part of the county.

Valley bottoms in western Montana are wide and flat. Cottonwoods and willows line the streams. Rolling hills flank the valley bottoms. Their southern and westerly slopes are covered with grass and sagebrush; while north and easterly slopes are usually forested. The mountains and higher valleys are almost completely forested. The predominant species in this area are

Figure 10

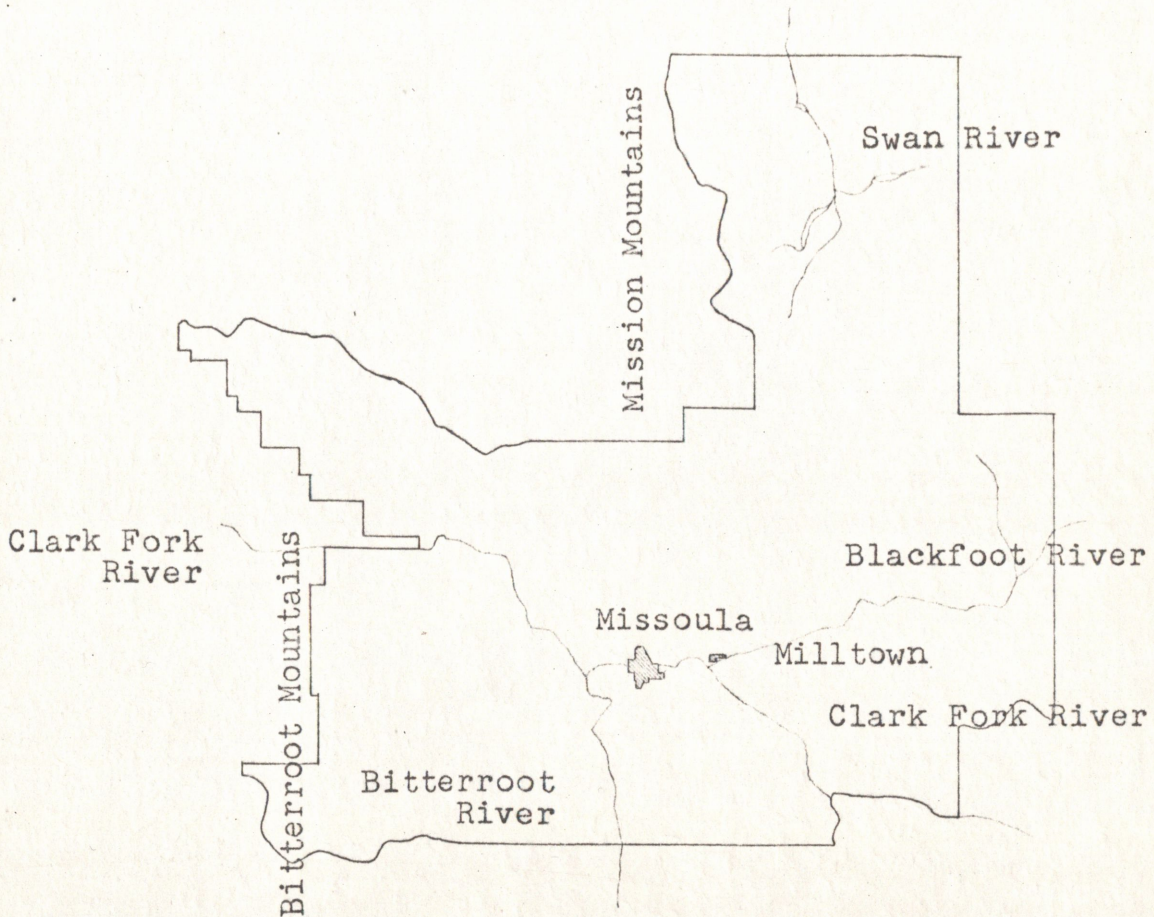
STATE OF MONTANA AND MISSOULA COUNTY



Source: Missoula Chamber of Commerce

Figure 11

MISSOULA COUNTY AND CITY OF MISSOULA



Source: Missoula Chamber of Commerce

Ponderosa pine, Douglas-fir, Engelman spruce and Western larch. Patches of Aspen are often found in creek bottoms and sheltered draws. Mountain peaks reach above the timberline, and are rocky and snow covered.

Economic

Missoula is the county seat of Missoula County. The city is located in the Columbia River Basin of western Montana at the intersection of the Clark Fork and Bitterroot rivers (fig. 11).

The Missoula of history has exhibited steady growth both in economy and population. Typically, because it is an urban area and urban areas grow rapidly, Missoula holds an important position in the economy of Missoula County and the state. These established trends in urbanization and centralization are expected to continue in the future. (1)

Natural resources, principally timber, have long been the backbone of the city's economy. However, the University of Montana has increased, and probably will continue to increase, in economic importance within the community. For example, enrollment is presently increasing at about five percent each year. Also, a larger selection of goods and services added to meet the needs of the growing population has attracted dollars from the residents of a six county region. (1)

Missoula is situated on several main routs to the Pacific Northwest. It is a division point on the Northern Pacific Railroad, and is also served by the Chicago, Milwaukee and St Paul

Railroad. Inter-state 90, a primary east-west highway, intersects U. S. Highway 93, an important link to the southwest, at Missoula.

The other major economic factors influencing the county are lumbering, mining, and agriculture. In addition, several wilderness and wild areas in the region combined with the proximity of Yellowstone and Glacier National Parks make Missoula an important tourist and recreation headquarters. (3)

No major changes are anticipated in the economy of the area during the planning period from 1965 through 1985. Growth can be expected to continue at about the present rate. Those industries that rely upon the timber resources of the area will continue to grow although at a slower rate. Timber harvest of sawlog material has about reached its peak. The city's role as the regional commercial and business center of the area extending throughout Missoula County and the five neighboring counties of Granite, Mineral, Lake, Ravalli and Sanders is expected to grow even stronger (fig. 12). The additional enrollment forecasted for the University of Montana is substantial, and future economic growth will be sustained by the expected increase. (1)

In 1965, the estimated number of persons employed in Missoula County was 18,200 (fig. 13). By 1985, the employment level is expected to increase to 28,440. This is an increase of 10,200 workers in the twenty year period, or an anticipated gain of 2.8 percent annually (fig. 14).

An estimated \$78.6 million in retail sales was transacted

Figure 12

RETAIL TRADE AREA



Source: Clark, Coleman and Rupeike, Inc.

Figure 13

ESTIMATED 1965 EMPLOYMENT

<u>Occupation</u>	<u>County</u>	<u>Planning area</u>
Ariculture, Forestry	700	100
Construction	950	700
Manufacturing	3,200	2,000
Trans., Comm., Util.	1,470	1,400
Trade	3,900	3,700
Finance, Insurance,		
Real estate	750	650
Services	3,230	2,950
Government ^a	<u>4,000</u>	<u>3,700</u>
Total	18,200	15,200

a. includes education

Source: Estimates by Clark, Coleman and Rupeike, Inc.
planning consultants.

in 1965. Between 1965 and 1985, the area is expected to show a \$33.3 million increase in retail sales for a total of \$112 million in business transactions by the latter year. (1)

Climate

Western Montana has a climate typical of the mountain west. Summers are hot and dry with frequent thundershowers. Winters are cold and wet with heavy snows accumulating in the mountains.

The weather during the spring and early summer is cool with frequent rain showers. During summer and fall, the days are clear and very warm. Throughout late fall and winter, snowfall accumulates in the mountains. Both snow and rain occur in the valleys at this time of year. Mountain snows produce heavy spring runoffs in May and June.

The following is a description of climatic conditions in the city of Missoula.

Wind:

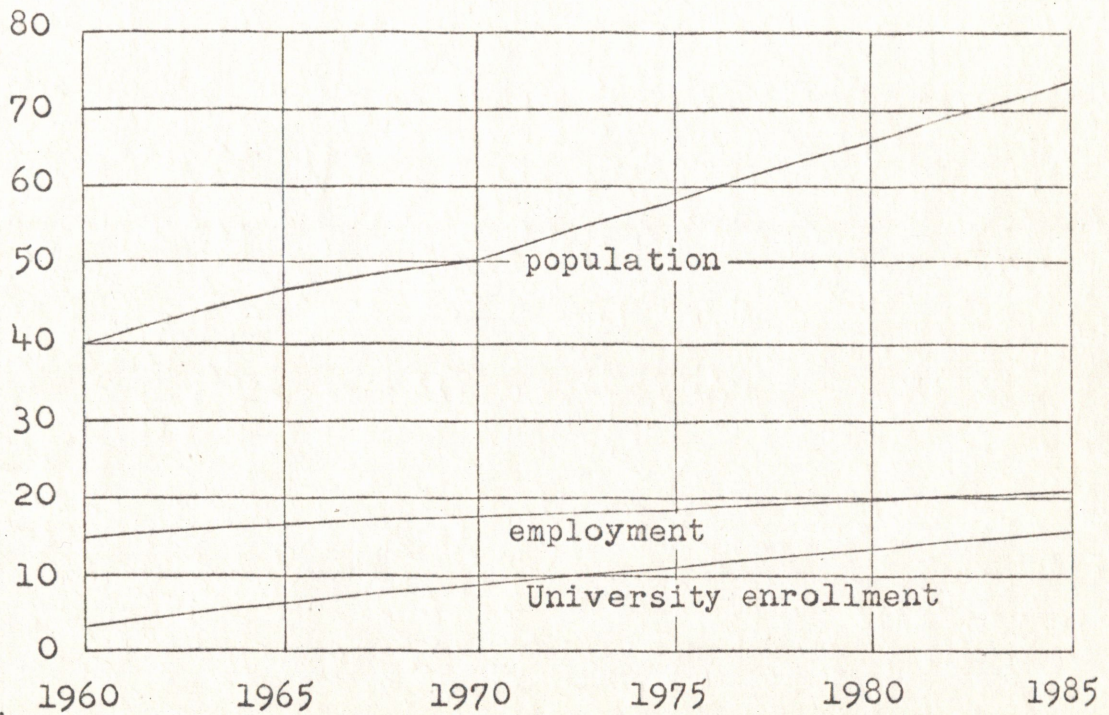
The prevailing wind is west to southwest during the spring and summer months. Throughout the winter, Hellgate Canyon funnels strong east winds into the city. These winds usually accompany storm systems, and seldom last more than a few days at a time.

Sun:

The sun shines 53 percent of the possible amount during

Figure 14

POPULATION, EMPLOYMENT AND UNIVERSITY
GROWTH TRENDS



Source: Clark, Coleman and Rupeike, Inc.

an average year. It shines from a minimum of 25 percent of the time in December to a maximum of 75 percent of the time in July. Throughout an average year, cloudy days number 207, and partly cloudy and clear days number 158. Sunshine throughout the winter is limited to 30 percent of the possible amount.

The sun angle on the shortest day of the year is 19.5 degrees on December 22. It rises at 7:45 AM on an azimuth of 43 degrees east of south and sets at 4:15 PM on an azimuth of 43 degrees west of south. During the longest day of the year, the sun angle is 66 degrees on June 22. It rises at 4:32 AM on an azimuth of 62 degrees east of south, and sets at 7:28 PM on an azimuth of 62 degrees west of south.

Rain:

Missoula receives from 12 to 15 inches of rain annually. The heaviest amounts occur during May and June, when approximately two inches are received each month. Daily showers usually occur in early spring.

Temperature:

There are 137 growing days annually in Missoula County. During the summer, the temperature seldom reaches 100 degrees. The minimum temperature in July and August averages about 50 degrees. January is the coldest month although sub-zero temperatures occur in December and February. Temperatures of less than zero occur 13 days out of the average year. Temperatures warmer than 90 degrees occur 18 days out of the average year.

Humidity:

The relative humidity during the morning hours averages 81 percent. It ranges from a low of 73 percent in July to a high of 86 percent in November. The afternoon humidity averages 51 percent, ranging from 28 percent in August to 78 percent in December.

Smog and Fog:

Missoula is an area famous for early morning fog. It has an air pollution problem of major proportions. The pollution is caused by industrial smoke combined with frequent weather inversions. The problem is most acute during the winter months.

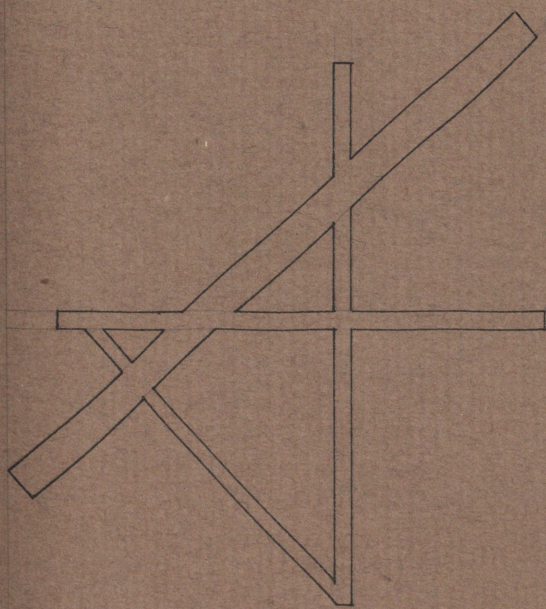
Page 11 contains a table showing annual temperature and precipitation variations based on a 30 year average. (5)

Figure 15

TEMPERATURE AND PRECIPITATION VARIATION

<u>Month</u>	<u>Average Temperature</u>	<u>Average Precipitation</u>
January	21.6°	1.01
February	27.2	.86
March	35.3	.87
April	44.9	1.03
May	52.8	1.81
June	59.8	2.01
July	67.7	.94
August	65.9	.86
September	56.2	1.23
October	45.4	1.06
November	33.1	1.08
December	25.2	1.12

Source: Missoula Chamber of Commerce and the U. S. Weather Bureau at the Missoula County Airport.



SITE CONDITIONS

SITE CONDITIONS

General

The Missoula County Airport is located in a long valley adjacent to the Bitterroot Mountain range, 5.8 miles northwest of the city of Missoula. The airport was constructed during 1941-1942, including the three runways in use today. Since 1942, the airport has undergone constant improvement. Runways have been rebuilt and extended; taxiways and aprons constructed; airfield lighting, and navigational aids installed; and hangars, a terminal building, a control tower, and service buildings completed.

The airport includes over 1,000 acres of rolling land. In conjunction with this land, there is a large Forest Service installation to the northwest. Both a road and a taxiway provide access from the Forest Service to Johnson Flying Service and all other airfield facilities. For their development needs, the Forest Service has acquired over 70 acres from the airport, and is leasing five additional acres. (2)

The land use situation around the airport is highly favorable for this type of development. The property surrounding the field is almost entirely undeveloped. It has experienced very little commercial, residential or industrial growth. The only exceptions are the Forest Service Aerial Fire Depot, and a trailer court which lies northwest of the airport (fig. 16).

Other than these installations, the airport is surrounded

Figure 16



Figure 16-a



Figure 16-b



on the west, south and southeast by rolling hills and farmland. To the northeast lie U. S. Highway 10 and the Northern Pacific Railroad. Beyond this is a one-mile wide strip of land bordered on the northeast by the recently completed Interstate Highway 90.

The Site

A planning study, released in July, 1967 by Isbill associates, Inc., suggests moving the airport's terminal facilities across the main runway to the west side of the field (fig. 17). The study found the present site inadequate for several reasons. As the airport grew, private aircraft facilities developed around the present terminal seriously limiting the expansion of its services. Construction of the Forest Service development on the north side of the field prevented further expansion in that direction. U. S. Highway 10 parallels the main runway prohibiting expansion to the northeast.

At the present time there is not enough automobile parking space to adequately handle both patrons and permanent personnel. The close proximity of the Johnson Flying Service and Missoula Sky-flite, Inc. rules out any possibility of expanding parking facilities to the needed amount.

The land surrounding the west, south and southwest sides of the airport is used primarily for agricultural purposes. Here, there would be ample space to construct a terminal and all its related services (fig. 16). There is no present airport use for this side of the field. (2)

Orientation

The site, selected by Isbill Associates, Inc., is located on the west side of the field in the NE $\frac{1}{4}$ of the SW $\frac{1}{4}$ of section 2, T13N, R20W, MPM. It lays between runways 7/25 and 16/34 (fig. 17). The building will have its primary view to the east, eliminating the disadvantage of afternoon sunlight which exists in the present terminal. It will lie almost directly opposite the present facilities. Access will be from the Mullan Road which is west of the site. According to O. J. Ballas, architect, this road will be improved in the near future to meet the traffic that is expected from new industry as well as from the airport.

Topography, Vegetation and other Resources

The airport lies on a large bench in the Clark Fork valley northwest of Missoula. The topography consists of rolling hills and shallow gullies. The bench drops sharply away on the southern and western sides of the field. It rises gently to the north and east. Two and one-half miles west of the airport, the Clark Fork River flows in a northwesterly direction. Patches of pine, fir and cottonwood grow in the bottomland. Willows grow in the gullies (fig. 20). The area immediately surrounding the field is grass covered. The site itself is treeless and grass covered.

Views

To the east, the Rattlesnake Mountains rise abruptly from

the floor of the valley. These mountains attain elevations in excess of 8,000 feet (fig. 21). To the west, the primary view is of the Bitterroot Mountains. They are lower and nearer than the Rattlesnakes (fig. 22). To the southeast, the city of Missoula rests beneath grass covered Mount Jumbo and Mount Sentinel (fig. 23). Lolo Peak rises to a snowcapped 9,500 foot elevation in the southwest (fig. 22). To the north lies Squaw Peak, a well known landmark in the area.

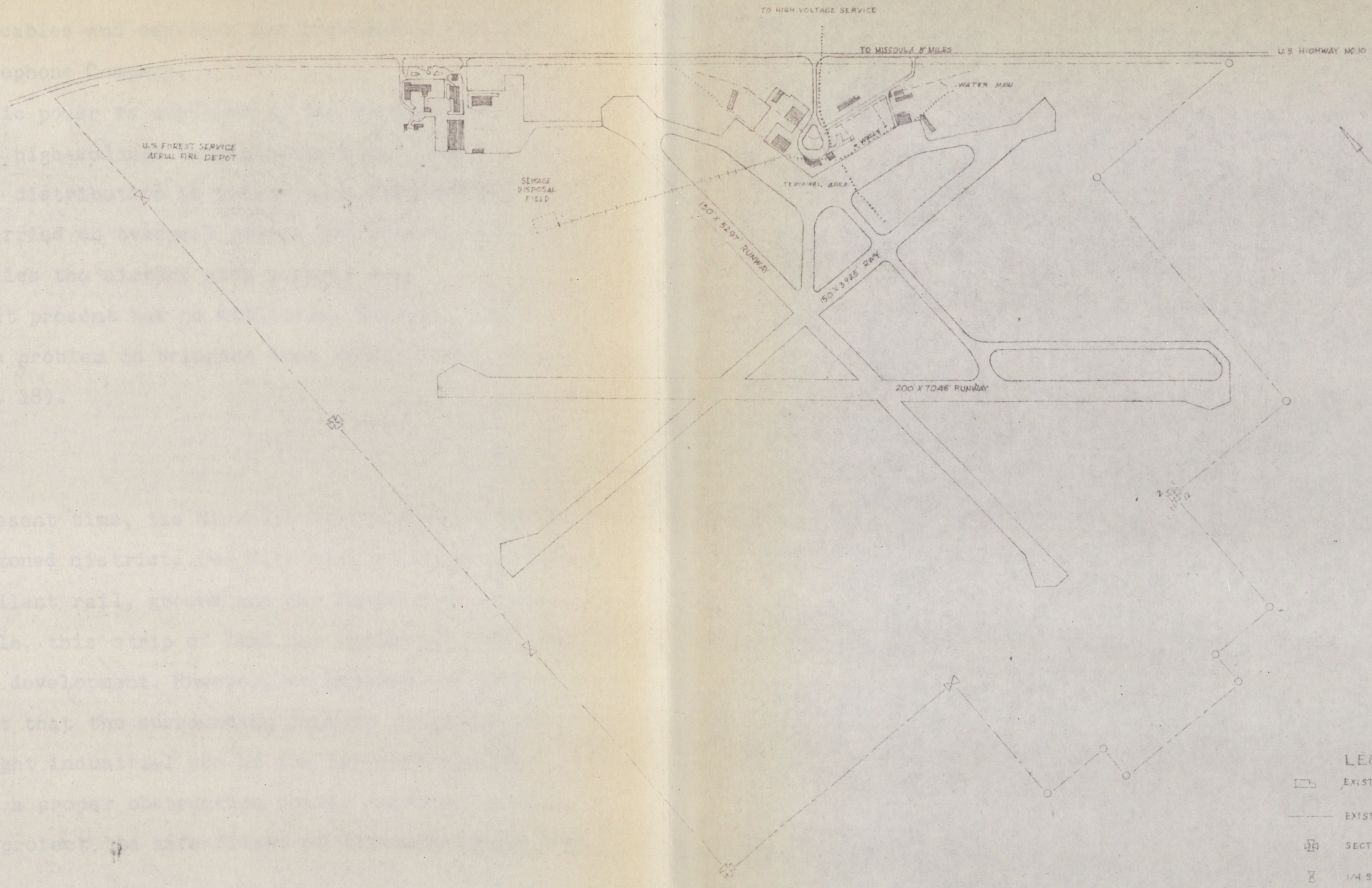
Soil Analysis

Missoula lies on a broad glacial lake bed 3,205 feet above sea level. Alluvial deposits have left an average of six feet of top- and sub- soil upon bedrock. The top-soil is sandy clay, and the sub-soil is gravel.

Availability of Utilities

Utilities are not a problem at the airport. The water system consists of two wells with 4- and 6-inch mains. They are owned and operated by the airport.

The existing sewer system consists of a collection system. The wastes flow through 8-inch pipes to a 5,000 gallon septic tank north of the terminal building. The sewage flows from the septic tank into the sewage effluent disposal field on the northwest edge of the airport property. Provisions have been made in the master plan for a new sewage disposal system. However, the new system will be very similar to the existing facility. (2)



- LEGEND
- EXISTING BUILDINGS
 - EXISTING PROPERTY LINE
 - SECTION CORNER
 - 1/4 SECTION CORNER

AIRPORT DATA	
PORT ELEVATION	3205'
PORT REFERENCE POINT ARP	LATITUDE 46° 54' 54"
COORDINATES	LONGITUDE 114° 05' 14"
AN MAX. TEMP. HOTTEST MONTH	86.3°F

MISSOULA COUNTY AIRPORT
MISSOULA, MONTANA

UTILITIES LAYOUT PLAN

FIGURE 18

Telephone cables and services are provided by the Mountain States Telephone Company.

The electric power is supplied by the Montana Power Company from their high-voltage transmission line along U. S. Highway 10. The distribution is three-phase 7200/12500 primary, and is carried on overhead poles. The Montana Power Company also supplies the airport with natural gas.

The site at present has no utilities. However, there would be little problem in bringing them underground across the field (fig. 18).

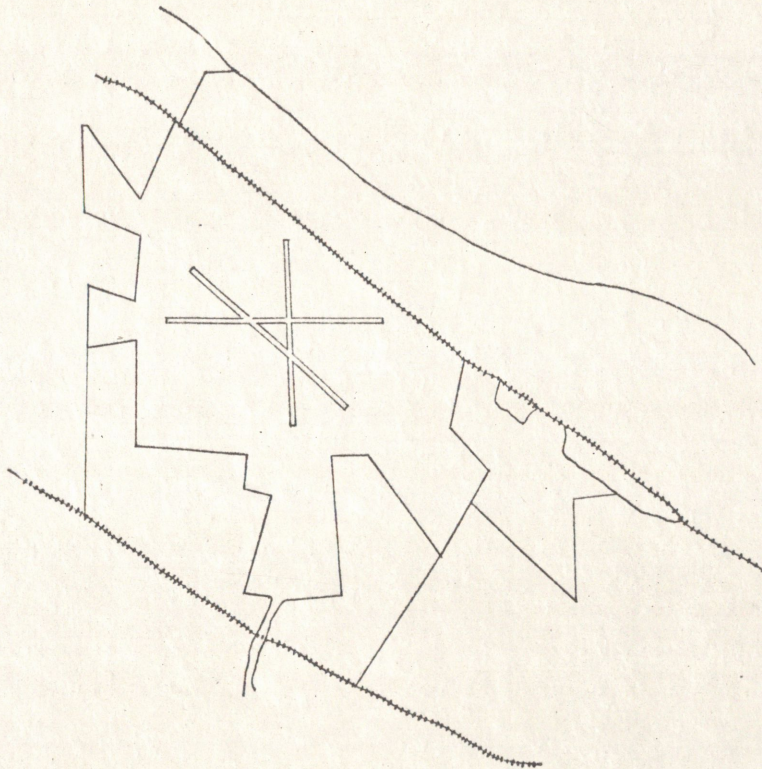
Zoning

At the present time, the Missoula County Airport is not included in a zoned district. (4) With highly adequate utilities, and excellent rail, ground and air facilities conveniently available, this strip of land has unlimited potential for industrial development. However, to protect the airport, it is important that the surrounding land be zoned for commercial and light industrial use at the earliest possible time. Further, a proper obstruction zoning ordinance should be enacted to protect the safe flight of aircraft around the airport. (1)

The Comprehensive Development Plan for Missoula calls for zoning the airport as a public use area, and the land surrounding the field as light industrial use (fig. 19). The surrounding land, more specifically, extends from the airport south to the Chicago, Milwaukee and St Paul route along the southern

edge of the airport. It would extend northeast to the Northern-Pacific route and then southeastward for about one and one-half miles (fig. 19).

PROPOSED ZONING REQUIREMENTS



- ☐ public and quasi-public
- ☐ parks and open spaces
- ☐ light industrial
- ☐ heavy industrial

Source: Clark, Coleman and Rupeike, Inc.

Figure 20



Site foliage

Patches of pine in
the vicinity of the
site



Site foliage

Figure 21



View to the east



View to the east

Figure 22



View to the west

View to the west



View to the southwest

Figure 23



View to the north



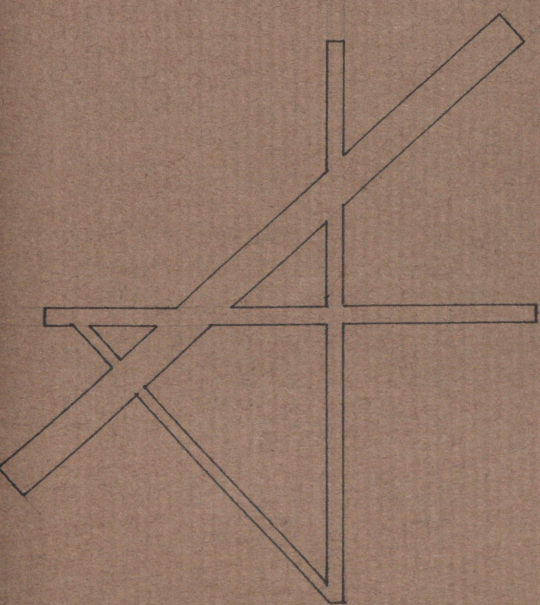
View to the northeast



View to the northwest



View to the southeast



FUNCTION OF THE BUILDING

FUNCTION OF THE BUILDING

The proposed terminal building for the Missoula County Airport will include only those functions relating to the movement of passengers and their property. Government agencies related to airport activities (Federal Aviation Agency and U. S. Weather Bureau) will remain in their present locations in the existing terminal. A new control tower will not be necessary since FAA officials indicate the existing facility is adequate to handle anticipated traffic in the foreseeable future.

The terminal building requirements were derived from the following sources:

1. Projected air carrier activity;
2. Gate positions required;
3. Type of aircraft by 1986;
4. Projection of annual passenger enplanement and aircraft departure based on recorded activity from 1966 to 1986. (2)

The basic consideration in anticipating the size of a terminal building is the relationship of area requirements to the number of peak-hour passengers. The term "peak-hour passengers" is defined in Air Terminal Buildings, published by the Federal Aviation Agency, as representing "the total of the highest number of passengers enplaning and deplaning during the busiest day of a typical week." Typical peak-hour passengers for 1976 are anticipated to be 114. However, the forecasted

peak-hour passenger activity in 1986 is 200.

The following components of the terminal and their relationships to each other are based on a study made by Isbill Associates, Inc.

TERMINAL BUILDING AREA ALLOCATION

Entrance Lobby:

The entrance lobby is a transitional space between surface transportation systems and the terminal proper. It should be an orientation area for the traveler. the entrance lobby is a relatively small space which flows directly into the ticket lobby and waiting room.

Ticket Lobby:

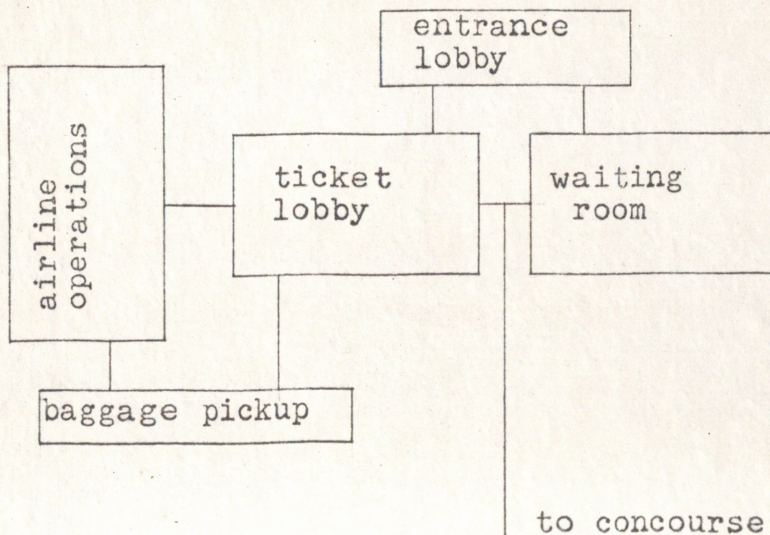
The ticket lobby is a focal space from which many terminal functions radiate. This area is exclusive of ticket counter space and airline operation space. It is basically a large circulation area with the perimeter containing ticketing, automobile rentals, trip insurance, and taxi service. Main functions closely associated with the ticket lobby include airline operations, baggage pickup, the waiting room, and the entrance lobby.

Airline Operations:

Airline operations refers to all space inside the terminal building required by the airlines. It includes:

1. Reservations;
2. Communications;
3. Baggage handling and storage;
4. Load control
5. Dispatching;
6. Management;
7. Employee requirements;
8. Counter space and back-of-counter work space.

The airline operation area must be directly associated with the ticket lobby, baggage pickup and the air carrier apron. Space for storing mechanical equipment such as tractors, loading ramps and baggage carts should be provided in airline operations. Business offices for airline officials will be provided in another area of the building.



Baggage Claim:

The baggage claim area is the space provided for deplaning passengers to pick up their property. It should be closely associated with the ticket lobby and the airline operations area. Baggage is taken from arriving aircraft to airline operations where it is checked-in, sorted and delivered to the baggage claim area.

Passenger Service (Ticket) Counter:

All counter facilities for ticketing passengers and checking-in baggage are found in this area. The length of counter space necessary will be based upon an expected three to five airlines operating in the Missoula area by 1986.

Rent-a-car:

This service is provided by local business enterprises. It is located in the ticket lobby near the concourse. Office space for record storage is provided in another area but with easy access to the counter. Space for counter, desk and a telephone will be required.

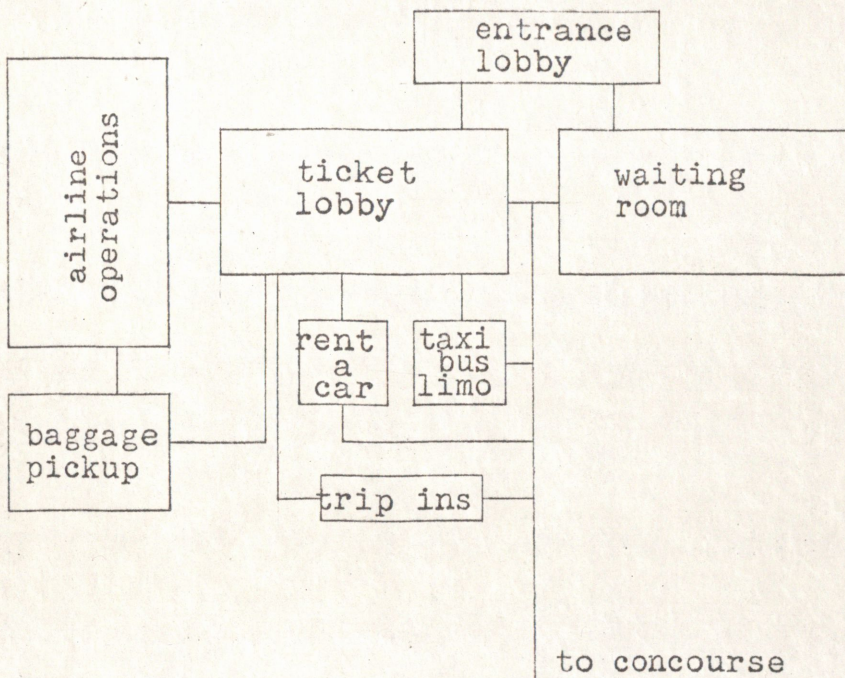
Limosine, Taxi and Bus Counter:

Local transportation firms supply this service to enable the traveler to proceed from the airport to his destination in Missoula or the surrounding area. It is a counter area similar to the space provided for rent-a-car. It should be closely associated with the ticket lobby and the concourse in order to be

readily available to deplaning passengers.

Trip Insurance:

In most cases, the traveler buys his insurance through a vending machine. Therefore, no office space or insurance staff need be considered. This area can either be placed along the concourse or in the ticket lobby.



Waiting Room:

The waiting room is the space provided for enplaning and deplaning passengers to await their respective flights. Concessions, restrooms and other passenger services are closely associated with the waiting room. Large windows should give

the traveler a panoramic view of the air carrier apron and the airfield beyond. Since the traveler spends much time in the waiting room, it should be a comfortable and spacious area. Access to the concourse and entrance lobby should be direct.

Coffee Shop:

The coffee shop is near the waiting room. It is a sandwich and short order service. A counter and tables or booths will accommodate patrons. Food preparation will be done on the premises. The coffee shop would be leased to a catering service or other private business for management.

Concessions:

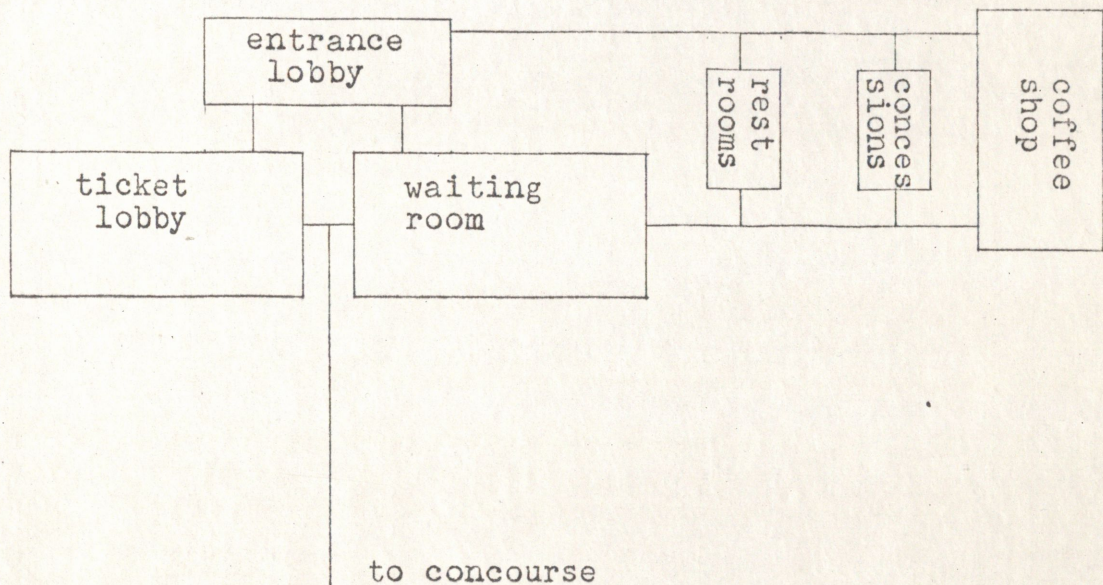
Newspapers, magazines, pocketbooks, candy and cigarettes are some of the items sold in the concession area. This area is another traveler convenience function which sells small items to help him pass time while waiting for his flight as well as while he is in flight. It should be closely associated with the waiting room and coffee shop. Access is through the waiting room or entrance lobby.

Baggage Lockers:

Baggage lockers are small cubicles where the traveler, for a small fee, can store hand carried possessions while waiting for his flight. They should be located near the ticket lobby and the waiting room with easy access to the concourse.

Rest Rooms:

Public rest rooms should be located in such a manner as to be accessible from the waiting room, ticket lobby and entrance lobby. Access from the coffee shop and dining room is also important. This access need not be direct; however, it should be convenient.



Dining Room:

An airport restaurant could be a welcome asset to the community as a whole. It would offer the area population a pleasant dining-out experience that is unique since it would overlook an airport and airport activities. Its major source of revenue would not come from the traveler but from the community. It should be a spacious area with an air age atmosphere. Functions relating to the dining room would include the

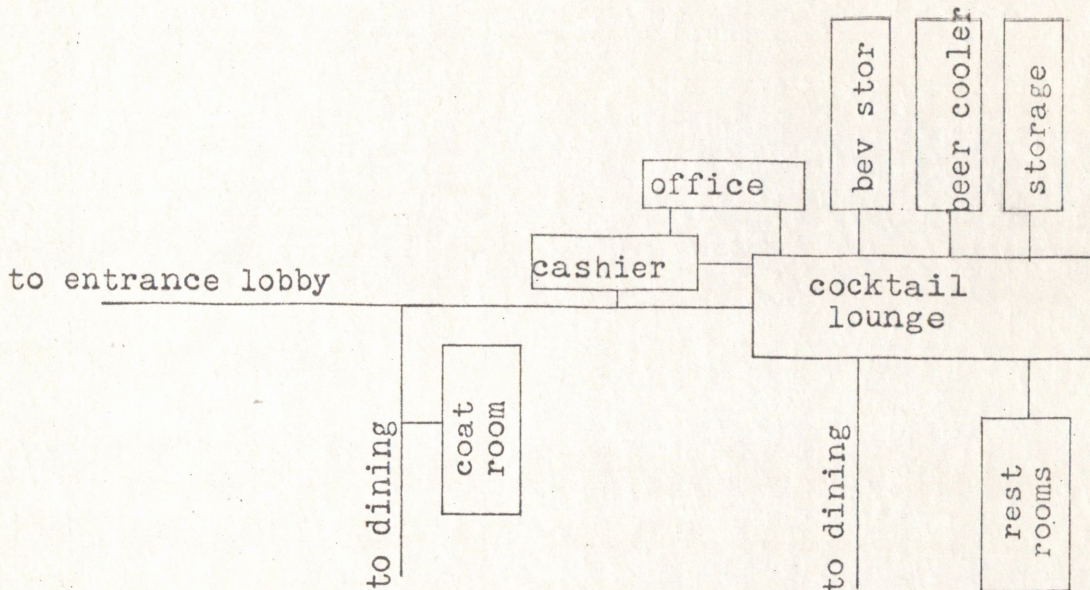
A floor plan diagram of a restaurant layout. The plan includes the following areas and connections:

- to waiting room**: Located on the left, connected to the main horizontal corridor.
- to cocktail lounge**: Located at the top left, connected to the main horizontal corridor.
- coat room**: A rectangular box located above the main horizontal corridor, connected to it.
- cashier**: A rectangular box located above the main horizontal corridor, to the right of the coat room, connected to it.
- office**: A rectangular box located above the main horizontal corridor, to the right of the cashier, connected to it.
- dining room**: A large rectangular box located to the right of the office, connected to the main horizontal corridor.
- to cocktail lounge**: Located at the top right, connected to the dining room.
- to service**: Located at the top right, connected to the kitchen.
- guest dining**: A rectangular box located below the main dining room, connected to it.
- kitchen**: A large rectangular box located to the right of the dining room and guest dining areas, connected to both.

The cocktail lounge is designed especially for the traveler; however, much use by the local populace can be expected. A bar in conjunction with small tables or booths should be included. Several storage areas will be required. They would include:

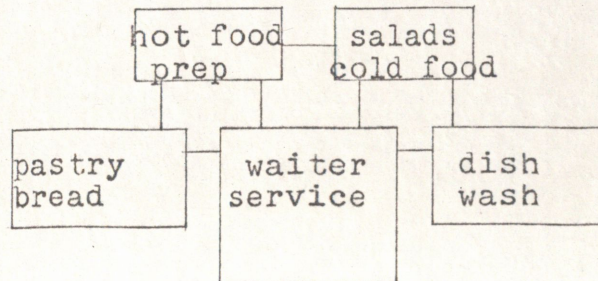
- A small office area is necessary for record storage and order preparation. A separate cashier's area might also be considered. The cocktail lounge should be near the dining room

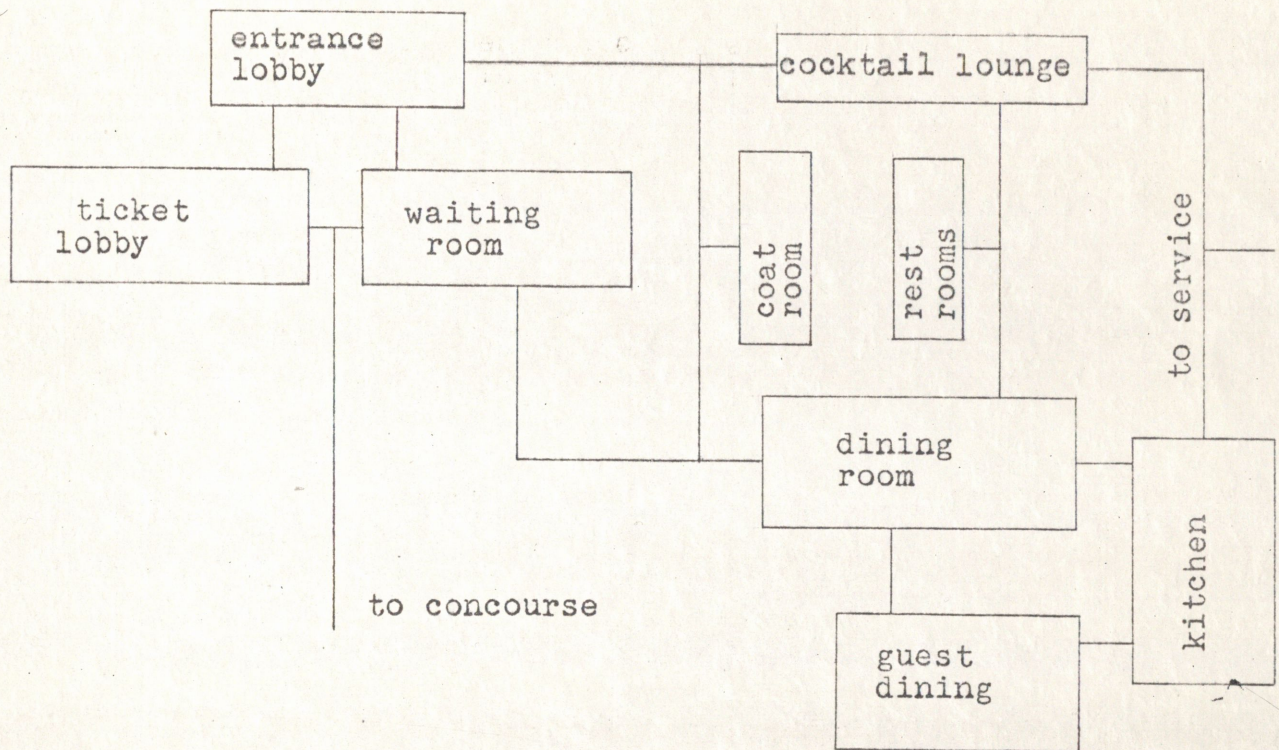
and the waiting room. Rest rooms, used by both dining room and cocktail lounge patrons, will be necessary. A coat room, centrally located, will be available to both the dining room and the cocktail lounge.



Kitchen:

The kitchen includes food preparation, food storage, food service and dish washing. Office space and staff locker rooms are also necessary. The kitchen must be designed in a manner that allows fast efficient service, ease of operation, and a minimum of employee walking. The kitchen is directly off the dining room and has access to an outside service entrance.





AIRPORT MANAGEMENT:

Reception:

This office is used by the airport manager's receptionist. Space will be provided for seating several people. All managerial functions radiate from this space.

Manager:

The airport manager's office should be large and formal. Space is necessary for a desk, a large worktable, and filing cabinets. This office should have direct access to the conference room and the reception office.

Conference Room:

The conference room must be large enough to seat eight to ten persons for business meetings. Entrance will be from both the manager's office and the reception room.

Secretarial:

An office for use by several persons on the secretarial staff is required. The secretarial pool is available to accounting, general administration, engineering and the manager. This office must have space for the storage and operation of several types of office machinery including typwriters, adding machines and reproduction equipment.

Accounting:

A small office for use by one or two accountants is necessary. This office will be closely associated with the secretarial office.

Engineering:

The engineering office is used by the airport engineer and one part time draftsman or engineering aid. It will handle all the mechanical aspects of the airport. Space is required for a drafting table, desk, and storage for records and drawings.

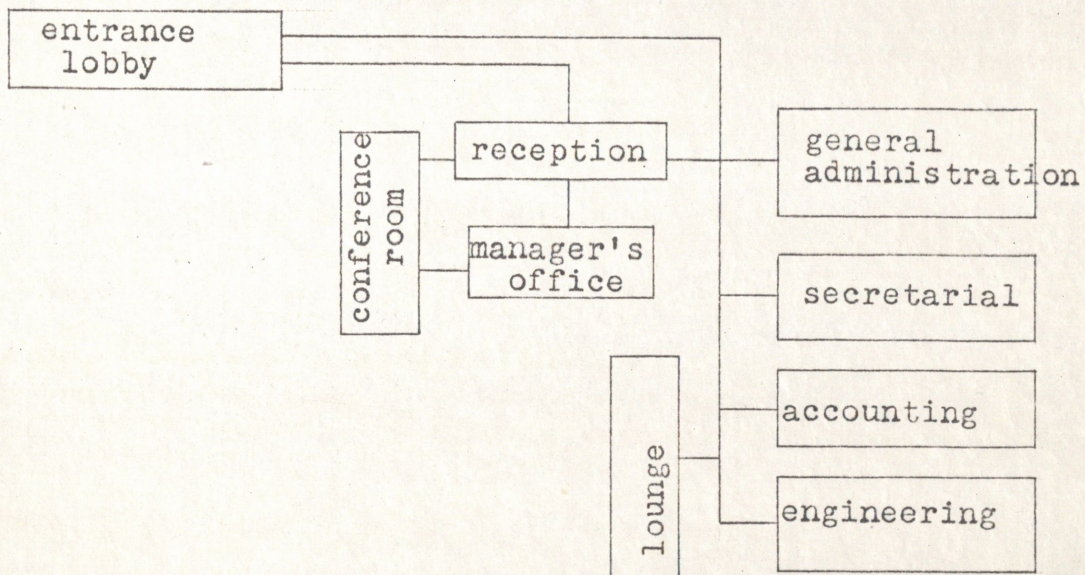
General Administration:

The general administration office houses the administrative

staff. Assistants of the airport manager reside in this office. It is a business office requiring two or three desks, filing cabinets and seating for several people.

Administrative Staff Lounge:

Rest rooms, coffee area, coat room and a lounge area are required. The staff uses the lounge for coffee and lunch breaks.



Airline Operations Crew Lounge:

This lounge will be used by crews working in airline operations and on the air carrier apron. It is a place for coffee and lunch breaks. A rest room will be provided.

First Aid Room:

A first aid room will be provided with the possibility of a part time nurse during heavy-traffic hours. The first aid room should be located in the vicinity of the concourse, ticket lobby

and waiting room.

Mechanical Room:

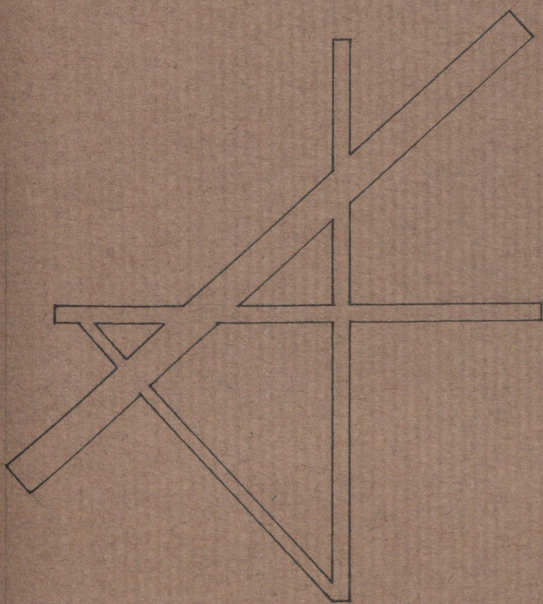
The heating and ventilating equipment should be located in some area where noise will not be a problem. The most probable location would be somewhere near airline operations. Space will also be needed for custodial facilities in this area.

Concourse:

At this time, it is unknown whether one or two concourses will be included in the terminal design. The concourse is a covered walkway to various aircraft parking areas. The passenger travels through the concourse to his respective flight where he leaves its protective cover and climbs a boarding ramp to his plane.

Observation Deck:

The observation deck is a raised platform which allows spectators to view activity on the air carrier apron as well as aircraft taking off and landing. Its location obviously has to be on the airport side of the terminal; however, its specific location cannot be known until the design stage begins.



AESTHETICS

AESTHETICS

The previous sections have all dealt with finite elements associated with the problem. Facts and figures, supported by a case study, proved the need for a new facility. Information regarding economics, social and climatic conditions established a general mood or character of the area's population. A more detailed study of the site yielded valuable information regarding views, soil conditions, topography, and vegetation. Finally, a study and compilation of the functions or activities to be included in the building program was completed.

The fact that the bulk of the material presented in this report concerns finite facts and figures does not lessen the importance of this section. Aesthetics is probably the most important single concern in the design of a building. Since the term "aesthetics" is associated with art, its importance in building design can be readily seen. For without aesthetics, there can be no architecture in the true sense of the word. Architecture without aesthetics becomes mere building.

Aesthetics is commonly defined as beauty. Webster defines it as "an appreciation of, or response to the beautiful in art or nature." Clearly, the term "aesthetics" has a vagueness which makes it difficult or even impossible to define in concrete terms. Generally speaking, aesthetics in art connotes the realization of form. Further, aesthetics in architecture could be expressed as the realization of form as evoked in building.

An airport terminal building is the service center for the transfer of passengers and their property from surface vehicles to aircraft. It is an area of transition for the traveler from the more conventional forms of surface transportation to vehicles of the air age. The very definition of a terminal building implies activity and excitement. It must serve all the psychological, sociological, and physical needs of the modern traveler. As the building program develops, these considerations will be as important as those of structure, function, and physical needs of the terminal.

Scale is an important element in the design of any building. It is particularly important in a project such as a terminal building, where many separate and varying functions must be housed. Each space requires its own unique handling; for example, public areas should have a grand scale. They should be impressive while carrying the basic theme of activity and excitement. The dining area and the cocktail lounge should be spacious and yet have a feeling of intimacy about them, where people can be by themselves if they so choose. Office areas should be small and intimate.

Proper scale for this project requires a combination of many spatial sensations; all related to one another in a manner which develops a well integrated whole. Proper use of material and logical arrangement of spaces will help solve the aesthetic problem of tying these diverse activities together, and yet allowing each area to maintain its own identity.

Aesthetic consideration of the buildings exterior is also

very important. The traveler's first impression of the terminal is from the exterior as he approaches either by plane or by surface vehicle. Therefore, the over-all theme of the building should reveal to him all the excitement and wonder of the air age.

Some of the factors involved in exterior considerations would include; the site, the surrounding area, and natural phenomena such as sun, wind, rain and snow. From the photographs in section three, titled "Site Conditions", it can be readily seen that the site itself is relatively flat and barren. There are no architectural works of any significance in the immediate locality. Views in all directions reveal timber-covered and snow-capped mountains. Only a limited portion of Missoula, which is five miles to the southeast, can be seen. The nearest highway is almost one mile to the east. For this reason, the site has an architecturally untouched feeling about it.

Consideration of natural phenomena can do much to enhance the character of a building; not only from a functional point of view such as light and wind protection, but also from an aesthetic standpoint. For example, the play of light and shadow across its surfaces can be a very pleasant element. Planning with regard to light and wind protection could give rise to many interesting spatial developments.

Judicious use of materials is another factor important to the aesthetic quality of the terminal. If the building is to maintain a single theme throughout, the basic materials used must help to maintain this theme. Every aspect of the building

must be so naturally and gracefully done that there would seem to be no other way in which it could be executed. The character of the outside must be carried to interior spaces so the traveler always maintains an identity with the building as a whole.

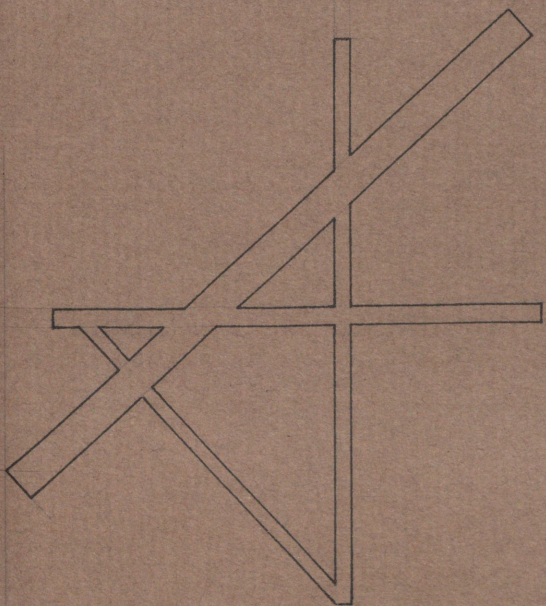
Aesthetic considerations governing architecture are not impersonal. The designer must become deeply involved in his creations. His feelings and philosophy are revealed through his architectural endeavors. Therefore, I feel it to be important that I reveal my personal feelings regarding an airport terminal building. After being involved in this project for a period of approximately six months, I feel that three key words are important to the final solution. They include simplicity, joy and excitement.

The simplicity of form, structure and function must be expressed from the over-all appearance to the final detail. The building must show this simplicity as a graceful and dramatic gateway to the air age. Interior spaces should be planned so the traveler can orient himself quickly and easily no matter what his location inside the building. To aid the traveler in making the transition from surface to air, the terminal should snuggle closely to the ground and soar toward the sky.

Architecture is the limitation of space. Space where certain predetermined activities are to take place. Each activity requiring its own degree of protection from the elements and physical comforts. Careful arrangement of space makes the difference between a structure that merely satisfies a need and one that is an environment in which to live.

Joy is related to the concept of spatial manipulation. Wherever possible, exciting experiences should be created. These could be visual such as unique and surprising spaces, or they could be physical such as varying levels between spaces. The architect must be more than a mere builder. All his imagination should be used in creating a joyous experience for the traveler.

The terminal should be visually exciting to approach and be within. There should be a quality of mystery and wonderment that constantly remains with the traveler as he moves through the building from entrance to concourse. The realization that each individual is a living and vibrant entity is very important in conceiving a space that is simple, exciting, and fun to be within.



ECONOMIC CONSIDERATIONS

ECONOMIC CONSIDERATIONS

In view of the fact that design of the building has not begun nor materials or construction methods chosen, it is difficult to make a valid cost estimate at this time. A rough estimate of spatial requirements indicates that approximately 50,000 square feet will be necessary to house the needed facilities. This figure is based on an anticipated peak-hour passenger rate of 200 by 1986. (2)

The airport consulting firm of Isbill Associates, Inc. completed a detailed study of the Missoula County Airport in the spring of 1967. As part of the study, the firm formulated cost estimates on each individual improvement (fig. 4). The estimated cost of a new terminal was 1.5 million dollars. This figure would include construction of the building, site preparation, site improvement, special equipment, architects fee, and cost of bringing utilities to the site. A new sewage system will be provided as a separate entity (fig. 4).

In an attempt to arrive at an approximate cost per square foot, the Marshal Valuation System was consulted. Since there was no reference made to airport terminals, several types of public buildings with similar characteristics were studied. After modifying and combining cost per square foot figures for these buildings, a figure was chosen for the terminal.

The Marshal Valuation System divides the class of building construction into four basic cost groups by type of frame (supporting columns and beams), walls, floors, and roof struc-

tures. The following is a brief description of the four classes:

Class A buildings have fireproofed structures, steel frame with reinforced concrete or masonry floors and roofs;

Class B buildings have reinforced concrete frames and concrete or masonry floors and roofs;

Class C buildings have masonry or concrete and masonry exterior walls, and wood or steel roof structures;

Class D buildings have wood or steel frames and roof structures, and generally include all buildings not specifically included in another class.

Figure 24, titled "Class of Construction Indicator" shows the above information in tabulated form.

The cost per square foot figure for this building has been calculated for each of the four classes of construction mentioned above (fig. 25).

In order to raise money for a public building, voters must pass a bond issue. There is federal aid available for airport improvements; however, the bulk of the money must come from Missoula County. Another possibility would be revenue bonds. The airport board feels that airport improvements cannot be financed through revenue bonds in place of general obligation bonds since revenue bonds from airlines and general aviation are only sufficient to the extent of providing a portion

Figure 24

CLASS OF CONSTRUCTION INDICATOR

<u>Class</u>	<u>Frame</u>	<u>Floor</u>	<u>Roof</u>	<u>Walls</u>
A	structural steel columns and beams fireproofed	concrete and or steel deck fireproofed	formed conc. precast slabs gypsum on steel deck and fireproofed	non-bearing, cavity, curtain, masonry, conc.
B	reinforced conc. columns and beams	concrete and or steel deck fireproofed	formed conc. precast slabs gypsum on steel deck fireproofed	non-bearing cavity, curtain, masonry, conc.
C	masonry or concrete load bearing walls	wood or steel floor joists	wood or steel joists, wood or steel deck	brick or conc. block
D	wood or steel studs in bearing wall, wood or steel frame	wood or steel joists wood or steel deck	wood or steel joists wood or steel deck	Any material except masonry or conc. may have masonry veneer

Figure 25

CLASS OF CONSTRUCTION

<u>Class</u>	<u>Type</u>	<u>Exterior walls</u>	<u>Interior walls</u>	<u>Light, plum</u>	<u>Heat</u>	<u>Cost</u>
A	municiple	metal panel conc., brick large glass area	plaster, terrazzo, vinyl tile	good fluores- cent, large rest rooms	steam	\$24.19
B	"	"	"	"	"	\$22.30
C	"	brick bearing wall, wood trusses	plaster, ceramic tile, vinyl tile	good fluores- cent, good rest rooms	"	\$18.26
D	"	brick veneer	plaster, hardwood, asphalt tile	adequate	"	\$17.70

of the funds needed for maintenance and operating costs. (12)
Another source of revenue would be returned to the county in
the form of payments made by lessees using facilities within
the terminal.

Interest on the county's share of a general obligation
bond issue would be 4.5 percent annually. Payments would be
made annually for a period of 20 years.

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AN AIRPORT TERMINAL

for

Missoula, Montana

ARCH. 490
THESIS SUMMARY
Jack R. Alley

The most important single factor to be considered in the design of this building was the fast and efficient flow of passengers and baggage between aircraft and ground transportation facilities. To accomplish this I first established the most direct route of travel possible between the air carrier apron and the main entrance to the building. Secondly I separated enplaning passengers and baggage from deplaning passengers and baggage.

Secondary, functions such as restrooms and concessions were located near the main path of travel but far enough away to discourage congestion. Restaurant and lounge are located above and out of the way of the general function of the terminal. This also gives the patrons an opportunity to view activity on the air carrier apron from a high vantage point.

Aesthetically, I tried to give the traveler a feeling of transition between ground and air. This was done by an open soaring structure which is low on the surface transportation side of the building and rises to a higher level over the air carrier apron.

Finally, I kept all service functions on the inside of the building to allow all outside walk to be transparent.

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