AIRPORTS: PLANNING

The term 'airport' can include not only the civil airports familiar to holidaymakers but also airfields (which may have few or no associated buildings) and heliports. They may be divided into those which are public (i.e. accessible to any air travellers) and those which are private (e.g. air-freight terminals, company airports, aeroclubs and airforce bases).

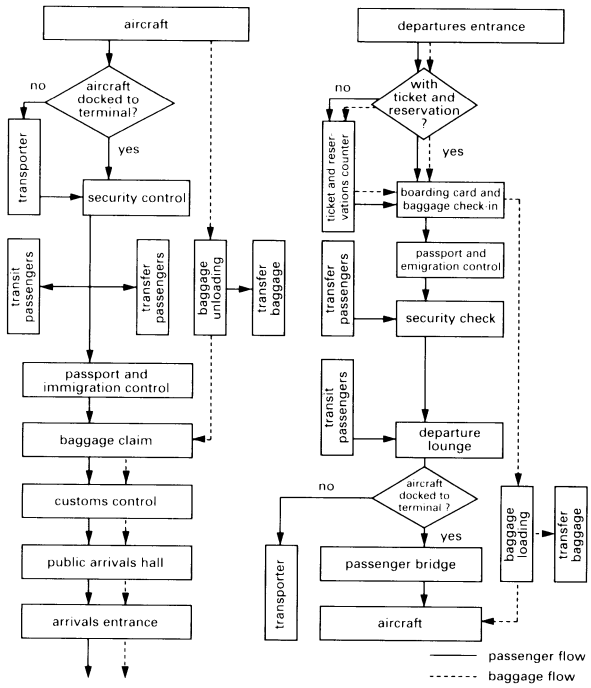
Location

The choice of location for an airport will depend on topographical, geological and meteorological conditions as well as the position of surrounding built-up areas. Sufficient land must be available for take-off and landing runways, taxiways, terminal buildings, maintenance areas, fuel storage, etc. and, ideally, for possible future expansion. Another important factor is proximity to existing and potential transport networks.

General expansion plan

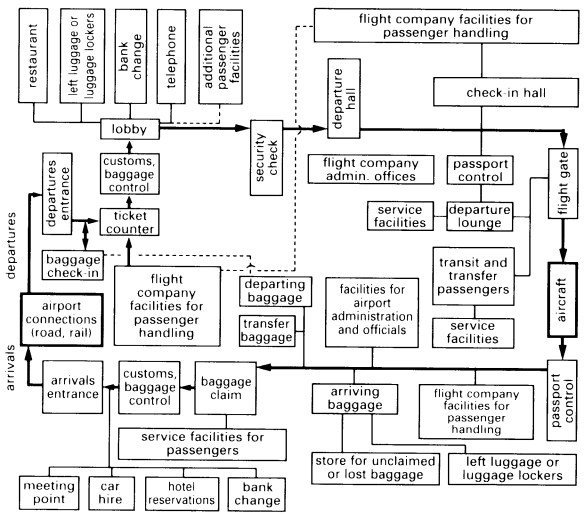
For all airports, an expansion plan covering at least 20 years ahead should be drawn up, and revised at regular intervals in order to allow for changes in the volume and nature of air traffic, developments in aircraft technology and other innovations.

Traffic forecasts should include information about movements of aircraft, numbers of passengers and volume of freight. They should be checked and updated on a regular basis to account for the pace of modern change. For the calculations, and design of the airport facilities and installations, typical peak traffic values (i.e. those reached 30 times per year or 10 times within the peak month) should be chosen, not the absolute peak values.

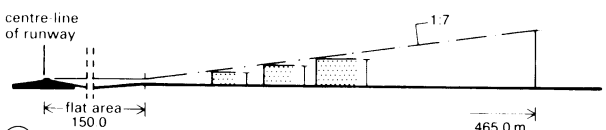


① **Passenger arrival flow diagram**

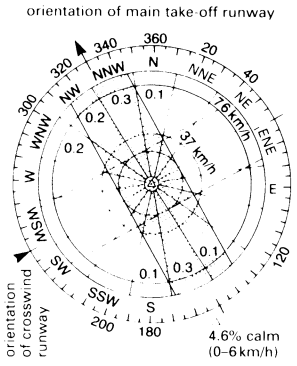
② **Passenger check-in/ departure flow diagram**



③ **Functional diagram of a terminal building**



④ **Permissible building heights immediately beside runways**

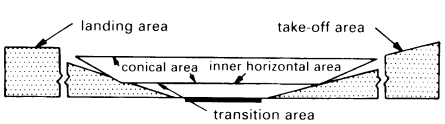


⑤ **Typical wind rose**

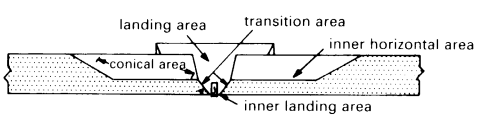
breakdown of wind speeds and directions experienced

direction	7–24 km/h	26–37 km/h	39–76 km/h	total
N	4.8	1.3	0.1	6.2
NNE	3.7	0.8	–	4.5
NE	1.5	0.1	–	1.6
ENE	2.3	0.3	–	2.6
E	2.4	0.4	–	2.8
ESE	5.0	1.1	–	6.1
SE	6.4	3.2	0.1	9.7
SSE	7.3	7.7	0.3	15.3
S	4.4	2.2	0.1	6.7
SSW	2.6	0.9	–	3.5
SW	1.6	0.1	–	1.7
WSW	3.1	0.4	–	3.5
W	1.9	0.3	–	2.2
WNW	5.8	2.6	0.2	8.6
NW	4.8	2.4	0.2	7.4
NNW	7.8	4.9	0.3	13.0
calm	(0–6 km/h)			4.6
total				100.0

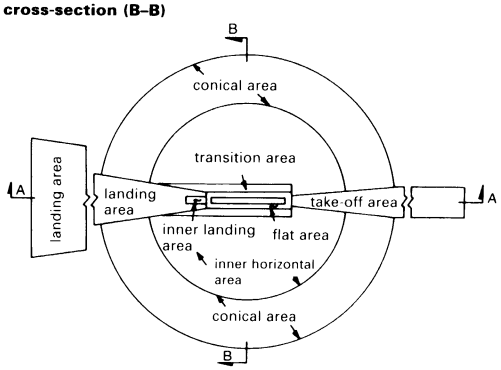
⑥ **Wind data**



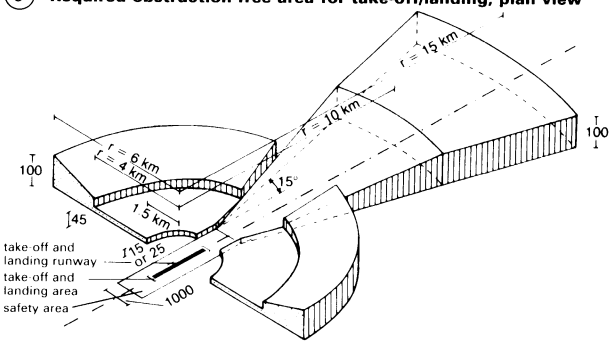
⑦ **Required obstruction-free area for take-off/landing, longitudinal section (A–A)**



⑧ **Required obstruction-free area for take-off/landing, cross-section (B–B)**

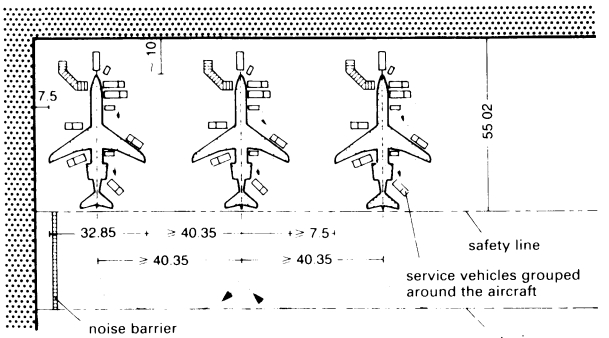


⑨ **Required obstruction-free area for take-off/landing, plan view**

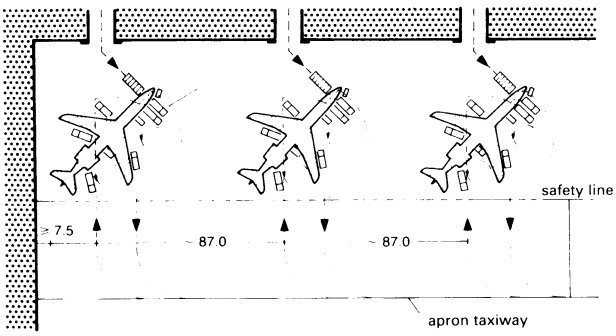


⑩ **Building protection areas for an airport with instrument landing**

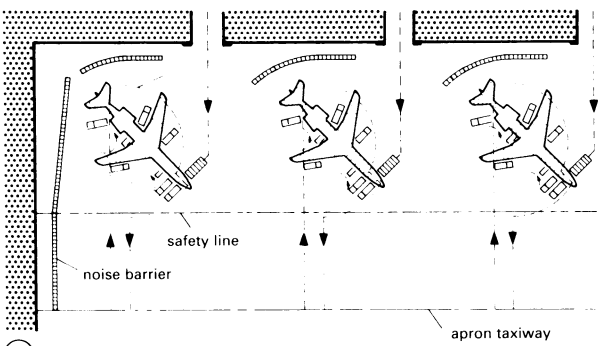
AIRPORTS: PLANNING



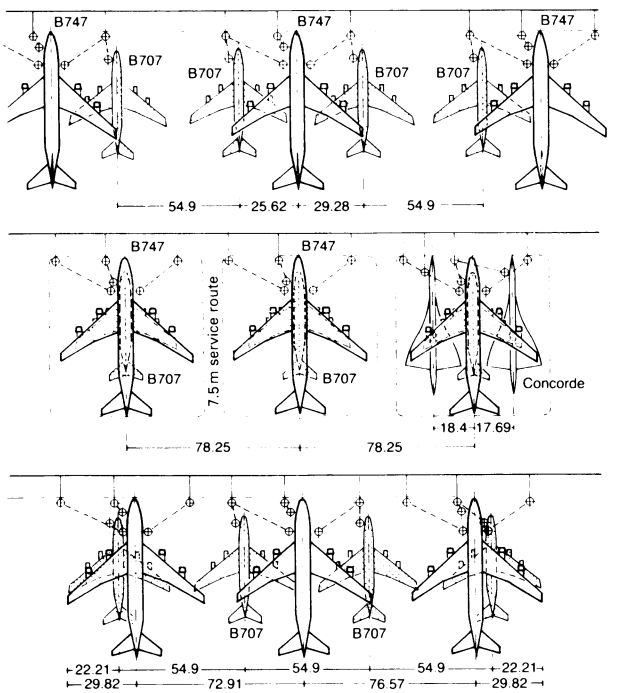
(1) **Nose-in parking position**



(2) **Diagonal nose-in parking position**



(3) **Diagonal nose-out parking position**



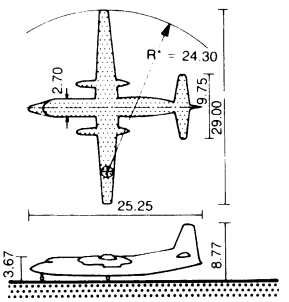
(4) **Typical aircraft parking arrangements**

Forward planning requires a traffic forecast based on the following data:

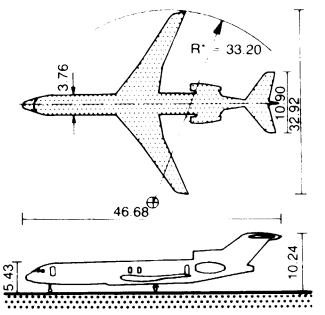
- average/peak passenger movements (overseas/domestic, arrivals/departures, transfers/transits, short-haul/long-haul);
- average/peak air-freight/mail take-offs and landings (overseas/domestic, import/export/transfer), proportion of standard dimensions (containers, pallets), average/peak total tonnage, number of items or volume of goods);
- average/peak movements of aircraft according to types of aircraft (passenger, freight, or mixed traffic).

Other factors important to planning are:

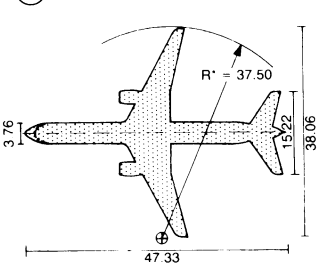
- choice of mode of transport by passengers (private car, taxi, public transport);
- average number of people accompanying each passenger, average number of pieces of luggage per passenger, number of visitors to airport (unconnected to passengers, employees).

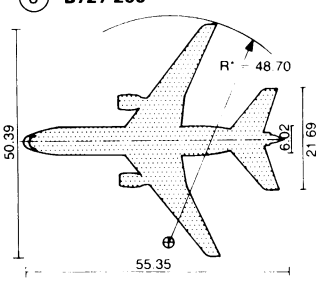


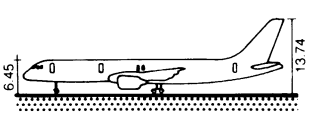
(5) **F50**



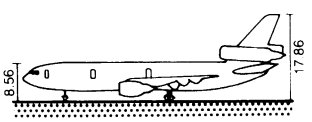
(6) **B727-200**



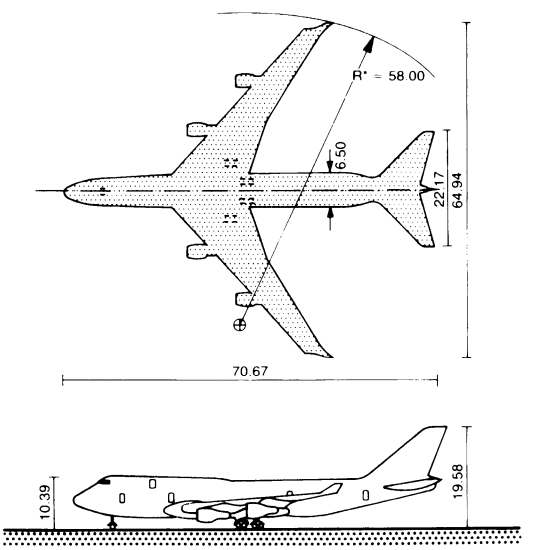




(7) **B757-200**

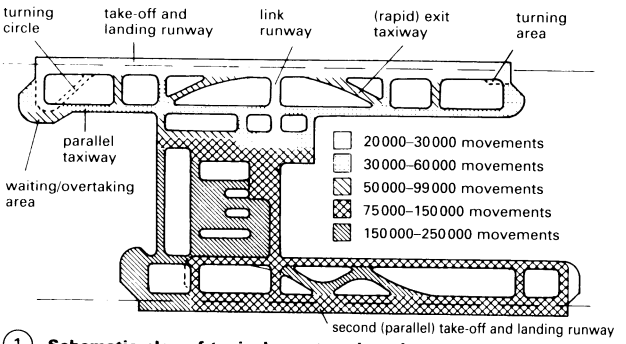


(8) **DC-10/30**

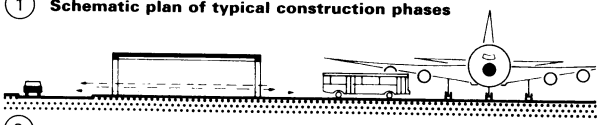


(9) **B747-400**

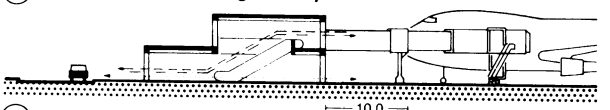
AIRPORTS: TERMINALS



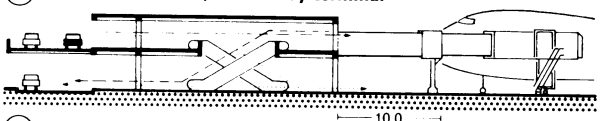
① **Schematic plan of typical construction phases**



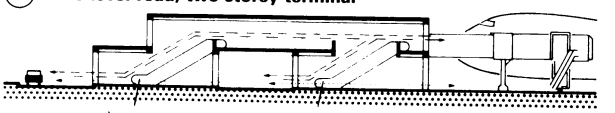
② **Ground level road, single-storey terminal**



③ **Ground level road, two-storey terminal**

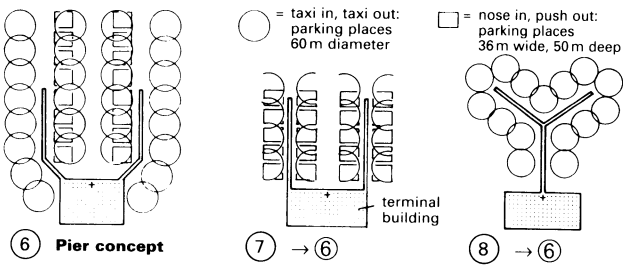


④ **Two level road, two-storey terminal**

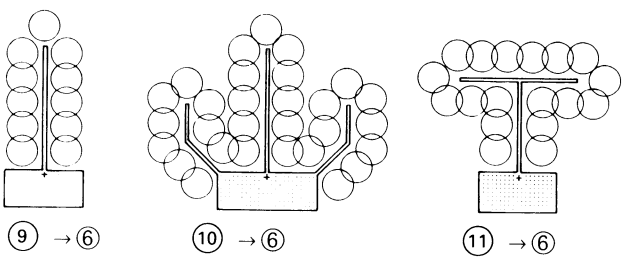


Typical arrivals/departures processing levels in a terminal building

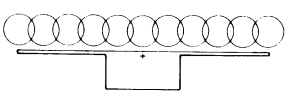
⑤ **Ground level road, two-storey terminal**



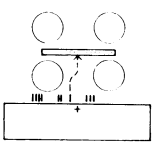
⑥ **Pier concept** ⑦ →⑥ ⑧ →⑥

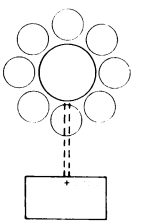


⑨ →⑥ ⑩ →⑥ ⑪ →⑥



⑫ **Linear concept**





⑭ **Satellite concept**

⑬ **Transporter concept**

All parking places in adjacent building (linked by passenger bridges) are situated within 300 m of the centre of gravity (+) → ⑥ - ⑭

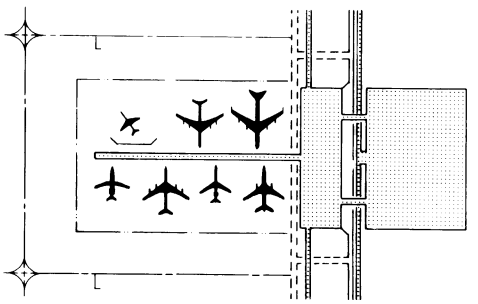
The following functional areas determine the airport capacity:

- take-off and landing runway system (possible movements of aircraft per unit time);
- taxiways and number of arrival/departure gates;
- passenger terminal buildings (possible movements of passengers, baggage and air-freight per unit time).

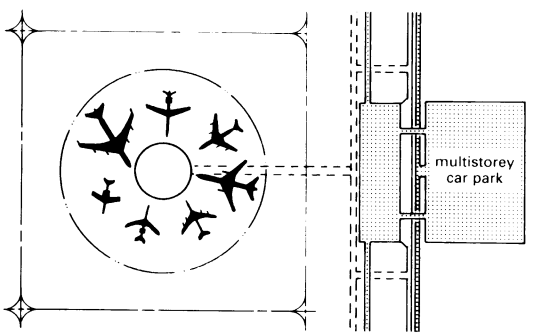
The capacity of the check-in system is determined by:

- the related road and rail systems (including parking provision, capacity of roads);
- passenger/baggage check-in clearance (number of counters and capacity of conveyor/transport system);
- passport control, security checks, checks prior to boarding the plane (size of waiting rooms, number of counters).

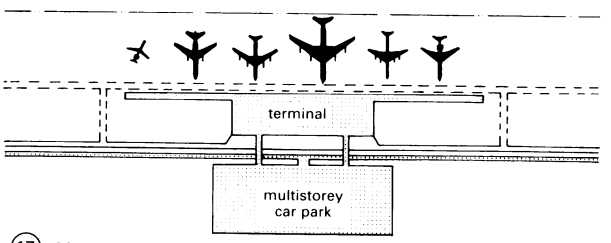
The apron is the area that connects runways to the terminal. It includes taxiways, aircraft manoeuvring/parking areas, associated traffic areas and roads for service vehicles, as well as storage areas for service vehicles and equipment, and should therefore be developed in conjunction with the terminal.



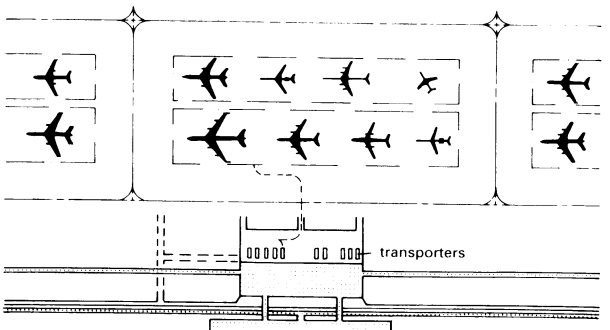
⑮ **Pier concept**



⑯ **Satellite concept**



⑰ **Linear concept**

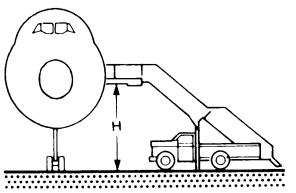


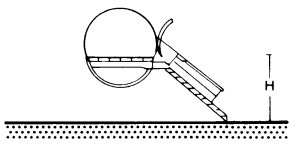
⑱ **Transporter concept**

take-off/landing runways	hourly capacity VFC movements/hour	IFC	annual traffic volume movements
	51 - 98	50 - 59	195000 - 240000
215 - 761 m	94 - 197	56 - 60	260000 - 355000
762 - 1310 m	103 - 197	62 - 75	275000 - 365000
1311 m +	103 - 197	99 - 119	305000 - 370000
	73 - 150 (⟶)	56 - 60	220000 - 270000
	73 - 132 (⟵)	56 - 60	215000 - 265000
	72 - 98	56 - 60	200000 - 265000

VFC = visual flight conditions
IFC = instrument flight conditions

(1) **Capacity of different take-off/landing runway systems**

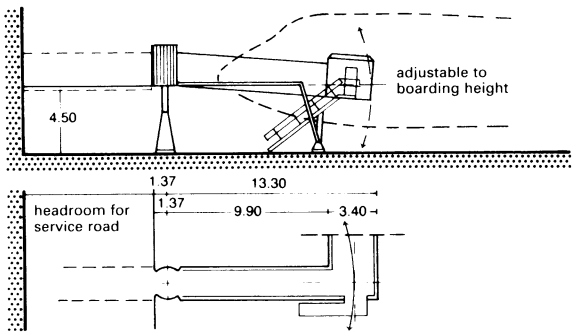




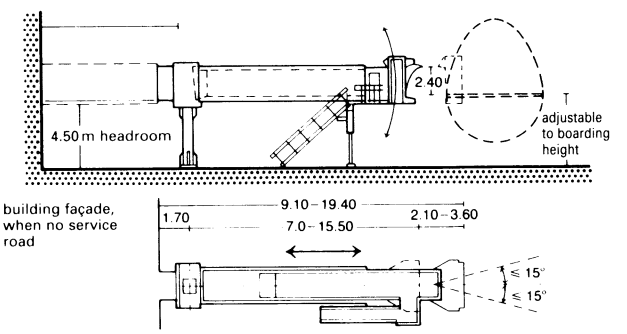
type	F50	B727	B757	DC-10	B747
H (m)	1.29	2.97	4.01	5.16	5.36

threshold height (H) of the integrated step to the cabin floor

(2) **Truck-mounted passenger steps**



(3) **Swivel landing bridge**



(4) **Telescopic variable height landing bridge with support column**

Passenger terminal concepts

Airports use different methods of accommodating aircraft and linking them with terminals and the main buildings. There are four main concepts.

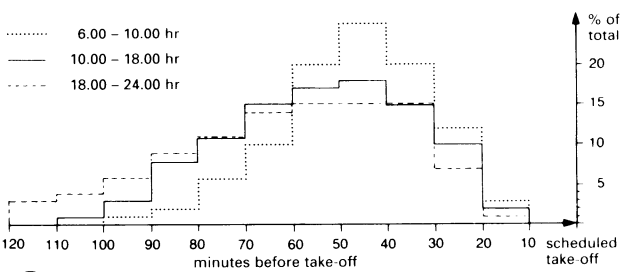
(1) Pier concept (with central main terminal →p. 448, ⑥ – ⑪ + ⑮). Aircraft park on both sides of a pier connected to the terminal building. Where there are two or more piers, the space in between has to be sufficient for 1–2 apron taxiways each (allowing taxiing in and out at same time).

(2) Satellite concept (with central main terminal →p. 448, ⑭ + ⑯). One or more buildings, each surrounded radially with aircraft parking places, are connected to the main terminal, generally by large underground corridors.

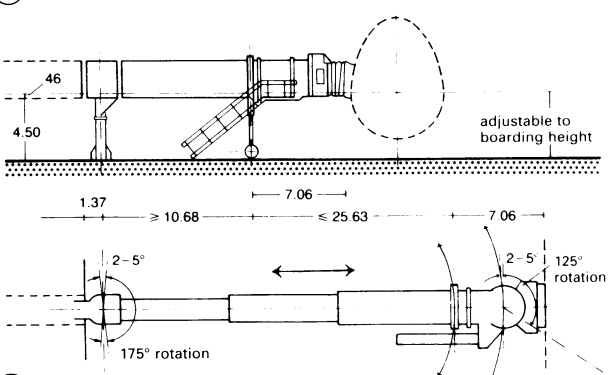
(3) Linear concept (→p. 448, ⑫ + ⑰). Aircraft are parked alongside the terminal building in a line next to one another in nose-in, parallel or diagonal positions. The parking position determines to a great extent the overall length of the terminal.

(4) Transporter concept (→p. 448, ⑬ + ⑱). Aircraft parking is spatially separated from the terminal and the passengers are taken to and from their flights by specially designed transport vehicles.

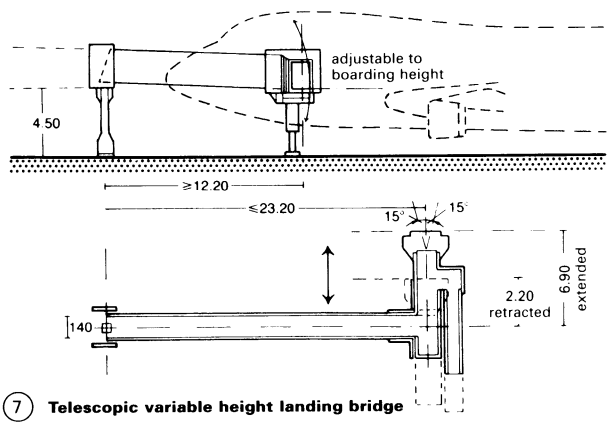
Further mixed variations (hybrid concepts) can be developed from these basic layouts.



(5) **Distribution of passenger arrival times ahead of scheduled take-off**

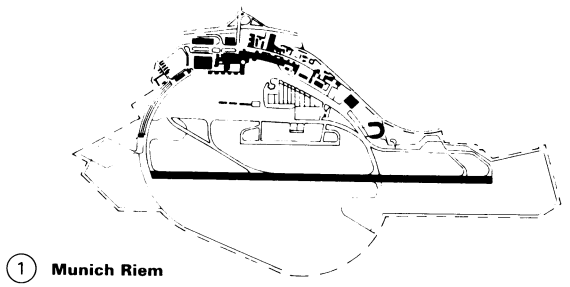


(6) **Swivel and telescopic landing bridge**

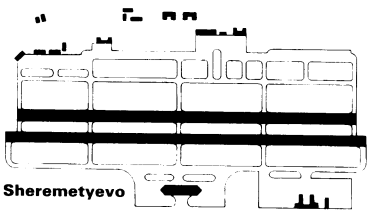


(7) **Telescopic variable height landing bridge**

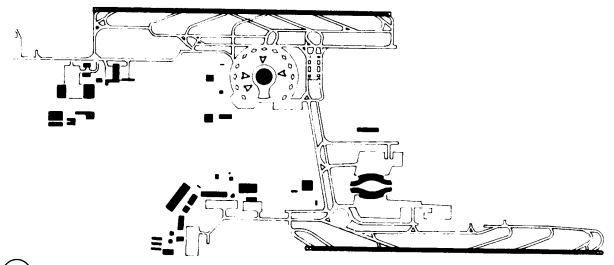
AIRPORTS: RUNWAYS AND APRONS



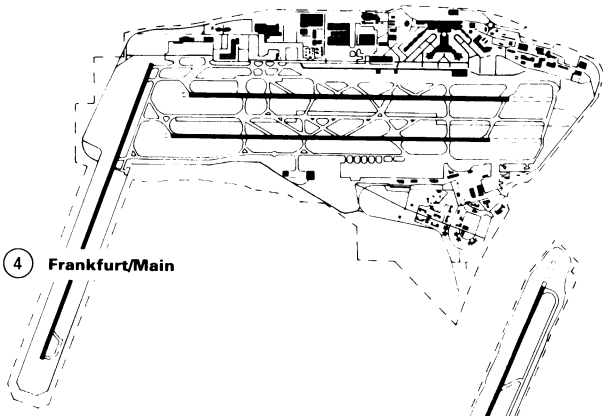
① Munich Riem



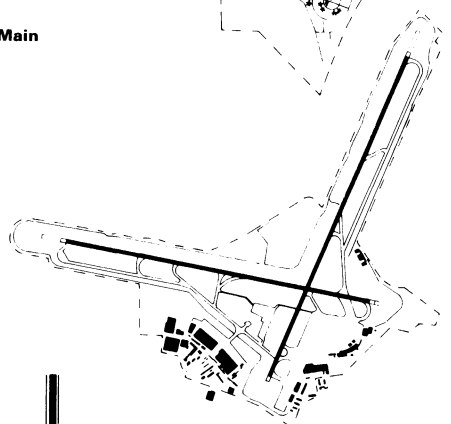
② Moscow Sheremetyevo



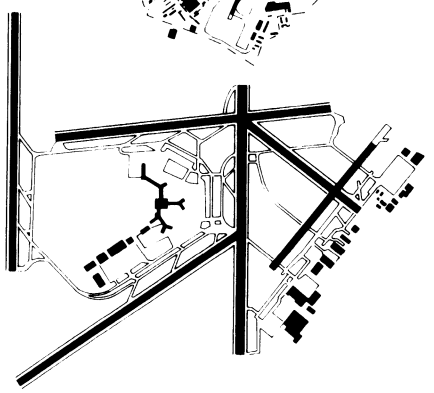
③ Paris Charles de Gaulle



④ Frankfurt/Main



⑤ Hamburg



⑥ Amsterdam Schipol

The orientations, lengths and numbers of take-off and landing runways are determined by a number of factors:

- Orientation is determined essentially by the prevailing local wind direction, the aim being to make it possible to approach the airport for 95% of the year (with a maximum side wind of 20 knots). Frequent strong crosswinds may make a corresponding second runway necessary → p. 446 ⑤ + ⑥.
- Length is determined by the type of aircraft, predominant climatic and topographic conditions, such as temperature, air pressure (related to height above sea level), land gradient etc.
- The number of runways is dependent upon the volume of traffic to be handled. A parallel arrangement (note that the minimum separation is 215 m) is particularly advantageous and, if the separation is more than 1310 m, simultaneous take-offs and landings are possible, which allows the highest theoretical capacity to be reached. → p. 449 ①

The taxiing area is to be designed in such a way that the runways can be cleared as fast as possible after a landing ('fast exit taxiing runways') and parking positions can be reached by the shortest possible routes. In especially busy airports, provision of overtaking areas or by-pass runways can help to increase capacity.

Aircraft parking positions

The 'nose-in' position (→ p. 447 ①) has the following advantages: small space requirements; few problems with exhaust streams for personnel, equipment and buildings; quick servicing times as the necessary equipment can be made available before arrival; and ease of connection to passenger bridges. However, this position requires a means of towing for manoeuvring purposes and this adds time and calls for trained personnel.

With 'taxi in/taxi out' parking (e.g. diagonal nose-in → p. 447 ② and diagonal nose-out → p. 447 ③ towing is not necessary. However, such parking needs a larger space and creates more fumes and noise pollution directly in the vicinity of the terminal as the aircraft are taxiing, thus making it necessary to add protective measures such as blast barriers.

The parallel parking system offers the easiest manoeuvring for arriving and departing aircraft and there is no need for towing. The disadvantages are that parallel parking has the greatest overall space requirement and limits activity in neighbouring aircraft positions during taxiing.

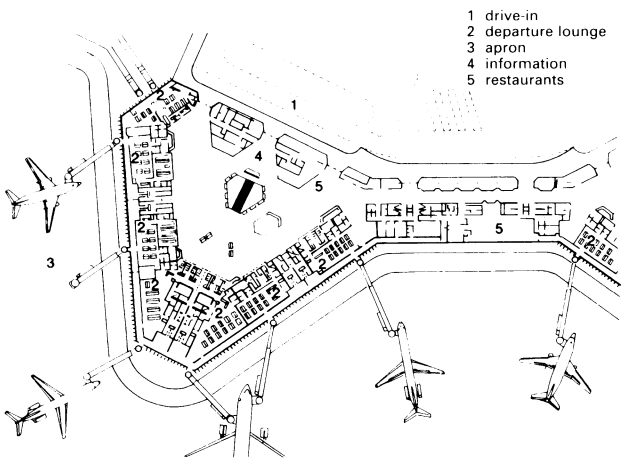
Apron roadways and parking spaces

Signposting and positioning of service roadways on the apron are of great importance to the efficient and safe functioning of the airport. Apron roadways should be designed to give direct and safe connection of the apron to the other working areas of the airport. The points at which they cross aircraft taxiways or other service vehicle routes should be kept to the minimum. They can be run in front of or behind planes in the nose-in position, or between the wings → p. 447 ④.

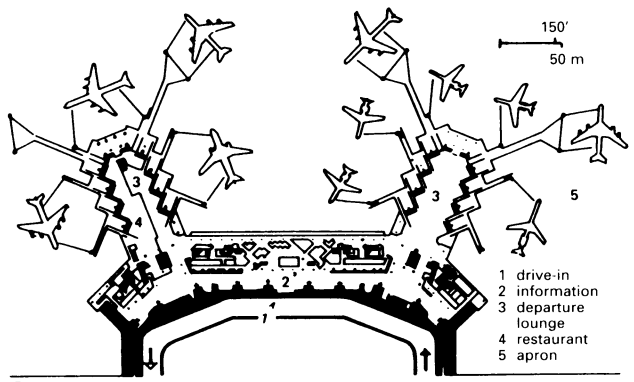
Should the roadways run underneath passenger bridges, sufficient headroom for all service vehicles is required (usually 4.50 m minimum) → p. 449 ③ + ⑦. Because of the extensive mechanisation and containerisation of aircraft servicing, it is vital to provide enough space for loading and parking of service vehicles and equipment (including empty containers).

Terminals essentially facilitate the transfer of passengers from ground transport (public transport, taxis, private cars) to the aircraft. They must therefore be planned in such a way that the movement of passengers and their luggage takes place efficiently, comfortably and quickly, and at the same time with the lowest possible running cost. An important criterion is passenger travelling distance: the distances between the car park/drop-off point and the main functional areas should be kept as short as possible. Modification to accommodate any increases in traffic must also be possible without radical and costly alterations to the original terminal.

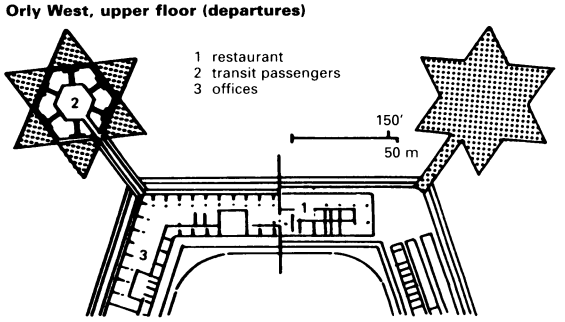
AIRPORTS: EXAMPLES



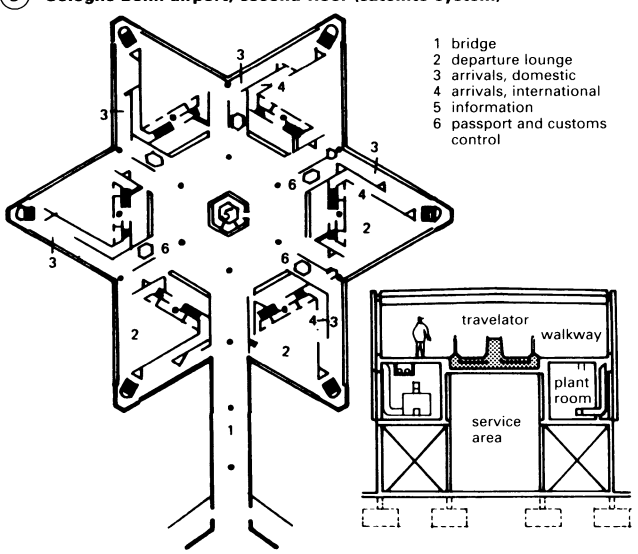
① **Hannover airport (decentralised system), part of departures level**



② **Orly West, upper floor (departures)**

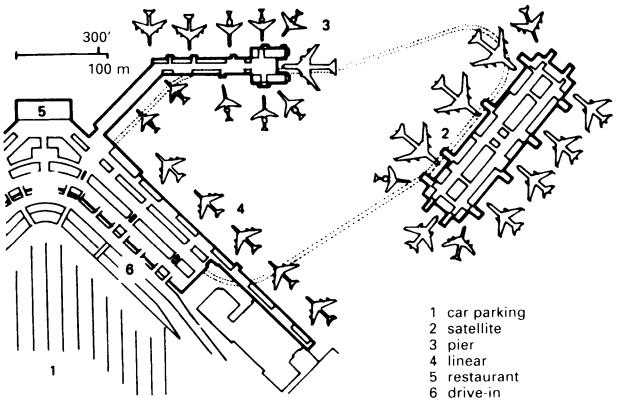


③ **Cologne-Bonn airport, second floor (satellite system)**

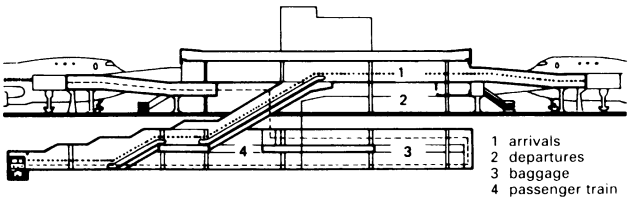


④ **Plan of satellite in ③**

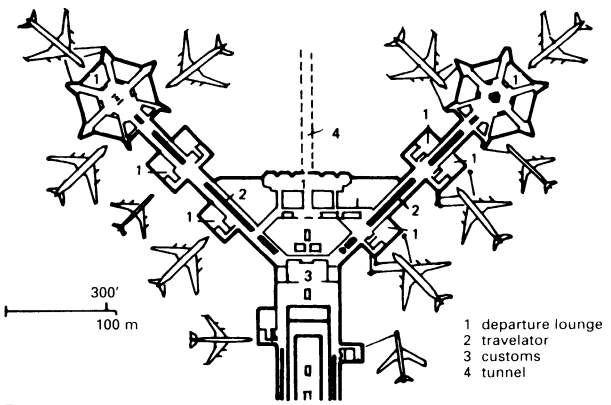
⑤ **Connecting link → ④**



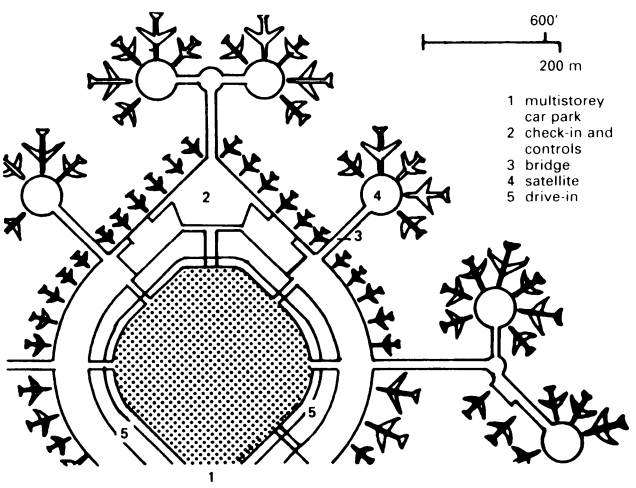
⑥ **Seattle Tacoma airport (combination of pier, linear and satellite system)**



⑦ **Section through satellite → ⑥**



⑧ **Frankfurt/Main airport, part of ground floor**



⑨ **San Francisco airport, departures level**