32

BRISBANE INTERNATIONAL AIRPORT REDEVELOPMENT CONSIDERATIONS FOR ITS PLANNING

I.W. Woonton
Chief Engineer
Airport Planning and Development
Director - Brisbane Airport
Project
Department of Transport
Canberra

R.C. Fawkes
Principal Engineer
Airport Planning and Development
Master Planner - Brisbane
Airport Project
Department of Transport
Canberra

Abstract:

This paper explains, in broad outline, the processes, factors and design pertaining to planning the redevelopment of Brisbane International Airport. It covers the roles of Commonwealth State and Local Government bodies, factors and policies which have influenced the redevelopment and planning of Brisbane Airport, some features of the design of the airport and the proposed initial development.

BRISBANE INTERNATIONAL AIRPORT REDEVELOPMENT CONSIDERATIONS FOR ITS PLANNING

INTRODUCTION

This paper explains, in broad outline, the processes, factors and design pertaining to planning the redevelopment of Brisbane International Airport. Particular aspects covered are

- redevelopment studies and programs
- co-ordination with State and Local Government
- co-ordination with the aviation industry
- responsibilities for airport planning and development
- purpose of the Master Plan
- planning objectives
- planning policies and philosophies
- forecasts of airport traffic
- land use, social and environmental factors
- air space and operational factors
- access considerations
- site constraints
- development of the Master Plan
- initial development planning and works

REDEVELOPMENT STUDIES AND PROGRAMS

For many years after World War II the wartime facilities (converted in many cases) plus a new runway in the late 1950's and minor additions sufficed for the relatively low volumes of traffic and types of aircraft of those years.

By the end of 1969 it was evident that the then Master Plan (based on development around the existing runways) would not suffice in view of

- the latest aviation traffic forecasts
- the noise nuisance imposed by aircraft operations on the existing runways
- the latest (then) proposals for Brisbane port development
- the restrictions on high rise development in the CBD arising from aircraft takeoff and landing surfaces
- airspace restrictions on Brisbane Airport arising from the RAAF Amberley airport.

By agreement between the Premier of Queensland and the Minister for Civil Aviation, a Brisbane Airport Advisory Committee (comprising Commonwealth, State and Brisbane Council representatives) was set up.

The Committee's report of January 1972 recommended that Concept Q should be the basis of the Master Plan of Brisbane Airport. Concept Q provided for three runways located astride the northern boundary of the existing airport and involved the acquisition of land to Moreton Bay and the provision of a floodway on the western boundary of the new airport to take the drainage from the Kedron Brook catchment area. The report also recommended a program of planning, design and construction with the aim of having the new airport operational in 1980.

In 1973 the then Commonwealth Government gave approval to the acquisition of land but referred the proposed program of development to the Bureau of Transport Economics for advice. The BTE advice, on economic grounds, was to defer construction of the new airport and to continue with development based on the existing runways.

BRISBANE AIRPORT REDEVELOPMENT

Late in 1977 the Commonwealth Government approved Brisbane Airport redevelopment based on Concept Q.

The program of Commonwealth and associated State development is aimed at the transfer of all aircraft operations from the existing airport to the redeveloped airport in 1986. Some non operational activities will remain at the existing airport for a period.

CO-ORDINATION WITH STATE AND LOCAL GOVERNMENT

The planning and development of an airport requires extensive negotiations and coordination between the airport authority and State and Local Government authorities whose responsibilities are affected by the airport. The topics of mutual interest include

- land acquisition
- land use planning
- environmental issues including aircraft noise
- airport access
- water, electricity, drainage and sewage services
- effects on State and Local Government planning and development.

This interaction is continuous over the life of an airport from its inception and, depending on the size and complexity of mutual problems and the number of interests involved, it may require the setting up of a formal joint body or bodies to investigate topics of mutual interest, define solutions and to make recommendations to the relevant Governments or relevant Departments, Authorities or Local Government. The power of decision on recommendations remains with that body which has the legal responsibility for the particular matter.

In 1978 a Joint Government Coordinating Committee was set up, by agreement between the Premier of Queensland, the Lord Mayor of Brisbane and the Commonwealth Minister for Transport, to coordinate items of mutual interest concerning the redevelopment of Brisbane Airport. The Committee is chaired by a representative of the Commonwealth Department of Transport and includes representatives of the

- State Co-ordinator-General's Department
- Brisbane City Council
- Commonwealth Department of Housing and Construction
- Commonwealth Department of Finance

CO-ORDINATION WITH THE AVIATION INDUSTRY

Obviously, as the aviation industry operates from airports, there is a need for discussions between the airport authority (Department of Transport) and aircraft operators (airlines etc) on matters of mutual concern namely

- the planning and development of the airport as it affects the aviation industry
- the requirements of the aviation industry for sites and facilities on airports
- problems arising in the daily operation of airports

This interaction is continuous over the life of the airport and as with State and Local Authorities it may require the setting up of formal joint committees to investigate problems, to define solutions and to make recommendations.

RESPONSIBILITIES FOR AIRPORT PLANNING AND DEVELOPMENT

The Commonwealth Minister for Transport is empowered by the Air Navigation Act and Regulations to establish, provide, maintain and operate aerodromes and air route and airway facilities. Aerodromes so established or provided, such as Brisbane Airport, are under the control and management of the Department of Transport.

Within the Department of Transport, the functions of the Ground Facilities Division include

- the selection of aerodrome sites and the master planning and development planning of aerodromes and aerodrome facilities
- the establishment, provision, maintenance and operation of aerodromes and aerodrome facilities.

By agreement with the Department of Housing and Construction and in accordance with the responsibilities of that Department for Commonwealth works, the Department of Housing and Construction provides engineering and architectural advice to assist the Department of Transport to carry out its functions. In addition the Department of Housing and Construction is responsible for the design and construction of works in accordance with the requirements of the Department of Transport.

PURPOSE OF MASTER PLAN

The primary purpose of the Master Plan of Brisbane Airport is to define and describe the planned ultimate development and stage development of the airport. In particular the Master Plan defines and describes

- the need for and role of the airport
- the location arrangement and scale of staged and ultimate airport facilities
- the airport external and internal access arrangements
- external arrangements necessary for the establishment, development and operation of the airport
- the planned pattern of aircraft operations at the airport
- the impact of the airport on the community, on development external to the airport and on the environment.

The Master Plan makes available to all interested parties information on the above items and on the data, factors and alternatives considered.

The Master Plan, in common with other community long term planning, is subject to review at periodic intervals in the light of any changes of demand or of other factors.

PLANNING OBJECTIVES

The overall planning objective is an Airport Master Plan which will satisfy forecast and potential aviation demands and which will be compatible with the environment, community development, other forms of transport and other airports.

Specific planning objectives include planning which will

- cater adequately and economically for forecast and potential volumes and types of aviation traffic and associated ground traffic throughout the life of the airport site
- make maximum use of the airport site in an economical and effective way
- achieve a balanced airport design whereby each element of the airport has a potential capacity commensurate with the capacity of each other element
- enable the effective and efficient operation of each separate facility within the framework of the most effective and efficient overall design
- enable progressive development of airport facilities when economically justified to meet the demand and with minimum dislocation to existing facilities and operations
- retain as far as practicable, flexibility and options for development to meet unforeseen demands
- achieve, as far as practicable, compatibility with the surrounding community and development

As developments proceed in accordance with the Master Plan, the options for any major changes will decrease. In the case of major elements of the Master Plan, the options for change will be minimal if a waste of resources invested in existing development and disruption to existing operations are to be avoided.

In the case of runways, because of their influence outside the airport (land and takeoff clearance requirements and aircraft noise), community development outside the airport and agreements with State and Local Government authorities on airport planning may debar any change of runway location and orientation.

In addition, because of the interrelation between runways and other airport facilities, the inability to change runway location and orientation may also debar major changes in the planning of those other airport facilities.

It follows that the initial determination of the framework of the Master Plan design is of vital importance if the master planning objectives are to be achieved.

PLANNING POLICIES AND PHILOSOPHIES

There is a need to adopt planning policies and philosophies designed to cope with

- the difficulties of securing and maintaining adequate airport sites without constraints on operations
- the uncertainities and difficulties of predicting future aviation demands.

An airport is a large and obtrusive public facility which uses land which could be suitable for other purposes and imposes a certain degree of noise on nearby areas. As it also has severe siting requirements, such as a large are of relatively flat land and freedom from obstructions in the landing and takeoff paths of aircraft it is patent that sites for airports within reasonable proximity of the community served are few in number. In addition, if a community is served by more than one airport, there is a need to provide sufficient separation between the airports so that each can operate efficiently and safely without overlap.

The uncertainities of prediction increase with the time range of the prediction and relate to

- aircraft, passenger and freight volumes
- aircraft sizes and characteristics
- the types and proportions of aircraft operations i.e. domestic/international, interstate/intrastate/ commuter airline, general aviation charter/business/private, passenger/freight
- the number of airlines and other operators and their scale of operations
- the number and scale of aircraft maintenance bases.

The inadequacies of past planning, the uncertainities of aviation demands and the inadequacy of past forecasts are clearly evidenced by current and impending deficiencies at airports throughout the world and by the massive redevelopment works that have been and are still being carried out. Many of these redevelopment works have involved the demolition or wholesale alteration of existing facilities and drastic modifications to early master plans based on past forecasts and concepts.

These miscalculations of past planning and development can largely be attributed to underestimates of future passenger, aircraft and freight traffic, reliance on short term planning and an inability to foresee the introduction and impact of large capacity aircraft. Perhaps the people who made these miscalculations were intent on avoiding accusations of grandiose planning.

Planning Horizon

In view of the scarcity of acceptable airport sites and as sites available now may not be available in the future, because of other community development, there is a need to adopt a long range planning horizon for the purposes of

- determining whether one or more airports will or could be required
- defining and acquiring or reserving the required airport sites
- ensuring that development planning by other authorities will not compromise sites required for airports.

In addition, as a corollary to the above and because of the desirability of limiting the number of airports in the interests of aviation and the community generally, there is a need to maximise the capacity of each airport site by planning and adequate land acquisition based on a long range planning horizon.

Planning based on a short range horizon will likely not be suitable for the increased traffic and likely larger aircraft beyond that horizon and will likely not be capable of change without massive and costly alterations to constructed facilities and interruptions to existing operations.

An alternative to such alterations and interruptions is the premature or possibly needless provision of a second airport. This would still leave the first airport with the limitations imposed by the early planning which may include an inability to accept aircraft above a certain size and under utilisation of the airport site.

The provision of a second major airport, be it warranted or not, imposes additional costs, disadvantages and potential air space problems. In the case of Brisbane, as the nearest second site is some 55km from the CBD, it would incur very large access costs.

Ideally planning would be based on the expected life of the airport site which, in the case of the redeveloped Brisbane Airport site, means an indefinite life or at least a life equal to the life of transport by aircraft.

Application of Aviation Traffic Forecasts

For airport master planning purposes, aviation traffic forecasts provide guidance on the types of traffic to be accommodated and on the relative proportions of such traffic.

However using such forecasts for planning the ultimate development of airports, as distinct from planning stage developments, presents difficulties in that the planning objectives for the ultimate airport development require long range forecasts which are not usually available and which, if they were available, can only have a low reliability rating.

It is common forecasting practice to provide a range of forecasts, from low to median to high. The median forecast is commonly presented to have the highest probability of success and, therefore, is frequently adopted for the planning of stage developments.

However this approach, for planning the ultimate development, ignores the probabilities of success of forecasts higher than the median forecast and also ignores the possibility that even the high range forecasts will be exceeded. The history of aviation is littered with cases of aviation forecasts which have underestimated the actual traffic.

In view of the indefinite life of an airport, the uncertainities of predicting future aviation demands and the lack and unreliability of long range forecasts, it must be concluded that aviation forecasts can have only a limited influence on the planning of the balanced ultimate development of the airport. However forecasts have sufficient reliability, because of the shorter time period involved when planning stage developments, to determine and evaluate alternatives.

Provision For Future Aircraft

The characteristics and size of aircraft are primary factors which influence the planning of an airport, especially the geometric layout of the aircraft movement area (runways, taxiways and aprons). The effect of aircraft size (passenger and freight capacity is also a dominant influence on the planning of terminal buildings.

The history of aviation shows a continuing increase in the physical size and load capacity of aircraft. There is no sign that the growth of aircraft size will not continue nor any firm information on ultimate limits of growth although aerodynamic and structural considerations do point to there being a limit beyond which there would be only minimal economic gain.

The pressure for larger aircraft arises from increasing passenger and freight volumes and airport and airspace congestion as well as the better economics of larger aircraft. Boeing, for example, has postulated a developed B747 of wing span 76m (now 60m), with a passenger complement of 633 and an 28 1/2% reduction in fuel consumption per passenger.

It must be borne in mind that particular aircraft have a life (of say 15 to 20 years) and that particular types go out of production as better types become available. Airline fleets, therefore, must be replaced periodically.

It must be concluded that the planning for an airport with an indefinite life should be based on the characteristics and sizes of future aircraft however difficult it may be to predict those factors. The alternatives are a decreasing capacity of the airport to accept newer and larger aircraft or massive expenditure to

correct inadequacies in geometric planning. One consolation, in regard to predicting future aircraft, is that the design of subsonic jet aircraft appears to have reached a degree of maturity (i.e. B757, B767, compared with B707, B727, B737 and B747 aircraft) which lends some confidence to the prediction of future aircraft sizes.

A feature of newer larger aircraft is their large capacity for the carriage of freight in addition to passengers. The airlines will be making strenuous efforts to utilise this freight capacity.

Provision For Different Operations and Numbers of Airlines and Operators

Inevitably there can be no precision about long term predictions of the types and proportions of aircraft operations i.e. domestic/international, interstate/intrastate/commuter airline, general aviation charter/business/private, passenger freight.

In these circumstances the most that can be done is to retain as much flexibility in the Master Plan as possible by planning

- the geometric layout of the whole manouvering area (runways and taxiways) to accommodate the largest design aircraft

- passenger terminal, freight terminal and aircraft maintenance areas on the same principle.

It must be borne in mind that such planning does not necessarily incur expenditure until facilities are provided. Some additional expenditure could be involved (mainly for services, roads and taxiways) with a small scale facility in a large area. However there will be savings arising from the ability to expand without massive alterations.

The number of airlines and other operators requiring accommodation in the long term cannot be predicted. This factor is of some importance as a greater number of airlines etc., will require more space than a smaller number, especially if they operate from separate facilities.

As the volume of air traffic increases there will be increasing justification for additional airlines etc. The multiplicity of airlines and other operators in the USA is a guide to what can occur with traffic volumes much larger than in Australia at present. With respect to Brisbane the forecasts show for the year 2000 compared with 1979

- a 2.3 to 1 ratio of aircraft movements
- a 3.8 to 1 ratio of passenger movements
- a 4.9 to 1 ratio of freight movements.

Provision For Aircraft Maintenance Bases

Unlike other activities on an airport the scale of aircraft maintenance facilities on an airport is related more to airline policies than to the volume of aircraft operations.

An airline will desire, most likely, to concentrate its overhaul maintenance activities at one airport with overnight maintenance bases at other airports. The airlines will be influenced in such decisions by their route network, availability of work force, availability of land on airports, etc. Currently the domestic airlines (AAA and TAA) overhaul bases are at Melbourne, Qantas at Sydney and East West Airlines at Tamworth.

In the face of an unpredictable demand by an unpredictable number of airlines or other operators for these vital activities it is deemed prudent to reserve a large area for aircraft maintenance bases on Brisbane Airport.

Capacity Design

As stated earlier the planning policy should be to maximise the capacity of each airport site by planning and adequate land acquisition based on a long range planning horizon.

An airport comprises a number of different traffic systems, each with its own capacity or capacities. The major traffic systems comprise

- the airspace system
- the runway system
- the aircraft taxiway system
- the passenger and freight terminal systems (including aprons and buildings)
- the vehicle parking and road traffic systems
- the airport access systems (including road and public transport)

Of these systems, the airspace and runway systems set an upper bound to the capacity of the airport site. The capacity of the airspace system may be limited by the proximity of other airports or by restrictions placed on aircraft routes or times of operation. The runway system capacity is primarily a function of the number and relative arrangement of runways and of the mix of aircraft (large and small, fast and slow).

Each of the systems need to have a capacity commensurate with the capacity of each other system if a balanced design is to be achieved and waste avoided. In addition, as the systems are interdependent, the arrangements of each system must harmonise with the arrangements of other systems.

It follows that the capacity of the whole airport is determined by the system which has the least capacity. The experience of overseas high volume airports indicates that airport access may be the ultimate limiting capacity.

FORECASTS OF AIRPORT TRAFFIC

As stated earlier forecasts of aviation traffic can have only a limited influence on the planning of ultimate development of an airport. However, forecasts are essential for planning the stage development (at 5 to 10 year intervals) of works directly associated with aircraft and passenger traffic i.e. terminals etc.

The following tables 1 to 3 show the past and forecast aircraft, passenger and freight traffic. Tables 4 and 5 are estimates of daily and peak hour road traffic.

TABLE 1 : ANNUAL AIRCRAFT MOVEMENTS

YEAR	SCHEDULED SERVICES			OTHER OPERATIONS			TOTAL
	INTER. AIRLINE	DOM. AIRLINE	COMMUTER AIRLINE	HEAVY CIVIL/MIL	LIGHT CIVIL/MIL	HELICOPTER CIVIL/MIL	
1975	2 856	37 652	7 128	4 937	27 526	2 297	82 396
1976	3 500	34 104	9 293	4 867	26 486	1 761	80 011
1977	3 149	35 196	10 990	5 347	27 402	2 100	84 184
1978	3 140	35 304	9 425	6 710	35 679	2 026	92 284
1979	3 129	34 924	13 240	8 800	37 230	4 079	101 402
1980	3 500	36 000	10 800	8 300	38 700	3 200	100 500
1985	4 500	44 000	16 200	14 000	55 100	4 000	137 800
1990	4 800	52 000	19 000	19 700	70 000	5 100	170 600
1995	5 000	59 000	22 400	24 900	80 100	6 600	198 000
2000	5 300	70 000	26 000	31 500	93 700	8 400	234 900

TABLE 2 : ANNUAL PASSENGER MOVEMENTS ('000)

YEAR	SCHEDULED SERVICES			TOTAL
	INTER AIRLINE	DOM AIRLINE	COMMUTER AIRLINE	
1975	190 4	2 251 3	32.0	2 473 7
1976	254 5	2 072 4	37.9	2 364.8
1977	250.9	2 147 7	42 9	2 441.4
1978	268.6	2 250.5	49.5	2 568.0
1979	301 1	2 396 7	69.2	2 766.9
1980	316	2 890	67	3 373
1985	500	4 335	141	4 976
1990	638	5 533	198	6 369
1995	814	7 063	278	8 155
2000	1039	9 012	389	10 440

TABLE 3 : ANNUAL FREIGHT MOVEMENTS (TONNES)

YEAR	AIRLINES			TOTAL
	INTER	DOM	COMMUTER	
1975	2 182	26 669	161	29 012
1976	3 270	23 633	133	27 036
1977	3 290	25 561	138	28 989
1978	4 152	27 656	159	31 967
1979	4 888	27 052	181	32 121
1980	5 200	30 500	190	35 890
1985	12 000	38 900	220	51 120
1990	24 100	50 000	250	74 350
1995	44 400	63 400	290	108 090
2000	74 800	80 900	340	156 040

TABLE 4 : VEHICLES PER DAY (INBOUND PLUS OUTBOUND) BRISBANE AIRPORT

YEAR	VEHICLE TRAFFIC ASSOCIATED WITH						TOTAL
	INTER PAX	DOM. PAX	COMMUTER PAX	EMPLOYEE	COMMERCIAL	GENERAL AVIATION	
1980	1 700	12 030	280	3 700	4 290	150	22 150
1985	2 680	18 040	590	5 230	6 380	210	33 130
1990	3 440	23 030	830	5 360	8 320	260	41 240
1995	4 380	29 410	1 160	5 550	10 930	330	51 760
2000	5 600	37 530	1 630	5 780	14 490	420	65 450
*2025	21 550	145 700	4 160	15 860	84 310	450	272 000

*SEE TEXT

TABLE 5 : PEAK HOUR VEHICLE TRAFFIC

YEAR	TOTAL TRAFFIC, VEHICLES PER DAY, INBOUND PLUS OUTBOUND	PEAK HOUR TRAFFIC, VEHICLES PER HOUR ONE WAY
1980	22 150	1 110
1985	33 130	1 660
1990	41 240	2 060
1995	51 760	2 590
2000	65 450	3 270
*2025	272 000	13 600

*SEE TEXT

The vehicle traffic quoted for the year 2025 is an estimation of possible road traffic demand for the airport developed to its maximum capacity, primarily for airline operations. The corresponding passenger traffic is about 40 million per annum. The nomination of the year 2025 is only meant to be an illustration of the time period when such volumes could be reached on an extrapolation of the forecasts to the year 2000. It remains to be seen whether such volumes of demand will be reached. In this connection there are overseas airports handling now annual passenger volumes in the region of 40 million and for which further growth in passenger traffic is forecast.

With respect to the year 2025 estimate of road traffic demand, it may well be that road connections to the airport to match that demand cannot be provided and that a public transport system will be essential to reduce the road traffic demand. Otherwise road access capacity would be the limiting capacity of the airport.

LAND USE, SOCIAL AND ENVIRONMENTAL FACTORS

The principal factors comprise

- aircraft noise
- Kedron Brook drainage
- Serpentine Creek and associated habitats
- dredging at Middle Banks, Moreton Bay
- effects on Bramble Bay
- resettlement of Cribb Island residents
- effects on Nudgee Beach residents
- compatibility with Brisbane metropolitan area development

Aircraft noise imposed on residential areas south west of the airport by operations from the present runways was a primary influence on the decision to redevelop the aiport on a different pattern of runways. The environmental study report of March 1974 stated

> "The proposed airport development will substantially reduce the number of people subject to aircraft noise nuisance in comparison with both the present situation and the future without redevelopment. This applies to both the ultimate and intermediate stages of the redevelopment. Nudgee Beach residential area will be exposed to aircraft noise nuisance when the crosswind runway is constructed but the noise for ultimate development will be much less than that currently experienced by residents in suburbs immediately to the southwest of the existing airport."

The Kedron Brook floodway is designed on the basis that the completed floodway and airport development will not cause any worsening of the flood characteristics at and upstream of Nudgee Road bridge.

The major detrimental effect will be the loss of Serpentine Creek and its associated mangrove forest and salt marsh areas representing some 6% of the total area of mangroves in Moreton Bay. However, the development of the Kedron Brook tidal inlet will permit partial replacement of this loss.

Dredging at Middle Banks is expected to have a negligible effect on the currently eroding beaches of Moreton Island between Tangalooma and Shark Spit and on the fish and prawn populations in Moreton Bay.

No major overall changes of the beaches and fauna of Bramble Bay are expected although some change to beach shape at the mouths of the Serpentine Creek and the new tidal inlet is likely to occur.

The redeveloped airport has required the resettlement of residents of Cribb Island. The resettlement was completed with substantial assistance by the Queensland Housing Commission.

Although Nudgee Beach residents will experience increased noise nuisance due to the redeveloped airport, the settlement will be outside the predicted 25NEF contour of noise exposure.

The present height restrictions on structures within the Brisbane CBD imposed by the clearance surfaces of the existing main runway will not be required for the redeveloped airport. The need for the removal of these restrictions has been stressed by the Brisbane City Council.

AIRSPACE AND OPERATIONAL FACTORS

The factors of importance to the present airport and redeveloped airport include

- The proximity of the Brisbane Airport to the RAAF airport at Amberley and general aviation airport at Archerfield
- the current noise abatement procedures for takeoff and landing at Brisbane Airport
- the obstructions to providing an Instrument Landing System (ILS) for the 04 direction (NE) of the main runway of the existing airport
- the jet aircraft curfew between 2300 and 0600 hours.

The proximity of the three existing airports has necessitated a compromise in fixing the controlled airspace zones (CTR's) around the three airports and a limit on the height of the Archerfield CTR. Provision has had to be made in this compromise for a lane between the Brisbane and Amberley CTR's for aircraft traffic between Archerfield and the north. The relocation of Brisbane Airport to the NE will improve the situation.

The current noise abatement procedures nominate runway 22 for landing (from the NE) and runway 04 for takeoff (to the NE) on the main runway. Such "nose to nose" operations are not feasible at times of high activity when aircraft have to operate in the same direction, which for least noise nuisance would be runway 04 (to the NE). This places the less severe landing aircraft noise instead of takeoff noise over residential areas SW of the airport.

However the present airport suffers from the disability that an Instrument Landing System (ILS) is not available for aircraft landing in the runway 04 direction and cannot be provided because of obstructions to the siting and clearance standards of ILS installations. Other approach aids, but with higher ceiling and visibility minima, are available for landings on 04. In addition the proximity of the Amberley control zone (CTR) constrains aircraft marshalling and approach procedures for landings on runway 04.

An Instrument Landing System will be provided on both ends of the initial main runway of the redeveloped airport and can be provided on all ends of other runways.

The ILS, separation of the new main runway from residential areas and the pattern of winds will permit the bulk of high runway activity operations to use runway 02 (landings from the SSW, takeoffs to the NNE) in all weather conditions and without inflicting unacceptable noise nuisance on residential areas.

At times of low runway activity, winds permitting, the preferred operation of the main runway for least noise nuisance would be runway 02 for takeoffs to the NNE and runway 20 for landings from the NNE.

The jet aircraft curfew of the present airport was imposed because of the proximity of resident development. The location and orientation of the runways of the redeveloped airport and their separation from residential areas permits, as shown by noise exposure forecasts, the removal of the curfew, especially for operations on the eastern parallel runway and cross runway.

Benefits flowing from the removal of the curfew include

- improved ability to recover from disruptions to airline services and to cater for holiday peak demands
- the ability to provide off peak schedules and services for certain classes of traffic (group travel, low fares, charters)
- greater utilisation of the domestic airline fleets through night freight and other night operations

- increased available hours at Brisbane for scheduling international services so as to cope with curfews at other airports and to achieve operations in "commercially attractive" hours at other airports.

AIRPORT ACCESS CONSIDERATIONS

Road access to the present airport is by main and secondary roads which lack the capacity and standard to cope with forecast volumes of airport traffic and other urban traffic in the area. Particular existing defects include

- a single main road of 4 lanes (Kinsford Smith Drive) for access between the airport and the CBD, south western and southern parts of the metropolitan area and which is heavily utilised by industrial and sea port traffic
- at grade railway crossings between the airport and Kingsford Smith Drive
- no main road connection directly to the western part of the metropolitan area
- a 2 lane main road (Mudgee Road) which provides access to the north and is also heavily utilised by industrial and sea port traffic.

The Pinkenba rail line provides a diesel passenger train service to the existing airport building area but is poorly patronised by airport employees and by virtually no air passengers.

The preference of airport employees and air passengers at airports throughout the world is strongly in favour of travel by road (private cars, taxis and airline buses, the latter by air passengers only). This preference is only disturbed when a convenient and frequent fixed rail service or priority bus service is available and where road traffic congestion and delays result in a decided time and/or cost advantage in favour of the fixed rail or priority bus.

With respect to any fixed rail system, normally only a direct service to the CBD with perhaps some intermediate interconnections can be economically justified and then only for airports with a very high volume of passenger traffic and high employee population.

Air passengers and airport employees with their widespread originations and destinations and with travel times from early morning to late at night and beyond are not well suited by metropolitan transport systems geared to the larger needs of the metropolis and radiating from the CBD. The changes of travel mode or vehicle inevitable in the use of such systems incur additional travel time and, in the case of a departing air passenger, uncertainty about whether he will catch his aircraft and problems with luggage on crowded public transport systems.

However the experience of overseas airports with large passenger volumes indicates that road access can become the limiting capacity of the airport and, therefore, that the planning of a large capacity airport must include provision for a public transport system or systems.

In view of the ground travel desires of air passengers and airport employees and their widespread originations and destinations and travel times, the planning policy must also be to achieve the maximum possible road access capacity with as many connections to freeways, arterials and other main roads as is feasible.

A major airport must be seen and recognised as a single very large generator of road and potential public transport traffic, both people and air freight, and accordingly it must be provided for in the road and public transport planning of the metropolitan area it serves.

It is generally proposed that the solutions to the near and long term road access needs of the airport include

- connection to the proposed North/South Arterial with acess over the proposed Gateway bridge to the southern metropolitan area and Gold Coast and access to the north
- connection to the projected Nothern Freeway or Arterial using the Schulz Canal route and to other main roads to the west to provide access to the CBD and western metropolitan area
- connection to other main roads in the vicinity of the airport.

With respect to public transport provision in the long term, the solutions appear to be either a fixed rail connection to the existing North Coast/Sandgate line or bus services using priority lanes or a combination of both.

SITE CONSTRAINTS

Major site constraints which have influenced or limited the planning of the airport include

- the Brisbane River and existing and proposed development on both sides of the river including port development at the mouth
- the location of the CBD
- the location of residential areas
- the Kedron Brook drainage needs
- high ground and development to the west of the airport site
- Moreton Bay
- external access from the south west
- the available land area and shape.

These constraints produced a roughly rectangular area of land of about 3000 hectares in a NNE/SSW direction with (see Fig. 6)

- the Brisbane River on the eastern and southern sides
- high ground and the proposed Kedron Brook floodway on the western side; and
- Moreton Bay on the northern side.

Long runway lengths are feasible in directions ranging from NNW/SSE to NE/SW but not in other directions. The constraints favoured locating the runways, particularly the cross runway, as far to the north as practicable.

DEVELOPMENT OF THE AIRPORT MASTER PLAN

The principal phases in the development of an Airport Master Plan are to

- determine the role of the airport

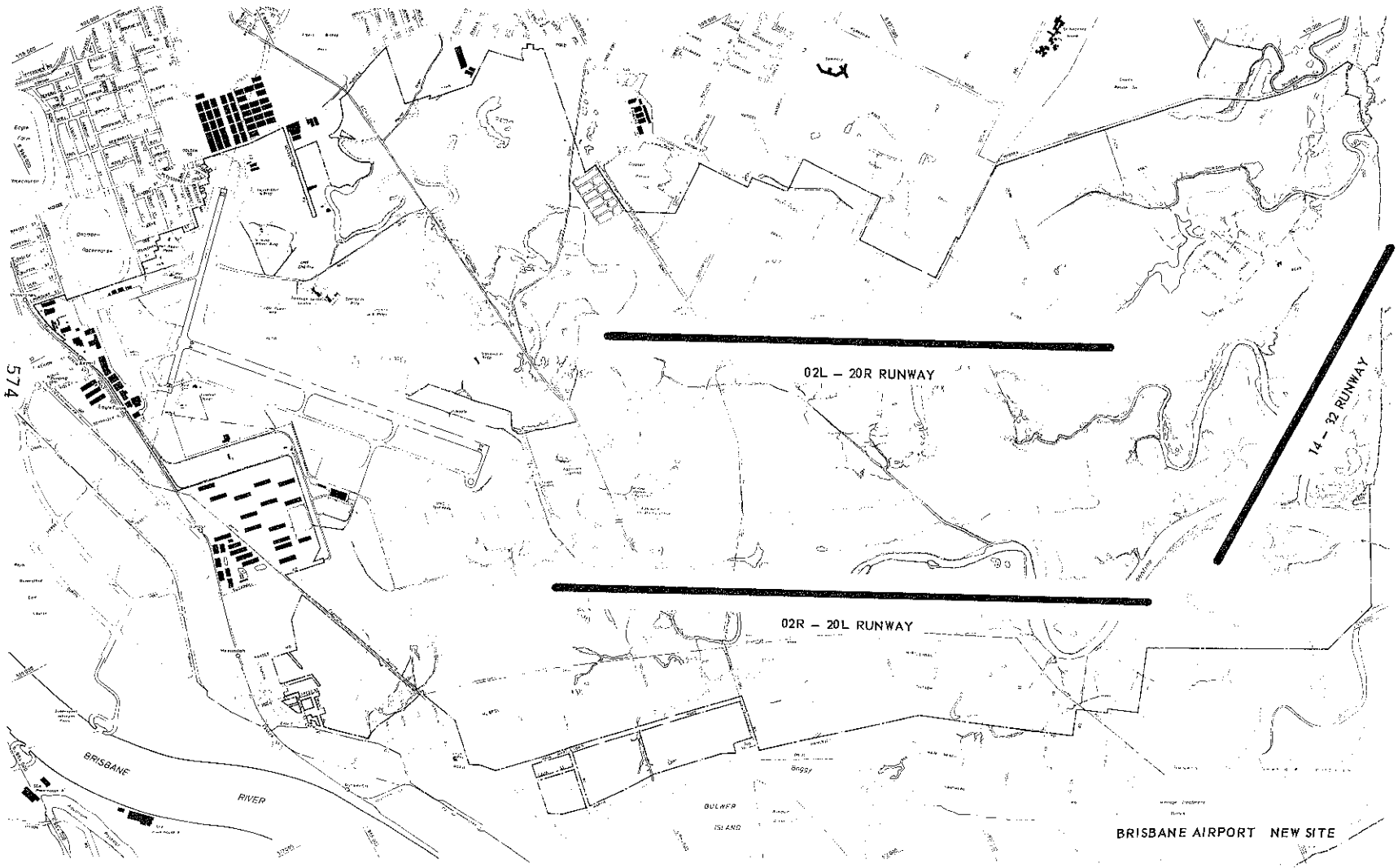

02L – 20R RUNWAY
14 – 32 RUNWAY
02R – 20L RUNWAY
BRISBANE
RIVER
BULWER
ISLAND
BRISBANE AIRPORT NEW SITE

FIGURE 6

- prepare forecasts of airport traffic
- determine airport facility and access requirements
- determine site constraints and environmental issues
- prepare and adopt airport design criteria
- prepare and evaluate alternative Master Plan concepts
- adopt and elaborate Master Plan
- negotiate compatible external land use planning
- negotiate adequate external transport planning

In the case of the redeveloped Brisbane Airport, the site of the airport and the general location of runways and the Kedron Brook floodway had been adopted as a result of the recommendations of the Advisory Committee review of 1970/71. The remaining planning included, broadly

- defining runway location, orientation and length
- the layout design of the taxiway system
- the layout design of the central terminal area
- the location and layout design of freight and aircraft maintenance areas
- the layout design of the internal road system, connections to external access roads and public transport provision
- the location of operational facilities such as control tower, fire stations, navigational and air traffic control aids
- the location of aircraft fuelling depots and routes for major pipe lines
- the location of airline aircraft catering and other airline etc., facilities

- the location and width of reserves for engineering services (electrical and control lines, water supply, sewerage, drainage etc)

- the formulation of airport clearance surfaces to protect aircraft takeoff and landing paths outside the airport and promulgation under the Air Navigation Act and Regulations

- negotiations with relevant State and City land use control and planning authorities to obtain and ensure external development compatible with the airport

- negotiations with State and City transport authorities to achieve urban road and public transport planning which will meet the needs of the airport.

Runway Planning

The combination of the site constraints mentioned earlier dictated that the parallel runways be orientated in a 16°M direction to achieve sufficient separation between the runways for independent operations on each runway and an adequate terminal area between the runways. (see Fig 7) Parallel runways are required to cater for future aircraft traffic volumes and to achieve maximum utilisation of the airport site.

The location and orientation of the proposed cross runway in a 135°m direction was dictated by residential areas on the coast, by existing and proposed development on both sides of the Brisbane River and by internal airport planning considerations. The cross runway is required to cater for aircraft with low permissable crosswind values and to reduce the incidence of operations with cross winds. It also increases the airports runway capacity.

Runway lengths of 4260m and 3600m for the parallel runways and 2600m for the cross runway are planned (See Fig 7). The 4260m exceeds present day needs but is designed to cater for the unknown requirements of future aircraft. Its adoption now will ensure protection of the associated aircraft takeoff and landing paths.

A runway width of 60m (instead of the current 45m standard) has been adopted to cater for future larger aircraft.

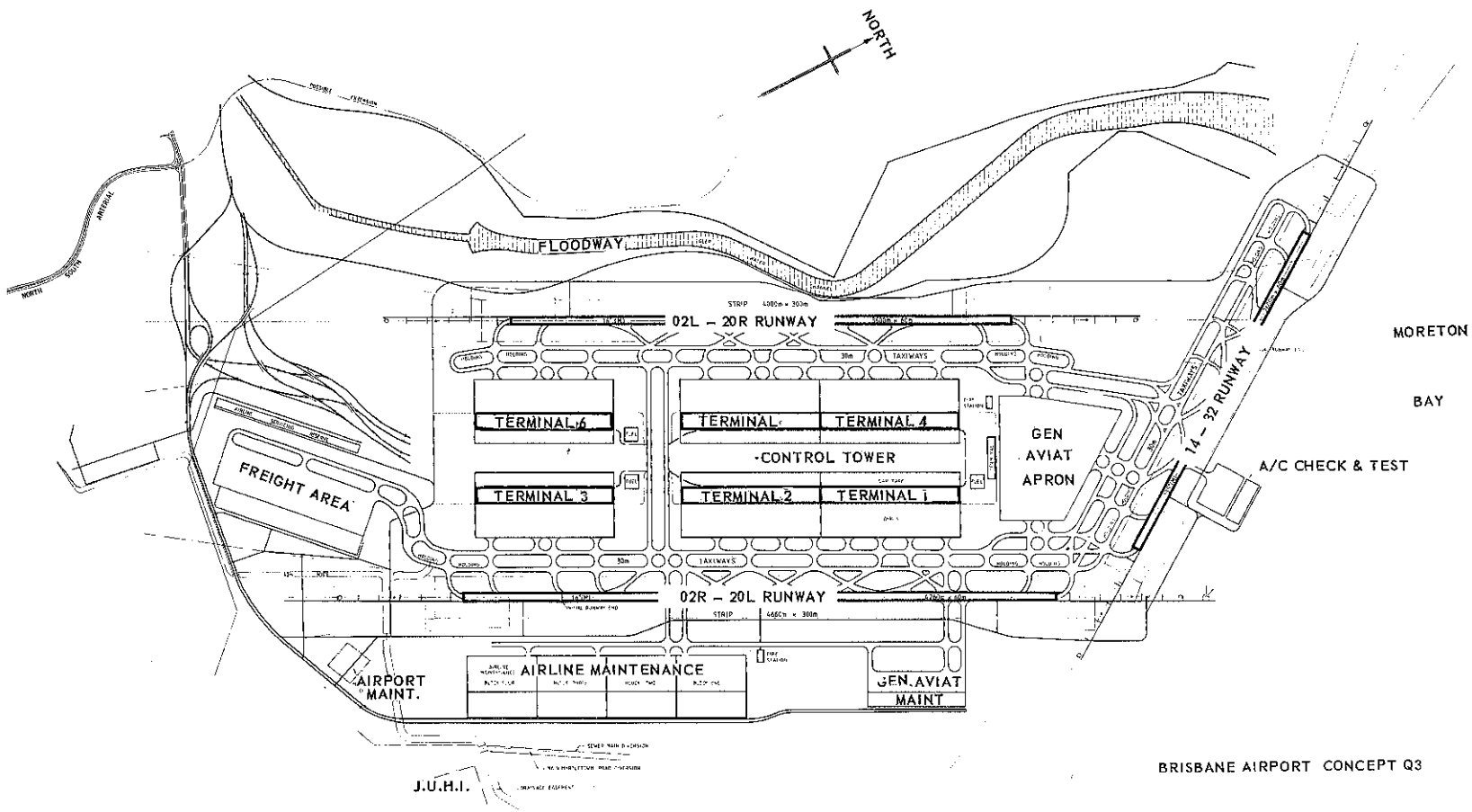

NORTH
FLOODWAY
02L – 20R RUNWAY
TERMINAL 6
TERMINAL 5
TERMINAL 4
CONTROL TOWER
TERMINAL 3
TERMINAL 2
TERMINAL 1
GEN AVIAT APRON
FREIGHT AREA
14 – 32 RUNWAY
02R – 20L RUNWAY
AIRPORT MAINT.
AIRLINE MAINTENANCE
GEN.AVIAT MAINT
J.U.H.I.
MORETON BAY
A/C CHECK & TEST
BRISBANE AIRPORT CONCEPT Q3

FIGURE 7

The runways and their associated taxiways are located so that aircraft taxiing between runways and terminals do not interfere with landing and takeoff operations on any runway.

Taxiway Planning

The taxiway system (See Fig 7) is designed to

- eliminate or minimise delays (and therefore costs) to taxiing aircraft by avoiding directional conflicts
- minimise taxiing distances (and therefore costs) in so far as other planning considerations permit
- permit aircraft to maintain high taxiing speeds by the provision of large radius turns
- permit aircraft to be held for takeoff clear of the runways but without impeding the flow of other taxiing aircraft.

The Master Plan (See Fig 7) provides for lateral taxiways connecting the two parallel runways, one pair splitting the terminal area and the other around the northern end. This combination instead of lateral taxiways at the extreme ends of the terminal area give a saving of

- 30% of overall taxiing distance for landing aircraft having to use lateral taxiways
- 2.4% of overall taxiing distance for takeoff aircraft having to use lateral taxiways

In connection with the above, it should be noted that landing aircraft may have to land on a particular runway for airspace management reasons regardless of their destination on the ground. Similarly, takeoff aircraft may be directed to takeoff on a particular runway to reduce airspace conflicts. In fact the takeoff aircraft may desire to incur additional taxiing distance to save expensive air distance.

Runway Entry Taxiways

The runway entry taxiways (See Fig 7) are designed to

- reduce runway occupancy time (and thereby increase runway capacity) by permitting aircraft to enter the runway at speed (25 knots or more) from the holding point
- eliminate line up allowance for large aircraft (one of two entry taxiways) by enabling runway entry across the end of the runway instead of across the side
- enable departure sequence management by Air Traffic Control by virtue of the two entry taxiways and the taxiway system feeding those entry taxiways.

The need for including line up distance allowance in the computation of takeoff distance required by a large aircraft arises from the fact that large aircraft require 100 to 200m of runway to line up on the runway centreline after entering a runway from a taxiway at right angles to the runway end. This is a loss of available takeoff distance.

Runway Exit Taxiways

The runway exit taxiway system (See Fig 7) is designed to

- reduce runway occupancy time (and thereby increase runway capacity) by permitting aircraft to exit the runway at high speed (50 knots)
- cater for aircraft of different touch down speeds and therefore requiring exit taxiways at different locations along the runway.

Air traffic control rules provide for separations of time/distance between landing aircraft, between takeoff and landing aircraft and between takeoff aircraft. Other rules are that the runway shall be clear of aircraft when a landing aircraft arrives over the threshold and when an aircraft commences its takeoff. The separations etc., are varied to take account of different approach and takeoff speeds and the hazard of the vortex of large aircraft to smaller aircraft.

The time saving between using high speed exits taxiways (50 knot, 30° turn off angle) as compared with low speed exit taxiways (15 knot, 90° turn off angle) varies from 13 to 16 seconds depending on the size of aircraft. The size varies the time when the aircraft is considered to be clear of the runway.

In practice, for landing operations alone and because of the separations required now between landing aircraft, there is not much value in the saving of time with high speed exit taxiways other than a wider margin of safety. The aircraft interarrival time at the runway threshold normally exceeds the time from threshold to clear of the runway.

However, with a mixture of landing and takeoff operation as is normally the case, the combination of high speed exits and entry taxiways does increase runway capacity significantly. The extent of the increase is variable depending on the mix of aircraft and is still under study.

Central Terminal Area Planning

As stated earlier one planning objective is a balanced airport design. As the runway system is the primary limiting capacity, the planning objective is to achieve for each other element of the airport capacities commensurate with the capacity of the runway system. This applies particularly to elements directly linked with runway movements, such as terminal areas.

The planning of the central terminal area (See Fig 7) provides for

- 6 terminal blocks for airline operations, 3 facing each parallel runway and each 1000m in length
- a general aviation terminal area (the term general aviation includes all non airline operations).

The terminal blocks (1 to 6) are designed to be adequate for a unit terminal in each. The principle of unit terminals was adopted in view of

- the inordinate area, distances and complexity that would be involved with a single terminal or two terminals with a capacity commensurate with the runway capacity

- the proposition that a unit terminal of the size and capacity envisaged (some 5 to 10 million passengers per annum) will be an optimum and viable size

- the desirability of avoiding costly and time consuming people mover systems necessary to cope with the larger distances involved in one or two terminals

- the principle that departing passengers should be able to proceed as close as practicable to their aircraft in the vehicle in which they entered the airport

- the need to minimise passenger walking distances

- the need to keep terminals simple and of a human scale in the interests of air passengers and visitors

- the need to provide for the different configuration of domestic terminals as compared with international terminals.

For planning purposes the number of active aircraft parking positions required is approximately equal to the number of runway movements per hour generated by those aircraft. If the capacity of the runway system was used largely for airline operations this would indicate a need for approximately 100 active parking positions plus a number of non active aircraft parking positions. Due to the time scale involved it is not possible to forecast with any precision what the capacity of the runway system will be nor what the ratio of parking positions to runway movements will be. With even larger aircraft it would be expected that the ratio will increase to reflect increased loading/unloading times.

The number of aircraft parking positions that can be accommodated in terminal blocks 1 to 6 depends on the sizes and proportions of each size and on the terminal concept. As a guide, if the 6000m length of the terminal blocks was used in a linear fashion with nose in parking this would provide

- 80 positions for 60m span aircraft (B747) or
- 110 positions for 45m span aircraft (Airbus) or
- 140 positions for 33m span aircraft (B727).

The provision for general aviation in the Master Plan (See Fig 7) reflects the increasing growth of that sector of aviation including the increasing introduction of larger aircraft for business and charter purposes. Aircraft of up to B707 size are used throughout the world and particularly in the USA by the general aviation sector.

The lower utilisation of general aviation aircraft compared to airline aircraft is reflected by the much larger number of inactive aircraft parking positions required compared to the number of active positions.

Freight Area Planning

The Master Plan (See Fig 7) provides for a separate freight terminal area south of the central terminal area.

The freight area (currently the location of the international terminal) is designed to accommodate

- international freight facilities including pure freight aircraft operations
- domestic freight facilities including pure freight aircraft operations.

Whilst the majority of freight is carried now on passenger service aircraft the upward growth of international freight, and the possible entry of domestic freight only operators indicate a need for space for substantial freight operations in the future. Whilst space is available for the current domestic airlines it is likely that they will wish to combine their freight and passenger facilities, at least for the short to medium term.

Aircraft Maintenance Areas Planning

The Master Plan (See Fig 7) provides for airline and general aviation maintenance bases on the eastern side of the airport.

As stated earlier it is difficult to predict the area required for maintenance bases as this demand is more influenced by airline etc., policies than by the volume of aircraft traffic at the airport.

The long term need for passenger terminals in the central terminal area to provide a capacity commensurate with the runway capacity precluded the location of maintenance bases in that area. Although this involves the towing of aircraft across an active runway, a study of such international movements at Sydney Airport indicates that the problem is manageable. In addition, as the times of domestic airline towing movements will largely be at times of low runway movements (early in the morning and late at night) and different to Sydney, this reinforces the view that it is acceptable.

INITIAL DEVELOPMENT PLANNING AND WORKS

The initial development proposed (See Fig 8) includes

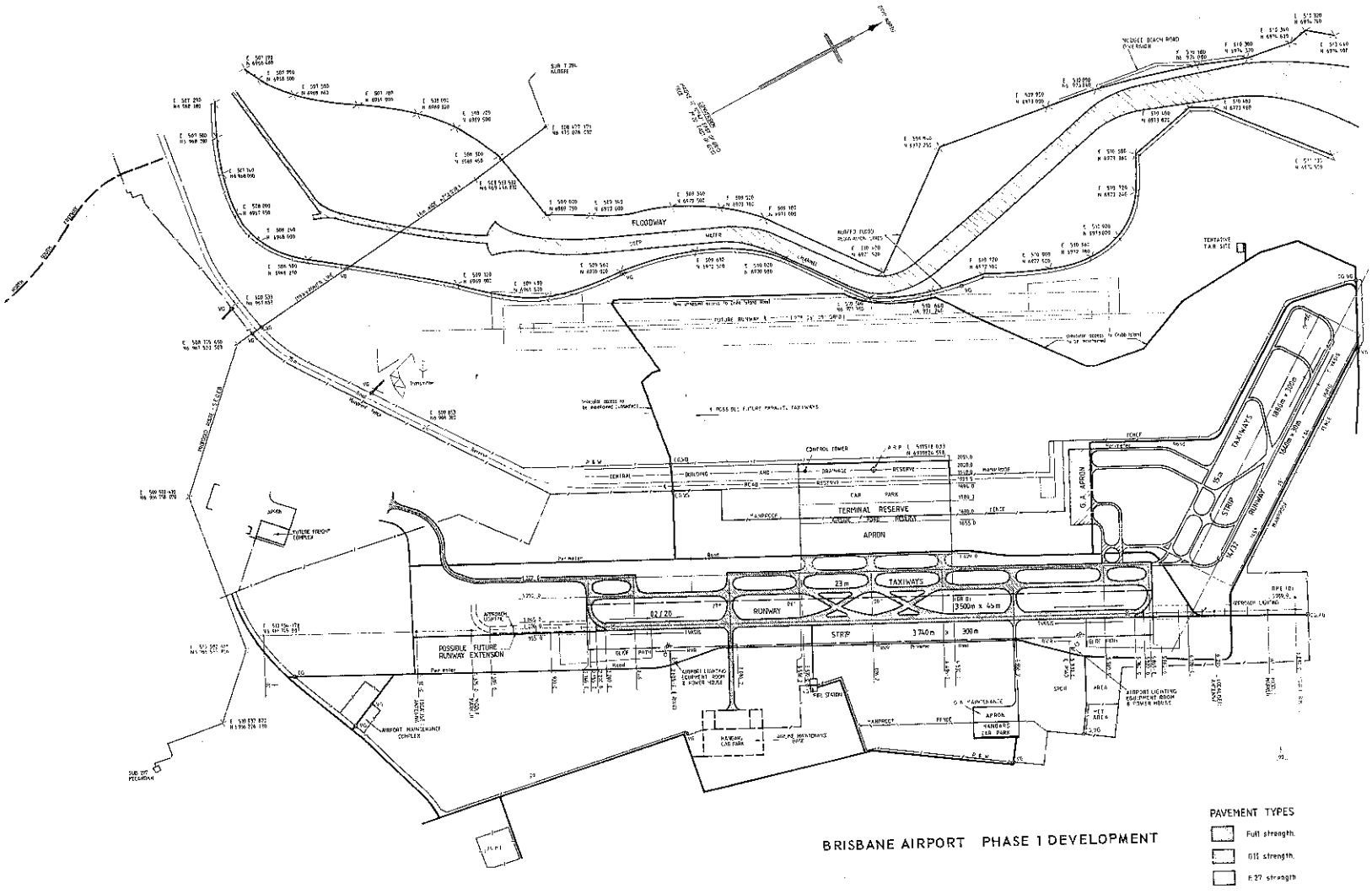
- the eastern parallel runway of 3500m length suitable for the strength and length needs of the most critical aircraft
- the cross runway of 1640m length initially constructed to suit F27 aircraft
- taxiways
- domestic airline terminals facing the eastern runway
- general aviation area in the central terminal area
- domestic airline maintenance bases
- general aviation maintenance bases
- operational facilities, services and roads.

The redevelopment is planned for completion in 1986 after which aircraft operations from the present airport would cease.

The existing international terminal is planned to continue with some expansion in its present location until some time in the 1990s. Subsequently, international operations would be conducted from a new terminal in the central terminal area on Terminal Block 3. The existing terminal building would probably be used for freight activities.

ACKNOWLEDGEMENTS

The thoughts expressed in the above paper are those of the authors and not necessarily those of the Department of Transport. However, we wish to thank the Secretary of that Department for permission to put them forward at this Forum for discussion.



BRISBANE AIRPORT PHASE 1 DEVELOPMENT

FIGURE 8