

CHAPTER 3 HKIA : OPERATIONS AND CAPACITY

Internal and External Transportation Links

- 3.1** Hong Kong International Airport (HKIA) is located right at the heart of passenger and cargo conveyance between Hong Kong, the Pearl River Delta (PRD), Asia Pacific and the world.
- 3.2** HKIA has retained its accessibility despite moving from the Kowloon Peninsula to Lantau Island in 1998. It is part of a network of infrastructure projects that connect the new airport with the rest of Hong Kong. These include the North Lantau Highway, Airport Express, West Kowloon Expressway, Western Harbour Crossing, Lantau Link and Ting Kau Bridge (Route 3). HKIA is linked to Hong Kong's downtown by the Airport Express, which takes only 24 minutes to reach Central. Travellers can also travel between downtown Hong Kong and the airport by buses, taxis and hotel coaches/limousines.
- 3.3** After 1997, there has been a growing demand for cross-boundary links between HKIA and the PRD. With a view to expanding its catchment area and to improve connectivity with PRD, the airport began cross-boundary coach and limousine services as well as ferry connections. The opening of SkyPier in 2003 enabled HKIA to provide ferry services to six ports in the PRD and two in Macao. Passenger processing Terminal 2 (T2), which opened in 2007, consolidates cross-boundary coach and limousine services covering approximately 115 destinations in the PRD and it only takes less than 1 hour from T2 to the existing boundary crossing points.
- 3.4** In 2009, HKIA served about 2.8 million passengers travelling via land or sea to and from the PRD. With more cross-boundary infrastructure projects underway, the airport will become an even more convenient and well-connected multi-modal hub. For instance, the Hong Kong – Zhuhai – Macao Bridge (HZMB), expected to be operational by 2016, will provide fast and convenient access between HKIA and western PRD. Also under planning is the Tuen Mun – Chek Lap Kok Link, which will provide a direct link between HKIA and the northwest New Territories and Lantau (see Figure 3.1).

Figure 3.1 : Major Infrastructure Developments around HKIA

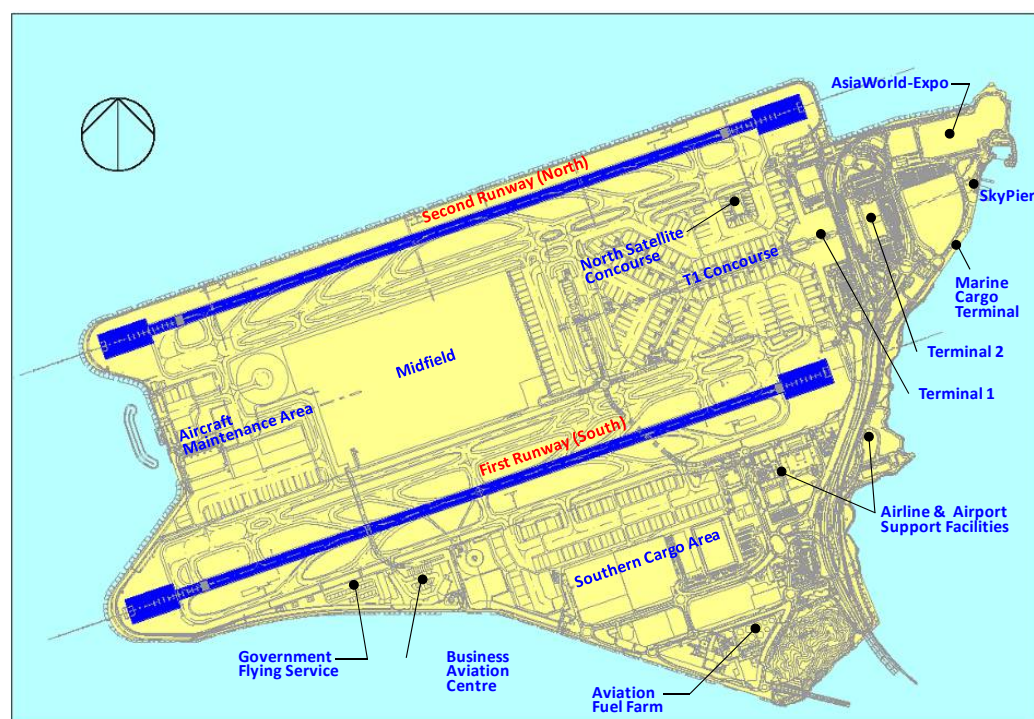


Source: Highways Department (April 2011)

Existing HKIA Layout

- 3.5 The existing airport layout (see Figure 3.2) consists of two runways, which are supported by two passenger processing terminals, two passenger concourses with 97 passenger aircraft parking stands, three cargo terminals, a cargo apron with 34 cargo parking stands, and other supporting facilities.

Figure 3.2 : Existing HKIA Layout



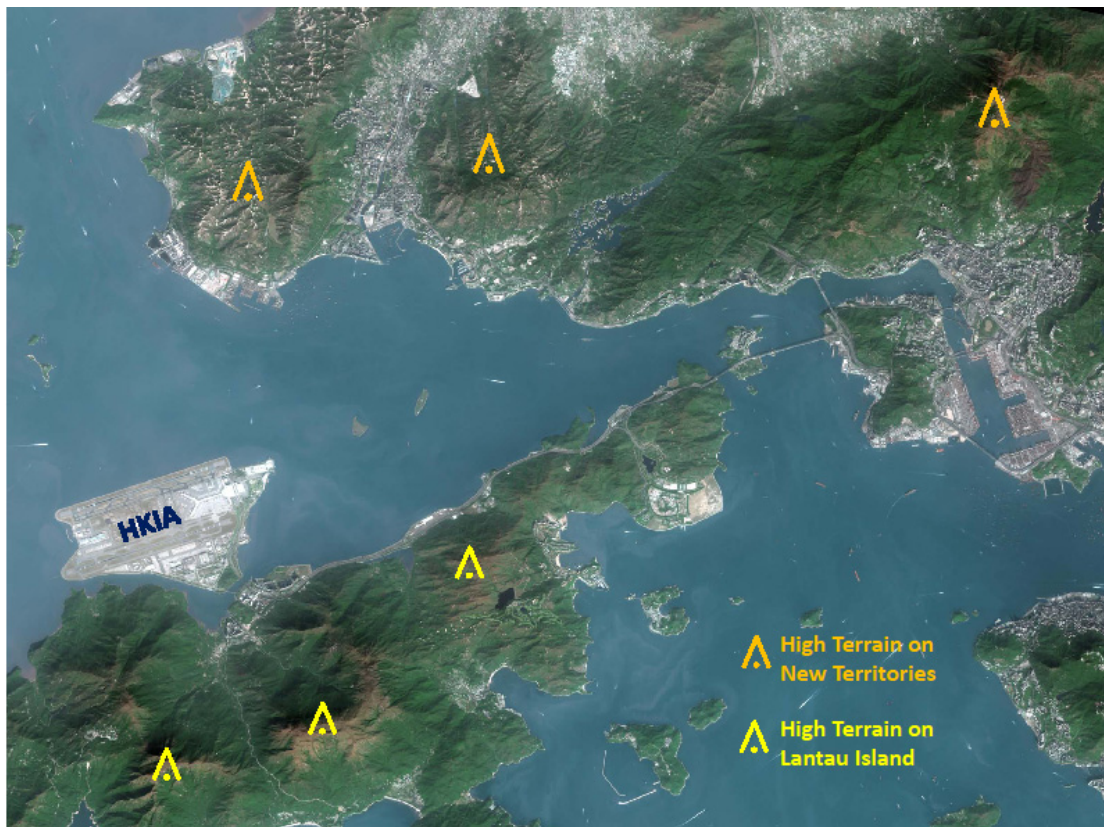
Practical Maximum Capacity of the Two-Runway System

- 3.6 Since 1998, HKIA has been meeting air traffic demand growth through progressively upgrading, maximising usage and increasing the efficiency of its facilities on the airport island. AAHK has always aimed to get the most out of HKIA's current capacity before considering expansion measures, as was the case with the one-runway Kai Tak Airport in the '80s and '90s.

Hourly ATM Capacity

- 3.7 The operating environment of HKIA is unique because of high terrain and a complicated and restrictive airspace surrounding the airport (see Figure 3.3).

Figure 3.3 : Geographical Constraints Surrounding HKIA



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- 3.8 AAHK has commissioned the British aviation experts "National Air Traffic Services" (NATS) to assess how the capacity of the existing two runways of HKIA can be maximised. NATS' recommendations include reforming the existing Air Traffic Control (ATC) philosophy, improving flight procedures and operations, increasing ATC-related manpower levels, enhancing airfield infrastructure, etc. **The practical maximum capacity that can be achieved with two runways will be 68 movements per hour** using the existing independent segregated mode of operations, i.e. one runway exclusively for departures and the other exclusively for arrivals (see Figure 3.4).

Figure 3.4 : Existing Independent Segregated Mode of Operations for the Dual Runways of HKIA



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- 3.9** Under independent segregated operations, each runway is limited only by its maximum arrival or departure rate. The following figure shows the levels that NATS has validated using fast time simulation modelling. These levels have already factored in International Civil Aviation Organisation (ICAO) recommended practices as well as other relevant factors (terrain, airspace, traffic mix, weather, etc.) (see Figure 3.5).

Figure 3.5 : Potential Runway Capacity of a Single Runway

Runway	ICAO Minimum Separation	Potential Runway Capacity
North Runway (Arrivals Only)	3 NM *	33 per hour
South Runway (Departures Only)	90 seconds **	35 per hour

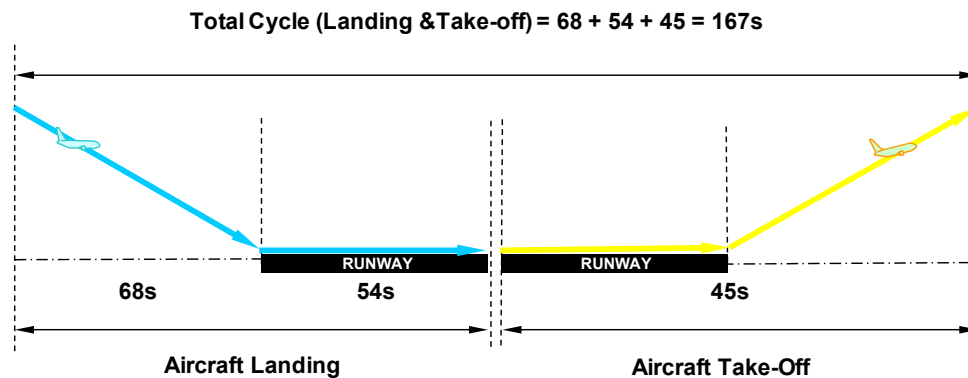
Note: * NM = Nautical Mile

** 90 seconds between all departures except 2 minutes vortex separation as appropriate

- 3.10** NATS has also determined that there will be no capacity gain by changing the dual-runway operations from segregated mode to mixed mode (i.e. both departures and approaches can take place on each of the two runways). Mixed mode operation can theoretically maximise the capacity of a single runway to 44 movements per hour. This is based on a typical six Nautical Mile (NM) spacing between approaches which can be translated into a typical time interval of 167 seconds for each landing and takeoff cycle

(note: 3,600 seconds (s) per hour/167 seconds per cycle x 2 = 44 movements as shown in Figure 3.6):

Figure 3.6 : Single-Runway Arrival/Departure Timeline in Mixed Mode



Note: The landing aircraft must be at least 3NM from the runway end when the departure begins and may not touchdown before the departing aircraft has left the runway.

3.11 NATS has concluded that only “dependent” mixed mode operations can be supported by the existing runways at HKIA, due to the following reasons:

- a) Due to the terrain on Lantau Island, the missed approach and departures procedures from the South Runway have to share the same track (see Figure 3.7). As a result, the minimum spacing between approaches has to be increased from 6NM to 8NM to adhere to the recommendation of the Manual of Air Traffic Control. This limits the hourly capacity to 34 movements under mixed mode operation. In contrast, there is no terrain constraint on the North Runway. This enables its missed approach and departure procedures to be separated under mixed mode operation, thus allowing the use of 6NM minimum spacing between approaches and 44 movements per hour in isolation.

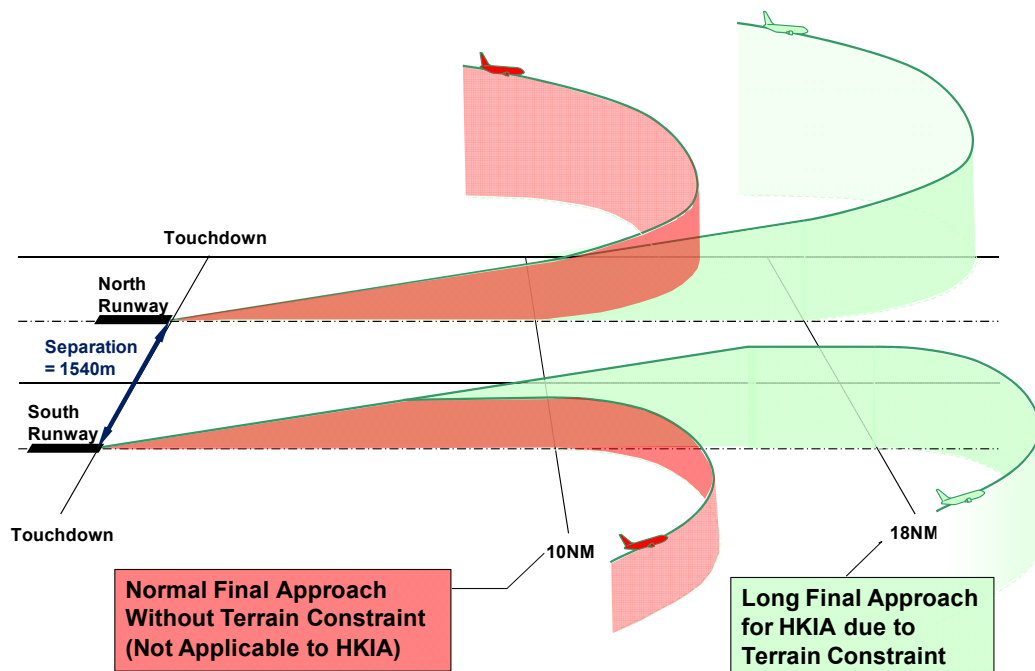
Figure 3.7 : Terrain Constraint on the South Runway Operations



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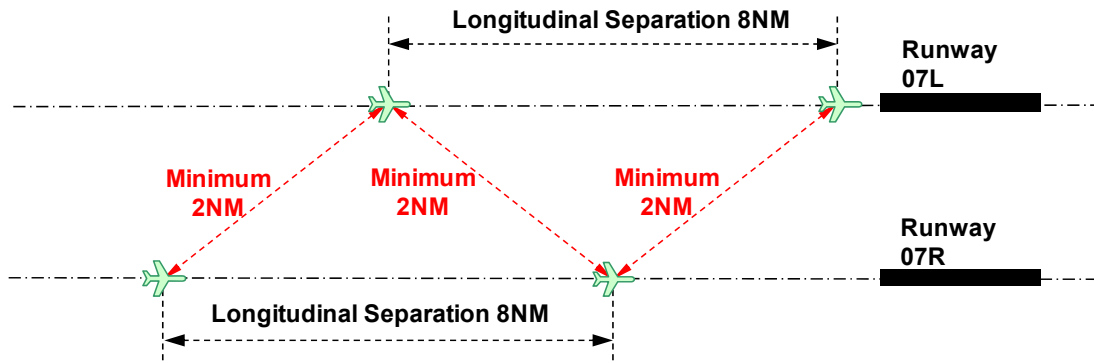
- b) The existing two runways cannot support independent parallel approaches. For independent parallel approaches to take place on both runways, a long final approach procedure (see Figure 3.8) needs to be adopted to avoid the terrain to the east (Tai Mo Shan) and interaction with Macao airport traffic to the west of HKIA (Note: the final approach is extended out to 18NM from touchdown, compared to the standard 10NM recommended in ICAO's Manual).

Figure 3.8 : Independent Parallel Approaches Requirement for HKIA (Long Final Approach)



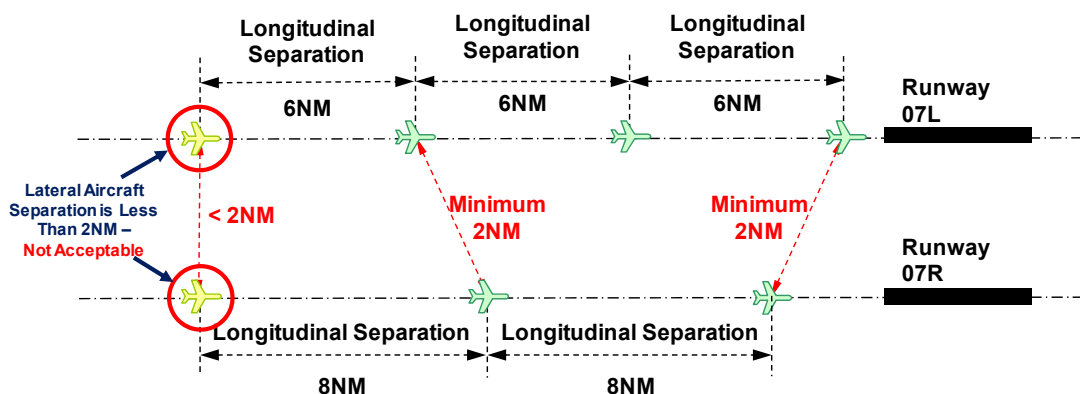
With a long final approach procedure needed for carrying out independent parallel approaches, a wider separation between runways than that currently available is needed to meet ICAO criteria for Instrument Landing System (ILS) performance. The current two-runway configuration is thus incapable of accepting independent parallel approaches and requires at least a 2NM stagger to be kept between respective approaches on the adjacent runways as per ICAO's mandates (see Figure 3.9). In other words, even under "mixed mode" operation, the North Runway has to be dependent upon the South Runway.

Figure 3.9 : Dependent Parallel Approaches Requirement for HKIA



- c) While the North Runway can accept unconstrained mixed mode operations, which requires a 6NM spacing between landing aircraft, the South Runway can accept only constrained mixed mode operations, which requires an 8NM spacing between landing aircraft. It is considered impractical for landing aircraft on the two runways to comply with these different approach spacing requirements (see Figure 3.10).

Figure 3.10 : Impracticality of Maintaining Dependent (Staggered) Approaches on the Existing Two Runways with Different Approach Spacing



Therefore, a consistent approach spacing of eight NM would have to be applied to both runways if they were to be operated in mixed mode, resulting in an hourly capacity of 34 movements for each runway, or a total 68 hourly movements for both. This demonstrates that changing the operations of the two runways from the current segregated mode to mixed mode will not increase overall capacity.

- 3.12** NATS reckons there is only a nominal potential to stretch the maximum capacity of the two runways beyond 68 movements per hour, even if there are future advances in air traffic control technology that reduce landing aircraft's arrival spacing. To further increase runway capacity, NATS recommended the evaluation of possible locations for a Third Runway and the associated potential for capacity expansion, taking into account operational challenges, ATC procedure design and PRD airspace considerations.

Daily and Annual ATM Capacity

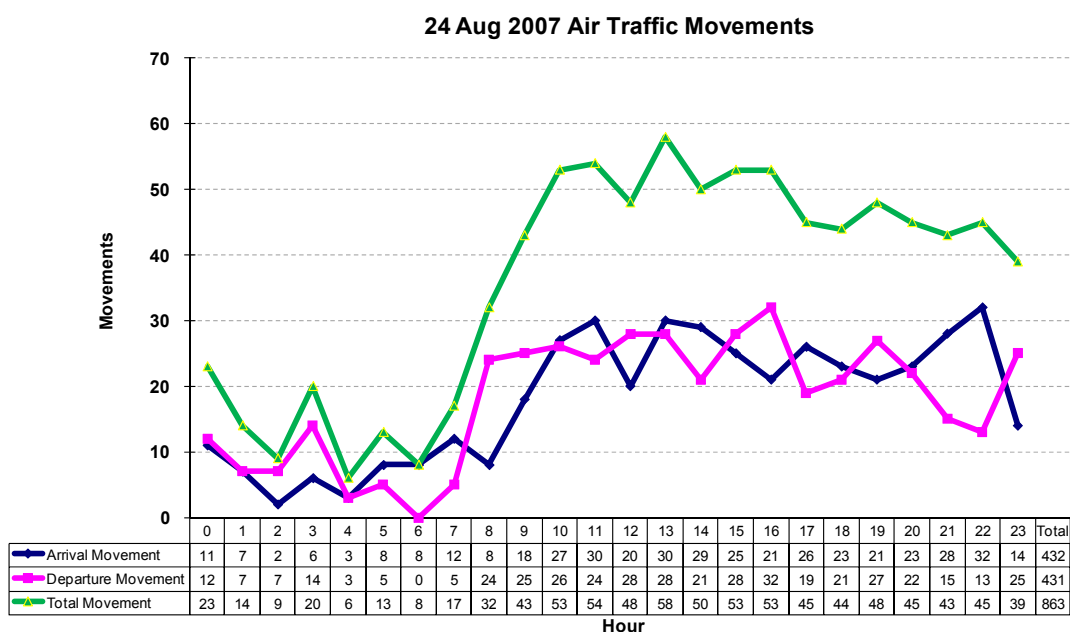
3.13 The key factors in determining a realistic absolute capacity for the airport are:

- Selection of the core period of the day during which the maximum of 68 movements per hour may be achieved;
- Estimation of sensible shoulder periods before and after the core period, (early morning arrivals and departures) during which demand is less than the maximum 68 movements per hour;
- Identification of periods and the probable demand therein when single runway operations can be undertaken to allow for maintenance work.
- Allowance for routine runway direction changes during the day; and
- Provision of a contingency allowance for unexpected circumstances and recovery from periods of disruption.

3.14 Considering the above factors it is possible to estimate the daily and hence the annual capacity figures for HKIA; further details to be set out below:

- a) HKIA has adopted IATA's busy day as the design day. The busy day is defined as "the second busiest day in an average week during the peak month (excluding special events such as religious festivals, trade fairs, conventions and sport events)". HKIA's design day traffic profile on 24 August 2007 is shown in Figure 3.11.

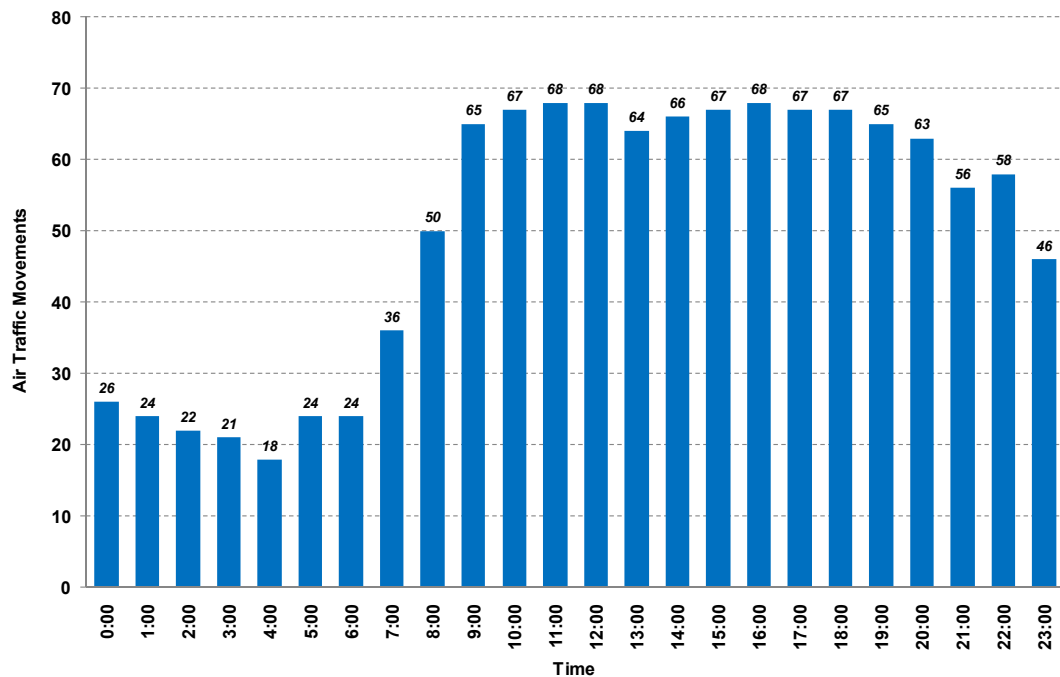
Figure 3.11 : HKIA Design Day Hourly Traffic Profile – 2007



- b) Using the above information, NATS has recommended that the night runway closure run from 00:00 to 07:59. Thus, the peak period is 08:00 to 23:59, during which 68 movements per hour may be achieved;

- c) During the night-time single runway period, the current declared capacity of a single runway at HKIA is 37 movements per hour;
- d) Using the above single runway and peak periods, a maximum of 1,384 ($8 \times 37 + 16 \times 68$) movements per day is possible in theory;
- e) Consideration of the traffic mix allows the above design day profile to be scaled to a daily movement profile of 1,200 movements (see Figure 3.12).

Figure 3.12 : Daily Movement Profile Based on 1,200 Movements per Day



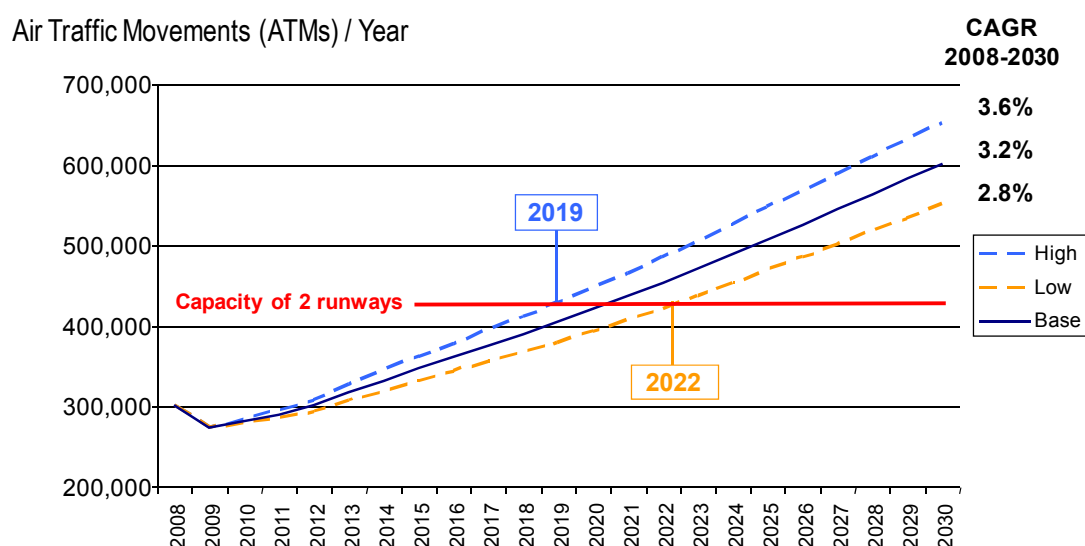
- f) As illustrated above, many hours, particularly in the peak period, are operating at or close to the maximum capacity of 68 movements per hour. Any slack during this peak period is required for routine events such as runway changes. Each routine change is expected to reduce capacity for five to ten minutes, resulting in a loss of up to eight movements. Therefore, assuming two routine runway changes, a loss of 16 movements needs to be allowed for. In the period between 09:00 and 21:00 there are only 21 free movements currently available to absorb this movement loss;
- g) The movement schedule also needs an allowance for contingencies. Unforeseen events such as aircraft incidents, adverse weather and equipment failure may impact capacity in some periods and some buffer has to be included to enable recovery from these periods of disruption. Assuming the theoretical maximum capacity of 1,200 movements, there are 184 unallocated slots, of which 16 movements are required to accommodate the two routine runway changes, leaving only 168 free slots. If weather disrupted operations for about two and a half hours, up to 170 flights could be affected — potentially using all the available slack to recover. Since the period between 09:00 and 21:00 is fully

scheduled, recovery would not be possible until the evening and night periods end;

- h) It is therefore recommended that recovery periods should be built into the schedule. Estimates for the size of the contingency allowance and their placement in the schedule should be made after consulting all stakeholders.

3.15 Based on the above, a daily capacity in the range of 1,100 to 1,200 movements is achievable. Applying the historical design day/annual ratio of 0.0029, this would provide an annual capacity in the range of 379,310 to 413,793 movements. In the context of NATS' finding that there is negligible potential to stretch the maximum capacity of the existing two runways beyond 68, **420,000 can be assumed to be the ultimate practical maximum annual ATM capacity if HKIA stays with the two-runway system.** Based on the high/base/low case of the unconstrained ATM demand forecast, it appears that the two runways' **maximum capacity of 420,000 ATMs per year will be reached between 2019 and 2022**(see Figure 3.13).

Figure 3.13 : Air Traffic Movements to Reach the Two-Runway Capacity Between 2019 and 2022



Latest Infrastructure and Facility Developments

Capacity Enhancement Projects

3.16 In 2006, AAHK committed HK\$4.5 billion to capacity enhancement works to the Passenger Terminal Building (PTB) and Airfield. These works, which involve both the upgrading of existing facilities and provision of new facilities, aim to enhance airport operational efficiency, meet updated safety and security standards, and improve the ambience of the concourse for passengers' comfort. These works include:

- Enhancements to the Airfield
 - North Satellite Concourse
 - 10 additional cargo stands

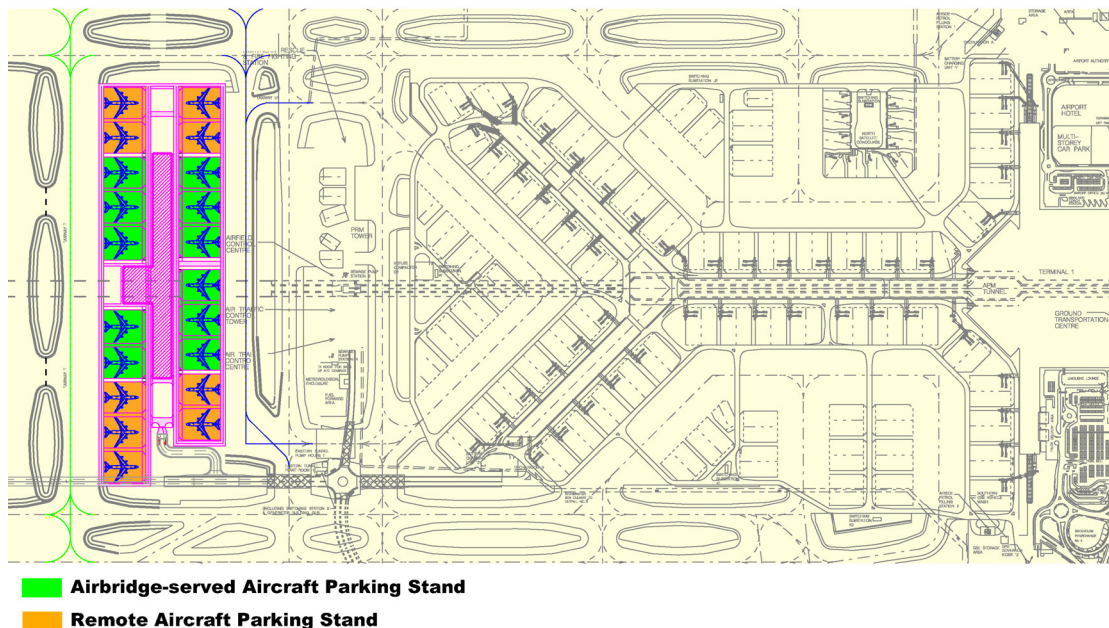
- Resurfacing of the two runways and the taxiways
- Enhancements to facilitate A380 operations
- Enhancements to Terminal 1
 - Increasing the capacity of the Baggage Handling System
 - Upgrading X-ray baggage screening machines
 - More transfer desks, security channels and immigration counters
 - Central Concourse extension

Midfield Development

3.17 AAHK has committed an additional HK\$9.3 billion to the first phase of the Midfield Development to ensure that there would be sufficient aircraft parking stands to serve the forecast passenger, cargo and ATM demand by 2015. These works include (see Figure 3.14):

- Construction of 11 airbridge-served aircraft parking stands and nine remote parking stands, as well as an “I-shaped” passenger concourse at Midfield (costing HK\$7.8 billion);
- Extension of the existing automated people mover (APM) system to the passenger concourse at Midfield from Passenger Processing Terminal 1 (T1) (costing HK\$1.3 billion); and
- Minor enhancements to the baggage handling system (costing HK\$0.2 billion).

Figure 3.14 : Planned Midfield Development by 2015



Long-Term Development

3.18 This Master Plan has reviewed two options for the development of HKIA in the longer term, beyond 2015 and up to the year 2030:

- Option 1 (two-runway system): The development plan is to serve the constrained demand forecast for passengers and cargo under the airport's existing two-runway system;
- Option 2 (three-runway system): The development plan is to serve the unconstrained demand forecast for passengers and cargo under a three-runway system.

Details of these two options are set out in Chapters 4 and 5.