I would like to dedicate this project to my parents, Loren C. Uridel & Carol Powers Uridel, for their support and understanding, and additionally, to my aunt, Darlene Uridel Fuentes for her continued support, encouragement, and guidance.
This project deals with the requirements posed by Continental Airlines for Facilities to be established at Houston's Intercontinental Airport (I A H). I would like to emphasize that this proposal is based on current information and goals, as I understand them. This proposal does not necessarily reflect Continental Airlines' plans.

Many people have contributed, significantly, to the outcome of this project. While a complete list appears in the Acknowledgements & Bibliography section, I would like to, especially, recognize the following people:

Robert F. Six
Chairman
Chief Executive Officer
William Wilson
Director of Facilities & Construction
Marcelino M. Hernandez
Senior Project Manager
Facilities Engineering
and Continental Airlines, for their special help and cooperation.

Additionally, I would like to acknowledge those members of the architectural faculty at Ball State, whose input was most highly appreciated and helpful:

Anthony J. Costello
Robert A. Fisher
Robert Koester
James R. Underwood
ABSTRACT

The culmination of architectural study and outside experiences is the selection and implementation of a thesis design project. This project is carried out over a course of nine months, and should reflect an area of the student's interest and degree of expertise.

Airport, and transportation, facilities have become a major directive of our society, and must now become a major focus of the architectural profession.

With background experience in aviation and design of general aviation facilities, I feel that exposure to the needs and requirements of airline operations and jumbo-jet oriented facilities provides an excellent educational experience. The opportunity to work with an airline support facility as the course of the project is most exciting.

Within the context of this project, the "support facility" refers to activities affecting aircraft maintenance, engineering and design, airline administration, employee training, food preparation, and other functions that contribute to the operation of an individual airline.

The design process included comprehensive facility programming, concept design, design development, and the final design product. The final design phase included areas of special detail design studies, and presentation of the final product.

The final design product is a response to concepts dealing with site progression of industrial vs. natural environment; scale of jumbo-jets vs. human figure; and auto vs. service traffic circulation. The industrial segment, suspended from a cantilever high-tech, exposed, steel structural system, and the multistory management offices, traditionally column supported, are separated, yet joined, by a multilevel glazed atrium. The facilities are serviced by means of an enclosed vehicular service core beneath the atrium, and separate site entries are provided for auto and service traffic.

Detail studies further exposed me to interior design concepts as the atrium space and adjacent office zones were organized. Graphic studies produced an aircraft graphic system adding to the special character of the hangar.

I feel that the project responds well to my goals and concepts, and is well organized into the context of the given site.
PART I PRODUCT

The material in this part represents the final design presentation and detail design work done during the third quarter.

Introduction
Final Design
Detail Design
Conclusions

PART II PROCESS

The material in this part represents the process of the design through the first and second quarters.

Facility Program... this document includes its own table of contents.
site analysis
related buildings study
Schematic Design
Design Development
mid-Quarter presentation - I
d end of quarter presentation - II
sketches:

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INTRODUCTION

AN AIRLINE SUPPORT FACILITY
INTERCONTINENTAL AIRPORT
HOUSTON, TEXAS

LOREN H. URIDEL
ARCHITECTURAL THESIS
1978–79
This thesis project is my first opportunity to manipulate a large scale project from its initial conceptualization through detail design stages. Additionally, it may be the only opportunity to completely document the progress of the project from start to finish in a format such as this.

The format of this book is developed into three parts. For ease of access, the product, final design, detail design, and reflections/conclusions of the project, is presented as part one. Part two documents the design process, presenting facility program with specific data about the project, schematic design, design and detail development. It includes presentation drawings from the development process as well as sketches that document the evolution of the design. Part three serves as the reference section documenting acknowledgements, bibliography and appendices.

Airport design is, traditionally, considered to be a horizontally oriented architecture. This is partly because of strict height restrictions for buildings within, and around airport zones.

However, the actual height of many airport buildings is underestimated due to the large scale of these facilities which is so much greater than one’s usual reference with respect to the height of the human figure.

The large scale is realized when one becomes familiar with operations of major airlines and the large, numerous pieces of support equipment.

Airport, and, more broadly, transportation facilities and their support facilities have become a major directive of our mobile society, and have become a major focus of the architectural profession.

With background experience in aviation and design of general aviation facilities (private and corporate aircraft), this designer feels that scale and equipment requirements leave his experiences far removed from knowledge required for providing jetliner-oriented facilities. Thus, at the culmination of an educational experience, and prior to introduction into a professional practice, the opportunity to work with an airline support facility is welcome and convenient.

An airline support facility is considered to be an individual airline’s facility from which numerous activities of its operation, not directly related to terminal passenger services, are conducted.

Within the context of this project, the support facility shall refer to activities effecting aircraft maintenance procedures, engineering and design, airline administration, employee training, flight food preparation, and other supportive functions and activities that contribute to the operation of an individual, major airline.

This project is three quarter undergraduate architectural thesis. During the first quarter the process of design began with facility
programming and schematic design. Facility programming is a comprehensive documentation of various project requirements and data. This document also includes the complete site analysis. It also includes a related building types study of various aspects of similar type projects, already constructed and in operation.

The schematic design phase incorporates concept studies responding to various design issues. Dealing with a restricted site, and a need for flexibility in operations, critical design issues for the project were established:

- Site Planning
- Expandable/Adaptable Facilities
- Structural Components
  - Flexibility
  - Large Spans

General conceptual issues were also created:

- Auto Vs. Service Vehicle Circulation
- Industrial Vs. Natural Environments
- Scale Changes: Jumbo-Jets Vs. Human Figure

The second quarter is entirely devoted to design development, and the final design emerges. The design development phase organizes the concepts and schematic designs into a physical building form.

Following up on feedback from preliminary reviews, I felt that the various components of the overall facility were not completely organized as separate elements, nor as a single harmonizing form. I determined that either a bold geometrical contrast of forms that would emphasize the individual character of various functions, or an overall harmonizing form into which all the functions must organize with a central character, sacrificing individual character of the elements. In conceptual organization, a link between industrial shops and offices, and managerial offices in the form of a naturally lit atrium was developed. This would integrate nature with the industrial and management activities and draw natural light into the interior segments of the building.

In a special design charrette, I worked with concepts of a single mega-structure facility organizing the various functions into a single ruling form, and a more distinct separation of functions establishing bold, contrasting forms, developing each as much as possible over the course of four days. Very different in concept of overall form, each solution had several merits. On the basis of its level of development, response to energy considerations, and a degree of personal preference, I elected to continue with the scheme of bolder geometry, and individualizing functions.

Further development of the scheme created responses to a progression from industrial to natural environment, scale change from jumbo-jets
to human figures, and manipulation of auto and service traffic.

A vast ocean of concrete ramp and a jungle of metal jet blast fences, and metal, mechanical jumbo-jet-birds borders the north site boundary. Within, the industrial segment is suspended from a high-tech, exposed, cantilever steel structural system. The two hundred thirty feet cantilever truss, thirty two feet in depth, with a fifty six foot bay defines the hangar itself. To the south of the hangar, the multistory maintenance shops and offices, and storage levels are suspended to serve as an "anchor" for the hangar trusses.

A glazed, multilevel atrium separates, yet joins the industrial segment, and the multistory traditionally column supported management offices. The atrium, designated as area of special study during detail design, creates an enclosed space of bridges, vegetation, and mechanical systems. Its interior organization is developed around a grid which is turned 45 degrees to the regular building grid. This serves as a means to integrate the actual atrium space into the surrounding office landscape.

From the exterior, the glazed atrium appears to slide between the forms of the industrial and office segments. The north edge of the atrium rests against the wall of the industrial side. It appears held in place by mechanical duct tentacles that reach into the roof of the atrium. The ducts connect to rooftop units above the maintenance shop levels. A more graceful connection between the glazing of the atrium and the facade of the management offices produces a surface that slopes down to the ground plane, and creates a scale to receive the human figure.

The south facade of the management offices creates a protection screen from the sun, and incorporates balconies overlooking the natural vegetation on the site's southern border.

The facilities are serviced from an enclosed vehicular service core beneath the atrium. Employees' auto parking is provided on the ground level under the management offices. Separate site entries for auto and service vehicle traffic are provided.

Additionally, a graphic study for the exterior of the hangar facility produced an aircraft oriented supergraphic incorporating the airline's color scheme.

During a considerable portion of the third quarter, design revisions are made and detail design studies of mechanical and structural systems, and a special area of interest in the project are developed. The thesis book is compiled during the remainder of the quarter. Detail design studies, as previously described, involving the atrium space organized an integration with the surrounding office zones. An open office landscape concept developed in conjunction with the organization of the atrium area on a 45° angle to the regular grid. The atrium study was prompted by research on interior urban design of atrium spaces in contemporary architecture for an urban design elective class. The research centered around the successful concepts set forth in contem-
emporary projects, such as Hyatt Regency Hotels by architect/developer John Portman, The Gallery in Philadelphia, and Water Tower Place in Chicago. I feel that the project fulfills the initial concepts and goals, and is well organized within the given context of the restricted site.
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Elevations / Section

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FINAL DESIGN

AN AIRLINE SUPPORT FACILITY
INTERCONTINENTAL AIRPORT
HOUSTON, TEXAS

LOREN H. URIDEL
ARCHITECTURAL THESIS
1978-79
DETAIL

DESIGN

LOREN H. URIDEL
ARCHITECTURAL THESIS
1978-79

AN AIRLINE SUPPORT FACILITY
INTERCONTINENTAL AIRPORT
HOUSTON, TEXAS
During the detail design phase, students selected a segment of the project which was of major interest to them to research and develop further. I decided to develop the interior spaces of the atrium, to coincide with a research project and presentation for an urban design elective course. Additionally, I wanted to do a graphic study for the exterior surfaces of the hangar, which would define its scale and add to its individual character.

Based on studies of atrium spaces of contemporary architecture such as The Gallery in Philadelphia, Water Tower Place in Chicago, Toronto's Eaton Centre, Housing at the University of Alberta, and the concepts of Hyatt Regency Hotels which employ the design philosophies of architect/developer John Portman. Portman discusses these interior architectural spaces as people places which are combinations of several ingredients:

- Nature
- Water
- Movement
- People Watching People
- Shared Spaces
- Light, Color and Materials
- Incorporation Of Dining/Eating

An outline of this presentation follows in the appendix as class materials.

The organization of the atrium is based on a grid turned 45° to the regular building grid. This grid extends into the adjacent open office landscape zones responding to the joint of the atrium glazing and the wall of the offices on the exterior facade. Further, it integrates the office zones and atrium. The service cores, incorporating elevators, stairs, restrooms, and other central services are planned within the atrium grid. This makes the stairs and elevators easily accessible and visible to add to the sense of movement in the space. Seating areas are created throughout the atrium, including inside thickets of vegetation.

A graphic study for the exterior hangar surfaces produced a full scale aircraft profile supergraphic that incorporates the airline's colors, red, orange, and gold, and emphasizes the airline's campaigns for "the golden jet".
CONCLUSIONS

AN AIRLINE SUPPORT FACILITY
INTERCONTINENTAL AIRPORT
HOUSTON, TEXAS

LOREN H. URIDEL
ARCHITECTURAL THESIS
1978-79
As a coalescence of previous education, training and experience, the thesis project emphasizes strengths and recognizes weaknesses.

Self-analysis of my performance over the course of the project revealed areas that I feel are confident strengths:

* Concept Development
* Site Planning

Areas recognized as weaknesses that lend themselves to further development are:

* Concept Transformation Into Design Development
* Technical Aspects Of Structural And Mechanical Systems
* Technical Hardline Drawing Work

I recognized several areas of improvement during the project:

* Sketching Abilities
* Graphic Presentation
* Detail Design Attention
* Knowledge And Understanding Of The Airline Industry In General, As Well As Its Architectural Requirements

Secondly, this offers time for reflections on the thesis curriculum itself. I have found the overall project educational and enjoyable. My strong interest in the subject of aviation is such that I never lost interest or fascination with the project itself. The technicalities involved with a single person implementing an entire project of such size, weariness with the process of the thesis curriculum develops at several points along the way. I had to rely on the merits of the project itself to progress onward.

The standard curriculum was unusually hurried this year in an attempt to allow time for minor revisions and detail studies that are important to many projects, but a level of which most have typically fallen short. This proved to be an excellent decision. Unfortunately, some miscalculations on behalf of the actual curriculum requirements for the third quarter detail design phases produced some disillusionments. The requirements became too stringent, not allowing enough diversity for the individual student and project. The primary result of this action was that few students were able to construct intricately detailed project models. Construction of such a model is of personal importance because it has been somewhat of a tradition at Ball State. However, without such experimentation in the program, one could not hope for improvement within it.

The comprehensive programming stage was an excellent exercise, and probably the most educational portion of the thesis. It is the first time that I was able to develop the complete package of information and requirements for a design project.
PART II
PROCESS
AN AIRLINE SUPPORT FACILITY
INTERCONTINENTAL AIRPORT
HOUSTON, TEXAS

LOREN H. URIDEL
ARCHITECTURAL THESIS
1978-79
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BACKGROUND & HISTORY

This project deals with one of the top ten (10) domestic airlines of the United States, originally established as the southwestern division of a small air transport company in 1934. 1959 brought the introduction of fan jet aircraft into service on the airline’s routes. With a phasing out of older, propeller driven aircraft, by 1968, the carrier’s fleet became entirely fan jet aircraft.

The continued success of the airline is largely attributed to the airline founder’s, and current president, stand on critical issues of safety and efficiency. Safety has been one of the foremost issues since the airline’s conception, crediting it with a practically accident-free record; the airline’s first fatal accident occurred in 1978, under very extenuating circumstances, in which two (2) passengers died. Secondly, the airline’s progress has been upheld through operational efficiency. Through careful operational evaluations, the fleet has been manipulated to currently include fifteen (15) McDonnell Douglas DC-10s, and 52 Boeing 727 aircraft. (See appendix)

The DC-10 is a wide body tri-jet aircraft with a passenger capacity of approximately 250, cruising at a range of 2700 miles and a speed of 544 miles per hour.

The B-727 tri-jet fleet consists of two models; 727-100 and 727-200. The 727-100 has a seating capacity for about 100, cruises at 530 MPH over
a range of 2,480 miles. The 727-200 is a "stretched fuselage" model to accommodate about 125 passengers, cruising at 530 MPH over a range of 1635 miles.

All other aircraft have been phased out of service as a result of being obsolete, inefficient operational costs, seating capacities, or several other factors.

Additionally, to attain greater efficiency, with maximum use of the entire aircraft fleet, aircraft maintenance/servicing occurs from 12:00 midnight to 8:00 a.m. when most passenger operations are closed down. These operations, as well as any major maintenance procedures that may require an aircraft for an entire day, or more, are carefully scheduled by an extensive maintenance planning department.

The airline's home offices and primary facilities are located at Los Angeles International Airport, Los Angeles, California (hereafter referred to as LAX). The airline's flight routes incorporate mostly southwestern and west coast cities, with service to some midwestern cities including Chicago, and major areas of Florida, and Hawaii.

Most major maintenance operations occur at the LAX facilities. Some servicing occurs at the airline's secondary facilities, located at major airport along the routes, or is contracted to other airlines at some locations where the carrier doesn't have facilities. Similarly contracted service is provided for aircraft of other airlines not having their own individual facilities at LAX. As an airport develops into a major center of airline operations within a regional area, it becomes feasible to locate secondary facilities there.

With its continued growth, the airline is in need of facilities around its south-central hub of Houston, Texas.
Initial developments for its operations at Houston Intercontinental Airport (referred to as IAH) will provide an aircraft maintenance facility, incorporating hangar space and supporting maintenance shops and storage areas. Subsequent phases of development will include additional maintenance shops and other airline functions including engineering and administrative offices, flight crew departments, crew training, and employee dining. These developments will occur on airport property controlled by the airline on the east, industrial side of IAH.

The airline is also, presently, nearing completion of its terminal facility including passenger loading positions for six (6) aircraft, amidst the airport's main terminal complex.
BOEING 727-200

CAPACITY:
- PASSENGERS: 176 (14 First Class, 112 coach, 52 economy)
- CREW: 2-4 or 5 flight attendants
- PAYLOAD (space limited): 12,881 pounds
- FUEL CAPACITY: 11,882 pounds (or 7,714 gallons)
- CARGO CAPACITY: 148 cubic feet

PERFORMANCE:
- CRUISE SPEED: Mach 0.80, 530 miles per hour
- RANGE WITH SPACE LIMITED PAYLOAD: 1,635 statute miles
- MAXIMUM ALTITUDE: 42,000 feet
- FUEL CONSUMPTION: 1.314 gallons/hour (all engines)

DIMENSIONS:
- WING SPAN: 108 feet
- OVERALL LENGTH: 163 feet, 2 inches
- OVERALL TAIL HEIGHT: 34 feet
- CABIN DIAMETER: 12 feet, 4 inches

WEIGHTS:
- MAXIMUM TAKE-OFF: 172,500 pounds
- MAXIMUM LANDING: 150,000 pounds

POWER PLANT:
- Engines: 3 Pratt & Whitney JT8D-9A
- Total Thrust: 43,500 pounds at take-off

ELECTRICAL SYSTEM:
- Enough 200 volt electricity generated on board to supply 80 typical homes, with enough wiring (40 miles) to wire 100 typical homes.

TIRES:
- Designed for safe ground speeds of 200 miles per hour. Average tire life is only about 210 landings for domestic aircraft, which is equivalent to approximately 844 miles of ground operation. The Air Mike 727-100 average tire life is only about 85 landings. Both the 100 and 200 versions of the 727 have a total of 6 tires, 2 on each main landing gear, and 2 on the nose wheel.

BOEING 727-100

CAPACITY:
- PASSENGERS: 100 Domestic (10 First Class, 3 Coach)
- Cargo: 1,000 pounds (in all passenger configuration), and 711 pounds of airfreight configuration.
- CREW: 2 or 3 flight attendants

FUEL CAPACITY:
- 51,000 pounds

CARGO CAPACITY:
- Both the domestic and Air Mike versions of the 727-100 can carry up to 8,000 lbs of cargo below decks. However, if the Air Mike is configured for both passengers and airfreight, it can (if both the front cargo compartment and the bottom deck space is utilized) carry a total of 11,000 lbs.

PERFORMANCE:
- CRUISE SPEED: Mach 0.80, 530 miles per hour
- RANGE: 2,480 statute miles
- MAXIMUM ALTITUDE: 42,000 feet
- FUEL CONSUMPTION: 1,267 gallons/hour (all engines)

DIMENSIONS:
- WING SPAN: 108 feet
- OVERALL LENGTH: 133 feet, 2 inches
- OVERALL TAIL HEIGHT: 34 feet
- CABIN DIAMETER: 12 feet, 4 inches

WEIGHTS:
- MAXIMUM TAKE-OFF: 160,000 lbs
- (Air Mike: 169,000 lbs)
- MAXIMUM LANDING WEIGHT: 142,500 lbs.

POWER PLANT:
- Engines: 3 Pratt & Whitney JT8D-7
- (Air Mike 9A)
- Total Thrust: 42,000 lbs. at take-off
  143,500 lbs. at take-off for Air Mike)
Figure 6-17 - Ground-Service Connections (DC-10)
Boeing's new planes on terminal design

American Airlines, with the aid of new and developing aircraft, projects future traffic requirements and area requirements that will affect the new generation of airports. A select.

A military transport 269 feet long by 33 feet high, the C-5, dramatically passed its first flight early in July. Lockheed plans a version, the L-500, for about 1971. In an en configuration, it could carry about 1,000 tons.

Relative floor heights

Concourse

Enplaning

Deplaning
SCOPE OF PROJECT

This program deals with the existing corporate organization both physically and managerially. It develops the organizational criteria and relationships for an individual airline's support facilities to be located at Houston Intercontinental Airport (IAH), Houston, Texas. This report also deals with the development of phased additions of facilities to establish a master plan for the site's development.

The project deals with the design of facilities for the various phases established for the master plan. The design will demonstrate the means of expansion to include additional new or existing functions and/or adapted re-use of areas for different functions.

Project Outline

I. Initial Requirements

  Maintenance Hangar/Apron
  Support Shops and Storage

II. Future Expansion

  Additional Hangar Space
  Additional Support Shops
  Engineering Offices
  Administrative Offices
  Flight Crew Departments
  Crew Training Facility
  Employee Dining
DESIGN APPROACH

Initial phase and site information has been extracted from research and requirements provided by Continental Airlines of Los Angeles. After visiting personnel and facilities at Continental's Los Angeles base, information for future expansion was developed.

This project deals with the requirements posed by Continental Airlines for its facilities at Houston Intercontinental Airport (IAH). The proposal does not necessarily reflect Continental's actual plans, however.
GOALS

The following points describe the direction in which I would like to concentrate my efforts during the developments of this project.

PERSONAL GOALS

Obtain an understanding and appreciation of the monumental scale and operating functions of support facilities of an airline industry.

Create an efficient, handsome facility in a usually unappealing and unexciting industrial environment.

Create a pleasant, humane working environment within such an inhumane, monumental scale environment.

CLIENT GOALS

Expandable facilities - for easily maturing the master plan.

Adaptable re-use of facilities as functions grow in size or change location.

Security supervision of pedestrian and vehicular accesses.

Efficient vehicular access to site from public roads.
CRITICAL ISSUES
Comprehensive Site Planning
Expandable Facilities
Adaptable Re-use of Facilities
Structural Components

Expandability
Large Open Span Hangars

Pleasant Working Environment and Appealing Industrial Appearance
HOUSTON INTERCONTINENTAL (IAH) DATA

By 1957 the Houston International Airport was becoming obsolete. A commission was established to acquire a site for a new location and facility. This group acquired a 3,126 acre site fifteen miles north of the city, which became known as the Jetero Airport Project. Begun in 1960, and after many delays, the airport opened in mid-1969. This produced a $110,000,000 facility moving approximately 5,000,000 passengers yearly (1972 data) and is expected to double in five years and again in ten.

Expansion for such accommodations is carried out with a linear plan of unit terminals connected by an underground concourse and electric shuttle train.
PROCESS FLOW

From City

Auto Parking → Maintenance Shops/Offices

Security → Deliveries

Hangar

Service Vehicles

Aircraft Ramp

Runways/Taxiways → Terminal

Telephone Communications

Inter-office/Departmental Communications, Associate and outside company communications.

Computer/Telex Systems

Inter-departmental, Airline Satellite communications, Information storage
**MANAGEMENT ORGAN**

The president of the company maintains strict control over regulations and procedures within the corporate structure. Planning and day-to-day activities, as well as detailed instructions are carried out through "computer communication". Computer terminals/receivers are located in the supervisor or foreman's office within each operation of activities of the entire airline. Instructions, procedures, and inter-departmental communications may be carried on with this program.

**PERSONNEL**

The airline presently employs some 11,000 full time employees and 700 part time employees. A maintenance crew of 15 mechanics typically works on each aircraft during the maintenance period.

**USER ACTIVITIES**

<table>
<thead>
<tr>
<th>USERS</th>
<th>ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visitors</td>
<td>Business Appointments/Tours/Job Interviews. Requires reception area and/or security passes.</td>
</tr>
<tr>
<td>Deliveries (Trucks, etc.)</td>
<td>To loading docks.</td>
</tr>
<tr>
<td>Company Delivery</td>
<td>Intra-company deliveries, i.e. flight kitchen, equipment and supplies. Traffic within industrial area, or between industrial and terminal areas.</td>
</tr>
<tr>
<td>Flight Crews</td>
<td>Parking/Check In/Obtaining transportation to terminals.</td>
</tr>
<tr>
<td>Other Employees</td>
<td>Daily functions within respective departments.</td>
</tr>
</tbody>
</table>
HANGAR

PERFORMANCE REQUIREMENTS

100,000 sq. ft.
The hangar shall be designed to enclose the following aircraft combinations:
a) One DC-10-30 and two B-727-200 aircraft.
b) One B-767-200 and two B-727-200.
c) Four B-727-200 aircraft. Two aircraft may be blocked by a third.
d) Two DC-10-30 aircraft.
e) One DC-10-30 and one B-767-200. Except for combination (e), all aircraft will be positioned with their nose front facing the hangar doors.

CLEAR OPENING height of door opening shall be a minimum of 70 feet.

HANGAR DOORS shall be designed by the Ferbuson Door Co. of 1937 W. 169th Street, Gardena, California 90291.

LIGHTING fixtures shall be high pressure sodium. Minimum illumination shall be 100 foot candles at floor level. Lighting control shall permit the following combinations:
a) Illumination of any one bay.
b) Illumination of the front or rear half of each bay.
c) Illumination of all bays.

HANGAR FLOORS shall be concrete with a white "Master Plate" sealer as specified by Master Builders, Cleveland, Ohio.

The floor shall be flat at each location where a jack must be placed to raise an aircraft.

EQUIPMENT:

Aircraft fuel, electrical, air start
power, utility services, etc., shall be provided for each bay through floor pits.

Motor generator units for aircraft power shall be by Hobart Manufacturing Co.

All electrical sub-stations and other electrical devices that may be damaged by water and/or foam sprayed by the overhead fire protection system shall be protected by a roof or cover as required.

Where practical, overhead light fixtures and ballasts shall be installed in such a manner that they will not be damaged by water and/or foam spray from the overhead fire protection system.

OVERHEAD CRANES:

Each of the (3) bays shall be equipped with a bridge which can travel forwards and aft of the full length of a DC-10. Bridge spans shall permit full coverage left and right of each aircraft depicted. Each bridge and its supporting structure shall be designed for a ten (10) ton live load. All bridges shall be designed to interlock with each other at approx. the midpoint of the hangar depth. Maximum line load on any bridge shall be limited to ten (10) tons live load.

Initial requirements and for one (1) ten ton radio controlled hoist, however, the crane system shall be designed to accept a future ten (10) ton hoist on each bridge without additional electrical modifications or structural reinforcement.

Bay #1 shall be equipped with a DC-10 center engine lift platform (similar to the one in Continental Airlines LAX Hangar Bay 5).

Bays #2 and #3 shall be equipped with B-727 aircraft tail stands (similar to the LAX Hangar Bay 3).

Air start gas turbines (2) shall be provided adjacent to hangar. These units shall provide high volume, low pressure air to each bay via underground ducts.
A total of six (6) ramp parking positions shall be provided for DC-10-30 aircraft as part of the initial requirements.

Wing tip clearances shall be twenty-five (25) feet.

Each aircraft parking position shall be equipped with aircraft fuel, electrical power, utility service pits, and flood lights.

Each aircraft position shall be designed to permit aircraft washing in accordance with building and safety codes of local, state and federal agencies.

BLAST FENCE design and installation shall be identical to LAX installation.

All new RAMP installations shall be concrete. Asphalt is not acceptable.

Shops facilities on first floor level. Stores area shall be located at 2nd floor level.

Initial building limits are recommended to be enclosed in a 100 ft. x 100 ft. multi-level facility.

CLEAR HEIGHT requirements from floor level to the bottom of the lighting fixtures for first floor shall be 18 feet and 13.5 for the second floor.

10,000 sq. ft. This area shall be designed for the storage of miscellaneous aircraft components, flammable liquids, in designated areas, cleaning supplies, lubricants, oils, etc.

CLEAR HEIGHT from floor to bottom of fixtures shall be a minimum of 13.5 ft.

FLORESCENT LIGHT fixtures shall be installed at a 45° angle to the sides of the walls and provide 70-80 foot candles of illumination at floor level.

FLOORS shall be designed for 250 PSF "Design Live Load".
FREIGHT ELEVATORS where indicated, shall have a minimum clear opening of 14' wide by 8' high, capacity shall be 12,000 lbs. min.

DUMBWAITER(S) where indicated shall have a minimum opening 3' wide and 4' high.

2,000 sq. ft. This shall be a ground level area, easily accessible by trucks from public roads. A loading dock equipped with dock levelers for four truck positions is required. An overhead canopy and monorails for each truck position are required. Depth of the dock shall be fifteen (15) feet.

An electrically powered roll up door ten (10) feet wide x ten (10) feet high is required at each truck position.

The capacity of each monorail shall be 4,000 pounds.

Inside area shall be approximately 50 x 50 ft. The outside area shall permit trucks to maneuver to and from the loading dock and public roads.

600 sq. ft. Two welding machine power receptacles.

Two cold water hose bibs.

Smoke ventilation for two welding positions/booths.

Two welding booths.

Chain link fencing of area.

Utility electrical duplex outlets every ten (10) feet.

2,000 sq. ft. Six overhead shop AIR OUTLETS

SOUND ATTENUATION of ceiling.

Chain link fencing of area.

Utility duplex electrical outlets every ten (10) feet.
INSTRUMENT AND ELECTRICAL LINE SHOP

200 sq. ft.
ILLUMINATION 100 foot candles.
Work benches and storage shelves.
Utility electrical outlets on work benches.
Walls and ceiling for total enclosure.

RADIO LINE SHOP

200 sq. ft.
Same as requirements above.

TOOL CRIB

800 sq. ft.
Chain link fencing sides and ceiling.
70 - 80 foot candle illumination.
Utility duplex electrical outlets.
Shop air outlets.

TRIM SHOP

2,000 sq. ft.
ILLUMINATION 70-80 foot candles.
Utility duplex electrical outlets.
Shop air outlets.
Full height dry wall partitions.
ENVIRONMENT REQ'TS.

ACOUSTICS
Shall be dealt with so as to insulate office complexes from hangar/shop noises and running aircraft engines on the ramp.

ELECTRONICS
Insulation may be required in electronics/radio shops to protect airport electronic navigational equipment from interference caused by electrical work or testing within the facility.

AIR CONDITIONING
May be employed in offices and fully enclosed shops. Open shops, stores areas and hangar - unconditioned.

HEATING
Required for all areas.

LIGHTING
As specified in special requirements. Natural lighting in shops as possible.

POWER/TELEPHONE, ETC.
As prescribed in special requirements, etc.

VISUAL AND AESTHETIC ENVIRONMENT
Visual access from offices/shops to hangar or outdoors where possible.

Aesthetic use of industrial building type environment.

Application of vegetation within a concrete/asphalt oriented industry.
Relationships of spaces and activities to each other, from a viewpoint of circulation, or conjunctive activities and dependencies, are established through the use of matrices and diagrams.

Matrices shall be developed on a scale of general activity zones. Further matrices may develop relationships within the specific complexes (i.e. offices, or shops), or activity (i.e. shipping and receiving, engine shops, or engineering).
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SPECIAL CONDITIONS
SPACE ENCLOSURE/CAELINESS
- OPEN
- ENCLOSED
- DIRTY
- CLEAN
- VERY CLEAN
CLIMATE (CONTROL, DUST, HUMIDITY)

majority of space
ENCLOSED SPACE - partitioned, fenced in, undivided
some areas may include special breakdowns into several categories.

partial section of space
ENCLOSED SPACE - enclosed all around, partitioned walls, ceilings
SPECIAL CONDITIONS

NOISE FACTORS

NOISE PRODUCING ACTIVITIES

NOISE INSULATION REQUIRED

- HIGH LEVEL
- MEDIUM
- LOW-MODERATE
- UNEFFECTED

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Facilities to be provided in the master plan concept have been developed through a three (3) phase program.

During this three phase program, new spaces/activity areas will be developed, and previous areas are expanded, relocated, or the space is re-adapted to other functions.
## GENERAL DEPARTMENT LISTINGS

**Area - Square Feet**

* Additional Area Included As Required  
- No Additional Area Included

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### SUMMARY

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<th>PHASE III</th>
<th>ESTIMATED TOTAL</th>
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<td>200,000</td>
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</table>

### Estimated Total Project Area (Including Mechanical/Circulation)

- Hangar Area: 200,000 sq. ft.
- Shops & Stores: 120,000
- Office Area (General): 100,000
- Engineering Offices: 14,000
- Training Facilities: 30,000

### Estimated Range For Total Building Area: 450 - 475,000 sq. ft.
PHASING PLAN SUMMARY

General areas are depicted with relative proportions of areas being indicated by the size of the bars in the graph.

<table>
<thead>
<tr>
<th></th>
<th>Phase I</th>
<th>Phase II</th>
<th>Phase III</th>
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</thead>
<tbody>
<tr>
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<tr>
<td>Shops</td>
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<td>Stores</td>
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<td>Training</td>
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<tr>
<td>Total Area Added (not including hangars)</td>
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</table>
FUNCTION

The facility complex functions as two basic entities, corporate offices and industrial division. The office division include airline management, and operations offices, crew training facilities, employee dining and facilities. The industrial segment is the storage and repair, activity spaces for the aircraft, and service vehicles, and flight preparation facilities, etc. From this complex, an individual airline is partly controlled and maintained.

FLEXIBILITY

The interior should be flexible for corporate growth and be able to adapt to natural changes that may restructure the philosophy and organization that the company may experience in the future.

CIRCULATION

Of primary concern is circulation corridors within the industrial facility, among shops and hangar areas. These circulation spaces must facilitate vehicular traffic such as forklifts and such service vehicles. Due to the large expanse of a fully-developed maintenance facility, supervisory personnel, who often travel throughout the entire complex

BLDG. CRITERIA

AIRLINE SUPPORT FACILITY

LOREN H. URIDEL
ARCHITECTURAL THESIS
1978-79
several times a day, often travel throughout the complex via bicycle.

**EXPANSION**

As described previously, expansion of the facility as well as adaptive re-use of facilities is a critical issue of the project. The ultimate expansion, however, will be limited to the developed master plan.

**EFFICIENCY**

Operation costs and diminishing fuel resources are cause for a careful attention toward the mechanical efficiency of this facility. The high heat loss of the hangar resulting from the necessity for opening large doors forces the concern for high insulative qualities for this space to capture and retain heat when the doors are closed, during that time when heating is necessary.

Economics of material usage for weather and climate exposure also brings up the concern of providing easy maintenance.

**SECURITY**

The security within this type of operation is of vital importance due to the requirement for safety of passengers and their possessions, and the general public. All personnel, visitors, and employees must be controlled within the facilities; thus employee I.D. or visitor passes must be displayed at all times.
PARKING

AUTO

Extensive parking area is required, as not only daily employees and visitors parking will be located there, but flight and terminal crews also use these parking facilities, and are transported to planes or terminal positions aboard the airline's shuttles for employees.

Parking/storage, and fueling facilities are required for company vehicles as well.

AIRCRAFT

See "Space Requirements" - aircraft ramp parking.

DOCKS

As specified under "Shipping and Receiving" requirements of "Space Requirements" section.

ROADS

Airport service drives connecting the support facilities with the terminal facility are required.

High volume traffic capacity roadway into and out of the site
to city highway network is required.

LIGHTING

Exterior lighting is required for safety, security, and nighttime operations. Particularly since vehicles of flight crews may be stored for several days at a time, safety and security control of these vehicles requires an adequate lighting level.

Lighting on ramp areas is required to satisfy normal working conditions. Since maintenance operations are carried out during nighttime hours. The mild climate of Houston makes outdoor working conditions favorable most of the year, so it becomes economical to take advantage of the outdoor environment, for that maintenance which may be conducted there.

LANDSCAPING

These aspects may be employed within the context of the site and facility as an aid to brighten up the environment of an, often, drab industrial environment.
SITE MATERIAL

The project site is a 28 acre tract located on the northeastern side of the airport and off the south end of runway 26.

An existing flight kitchen facility, and support vehicle maintenance facility is located within the boundary of the site. While continued use of these facilities would be the most economical approach, it is the designer's option to incorporate, or replace these facilities within the master plan context. Should it be the decision to replace them, it is important to note that they are currently operational facilities and their functions can not be curtailed during any construction time for other facilities.
### CLIMATE

**HOUrTON**  
Elevation 96 Ft.

<table>
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<tr>
<th>Temperature Average</th>
<th>Degree Days Average</th>
<th>Rel. Hum.</th>
<th>Prec.</th>
<th>Wind</th>
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</table>
Annual temperature ranges from absolute minimum to absolute maximum temperatures recorded for Houston are shown on the graph below. The shaded area depicts the temperature range to be considered adaptable for outdoor/open air maintenance operations. This indicates that during most of the year minor aircraft maintenance operations (not requiring extensive maintenance equipment) may be conducted at ramp parking positions.
Pilots use airport approach charts which provide general airport information as shown below. Subsequent charts would indicate detail landing information from instrument landings on various runways.

NOTE: All objects (towers, vegetation, etc.) within the surrounding area, below 50′ in height above ground are not shown in this diagram.

NOTE: Ground elevation is 95 feet above sea level.