THE PASSENGER TERMINAL BUILDING
FOR THE
INTERNATIONAL AIRPORT OF
BEIRUT.

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1. INTRODUCTION.

A GOALS AND OBJECTIVES

1 LEBANON IS A COUNTRY THAT DEPENDS ON TOURISM AND SERVICES THEREFORE IT NEEDS FIRST OF ALL A DECENT AIRPORT TERMINAL INORDER TO REFLECT THE IMPORTANT POSITION OF LEBANON IN THE MIDDLE EAST AS A LINK BETWEEN EAST AND WEST.

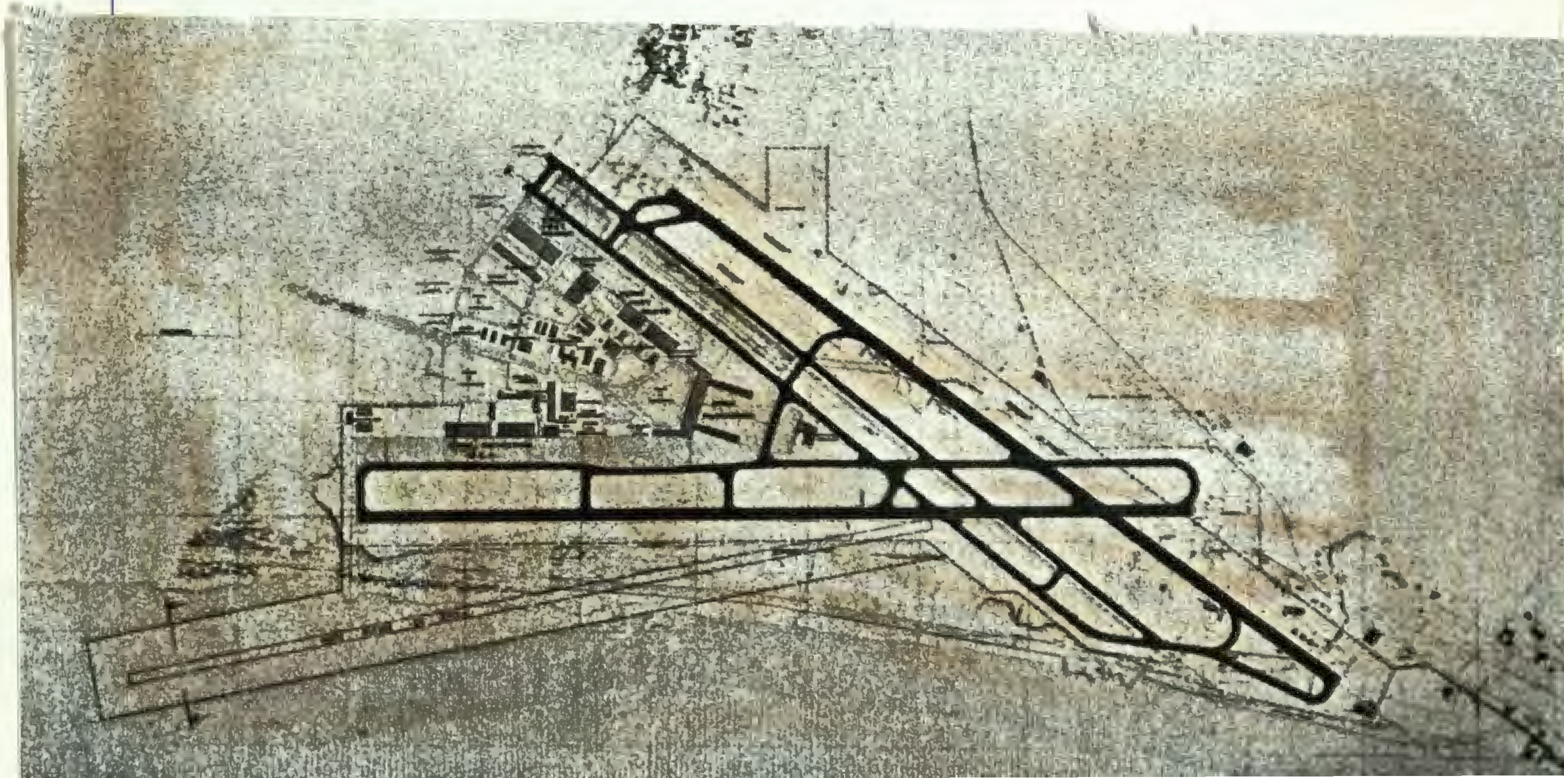
2 A DECENT TERMINAL will HELP IN IMPROVING THE ECONOMIC SITUATION OF THE COUNTRY AND FACILITATE~~S~~ THE COMONICATION OF LEBANON WITH OTHER COUNTRIES.

3 THE DETORIARATING SITUATION OF THE EXISTING TERMINAL DECTATES THE NEED OF BUILDING

A NEW TERMINAL ~~THE~~ CAN HANDLE THE NEEDS OF "LEBANON of THE FUTURE"

B LOCATION

7 ACCORDING TO THE LEBANEASE GOVERNMENT POLICY IN REDEVELOPING THE EXISTING INTERNATIONAL AIRPORT AT KHALDE'H, IT WAS FOUND THAT SUGGESTING A NEW TERMINAL FOR THIS AIRPORT WOULD BE ADEQUATE.



2. AIRPORT CONFIGURATION.

A INTRODUCTION :-

IN THIS SECTION THE PRINCIPLES GOVERNING THE LAYOUT OF RUNWAY ARE PRESENTED.

THE AIRPORT IS DIVIDED INTO TWO PRINCIPAL ELEMENTS.

1. THE LANDING AREA (RUNWAYS AND TAXI WAYS).
2. TERMINAL AREA (APRON; BUILDINGS, CARPARKING, HANGARS)
3. A THIRD ELEMENT IS NAMELY THE PROCEDURES AND TECHNIQUES GOVERNING THE CONTROL OF AIR TRAFFIC IN THE AIRSPACE SURROUNDING THE AIRPORT (COMMONLY REFFERED TO AS TERMINAL AIR TRAFFIC CONTROL)

THE THREE ELEMENTS DEPEND ON EACH OTHER, AND THE CAPACITY OF THESE THREE ELEMENTS SHOULD BE BALANCED AND EQUAL.

B LANDING AREA.

IT INCLUDES THE RUNWAYS, THE INTERCONNECTING TAXIWAYS AND THE TAXIWAYS LEADING TO THE TERMINAL AREA. THE PRINCIPAL FEATURES OF THE LANDING AREA IS THE RUNWAYS

THE NUMBER OF RUNWAYS AND THEIR PATTERN DEPEND ON

1. THE VOLUME AND THE CHARACTER OF TRAFFIC
2. WIND DIRECTION
3. NOISE ABATEMENT.

THE RUNWAYS SHOULD BE ARRANGED SO AS TO

1. PROVIDE ADEQUATE SEPERATION IN THE AIR TRAFFIC PATTERN.
2. CAUSE THE LEAST INTERFERENCE AND DELAY IN THE LANDING, TAXIING, AND TAKE OFF OPERATION
3. PROVIDE THE SHORTEST TAXI DISTANCE POSSIBLE FROM TERMINAL AREA TO THE END OF RUNWAYS.

4. PROVIDE ADEQUATE TAXIWAYS, SO LANDING AIRCRAFT CAN LEAVE THE RUNWAYS AS QUICKLY AS POSSIBLE TO AND FOLLOW ROUTES AS SHORT AS POSSIBLE TO THE TERMINAL AREA.

C AIRPORT CAPACITY.

IT REFERS TO THE NUMBER OF AIRCRAFT MOVEMENTS AN AIRPORT CAN PROCESS WITHIN A SPECIFIED PERIOD OF TIME WITH THE AVERAGE DELAY TO AIRCRAFT KEPT TO SOME ACCEPTABLE LIMITS OF TIME.

FACTORS THAT AFFECT THE CAPACITY OF AN AIRPORT ARE:

1. THE CONFIGURATION OF THE RUNWAYS AND THEIR APPORTENANT TAXIWAYS.

2. THE CHARACTERISTICS OF THE AIRCRAFT USING THE AIRPORT AND THE RATIO OF AIRCRAFT ARRIVALS TO DEPARTURES.

3. WEATHER CONDITIONS.
4. THE AIDS TO NAVIGATION AVAILABLE AT THE AIRPORT
5. THE CONTROL TECHNIQUES AVAILABLE TO THE CONTROLLER IN PROCESSING AIRCRAFT.
6. THE EXPERIENCE OF INDIVIDUAL CONTROLLERS IN HANDLING LARGE VOLUMES OF TRAFFIC.
7. TERRAIN AND MA~~I~~NMADE OBSTRUCTIONS
8. SPACE AVAILABLE AT THE LOADING RAMP.

D RELATION OF TERMINAL AREA TO RUNWAYS

THE KEY TO A DESIRABLE AIRPORT LAYOUT IS TO PROVIDE THE SHORTEST TAXIING DISTANCES FROM THE TERMINAL AREA TO THE TAKE-OFF ENDS OF RUNWAYS AND TO SHORTEN THE TAXIING DISTANCES FOR LANDING AIRCRAFT AS MOCH AS PRACTICABLE.

7.

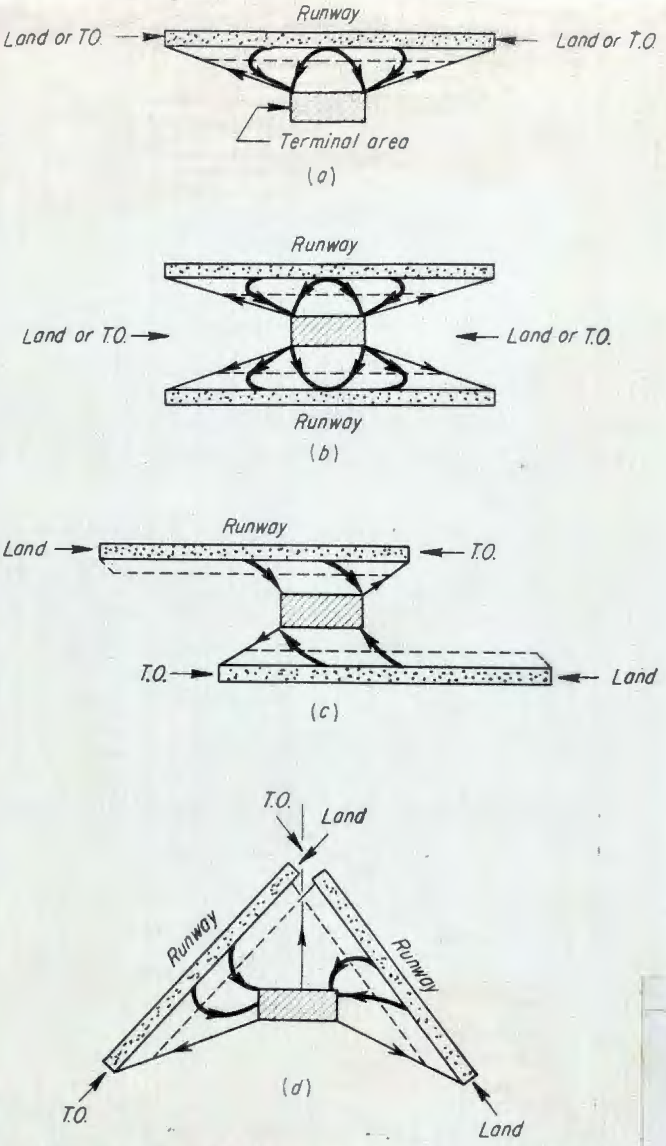


FIG. 7-3. Typical Airport Configurations (Schematic)

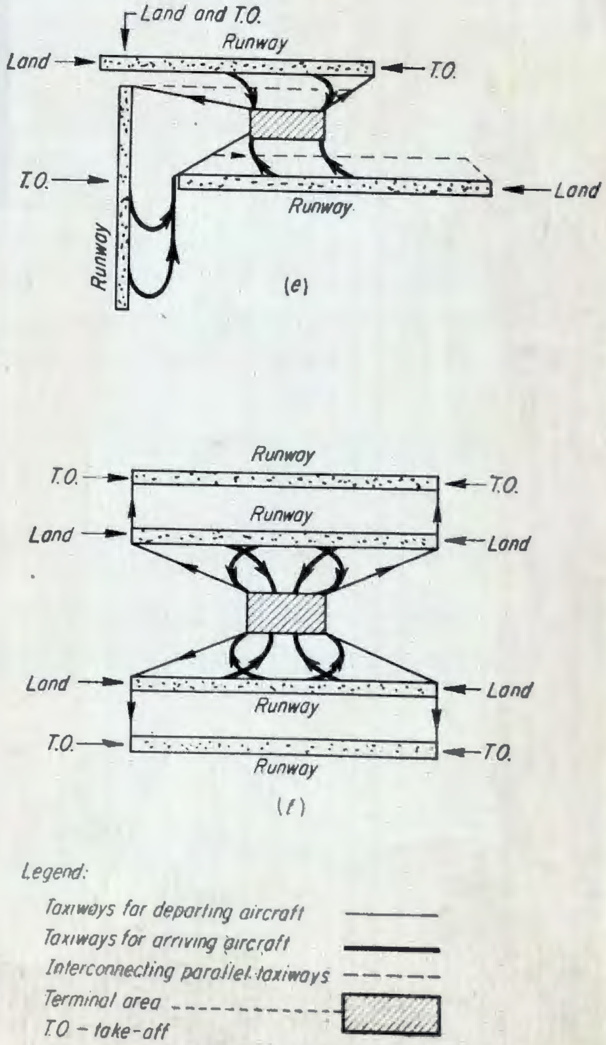


FIG. 7-3. Continued

E TERMINAL AREA AIRTRAFFIC CONTROL AND AIRPORT CAPACITY.

THE TERMINAL TRAFFIC CONTROL AREA IS THE AIRSPACE ASSOCIATED WITH AN AERODROME OR SYSTEM OF AERODROMES SERVING A COMMUNITY WHERE IN IT IS NECESSARY TO CONTROL THE FLOW OF AIR TRAFFIC WITH SUFFICIENT PRECISION AS TO PERMIT THE UTILIZATION OF AERODROMES TO THEIR USEFUL CAPACITY.

TO ACHIEVE SIGNIFICANT GAINS IN AIRPORT CAPACITY, THE AIRBORNE PART OF THE SYSTEM MUST PROVIDE

1. SMALLER INTERVALS OF TIME BETWEEN AIRCRAFT ON FINAL APPROACH
2. MORE UNIFORMITY IN THE FLOW OF TRAFFIC ON FINAL APPROACH.

TO ACHIEVE THIS THE FACILITIES AT THE AIRPORT MUST ALSO BE ARRANGED WHEREVER PRACTICABLE SO AS NOT

TO LIMIT THE CAPACITY OF THE AIRBORNE PORTION OF THE SYSTEM, THIS MEANS ADEQUATE SEPERATION BETWEEN RUNWAYS AND PROPER LOCATION OF EXIT TAXIWAYS AND OTHER FEATURES CONCERNED WITH AIRPORT CONFIGURATION.

3. ESTIMATES OF AERONAUTICAL DEMAND

A ANNUAL PASSENGER VOLUME.

IT IS IMPORTANT TO KNOW THE VOLUME OF PASSENGERS THAT USE THE AIRPORT/ANNUM, AND ACCORDING TO THE ANNUAL INCREASE PERCENTAGE A DECISION IS TAKEN FOR THE FUTURE PLANNING AND WHICH DICTATES THE SIZE OF THE AIRPORT CAPACITY (A TECHNIQUE IS APPLIED TO FIND OUT THE INCREASE).

B ANNUAL VOLUME OF AIRCRAFT.

A SIMILAR TECHNIQUE OF THE PREVIOUS ITEM IS USED TO ARRIVE AT A FORCAST OF THE ANNUAL NUMBER OF AIR CRAFT MOVEMENT

C PEAK HOUR AND PEAKDAY VOLUMES

THE PEAK HOUR VOLUMES OF PASSENGERS ARE

NECESSARY FOR PROPER ALLOCATION OF SPACE IN TERMINAL BUILDING AND FOR DETERMINING HOW MUCH WILL BE NEEDED.

THE PROC~~E~~EDURE INVOLVES ESTIMATING VOLUMES FOR THE PEAK MOUNTH, PEAK DAY AND FINALLY PEAK HOUR

AVAILABLE

WITH THE VARIOUS PERCENTAGE AVLAIBLE A PERCENTAGE RATIO MAY BE DERIVED SO WHEN IT IS APPLIED TO ANNU~~E~~AL MOVEMENT, THE RESULT WILL BE THE PEAK HOUR MOVEMENT, THIS RATIO IS OBTAINED BY MULTIPLYING THE RATIO OF THE FOLLOWING MOVEMENTS

$$\frac{\text{PEAK MONTH}}{\text{ANNUAL}} \times \frac{\text{PEAK DAY}}{\text{PEAK MOUNTH}} \times \frac{\text{PEAK HOUR}}{\text{PEAK DAY}}$$

APPLYING THIS FACTOR TO THE FORCAST OF ANNUAL AIRCRAFT MOVEMENTS YIELDS THE PEAK HOUR MOVEMENT.

D MAIL

USUALLY THE POST OFFICE DEPARTMENT DETERMINES ITS OWN SPACE REQUIRMENTS IN THE TERMINAL BUILDING, MAKING IT UNNECESSARY FOR THE AIRPORT PLANNER TO PREPARE A SEPERATE ANALYSIS FOR THIS FUNCTION

A VOLUME FORCAST SHOULD BE OBTAINED BY THE P.O. DEPARTMENT, THEN IT IS NESESSARY TO SEE WHETHER THERE IS SUFFICENT CAPACITY IN THE COMBINATION AIRCRAFT AND ALL CARGO AIRCRAFT TO HANDLE THIS VOLUME.

E GENERAL AVIATION ACTIVITY.

THIS SHOULD BE ESTIMATED AND KNOWN, AND THE GROWTH SHOULD BE EVALUATED, AND TAKEN INTO CONSIDERATION DUE TO ITS EFFECT ON THE DESIGNING OF THE CAPACITY OF THE TERMINAL.

F OTHER CONSIDERATIONS IN FORCASTING AERONAUTICAL DEMAND.

THE AERONAUTICAL ACTIVITY IS RELATED TO THE AREAS OF ECONOMIC CHARACTER NAMELY TRADE AND INDUSTRY AND CLASSIFIED INTO 4 AREAS

1. MARKETING CENTERS
2. INDUSTRIALS
3. BALANCED
4. INSTITUTIONALS

4. PLANNING AND DEVELOPMENT OF TERMINAL AREA.

THE TERMINAL AREA HAS BEEN DEFINED AS THAT PORTION OF THE AIRPORT OTHER THAN THE LANDING AREA; IT INCLUDES:-

1 THE TERMINAL BUILDING FOR PROCESSING PASSENGERS AND BAGGAGE.

2 FACILITIES FOR LOADING AND UNLOADING PASSENGERS, BAGGAGE, AND CARGO.

3 APRONS FOR PARKING AIRCRAFT.

4 VEHICULAR PARKING AREAS.

5 CARGO STORAGE BUILDINGS.

6 MAINTAINCE HANGARS.

A PASSENGERS TERMINAL BUILDING CONCEPTS.

THE PASSENGER TERMINAL BUILDING IS THE FOCAL POINT OF THE TERMINAL AREA, AROUND WHICH ALL OTHER FUNCTIONS

MUST BE PLANNED ; ITS SIZE AND ARRANGEMENT DEPEND ON THE VOLUME OF TRAFFIC TO BE HANDLED ; THERE ARE DIFFERENT ARRANGEMENTS FOR SUCH A BUILDING .

a CENTRALIZED AND UNIT TERMINALS:

WHERE ALL PASSENGERS AND BAGGAGE ARE PROCESSED IN ONE BUILDING ; WHEN THE TRAFFIC IS VERY HIGH EACH AIRLINE MAY HAVE ITS OWN SEPARATE TERMINAL BUILDING, THEN IT IS REFERRED TO AS THE UNIT TERMINAL CONCEPT. THESE TWO CONCEPTS CAN BE CAN BE COMBINED IN VARIOUS DEGREES.

THE SINGLE CENTRALIZED TERMINAL BUILDING HAS MANY ADVANTAGES ; IT REPRESENTS A REASONABLY COMPACT OPERATION WITHOUT THE PROBLEMS OF TRANSFERRING PASSENGERS AND BAGGAGE FROM ONE BUILDING TO ANOTHER ; THUS IT IS IMPORTANT TO PLAN A TERMINAL BUILDING SO IT CAN BE

READILY EXPANDED AS TRAFFIC GROWS.

b NUMBER OF LEVELS OF OPERATION IN A TERMINAL BUILDING:

THE VOLUME OF TRAFFIC PRIMARILY INFLUENCE THE DECISION AS TO WHETHER THE DESIGN OF THE TERMINAL BUILDING SHOULD INCORPORATE ONE, TWO, OR THREE LEVELS (FLOORS)

- FOR SMALL TRAFFIC THE ONE LEVEL OPERATION IS NORMALLY MUCH MORE ECONOMICAL THAN THE OTHERS
- THE TWO LEVELS OPERATION CAN BE ECONOMICALLY JUSTIFIED ONLY AT A HIGH - TRAFFIC VOLUME AIRPORT.

THE DEPARTING PASSENGERS ARE USUALLY PROCESSED ON THE UPPER LEVEL AND THE ARRIVING PASSENGERS ON THE LOWER LEVEL. THE FING~~U~~ER~~E~~S LEADING TO THE AIRCRAFT ARE ALSO ABOVE THE LEVEL OF THE APRON; THE ADVANTAGE OF THIS SYSTEM IS THAT CONGESTION IN THE FLOW OF PASSENGERS AND BAGGAGE CAN BE REDUCED CONSIDERABLY; THE DISADVANTAGE IS HIGH COST.

PIER

c SATTELITE AND PEIR FINGERS.

ARE THE FACILITIES BY WHICH PASSENGERS ENTER OR LEAVE THE AIRCRAFT TO OR FROM THE TERMINAL BUILDING.

B FUNCTIONS THE PASSENGER TERMINAL MUST ACCOMMODATE.

1 AIRLINE OPERATIONS

2 FACILITIES FOR THE CONVENIENCE OF PASSENGERS

3 OFFICES FOR AIRPORT MANAGEMENT.

4 AERONAUTICAL FUNCTIONS OF THE FEDERAL GOVERMENT.

5 NON-AERONAUTICAL FUNCTIONS OF THE FEDERAL GOVERMENT (POST OFFICE, DEPARTMENT, PASSPORT, CUSTOM CONTROL,).

1 AIRLINE OPERATIONS

ARE.

a PASSENGER AND BAGGAGE HANDLING COUNTERS (TICKETING, ECT...)

b OFFICE SPACE ADJACENT TO PASSENGER HANDLING COUNTER.

c BAGGAGE CLAIM AREA

d INFORMATION CENTER

e TELECOMUNICATION FACILITIES

f SPACE FOR HANDLING AND PROCCESSING OF MAIL, EXPRESS AND LIGHT CARGO.

g AIRCRAFT OPERATIONAL ACTIVITIES
  - WEIGHT AND BALANCE COMPUTATIONS
  - COMPILATION OF AIRCRAFT DOCUMENTS
  - COORDINATION OF FUNCTIONAL FLOW ACTIVITIES.

h CATERING ACTIVITIES

i CREW REST FACILITIES.

g& i NEED NOT BE IN THE TERMINAL BUILDING PROPER BUT CAN BE LOCATED IN THE ~~PEIR~~ PIER FINGER ADJACENT TO THE AIRCRAFT LOADING POSITIONS.

2 FACILITIES FOR THE CONVENIENCE OF PASSENGERS ARE

a CENTRAL LOBBY WHERE PASSENGERS MAY REST, WHILE

WAITING FOR FLIGHTS

?

FACILITIES FOR DISPERSING FOOD AND BEVERAGES

NURSERY FOR CHILDREN.

TOILET FACILITIES

CONCESSIONS SUCH AS BARBERSHOPS, BANK, MAGAZINES, AND NEWSPAPER, CAR RENTAL, FLIGHT INSURANCE ECT....

PUBLIC TELEPHONES

PUBLIC ADRESS SYSTEM.

STORAGE LOCKERS

FIRST-AID ROOM.

- SLEEPING ACCOMODATIONS AT MODERATE COST FOR TRAVELERS WHO HAVE MISSED CONNECTIONS OR ARE DELAYED ARE BECOMING MORE AND MORE NECESSARY

- AREAS FOR SPECTATORS SHOULD BE PROVIDED, BUT AS FAR AS PRACTICABLE; SPECTATORS SHOULD BE SEPARATED FROM PASSENGERS AND PEOPLE WHO ACCOMPANY PASSENGERS

TO THE AIRPORT.

3 OFFICES FOR AIRPORT MANAGEMENT.

OFFICE SPACE MUST BE PROVIDED FOR THE AIRPORT MANAGER AND HIS STAFF; STAFF FUNCTIONS INCLUDE; ACCOUNTING, MAINTAINENCE, OPERATION, AND PUBLIC RELATIONS.

4&5 ACCOMMODATIONS FOR GOVERNMENT FUNCTIONS

FEDERAL OR NATIONAL AVIATION AGENCY.

WEATHER BUREAU.

COMMUNICATION FACILITIES

POST OFFICE DEPARTMENT.

CUSTOMS CONTROL

PASSPORT AND HEALTH CONTROL.

IN CASE OF HAVING A SEPERATE BUILDING THAT MAY HOUSE THE AIRCRAFT CONTROL TOWER, THE FUNCTIONS OF THE

FEDERAL AVIATION AGENCY, THE COMUNICATION FACILITIES, AND THE WEATHER BEREAU, CAN BE HOUSED IN THE LOWER FLOORS OF THE SAME BUILDING, THEN CUSTOMS, HEALTH, AND PASSPORT CONTROL, AND POSTAL ACTIVITIES MUST BE CLOSE TO THE AIR CRAFT LOADING POSITIONS

PASSENGER - HANDLING CONSIDERATIONS.

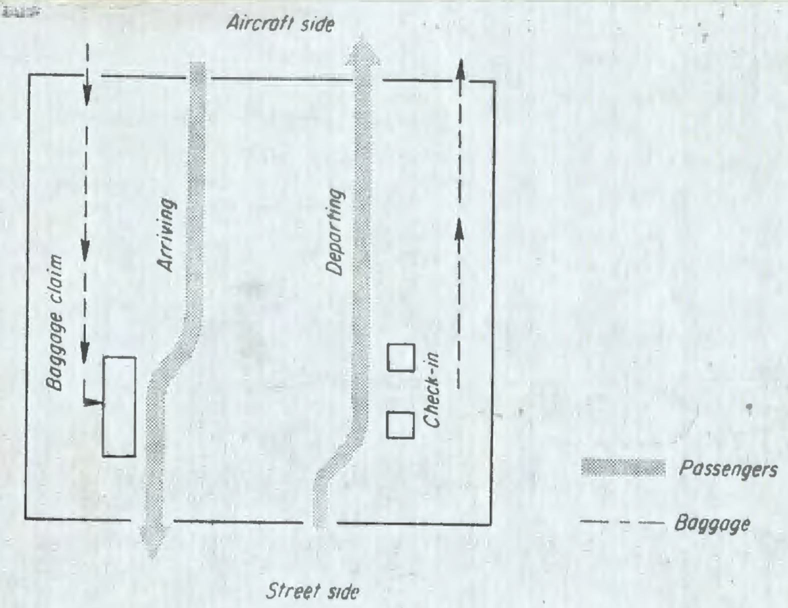
THE FOLLOWING PRINCIPLES SHOULD [redacted] GOVERN THE FLOW OF PASSENGERS:-

1 AT LARGE AIRPORTS, ARRIVING AND DEPARTING PASSENGERS SHOULD BE SEPARATED.

2 PASSENGERS ROUTES SHOULD BE AS SHORT AS POSSIBLE AND CLEARLY MARKED, CROSS TRAFFIC FROM OTHER SOURCES SHOULD BE AVIODED (oi) WHENEVER POSSIBLE

3 CONCESSIONS SHOULD BE LOCATED SO THAT THEY DO NOT SERIOUSLY INTERFER WITH PASSENGERS FLOW

4 FOR DEPARTING PASSENGERS THE DISTANCE FROM THE POINT OF ARRIVAL AT THE BUILDING TO BAGGAGE CHECK-IN SHOULD BE AS SHORT AS POSSIBLE.



(a) Flow in domestic terminals

(b) Flow in international terminals

FIG. 9.2. Diagram of Passenger and Baggage Flow Routes (COURTESY: International Air Transport Association.)

BAGGAGE HANDLING FACILITIES

CONVEYING BAGGAGE FROM THE AIRCRAFT TO THE TERMINAL BUILDING AND VICE VERSA IN A RAPID AND SIMPLE MANNER WITHOUT THE NECESSITY OF REHANDLING BAGGAGE A NUMBER OF TIMES IS THE MAJOR AIM FOR A SUCCESSFULL OPERATION IN THE TERMINAL BUILDING.

MECHANIZATION IS USUALLY USED AT THE TERMINAL BUILDING BUT NOT NESSESSARY EXTENDED TO THE AIRCRAFT.

THE SPACE REQUIRMENT FOR THE ABOVE MEN~~S~~TIONED FUNCTIONS ARE RELATED TO THE PEAK-HOUR PASSENGERS AND BY OBSERVATION OF OTHER AIRPORTS OPERATIONS.

THE RELATIONSHIP BETWEEN ANNUAL NUMBER OF PASSENGERS AND PEAK HOUR PASSENGER ARE INDICATED BY THE FOLLOWING TABLE.

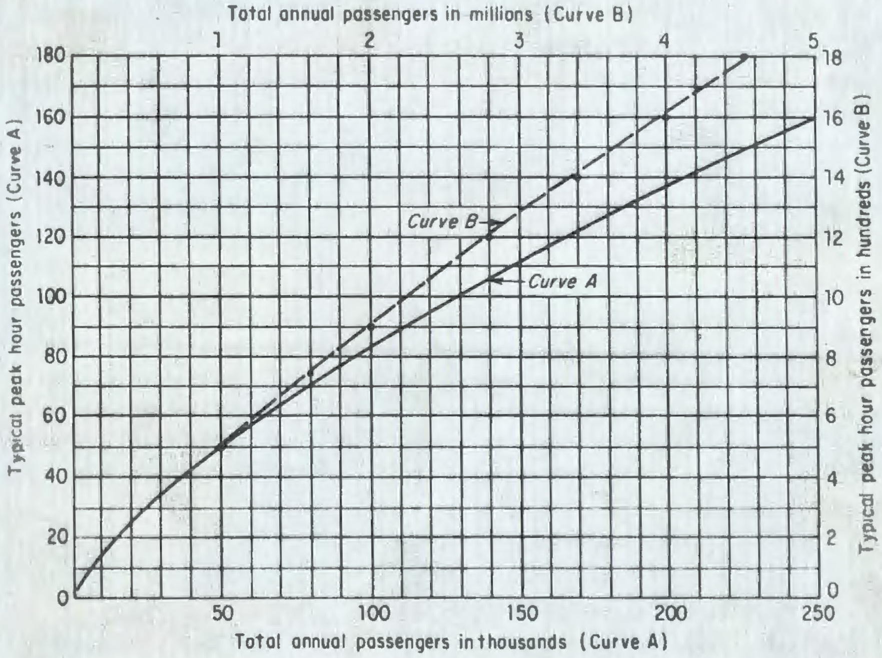


FIG. 9-4. Typical Peak-hour Passengers Related to Annual Passengers (COURTESY: Federal Aviation Agency.)

C VEHICLE PARKING AREA-

PARKING SHOULD BE PROVIDED FOR:-

1 PASSENGERS
2 VISITORS ACCOMPANYING PASSENGERS
3 SPECTATORS
4 EMPLOYEES
5 CAR RENTAL

- PARKING FOR PASSENGERS SHOULD BE LOCATED

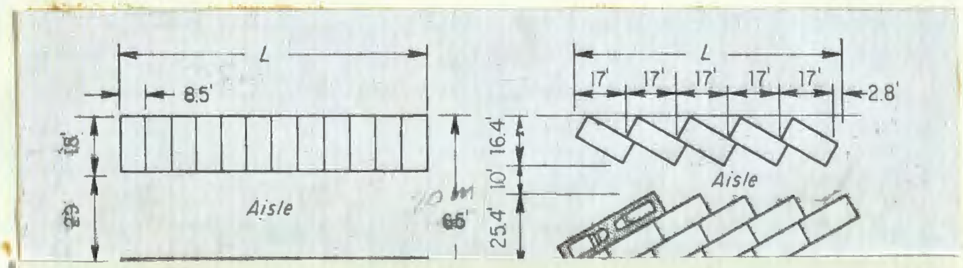
IMMEDIATELY ADJACENT TO THE TERMINAL BUILDING, SO THAT WALKING DISTANCES ARE KEPT TO A MINIMUM.

- IT IS DESIRABLE TO SEPERATE SHORT-TIME PARKING SPACES FROM THOSE OF LONGER DURATION AND TO LOCATE THE SPACE FOR SHORT TIME PARKING AS CLOSE TO THE TERMINAL BUILDING AS POSSIBLE

- SEPERATE PARKING FOR EMPLOYEES AND CAR RENTAL IS NECESSARY

- WALKING DISTANCE FROM THE CAR TO THE TERMINAL SHOULD NOT EXCEED 300 M AND PREFERABLY LESS.

- PUBLIC PARKING FACILITY SHOULD ACCOMODATE FROM 1½ TO 2 CARS FOR EACH PEAK - HOUR PASSENGER.



VEHICULAR TRAFFIC.

ARE MAINLY :-

- PASSENGERS
- VISITORS
- SPECTATORS
- SERVICE.

- AT LARGE AIRPORTS SERVICE IS SEPERATED FROM OTHERS.
- SUFFICIENT SPACE SHOULD BE PROVIDED FOR TAXIS ADJACENT TO THE ENTRANCE OF THE TERMINAL BUILDING TO LOAD AND UNLOAD PASSENGERS WITHOUT CAUSING AN UNDUE AMOUNT OF CONJESTION.
- THE CIRCULATION OF TRAFFIC AT AN AIRPORT SHOULD GENERALLY BE ONE-WAY AND COUNTER CLOCK WIZE WITH WIDE DRIVE-WAYS.

D APRON REQUIREMENTS.

THREE BASIC FACTORS GOVERN THE SIZE OF PASSENGER LOADING APRON:-

1 SIZE OF THE LOADING AREA REQUIRED FOR EACH TYPE OF AIRCRAFT (GATE POSITION).

2 THE NUMBER OF GATE POSITIONS REQUIRED.

3 THE AIRCRAFT PARKING CONFIGURATION.

SIZE OF LOADING AREA.

THE AMOUNT OF SPACE REQUIRED FOR A PARTICULAR TYPE OF AIRCRAFT DEPENDS LARGELY ON ITS SIZE AND THE MANNER IN WHICH IT ENTERS AND LEAVES THIS SPACE.

OTHER FACTORS THAT INFLUENCE ON THE SIZE OF THE GATE. ARE:-.

1 THE DESIRABLE CLEARANCES FOR MANUVERING AIRCRAFT NEAR OTHER AIRCRAFT AND BUILDING.

2 THE EXTENT OF GUIDE LINES AND THE NUMBER OF PERSONEL ON THE GROUND TO GUIDE THE PILOT.

3 THE LOCATION OF AIRCRAFT SERVICING POINTS

4 THE ANGLE AT WHICH THE AIRCRAFT IS PARKED RELATIVE TO THE BUILDING.

TAXING INTO AND OUT OF A GATE POSITION NORMALLY

INVOLVES A 180° TURN, A GENERAL GUIDE HAS BEEN PREPARED BY THE INTERNATIONAL AIR TRANSPORT ASSOCIATION BASED ON A PARKING ANGLE OF APPROXIMATELY 36° NOSE-OUT FROM THE TERMINAL BUILDING OR PEIR-FINGER. THE SUGGESTED SPACINGS BETWEEN CENTERS OF GATE POSITIONS ARE AS FOLLOWS:, ASSUMING THE AIRCRAFT ENTERS AND LEAVES THE POSITION UNDER IT'S OWN POWER.

BOEING 707-320/420 ⟶ 220-250 ft.

FOR BOEING 707-320 PARKED AT AN ANGLE (A) OF 52.5° AND A DESIRED MINIMUM CLEARANCE (G) OF 25 ft BETWEEN AIRCRAFT AND BUILDING, THE FOLLOWING DIMENSIONS ARE OBTAINED.

C = 36 ft

D = 200 ft

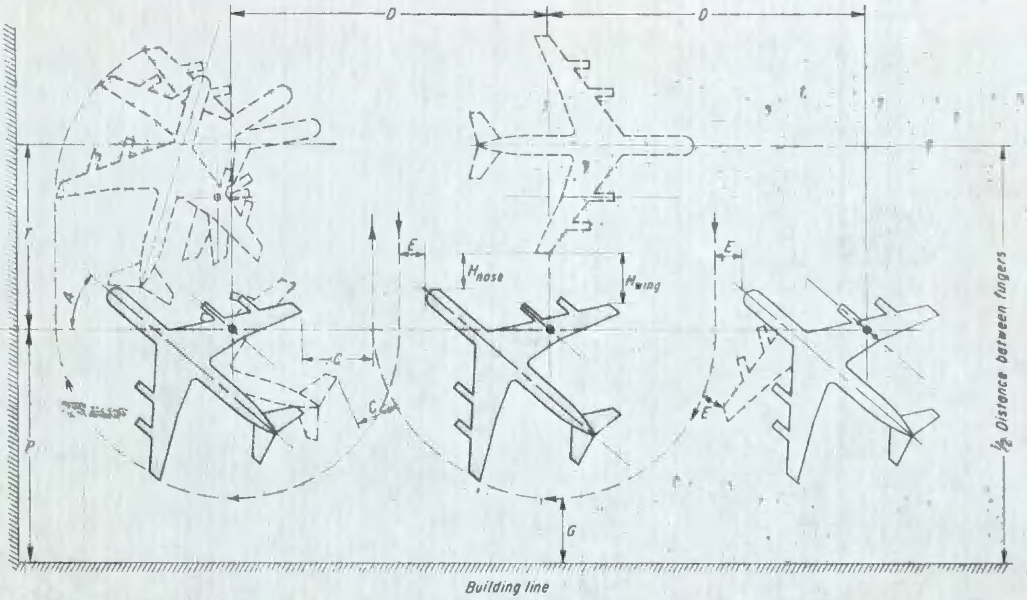
E = 15 ft

F = 12 ft

H = 39 ft

P = 143 ft

T = 150 ft.



A = parking angle
C = clearance between outgoing airplane and parked airplane
D = spacing between centers of rotation of parked aircraft
E = clearance between incoming airplane and parked airplane
F = clearance when turning between a swept-wing airplane and a parked swept-wing airplane after the outgoing aircraft has taxied forward
G = clearance between an incoming turning airplane and a building
H = clearance between an airplane on the taxiway and a parked airplane
P = distance between building and parking position
T = distance between parking position and center line of taxiing airplane

FIG. 9-6. Aircraft Clearances on Parking Aprons (COURTESY: Federal Aviation Agency.)

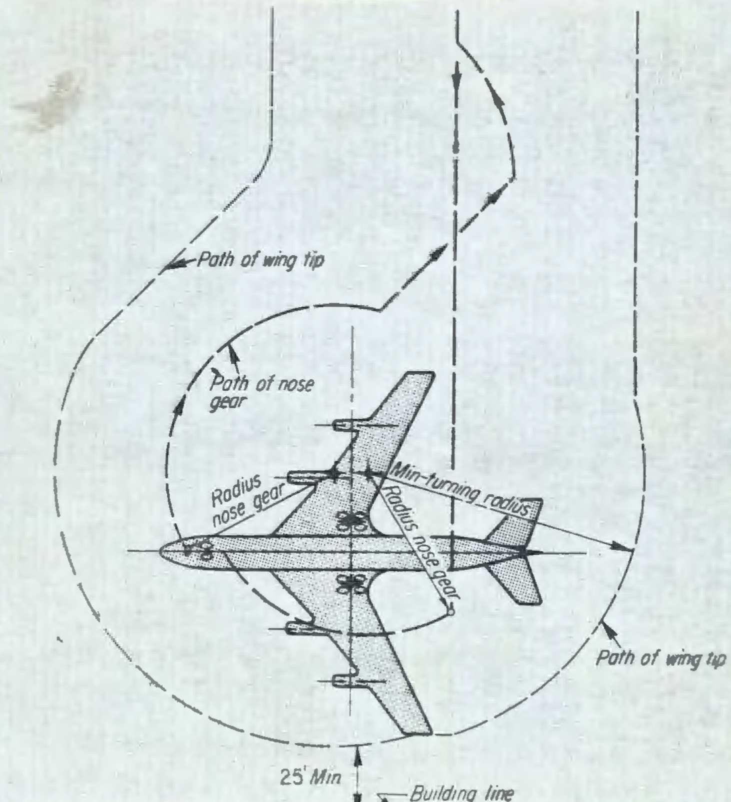


FIG. 9-7. Typical Gate Position

EACH GATE POSITION CAN BE REPRESENTED FOR GENERAL PLANNING ~~PUPUR~~ PURPOSES AS A CIRCLE. WITH A DIAMETER SLIGHTLY LARGER THAN TWICE THE TURNING RADIUS OF THE AIRCRAFT. THE POSITION OF THE CIRCLES IN RELATION TO EACH OTHER WILL DEPEND ENTIRELY ON THE PARKING CONFIGURATION (PARALLEL, NOSE IN, NOSE OUT...) AND WHETHER THE AIRCRAFT ARE TO BE TOWED.

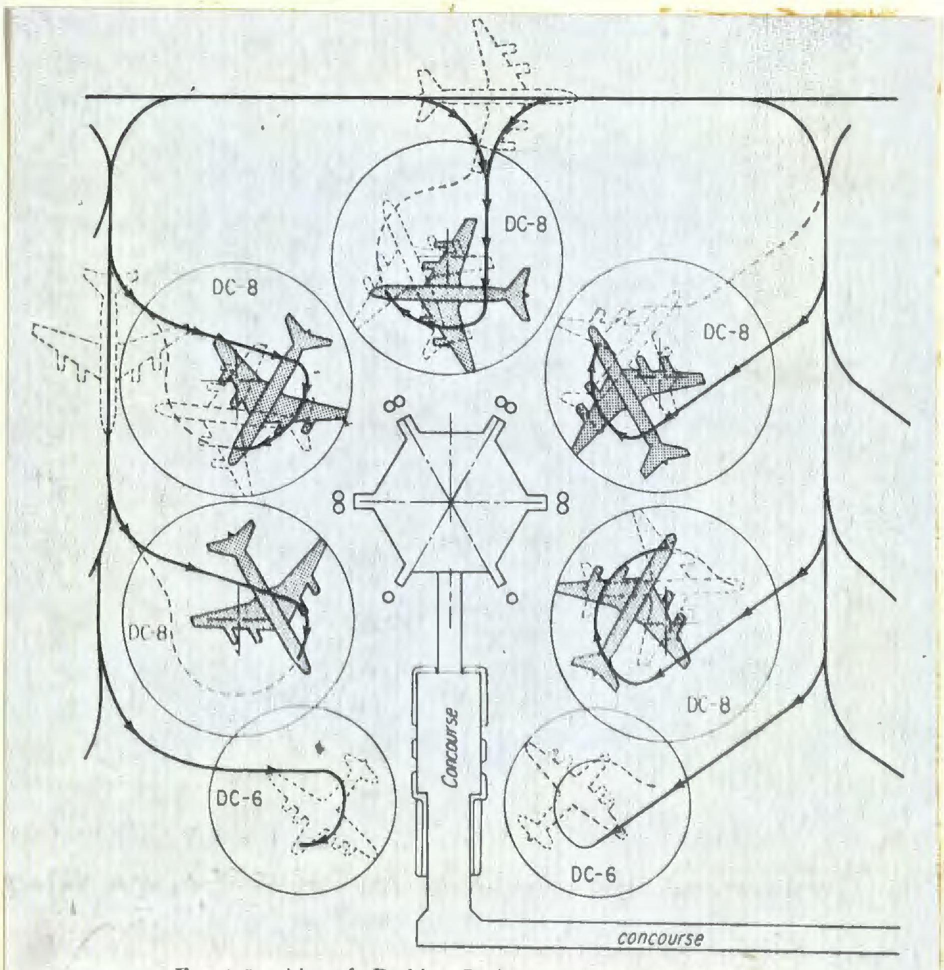


Fig. 9-8. Aircraft Parking Positions around Pier Finger

NUMBER OF GATE POSITIONS.

IT DEPENDS LARGELY ON:-

1 THE PEAK VOLUME OF AIRCRAFT TRAFFIC

2 THE OCCUPANCY TIME OF EACH AIRCRAFT AT THE GATE POSITIONS (THE LARGER THE AIRCRAFT THE MORE TIME IT NEEDS)

FOR PLANNING PURPOSES THE RAMP TIME FOR LARGE AIRCRAFT SHOULD BE ESTIMATED AT NOT LESS THAN 60 MIN FOR SMALL AIRCRAFT AS 12 MIN

IN ORDER TO ACHIEVE A BALANCE IN THE AIRPORT SYSTEM, THE NUMBER OF GATE POSITIONS SHOULD NOT EXCEED THE CAPACITY OF THE RUNWAYS

FOR EXAMPLE: IF THE CAPACITY OF THE RUNWAY SYSTEM IS 60 AIRCRAFT PER HOUR AND EACH AIRCRAFT REMAINS ON THE AVERAGE, 30 MIN AT THE LOADING APRON, THE NUMBER OF GATE POSITIONS REQUIRED IS 15; IF THE AVERAGE TIME AT THE APRON IS 60 MIN THE NUMBER OF GATE POSITIONS REQUIRED IS 30. THE RELATIONSHIP IS AS FOLLOWS

$$\text{NUMBER OF GATE POSITION} = \frac{\dfrac{\text{CAPACITY OF RUNWAYS IN AIRCRAFT PER HOUR}}{60}}{\text{AVERAGE GATE OCC. TIME}} \times 2$$

AIRCRAFT PARKING CONFIGURATION.

IT REFERS TO THE ANGLE OF THE AIRCRAFT LONGITUDINAL AXIS RELATIVE TO THE ADJACENT BUILDING WHEN THE AIRCRAFT IS IN PARKED POSITION . AIR CRAFT SHOULD BE PARKED SO THAT THEY WILL CAUSE THE LEAST AMOUNT OF INTERFERENCE DUE TO HEAT, FUMES, AND BLAST WHEN MANEUVERING INTO AND OUT OF A GATE POSITION .

AIRCRAFT CAN MANEUVER INTO AND OUT OF A GATE POSITION

1 UNDER THEIR OWN POWER

2 TOWED IN AND OUT BY AUXILIARY POWER DEVICES

3 BY A COMBINATION OF THE TWO METHODS

METHODS FOR LOADING AND UNLOADING PASSENGERS HAVE VARIED CONSIDERABLY , LOADING WAS

ACCOMPLISHED BY CONVENTIONAL STAIRS, BUT AIRLINES HAVE INSTALLED ELABORATE PASSENGER LOADING DEVICES WHICH COMPLETELY PROTECT THE PASSENGERS FROM THE ELEMENTS.

THESE DEVICES ARE USUALLY IN THE FORM OF SWINGING GANGPLANKS WHICH SWING FROM THE BUILDING TO THE AIRCRAFT DOORS.

IF THE PASSENGERS ARE NOT PROTECTED FROM THE ELEMENTS AND THE AIRCRAFT UTILIZES ITS OWN POWER TO MANEOVER INTO AND OUT OF THE GATE POSITION, THE FOLLOWING PARKING CONFIGURATIONS SHOULD BE CONSIDERED.

1 NOSE IN

2 ANGLED NOSE IN

3 NOSE OUT

4 ANGLED NOSE OUT

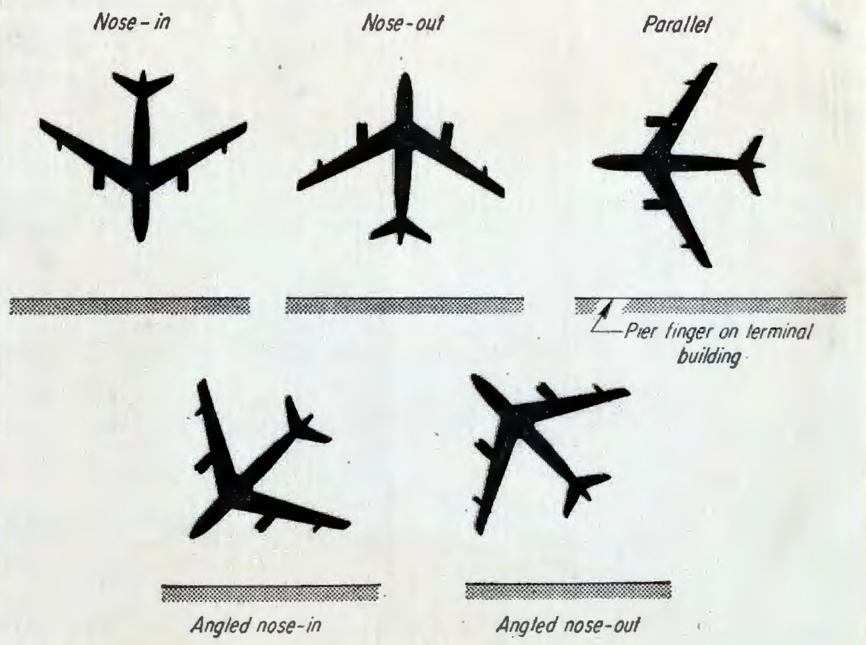


FIG. 9-10. Aircraft-parking Configuration (COURTESY: International Air Transport Association.)

IT IS EVIDENT THAT NO ONE PARKING CONFIGURATION CAN BE CONSIDERED AS IDEAL.

E AIRCRAFT PARKING SYSTEM.

CLASSIFIED AS FOLLOWS

1 FRONTAL SYSTEM : AIRCRAFT ARE PARKED ON THE APRON IN A LINE IMMEDIATELY ADJACENT TO THE TERMINAL BUILDING ; IT IS A VERY SIMPLE AND ECONOMICAL SYSTEM BUT IT IS LIMITED IN ITS APPLICATION TO AIRPORTS WHERE NUMBER OF AIRCRAFT TO BE SERVED IS SMALL

2 OPEN APRON SYSTEM:- AIRCRAFTS PARKED IN GROUPS AWAY ABIT FROM THE TERMINAL DUE TO THE INCREASE IN NUMBER OF AIRCRAFTS. IT REQUIRES THE CONVEYANCE OF PASSENGERS BY SOME SORT OF VEHICLE IF THE DISTANCE BETWEEN THE AIRCRAFT AND THE TERMINAL BUILDING IS LARGE (MOBILE LOUNGES ARE USED AT DULLES INTERNATIONAL AIRPORT).

3 FINGER SYSTEM :- EXTENSION OF THE FRONTAL SYSTEM FINGERS ARE PROTRUSIONS FROM THE TERMINAL BUILDING WHICH EXTEND INTO THE APRON AREA ; A FINGER CAN BE A FENCED OPEN WALKWAY OR A COMPLETELY ECLOSED STRUCTURE ONE OR TWO STORIES IN HEIGHT. IT CAN BE STRAIGHT, Y-SHAPED OR T SHAPED.

ITS MAIN ADVANTAGES :-

1. IF ENCLOSED IT PROVIDES COMPLETE PROTECTION FOR THE PASSENGER FROM WEATHER, NOISE, FUMES, AND BLAST

FOR THE MAJOR PORTION OF THE JOURNEY FROM THE TERMINAL BUILDING TO THE AIRCRAFT.

2. IT CAN BE EXPANDED VERY READILY

3. IT PERMITS THE INSTALLATION OF SWINGING GANG PLANKS TO AIRCRAFT DOORS OR SHORT NOSE - LOADING BRIDGE

4. IT ENABLES THE PARKING OF A GREATER NUMBER OF AIRCRAFT IN CLOSE OR APROXIMITY TO THE TERMINAL BUILDING THAN WITH THE OPEN APRON SYSTEM

THE FINGERS ARE SOME TIMES 2 STORY STRUCTURES THE UPPER STORY IS RESERVED FOR PASSENGERS AND IT IT IS COMPLETELY CLOSED; THE GROUND FLOOR IS USED FOR AIRLINE OPERATION AND THE HANDLING OF BAGGAGE AND EXPRESS, OPENINGS ARE USUALLY PROVIDED ON THE GROUND FLOOR TO PERMIT THE PASSAGE OF VEHICULAR TRAFFIC

4 SATELLITE SYSTEM : IS DEFINED AS A SMALL BUILDING LOCATED ON THE APRON AND CONNECTED TO THE MAIN TERMINAL BUILDING BY MEANS OF A TUNNEL OR PEIR, AIRCRAFT ARE PARKED AROUND EACH SATTELLITE BUILDING. ITS ADVANTAGES ARE ONLY REALIZED IF THE CONNECTION TO THE TERMINAL BUILDING IS BY A TUNNEL ALLOWING AIRCRAFT TO BE PARKED ALL THE WAY AROUND THE SATTELLITE, AND AIRCRAFT ARE FREE TO MOVE INTO AND OUT OF THEIR RESPECTIVE GATE POSITIONS WITHOUT MAKING AS MANY TURNS AS IN THE FINGER SYSTEM.

ITS DISADVANTAGES :-

1. THE LARGE EXPENSE OF CONSTRUCTING TUNNELS

2. THE NECESSITY FOR PASSENGERS TO CHANGE SEVERAL LEVELS IN THEIR JOORNEY FROM THE TERMINAL ENTRANCE TO THE DOOR OF THE AIRCRAFT.

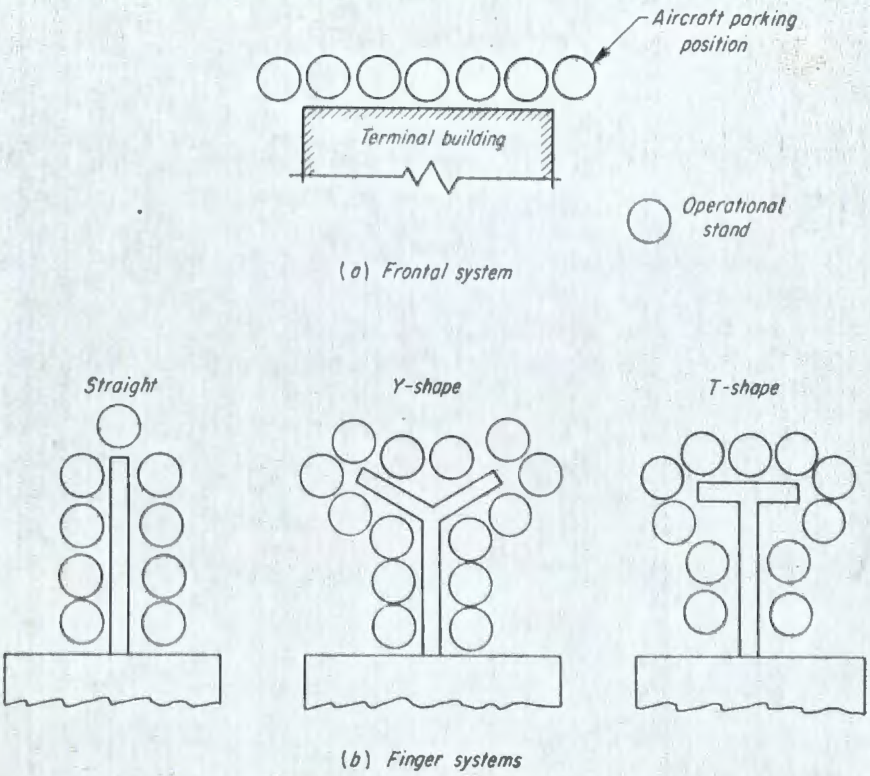


FIG. 9-11. Types of Parking System Layout

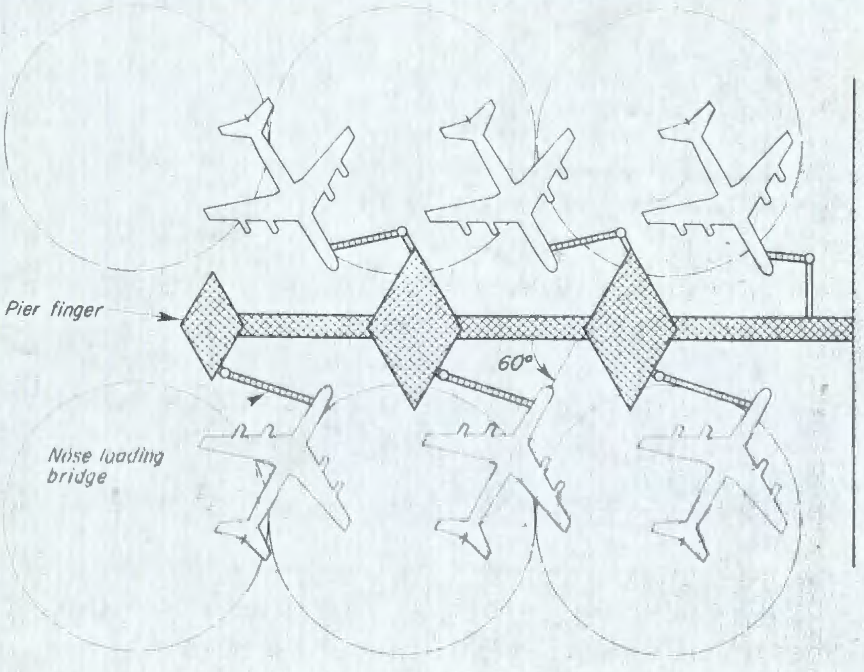


FIG. 9-9*c*. Schematic of Nose-loading Arrangement (COURTESY: Port of New York Authority.) Aircraft arrive at the gate position under their own power. On departure, they are pushed out several hundred feet by tow bar and tractor.

F HANDLING OF PASSENGERS TO AND FROM AIRCRAFT.

PASSENGERS ARE CONVEYED FROM THE TERMINAL OR FROM ONE OF ITS FINGURES OR SATELLITES BY:

1. FOOT ON THE APRON
2. BY VEHICLE
3. BY ENCLOSED SWINGING GANG PLANKS OR NOSE-LOADING BRIDGE.

5. DATA AND AREAS PROGRAM

5. AIRCRAFT AND PASSANGER MOVEMENT

1 AIRCRAFT TRAFFIC

ANNUAL	60,000
PEAK HOUR	20

2 PASSANGER MOVEMENT

A. ANNUAL TRAFFIC(LOCAL)	5,357,000
B. ANNUAL TRAFFIC(TRANSIT)	606,000
C. TOTAL	5,963,000

PEAK HOUR TRAFFIC

D. ARRIVAL+DEPARTURE(LOCAL+TRANSIT)	1960
E. ARRIVAL OR DEPARTURE(LOCAL+TRANSIT)	1310
F. ARRIVAL OR DEPARTURE(WITHOUT TRANSIT)	1180

3 CALCULATIONS FOR THE 10 MINUTES PEAK

A. ARRIVAL + DEPARTURE (LOCAL + TRANSIT)

$$\frac{1960}{6} + 2\times\sqrt{1960\times\frac{1}{6}\times\frac{5}{6}} = 360$$

B. ARRIVAL OR DEPARTURE (LOCAL + TRANSIT)

$$\frac{1310}{6} + 2\sqrt{1310\times\frac{1}{6}\times\frac{5}{6}} = 245$$

C. ARRIVAL OR DEPARTURE (WITHOUT TRANSIT)

$$\frac{1180}{6} + 2\sqrt{1180\times\frac{1}{6}\times\frac{5}{6}} = 220$$

ARRIVAL HALL		5,000 M^2
A BAR + STORAGE	120 M^2	
TOILETS	120 M^2	
BANK-EXCHANGE COUNTER	240 M^2	
2 BAGGAGE ROOMS	350 M^2	
2 PUBLIC RELATIONS OFFICES	100 M^2	
14 COUNTERS FOR CAR RENTAL, HOTEL RESERVATIONS	450 M^2	
TELEPHONE & WRITTING COUNTERS	100 M^2	
PRE-ARRIVAL HALL		12,000 M^2
ARRIVAL AREA WITH 6 TO 8 HEALTH STATIONS	900 M^2	
10 TO 15 POLICE CHECK STATIONS	1,275 M^2	
4 INTEROGATION ROOMS	100 M^2	

3 OFFICES	75 M²	
3 HOLD ROOMS	60 M²	
TOILETS	240 M²	
BAGGAGE CLAIM AREA WITH 10 CAROUSSELS	4,000 M²	
BAGGAGE STORAGE	300 M²	
LOST BAGGAGE INFORMATION DESKS & OFFICES	80 M²	
CUSTOMS AREA WITH 8 BAGGAGE CHECK STATIONS		2,500 M²
3 TO 4 CUSTOMS ROOMS	100 M²	
CUSTOMS DEPARTMENT	108 M²	
2 BAGGAGE-HOLD ROOMS	75 M²	

DEPARTING BAGGAGE AREA		6,380 M²
HALL WITH 8-CAROUSSELS	5,500 M²	
HEAVY BAGGAGE AREA	150 M²	
OFFICES	650 M²	
TOILETS	60 M²	
V.I.P. FACILITIES		1,500 M²
HALL OF HONOUR	100 M²	
LOUNGES	600 M²	
TOILETS	60 M²	
OFFICES	300 M²	

DEPARTURE HALL INCLUDING 64 BAGGAGE CHECK COUNTERS + 2 FOR HEAVY BAGGAGE		8,800 M²
AROUND THE COUNTERS AREA	6,300 M²	
TOILETS	144 M²	
BEHINED THE COUNTERS AREA INCLUDING 600 M² OF OFFICES FOR THE COMPANIES AND 100 M² OF TOILET AREA.	700 M²	
CHECKED DEPARTURE AREA INCLUDING 14 POLICE STATIONS (PASPORT CHECK).		14,000 M²
WAITING LOUNGES	10,000 M²	
OFFICES	1,250 M²	
TOILETS	200 M²	

FREE ZONE AND LOOK-OUT AREA		4,000 M^2
SHOP AREA	1,000 M^2	
RESTAURANTS		6,000 M^2
PUBLIC RESTAURANT & BAR TRANSIT RESTAURANT & BAR CREW RESTAUNT & BAR KITCHENS	1,500 M^2 1,250 M^2 1,000 M^2 1,500 M^2	

AIRLINE OPERATIONS		2,900 M^2
INFORMATION CENTER	60 M^2	
TELECOMUNICATION FACILITIES	50 M^2	
SPACE FOR HANDLING AND PROCCESSING MAIL, EXPRESS & LIGHT CARGO	360 M^2	
CATERING FACILITIES	1,000 M^2	
CREW REST FACILITIES	900 M^2	
FACILITIES FOR THE CONVENIENCE OF PASSENGERS		2,300 M^2
NURSERY FOR CHILDREN	100 M^2	
PUBLIC ADRESS SYSTEM	64 M^2	
STORAGE LOCKERS	40 M^2	
FIRST AID ROOM	60 M^2	
SLEEPING ACCOMODATIONS	2,000 M^2	

AIRPORT MANAGEMENT		375 M^2
OFFICE FOR THE MANAGER	25 M^2	
OFFICE FOR THE ASSISTANT MANAGER	25 M^2	
SECRETARY, FILES AND WAITING AREA	30 M^2	
ACCOUNTING	100 M^2	
OFFICE FOR MAINTANANCE DEPARTMENT	50 M^2	
OPERATIONS & PUBLIC RELATIONS	75 M^2	
GOVERMENT FUNCTIONS		700 M^2
NATIONAL AVIATION AGENCY	75 M^2	
WEATHER BUREAU	75 M^2	
COMMUNICATION FACILITIES	40 M^2	
POST OFFICE DEPARTMENT	100 M^2	
MIGRATION	150 M^2	
POLICE & AIRPORT PROTECTION (OFF.)	150 M^2	

CONTROL TOWER		1,500 M^2
AUXILIARY OFFICE SPACE		4,000 M^2
UNDER GROUND SERVICES INCLUDING STORAGES, MACHINE & TRANSFORMATION ROOMS, ECT. ...		90,000 M^2
TOTAL BUILT-UP AREA		162,000 M^2
PARKING		200,000 M^2
PASSENGERS	100,000 M^2	
VISITORS ACCOMPANYING PASSENGERS	50,000 M^2	
SPECTATORS	10,000 M^2	
EMPLOYEES	30,000 M^2	
CAR RENTAL	2,500 M^2	
TAXIS	5,000 M^2	

* SOME OF THESE PARKINGS ARE COVERD OR BUILT-UP.

6. EXAMPLES.

BUILDING TYPES STUDY 454®

AIRPORTS

> **"For me, aviation has value only to the extent that it contributes to the quality of the human life it serves."**
> **—Charles A. Lindbergh** *July 1972*

Architects who regard airports as opportunity are correct in that surmise, but often they are unaware of its full implications. There has never been a field where the basic skills of architecture have been more necessary or have met more negative constraints.

Anyone who travels by air must have encountered the consequences of those constraints: bleak and confusing terminals; exhausting delays on ticket lines; more exhausting hikes on foot with heavy luggage, traversing unconscionable distances mandated by the convenience and configuration of machines; demands upon the traveler's time and person, serving no purpose but the proprietary images of airlines; shrinkage and withering of the quality of life, subservient to the economics of machines and to the monstrous conditions they create. But here and there has been a fragmentary victory by architects on behalf of people—so logical and so expensive, on the Draconian scale of dollars per enplaned passenger, that airlines boggle at the landing fees.

Lip service to reform has been paid by our bureaucracies. "Ecology" has crept into the lexicon of political aspirants. "Environmental impact" has gained buzzword status among those who wield the power of regulation without the wisdom that must qualify legislation. There is now a requirement that aspirant architects must predict the effects of airports on the life and joy of every blade of grass and every bird and insect (but not on every passenger) within the sphere of influence of still-undetermined designs. The definitions of acceptable "environmental impact studies" are such that an architect who hopes to qualify merely to make a presentation, preamble to commission, must spend as much as half a million dollars with no assurance that he will get the job, nor that his fee will cover that expense even if he does.

Some architects do get airport work, however. Sometimes, nowadays, that is when their troubles begin. Airlines, in pursuit of bigger and more profitable loads have spent the treasure of good years on giant vehicles in the incredible assumption that flying on schedule for a subsidized profit is both a necessary attribute and a passionate goal of mankind.

Mankind, meanwhile, has found itself priced out of flying for business on unlimited expense accounts. While the airlines were buying giant vehicles and feeling economic pangs, other fields of endeavor were suffering equal pangs from other causes. Diminished expense accounts, as well as the second thoughts of individual touring enterprise, began to slow the rate of growth in air travel.

But the airlines—not the travelers—are the essential client of architects in this arena. So the airports are for airlines, not for travelers. Architects, whatever their social consciences, must either deal with the goals of clients or pass the work along to those who will —*William B. F*

AIRPORT TERMINAL PLANNING FOR THE 1980'S

Arnold W. Thompson, president, Arnold Thomp- n Associates Inc., a subsidiary of Lester B. Knight and Associates, Inc.

In the mid 1960's a discussion of airport termi- ls would invariably lead to the question, "Is big enough?" The new terminals at Dallas/Fort Worth, Newark, and Kansas City reflect that consideration. Recently, however, minal development in the United States has en largely stymied and the contemporary question seems to be: "Do we need it all?"

Much has been written about the turbu- nt 60's with the aviation industry, perhaps mbolic of technology, sharing the concerns of society in general. The rise of consumerism, devastating airline recession, and an awak- ing to our responsibility to the environment have all had their effects. Airplanes have become larger as we expected during this period, t the SST has been delayed. Airline traffic owth has virtually stalled at many cities, although at others congestion increases seemingly unabated. Noise remains a problem but w seems to be solvable.

One element affecting terminal planning has remained constant—the passenger. Pas- ngers still want to use the terminal easily, thout confusion and with a sense of dignity.

The questions most frequently asked today about the planning of terminals for the 980's are: 1) What technology is emerging to er terminal planning? 2) Can the solution be economically justified and funded? 3) Will future travel and social changes affect design?

Technology will deal with size and numbers—and sometimes people

Four major categories of technological development will affect planning for the 1980's: 1) aircraft characteristics, 2) passenger processing procedures, 3) baggage handling, 4) intra-airport transportation.

1) *Airplanes.* In the early 70's the Boeing 727 and DC-9 were the most significant. The DC-10 and Lockheed 1011 appear to have this role during the next ten years. The Boeing 747 is not so far as much a factor domestically as had been anticipated, except as it emerges as a charter airplane. It is, perhaps, ahead of its time in a role more economically filled by the DC-10. The SST will arrive, but its impact on terminal design is so far minimal. For the 1980's we can anticipate larger capacity, more efficient aircraft, perhaps up to 1000 passengers, in response to airport capacity limitations. Some consolidation of airline schedules will continue but not to the extent that gate requirements will be greatly reduced. Possibly an airplane specifically designed for cargo operations will emerge—but until it does "belly" cargo containers will continue to be a ground handling problem. Much publicity has been given to the development of an efficient 100-passenger STOL (short takeoff and landing) airplane. If successful, this might divert some activity away from some larger airports, but its direct effect on terminal planning would be negligible.

In short, the major airplane factor will be the number of passengers arriving or departing at the same time.

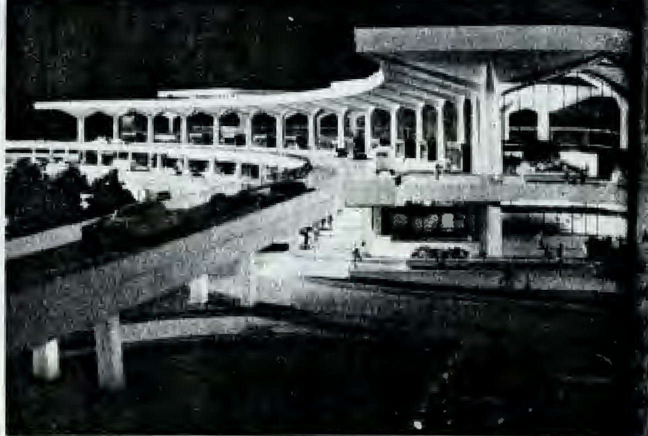
2) *Passenger processing.* Procedures for ticketing, holding, screening and otherwise handling people have been a dominant factor in shaping terminals. In the 1950's an experiment in lifting tickets at the aircraft gate led to gate waiting rooms. All major terminals from that time reflect that idea, and for a time it appeared that the ticket lobby was obsolete. The "drive to gate" concepts at Dallas/Ft. Worth and Kansas City reflect this principal. There seems to be a reversal of this design trend brought about by soaring operating and security costs. Consolidation of gate waiting rooms for efficiency in manning and sharing of space between gate areas seems to be appropriate for the 1980's.

Security has also emerged as a major consideration. Government authorities predict security will unfortunately continue to be a problem for many years ahead. Single-point control of passengers is, when practical, the ideal solution. Another consideration in the plan is to allow "secure" passengers to transfer between airplanes without having to leave and reenter secured areas. This is not unlike the physical arrangement for "in-transit" international passengers at an intermediate stop.

3) *Baggage handling.* As every passenger has experienced, this is a major airline problem. Unfortunately, security requirements have created larger quantities of checked baggage and added to the processing time. More

HOK/BHA

Kivett & Myers



Dallas/Fort Worth Airport (above), Kansas City bove right) and Newark (right) are the est in the drive-to-your-gate airports eferred to in text above.

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ou baggage does not lend itself to
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th may be rerouted from the terminal
ing on the configuration of the road
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g nd transportation.
t planners, mechanical distribution
nore flexibility in the location of termi-
ents. Provisions for equipment tunnels
terminal and interline transfer sys-
e considered.

Intra airport transportation. Systems for
g people will be the planners'
h of the 1980's for larger terminals.
inal is defined as having more than
craft gates, unusual transfer charac-
excessive walking distances due to
a n. These systems have been slow
rge, probably because research money
t been available to what had been a
t in the past.
oving sidewalks of Love Field in the
, the mobile lounge at Dallas in the
the terminal at Houston in the mid-
Westinghouse shuttle system at
972, the underground transit loop
Tac and the Airtrans at Dallas/Ft. Worth
answers, and other systems are on the way. When such systems are standardized with "off the shelf" hardware components the cost will stabilize and the system will become economically practical. Major terminals will be planned with these systems integrated into the design.

A stringent economy affects construction budgets

With inflation, the airline recession and the financial woes of large cities, it has become imperative that terminal development be financially sound. During the 1960's these problems had not yet emerged. A basis for evaluating terminal cost has subsequently been developed among airlines and referred to as "cost per enplaned passenger." With this procedure, annual terminal costs (which include construction cost plus maintenance and operation, escalation and other necessary related cost items, less Federal participation) can be compared across the country and new facilities compared with the cost of existing ones. Recently one of the airlines utilizing this procedure expressed concern that its cost on moving into a new terminal will increase from less than $1 per enplaned passenger to over $4 per enplaned passenger. This procedure has its limitations since the basis used for comparison is initial cost rather than costs averaged over the period of the bonds. Nevertheless this procedure has evolved and can be used as a guide to establish a realistic budget. It should be used with background perspective, however.

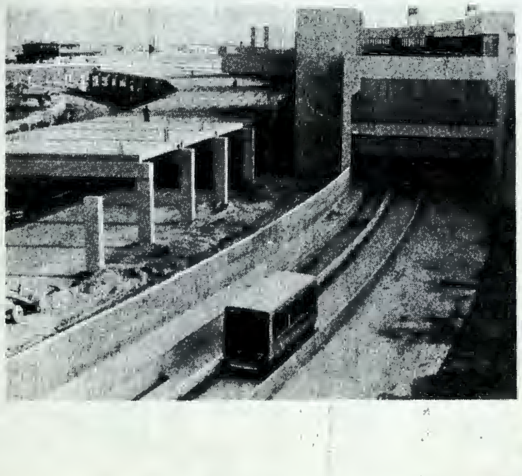
Tackling problems of social and environmental impact

Airport noise is the most publicized airport environmental problem. While this has delayed new airports it is not a significant factor in terminal building design. The impounding of water runoff and the removal of fuel and solvents do represent important considerations as does air pollution. Surprisingly, studies show that heavy concentrations of fuel combustion pollutants are caused by ground vehicles rather than airplanes. Remote auto parking areas and adequate provisions to control traffic at the baggage claim curbside are successful solutions.

A major change has taken place in the character of air travel—the growth of low-cost group travel by charter. This phenomenon is increasing and will affect every city that has an air-carrier type airport (i.e. one served by scheduled airlines rather than exclusively general aviation or utility flights). Unfortunately, few terminals have the surplus space to accommodate the surge of travelers and their friends. While many of the charters are handled by the scheduled carriers, little provision was made in their planning for such operations for economic reasons. The terminal of the 1980's must take this into account by having sufficient surge space of a public nature located preferably at the extremities of the building. This location is least disruptive to the normal functions of the terminal and crowd control planning needs to be considered.

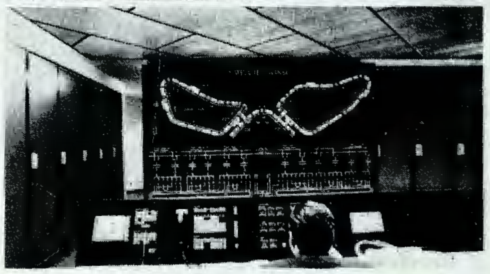
Hugh Stratford

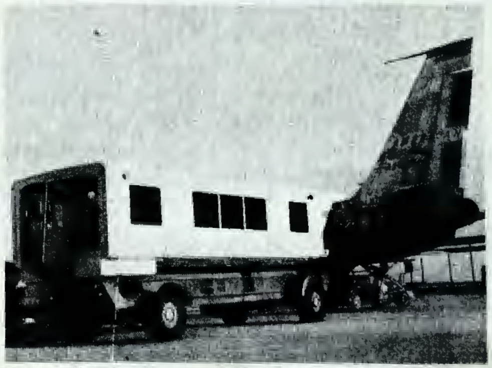
Idaka



American Airlines

Westinghouse





tic transit and baggage handling systems
ov in these photos. Baggage pickup
a ea-Tac is above. Sea-Tac transit
and control center are at top right.
's satellite shuttle is top center and the
stem at D/FW is at bottom center. A
nge at Dulles International Airport
wn at bottom.

Charlotte plans for growth toward thriving 1980's

A new terminal is currently being planned for Douglas Airport in Charlotte, North Carolina. This community is one of those in the southeastern part of the United States showing spectacular growth and is potentially a major city of the 1980's. Aviation has good public support, the city is financially solvent, well managed and the airport has potential runway capacity through the year 2000. Runway capacity is the limiting factor to most existing airports. A few pertinent facts demonstrate the planning problem.

Aircraft gates: 16 at the existing terminal, 22 wide-body gates by 1980 and 40 by 1990. A planners guide to terminal size is gauged by gates, as it is the key to its geometry. If the wide-body gates were converted to conventional gates the numbers would be 26 and 48—a large terminal by anyone's measure.

Transfer activity: surveys reveal that over 30 per cent of the passengers at Charlotte transfer compared to an average at many airports of 10 per cent. There are strong indications that the percentage may increase substantially due to changes in airlines routings. Aircraft gate requirements will be further increased by this type of activity.

Vehicular activity: During the 20-year forecast period, the average annual daily traffic (AADT) will rise to 19,000 vehicles, a 500 per cent increase. The number of vehicles will not be affected by the rise of transfers except as schedule service improves over the years.

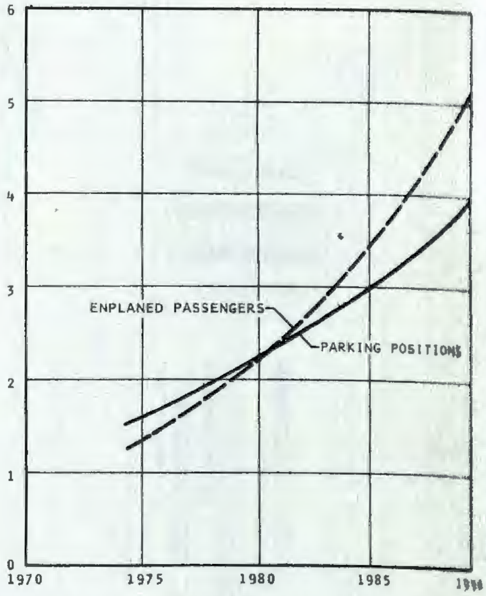
A new terminal is currently planned for occupancy by 1980. Various configurations have been studied such as; 1) a frontal gate and concourse scheme, 2) a satellite boarding area system, 3) a transporter concept and 4) a conventional unit terminal scheme. These ideas were evaluated by the city with the assistance of the airlines. Subsequently, the airlines' ideas evolved into their schemes A/L-1 A/L-3 (see sketches).

It was determined that the airlines' schemes tied up too much of the site. Subsequently, the consultants developed schemes 2A and 2B which place the terminal unit in a more central position on the site. Redevelopment for 60 or more wide body jets has been allowed.

These schemes provide for a transportation system to take advantage of the interior of the site with various options available on the type of device to be used. Virtually the entire second level of the terminal is secured so that transfer passengers can move between gate units with ease.

Parking is provided on the site with provision, when economically justified, for close-in parking structures. Consideration is being given to remote, on-grade parking as well, with a people-mover evaluated against the cost of the close-in structures.

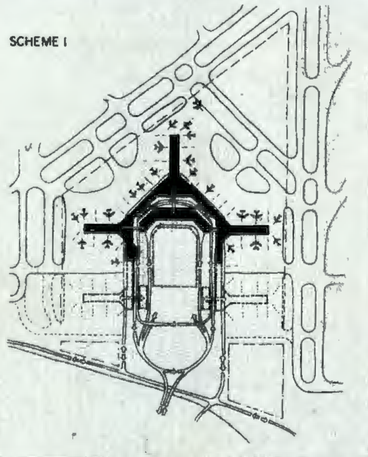
Access routes will be provided from two locations, and a tunnel connecting a cargo site on the south side of the airport is under study.



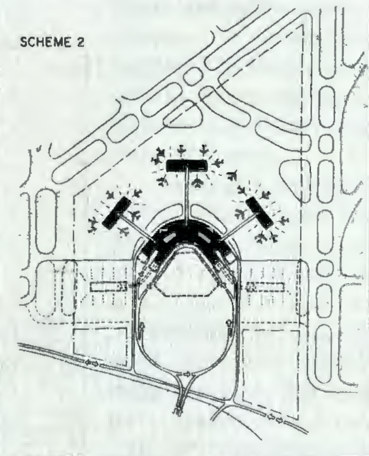
AIRCRAFT PARKING POSITION FORECAST

These concepts are being refined at the present time to permit funding in 1974 and construction by 1976. Indications are that the $40,000,000 program can be developed at an amortized cost of somewhat above $1 per enplaned passenger. With the explosive growth possible at Charlotte, the program must be kept flexible as long as practical. But the concept must be put to the test to meet the challenge of the 80's.

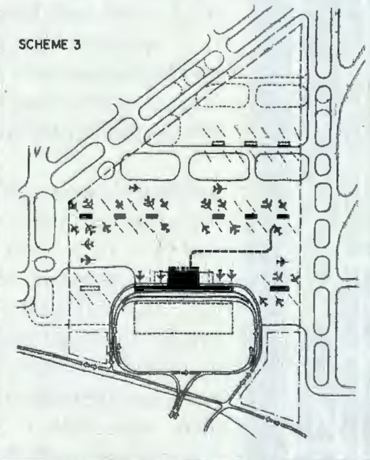
SCHEME 1



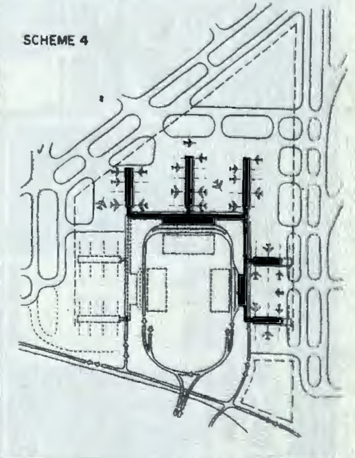
SCHEME 2



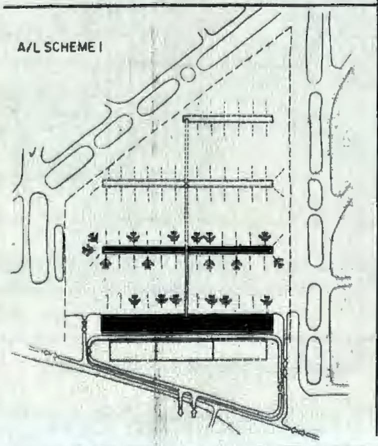
SCHEME 3



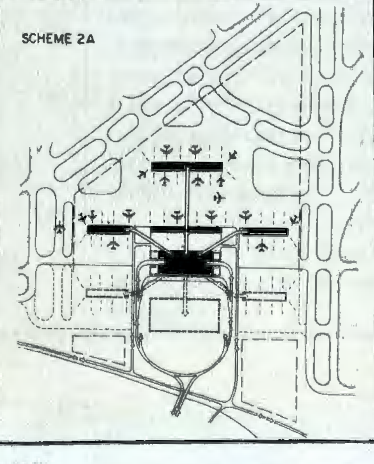
SCHEME 4



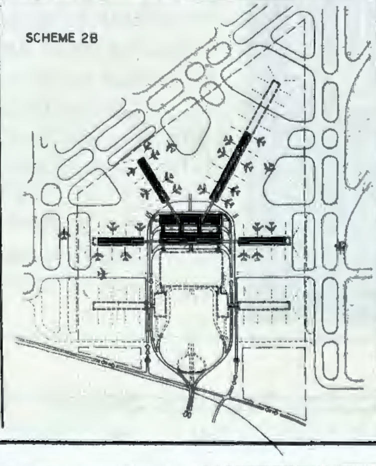
A/L SCHEME 1



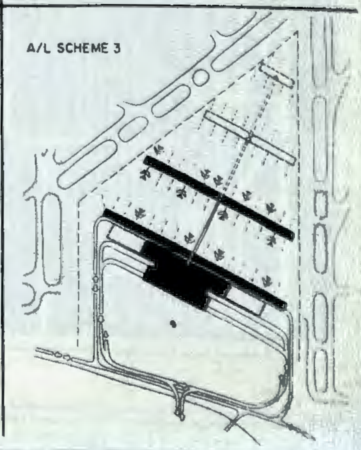
SCHEME 2A



SCHEME 2B



A/L SCHEME 3

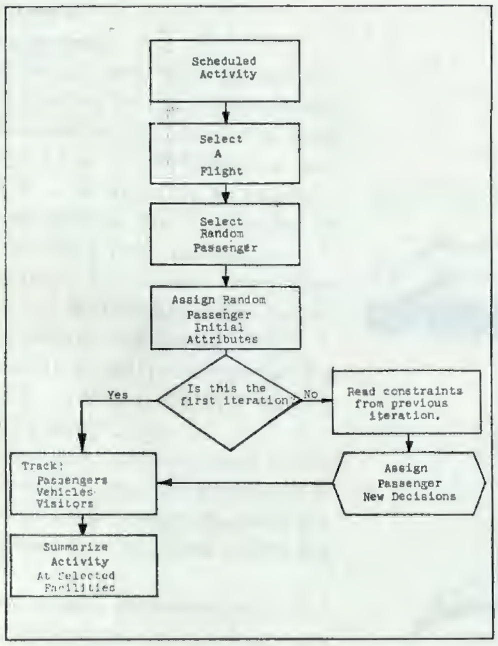


When the BHA input gives the German firm a definite stipulation as to how traffic and space will relate, the next step is to test the proposed design solutions. The German firm is meticulous about receiving the assurance of BHA that proposed internal transit devices will indeed work in the spaces to be provided, and no submission is made to the airport authority until there is a concurrence of view.

There are several salient points. The circumstances of the drive-to-the-gate user are one problem. The user arrives at what has been called, in reference to early design proposals for the new Paris Airport, a string of pearls. This concept, a series of ovoid terminal complexes, was developed as long ago as about 1952. Adler reminds us that the string of pearls falls apart if there is not a substantial string in it. The string at Munich, then, becomes the internal transit system.

The development of a realistic approach to such a transit system relies on authentic flight schedule data, which the airport authority did not have readily at hand. Their suggestions as to flight schedules were largely theoretical and did not contain data giving numbers of passengers classified as to destination or ground movement or probability of early or late arrival or departure. It is necessary to plot such factors of variation in order to simulate and observe the probable impact of real commerce on the airport facilities.

So the first question BHA had to ask was: What are the actual characteristics of your printed schedule today, and what has really happened in the traffic conditions it reflects in terms of individual movements of planes and people? While the question had never been analyzed by the Munich authority, BHA pointed out to them that a definite answer to it was the only valid basis for the kind of projection that was necessary. Further, the basic was a review of the records of the existing control tower in Munich. There, it was discovered, the most minute records had been kept regarding aircraft arrivals, types, loading destinations and passengers, and all information affecting the movement of people. These data were then related to the existing printed schedules, and the actuality of deviation became apparent, although the detailed labor of computerized analysis was monumentally complex.



Demonstration of the Brodsky, Hopf & Adler approach to computer simulation of airport traffic projections.

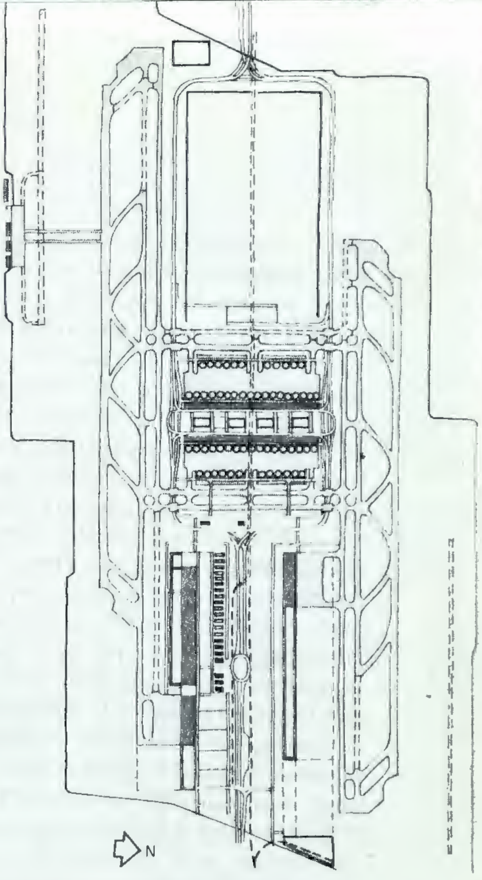
Programming the data and projecting the results into a realistic future were specialties BHA brought to bear on the job. By methods of simulation and analysis, the answers to surprisingly specific questions are attainable. For example, when will an airline introduce a new kind of airplane? Logically, they will introduce a new airplane at a peak period since the purpose is to absorb surges of profitable traffic. Having developed the first rough cut of initial and projected flight schedules, the movement of people and the peaks wherein new aircraft might be introduced are beginning to be established.

The next step will be to suggest to the airport authority the operational methods that might best accommodate the emerging patterns of future traffic. These patterns will relate not only to schedule proposals but to actual assignment of internal traffic controls. When these data and proposals have been related to the work of the German firm, the U.S. firm will then be ready to make physical proposals of the transit systems for the airport—the string—so that both transit and building design can proceed concurrently at a pace now projected for early 1974.

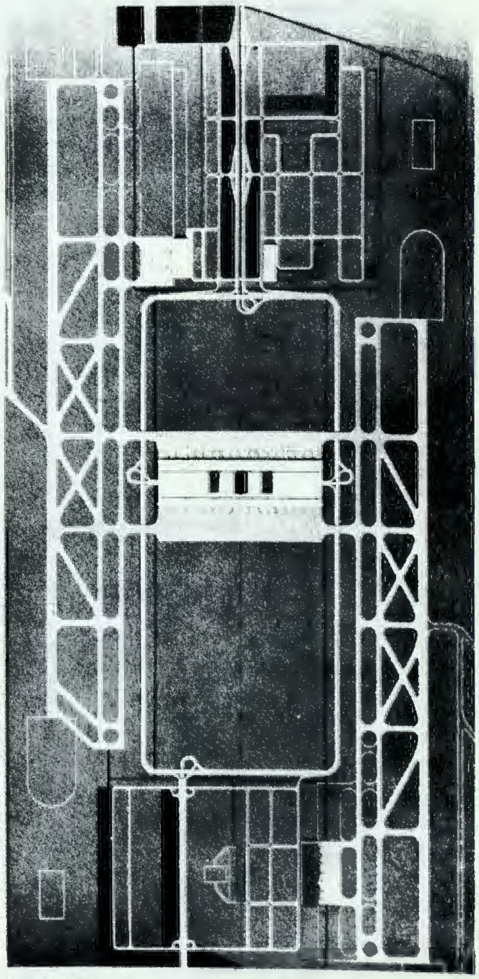
The simulation task extends beyond the periphery of the Munich Airport in that the data describe origins and destinations of all aircraft on an international basis. The study, then, must extend to projected characteristics of all these destination ports—and they range from London, to Scandinavia, to Moscow and beyond. The information is then translated into growth rates projected for each of the destination ports and the consequent impact on the Munich Airport.

Another factor affecting growth patterns and schedules is the probable change in airplane characteristics not only as to size, but also to speed, since both passenger loading and times of arrivals and departures will be affected. Not only is a given flight time shortened by higher speeds, but the optimum departure time, that is the required lead time for a desired arrival time at destination, will shift with these changes. It then becomes an operational and financial decision as to the inducements in ticket cost that might be applied to evening out the loading of the overall airport traffic. The computer is again enlisted to sort out the optimum controls by pointing out conflicts and peaks that may require one kind of attention or another.

"As architects," says Richard Adler, "we cannot walk away from our responsibility to probe and respect the realities of growth and change."



Current master plan for Munich Airport as of December 1972 is shown above. Model photo of the Becker/Kivett & Myers competition submission is below.



ʼHILADELPHIA PHASES INTO A GROWTH PATTERN

adelphia the growth of airport facilities her as dynamic nor as urgent, as it is in me other cities. One reason is that, although e city itself is commercially dynamic, its po- on the seaboard between New York and ington is such that many international air elers tend to book their passages through e the other cities. The airlines themselves nded to encourage that tendency, per- because there is no airline with Phila- phia as a home base. For the domestic inter- veler, it turns out that the distances from lphia to other coastal cities is so short t ground commuter travel is often as con- nient as air travel. Nevertheless, the very Philadelphia as the nation's fourth-larg- with far flung commercial interests, nerated a strong growth potential in spite the inhibitions mentioned. The existing air- g cramped in minimum facilities, de- a condition of crowding and chronic that overrode the inhibitions cited even they were compounded by a series of tration changes. The stop-and-go of Vincent G. Kling & Partners, on am since 1967 for implementation of a plan, finally reached a node of deci- July 1972, the Philadelphia Art Com- sion approved plans and model of a 0 million construction that will eventually rebuild Philadelphia International Dan Peter Kopple, Kling's partner-in- ge of the airport project, describes the g and development process (see), August 1968) in the following ex- his full report.

background
anning process

Philadelphia International Airport sys- eing developed on the 2,500-acre site esent airport (located about nine miles t of the City of Philadelphia) and the City and region by an extensive and rail network. The three major re- s demanding a new facility are:

forecast of 27,000,000 annual pas- 1995. (7 million passengers passed e present terminal during 1972.)

orecast of 22,000 passenger parking 1995. (5,000 passenger parking rrently available.)

panded gate positions and apron commodate the 2nd generation of jumbo jet airplanes introduced in the well as future airplanes scheduled later.

phased design, documentation, and tion of 16 separate bid packages are successive degrees of comple- manent improvements to increase of the terminal, the airfield and stems. The total facility—an in- portation system—is proposed to Delaware Valley's air transportation through 1995.

ning for Philadelphia International Airport (PHL) started with the development of interim facilities to make the existing structure, built in 1953, suitable for the needs of the early seventies. Interim work, defined as Phase I, was to allow service to continue at normal levels while Phase II, so-called "permanent construction," was being built.

Phase II has been designed as an infrastructure sufficiently flexible to provide ground-to-air interface until the air space, airfield and highway systems of the present site are saturated.

The first stage of interim improvements, called Stage I-A, was completed in early 1970. It increased the number of gates from 25 to 39. Each gate includes a new loading lounge, constructed on the second level, flanking the existing fingers and connected to the aircraft by enclosed loading devices.

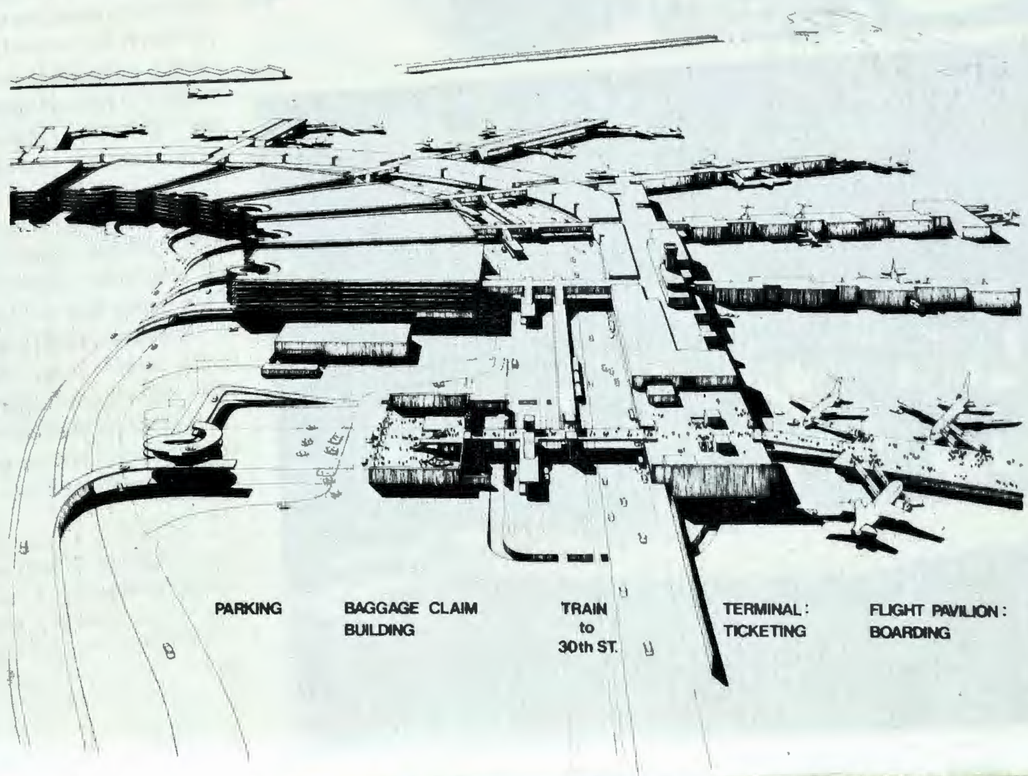
To facilitate rapid execution without curtailing airport operations, the Stage 1-A construction utilized light steel framing, metal panel walls and a system of heating, ventilating and air conditioning units deployed on a modular basis.

Stages I-B and I-C, which improved the existing ticketing and baggage facilities in the body of the old terminal building, were completed in early 1973.

Phase II-A, the first step of the second phase, now being implemented, is based on a system of circulation patterns and related buildings. The master plan (see sketches below and next page) envisions a continuum of eight unit terminals spanning a transportation corridor containing all forms of ground transportation in segregated rights-of-way. The terminal area is serviced by three multi-lane, limited access, integrated roadways linking the airport with Interstate I-95 and a proposed Cobbs Creek interchange, prime elements of the regional highway network. Each airport roadway will carry a segregated flow of traffic: enplaning and deplaning passengers using the garages will enter and leave on the garage roadway; deplaning passengers leaving the airport by taxi, bus and automobile will claim their baggage and depart by the deplaning road; outbound flight passengers arriving in roadway vehicles will arrive on the enplaning roadway and enter directly into the terminal. A mass transit line is being developed between Center City Philadelphia and the airport. Existing rights-of-way and trackage will be utilized, and the mass system will have stations between each pair of units in the eight-unit terminal development.

The terminal system is a series of bridges

Each terminal unit is an elevated passenger bridge connecting aircraft positions to separate grade level structures for check-in, baggage claim, mass transit access and garages. One structure, adjacent to the garage, will be reserved for deplaning passengers exclusively, with baggage claim and rental car functions.



The second structure will provide ticketing and baggage check-in for enplaning passengers at grade, with concessions and waiting spaces at the upper level. An intra-terminal people-movement system will ultimately be provided, accessible from the passenger bridges, to connect the elements within the continuum of terminals at the airport.

Flight pavilions are a linear continuation of the passenger bridges which will accommodate passengers' and visitors' waiting spaces tailored to each airline's needs. Enclosed loading bridges will connect these spaces to the aircraft at each gate.

The master plan has been developed to include parking for approximately 22,000 cars, in eight garages. Vertical circulation cores in the garages are a part of the terminal pedestrian system, and lead directly to the passenger bridge which is the spine of the transportation level. No garages are included in the first phase of permanent expansion; however, structured parking will be provided as the demand increases sufficiently to insure their economic feasibility. It is hoped that two of the garages will be developed by the completion of the II-A package now under construction.

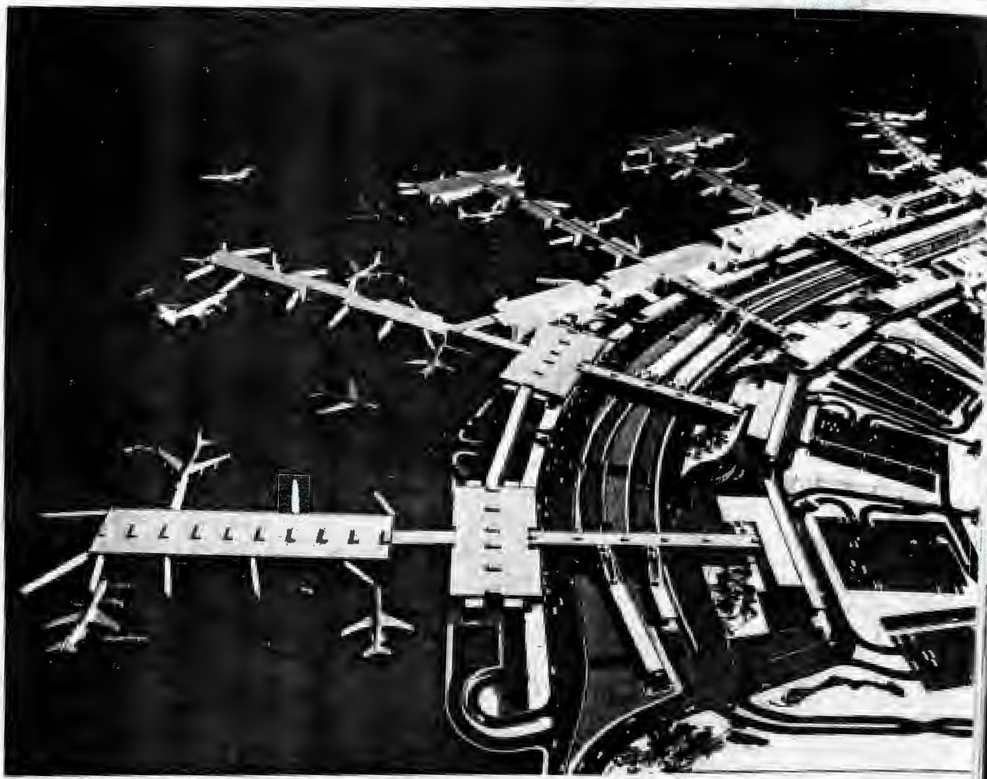
The entire complex will be built in five construction stages. The construction of the first stage (Stage II-A), started in the spring of 1972, will cost approximately $120,000,000. Stage II-A will include one terminal unit west of the existing structures and one to the east, plus modification to the existing terminal to change its functional patterns to be consistent with the new facilities to be provided.

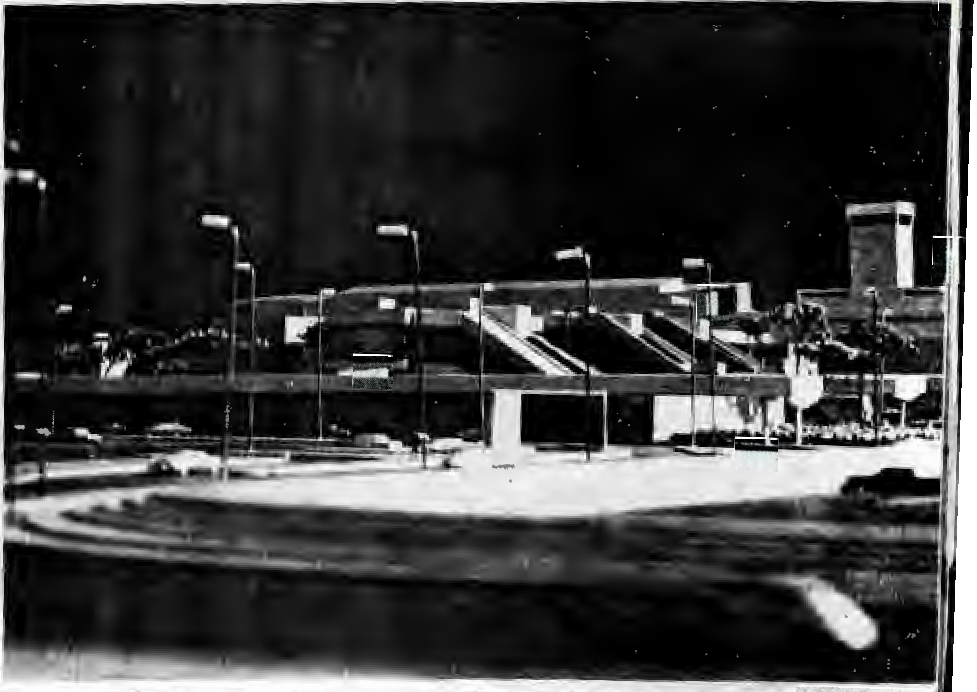
All building elements of the complex will have a precast structural system of columns, girders and tees, organized to accept units of a modular mechanical heating, ventilating and air conditioning system. The precast structural elements will be the structure, finished exterior surface and interior surface of the building.

The airport is owned and operated by the City of Philadelphia, and much of the credit for putting through a viable plan for growth goes to Harry Belinger, Director of Commerce; William T. Burns, Deputy Director of Aviation; Gordon Jacobson, Division of Aviation, Director of Planning and Engineering; and to Ed Foster, the city's project manager of passenger terminals areas. Development of the plan had a similar multiple backup in the Office of Vincent G. Kling & Partners. In addition to Dan Peter Kopple, partner-in-charge, was Richard J. Sheward, lead staff architect, who was the coordinating architect for five task group leaders who, in turn, gave special attention to various segments of the work. These group leaders were: David Doelp, John Di Ilio, Peter Simoncelli, Donald Snyder and Mark Spitzer. The Kling team working on the airport project has varied in number from 8 to 35 people.

PHILADELPHIA INTERNATIONAL AIRPORT. Architects: *Vincent G. Kling & Partners—partner-in-charge: Dan Peter Kopple.* Engineers: *Urban Engineers, Inc. (structural and civil); United Engineers & Constructors, Inc.* (mechanical/electrical). Consultants: *Arnold Thompson Associates, Inc.,* (airport master plan); *Peter Muller-Munk Associates, Inc.,* (graphics); *Meridian Engineering, Inc./MCM* (construction management).

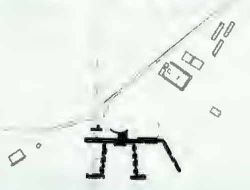
Harris Davis



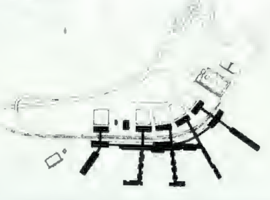


Harris Davis

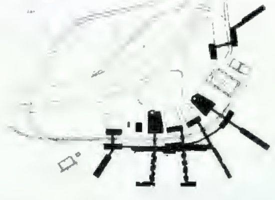
STAGE 1



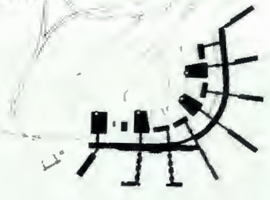
STAGE 2A



STAGE 2B



STAGE 2C



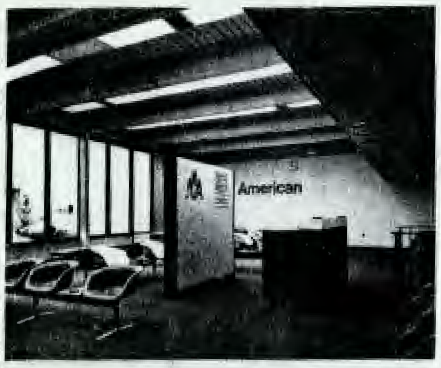
Stage 1
new ticketing and baggage claim
new boarding lounges
new loading bridges
39 aircraft gates

Stage 2A
new roads and mass transit system
three new baggage buildings
two new terminal units
60 aircraft gates

Stage 2B
new interterminal transit system
new parking structure
new international terminal unit
69 aircraft gates

Stage 2C
completed road network
new parking structure
two final terminals
87 aircraft gates

Tom Crane



SEA-TAC, A GIANT THAT CARES FOR PEOPLE

eattle-Tacoma International Airport is nearing completion of a $175-million expansion pro- am that began (at substantially lower pro- cted costs) in 1966. At that time, the annual passenger load was 2.8 million, stretching the capability of the 25-year old existing facilities. rowth projections showed a probable traffic more than 13 million passengers by 1980. Although recent slowing of the growth rate eems to modify that figure, there is no doubt at a continuing rise in airplane traffic nation- ly will prevail over the long term.

The facilities at Sea-Tac are such that trav- ers with an option are likely to favor this air- rt. It is the most highly automated large facility among the giants finished in this decade, and it went through its development phases in e more opulent years of the late 1960's. Both e Port of Seattle and user airlines were willing to invest in development of an automated eople-mover system and baggage handling stem, thus opening the options of the plan.

The over-all plan, regional in scope, is the result of a cooperative effort among a long list participants and consultants, whose efforts ere focused through the joint planning capabilities of The Richardson Associates, architects and engineers, and the planning staff of e Port of Seattle. The plan strives for maxi- um use of the existing site, which has the advantages of convenient location to both Seattle and Tacoma and a long history of port owner- ip. Although the site is constrained by sur- unding development, including highway connections, topography and limited acreage, has sufficient potential to warrant intensive evelopment.

Basically the current phase of expansion provides an extension and redevelopment of e existing terminal plus two remote satellite ite facilities and a 4,300-car garage close within the chevron shape of the main terminal. A new cargo area is also being developed. All these facilities are inter-connected by auto- ated transit systems and an integrated baggage handling system. The result is an airport with somewhat more capacity than actual cur- nt use requires, but one that will remain onomically operable for at least the full period of current projections.

me extra space now may save money later

There have been some critical observations of extent to which the facility exceeds current uirements and of the increased cost resulting from inflation and "over-mechanization" with the combined effect of increasing landing fees a me when airlines were facing financial oblems of their own. In spite of the slow down in traffic and the decline especially in ilitary traffic, there is now an upturn from the ateau of 4.5 million passengers that prevailed from 1968 through 1971. Some of the airlines, United for example, registered a 12 per cent gain in the first quarter of 1972. That and the concurrent experience of the airport in general support the projected growth rate of about 10 per cent, so that the airport should reach near-capacity about 1981. By that time, it is hoped that the port will have proved itself and alleviated the unhappy second thoughts of airlines that almost immediately followed their optimistic surge of initial investment in the giant parking garage and automated people movers. The existence of these facilities will perhaps bear out the judgment of that investment, and the landing fees, now high by national standards, will in all likelihood remain more stable than those of less advanced airport designs.

In this regard, the architect makes the following observation: "The airlines make the basic projections and based on these they determine their space needs. This, in effect, becomes the program and therefore if the demand figures are not realized then overbuilding results. I might note that this is not a calamity but generally results in the building of a facility that is more than sufficient for the traveling public during its first years and not subject to additional construction immediately following the completion of the project; a situtation which often is the case when initial projections are realized or surpassed. One other clarification; on the basis of square foot costs and quality of facilities provided, the Sea-Tac project costs look very attractive when compared to other airports built during the same period."

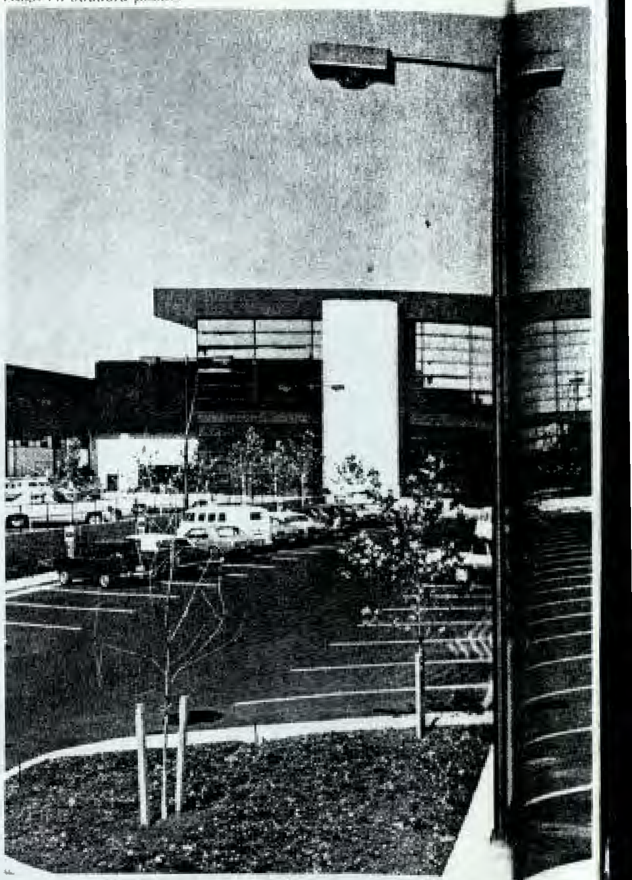
The ultimate in traditional design approaches

In contrast to the drive-to-your-gate concepts emerging in some of the newer airports, the development at Sea-Tac follows a more traditional approach in that the Port authorities and architects considered the convenience of the passengers worthy of investment. That is, if the facility spends money and design logic on costly garage space reasonably close to the terminal and then makes it possible for passengers to travel a well-coordinated people mover while their baggage is handled and transported automatically, this may indeed increase the landing fees temporarily but it is perhaps a more durable solution than some of those which attempt to circumvent such expenditures by other configurations. The systems at Sea-Tac will result in a maximum walking distance between ground vehicle and plane of about 600 feet—and that is from any airplane to any ground vehicle whether at curbside or parked in the huge garage. The consequences in the long-term adaptability to changes in both terminal tenancy and air travel modes seems a substantial plus.

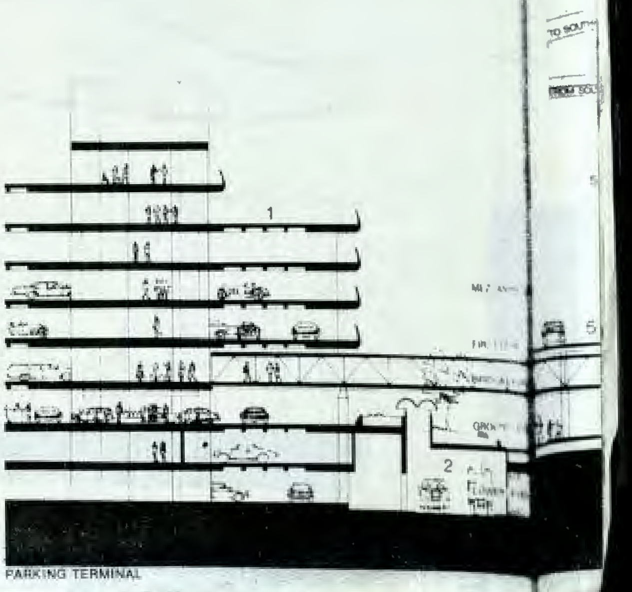
The following specifics of the design are extracted from a report prepared for a May 1972 Airport Forum by E. K. McCagg, assistant project architect.

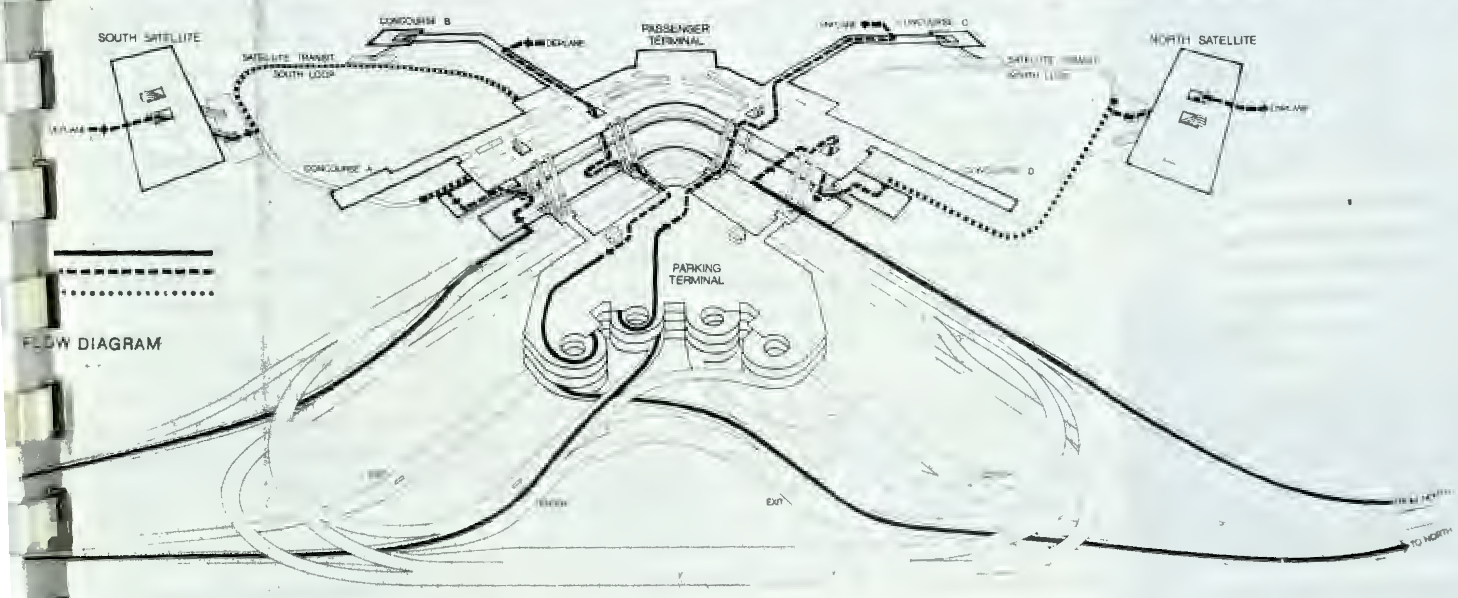
The completed main terminal without satellites provides 37 gates, their distances from

Hugh N. Stratford photos

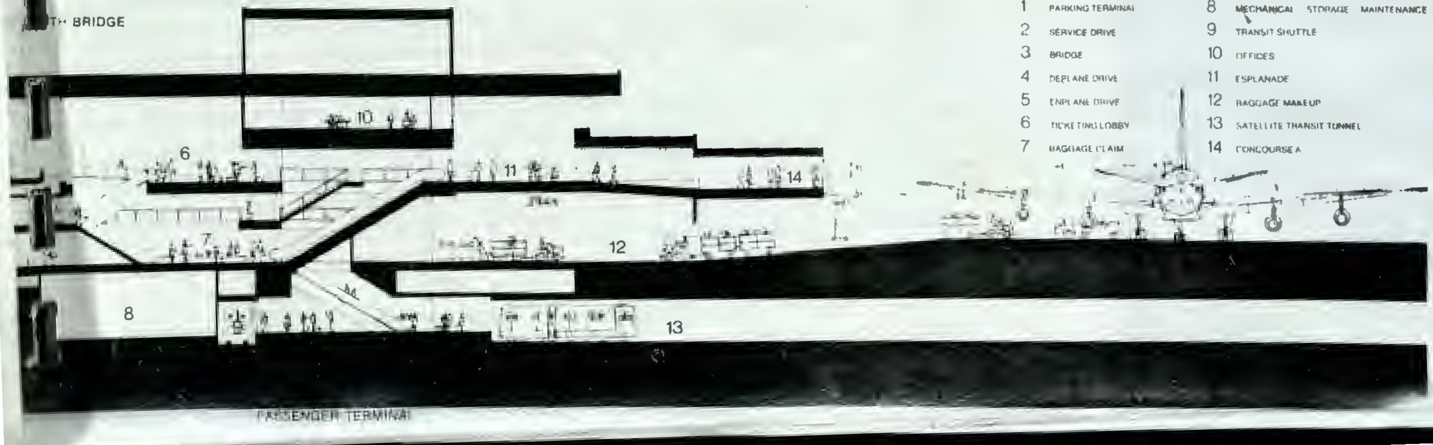


Automobile traffic areas, which include the parking terminal are constructed with lightly sand-blasted concrete. The passenger terminal by contrast is constructed with steel framing and is enclosed with an aluminum and glass curtain wall that faithfully represents the internal flexibility and openness of arrangement of the terminal. Short bridges connect the enplane drive and the terminal at each entry to the building and allow the remainder of the curtain wall to run free of the drive.





FLOW DIAGRAM



1	PARKING TERMINAL	8	MECHANICAL STORAGE MAINTENANCE
2	SERVICE DRIVE	9	TRANSIT SHUTTLE
3	BRIDGE	10	OFFICES
4	DEPLANE DRIVE	11	ESPLANADE
5	ENPLANE DRIVE	12	BAGGAGE MAKEUP
6	TICKETING LOBBY	13	SATELLITE TRANSIT TUNNEL
7	BAGGAGE CLAIM	14	CONCOURSE A

PASSENGER TERMINAL

the terminal entrance varying from 215 to 570 feet for enplaning passengers, and from 265 to 620 feet for deplaning passengers. The key circulation systems which radiate from the central passenger terminal include underground transit lines to the satellite passenger terminals, baggage conveyor lines serving enplaning and deplaning passengers, service driveways, separate driveways for arriving and departing passengers, and pedestrian bridges connecting the passenger and parking terminals. All these are interlaced at various levels of the terminal, to coordinate their functions with passenger traffic and airline requirements.

An automatic baggage system is almost ready to work

On approaching the terminal area, car drivers are directed to the terminal curbs to drop-off passengers, or (after shakedown of the baggage system about the end of this year) to the automobile baggage check-in (ABC) where they may check their baggage at airline curbs in the parking terminal, or directly to parking stalls. Terminal curbs, check-in points and parking terminal are all identified in sections according to the nearest airline ticketing location, thereby reducing pedestrian walking distances. Rental car users may also avail themselves of the auto-bag-check before returning to the drive system. Those who drive directly to the parking terminal are guided by automatically operated signs on the entering spiral ramps to the available parking areas closest to the airline with which they are concerned.

Approach to the ticket counters for those who are dropped at the terminal curb is through automatic doors into the ticketing lobby. ABC pedestrians climb one flight of stairs, or take nearby elevators in the parking terminal, and walk for a short distance along a mezzanine to the glass-enclosed bridge leading to the passenger terminal. Pedestrians who have parked their cars walk to the nearest elevator core and ride to the fourth floor lobby of the parking terminal which opens onto the pedestrian bridge. The bridge user, on crossing to the passenger terminal, ascends by escalator to the ticketing area.

Once ticketed, the passenger is directed across the esplanade to the concourses or to the escalators which lead down to the satellite transit system. The esplanade will also provide access to toilets, lounges and a variety of concessions.

An automatic transit system shortens walking distances

The passenger can walk to nearby plane positions in the concourses, or takes the escalators down to the satellite transit system for access to the more remote gates. In the latter case, he boards transit vehicles for a short ride to either the north or south satellite where he is directed up escalators into an independent terminal building, which is ringed with gate lobbies and is served by a core containing additional services and concessions. The far ends of concourses B and C are also reached by use of the satellite transit system.

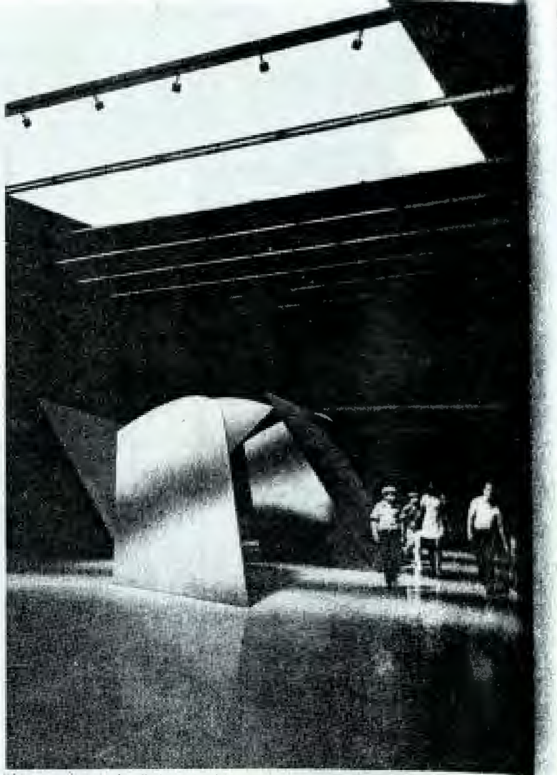
At the ABC islands and at the ticketing counters, check-in devices of the baggage conveyor system are installed that receive baggage to be conveyed automatically to appropriate baggage make-up areas from which the baggage is carried by cart to the planes.

The arriving domestic passenger from the close-in plane positions walks to the terminal where he will be directed down an escalator to the baggage claim lobby. From the satellites he returns via the satellite transit system to a terminal station before going up one escalator to the baggage claim lobby. The international arrival is guided into the international corridor, down escalators and into the arrivals hall where he will be processed through Immigration, Public Health and Customs inspections. He is offered the opportunity to recheck his bags after customs inspection before stepping into a spacious greeters' lobby and prior to boarding the transit system. On his arrival at the central terminal he may then claim his bags in the baggage claim lobby. After claiming his bags, the passenger is able to step out to the terminal curb to be picked up, or he may take an escalator up to the pedestrian bridges which cross into the parking terminal. After exiting through the spiral ramp system and toll plaza, drivers who are leaving the parking garage can pick up passengers at the terminal curb, or they may drive directly out to the freeway system.

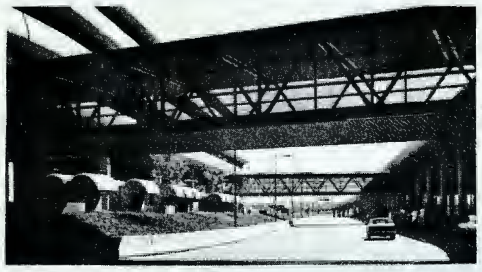
The passenger terminal separates its two principal passenger functions by floors. The first level serves the ticketing and baggage-check-in functions. These are positioned along the east side of the first level between the enplane drive and the concourses. This level also contains passenger lounges, restaurants and concessions. Additional public spaces and terminal offices occupy the mezzanine level which is located above the first level airline ticket counters and offices.

The ground level is adjacent to the deplane drive and houses the baggage claim area and baggage handling areas. The baggage make-up rooms at this level receive incoming baggage by conveyor from the first level ticket counters. From here it is dispatched directly to planes or to the satellites. Baggage from the automobile baggage check-in stations in the parking terminal is also conveyed to this level and is handled similarly. The entire terminal complex will be served by baggage carrier vehicles which circulate between these baggage rooms and connect with each of the terminal buildings. Deplaning passengers pick up their baggage at claim devices in the baggage claim lobby at ground level. The claim devices are fed directly by conveyor from the adjacent baggage handling rooms.

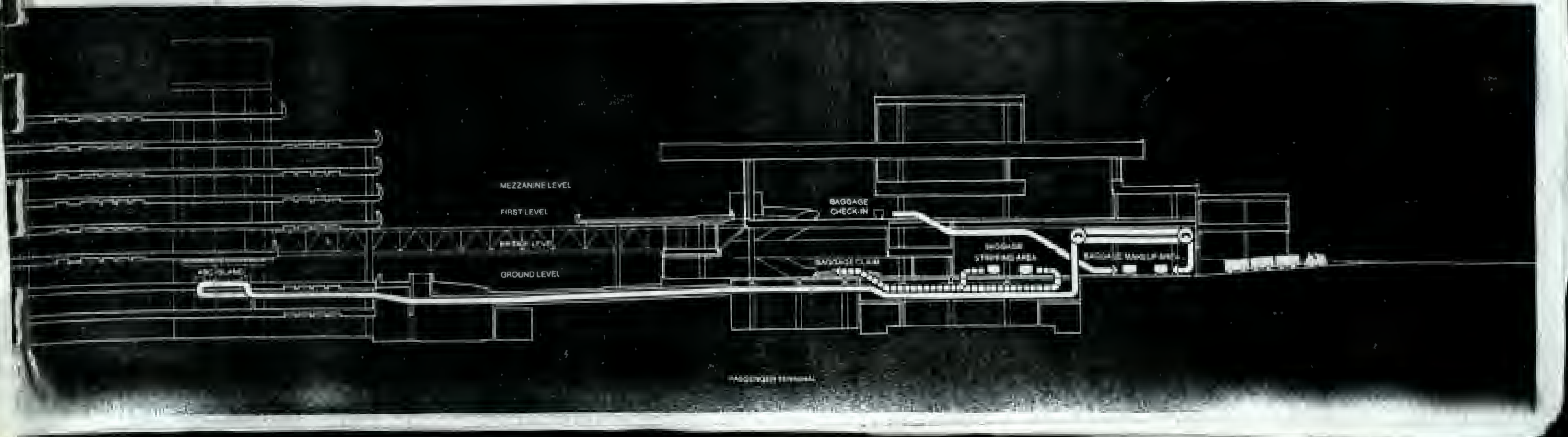
SEA-TAC INTERNATIONAL AIRPORT, Seattle, Washington. Owner: *Port of Seattle.* Architects and engineers: *The Richardson Associates; project architect: Allen D. Moses; assistant project architect: Edward K. McCagg.* Engineer consultants: *Victor O. Gray & Co., Andersen, Bjornstad & Kane* (structural); *Dames & Moore* (foundation); *Miskimen/Associates* (mechanical); *Beverly A. Travis & Associates* (electrical). Consultants: *Paul Veneklasen & Associates; Robin M. Towne & Associates* (acoustical); *Talley & Associates; Sasaki, Walker & Associates, Inc.* (landscape); *The Environmental Analysis Group* (programming and automation studies). General contractors: *Morrison-Knudsen Company, Inc., (passenger terminal); Peter Kiewit Sons' Company (parking).*



Plaza sculpture by Robert Maki

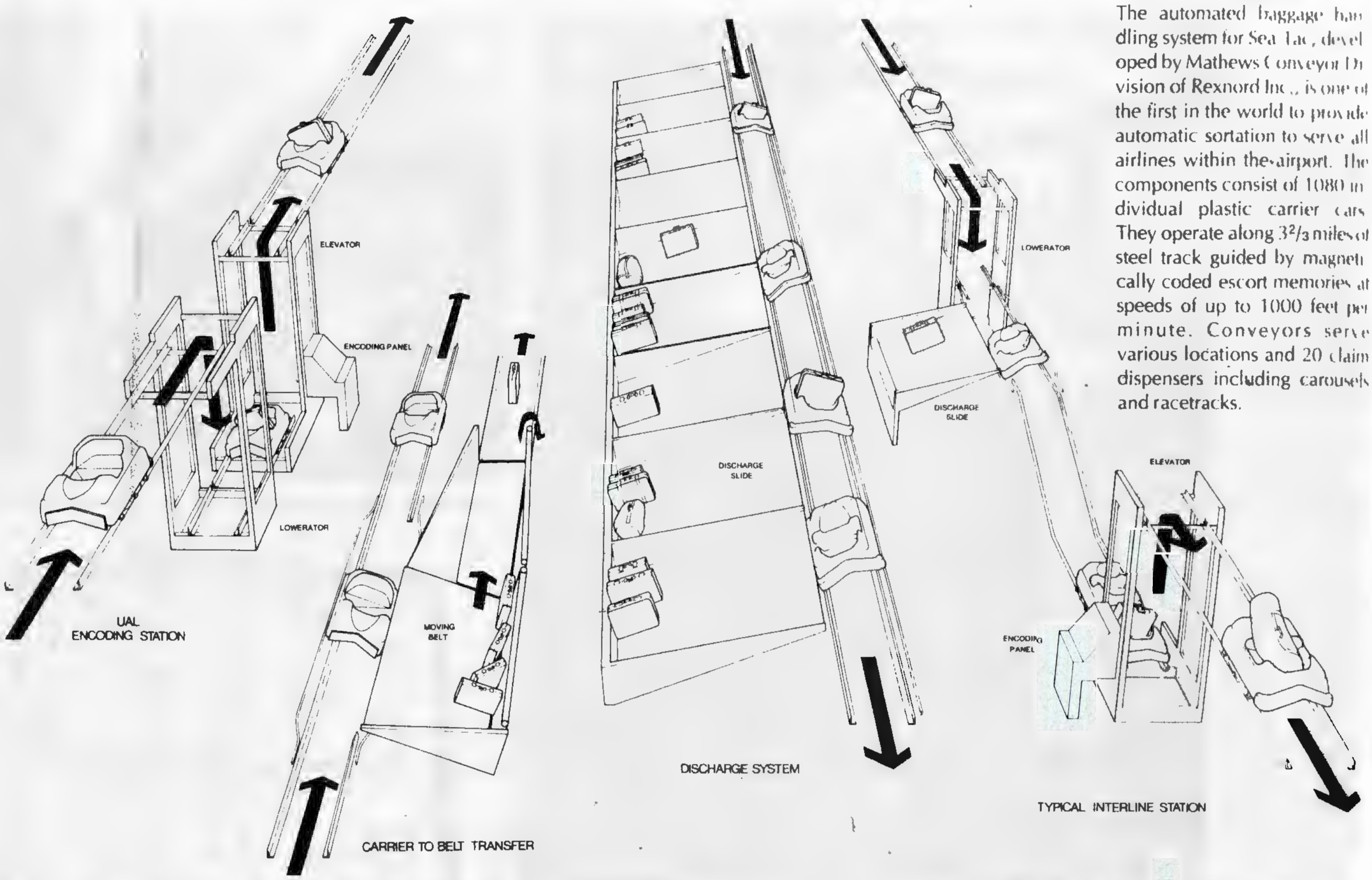


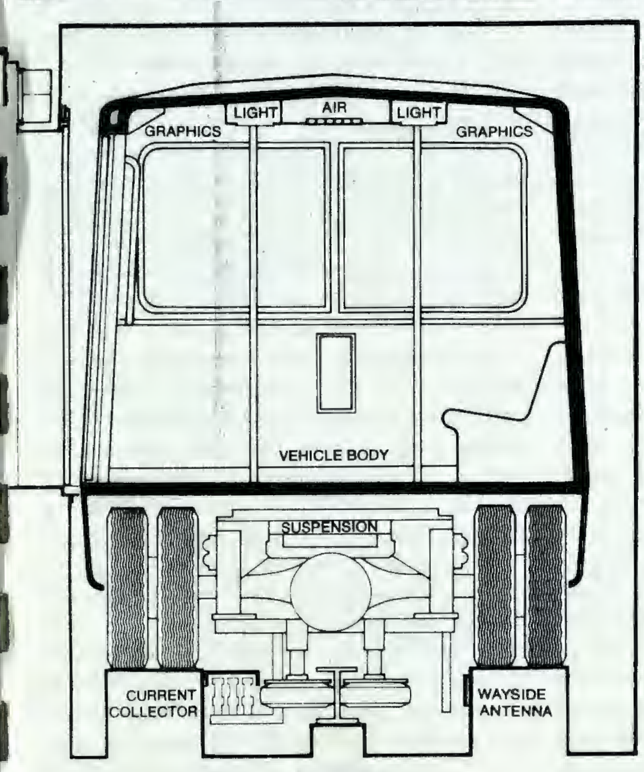
The floors in public spaces are terrazzo in the circulation areas and carpet in waiting areas. Walls and partitions display a variety of finishes, predominantly plastic laminate veneers in public spaces and columns are to be finished in black granite. Ceilings in public circulation spaces are perforated metal channels with integrated lighting systems. Offices on the first and mezzanine levels are floored in vinyl tile, with acoustic panel ceilings. The bridge connecting the passenger and parking terminals is finished to match the passenger terminal itself, entering the terminal between its ground and first levels.



Baggage handling system

The automated baggage handling system for Sea-Tac, developed by Mathews Conveyor Division of Rexnord Inc., is one of the first in the world to provide automatic sortation to serve all airlines within the airport. The components consist of 1080 individual plastic carrier cars. They operate along 3²/₃ miles of steel track guided by magnetically coded escort memories at speeds of up to 1000 feet per minute. Conveyors serve various locations and 20 claim dispensers including carousels and racetracks.





te nsit system

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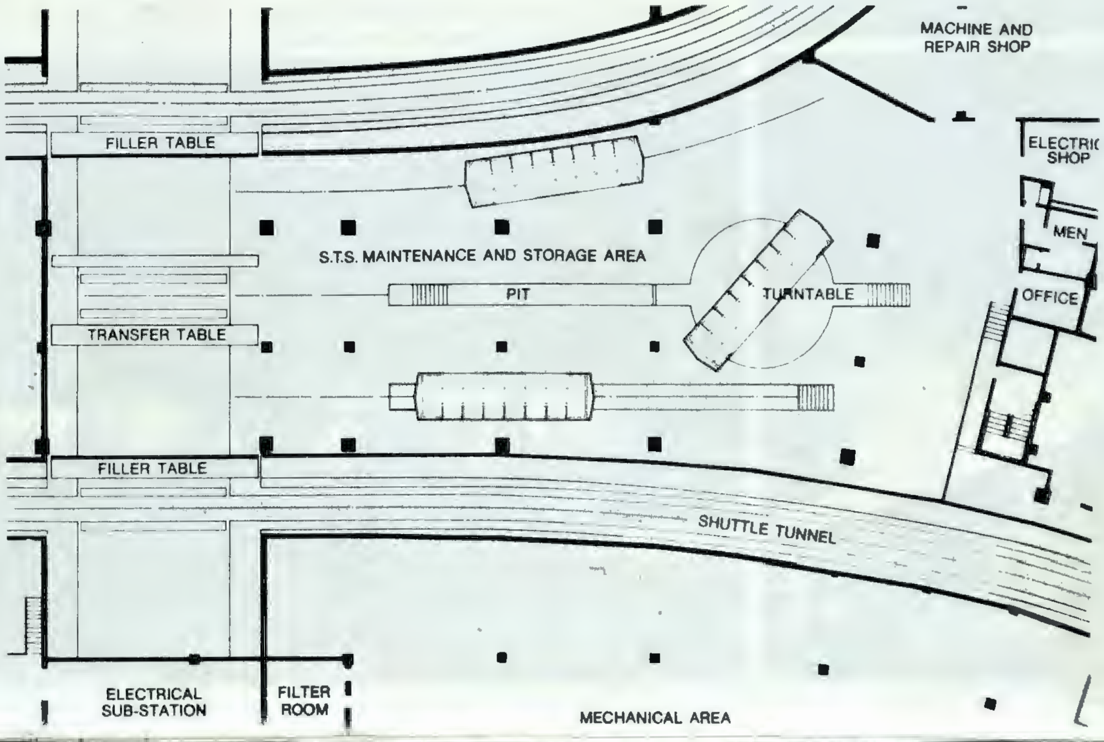


YOU CAN STILL ENJOY FLYING IN HAWAII

An airport that has stood the test of time despite substantial increase in traffic since its first-phase completion in 1966 is the Kahului Airport terminal serving the Hawaiian island of Maui. It was designed by Vladimir Ossipoff & Associates precisely to absorb a 20 to 30 per cent annual increase in traffic then prevailing at the aging building it replaces. Perhaps the Hawaiian pace has something to do with the pleasant durability of this facility. More likely, however, it is the open spaciousness of the original design and the fact that the terminal building serves only two inter-island airlines. In any case, it has handled the increases so far over its initial 350,000 passengers per year.

The state of Hawaii had established a budget that allowed a building of less than 40,000 square feet based on an estimated cost of $20 per square foot. The program developed by the architects on this premise called for a simple block form having two curbside exposures that separate the flow of vehicles and pedestrians arriving and departing. All primary functions of checking in, boarding and baggage claim take place in this space, but the baggage claim area, placed conveniently near curbside, is separated from the gate area by a 50-ft diameter circular central court. A conveyor tunnel carries baggage from the gates to the baggage carousels. There is additional baggage assembly and pickup space at curbside, and, of course, baggage sorting and dispatching space near gates at the apron level. A restaurant on the second floor level provides a view of airport traffic and the mountain background beyond. At Maui, there is a ratio of three well-wishers to each passenger and the single open lobby space with planted court provides a pleasant space for the kind of mingling that tends to be more frantic in other climes.

Although warm temperatures and low rainfall might make an open building tenable, the trade wind velocity averaging about 18 knots was a factor in screening measures adopted. The solid end of the building was turned toward the prevailing wind so that the automobile approach sides were sheltered and comfortable without being enclosed. On the aircraft side, the building is glazed as a shield against blast and noise.

A lightweight steel framing system was used in the form of five-feet-deep carrying trusses supporting three-feet-deep open web beams spanning 56 feet. The structures, resembling a space frame, uses prefabricated members. This permitted off-site assembly in Honolulu and shipment by sea to the site for simplified erection.

The exterior surfaces are composed of precast concrete fascia, welded onto the steel roof structure, built-up roofs with mineral cap sheet, copper flashings, concrete columns, pre-cast concrete wall panels (waffled on the interior side), stainless steel doors, and window frames and fixed glazing held in rubber gaskets supported on painted tubular steel mullions.

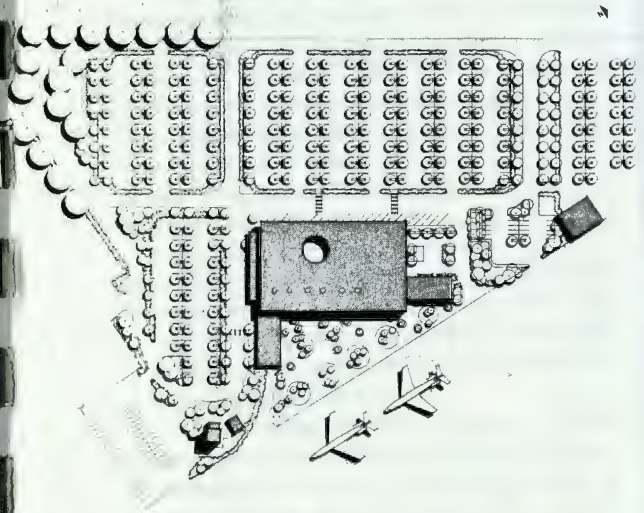
The ceiling of the structure is entirely wet plastered. The coffered form results from the five-feet-high main trusses (single and double) and the three-feet-high open web trusses. Coffered areas are acoustical plaster, integrally colored on the interior and cement plaster with color on the overhangs. The flat portions (below the main trusses) are painted plaster.

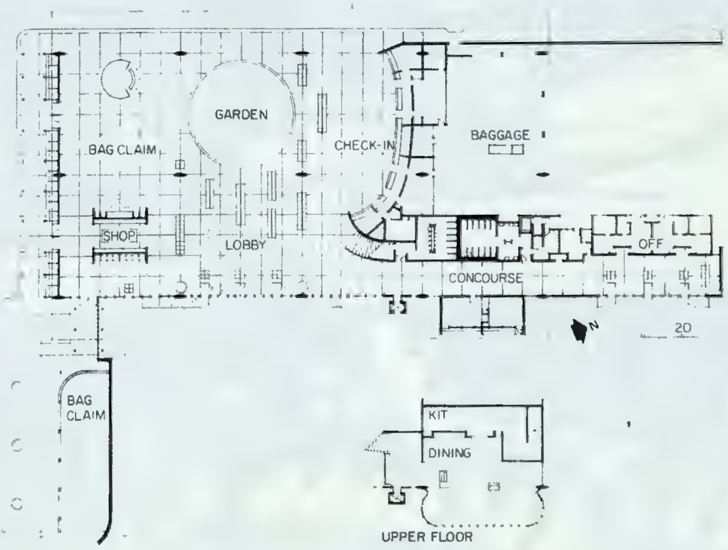
Floors are integrally colored concrete. A local wood (koa) is used for paneling. Counter tops are travertine, counter faces are tapa cloth design protected with fiberglass resins, telephone booths are bamboo lined.

It is not possible to make direct comparison between this low cost, open structured airport facility and those of the giant intercontinental terminals, but it is nice to know that somewhere the traveler is invited to enjoy.

KAHULUI AIRPORT TERMINAL, Maui, Hawaii. Architects: *Vladimir Ossipoff and Associates; Sidney E. Snyder, Jr., designer.* Engineers: *Shimazu, Shimabukuro & Fukuda* (structural); *Bennett & Drane* (electrical). Landscape: *George S. Walters.*

Wenkam/Salbosa photos





The combination of low-cost preformed systems and mild climate resulted in this low profile building designed and landscaped to reflect its south sea island location. There is not much exotic about concrete and glass, but the architect's sense of form and scale is fitting to this tourist airport.

A PERSIAN AIRPORT JUST FOR FUN

Kish is an island in the Persian Gulf approximately 8 by 15 kilometers in size. Until very recently the island was undeveloped except for two small villages with a resident population of a few hundred persons who subsisted on fishing the surrounding waters.

Because of its location within sight of the Iranian mainland, its agreeable climate and the Persian Gulf, which is excellent for water sports, the Iranian Government commissioned architects Rader Mileto Associates to prepare a master plan for the development of Kish as a tourist and recreational center including this small airport. The complete master plan projects an ultimate development over a ten-year period to include five hotels, approximately 2000 residential units (divided into individual villas and condominium apartments), recreational facilities, commercial and shopping facilities, administrative elements, schools, marinas, an 18-hole golf course and the infrastructure to support this development.

His Imperial Majesty, the Shah of Iran, encouraged the development plans by commissioning the same architects to design a small palace for the Royal Family on Kish Island, the construction of which was completed last year.

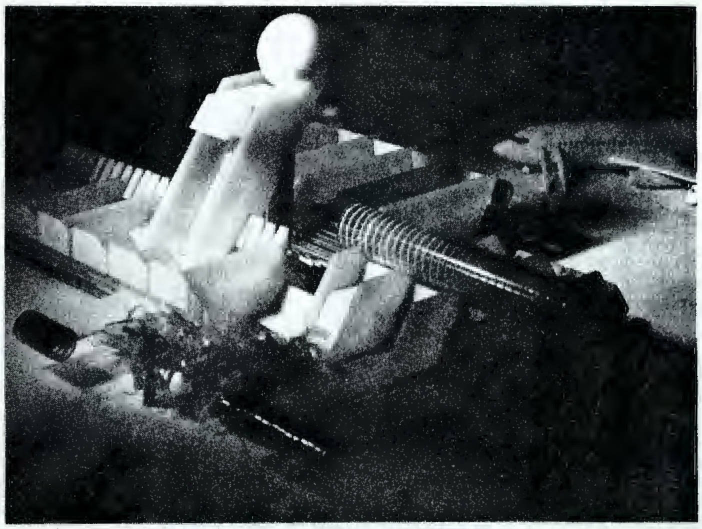
Under design development this year, the first construction phase will consist of a new airport terminal, a 200-room hotel, and the first of the housing and administrative facilities.

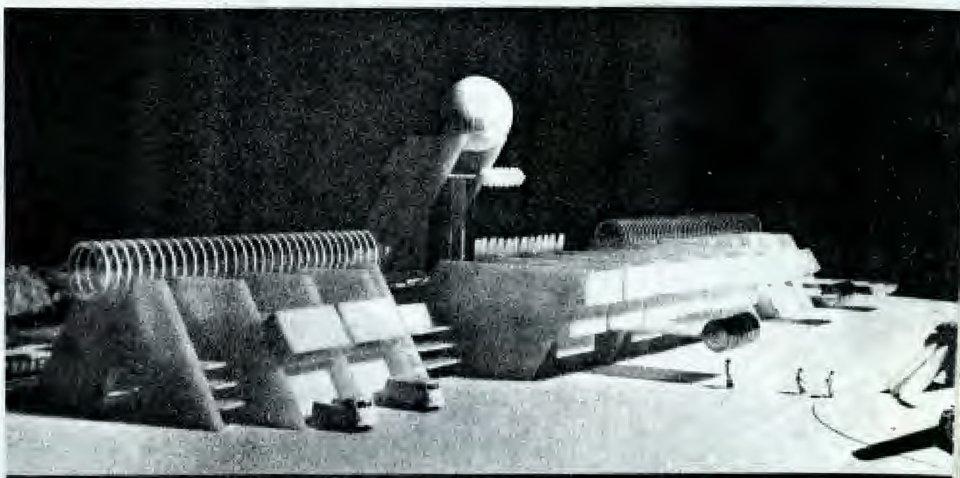
The airport will be served by a single runway and taxiway, which should serve the traffic needs for the foreseeable future. Vehicular access to the terminal is accomplished through a short road connecting to the main loop road which serves the entire island.

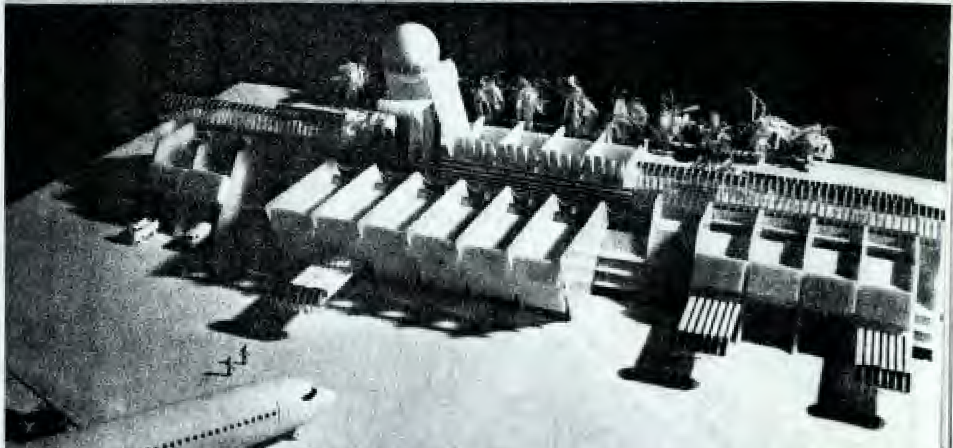
The terminal building consists of three units respectively: ticketing and check-in; transit lounge and services; and arrivals. A partial upper floor will contain offices. The project may be phased with only the center section being built initially. The total enclosed area of the project consists of 2300 square meters on the ground floor and 800 sq mts on the upper floor. The control tower is enclosed in a geodesic dome.

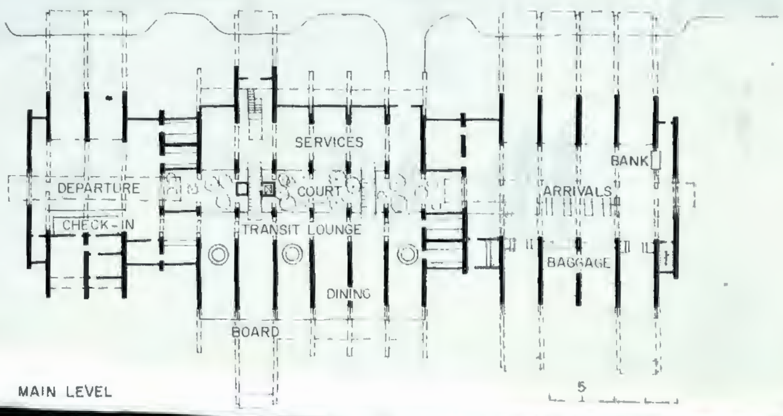
The basic design language of the project is expressed in strongly articulated pairs of raw concrete fins leaning inward for the outside units (check-in and arrivals) and leaning outward for the center section (the transit lounge area). The outward leaning fins of the center section define an inner court partially covered by the cable structure supporting louvers. The concrete will be covered with a thin coating of rough sprayed cement. All glazing will be with dark anodized aluminum sash. All public spaces will be carpeted throughout. This design language is consistent in principle with those initially established for His Majesty's palace and for other structures being planned within the scope of the master development plan—in terms of form, finish and material.

AIR TERMINAL, KISH ISLAND, Persian Gulf, Iran.









Dallas-Fort Worth: Metroplex and MegaAirport

By John Pastier

1. The Sibling

Once dazzled by the size and dynamism of Dallas, it is easy to overlook its smaller, lower keyed neighbor to the west. Like many other large urban centers, it is Fort Worth's fate to be the number two city in its metropolitan area.

But it is first among seconds: By continuing to grow to an estimated population of 410,000, it has pulled ahead of all the others in that category including St. Paul, Oakland, Long Beach and Newark. And despite its position on the wrong side of the hyphen, it is no mere satellite, but rather a city whose special character complements and balances that of its bigger sister with an almost ecological aptness.

Dallas reflects Southern, Midwestern and even Eastern influences in its development and ways of doing business, but Fort Worth is undiluted Texas. In Dallas, a Cowboy is a high-priced football star; in Fort Worth he sports a lower-case "c," wears pointy boots and hangs out at the stockyards on the city's north side.

Dallas is a place of self-made men and corporate newcomers while Fort Worth is one of influential old families. Dallas is a city full of real estate entrepeneurs dealing in an arena as fast paced and heavily leveraged as Chicago pork belly futures, whereas downtown Fort Worth businessmen have for decades built only to house their own operations and are just now beginning to include significant amounts of uncommited rental space in their office projects. The downtown Dallas skyline flashes large expanses of glass and metal, but Fort Worth's core is still mainly built of masonry.

From these comparisons one might conclude that Fort Worth is utterly conservative and unadventurous. That isn't so, according to Dallas architect James Pratt. He finds the smaller city more liberal than his own in presenting "Oh Calcutta!," major rock concerts and other

Mr. Pastier teaches urban design and architecture at California Polytechnic State University of Pomona and at Southern California Institute of Architecture.

Above, First Christian Church, John Portman's Fort Worth National Bank and, in the distance, Tandy Center; at left, Tandy's triple-decker mall and skating rink. Despite recent additions, downtown's texture is predominantly older, masonry buildings (right).

vents that are not welcome in Dallas. ratt also claims that Fort Worth's moneyed class, when building homes, is ore individualistic and less afraid of splaying its wealth.

And if you're wondering whether Fort Worth may be lacking in taste and sophistication, consider that this self-designated Cowtown U.S.A." is emerging as a major art center, with three solid museums (including one, the Kimbell, which is housed what is arguably Louis Kahn's most transcendent building).

The three museums are clustered less than two miles from a downtown of surprising interest. It is anchored on the north by a splendid 19th century courthouse whose silver domed tower culminates the view up Main Street. Its southern end is occupied by Philip Johnson's recent Water Garden, a three-block amalgam of civic plaza, park, pools and fountains whose jazzy design falls a bit below the standard set by the best of Lawrence Halprin's work, but clearly surpasses Johnson's own downtown plaza for Dallas' Thanks-Giving Square.

John Portman's 37-story Fort Worth National Bank is the tallest building in town. This mirrored octagonal tower is entered through a three-story tall bridged and balconied space shared by a banking hall, building lobby and circular restaurant. Another recent work, the Fort Worth municipal building, wraps city offices around an atrium and fountain. Although not as complex and sophisticated as the new Dallas city hall, it is good levelheaded architecture and may well be Edward Durell Stone's most direct and unaffected opus since his New York Museum of Modern Art.

Downtown's most significant project is Tandy Center, a multiblock grouping of twin office slabs, parking structures, a department store and a three-level shopping galleria flanking an atrium that contains an ice-skating rink and is criss-

Dallas-Fort Worth's semicircles and runways cover an area greater than that of Manhattan Island. At far right, planes cozy up to one of the terminal buildings.

3. The Airport

As early as four years ago, when the gargantuan Dallas-Fort Worth airport opened for business, it was clear that architecture was not what that $875 million undertaking was really all about. This is not to say that it was architecturally unsuccessful or inadequate, but rather that the art of building was overshadowed by the airport's unprecedented scale—it was the world's largest—and its regional implications, effects upon users, and by its labyrinthine internal circulation and distribution systems.

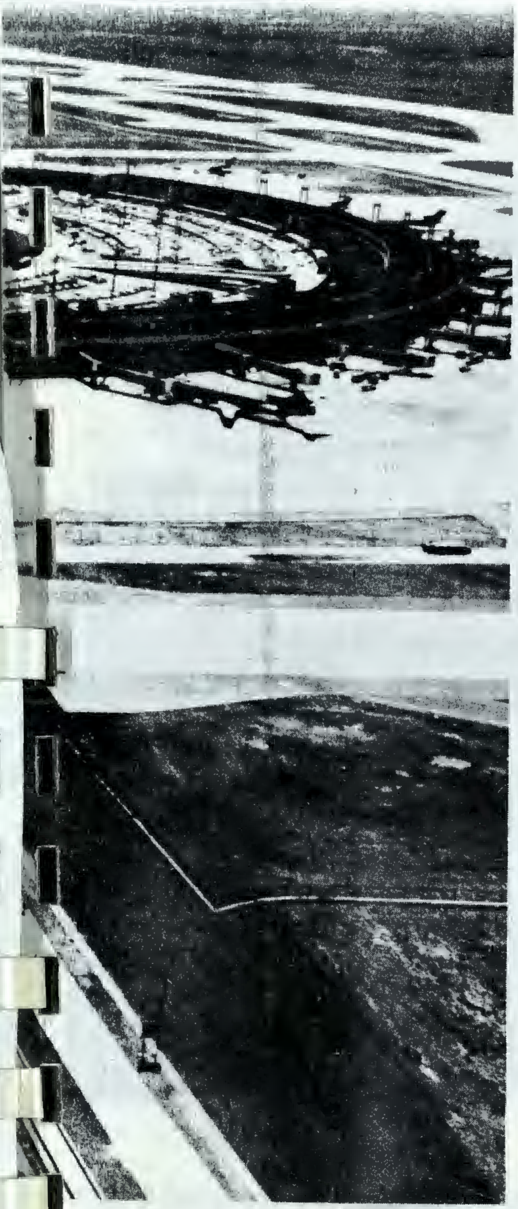
The nation's architectural press has effectively confirmed this conclusion by not publishing any major articles about the airport since it opened. (The architects were Hellmuth, Obata & Kassabaum and Brodsky, Hopf & Adler; associate architects were Preston M. Geren Jr., FAIA, and Harrell & Hamilton.) But now, with the passage of time, it is apparent that the original architecture has gradually been transformed by tenant improvements and alterations, much as a beekeeper's hive is filled in by its occupants.

Perhaps this state of affairs is a warning that architects' influence is narrowing in an increasingly complex and technocratic society. Or possibly it reflects a less than comprehensive definition of architecture on the part of people who labor to keep the profession informed. Whatever the reason, the omission is surprising, for the Dallas-Fort Worth airport (or, as the luggage tickets say, DFW) is one of America's great cultural monuments. It embodies and celebrates our wanderlust and impatience, our fascination with motion for its own sake, our stereotyped notions of Texan ambition and boosterism, our hard-dying growth ethic, our continuing profligacy of energy use, and, above all, our never-ending desire for innovation.

It is easier to love the airport as a symbol of our society than as a functioning transportation center. DFW does have its undeniable achievements: It handles more commercial flights and passengers than any other installation in the Southwest, pays its own way (albeit with the help of some direct and indirect subsidies, estimated at $300 million), has reduced most of its initial operating problems and has helped effect a discernible unification between its two rival host cities. Nonetheless, opinion outside the north Texas region seems tepid at best, and some knowledgeable observers are unhesitant in pronouncing it unsatisfactory. In his book *Airport Systems Planning,* Berkeley professor Richard de Neufville terms it "a financial and operational misfortune . . . an embarrassingly inconvenient and expensive airport." One planner at Los Angeles International Airport (which serves 60 percent more annual passengers than DFW in a far smaller and older facility) is even more blunt, calling it "a turkey whose time has come and gone."

The popular press too was unexpectedly critical of DFW when it opened, citing its sprawling distances, balky passenger shuttle system and charges to ride that shuttle, to use the toilets, to drive on the access road and even to use the change-making machines necessitated by those other tariffs. Basically, most of these objections leveled by specialists and journalists can be traced back to the two basic decisions made by DFW's administrators and planners: the airport's size and location.

Together, those factors virtually decreed a project of unprecedented cost and



operational complexity, at a less than convenient distance from the two cities it was primarily meant to serve.

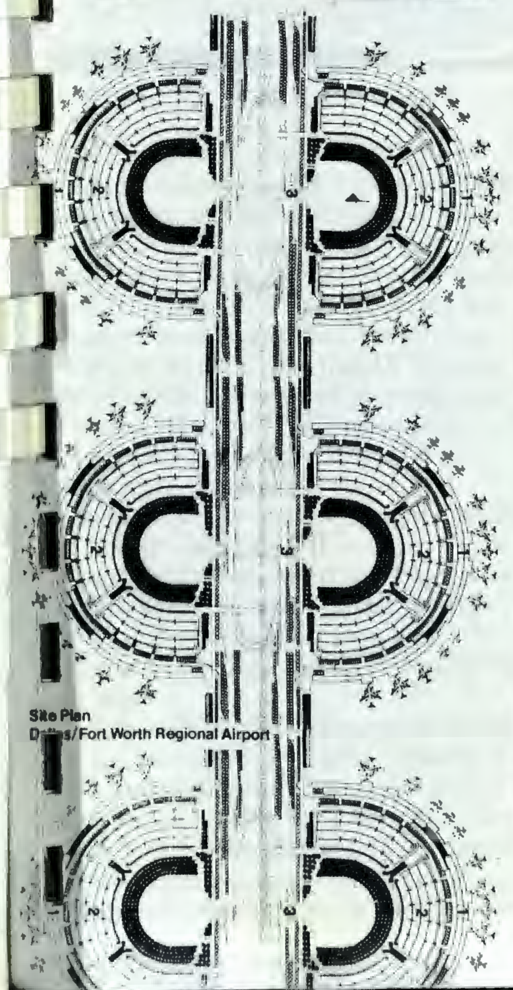
Location presented a dilemma, since the centers of Dallas and Fort Worth are 31 miles apart. At best, a regional airport would have to be at least 16 miles from one of the cities. DFW is sited about midway between the two downtowns, but several miles north of the axis connecting them, so that the closest terminal building is about 21 highway miles from downtown Dallas and 23 from downtown Fort Worth. These distances translate to bus fares of $3 to $4, and cab fares of $14 and higher. Telephone calls to the two downtowns are 25 cents, but that charge appears less extreme ever since the basic rate was raised to 20 cents for local calls.

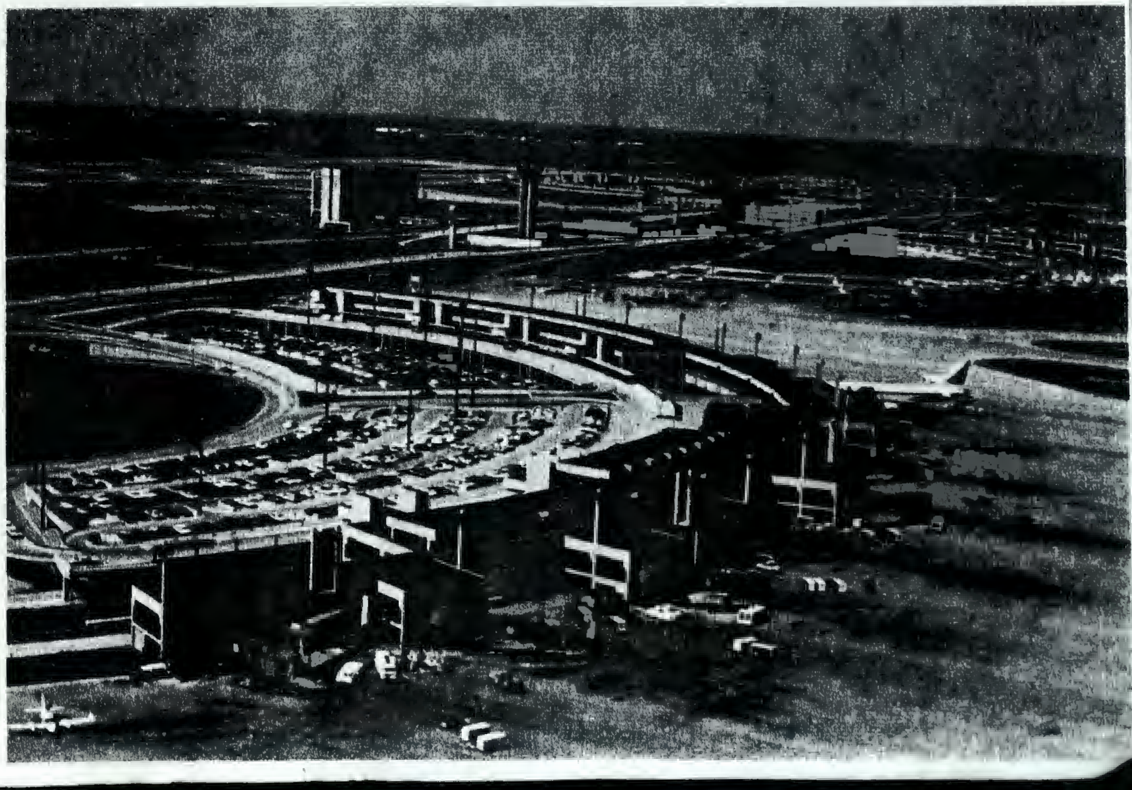
Although options for location were limited, there was considerable leeway in setting a size for DFW. The choices that were made were grandiose and questionable. One of them, the decision to make this the world's largest airport in acreage, could be defended on grounds of availability of relatively cheap ($3,700 per acre in 1968 dollars) and relatively vacant land, the necessity for generous buffer zones, and the possibility that space demands for future aircraft would increase. Still, at 17,500 acres, DFW is larger than Manhattan Island with four extra Central Parks thrown in, and far larger than any of the country's major established airfields.

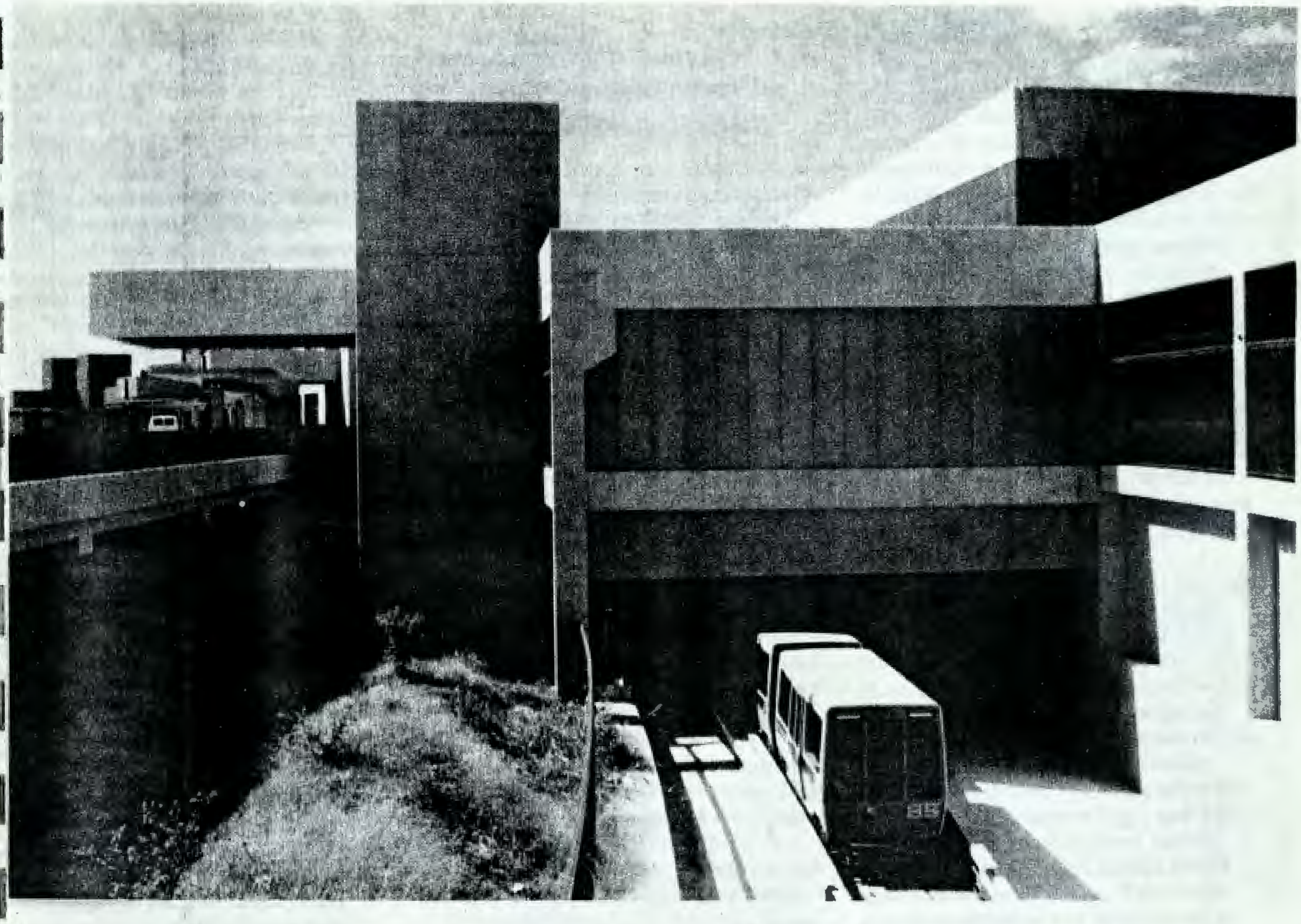
The decision to make DFW the world's largest in terms of ultimate passenger capacity is far less understandable. Its design capacity after expansion is about 150 million annual passengers—10 times its present traffic, or roughly equal to the combined passenger volume at the world's six busiest airports.

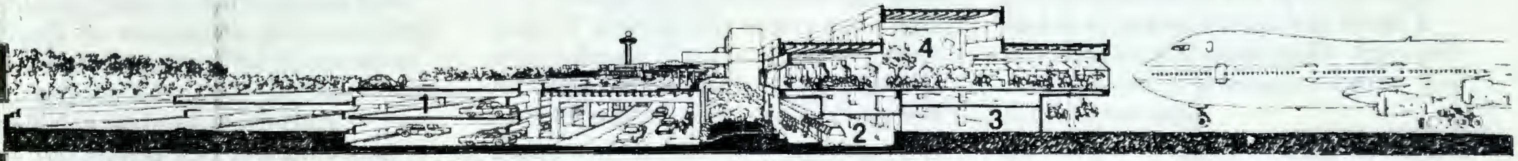
Obviously, this requirement mandated a master plan of vast distances and awesome statistics. If DFW were ever built to its design maximum, it would contain 13 terminals, each a half-mile long, lined up in a double row stretching nearly four miles. Cargo terminals at either end of this procession would extend its length to seven miles. Internal transportation for both passengers and employees would clearly be a major problem. Human scale, comprehensibility and user orientation would inevitably be impeded in a work of such staggering scope.

But from one perspective—regional politics and economics—the concept of the world's greatest airport had a certain appeal. Perhaps only a project so spectacular could have induced the public and private leadership of the two rival cities to work together effectively. This unprecedented municipal cooperation was no small accomplishment. Dallas architect David Braden, FAIA, calls it "the Texas equivalent of Anwar Sadat meeting with Menahem Begin." Indeed, discussions concerning a single regional airport and unsuccessful attempts at its creation date back as far as 40 years prior to the 1968 DFW groundbreaking.

Once underway, however, detente between Fort Worth and Dallas did not stop with the airport. The North Texas Commission, comparable to a regional chamber of commerce, was formed to recruit new business to the area using the huge airport as one of its major inducements. Local leaders also persuaded the U.S. Bureau of the Budget to marry the two metropolitan areas into a single 11 county statistical unit. (Flushed with success, they dubbed their new realm "the Metro-

Site Plan
Dallas/Fort Worth Regional Airport







1. Parking Decks **2.** Transit System **3.** Airline Offices **4.** Terminal

From parking (left) to plane (right) is a short trek over an automobile access road and into the terminal, which spans the Airtrans right of way. Across page, a lower level drop-off point.

plex.") This was more than a bureaucratic technicality, since it allowed Dallas-Fort Worth to supplant Houston, literally overnight, as the metropolis of the Southwest. Although this victory may be shortlived (current growth rates indicate that Houston could regain its crown by the next census), it is clear that DFW's ambitious scope has resulted in a somewhat elevated metropolitan consciousness and an expanded regional economy. Four years after opening, it is the world's seventh busiest airport with eight million passengers annually—three times the regional population. An astounding proportion of Texas' air traffic passes through DFW: 55 percent of all passengers, 56 percent of all cargo and 63 percent of all air mail.

This activity has been accommodated in just four of the ultimately planned 13 terminal structures. These semicircular arcs line up on either side of a 600-foot-wide traffic spine that extends four miles between toll plazas and seven miles between its connections to the public highways. Each terminal building resembles an enlarged half of Bernini's colonnade at St. Peter's in Rome, but rather than embracing a grand pedestrian plaza, it instead cradles a 2,000-car parking lot. This plan provides great convenience for passengers arriving by automobile, since they can usually park within a few dozen yards of their departure gate. On the other hand, it precludes a compact overall pattern for the airport and its structures. The resulting distances are so great that the designers gave up on the pedestrian altogether—it is physically impossible to walk between airport buildings, or from the buildings to the outlying parking lots.

Tippets-Abbett-McCarthy-Stratton, the DFW master planners, thought to overcome this lack of proximity by specifying an automated passenger shuttle to link the various terminal structures to one another, to remote parking areas for employees and passengers and to the 600-room Airport Marina Hotel near the airport's center. Known as Airtrans, the shuttle is a low-speed (17 miles per hour maximum) electric vehicle the size of a minibus, running on rubber tires in a trough-shaped concrete guideway either singly or in two-car trains. In addition, open cars carry containerized freight along the same right of way.

Airtrans was a brand-new piece of technology, rather like San Francisco's trouble-plagued automated rapid transit system, and many of its bugs had to be worked out in day-to-day operation. At first, Airtrans was so unreliable that backup buses had to serve 44 percent of the passengers. After four years of improvement, an unlucky 2 percent of Airtrans patrons still find themselves involuntary bus riders. Even for the lucky majority the ride is amazingly slow and rather jerky, bumpy and swaying. It is also fairly noisy, considering its rubber wheels and low speed. The monorails in Disney World and downtown Seattle, in comparison, provide a more speedy and satisfying ride.

There are five separate routes running on various segments of a tortuous 8.2 mile right of way, each overlapping and interlocking with the other four. Each of the 14 Airtrans stations, resembling pristine, scaled-down subway stops, is served by two or three routes, at least one of which will take the passenger to any given station. Passengers must take care to board the correct train, and, since every route is a counterclockwise loop, must also be alert in departing; for if they miss their stop, they cannot simply go back but must continue all the way around again.

Entry to the Airtrans stations requires a quarter, but there are no change makers, either human or mechanical, at the entrances. Inside, passenger service agents provide explanations and assistance to riders. One particularly helpful and energetic agent, Pam Palazzetti, holds car doors open for tarrying passengers, greets each arriving train with an announcement of the airlines served by that stop and gives departing passengers directions to the boarding gates. On the job since DFW opened, she understands passenger reaction to Airtrans: "This is confusing to a lot of people. It would scare me half to death. But the system has gotten better—you wouldn't believe how much better."

Human presence and judgment have softened the mechanistic character of Airtrans, but cannot expedite its operation. For example, a trip from the Continental terminal to the hotel took nearly 12 minutes from station door to station door. This is equivalent to an average speed of [illegible] mph, and, because Airtrans routes are so convoluted, the train must travel a mile and a quarter to connect destinations [illegible]00 feet apart. If walking were possible in this case, it would take two-thirds the time consumed by DFW's computer-aided marvel.

Airtrans is as expensive as it is slow. The 25 cent fare does not come close to meeting expenses, which total roughly [illegible]25 for each short ride. This deficit requires a $5 million annual subsidy which absorbs one-fourth of the landing fees collected at DFW.

Thus, DFW provides maximum convenience for passengers arriving by automobile, but in doing so makes connections between terminals impossible by foot and inconvenient and expensive by machine. This priority would be justified in most other major city airports, since passengers arriving by ground transport exceed those transferring between flights by about a three to one ratio. But DFW has the second highest proportion of transfer passengers in America, and these passengers actually outnumber those arriving by surface transportation. Quite clearly, the form taken by this airport is not in keeping with the unusual nature of its function as a transfer point.

Ease of arrival by auto at the expense of convenience for terminal-to-terminal transfer.

But appropriate or not, when seen from above, this master plan produces a monumental visual image that is surprisingly effective in formal and metaphorical terms. The high-speed traffic spine, with its flanking terminals that in turn are flanked by taxiways and runways, all combine to produce an ensemble that does expressive justice to the intricate patterns of movement within. The bold straight lines in this vast diagram—the central spine and outer runways—align themselves exactly north-south and accommodate the swiftest and most energetic traffic: ground vehicles arriving and departing, and the great jets taking off and landing.

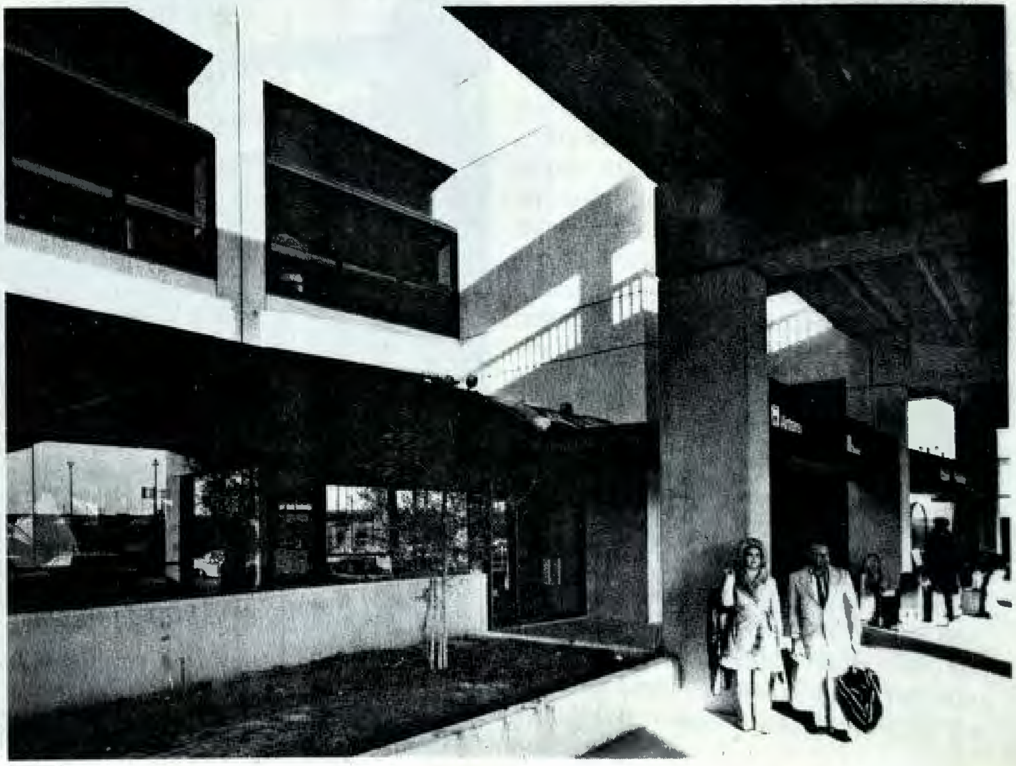
The cross-links and curves correspond to slower and less direct motion: cars and buses making looping 270-degree turns into the terminal areas and then proceeding in arcs once there, and the barely visible Airtrans pods grinding patiently along their labyrinthine paths.

To a technology freak, this must be an image of unspeakable beauty and a ballet of high drama. Even to someone rather ambivalent about the joys of all this high energy hardware, the large-scale view of DFW can be awesome in an almost archeological sense. Perhaps this is the Stonehenge of the American prairie, a place that is as much a monument to its own technological rituals as it is a purposeful construction.

Down at eye level this mystic design is no longer easily discernible, so that most of the magic flees from the airport's imagery. At closer range, the structures' abstractness becomes unsatisfying and schematic. There is a lack of architectural conviction and significant detail in the repetitious terminal buildings and particularly in the hotel. Although these buildings are not offensive, they do not approach the quality of even a courageous failure such as Eero Saarinen's TWA terminal at Kennedy Airport, much less that of a self-assured success such as his Dulles Airport terminal. The one exception to this bland collection of DFW buildings is the not totally graceful but nevertheless strongly articulated control tower designed by Welton Becket & Associates.

The architects for the airport were able to invest the interiors of the terminal buildings with greater degree of distinction than the exteriors. Built on a radius of nearly 900 feet, these immense arcs are framed by handsome warm beige concrete structural system composed of precast beams that fit nicely into boldly bracketed columns. There are normally three 40-foot transverse bays, and intermittently raised roof sections permit clerestory windows and double height spaces as required within. This simple spatial modulation and intelligently revealed structural system help create a scale and level of detail highly appropriate to a terminal ambience—neither too bold nor too fussy.

These buildings are of Brobdingnagian length. The shorter terminals verge on 2,000 feet, and eventually will be expanded to the full semicircle of roughly



half-mile extent. Fortunately, the mixed enancy of most terminals and the punc-uating effect of the various concessions serve to break up that length fairly well. Typical users, moreover, would not need traverse much of any terminal's length nce most functions repeat every few hundred feet, and since passengers are pected to take Airtrans over long longi-dinal distances. The only people likely to walk through a terminal from end to end are restless pacers and sightseeing chitects.

The basic interior shell has been diversified and frequently enlivened by the installations of various airlines, most tably Braniff, and by food, drink, news-stand and gift shop concessions. At times this variety of visual treatment flirts with thetic chaos, but that precarious state of airs seems preferable to the excessive consistency known as the airport blahs. In one classic respect, the DFW interiors fall ort: As in nearly every other transporta-n terminal, the seating arrangement is a rigidly antisocial array of immovable aight rows.

User reaction to the airport covers a wide gamut from strong satisfaction to virtual hatred. Employees like it best, soned out of town travelers least and al passengers stand somewhere in between.

An Atlanta market analyst, who spends out $15,000 a year on air fare, says of W: "It's the pits. I've had to lay over twice because of the way it's laid out—I stuck on Airtrans. I fly to the top 100 es in the country and find that small airports are best. This place accommodates the inadequacies of the airlines least—it compounds them. You can't dash between terminals."

Another frequent traveler, Austin architect Edward Maurer, AIA, is even more outspoken: "This is the biggest abortion. It's not made for people—travelers—it's all for baggage and the convenience of the airlines. I hate the place. You can't change planes conveniently. They have a machine that gives you two choices: It eats your luggage or loses it."

Diana Folds, a local resident seeing off a friend, finds the airport "beautiful—not functional but pretty. There's no place to lie down when you miss a connecting flight. They need lounges, couches and coffee shops that stay open past 9. Love Field (the old, close-in Dallas airport) is better and cheaper."

Ross Pinkepank, also a resident of the region, says, "I like it very much. I often meet people who fly in on business. Most don't like it. When they get off the plane, people don't know where to go, and their luggage is slow. But I like the convenience of being able to drive in and pick up people at the door."

Sandy Burr, a gift shop salesclerk, likes working at the airport, but also hears many passenger complaints about insufficient eating places, four- to six-hour layovers and inadequate signing and departure announcements. Many passangers come to the gift shop to get change for Airtans or to seek directions. In general, concession employees and ground transportation personnel informally provide information and services that would normally be the airlines' or airport's responsibility. This assistance is provided with genuine Texas friendliness and is one reason DFW works even as well as it does.

Ruby Lefler, a Texas International Airlines customer service hostess, deems the airport better than its counterparts in New York or Los Angeles. Many of the passengers' problems are not necessarily DFW's fault: "People don't read the signs. . . . They come with a preconceived idea that this place is going to be big and confusing." She prefers this big airport to smaller Love Field, but finds the Austin airport even easier to work in.

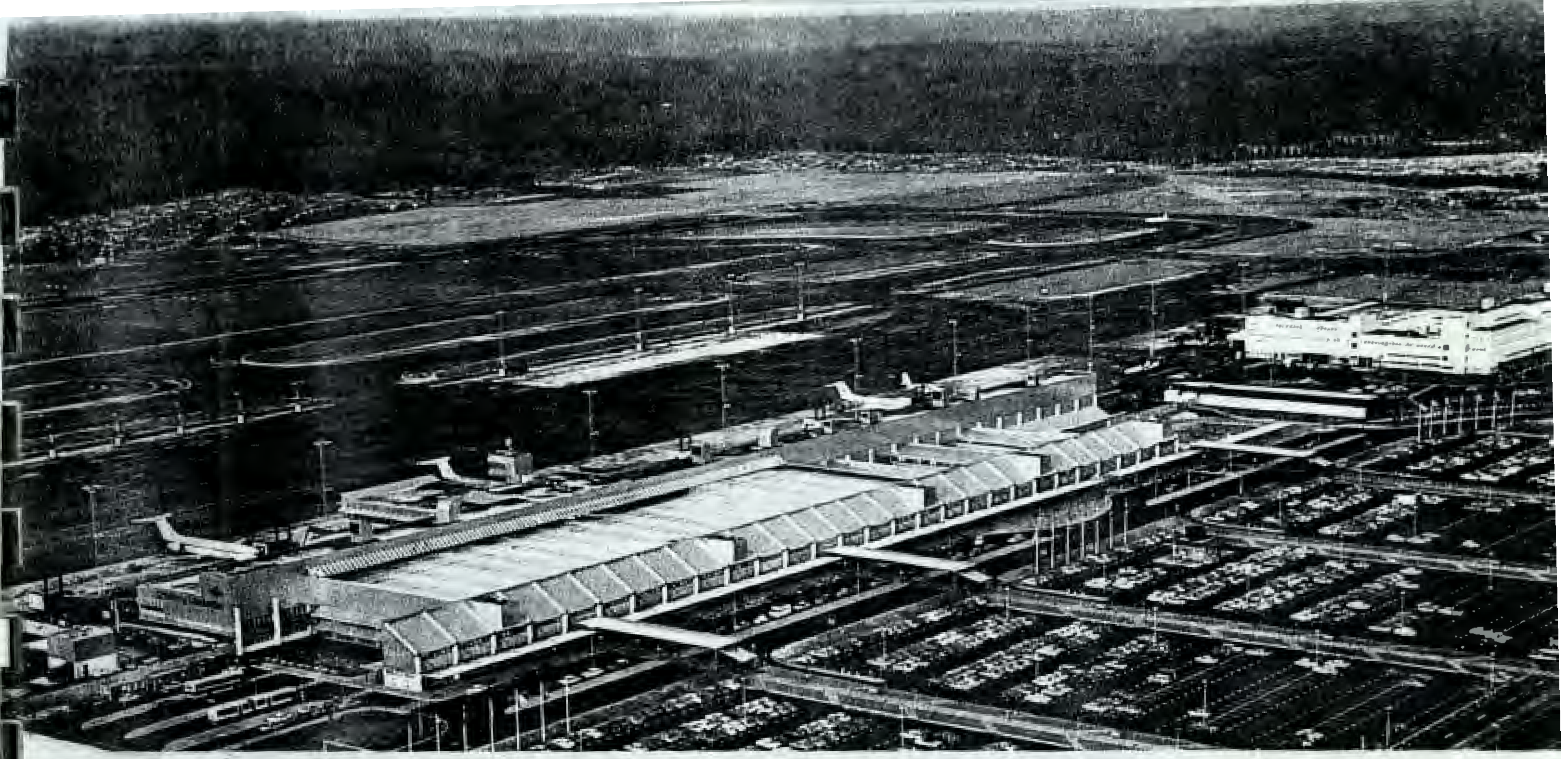
A Braniff pilot considers DFW "the airport that makes my job easiest. It's one of the best airports ever designed, safety-wise." However, he concedes that connecting between airlines, which is a problem in every airport, is especially difficult in DFW, and offers the judgment that Tampa's airport is the best for passengers.

Thus, the answer to any question about the adequacy or success of the Dallas-Fort Worth Airport must depend upon one's role and viewpoint. Since more of us are passengers than are airline personnel, airport employees or leaders of the Metroplex, the most democratic answer would have to be that the builders of DFW attempted too much too quickly, not unlike the builders of the Tower of Babel or of Beauvais Cathedral.

However inadequate and costly this airport may be to many of its patrons, it still seems to deserve some grudging admiration. It must be understood that DFW's purposes were as much political as they were rational, and as much symbolic as they were functional. If it is an operational inconvenience, it is also a cultural landmark of the first order.

Whether it is, in the words of former Secretary of the Interior Stewart Udall, "a monument to our technological arrogance," or whether it is a more benign celebration of our optimism and curiosity about things untried, is an endlessly debatable question. What is more certain is that the Dallas-Forth Worth Airport is a Texas structure in scale with its state, and must be counted as one of the seven wonders of our volatile world, at least for the time being. □

Below, an Airtrans station and ticket counter; right, Braniff's terminal.



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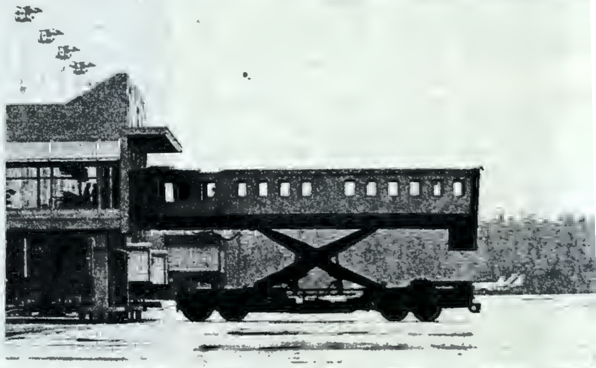

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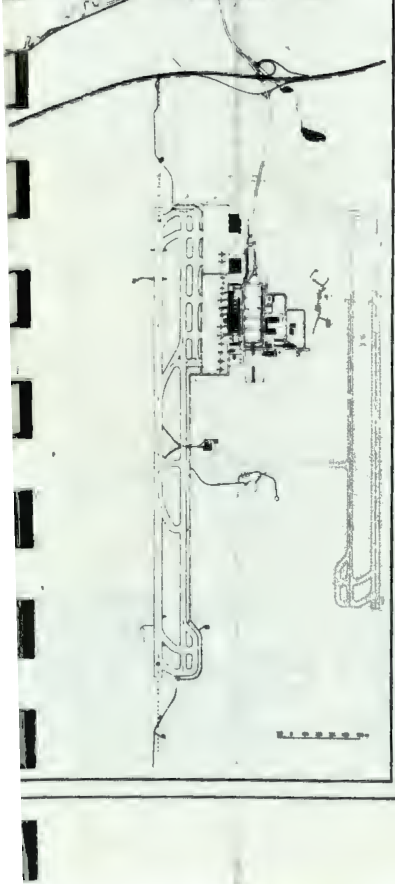
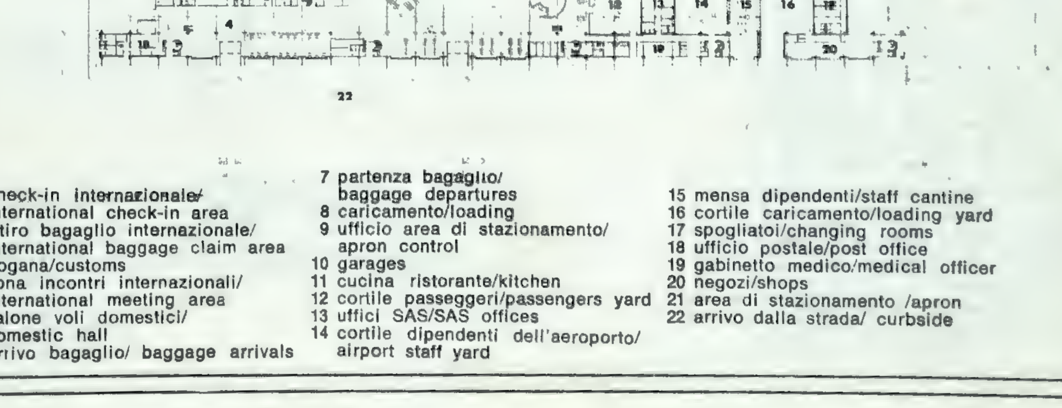
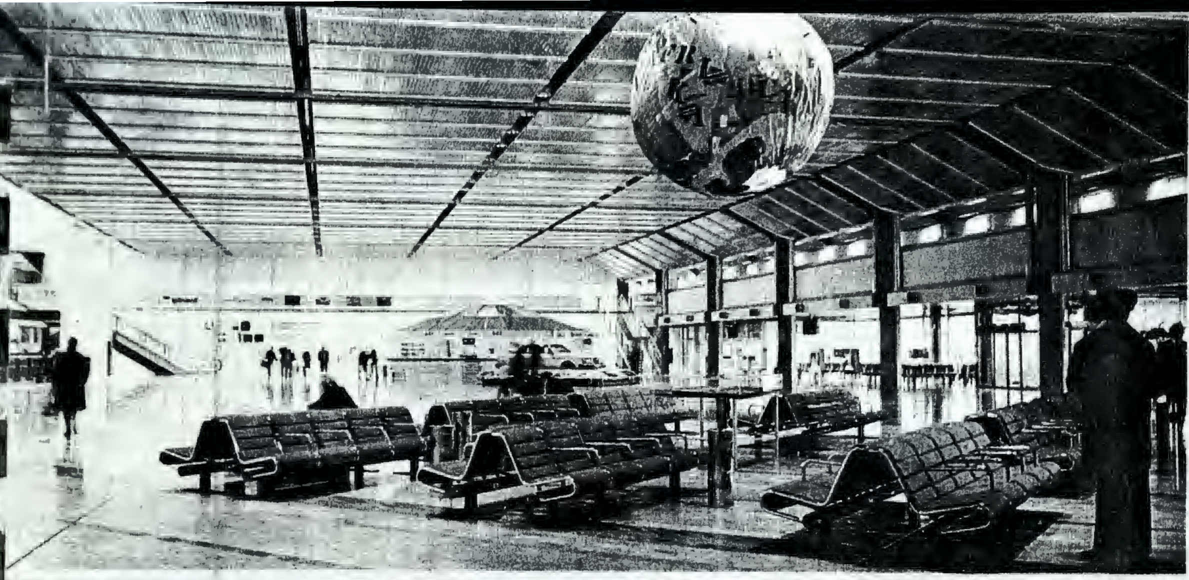
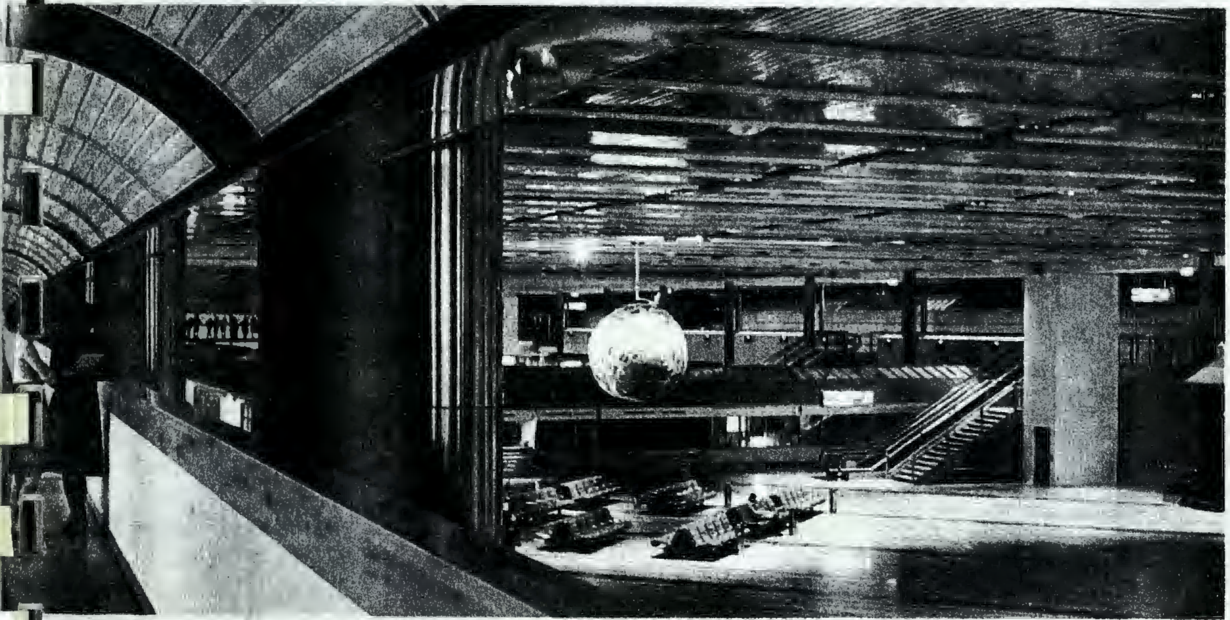


PIANO TERRA/GROUND FLOOR



1 check-in internazionale/ international check-in area
2 ritiro bagaglio internazionale/ international baggage claim area
3 dogana/customs
4 zona incontri internazionali/ international meeting area
5 salone voli domestici/ domestic hall
6 arrivo bagaglio/ baggage arrivals
7 partenza bagaglio/ baggage departures
8 caricamento/loading
9 ufficio area di stazionamento/ apron control
10 garages
11 cucina ristorante/kitchen
12 cortile passeggeri/passengers yard
13 uffici SAS/SAS offices
14 cortile dipendenti dell'aeroporto/ airport staff yard
15 mensa dipendenti/staff cantine
16 cortile caricamento/loading yard
17 spogliatoi/changing rooms
18 ufficio postale/post office
19 gabinetto medico/medical officer
20 negozi/shops
21 area di stazionamento /apron
22 arrivo dalla strada/ curbside





INTERNATIONAL AIRPORT GÖTEBORG-LANDVETTER
ARCHITETTI:
A4 ARKITEKTKONTOR AB
1967-1977

Grande flessibilità nel progetto del nuovo aeroporto di Göteborg, a Landsvetter (20 km est-sud-est dalla città) in previsione del traffico aereo ancora in aumento — per ora, crisi del petrolio permettendo — e della conseguente necessità di ingrandire l'edificio ora inaugurato, di aggiungere altri fabbricati e di costruire una seconda pista.

Il nuovo edificio del terminal è un terminal tipicamente svedese (vedi anche quello dell'aeroporto di Stoccolma-Arlanda, domus 573/77): i materiali impiegati — acciaio, alluminio, vetro — creano un'impressione generale di sobrietà e funzionalità, ma talvolta, e soprattutto all'interno, di impersonale sterilità. A questa impressione si è ovviato con l'aiuto dei materiali e dei colori degli arredi, con la creazione di vetrate e con un sapiente uso della luce naturale che penetra anche dall'alto.

Attrezzatura singolare: le «mobile lounges»: delle «sale d'attesa» mobili che portano i passeggeri dal terminal direttamente all'aereo evitando loro scale, trasbordi sugli autobus, disagi del clima. (Sviluppo dell'idea già realizzata da Eero Saarinen nell'aeroporto di Dulles a Washington, nel 1962).

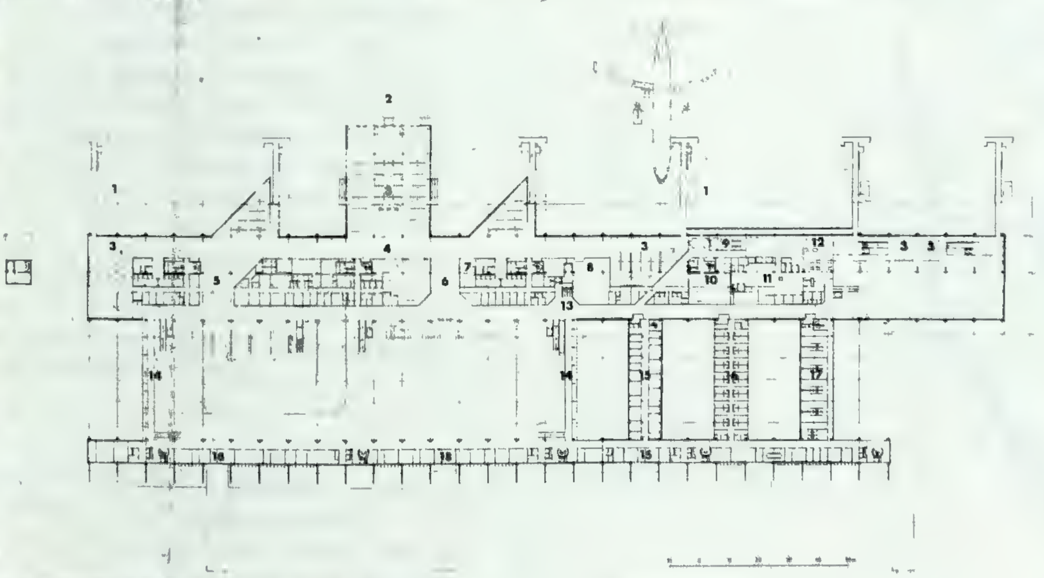
Flexibility is the keynote of the plans for the new airport of Göteborg at Landsvetter (20 km east-south-east of the city). The reason for this is the still-increasing volume of air traffic. The new terminal building is typically Swedish (cf. the Stockholm-Arlanda terminal in domus 573/77): materials used — steel, aluminium, glass — give a general restrained and functional feel, but occasionally, especially inside, it seems impersonal and sterile. This problem has been dealt with by means of furnishing materials and colours, windows, and skilful use of natural light.

A special feature: «mobile lounges», which carry passengers directly from terminal to aeroplane, eliminating stairs, transfer to buses or discomfort of outside weather.

Nécessité d'une grande flexibilité dans le projet du nouvel aéroport de Göteborg, à Landsvetter (à 20 km à l'est-sud-est de la ville) en prévision du trafic aérien sans cesse croissant. Le nouveau bâtiment du terminal est un terminal typiquement suédois (voir aussi celui de l'aéroport de Stockholm-Arlanda, Domus 573/77): les matériaux employés — acier, aluminium, verre — créent une impression générale de sobriété fonctionnelle, mais parfois, et surtout à l'intérieur, de stérilité impersonnelle. A cette impression on a essayé d'obvier en choisissant des matériaux et des coloris de meubles ad hoc, en créant des baies vitrées et en utilisant savamment l'éclairage naturel.

Equipement singulier: les «mobile lounges», des salles d'attente mobiles qui portent les passagers directement du terminal à l'avion, leur évitant ainsi les escaliers, les transbordements en autobus, les désagréments du climat.

IMO PIANO/FIRST FLOOR

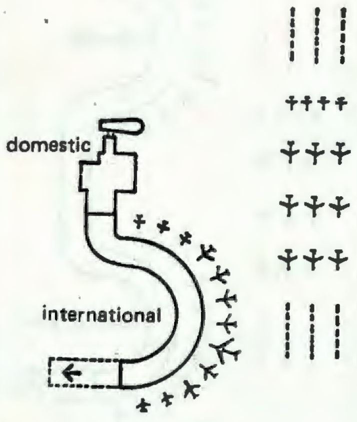


ponte passeggeri/air-bridge
«sala d'aspetto mobile»/
mobile lounge
ala d'attesa/waiting lounge
4 galleria partenze internazionali/
international departures gallery
5 controllo passaporti arrivo/
rrivals passport control
controllo passaporti partenze/
departures passport control
7 gioco bambini/
children's playroom
8 duty free shop
9 ambienti vip/vip room
10 sale riunioni/conference rooms
11 cucina ristorante/
restaurant kitchen
12 ristorante/restaurant
13 alla terrazza panoramica/
to spectators terrace
14 galleria/gallery
15 ufficio amministrazione aeroporto/
airport management office
16 wc
17 spogliatoi/changing rooms
18 uffici linee aeree/airline offices

Algeria International Air Terminal Building

1976–

Algiers, Algeria



First Stage	
terminal building	56,540m2
luggage warehouse	5,400m2
hotel	12,850m2
VIP facilities	1,440m2
offices	3,600m2
emergency aid and fire department	1,800m2
ancillary facilities	7,650m2
energy center	1,500m2
total floor area	90,780m2
parking equipment	200,000m2
road	3,600m
elevated roadways	300m
landscape	180,000m2
annual passenger capacity (international lines)	5,000,000
loading bridges	12 gates
buses	7 gates

(This information is from the Tange proposal submitted to a specified competition held in September, 1976. Though the results of the competition have not yet been announced, the permission of the Algerian authorities was obtained in order to introduce this report here.) From the outset, the Tange staff worked in cooperation with TAMS (Tippetts–Abbett–McCarthy–Stratton) designers of the Fort Worth Dallas Airport.

The project is to be carried out in three stages. In the first, a new semicircular module is to be added to the existing airport; it will have an annual passenger capacity of five million people. In the second stage, another semicircular module will be added on the other side of the existing airport. This will ease passenger strain on the facilities to the point where the old building can be razed. Rebuilding it is the work to be carried out in stage three. The three zones of the airport—the outer zone symbolizing international contacts, the inner zone symbolizing domestic contacts, and the checking zone between them—are given formal identity in the section. The inner and outer zones are covered by individual vault-shaped roofs. The vault shells have a further symbolic function because of the similarity in shape between them and aircraft fuselages. In other words, they express continuity between the building and the planes that arrive and depart from it.

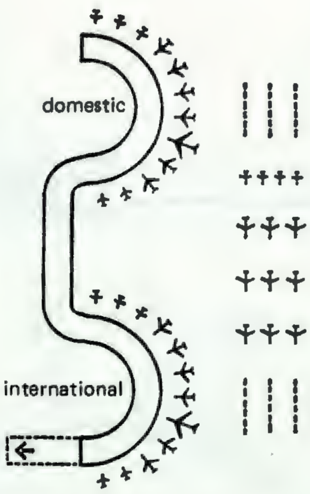
client: Government of Algeria
architects: Kenzo Tange and URTEC;
Kozo Yamamoto, Nobuo Goto, Yoshimichi Tsuboi, Eiichiro Miyake, Tetsuo Furuichi, Kiyoshi Iijima
airport engineers: TAMS (Tippetts–Abbett–McCarthy–Stratton)

total floor area: (excluding hotel)	147,260m^2
first phase:	56,540m^2
second phase:	56,540m^2
third phase:	34,180m^2

Plot plan; scale: 1/40,000.
1. terminal building
2. hotel
3. control tower
4. VIP building
5. cargo terminal
6. catering facilities

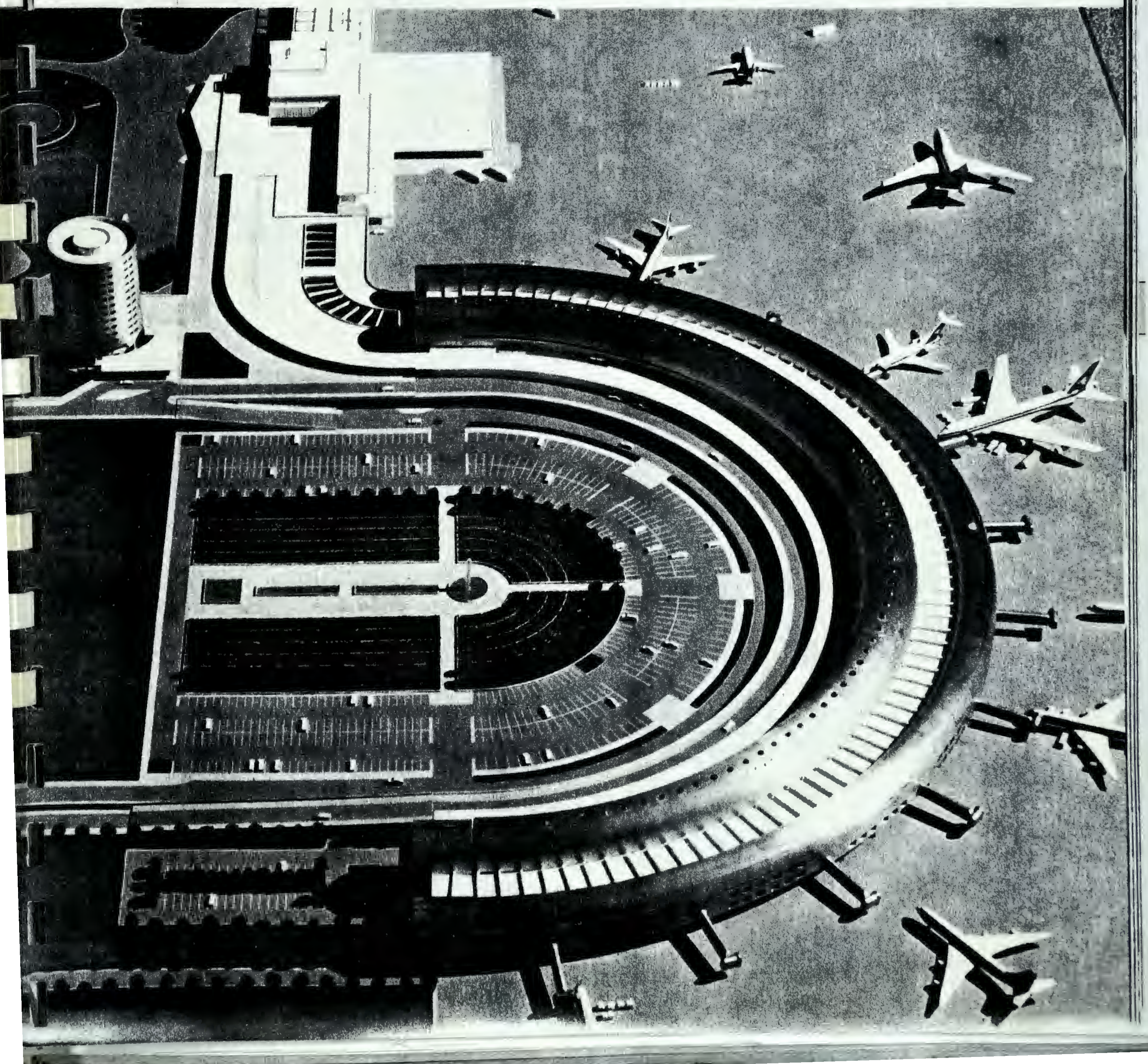
Second Stage

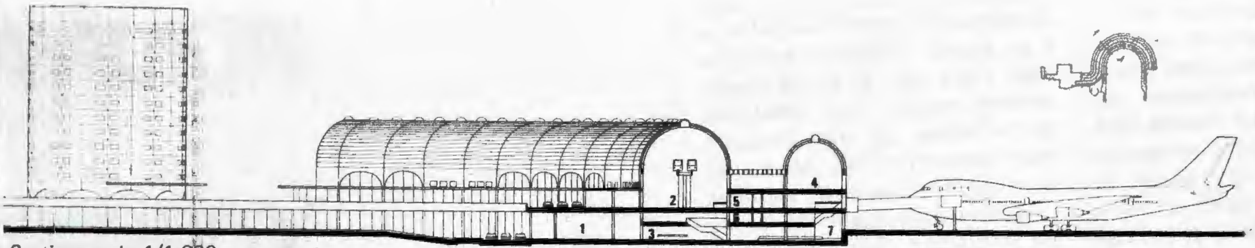
terminal building	56,540m^2
luggage warehouse	5,400m^2
control tower	1,500m^2
total floor area	63,440m^2
parking equipment	90,000m^2
road	6,000m
elevated roadways	200m
landscape	290,000m^2
annual passenger capacity (domestic lines)	5,000,000
loading bridges	12 gates
buses	7 gates



Third Stage

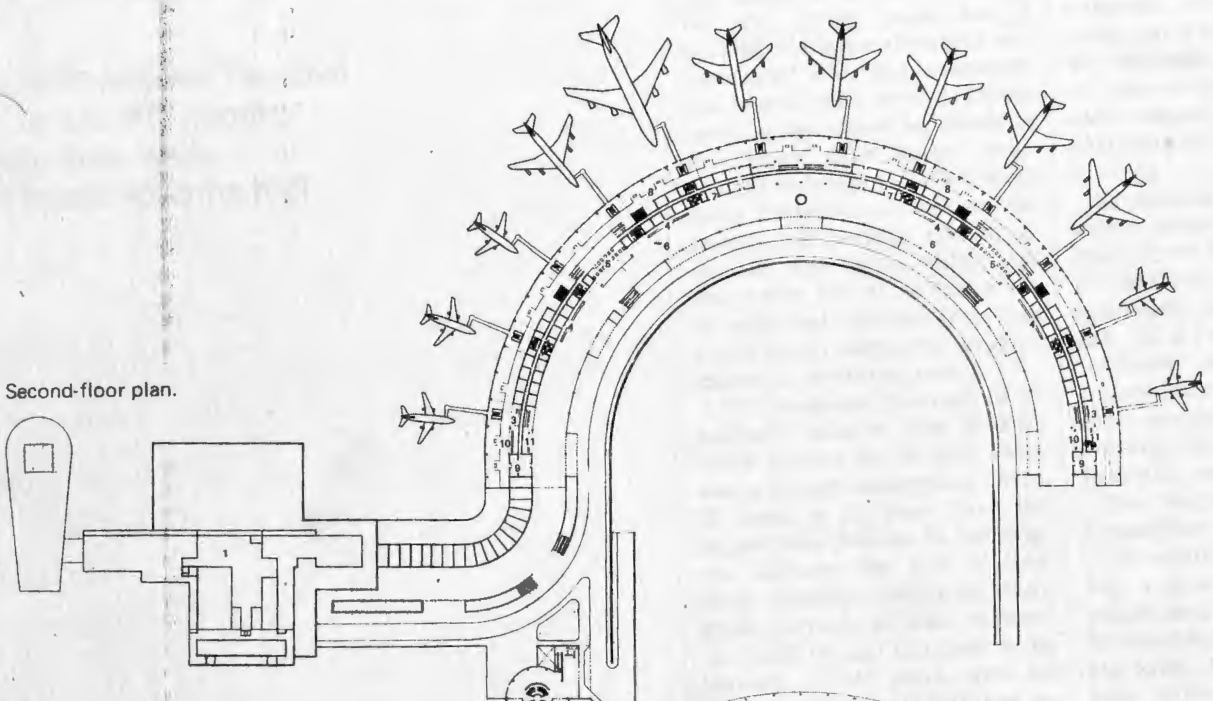
terminal building	34,180m^2
luggage warehouse	10,800m^2
offices	12,850m^2
total floor area	57,830m^2
parking equipment	20,000m^2
annual passenger capacity (international lines)	2,000,000
loading buses	10 gates





Section; scale: 1/1,600.

1. arrival hall
2. departure hall
3. customs
4. restaurant
5. departure passport control
6. arrival passport control
7. operation's room



Second-floor plan.

1. existing terminal building
2. deck
3. shops
4. check-in counter
5. passport control for departure
6. departures hall
7. offices
8. lounge
9. V.I.P. room
10. cafe
11. bar
12. lobby for hotel
13. reception for hotel
14. cafeteria for hotel
15. operations room
16. mosque
17. church
18. meeting room
19. exhibition room

✓20. police

✓21. clinic

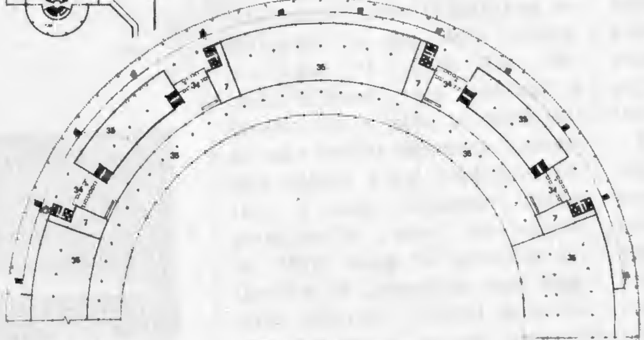
✓22. , machine room

23. checkpoint
24. departing luggage
25. arriving luggage
26. customs
27. baggage claim
28. customs office
29. waiting room
30. arrival hall

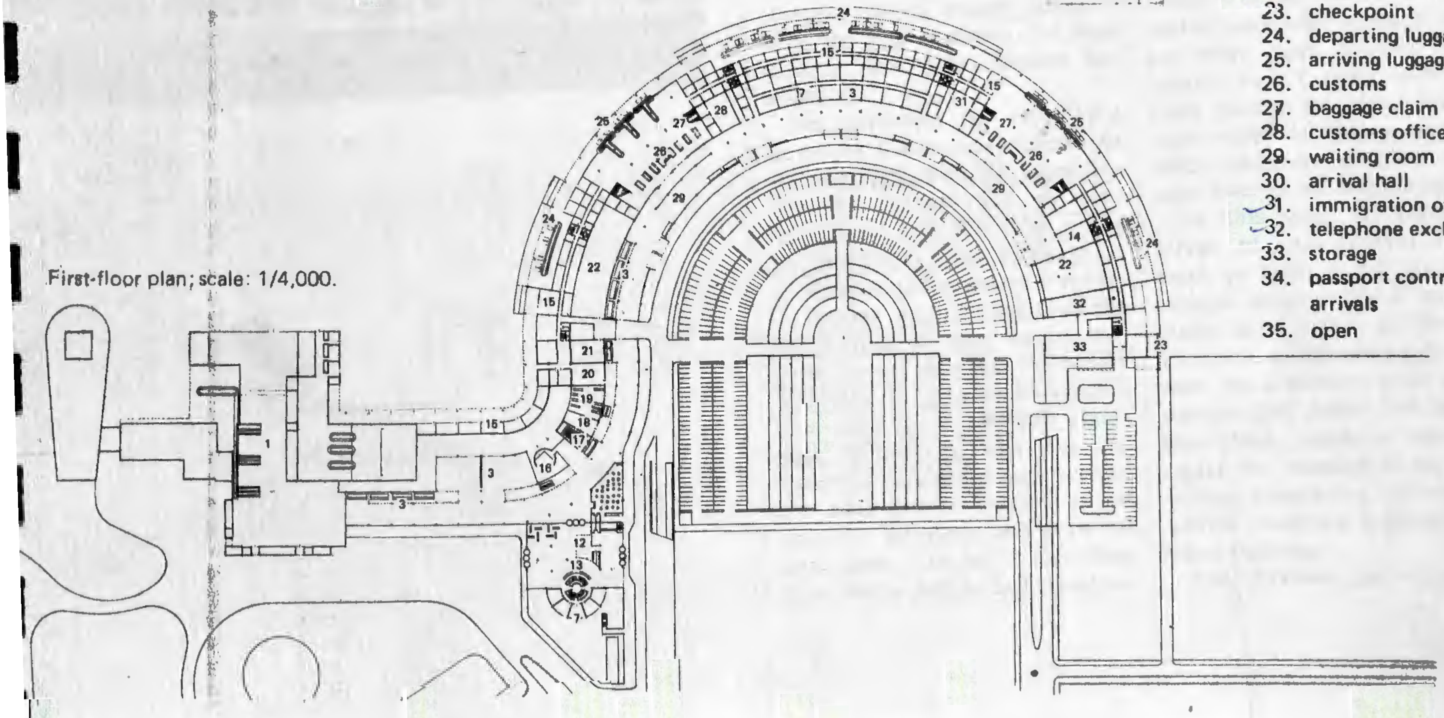
✓31. immigration office

✓32. telephone exchange

33. storage
34. passport control for arrivals
35. open



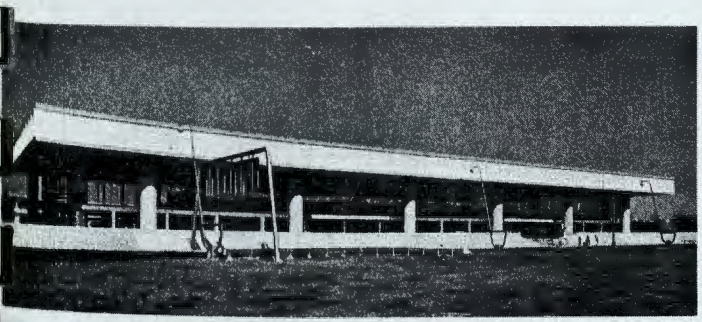
Mezzanire-floor plan.

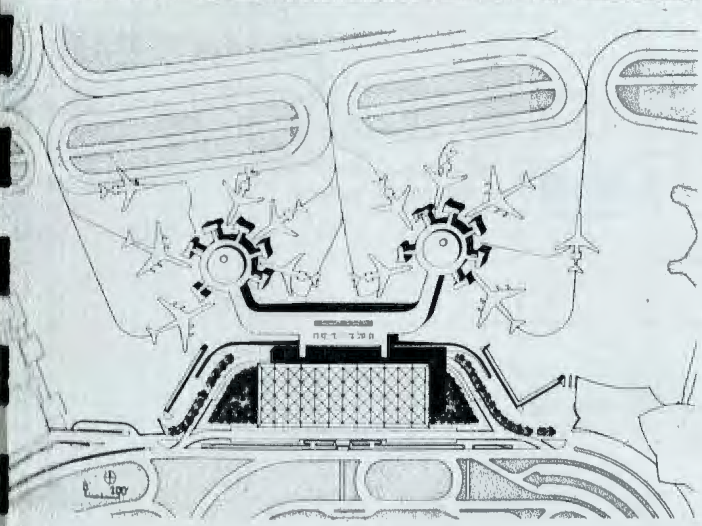


First-floor plan; scale: 1/4,000.

PAVILION AT KENNEDY

he National Airlines Terminal
New York's JFK Airport,
has crystal clear walls
nder a broad, hovering roof





New York's Kennedy Airport is a notorious cluster of unrelated, assertive buildings, caught in a visual tangle of road signs, light standards, and airplane tailfins. Dropped into the middle of all this, I. M. Pei & Partners' new National Airlines Terminal is an island of conspicuous serenity.

When Pei first considered the site, back in 1960, he decided that the setting called for "a building of classic simplicity and geometry," and that conviction still seems valid over a decade later. A few other terminals at the airport have shown architectural restraint (SOM's United-Delta Terminal is the best example), but National is both restrained and highly visible; the long white line of its fascia can be seen and enjoyed from half a mile away, across the airport's enormous cloverleaf core.

The completed terminal is remarkably true in form to Pei's initial scheme for the site, which won a limited competition (Sept. '60 issue, p. 5). Soon after, the project was shelved by the original sponsor, the Port of New York Authority (when the many small carriers it was intended for failed to sign up), only to be revived a few years later by National Airlines (which had no obligation to use Pei's design, but liked it). Since then, the basic scheme has survived a drastic cut in size, to meet National's lighter demands, numerous delays and modifications, then a major expansion during construction, when the advent of 747's upset all previous estimates of passenger and baggage capacity. ("What is so interesting about airport design," says Pei half seriously, "is how quickly your plans become obsolete.")

Pei attributes the staying power of the original scheme to its simplicity. The big space under the canopy was so nonspecialized that functions could be shuffled around inside it up to the day the counters went in.

Another feature that gave the competition-winning design survival value was its innovative approach to automobile circulation—innovative by 1960 standards, at least. By that time, automobile congestion had become the most critical problem in air terminal planning, and Pei's design team attacked that first. Automobile access had traditionally been limited to the "front" of the building, with the rear reserved for transfer of baggage to and from the planes. (Passenger connections to the planes were already being made through second-level bridges.) The need to expand the crowded curbsides in front of the terminal had led to double-decking of automobile approaches at several terminals, including a few at Kennedy, but frontages for individual terminals there were short, so that ramps had to be steep and cramped, leaving only short straightaways for passenger handling.

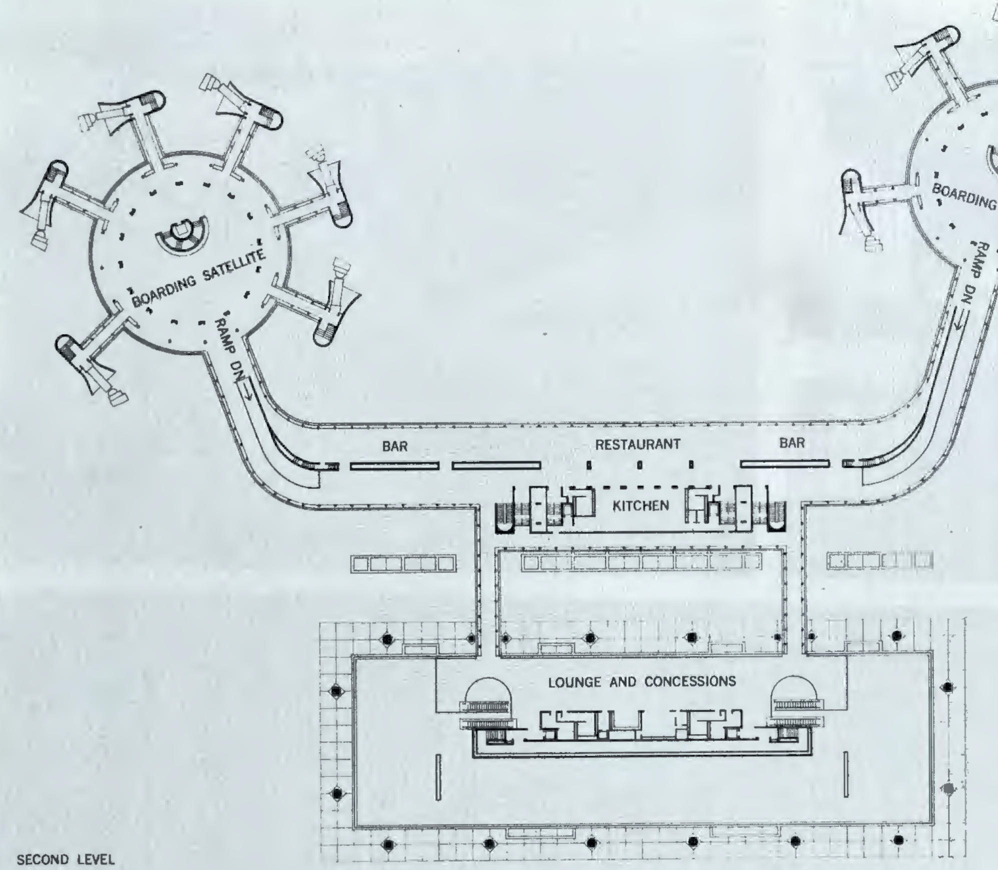
By splitting the access roads—with a drop-off platform on the front of the terminal and a pick-up platform on the field side (plan, left)—Pei's designers were able to double the available "curbside" without resorting to clumsy ramp arrangements. Baggage movement just had to be lowered into a tunnel under the field-side roadway.

The design produced for the competition was very clear-cut in its organization. The big room had a long counter down the middle and a mezzanine behind it, linked by bridges to the boarding gates. Deplaning passengers were to come down from the mezzanine, pick up their baggage from carousels in the *ends* of the main room, and go out the rear exits.

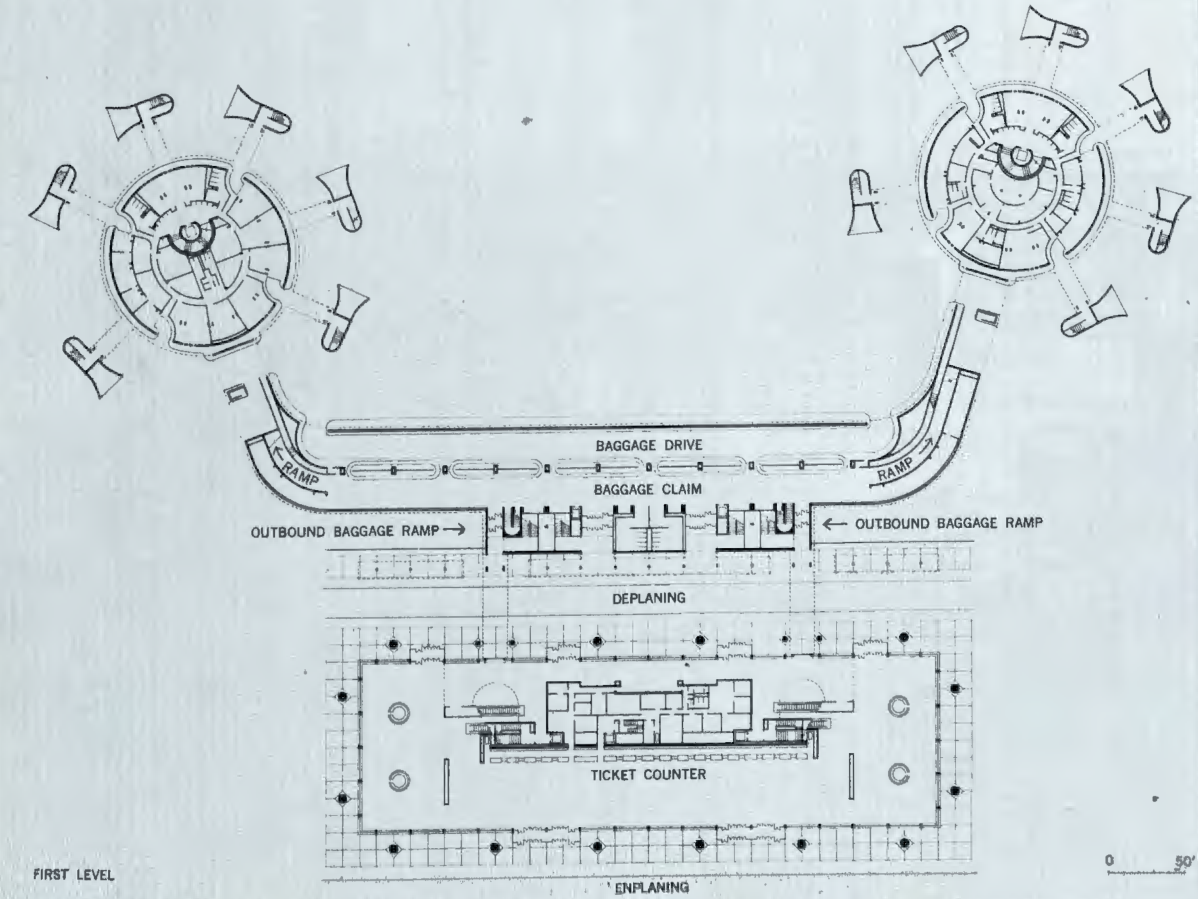
Construction was already underway when changes in airline operation forced a shift of functions. When domestic baggage restrictions were lifted and 747's were introduced (an obvious choice for National's heavy, seasonal Florida traffic), the required peak-hour baggage capacity more than doubled. There simply wasn't room under the main canopy for expanded baggage claim facilities—especially since check-in counters there also had to be lengthened.

At this point, an unforeseen virtue of the original scheme came to light: it left an almost natural location for a baggage-claim area next to the field. Here, in a 100,000-sq.-ft. addition, the architects were able to provide 300 linear feet of baggage-claim platform practically under the wingtips of the planes —thus eliminating the need to deliver incoming baggage to the main building.

The inbound passenger need



SECOND LEVEL



FIRST LEVEL

walk only about 200 ft. from deplaning gate to baggage claim, and another 60 ft. to the curbside for pickup. He may miss the symbolic satisfaction of actually entering the big room, but that is small sacrifice for the absolutely minimal distance he has to walk.

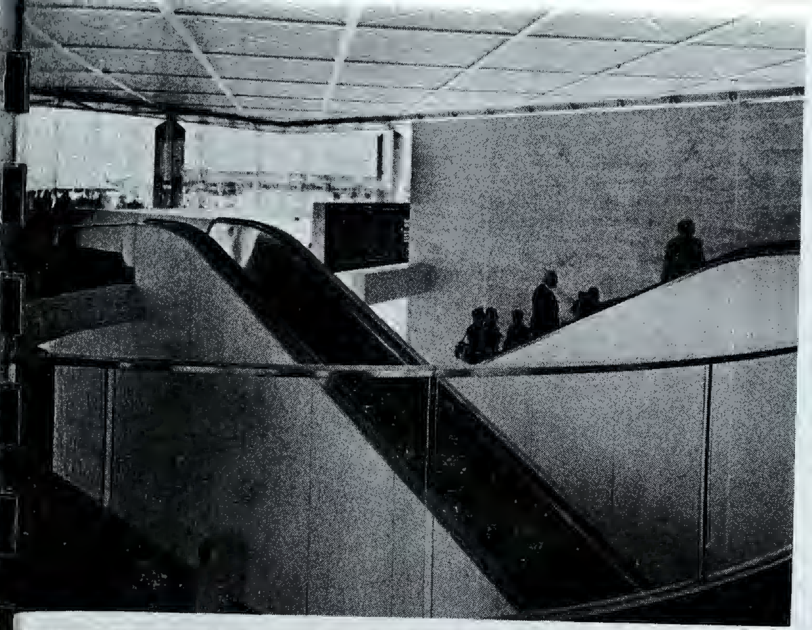
Once the field-side wing was needed, it was logical to move the restaurant and bar out of the mezzanine of the main building to a location above baggage claim, right along the apron. Except for a few shops, mezzanine space has been left open as a lounge, offering essential overflow space for the travelers and greeters at times of peak travel.

The visual image of the terminal was that of a glass-walled pavilion, and the Pei office was determined to keep the walls light and transparent. Pei looked around at other glass - walled buildings — including Saarinen's TWA Terminal, next to this one —and realized that "when the mullions were strong enough to take the wind, they looked strong enough to support the building." The answer was to brace the glass with glass, a system already used in Europe. "If the mullions are glass, there is no doubt about what is holding up the roof."

The architects had to prove to the Port Authority (which controls all construction on its property) that such a system could withstand the rigors of weather and jet-blast at Kennedy. The European system was modified to include two sets of stiffeners at each joint (detail, p. 24) instead of just one. Then a full scale mock-up was tested against 140 mph winds. In all, the system went through three cycles of adjustment and full - scale testing.

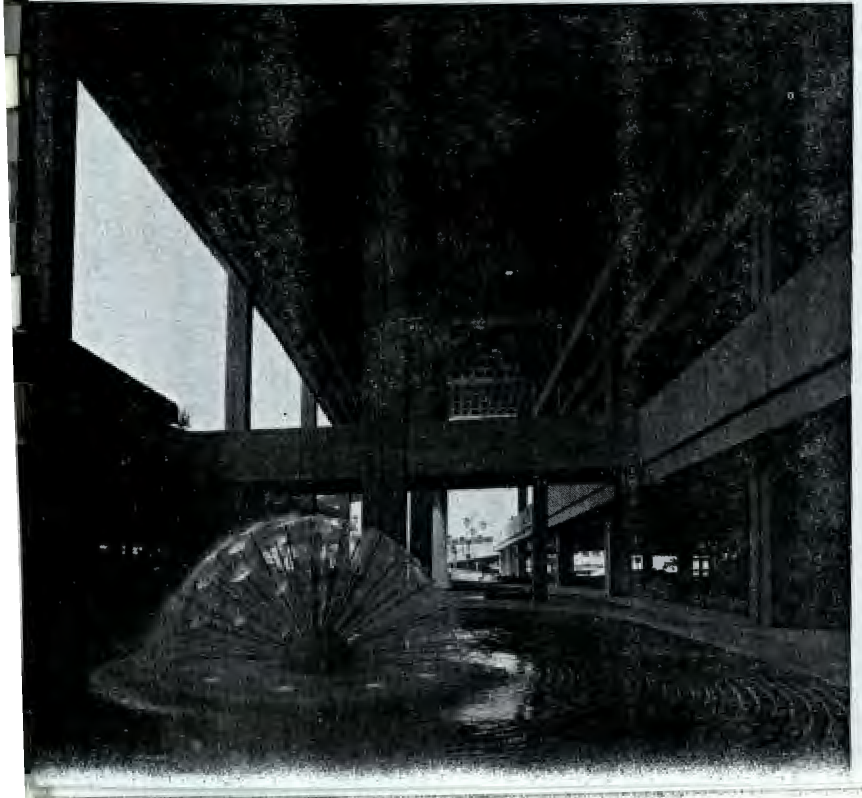
The gigantic roof canopy—430 ft. by 160 ft.—is supported

The main pavilion is bounded by two roadways (plans, left), one for enplaning passengers along the front and one for deplaning passengers at the rear. The field-side wing has a baggage claim area along the deplaning roadway and boarding gates on the upper level, radiating from circular satellites. In the main hall (right) travertine floors and white, perforated metal ceilings reinforce high light levels. Enplaning passengers take escalators (top right) to the red-carpeted mezzanine. Bridges from there to the boarding areas (top, far right) pass through concrete portals which are substituted for columns at two points.




← Gates 7-8-9-10-11-12
Restaurant
Gates 1-2-3-4-5-6


This Car Next
Take Shu
Termin



Interiors (above left) are subdued, unified by gray-brown carpet and split stone veneer on structural members. Light is more intense over counters, escalators, and baggage conveyors. Fountains (bottom left) liven the shaded court between Landside and the car rental structure. Of the four Airside buildings, only National's (above) has boarding lounges at shuttle level, allowing planes to nose in under structure. Pairs of automated shuttle cars (top right) pass at mid-course; concrete median strip could be converted to pedestrian concourse. Passengers enter shuttle through elevator-like doors (near right), after those on board exit through opposite doors; they remain standing (far right) for 40-second trip.

FACTS AND FIGURES

Landside/Airside Terminal Complex, Tampa International Airport, Tampa, Fla. Architects: Reynolds, Smith & Hills (Ivan H. Smith, officer-in-charge). Aviation Advisor: Peat, Marwick, Mitchell & Co. (Leigh Fisher Associates). General Engineering Consultant: J. E. Greiner Co. General contractors: McDevitt & Street Co., J. A. Jones Construction Co., C. A. Fielland, Inc., Building areas: Landside terminal, 409,500 sq. ft.; Landside parking, 741,200 sq. ft.; Airside terminals, 652,700 sq. ft. Project cost: $79,858,000.

(For a listing of key products used in this building, see p. 69.)

PHOTOGRAPHS: Pages 34 (top) and 37 (top), Sandy Gandy; page 36 (left), Kurt Waldmann; aerial photo, Selbypic.

minute wait is too long when you are rushing for a plane.

The system that best met these needs is an adaptation of a Westinghouse transit car (already proven for mechanical dependability at their Pittsburgh test installation). Each shuttle link has two cars, of 100-passenger capacity, making the 1,000-ft. trip in 40 seconds. Allowing about 60 seconds at the end of the line for unloading and reloading, one car should leave either end every 100 seconds.

The shuttle cars have no seats, since the passengers spend barely a minute on board. Running in the open, over highways and groves of palms, the shuttle makes a very appealing trip. (Airport authorities, aware of its amusement value, let the public ride the shuttle for weeks *before* the terminal opened.)

The architects, brought in at the point when the overall scheme was accepted, realized that there was no place in this multidirectional complex for a monumental gateway. They tried to pull together all of the parts—buildings, ramps, and trestles—with similar exposed concrete framing and the same dark glass in all windows. The dominant image of the Landside building is based on the bold crisscross of ramps on its south face, the tall columns and visible trusses that frame roadway and shuttle entrances, and the broad lid of the parking garage at the top.

Much of the open space within Landside's matter-of-fact structural frame is used for sheltered dropoff and pickup platforms. And some of it may eventually be enclosed, when ticketing and baggage-claim areas are expanded by 50 per cent.

Expansion plans — which involve adding two more Airside buildings and three more decks of parking on top of Landside—are based on projected needs of the year 2,000, when 12 to 15 million passengers per year are expected. Present facilities will handle up to about 8.5 million, more than double the current volume of 3.1 million.

With so much reserve capacity, Tampa is functioning rather effortlessly at the moment. Increasing traffic, as it approaches the capacity of the present complex, should provide an interesting test of the road network, escalators, elevators, and transit on which travelers here depend.

TRANSFER AT TAMPA

Florida airport terminal is a mechanism for switching from aircraft to surface vehicles

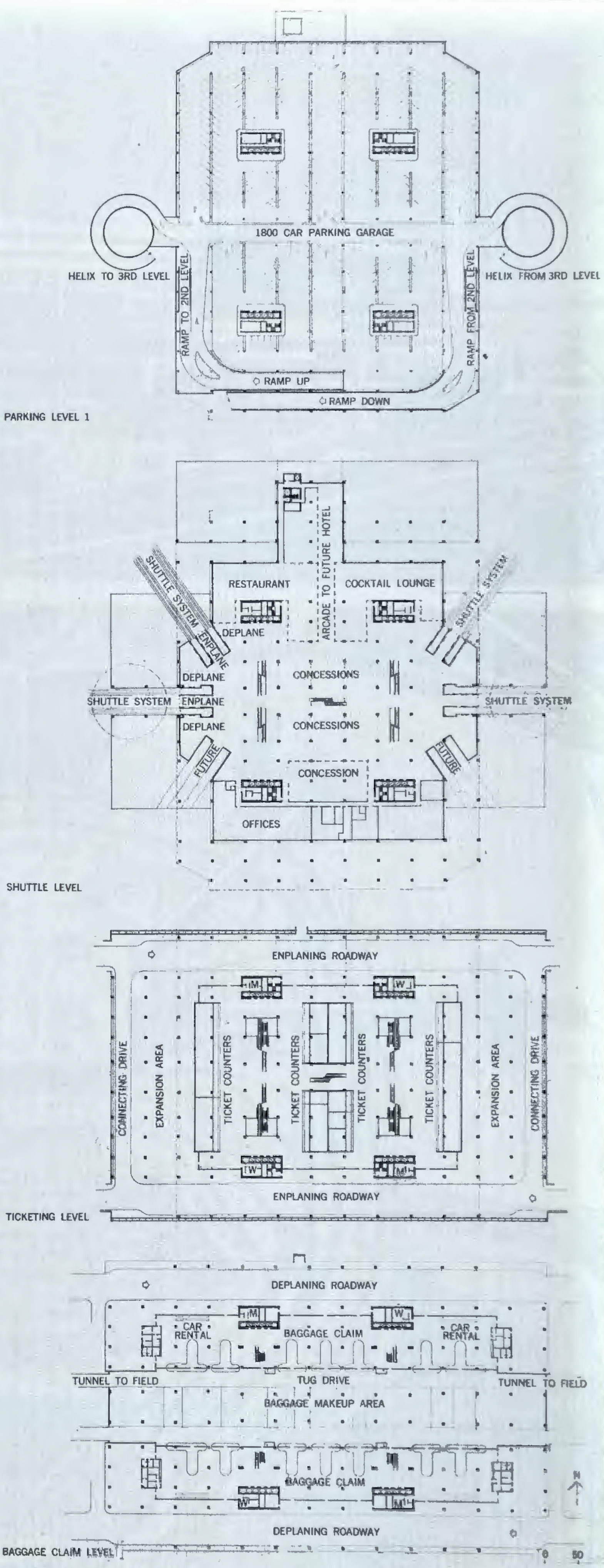
At the center of Tampa Airport is an intricate interchange—involving aircraft, automobiles, and automated transit—which is called, for want of a better name, a "terminal." But James A. Meehan, airport consultant for Architects Reynolds, Smith & Hills, reminds us that no air terminal is ever the end of the trip, just a place to transfer from one mode of transportation to another.

At Tampa, the traveler is always aware that he is just passing through. In fact, he is never sure precisely when he has "arrived" at the terminal. He goes through the central "Landside" building, where he may park his car, then takes an automated shuttle to one of four "Airside" buildings, where he boards his plane. In the process, he will take two escalators (plus an elevator, if he parks his own car), but he will *walk* no more than 700 feet.

The Landside/Airside scheme originated back in 1962 as a means of eliminating the long treks demanded by existing airports. (It is no coincidence that about half of this airport's traffic originates in the retirement meccas of St. Petersburg and Clearwater.) Airport consultants Leigh Fisher Associates studied all existing schemes. Then, working with engineers of the J. E. Greiner Company, they came up with the Landside/Airside concept, based on automated transit links.

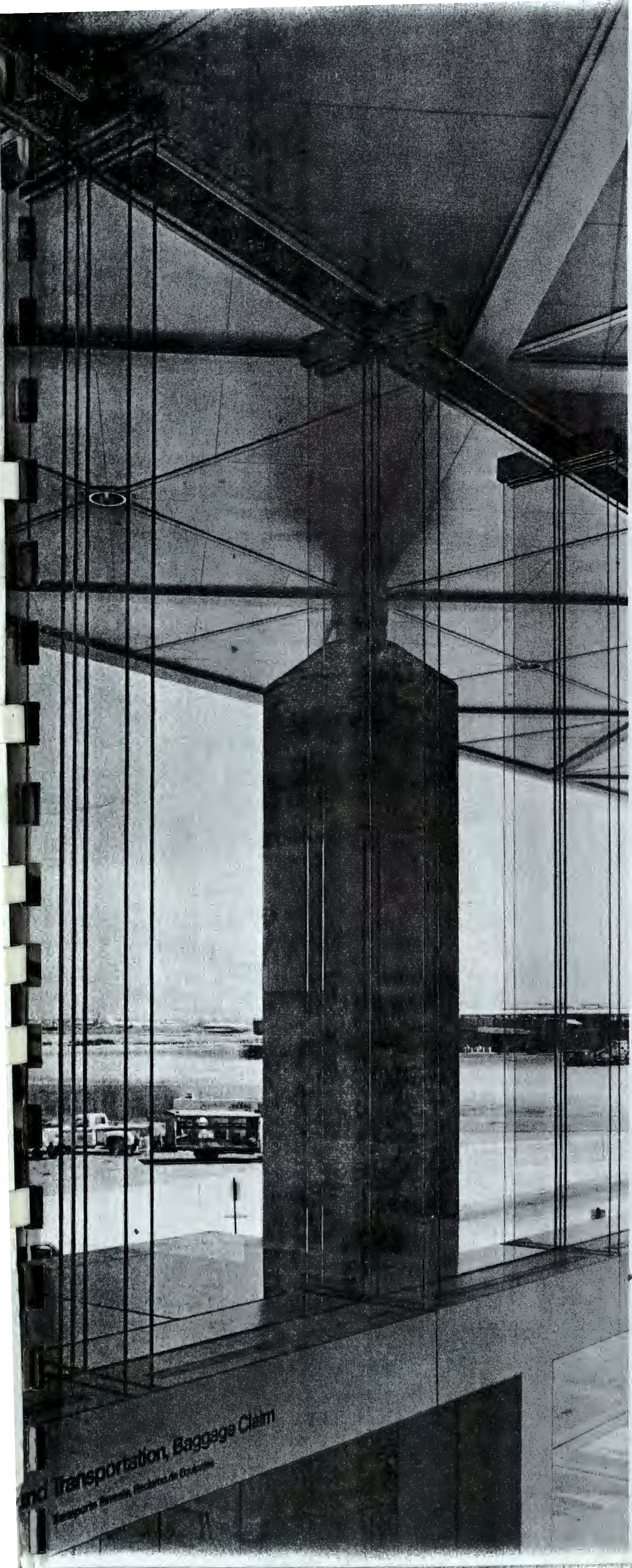
This scheme avoided the pitfalls of other walk-reducing schemes: the clumsy passenger-loading operations of the mobile lounge, and its dependence on specially-trained drivers; the redundant ground connections and passenger services of decentralized schemes. And it allowed for future expansion of all parts without disturbing operations.

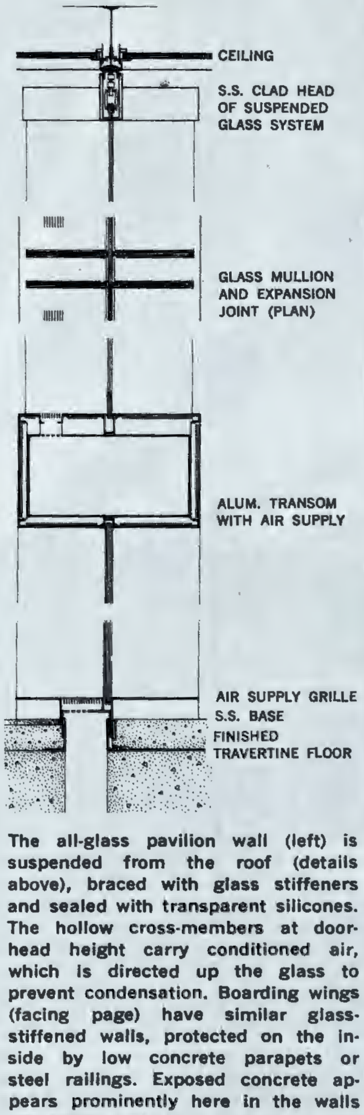
At the time the Landside/Airside scheme was adopted, however, it was not certain that a suitable shuttle vehicle even existed. As the sole way of getting from Landside to Airside (except in emergency), it had to be safe, foolproof, and easy to board—with no attendants present. Its capacity was based on the unlikely event that four DC-8's would arrive at one Airside at the same time; that called for moving 840 people to the Landside building in 10 minutes. For enplaning passengers, *frequency* of service was critical; a two-



The 1 million-sq. ft. Landside building at the center of the terminal (top left) is penetrated by roads at several levels and has three decks of parking at the top. Elevated transit lines link Landside to four Airside buildings (aerial, left). To the south of Landside (foreground in aerial) are long-term surface parking and a two-deck rental car terminal; just to the north, a 300-room hotel and a control tower are under construction. Two more Airsides will be added, to the south, and the road loop will have a second outlet, to the north.

Arriving
Flights





The all-glass pavilion wall (left) is suspended from the roof (details above), braced with glass stiffeners and sealed with transparent silicones. The hollow cross-members at door-head height carry conditioned air, which is directed up the glass to prevent condensation. Boarding wings (facing page) have similar glass-stiffened walls, protected on the inside by low concrete parapets or steel railings. Exposed concrete appears prominently here in the walls and ceilings of ramped passages (top left photo), in turrets that support boarding bridges (top right), and in the umbrella-like framing of boarding lounges (lower photo).

on just 16 concrete columns. Conical column caps, carrying 21-inch spherical bearings, give an effect of almost effortless support. Actually, the joint is by no means as simple as it looks: cylindrical chases running up through columns, sockets, and ball-bearings are needed to accommodate rain leaders, electrical conduits, and plumbing vents (the latter passing through the basement to reach the columns).

In the original design, the roof itself was to be a space-frame with the layout of its bottom members visible as a criss-cross pattern in the ceiling. A more conventional steel girder-and-beam system turned out to be less expensive, but the architects kept the appealing criss-cross pattern anyway.

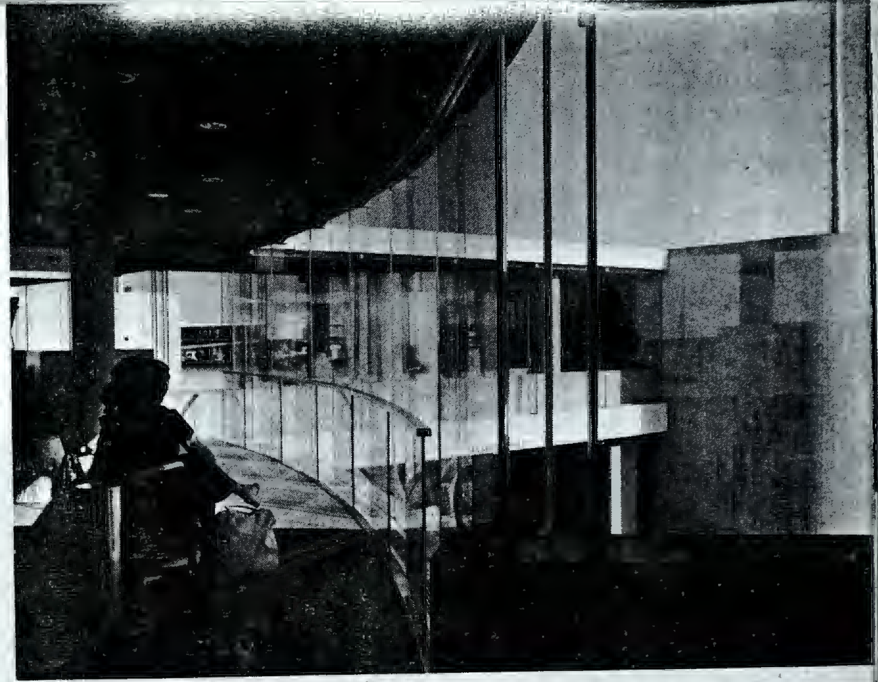
The fascia, which had originally been a mere enclosure, became a structural edge beam in the revised framing system. Exposed and painted white, this built-up beam has become an important visual asset.

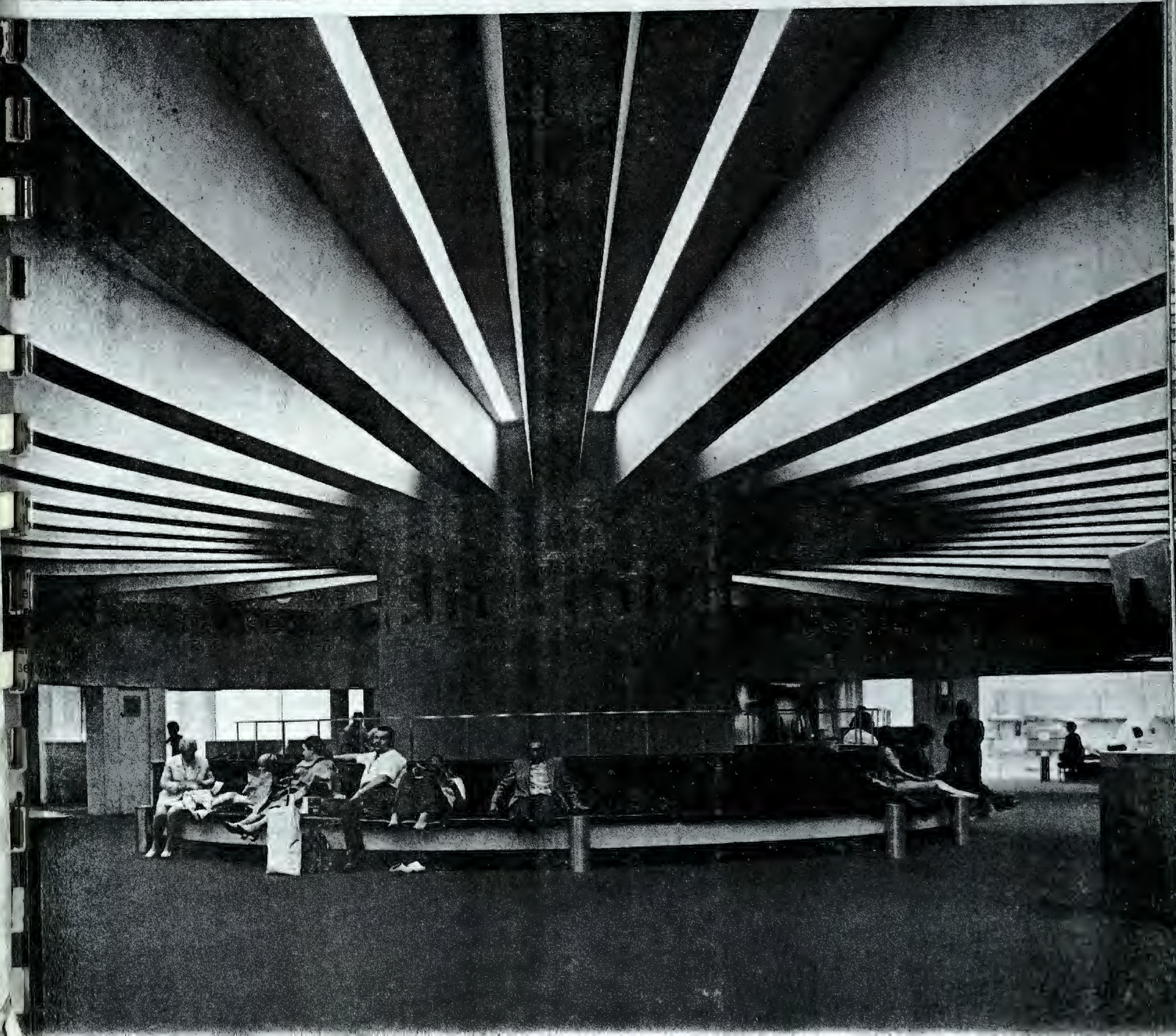
Throughout the building, almost every surface that is not clear glass is white or near-white in color. Travertine is used for the main floor and the walls of the core and white-coated aluminum is used for framing of the lower walls, for partitions, for freestanding signs, etc. (Only at mezzanine level does deep color appear over a large area—in red carpet which is not visible from outside.)

One objective of the light-colored, reflective surfaces is to keep light levels inside as close as possible to outdoor conditions, so that the activities of people inside — and National Airlines' lively orange and yellow sun symbols—will show up clearly from outside. "After all," says Pei, "that's what a glass pavilion is all about."

FACTS AND FIGURES

National Airlines Terminal, Kennedy International Airport, New York, N. Y. Architects: I. M. Pei & Partners (Eason H. Leonard, partner-in-charge; Kenneth D. B. Carruthers and William J. Jakabek, associates-in-charge; Paul L. Veeder II, resident architect). Engineers: Ammann & Whitney (structural) Seelye, Stevenson, Value & Knecht (mechanical and electrical). Consultants: Bolt, Beranek & Newman, Inc. (sound); Edison Price, Inc. (lighting); Warren Travers & Assoc. (traffic). General Contractor: John Lowry, Inc. Building Area: 349,719 sq. ft. Construction costs: $37,000,000. (For a listing of key products used in this building, see p. 69.)
PHOTOGRAPHS: George Cserna.





Flughafenanlagen

M[illegible]hard von Gerkan, Hamburg *

Elemente der Flughafenplanung

Eléments de la planification des aéroports

Elements of air terminal planning

Fliegen ist in der Energieausnutzung die unwirtschaftlichste Beförderungsart. Ein mit 70 Passagieren besetztes Mittelstreckenflugzeug verbraucht mehr Treibstoff als 35 Mittelklassewagen mit je 2 Fahrgästen für die gleiche Strecke.

Trotzdem weist der Luftverkehr seit langem große Zuwachsraten auf.

Wachstumsprognosen, die für Hamburg oder München jährliche Passagieraufkommen von über 30 Millionen – 1974 waren es ca. 4 Mio. – noch für dieses Jahrhundert voraussagen, werden sich zwar nicht erfüllen, nichtsdestoweniger ist die Bedeutung des Luftverkehrs bei fortschreitender und weltweiter wirtschaftlicher Verflechtung evident. Die Ursache hierfür liegt in der zeitlichen Überlegenheit des Fliegens. Das Flugzeug ist jedem anderen heute verfügbaren Reisemittel bereits bei einer Distanz von ca. [illegible]0 km zeitlich deutlich überlegen. Bei Mittelstrecken von 2000 bis 3000 km beträgt die zeitliche Überlegenheit bereits das 6- bis 10fache. Bei Langstrecken von über 5000 km kann man das Flugzeug als konkurrenzlos betrachten.

Der Luftverkehr bindet die regional begrenzte Reichweite von Straße und Schiene in die kontinentale und weltweite Dimension ein. Der Flughafen ist der Umschlagplatz beider Verkehrsarten, Bodenverkehr und Luftverkehr. Die unterschiedlichen Charakteristiken dieser beiden Verkehrsarten determinieren auch den Anforderungskatalog und die Funktion eines Flughafens etwa gleichgewichtig. Ein Flughafen ist zugleich auch immer ein Autohafen.

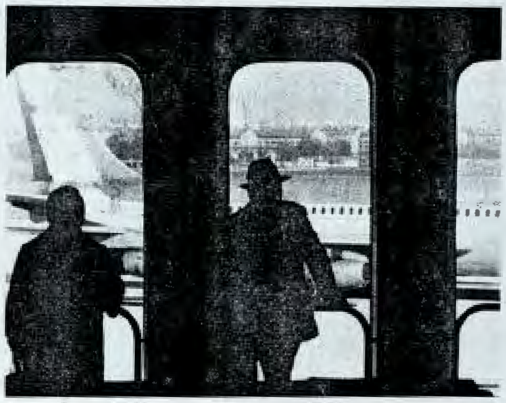
Flughafenplanung reicht von der Ordnung des Luftraumes mit seinen Einflugschneisen über die infrastrukturelle Standortbestimmung, das Start- und Landebahnsystem, die Straßen- und Bahnanbindung bis hin zur flughafeninternen Organisation, bei der die Passagieranlagen in die übrigen Betriebsanlagen für Fracht, Flugzeugwartung, Energieversorgung usw. funktionell eingebunden werden müssen.

Im Gegensatz zur klaren Typologie z. B. von Eisenbahnhöfen weisen Flughäfen eine unübersehbare Zahl von Typen auf. Das hat folgende Ursachen:

- Die Verkehrscharakteristik des Luftverkehrs hat sich, seit dem es Flughäfen gibt, ständig verändert. Die Kapazität der Maschinen ist permanent bis auf ca. 400 gewachsen. Geplanten Großtransportern mit einer Kapazität von 900 bis 1000 Plätzen wird z. Z. kaum eine wirtschaftliche Chance eingeräumt.

  Die Reisegeschwindigkeit ist rasch auf ca. 1000 km/h angewachsen und hat sich für fast alle gängigen Mittel- und Langstreckenmaschinen an dieser Marke eingependelt.

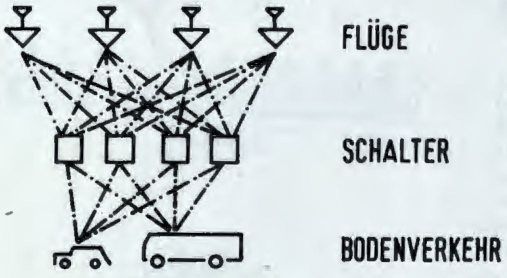
  Die mehr als doppelt so schnellen Überschalltypen wurden aus wirtschaftlichen und Umweltschutz-Gründen entweder gar nicht erst gebaut (Boeing SST) oder dienen nur noch als Prestigeobjekte (Concorde). Immer größere Flugzeugmuster und höhere Fluggeschwindigkeiten haben die Abmessungen der luftseiti-



1
Fluggastabfertigung im »Common Check-in«-System.
Enregistrement des passagers selon le système «Common Check-in».
Common Check-in system for passengers.

2
Abfertigung im »flight check-in«-System.
Enregistrement selon le système «flight check-in».
Flight Check-in system.

3
Abfertigung im »gate check-in«-System.
Enregistrement selon le système «gate check-in».
Gate Check-in system.



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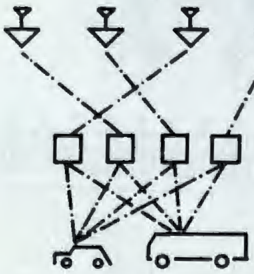

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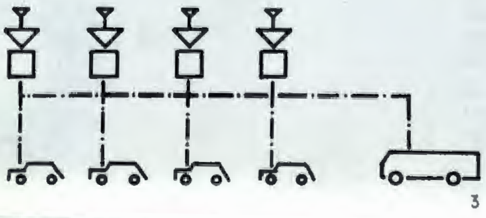


3

bahn, Zurollwege, [illegible] positionen) beträchtlich vergrößert.

- Die »luftseitige« Verkehrscharakteristik ist für jeden einzelnen Flughafen sehr unterschiedlich, je nach Anteil von Kurz-, Mittel- und Langzeitflügen und den dafür vorzugsweisen eingesetzten Flugzeuggrößen.
- Die Charakteristik des Bodenverkehrs ist ebenfalls je nach Standort sehr unterchiedlich.

  Bei vielen amerikanischen Airports entfallen nahezu 100 Prozent auf den Individualverkehr (Pkw und Taxi), für den neuen Münchener Flughafen hingegen werden 50 Prozent des Verkehrsaufkommens von der schienengebundenen S-Bahn erwartet.
- Das stark unterschiedliche Verkehrsaufkommen bewirkt bei wachsender Größe eine Komplizierung der Funktionsabläufe.

  Die simple Addition von kleinen Flughäfen zu einem Großflughafen á la Kennedy-Airport in New York macht diesen zu einem fast unsteuerbaren Apparat mit teilweise chaotischen Zuständen.

Diese Ursachen:

- ständige Neuentwicklung des Fluggeräts (Vergrößerung und höhere Geschwindigkeit),
- für jeden Standort unterschiedliche Charakteristiken des Luftverkehrs (Kurz-, Mittel-, Langstrecken, Verteilung zwischen reinem Quell- und Zielverkehr und Umsteigern),
- die beträchtlichen Unterschiede in der Charakteristik des Bodenverkehrs (Verteilung zwischen Individual- und öffentlichem Zubringer),
- die Größenordnung des einzelnen Flughafens selbst

haben bewirkt, daß für die bauliche Lösung immer wieder andere Wege gesucht und neue Systeme entwickelt wurden.

Trotz der großen Zahl von Archetypen erlauben die wesentlichen Merkmale eine gewisse systematische Gliederung, die gleichzeitig bestimmte »Flughafengenerationen« erkennen läßt.

Die Planung von Fluggastempfangsanlagen betrifft drei Bereiche:

Bereich Luftseite (Luftverkehr), Bereich Abfertigung, Bereich Landseite (Bodenverkehr).

Die typischen Unterschiede der verschiedenen Systeme betreffen die unterschiedliche Ausbildung der Bereiche selbst, im wesentlichen jedoch die Zuordnung der Bereiche zueinander.

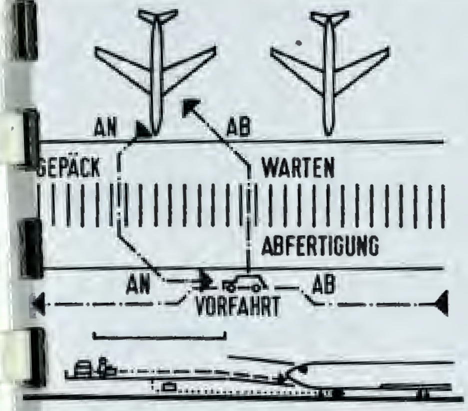
Bereich Luftseite und Zuordnung zum Bereich Abfertigung

Die Alternativen in diesem Bereich beschränken sich quasi auf die Art der Flugzeugaufstellung. Die Positionierung auf offenem Vorfeld erlaubt die freie Manövrierfähigkeit der Flugzeuge aus eigener Kraft, erfordert aber, daß die Fluggäste den Weg von und zur Abfertigung zu Fuß oder per Bus zurücklegen müssen. Will man diesen Weg verkürzen, so bieten sich in gebäudenaher Aufstellung die Unterschiede zwischen »Nose in«, »Angle in«, »Parallel«, »Angle out« und »Nose out« an. Dabei hat sich die »Nose in«-Aufstellung weitgehend durchgesetzt, weil der Platzbedarf am geringsten ist und Fluggastbrücken gut anzuschließen sind. Die Maschinen rollen mit eigener Kraft – »power in« – herein, müssen jedoch, das ist der Nachteil, mittels Schlepper – »push out« – herausgedrückt werden.

Bereich Abfertigung

Die drei Primärfunktionen sind
Abflug, Ankunft, Umsteiger
mit stark abweichenden Charakteristiken. Notwendige Paß- und Zollkontrollen teilen allein die eine Primärfunktion Umsteiger in weitere 4 Kategorien:

3



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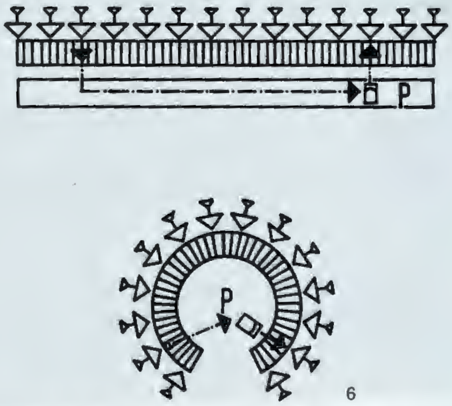

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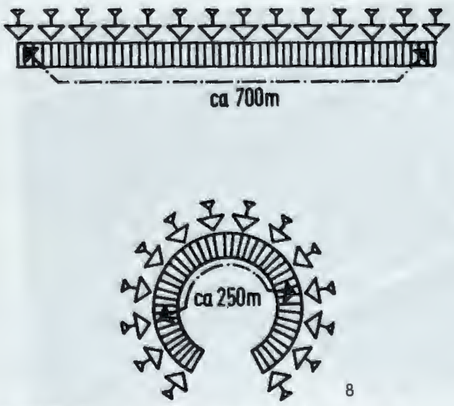

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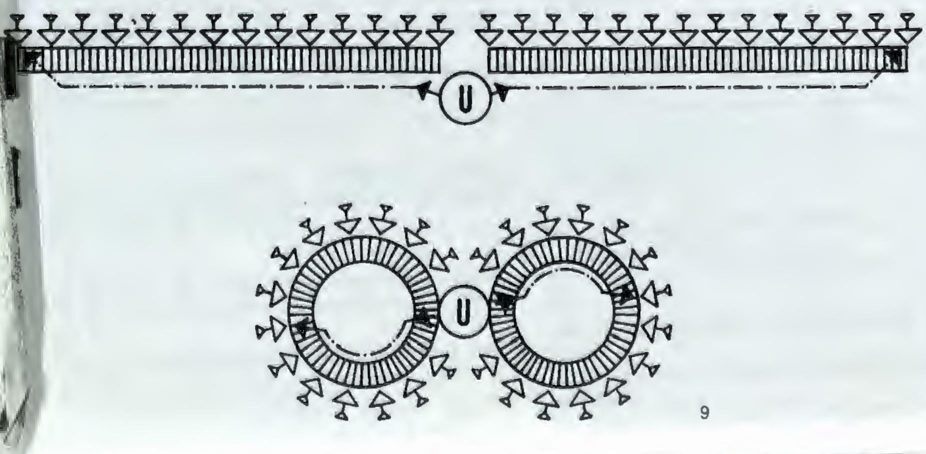


9

3
Modellfoto mit Erweiterung des Dauerparkplatzes durch ein sechsgeschossiges Parkhaus.

Photographie de la maquette montrant l'extension du parking longue durée sous la forme d'un garage de six niveaux.

Photo of model with extension of car park by a 6-storey garage.

4
Wettbewerbsmodell.

Maquette du concours.

Competition model.

5
Elementare und direkte Zuordnung von Vorfahrt, Abfertigung und Flugzeug, Abflug und Ankunft auf einer Ebene.

Correspondance élémentaire et directe entre les accès, l'enregistrement, les départs et arrivées des appareils sur un seul niveau.

Elementary and direct coordination of access, dispatching, arrivals and departures on one level.

6
Durch ringförmiges Zusammenschließen verkürzt sich die mittlere Wegentfernung für Umsteiger von 700 auf 250 m.

Grâce à la forme annulaire, la distance moyenne parcourue par les passagers en transit se réduit de 700 à 250 m.

Owing to the circular lay-out, the average distance for transit passengers is reduced from 700 to 250 m.

Die Ringform schafft auf der »Luftseite« zur Aufstellung der Flugzeuge mehr Platz und reduziert die »Landseite« auf das richtige Maß. Kapazitätsausgleich von Land- und Luftseite.

Tout en accroissant les aires de stationnement du côté appareils, la disposition annulaire réduit le côté passagers à ses justes proportions. Equilibre des capacités entre les côtés terrestre et aérien.

The circular lay-out increases the plane docking area and decreases the passageways for passengers to reasonable proportions. Capacity balance between land and air sides.

Dauerparker, die an einem anderen »gate« zurückkommen, haben zu einem ringförmig umschlossenen – im Gegensatz zu einem linearen – Parkplatz bedeutend kürzere mittlere Wegentfernungen.

Par rapport au parking linéaire, le parking central réduit notablement le chemin des passagers dont le retour se fait par une autre «gate» que celle du départ.

In contrast to linear parking, centralized parking greatly reduces the traffic routes, and different gates are used for arriving and leaving.

Die in der Mitte von zwei Ringen geplante U-Bahn-Station ist von den »gates« im Mittel nur ca. 160 m entfernt.

La station de métropolitain prévue au milieu de deux anneaux n'est éloignée des «gates» que de 160 m.

The rapid transit railway station planned for the centre of two rings is only 160 m from the gates.

10
Zentrale Vorfahrtshochstraße von der grünen »Birne« aus gesehen.
La voie d'accès centrale supérieure vue de la pelouse centrale en forme de poire.
Central elevated access road seen from the central pear-shaped lawn.

11
Luftaufnahme des 1. Bauabschnittes.
Vue aérienne de la 1ère étape.
Air view of the 1st construction stage.

12
Die Geschosse des Zentralgebäudes wurden gestaffelt.
Les niveaux du bâtiment central s'organisent en terrasses.
The floors of the central building are terraced.

13

14

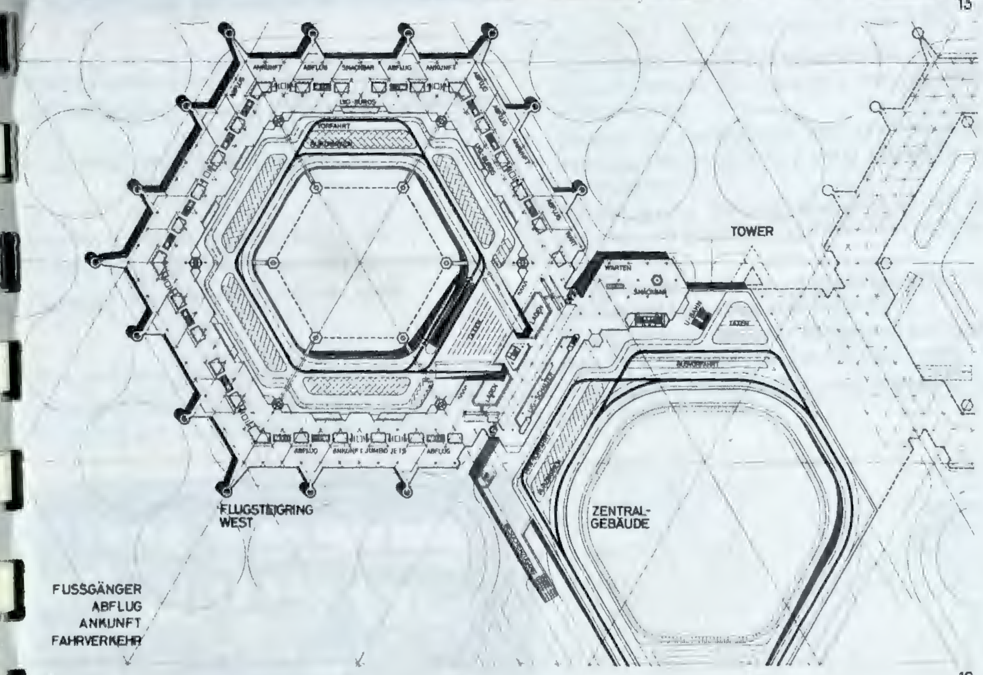
15

13–15

Detail des Flugsteigringes. Der Übergangsbereich zwischen Flugzeug und Gebäude zeigt Gestaltungsmerkmale des Flugzeugbaus.

Détail de l'anneau d'embarquement. La zone de transition entre l'avion et les bâtiments présente des formes propres à la construction aéronautique.

Detail of circular dock. The intermediate area between plane and building reflects aircraft design principles.

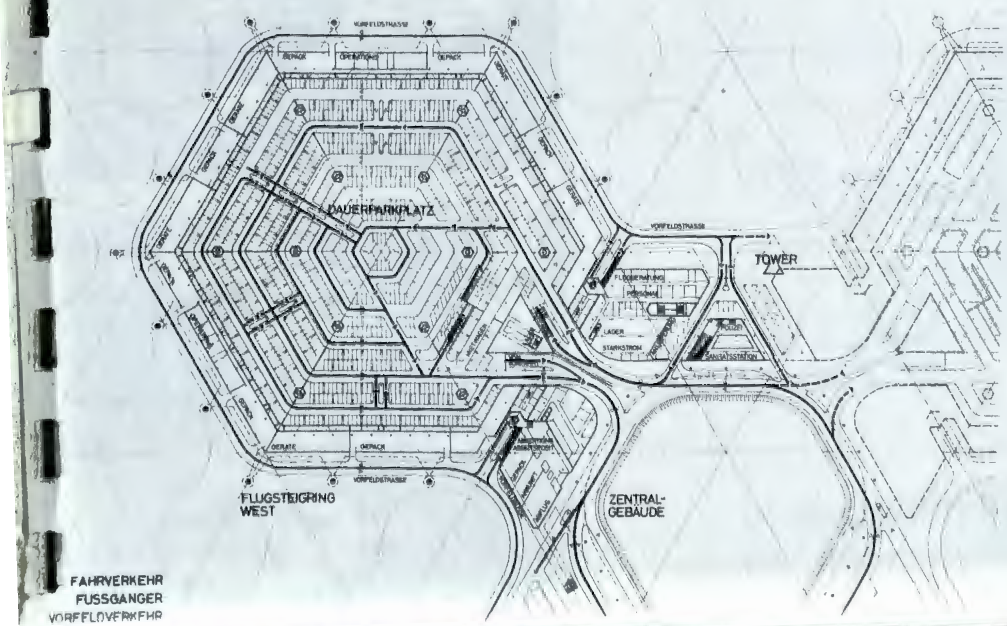


16

Grundriß des Fluggastterminals Ebene + 1.

Plan au niveau + 1 du terminal passagers.

Plan of passenger terminal, level + 1.



17

Grundriß des Fluggastterminals E 0.

Plan du terminal passagers E 0.

Plan of passenger terminal E 0.

18

19

20

18

Abfertigungsschalter im Flugsteigring.

Guichets d'enregistrement dans l'anneau d'embarquement.

Dispatching points in circular dock.

19

Eine von fünf Seiten des Flugsteigringes.

L'un des cinq côtés de l'anneau d'embarquement.

One of the five sides of the circular dock.

20

Halle mit Läden und Buchungsschaltern.

Hall avec boutiques et guichets des compagnies.

Concourse with shops and booking windows.

21, 22

Wartemöbelsystem, das raumbildend aus dem hexagonalen System des Baus von den Architekten entwickelt wurde.

Système de meublement des aires d'attente développé par les architectes à partir du réseau constructif hexagonal.

Furnishings for lounges developed by the architects based on the hexagonal system of the building.

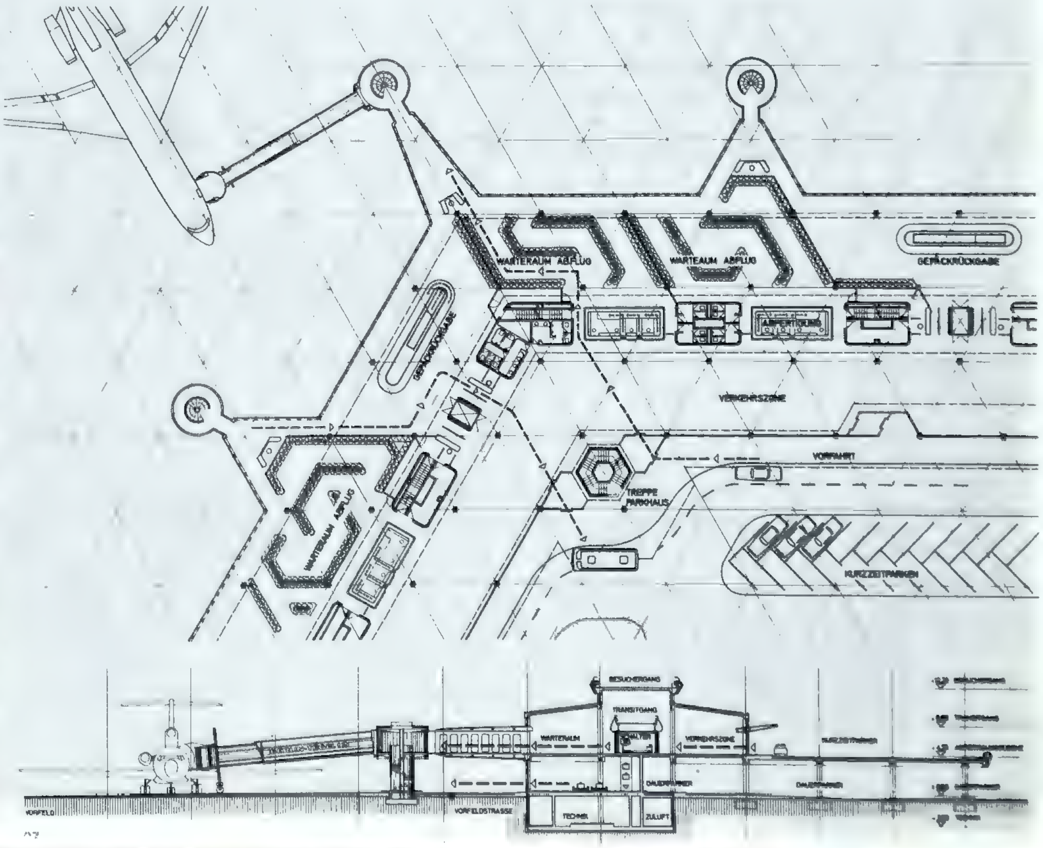
23

Grundrißausschnitt der Abfertigungsebene mit Funktionsablauf für Abflug und Ankunft.

Plan partiel du niveau d'enregistrement indiquant le schéma fonctionnel des départs et arrivées.

Plan detail of dispatching level indicating departure and arrival procedure.

21



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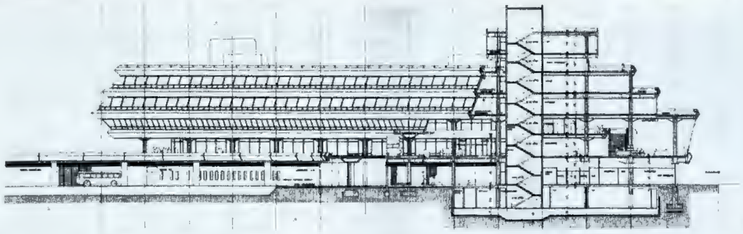

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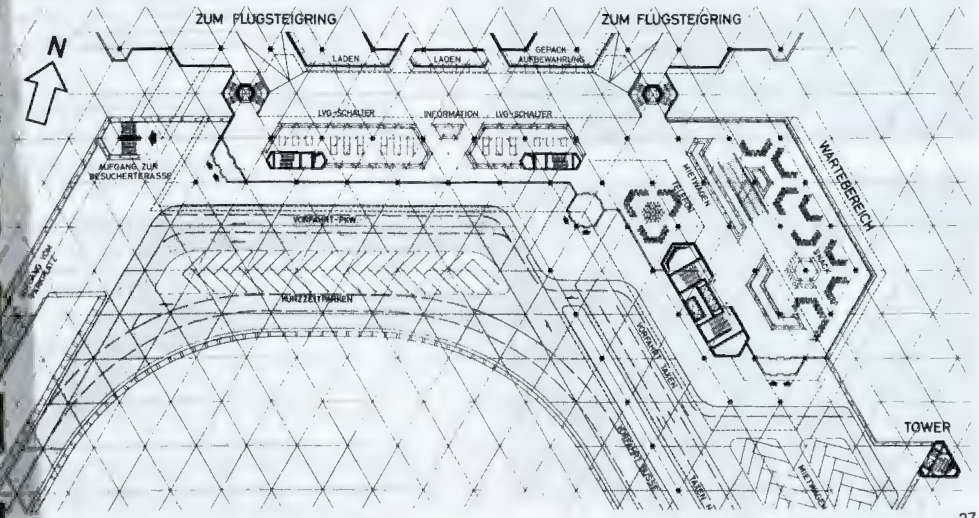

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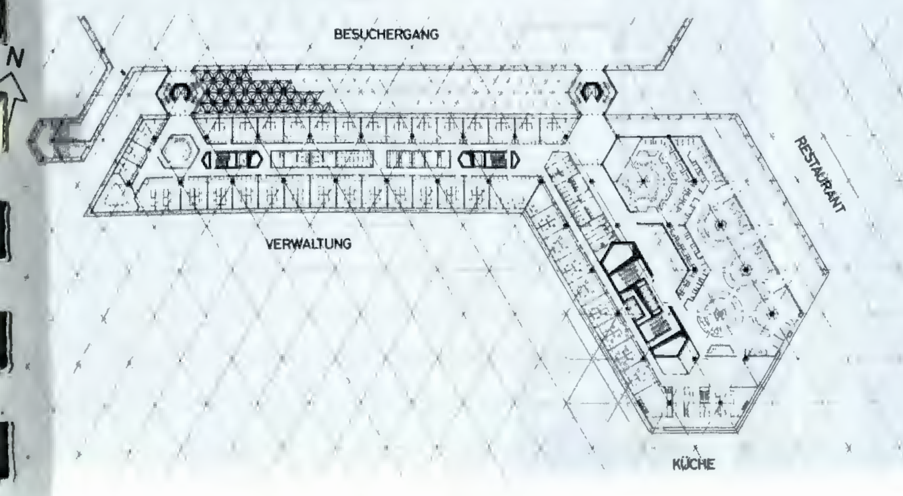


24
Zentrale Vorfahrt.
Accès central.
Central access.

25
Kontrollturm.
Tour de contrôle.
Control tower.

26
Schnitt durch das Zentralgebäude.
Coupe sur le bâtiment central.
Section of central building.

27
Grundriß Ebene + 1 des Zentralbereiches.
Plan de la zone centrale au niveau + 1.
Plan of level + 1 of central tract.

28
Grundriß Ebene + 3 des Zentralbereiches.
Plan de la zone centrale au niveau + 3.
Plan of level + 3 of central tract.

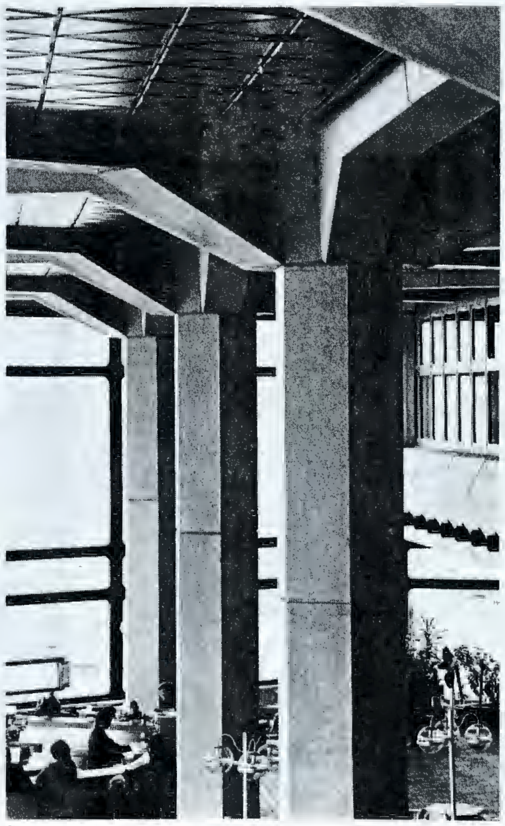
29

30

31

32

33



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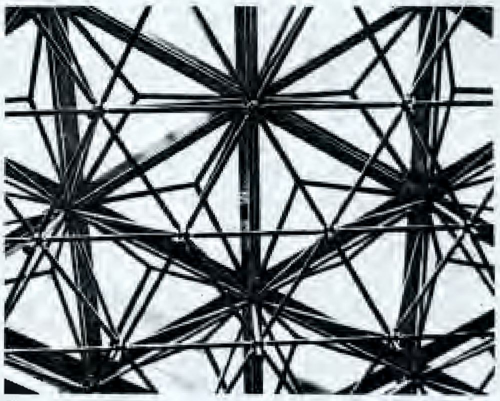

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36

Galerie in der zentralen Halle mit Post, Bank, Friseur.

erie dans le hall central avec poste, banque et ffeur.

Gallery in the central concourse with post office, bank and hairdresser.

ck auf den zentralen Parkplatz in der »Birne«.

Vue sur le parking central dans la «poire».

View of the central car park in the "pear".

gang in einem sechseckigen Treppenturm.

Vue montrant une cage d'escaller hexagonale.

Ascent in a hexagonal well.

Baukörperabschluß des Zentralgebäudes.

Extrémité du volume dans le bâtiment central.

of central building.

Ausblick von der Snackbar.

Vue à partir du snack-bar.

w from snack bar.

Stützen und Unterzüge sind in der Halle sichtbar.

Les poteaux et les poutres du hall sont apparents.

lars and beams are visible in the concourse.

35, 36

Struktur des Glasdaches über der Haupthalle.

ucture de la verrière surmontant le hall principal.

ucture of the glass roof over the main area.

37

Energiezentrale mit Schornsteingruppe. Rückkühlwerk auf dem Dach.

Centrale d'énergie avec groupe de cheminées et tour de refroidissement en toiture.

Power central with stacks. Cooling tower on roof.

38

Luftfrachtgebäude mit Verwaltungsräumen im Obergeschoß des »Rückgrates«.

Bâtiment de fret aérien avec locaux administratifs à l'étage de l'«arête centrale».

Air freight building with offices on upper level of central "spine".

38

39

39

Betriebshofflächen mit Kfz.-Halle.

Aire de service avec hall des véhicules.

Service area with garage.

40

Gebäudecontainer der betriebstechnischen Gebäude.

Un volume container des bâtiments techniques d'exploitation.

Building container for operations buildings.

41

Türme mit Schneckenförderungsanlage zur Beschickung des Streugutlagers.

Tour avec transporteur à vis sans fin pour l'allmentation du stockage de matériaux anti-gel.

Towers with screw conveyors for supplying stock rooms with anti-freeze material.

42

Konstruktionsdetail des Daches vom Hangar.

Détail constructif de la toiture du hangar.

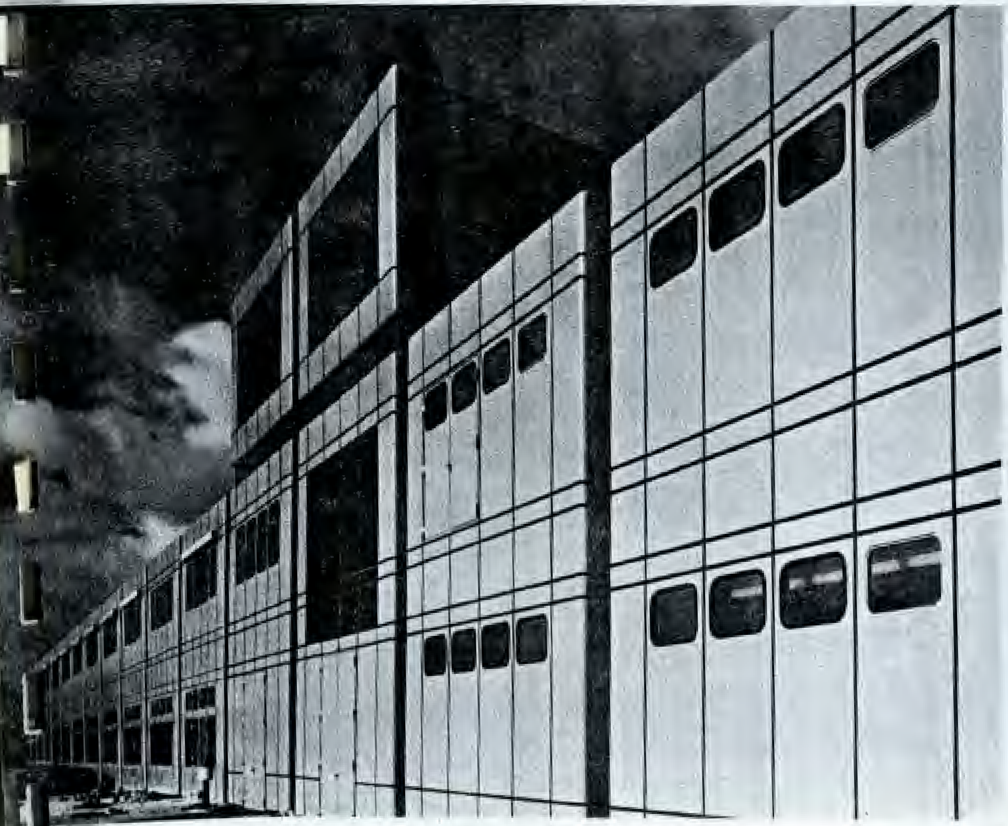
Construction detail of hangar roof.

43

Detail der Längsseite des Hangars.

Détail du grand côté du hangar.

Detail of the longitudinal side of the hangar.

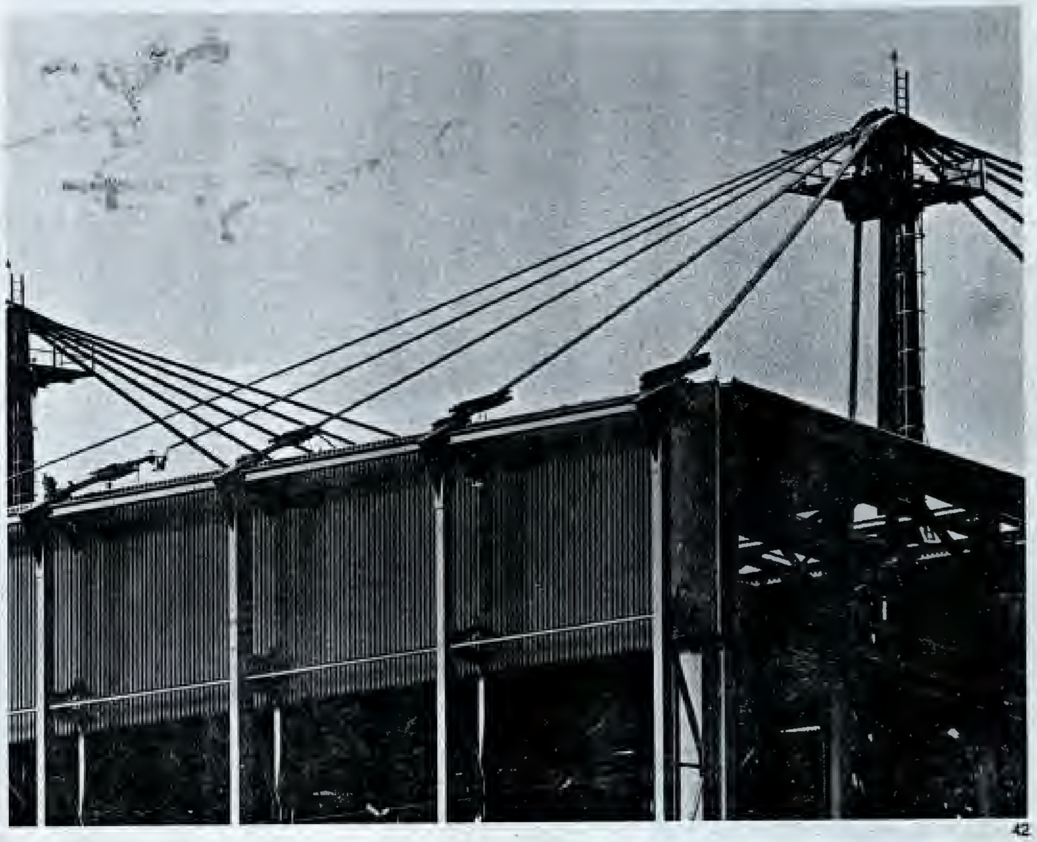


40

44
Giebelansicht des Hangars.
du hangar côté pignon.
view of hangar.

45
Hangar vom Besuchergang des Flugsteigringes.
hangar vu du couloir visiteurs de l'anneau d'em-
quement.
Hangar from visitors' corridor of circular dock.


41


42


43


44


45

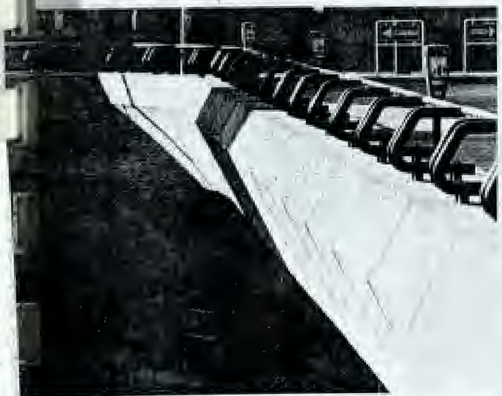
Blick auf Zufahrt und Flugzeugbrücke.
e sur l'accès et le pont d'embarquement.
w of access and boarding bridge.

rtal der Flugzeugbrücke.
rtique du pont d'embarquement.
rtal of boarding bridge.

48
änderdetail.
ail de la rampe.
Detail of the banisters.

49
er der Flugzeugbrücke.
e sous le pont d'embarquement.
Under the boarding bridge.

46



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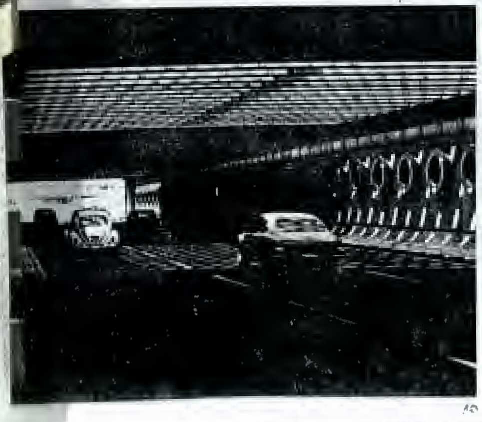

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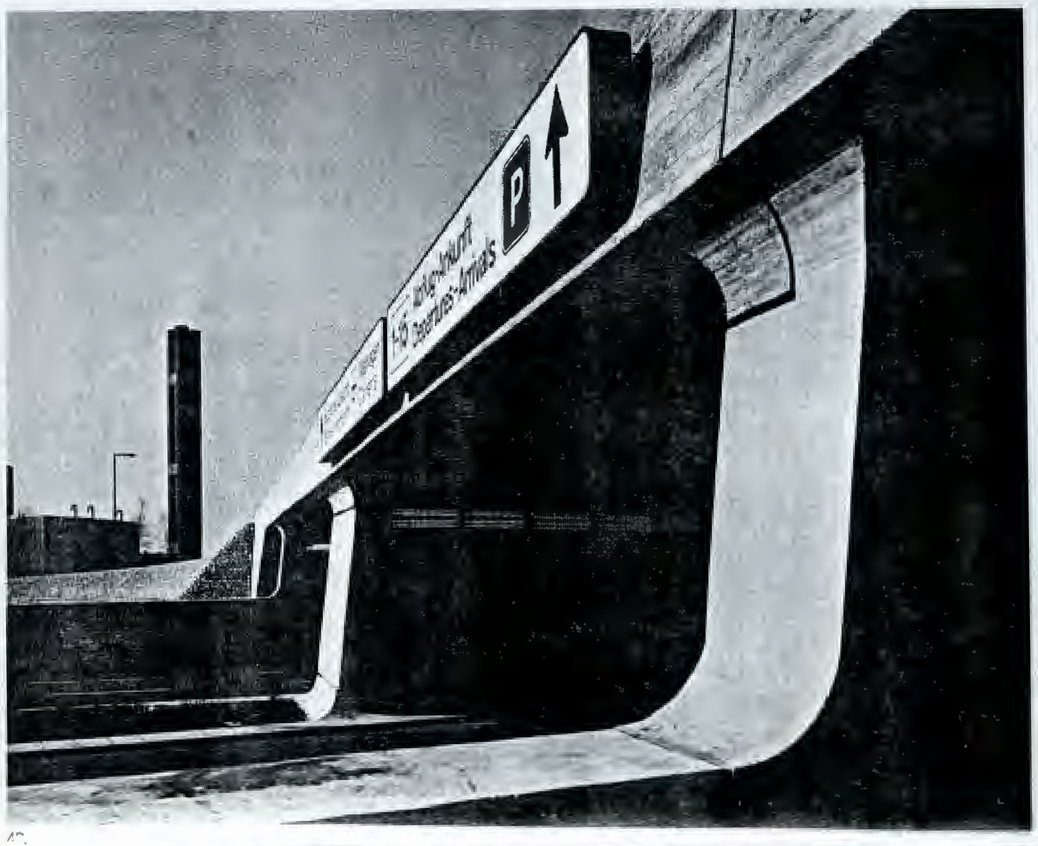


47

n Flughafen der neuen eneration

aeroport de la nouvelle génération
port of the new generation

rr:
lner Flughafengesellschaft mbH
d anzösische Schutzmacht

Entwurf + Bauleitung
von Gerkan, Marg, Nickels,
Dipl.-Ingenieure, Architekten BDA

Projektleitende Partner:
K. Brauer, R. Niedballa, K. Staratzke

Mitarbeiter:
Auder, August, Bickenbach, Brockstedt, Eickemeyer, Ferdinand, Franz, Gerhardt, Gräbner, Grzimek, Henning, Hertel, Herzlieb, Hönicke, Illig, Perisić, Römer, Seule, Srouji, Wetter, Yunis, Zimmer

Brandi, Tschapke, BMS

Statik:
Prof. Polonyi, Pegel & Sohn, Roik, Franke, Nicklisch

Flughafen Berlin-Tegel
Aeroport de Berlin-Tegel
Berlin-Tegel Airport

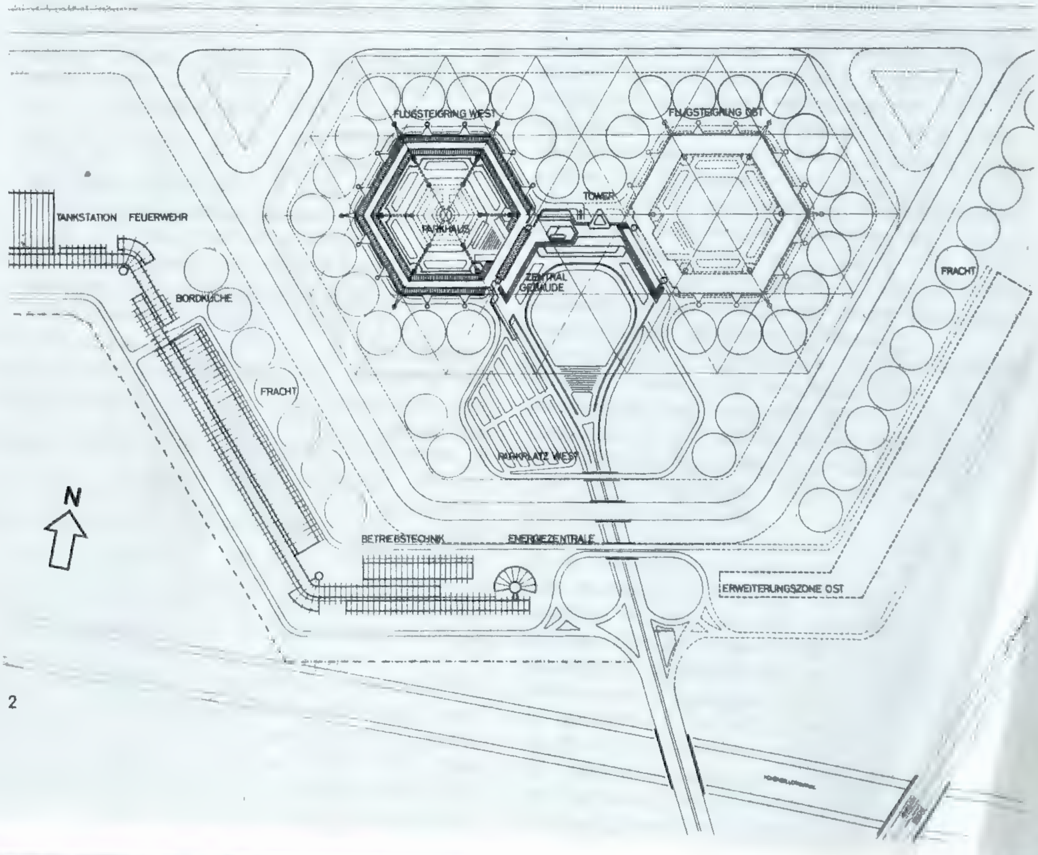
1

lick auf Taxiwaybrücke und Zentralbereich mit Kontrollturm von der Zufahrt. Rechts Informationstafeln Wechselanzeige.

ont d'accès des taxis et la zone centrale avec de contrôle et voie arrivée véhicules. A droite e tableau d'information avec indication des vols.

iew of taxi access and central area with control er from motorway approach. Right, information rds.

2
ageplan.
n de situation.
plan.



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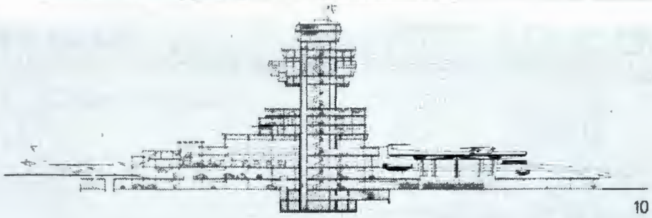

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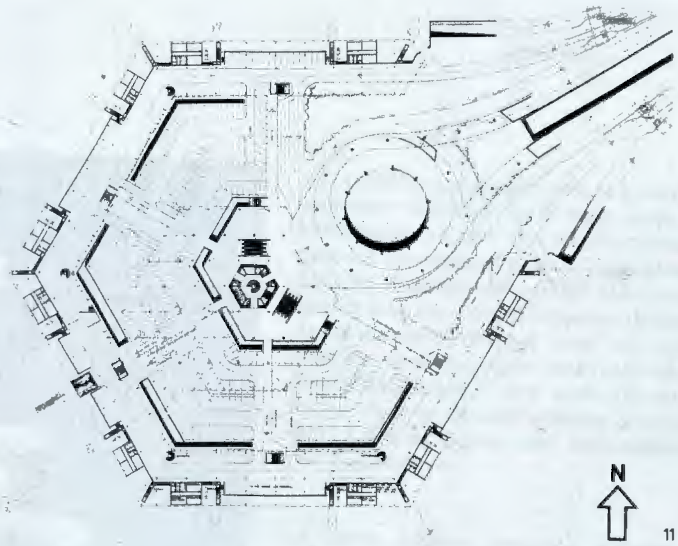

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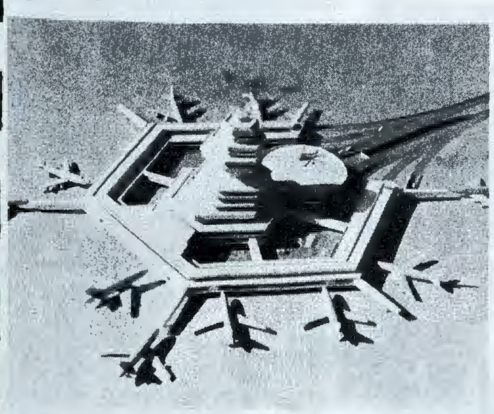

9

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Erst in der 3. Genration entstand die große Vielfalt von Archetypen wie

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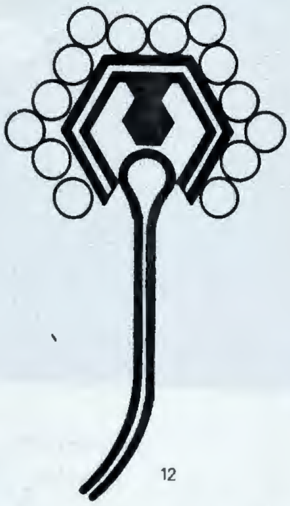

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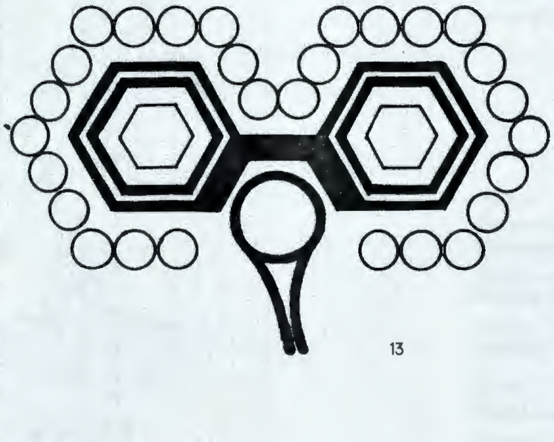

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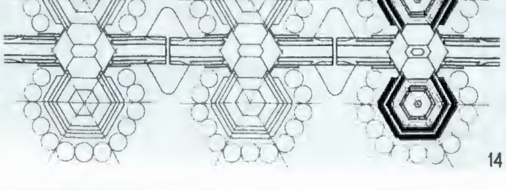

14

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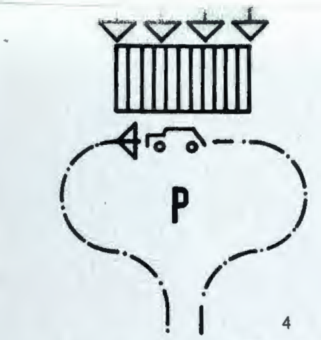

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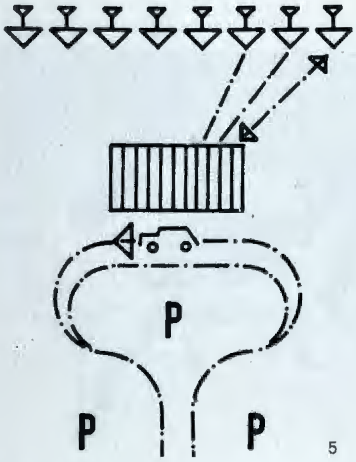

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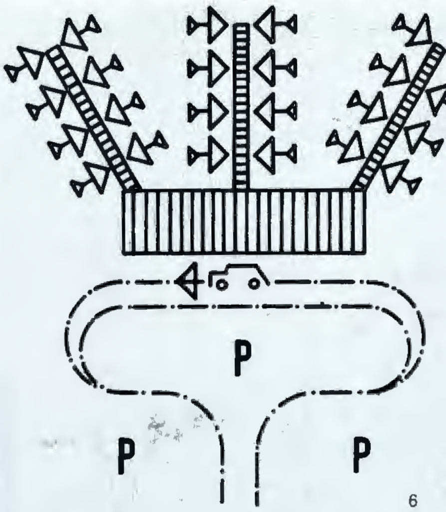

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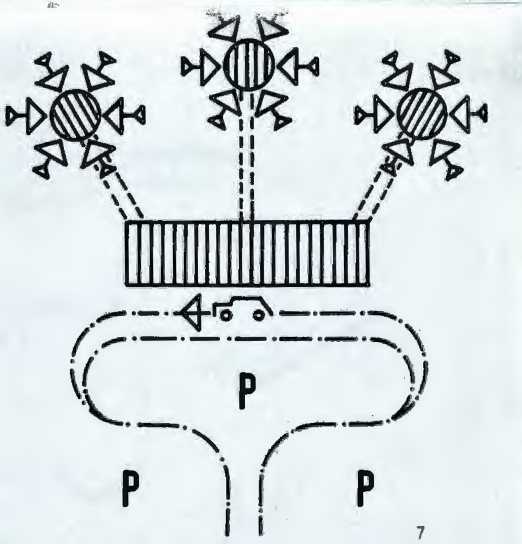

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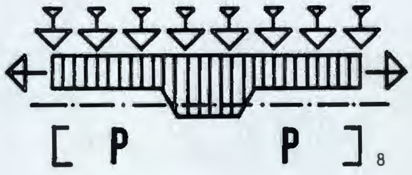

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4
Flughafensystem der 1. Generation.
Aéroport du type 1ère génération.
Airport system of 1st generation.

5
Flughafensystem der 2. Generation.
Aéroport du type 2ème génération.
Airport system of 2nd generation.

6
Flughafensystem der 3. Generation mit Fingerflugsteigen.
Aéroport du type 3ème génération avec «doigts» d'embarquement.
Airport system of 3rd generation with finger docks.

7
Flughafensystem der 3. Generation mit Satelliten.
Aéroport du type 3ème génération avec satellites.
Airport system of 3rd generation with satellites.

8
Flughafensystem der 4. Generation.
Aéroport du type 4ème génération.
Airport system of 4th generation.

9, 10, 11, 12
Modellfoto, Schnitt, Grundriß und System der Diplomarbeit M. v. Gerkan für Flughafen Hannover.
Vue de la maquette, coupe, plans et principe du projet de diplôme de M. v. Gerkan pour l'aéroport de Hanovre.
Model photo, section, plan and system in dissertation by M. v. Gerkan for Hanover Airport.

13
System Flughafen Berlin-Tegel.
Le principe de l'aéroport de Berlin-Tegel.
Berlin-Tegel Airport system.

14
System des Gutachtenentwurfes II Flughafen Hamburg Kaltenkirchen (Verfasser: v. Gerkan, Marg, Nickels, Ohrt).
Principe du projet-rapport II pour l'aéroport de Hambourg-Kaltenkirchen (Auteurs: v. Gerkan, Marg, Nickels, Ohrt).
System of Expert Opinion II, Hamburg-Kaltenkirchen Airport (Authors: v. Gerkan, Marg, Nickels, Ohrt).

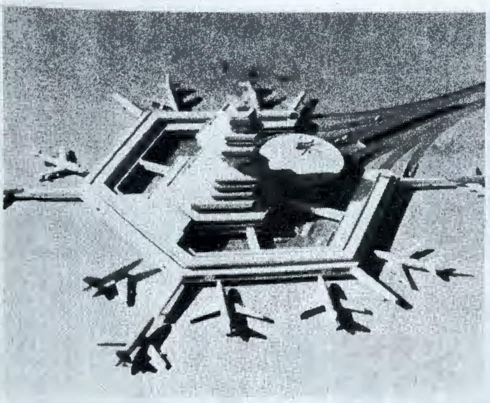
1. Inland/Inland 2. Ausland/Ausland, 3. Inland/Ausland 4. Ausland/Inland.
Deswegen soll nur die Primärfunktion »Abflug« beispielhaft herausgegriffen werden. Diese Funktion kennt drei unterschiedliche Abfertigungssysteme:

- »Common check-in« (siehe Skizze 1)
  An mehreren zentral gelegenen Abfertigungsschaltern werden alle Flüge parallel abgefertigt. Fluggastdaten und Gepäck werden gemischt und müssen anschließend entflochten werden. Dieses System gehört der vorletzten Flughafengeneration an und ist heute noch am häufigsten vertreten.
- »flight check-in« (siehe Skizze 2)
  Für jeden Flug gibt es separate Abfertigungsschalter, wodurch eine weitgehende Entflechtung erreicht wird.
  Beide Systeme haben die Einrichtungen jedoch zentral, wodurch zwischen Abfertigung und Flugzeugeinstieg mehr oder minder große Distanzen liegen, die entweder innerhalb des Gebäudes (Gebäudefinger, Tunnel etc.) oder außerhalb (zu Fuß oder mit Bus) zurückgelegt werden müssen.
- »gate check-in« (siehe Skizze 3)
  Die Abfertigung ist dem Flugzeug (gate) räumlich direkt zugeordnet, also in der Gesamtorganisation dezentralisiert.

Zur Vermeidung langer Wege im Gebäude entstand eine Dezentralisierung der Anbindung des Bodenverkehrs im Sinne von »drive in« oder »drive to your gate« (Berlin-Tegel, Cansas-City, Dallas, projektiert für Hamburg und München II). Für eine Dezentralisierung ist jedoch nur der Individualverkehr (Pkw und Taxi) geeignet, während öffentliche Verkehrsmittel, insbesondere schienengebundene, nur eine zentrale Anbindung erlauben. Größere Entfernungen zwischen diesem Zentralpunkt und den »gates« erfordern dann flughafeninterne Transporthilfen in Form von Rollsteigen oder Kabinenbahnen.
Bei grundsätzlich einheitlicher Tendenz der letzten Flughafengeneration in Richtung »gate check-in« und »drive to your gate« ist umstritten, ob »Abflug« und »Ankunft« auf zwei Gebäudeebenen getrennt werden sollen oder nicht. Für eine Trennung spricht die Entflechtung unterschiedlicher Funktionsabläufe, gegen eine Trennung die Kompliziertheit auf der Landseite – zwei Vorfahrtsebenen, Niveausprünge etc. – und der größere Raumbedarf.

Bereich Landseite

Individualverkehr und öffentlicher Verkehr stellen diametrale Anforderungen; während der eine für Dezentralisierung prädestiniert ist, fordert der andere eine Zentralisierung.
Für die Häfen in Cansas-City und Dallas stellt diese Polarität kein Problem dar, da es fast nur Individualverkehr gibt, die Konzeption und Größenordnung von Berlin-Tegel vermag »beiden Herren zu dienen«, in Hamburg-Kaltenkirchen und München II muß dieser Konflikt jedoch planerisch bewältigt werden.
Die von Dauerparkern im Flughafen abgestellten Autos stellen wegen des großen Flächenbedarfs, daraus erwachsender Weglängen und Orientierungsprobleme einen eigenen Problembereich dar. Die totale Verbannung aller Dauerparker aus dem Bereich der Fluggastempfangsanlage auf abgelegene Parkplätze und die Anbindung über ein internes Verkehrssystem würde die Selbstfahrer den Benutzern öffentlicher Verkehrsmittel á la »park and ride« gleichstellen und grundsätzlich neue Systeme erlauben. Diese Vorschläge haben sich jedoch bis heute nicht durchsetzen können.
Flughäfen der 1. Generation sind bei geringer Kapazität heute noch funktionstüchtig, einfach, übersichtlich und preiswert. Sie sind als »Feldflughäfen« in der ganzen dritten Welt zahlreich vertreten, genügen aber auch den Anforderungen von Luxemburg, Nürnberg oder Saarbrücken (siehe Abb. 4).
Die 2. Flughafengeneration ist überwiegend durch Umbau und Erweiterung der 1. entstanden (Hamburg-Fuhlsbüttel). Oftmals wurden die Bereiche Abfertigung und Landseite nur mühsam der gewachsenen Kapazität angepaßt. Der gestiegene Flächenbedarf durch größere und zahlreichere Flugzeuge auf der Luftseite hatte die Entfernung der Aufstellpositionen vom Gebäude zur Folge (siehe Abb. 5).
Die geistreiche Lösung in Washington – International durch Saarinen, der die Warteräume zu fahrbaren »mobil loungnes« gemacht hat, fand



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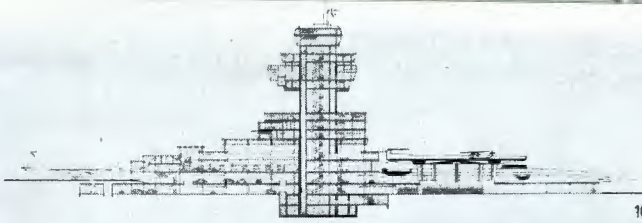

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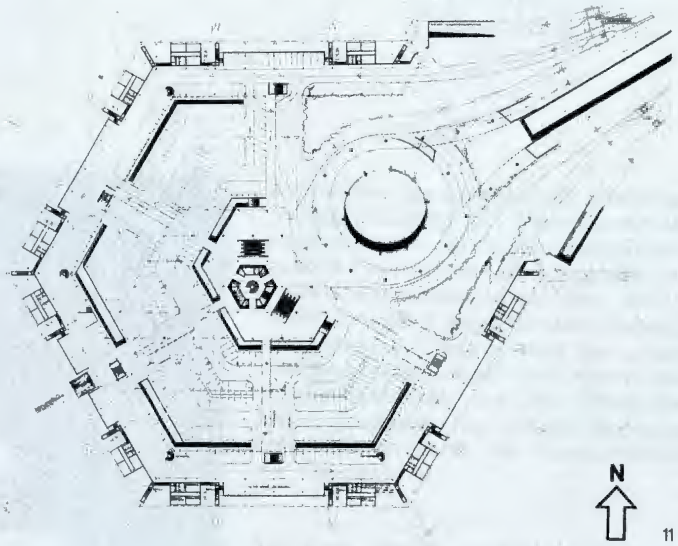

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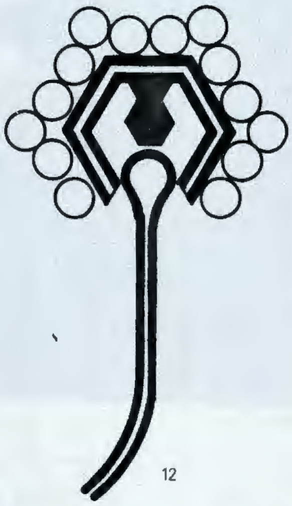

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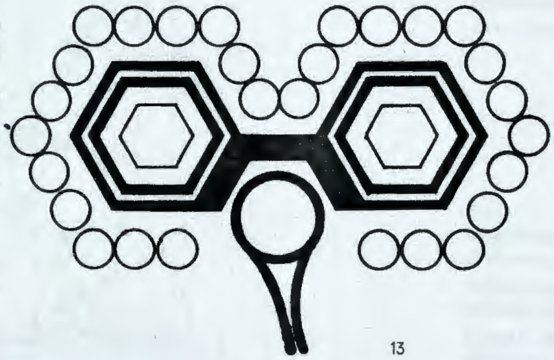

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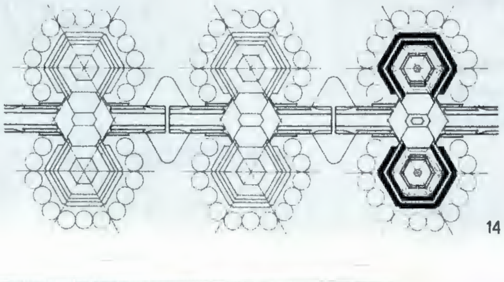

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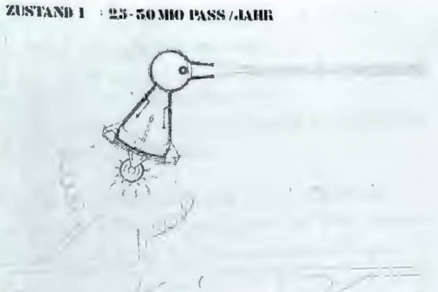

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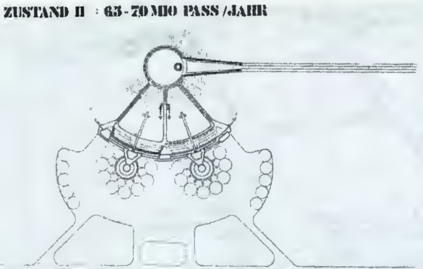

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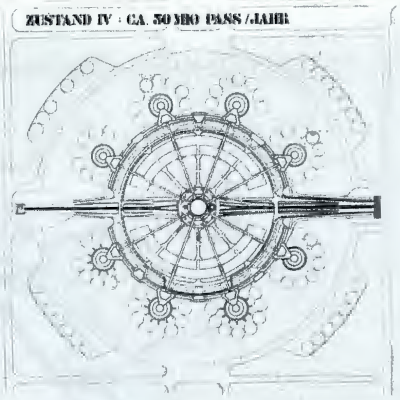

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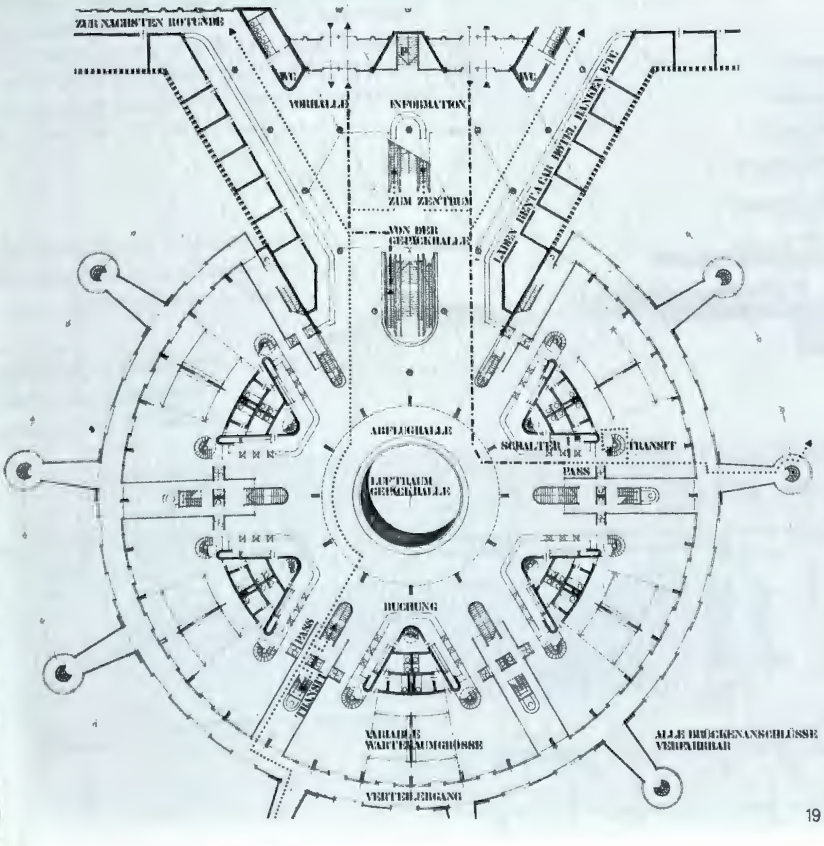
18

Die kreisförmige Gesamtanlage erlaubt nur einen zentralen Anschluß der S-Bahn in der Mitte. Die Verbindung zu den bauabschnittsweise erstellbaren 8 Terminals mit einer Kapazität von je ca. 3,5 Mill. Passagieren erfolgt über radial verlaufendes internes Transportsystem (Rollsteige oder Kleinkabinen). Dadurch wird den unterschiedlichsten Anforderungen des Individualverkehrs (Dezentralisierung) und des öffentlichen Verkehrs (Zentralisierung) optimal Rechnung getragen. Kritisiert wurde der Absolutheitsanspruch der Gesamtform.

La forme globale circulaire n'autorise qu'une seule liaison centrale au réseau de métro aérien. La liaison avec les 8 terminals passagers réalisables par étapes avec une capacité de quelque 3,5 millions de passagers chacun, est assurée par un réseau de transport radial (Tapis roulants ou chaîne de cabines). Cette solution prend ainsi en compte toutes les exigences du trafic individuel (décentralisation) et du trafic collectif (centralisation). La forme d'ensemble définitive du projet a fait l'objet de critiques.

The circular complex permits only central access to the rapid-transit railway in the middle. Connection with the 8 terminals, to be built in stages, with a capacity of around 3.5 million passengers each is effected via a radial internal transportation system (escalators or miniature cars). In this way the best balance is achieved between the requirements of individual transportation (decentralization) and public transport (centralization). The definitive character of the overall design was criticized.



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15–19
Gutachtenentwurf I Flughafen Hamburg-Kaltenkirchen (Verfasser: v. Gerkan, Marg, Nickels, Ohrt).
Projet-rapport I pour l'aéroport de Hambourg-Kaltenkirchen (Auteurs: v. Gerkan, Marg, Nickels, Ohrt).
Expert Opinion I, Hamburg-Kaltenkirchen Airport (Authors: v. Gerkan, Marg, Nickels, Ohrt).

15–17
Wachstumsraten des Planetensystems.
Phases de croissance du système planétaire.
Growth phases of the planetary system.

18
Fluggastterminal im Endzustand als Modell.
Terminal passagers en phase finale, maquette.
Passenger air terminal in final stage, model.

19
Ebene + 1 einer Abfertigungsrotunde.
Niveau + 1 d'une rotonde d'enregistrement.
Level + 1 of a check-in rotunda.

20–23
G chtenentwurf Flughafen München II (Verfasser: v. rkan, Marg + Partner K. Brauer).
Pr et-rapport pour l'aéroport de Munich II (Auteurs: v. Gerkan, Marg et K. Brauer associé).
Expert Opinion, Munich Airport II (Authors: v. Gerkan, M + K. Brauer Associates).

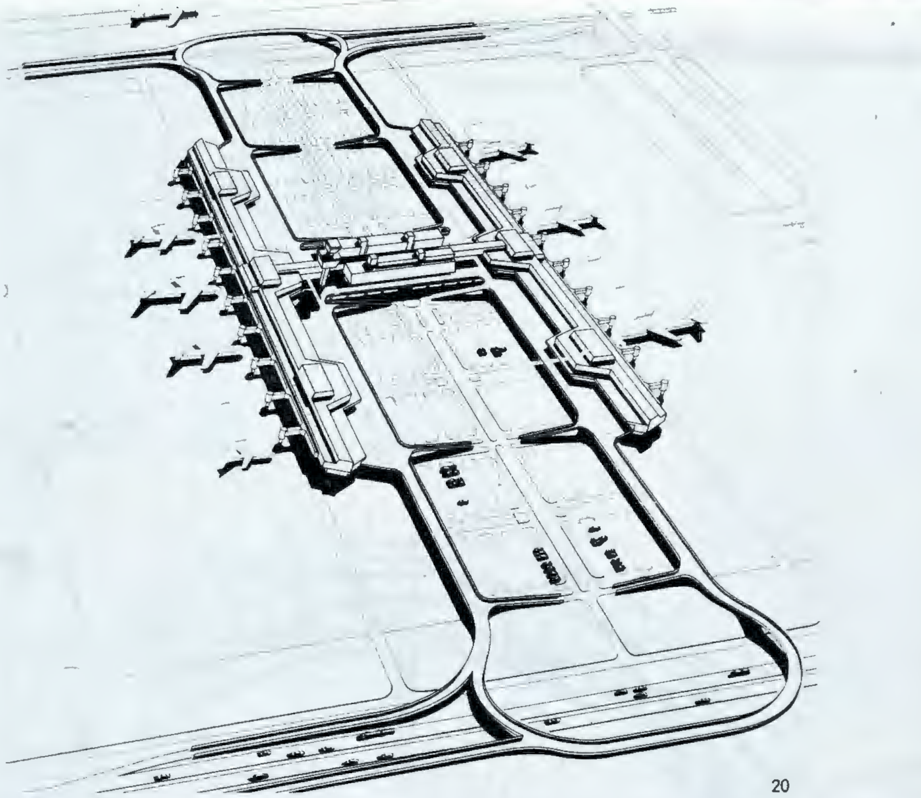
2C
Schaubild des Fluggastterminals im 1. Bauabschnitt.
Vue générale du terminal passagers en 1ère étape.
G eral view of terminal in 1st construction stage.

21
Schnittperspektive der »Abfertigungsstangen«.
Coupe perspective sur les «ailes d'enregistrement».
Pe pective section of check-in aisles.

Die dezentralisierte Abfertigung der Passagiere erfolgt in den parallelen Gebäudestangen.
D S-Bahn-Station liegt unterhalb des querge- st ten Zentralbereiches. Dem Transport von der Zentrale zu den im Endausbau 1 km langen »Stangen« dient ein unterhalb der Abfertigungs- e ne verlaufendes, flughafeninternes Verkehrs- s em (s. Abb. 21). Ein Nachteil dieser Konzeption liegt in der großen Distanz und unzureichenden Verknüpfung zwischen Zentralbereich und » ngen«.

L'enregistrement décentralisé des passagers se fait dans deux «barres» parallèles.
L station de métro aérien est située en dessous d volume central placé en travers des barres. Les mouvements entre le centre et les extrémités de ces barres (1 km en phase finale) sont a urés par un réseau de transport tracé sous le iveau d'enregistrement (voir vue 21). Désavantage de cette conception: Distances trop grandes et liaisons insuffisantes entre la zone c trale et les «barres».

The decentralized handling of passengers is e cted in the parallel linear buildings.
T rapid-transit railway station is located beneath the transverse central tract. A single-level, internal transportation system (cf. Fig. 21) und neath the service area handles communica- ti s between the central tract and the "rows", ch in final stage are 1 km long. A disadvantage of this conception is the great distance involved and the insufficient integration between c tral tract and "rows".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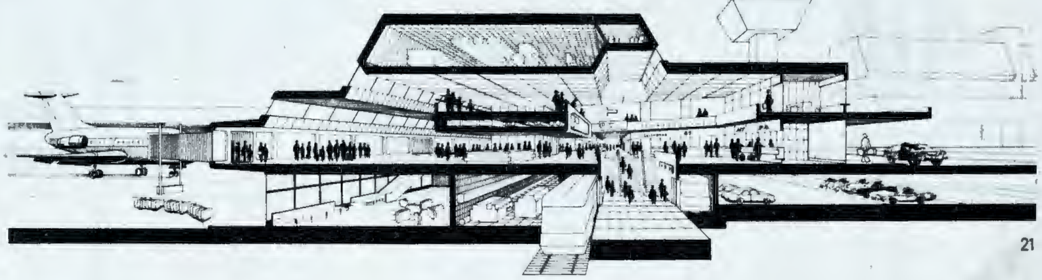
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2
nittperspektive des Zentralbereiches.
Coupe perspective de la zone centrale.
Perspective section of central zone.

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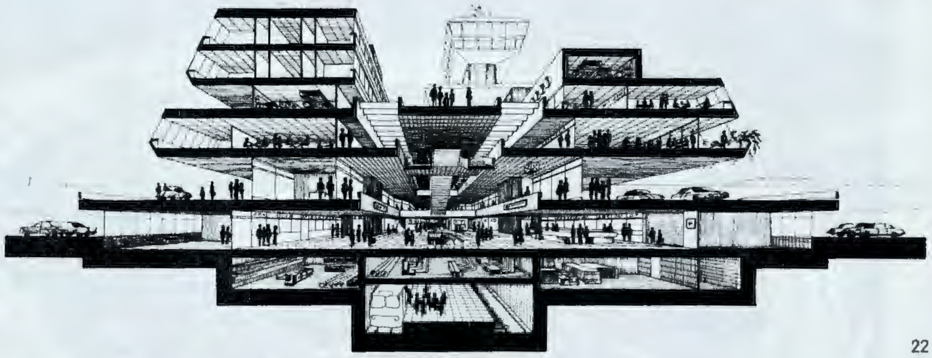
dellfoto der Gesamtanlage.
L'ensemble vu en maquette.
Model photo of entire complex.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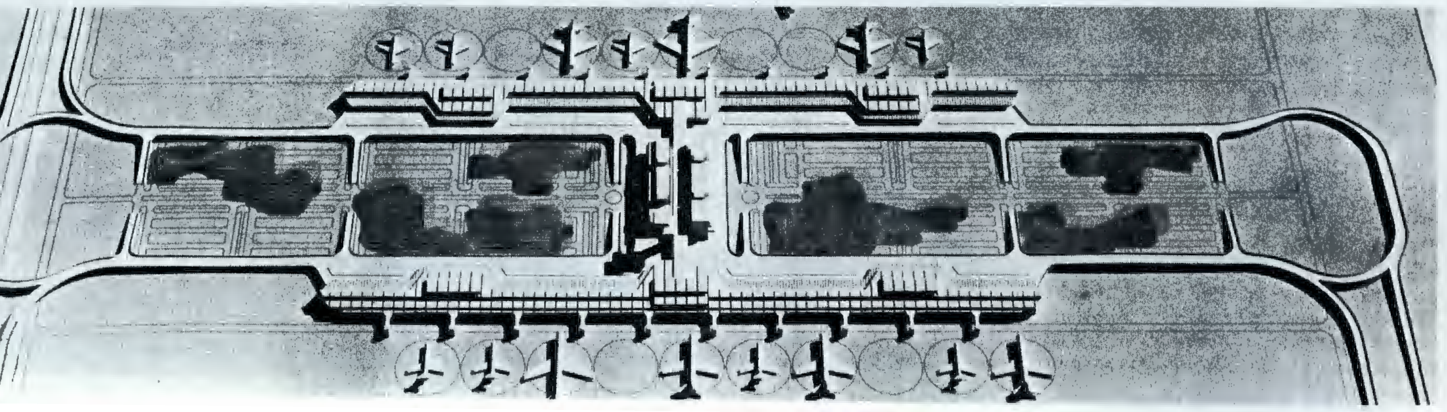
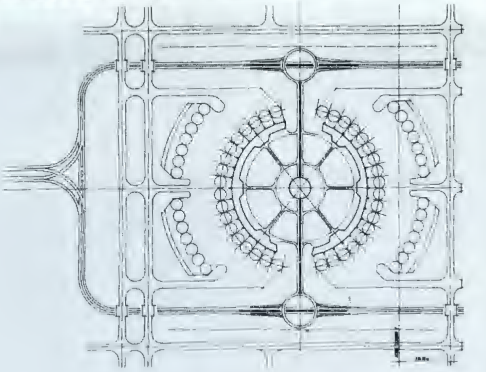


Alternativer Gutachtenentwurf Flughafen München II (Verfasser: v. Gerkan, Marg + Partner K. Brauer).

A rnative au projet-rapport pour l'aéroport de M ich II (Auteurs: v. Gerkan, Marg et K. Brauer associé).

Alternative Expert Opinion, Munich Airport II (Authors: v. erkan, Marg + K. Brauer Associates).



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24
Übersichtsplan.
Plan général.
General plan.

Di e Variante der »Stangenlösung« von München II versucht einige Nachteile durch das Biegen der beiden Stangen zu einem Kreis zu be ben. Der Unterschied zur Konzeption des Gu chtenentwurfes I für Hamburg-Kaltenkirchen besteht im wesentlichen in der anderen Ausbildung des dezentralen Abfertigungsbereiches. Lin re Reihung und Einebenenlösung anstelle de n den teilzentralisierten Rotunden auf 2 Ebenen vorgesehenen Funktionen. Die Anbindung an die zentral gelegene S-Bahn-Station erfolgt für lle Bereiche gleichwertig über ein oberirdisch , radial verlaufendes FIV-System.

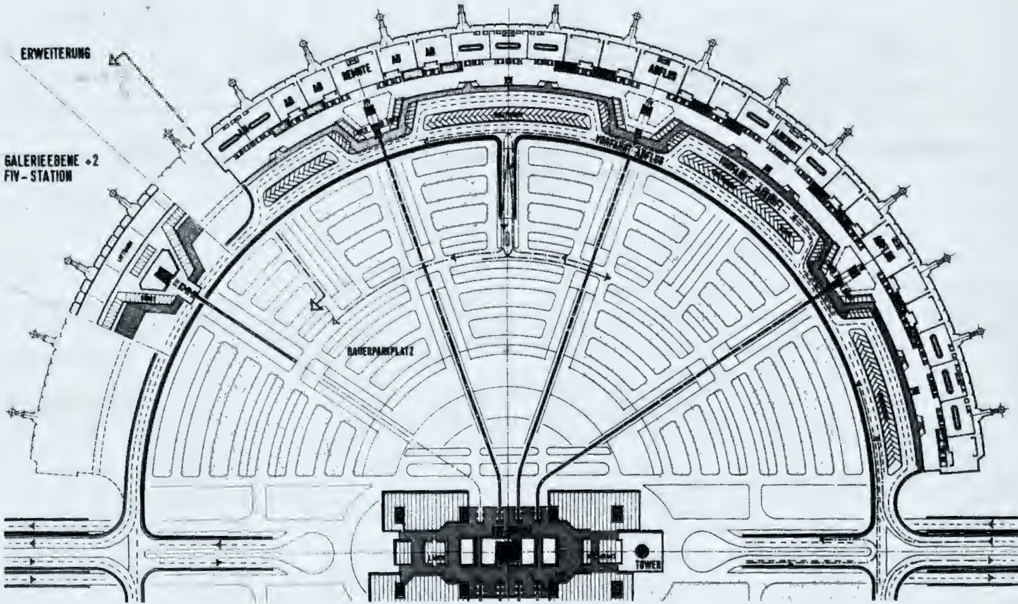
De Einwand gegen diese Konzeption betraf ebenfalls den Endgültigkeitsanspruch der Gesamtform sowie eine durch den Kreis bedingte Ori tierungserschwernis.

Cette variante du «parti en barres» de Munich II ent d'éliminer quelques désavantages en recou ant les deux «barres» en un cercle. La ifférence de conception en regard du projet-apport I pour Hambourg-Kaltenkirchen réside ssentiellement en ce que les zones d'enregistrem nt décentralisées sont organisées différem ent: Implantation linéaire et solution à iveau unique au lieu des rotondes à deux iveaux centralisant partiellement les fonctions. a son avec la station de métro aérien se it manière unitaire pour toutes les zones râce à un système FIV à disposition radiale tué au dessus du sol.

co énient de cette solution: La forme de ens nble a un caractère définitif et elle crée s difficultés d'orientation inhérentes à la forme rculaire.

is riant represents an attempt to overcome me of the disadvantages of the Munich II near solution" by bending the two rows into ci e. The difference from the conception hi preliminary project I for Hamburg-Kalnkirchen consists mainly in the different delopment of the decentralized service area. nea alignment and single-level construction te of the partially centralized rotundas on evels. There is equal access from all sides to centrally located rapid-transit railway station, a dial system at grade level.

e jections to this conception were that the sign was too definitive and the circular lay-out de orientation difficult.



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undriß der Abfertigungsebene.
n a niveau de l'enregistrement.
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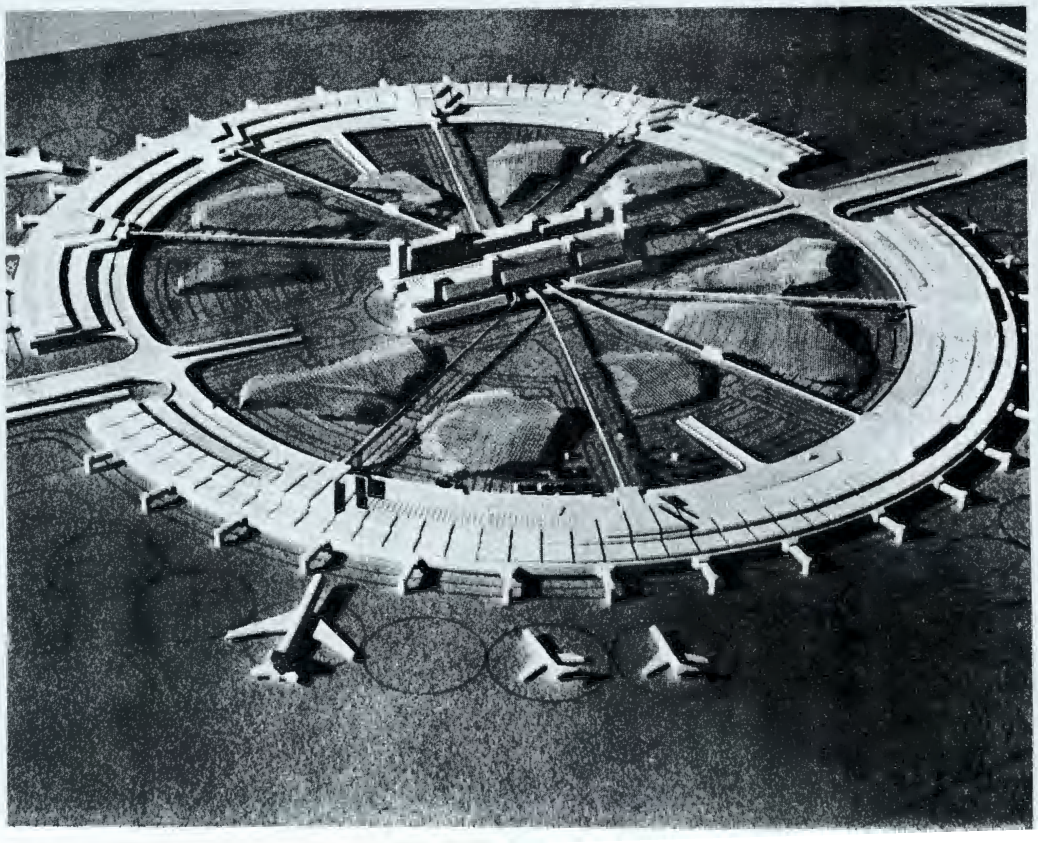
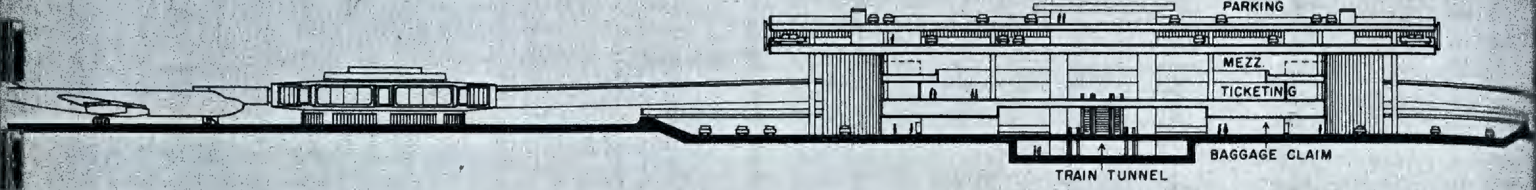
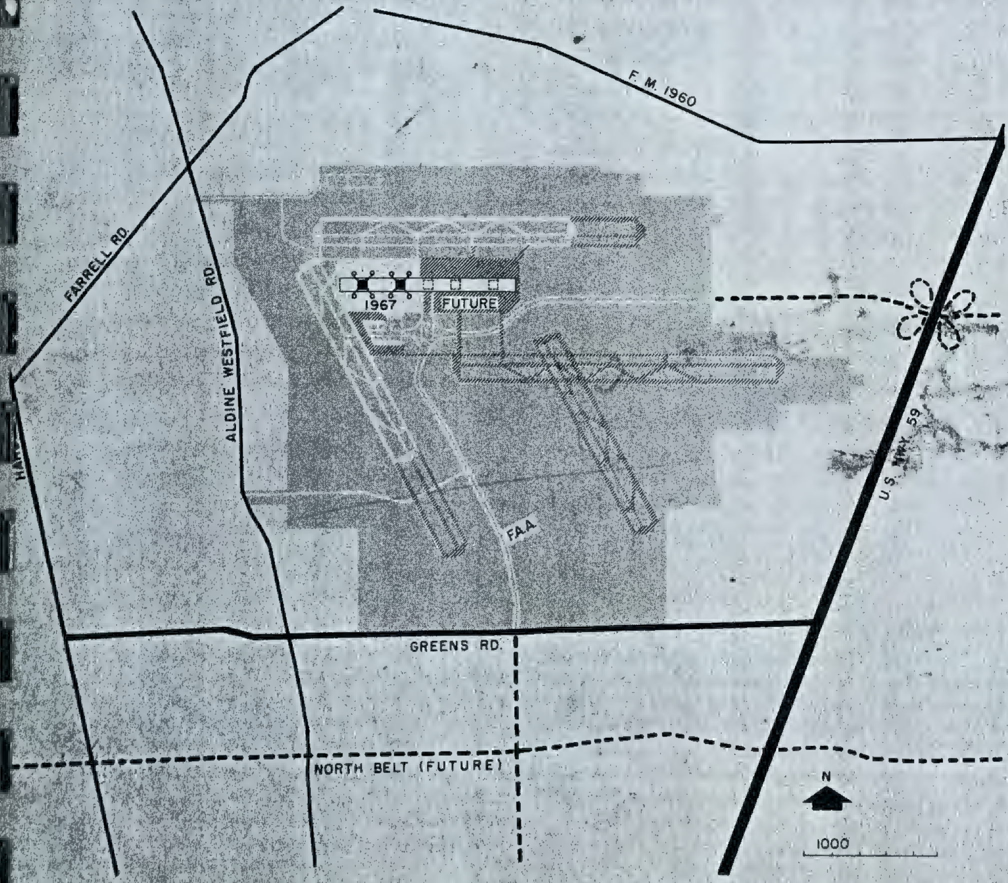


ntral reich im Modell mit den TIV-Trassen.
que de la zone centrale avec les tracés TIV.
ntral zone in model with TIV aisles.



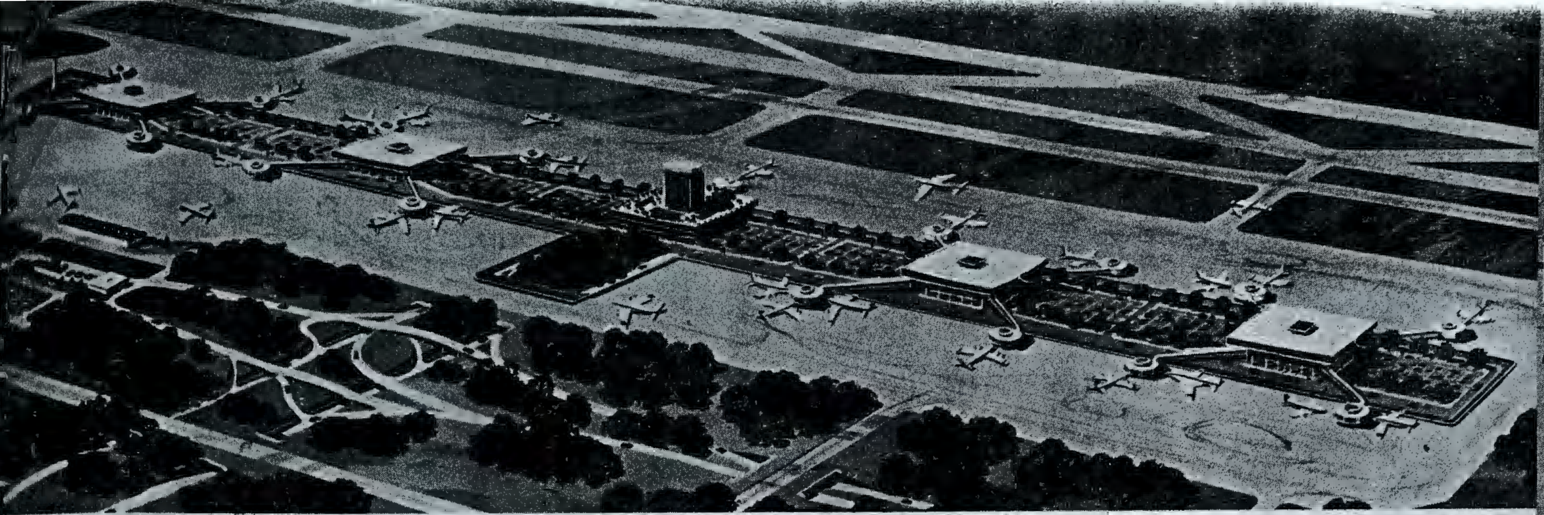
Houston Intercontinental Airport brings people and planes together in a straight-line series of terminals



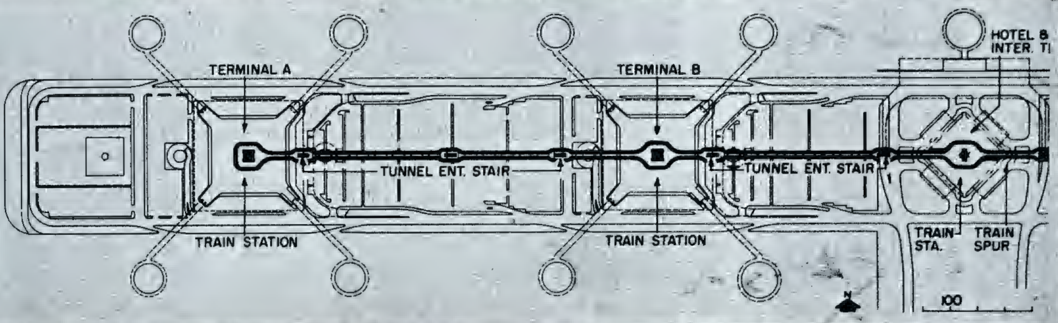
Houston's completely new airport—on a giant site (more than 6000 acres) with all-around access—offered airport architects Golemon & Rolfe and Pierce & Pierce a virtually unprecedented opportunity to take a new look at airport planning and design criteria, with the passenger at the focal point of consideration.

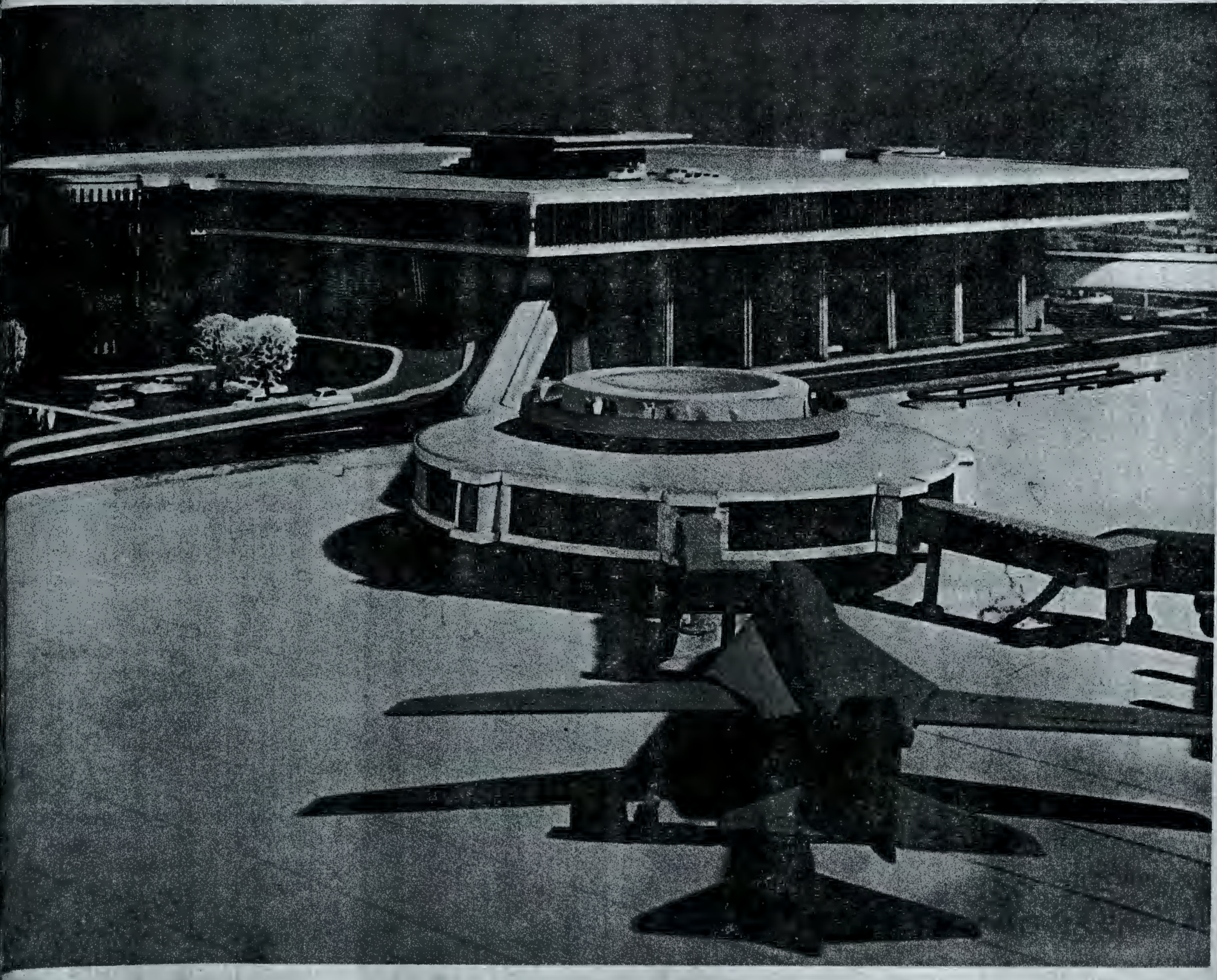
Out of their researches came the growing conviction that the natural evolution of airports from their earliest pasture-and-barn beginnings has been a series of geometric expedients to cope with increasing numbers of planes and airlines. Barns became terminals which grew fingers and then satellites while more and more of bigger and bigger pastures was assigned as holding area for automobiles. The result was a seemingly limitless stretching of distances between the groundside and the airside of terminals through which passengers were challenged to wend their weary ways.

With the Saarinen concept of the mobile lounge at Dulles striking an early blow for passenger relief (RECORD, March 1960), the logic of shortening walking distances became basic to the approaches of many airport planners and terminal designers. Most of these, however, were faced with the restrictions, physical and economic, of redeveloping existing facilities. The Houston airport architects were not so constrained—although, of course, they faced the usual complexities of dealing with the multi-faced client typical of the city-owned, multi-line, international airport. And they had to deal with those problems in a city where other airports, municipal, military and commercial, were already demand-



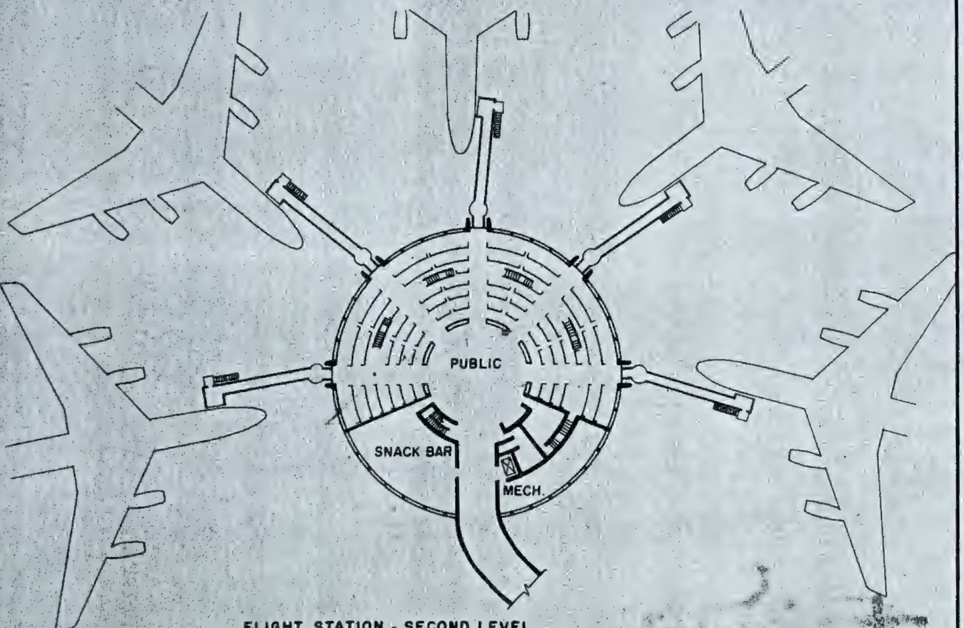
The unit terminal concept is not a spine concept, as Harry Golemon points out. It creates integral nodes of related ground and air activities and provides opportunity for full access to air space from all sides of each unit terminal. For those occasions (less than 20 per cent of passengers) when travel between terminals is required, a battery-operated electronically-controlled train has been developed, under the architect's direction, by a manufacturer of equipment already in use in warehouses. Track loop is shown at right.





Barrett Electronics Corp. photo

Construction photos show scale of the departure curb area and the spiral ramp to parking. Control tower in the background is designed by I. M. Pei Associates. Electronically controlled, battery-driven train connects all buildings and inter-building parking.



FLIGHT STATION - SECOND LEVEL

Two-level plan of airside satellites provides holding areas and limited public facilities for passengers entering and leaving planes at the upper level, with baggage handling and airport operations below. In the first phase of construction comprising two completed terminal nodes, one satellite will be assigned to handle international traffic and will temporarily house customs inspection areas.

ing increased air space all around them.

The earliest terminal area plans presented for approval through the multiple channels of the airport situation were very general. But six important criteria were established at this phase, and provided a firm basis for all subsequent developments. They were: (1) ease of use by passengers; (2) minimum walking distance; (3) in-house parking; (4) simple operation; (5) flexibility; (6) expansibility.

The first terminal considered was a single central terminal with radiating piers and an underground parking garage. This concept proved restrictive of several of the criteria, especially those of walking distances and expansibility. Further, a firm program requirement for hotel facilities in the hub generated complex traffic and building height problems in developing the single-terminal concept.

Starting with the preliminary budget of about $16 million for terminal construction, the architects studied costs at 17 comparable airports and established a general order of about $25 per square foot for terminal areas and $8 per square foot for parking garage area. With this yardstick they were able to examine various types of terminal solutions.

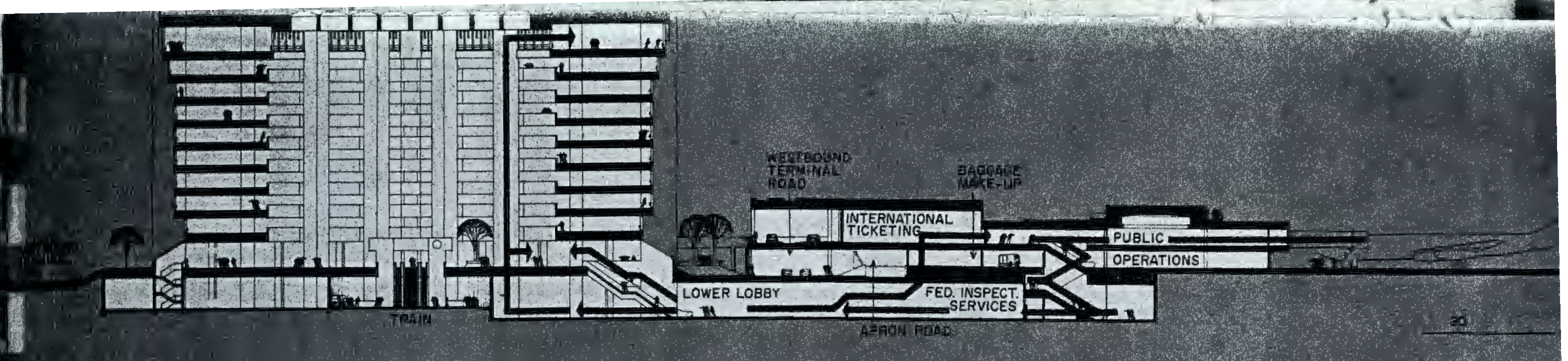
In July 1963, four terminal concepts were presented to the city. These envisioned using (1) mobile lounges, (2) pier or finger construction, (3) satellite enplaning structures and (4) a series of unit terminals.

The unit terminal with drive-in parking was a new concept at that time and was the one that best complied with the six original criteria.

Based on an analysis of ultimate air space capacities and probable airline use, a series of four unit terminals, basically square in configuration, was planned. Each will have four corner concourses, leading a maximum of 500 feet from ticketing area to circular structures housing five gate positions each. There will be two such terminals on each side of a central hotel which will eventually house the international customs and inspection areas in a terminal annex, reached through a single concourse.

The whole series of terminals and hotel will be connected underground by a continuously running battery-operated electronically-guided train. The train, an adaptation of equipment now used in warehouses, will be noiseles, fumeless, operatorless and safe for public use. It will serve each terminal and the hotel, as well as outdoor parking between the terminal buildings.

The City of Houston adopted the unit terminal concept on September 9, 1963. "If it is as attractive as it appears and as functional as you promise," Mayor Louie Welch told the architects, "it will



The Central Hotel (above) planned for phase two of construction will have a three-level terminal annex to handle international passengers. It will connect, through customs areas, directly with the hotel lobby and, via electronic train, to other parts of the airport. The connection between terminal and hotel will be penetrated by the peripheral terminal roads and the blast-protected apron road.

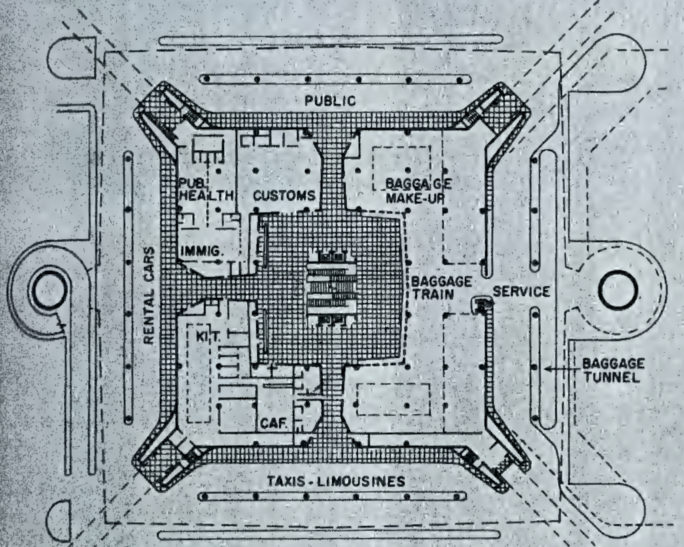
Plans below show arrangement of spaces on three levels of terminal buildings with temporary spaces for customs and immigration.

Area Tabulation: Terminal Buildings

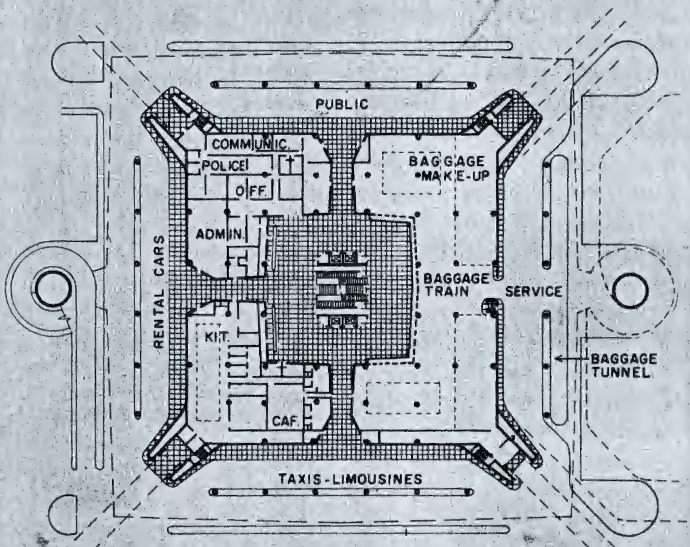
Total terminal buildings and flight stations less items below	sq. ft. 605,592
Garage floors (3 + roof)	565,592
Spiral ramps	70,515
U-ramps	101,900
Baggage tunnels	36,258
Service tunnels	5,265
Train tunnel	35,034

Parking Tabulation

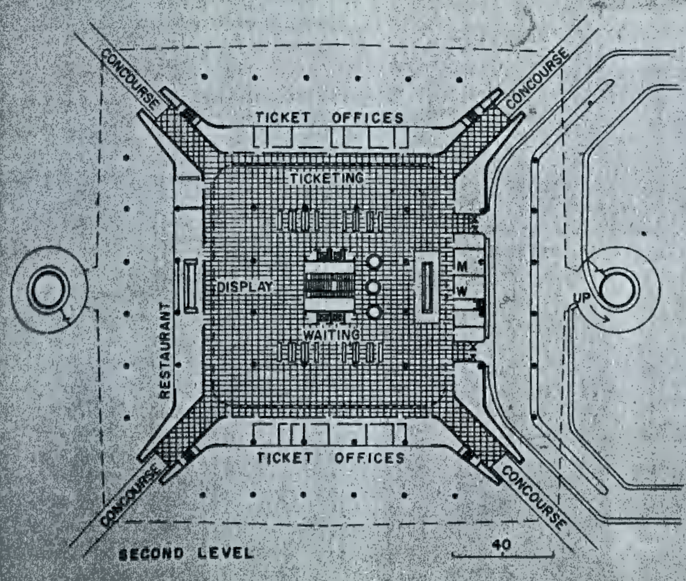
Garage (two terminals)	Cars
3rd levels	692
Roofs	830
	1522
Surface Parking	
Contract parking N & S of control tower	192
Rental cars/limousines	247
Short term	317
Center lot	739
East of tower	417
	1911



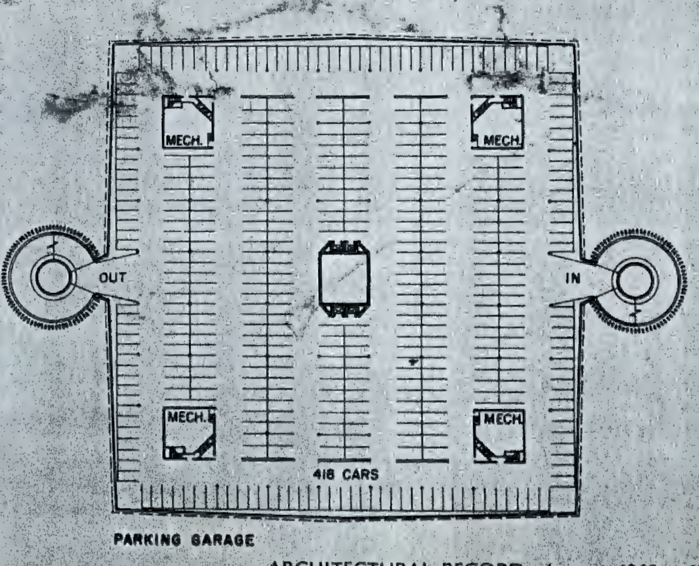
GRADE LEVEL Terminal 1



GRADE LEVEL Terminal 2



SECOND LEVEL



PARKING GARAGE

be the greatest airport in the world." City Aviation Director Joseph A. Foster (now vice president for airport facilities of the Air Transport Association) said, "The unit terminal concept is a new approach to air terminal design. We believe that for the first time in the world we have a design that deals successfully with the basic humanties of public conveniences."

The concept of the buildings, Mr. Foster observed, is based on telescoping the parking, walking and baggage-lugging of the air passengers to a minimum. Upon reaching the terminal, the passengers' movements will be mostly vertical by way of elevators and escalators, instead of lateral along lengthy walkways through wings and fingers.

The vertical movement will be achieved by stacking parking facilities, ticket counters and baggage checking centers on top of each other and connecting them with central elevators and moving stairs.

During the design evolution of the study, it was determined that 35 gate positions would be required for 1970, 45 for 1975, and ultimately about 80. Four million passengers are expected by 1970. Predictions are that by 1975 six million passengers annually will pass through the Houston Intercontinental Airport.

Two of the terminals will be built in the first phase of construction. Each terminal will be identical, with two exceptions: one terminal contains the international area which includes customs, public health and immigration, while the other terminal is planned with administrative offices. Ultimately, the immigration gate positions and related areas will adjoin the hotel.

Each terminal has two passenger-handling floors plus two garage floors, with structure for one additional garage floor. Enplaning passengers will arrive by car, taxi or limousine, and possibly in the future by helicopter. If the passenger arrives by car he will drive to the parking garage, enter an elevator on the third or fourth floor, leave the elevator at the ticket counter (second floor), obtain his ticket, partake of concessions and walk approximately 500 feet to his plane. If the passenger arrives by taxi or limo, he will leave the vehicle at the second floor, obtain his ticket, and board his plane.

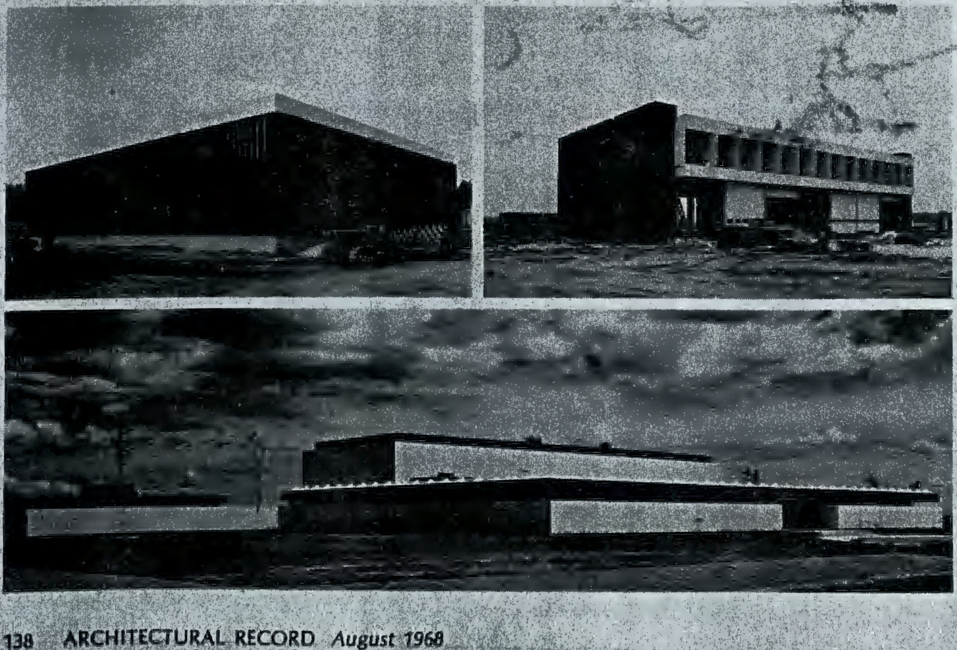
Deplaning passengers will leave planes at the second level, take a moving stair or elevator to the first floor, receive baggage, and leave the terminal by private automobile, taxi or limousine.

The deplaning passenger enters his taxi, limousine or private transportation at the first floor or baggage claim level. If he has parked his car in the terminal, he takes an elevator to the parking garage. The inter-terminal transportation system will be used by those passengers wishing to go from one terminal to another, to the hotel, or to adjacent outdoor parking.

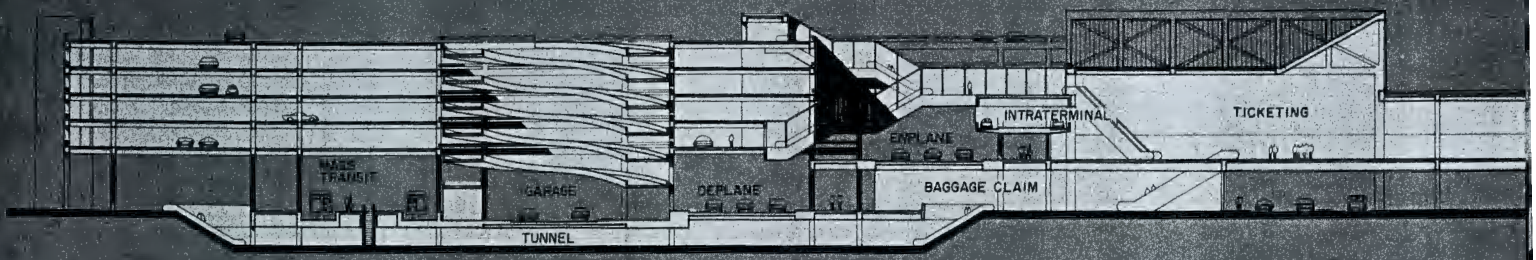
Perimeter roads encircle the terminal area complex and are protected from jet engine blasts by being six feet below the plane ramp and having a blast protector built between the road and the ramp.

As design work proceeded over a three-year period, the architects developed, and the city accepted, written design guidelines of all leased ancillary facilities at the airport. These guidelines specified the use of concrete and glass as major materials and provided for other criteria of quality and construction.

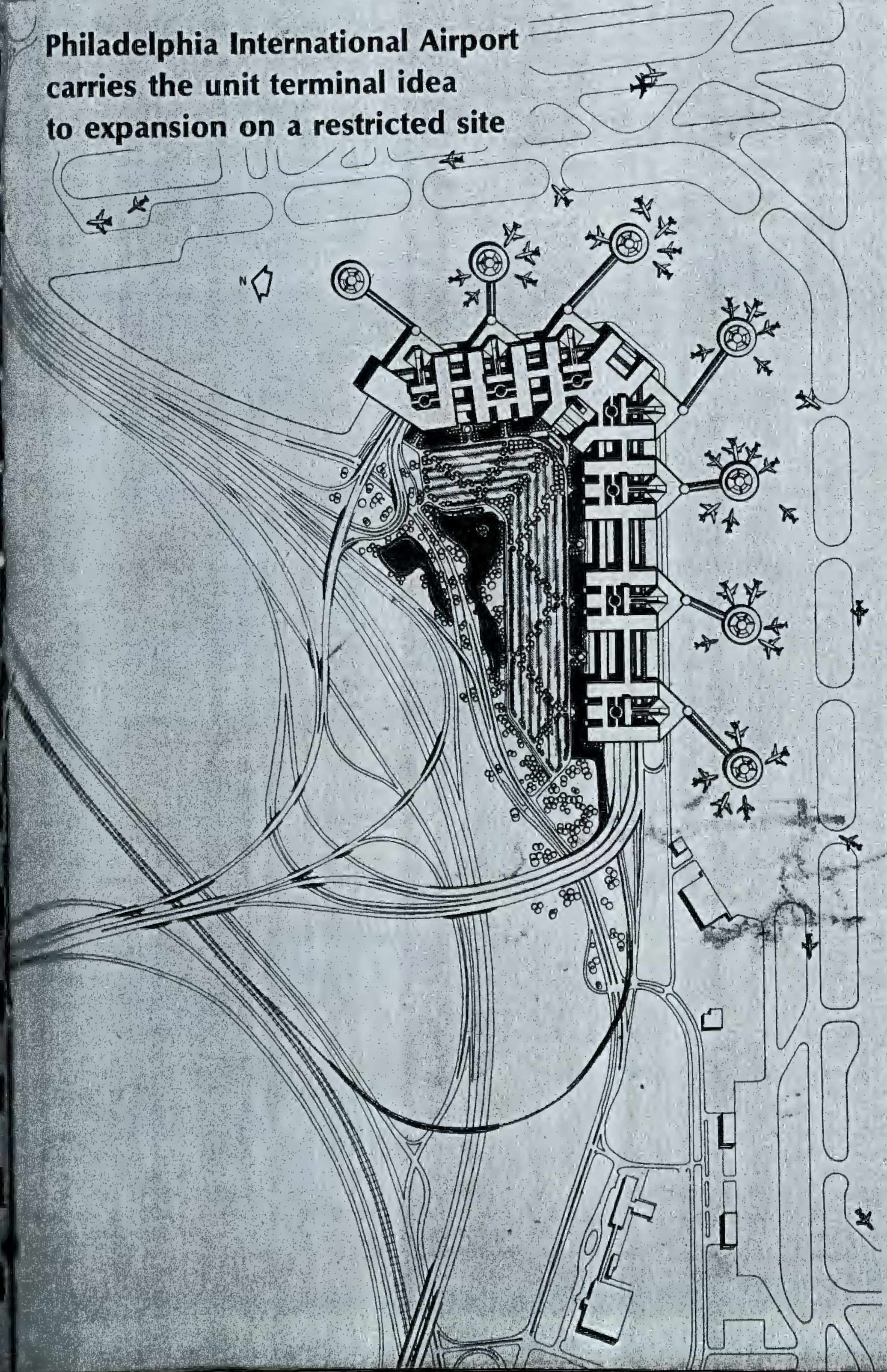
HOUSTON INTERCONTINENTAL AIRPORT. Airport architects: *Coleman & Rolfe and Pierce & Pierce;* engineers: *Engineers of the Southwest, a joint venture of Lockwood, Andrews & Newman, Inc; Bovay Engineers, Inc.; and Turner, Collie & Braden, Inc.;* landscape architects: *Bishop & Walker and Fred Buxton;* lighting consultant: *Seymour Evans;* graphic consultant: *Architectural Graphics;* contractor: *R. F. Ball Construction Company.*



Buildings at left are ancillary to the airport spaces. Bottom is building housing the Federal Aviation Agency's regional control facilities, which comprise computerized communication equipment for a nationwide network of Federal and airport traffic centers. Buildings at top are a fire station (right) and a maintenance building. All are designed by the airport architects.



Philadelphia International Airport carries the unit terminal idea to expansion on a restricted site



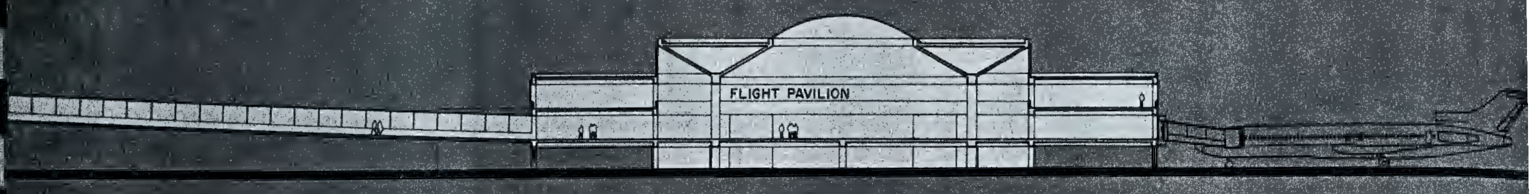
Expansion of the Philadelphia International Airport terminal facilities must be done within the limited space bounded by present runways, and on the same site as the present terminal. In addition, a new 10,000-foot runway must be built on the far side of the present east-west runway; and a whole new multi-level interchange of access highways and transit tunnels must be constructed. There will also be a new cargo facility on the western part of the airport. All of this presents a difficult problem of phasing construction since no functions of the airport can cease while building goes on.

Architects Vincent G. Kling and Associates have come up with a terminal solution that condenses even further the ground-to-air concepts of Houston, although the architects were forced to live with the one-direction, highway-to-runway flow that prevails at so many airports.

Each of the six terminals connects to a round pavilion which can dock 11 aircraft, including 747's and SST's. Also linked with each terminal is a five-level parking garage, each for 2,000 cars.

The first phase of the program consists of expanding present airport facilities from 30 gates to 41 (see phasing diagrams on page 141). Additional holding rooms are also being constructed of light steel framing and metal walls. These will go alongside existing concourses and holding rooms. Larger public waiting areas, expanded ticket sales space, medical facilities and concession spaces are included. Construction of all-new terminals will begin shortly after these improvements are completed next year.

The architect states, "Each terminal in the new plan is conceived as a funnel leading from its parking garages and drop-off curb, through a linear concourse directly to its pavilion." The lowest or deplaning level (see section above) is primarily a baggage claim area with private vehicle pickup lanes on one side and taxi lanes on the other. Each element lends itself to growth in that the terminals can be expanded along the interconnect-



ing walkways. A moving stair system is used to collect passengers from garage levels and transport them to the terminals. The average walk from garage to pavilion is 800 feet; from curb to pavilion, 600 feet.

Each pavilion is designed as a highly flexible hub which will accept different sizes of holding rooms at its outer ring, and have major circulation and some concessions in the center. If it is found more feasible to load the 747's from a higher level, mezzanines can be built in later.

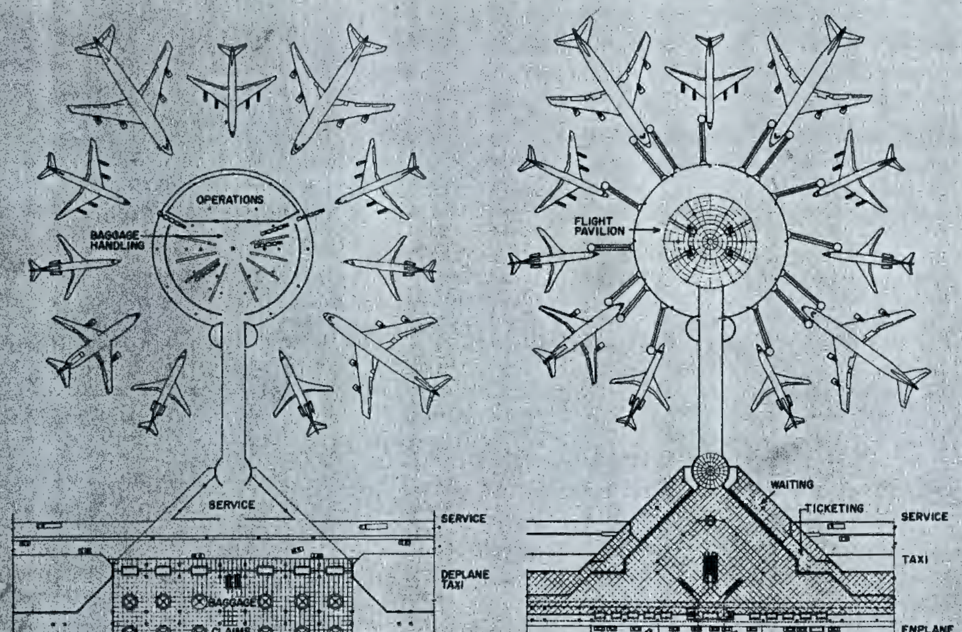
The five-level garages are served by large diameter, helical ramps and interconnected at all levels to increase flexibility. In order to handle baggage check-in more efficiently and quickly, baggage delivery and claim areas are being designed into each garage level. Sufficiently sophisticated baggage delivery and recall systems may not be available at the time the first two terminals and garages are completed, but right-of-way for these systems is being built into the structures. Ultimately, the garages will have a 14,000 car capacity. Three thousand on-grade parking spaces will be available for employes and car rental companies.

To accommodate the passenger who arrives on one airline and is scheduled to leave on another, an intra-terminal transit system, initially a right-of-way for small electric vehicles, is being constructed. In later development a more sophisticated people-moving system may be employed.

Incorporated in the structure of each garage unit, and looping through the entire complex, is a right-of-way for a mass transit system which will take people directly to downtown Philadelphia.

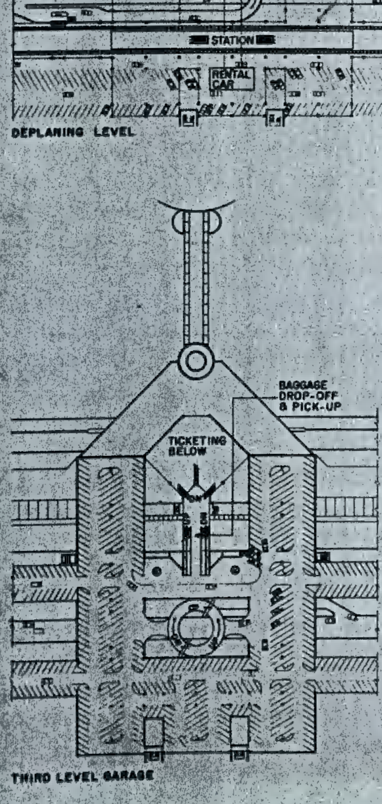
Current estimates of the complete project are about $204 million for the terminal, related roadways, site work and aprons.

PHILADELPHIA INTERNATIONAL AIRPORT. Architects: *Vincent G. Kling and Associates*; master planning and consultation: *Arnold W. Thompson and Associates with Paul Stafford Associates*; engineers: *A. Ernest D'Ambly and Urban Engineers, Inc.*



DEPLANING LEVEL

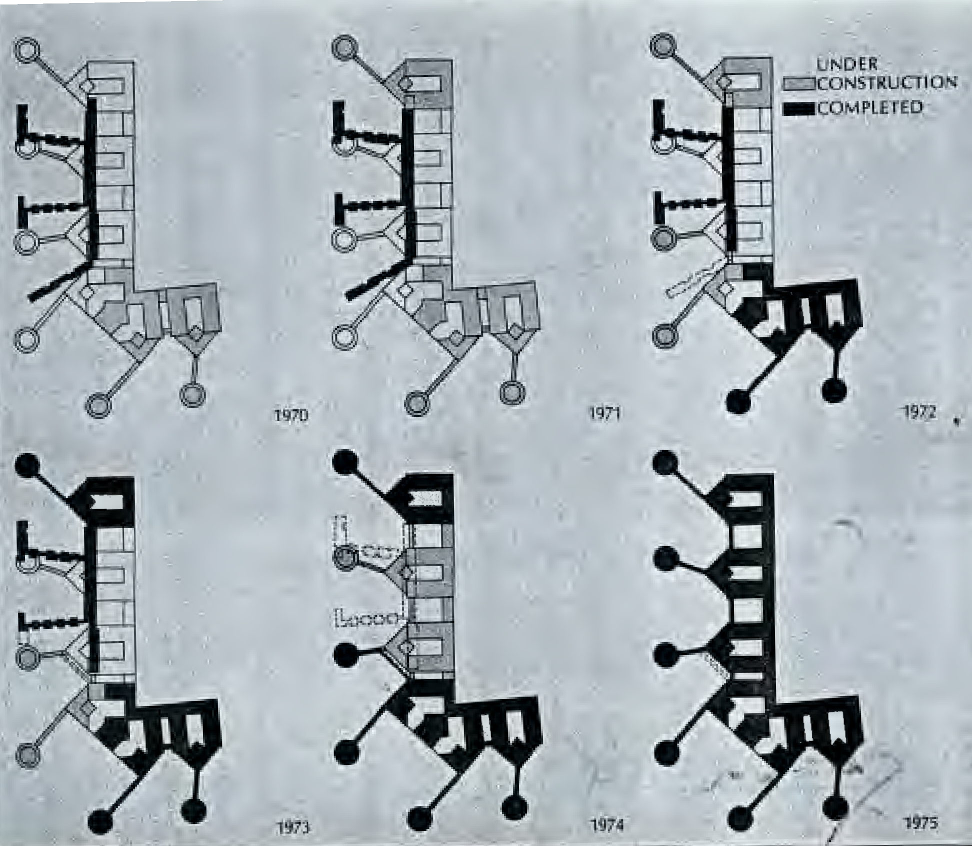
ENPLANING LEVEL

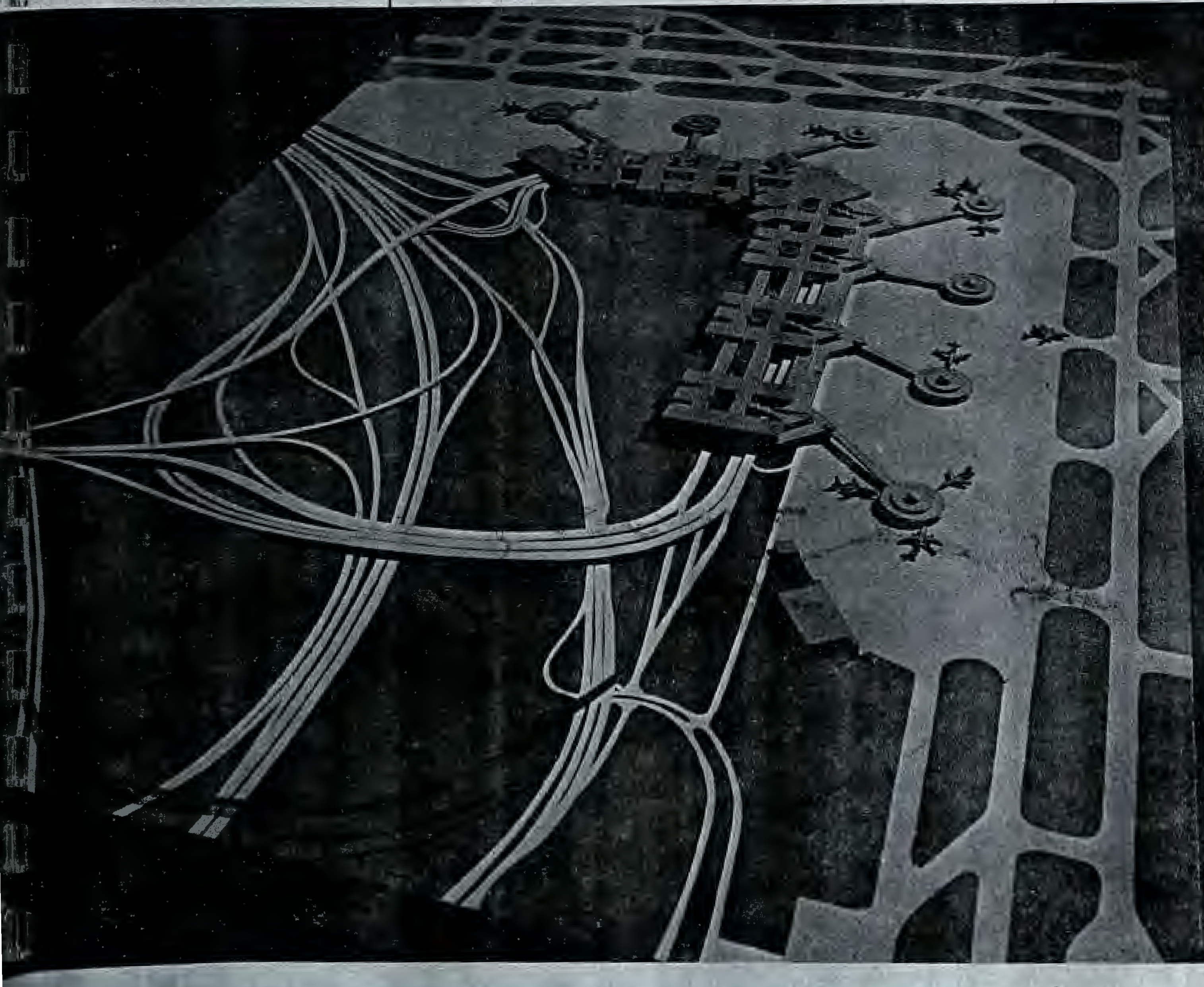


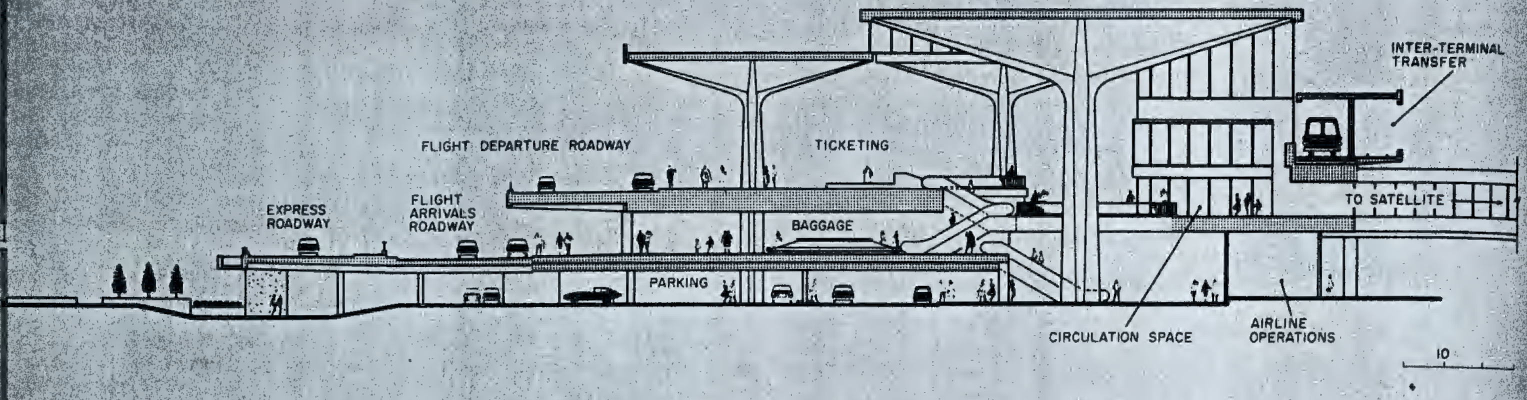
THIRD LEVEL GARAGE

The plans at left are of the ground or deplaning level, the boarding level and the third level of the garage. The average walk from garage to enplaning pavilion is 800 feet; from curb to pavilion is 600 feet.

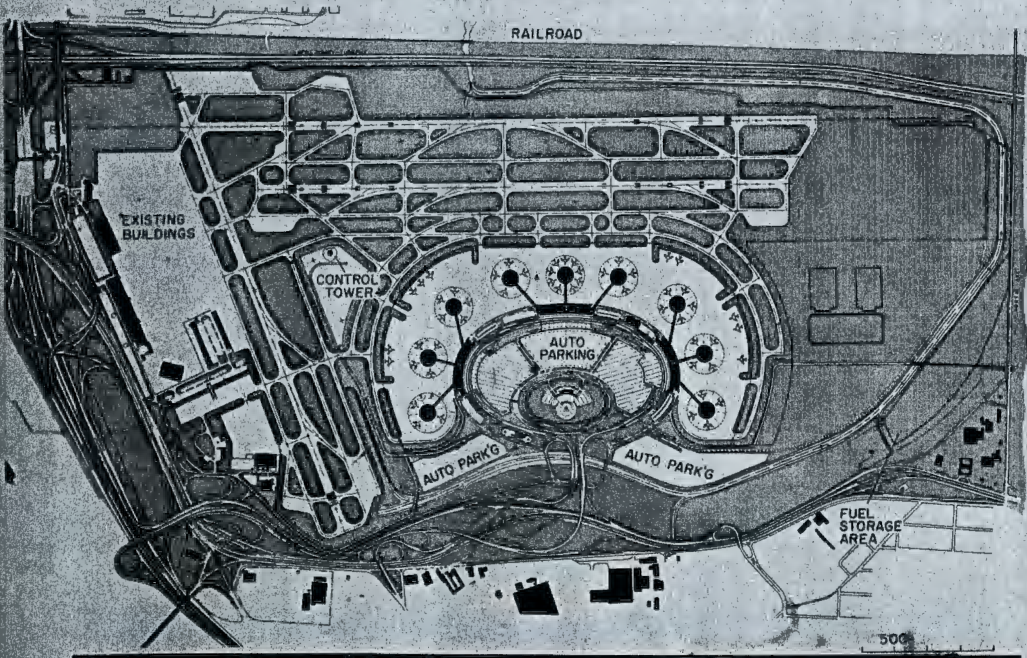
The diagrams at right show the annual construction phasing of the terminals, pavilions and garages from 1970 through 1975. Expansion of the present terminal must be completed by 1970 before work can begin on the all-new one. Below, the model photograph shows the overall plan with the connecting arteries to downtown Philadelphia.







Newark Airport redevelopment program combines layered operation with close-coupled parking



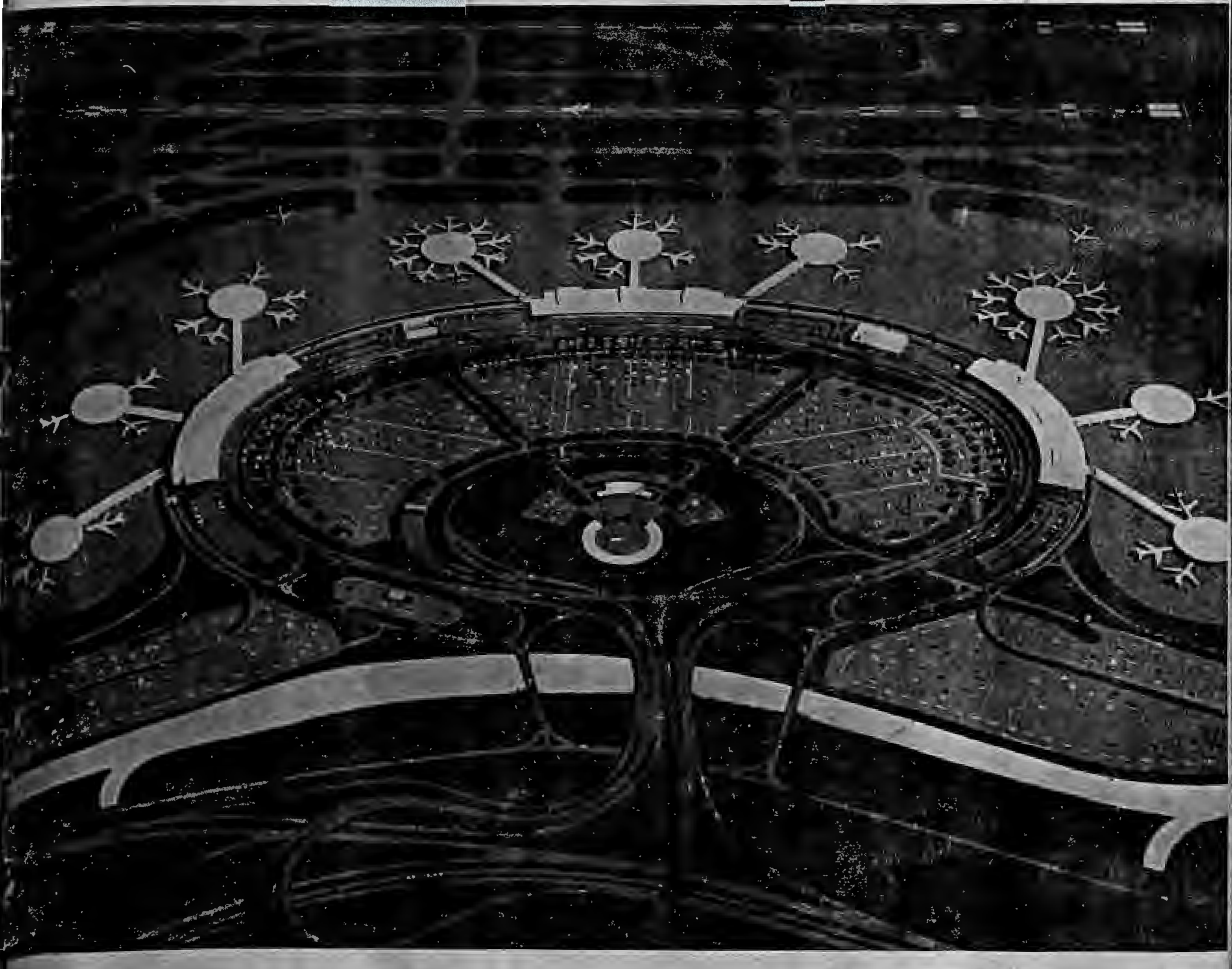
The Port of New York Authority expects air travel at Newark Airport to grow some 150 per cent during the next decade, and will spend more than $200 million to expand ground facilities and construct a new passenger terminal complex. There will be a new 8200-foot runway parallel to the existing instrument runway, plus a secondary general aviation runway and extensions of existing runways.

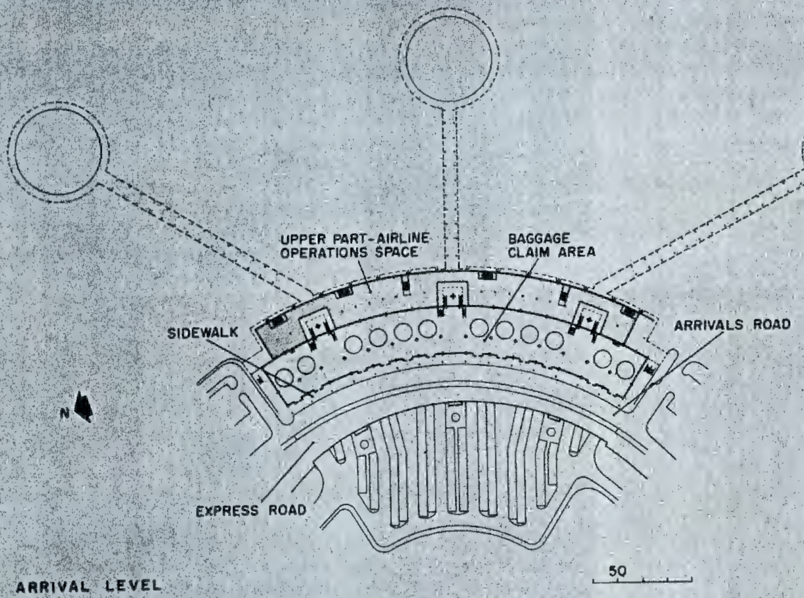
The terminal area will consist of three new terminal buildings disposed around an oval pattern of access roadways. Each of the terminal buildings will be a split-level main structure to which three circular two-level satellite gate-buildings will be attached by 600-ft arcades. Of the nine satellites, seven will accommodate nine DC-8-type aircraft loading positions each, and two will have ten positions each for smaller craft—a total of 83 positions serving 14 airlines carrying a projected 12,000,000 passengers yearly. Only domestic flights are contemplated from the Newark airport.

"In the abstract," says John Veerling, PNYA project director, "the single or centralized terminal building concept is the simplest for a passenger to understand. But here, where the aircraft apron extends through 83 positions representing a linear frontage of some three miles . . . the funneling of passengers through one building would mean tremendous walking distances or unduly extensive mechanization [for people moving]. . . . At the other extreme, extensive multiplication of individual terminals is confusing to passengers because of multiplicity of choice and direction and inefficient splintering of supporting facilities. Bearing these factors in mind, the terminal design team selected an optimum terminal unit comprising three satellite buildings connected to a main building."

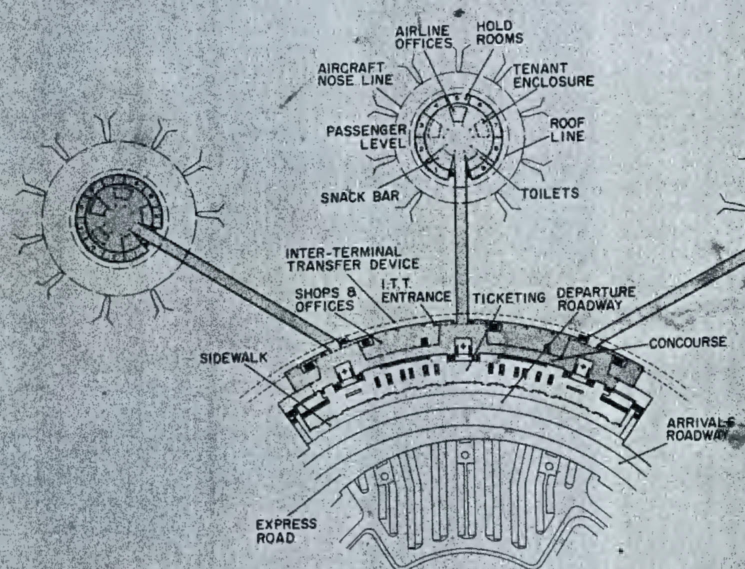
There will be parking facilities for over 10,000 automobiles, mostly within the oval, and some in covered areas adjacent to the terminal. These covered areas will be created by an elevated two-level system of access roadways for ar-

The blending of the three roadside levels and the two apron levels yields a 3/2 split-level design. In the cross section (opposite) passengers move only level or downward in traversing the building, except for the departing passenger at the parking lot level. For this exception, and for general passenger convenience, moving stairs are intended. Furthermore, the connectors between terminal buildings and their satellites are scaled to accept moving sidewalks. At three traffic nodes in each terminal, raised parabolic umbrellas create deeper spaces to give passengers a sense of place and function at circulation crossroads.





ARRIVAL LEVEL



DEPARTURE & CONCOURSE LEVEL

In plan, the terminal buildings are simply a functional expression of interface between air and ground transportation. The aircraft side of the terminal buildings, as well as their satellites and connectors, are two-level—(1) airline operations at grade, and (2) passengers above. The interior heights of the airline operations areas are held well up to permit hanging conveyor systems (as well as essential building services), which can be extended along the underside of the connector to the satellite.

rivals, departures, and rental car pickup. Surface parking in the center of the oval will accommodate long-term parkers, while covered parking permits access without crossing any major roads. The three-level arrangement also allows for about 4,000 linear feet of curb frontage, a pressing need at air terminals. If jumbo jets push passenger loading beyond estimates, parking and curb frontage can be expanded.

On the plane side of the terminals a blast-protected system of perimeter service roadways will handle baggage and supplies.

Approaches to the terminals consist of an express roadway running completely around the oval, with signalled take-off points for arrival driveways and entries from departure roadways serving the individual terminals.

Provision is made in the master plan and terminal structures for an automatic transportation system (for passengers) to provide inter-terminal services to passengers with connecting flights and to the long term parking lot. Present plans also envision, and structure is provided for, connection to the municipal transit system at a nearby station.

The basic design element is a series of concrete hyperbolic paraboloids on tapered columns. This unit follows through the architectural scheme of the terminal area oval and modest concavity of the individual terminal plans.

NEWARK AIRPORT, New Jersey. Architects and engineers: *The Port of New York Authority—John P. Veerling, project director; Gordon A. Lorrimer, Sheldon D. Wander and George E. Ralph, PNYA architects.*

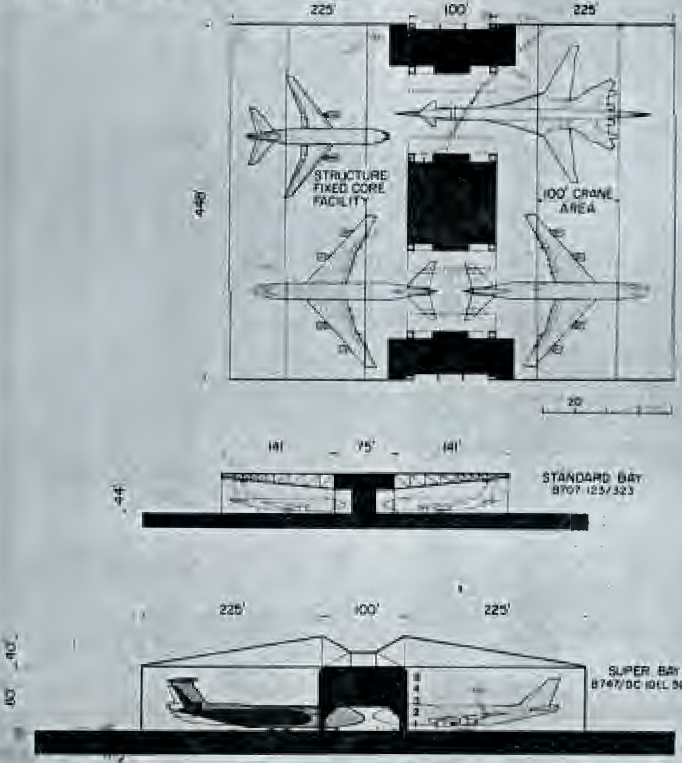
Ancillary commissions large and small grow out of airport development

United Airlines retained Kent Cooper & Associates to undertake a broad program of renovation and expansion for United's Customer Service Facilities in the Washington, D.C. area. The photo above is of the ticket office in a downtown hotel. Below is the ticketing, waiting and check-in facility at Washington National Airport.

Commissions such as these are available at new airports like Newark, in this article, since the terminal buildings are constructed as shells in which the individual airlines create their own images.

The flight training center below for United Airlines at the Denver Airport was designed by The Perkins & Will Partnership.

A prototype super-hangar designed for American Airlines by Zetlin, De Simone, Chaplin & Associates jointly with Conklin & Rossant, will cover an area the size of seven football fields. The design will be used at seven airports around the country. A roof of high-strength steel cables and sheet steel was designed to form an integral part of the structure, and support a suspended grid of rails on which travelling cranes will be installed. To be used to maintain any combination of present aircraft, 747s and SSTs, each hangar will cost about $2 million.



The graphics below were designed by Arnold Thompson Associates for the Air Transport Association of America as a study to explore ways of developing better airport signs and identifying their proper use.

Pan Am's new maintenance base at Kennedy Airport in New York is being designed by Ammann & Whitney in association with Burns & McDonnell Engineering Company. The base will consist of a component overhaul building 1200 feet long and 450 feet wide, two huge new hangars, an engine test cell and a power plant. The cut-away drawing above shows the overhaul center.

The base will be a prime overhaul center for Pan Am's next-generation fleets of jumbo-jets and supersonic transports. The two hangars each will be 284 feet long and 263 feet wide. They will be 90 feet high to accommodate the tails of the new aircraft. Special craneway systems will be suspended from the ceilings to provide a portable platform for mechanics working on the high tails.