

International Civil Aviation Organization

ICAO

WORKING PAPER**Asia and Pacific (APAC)
Twelfth Meeting of the Meteorological Requirements
Working Group (MET/R WG/12)**

Bangkok, Thailand, 02 to 05 May 2023

Agenda Item 4: Collaboration between MET services and ATM stakeholders**DIURNAL WIND VARIATION STUDY FOR RUNWAY CAPACITY OPTIMIZATION
AT HONG KONG INTERNATIONAL AIRPORT**

(Presented by Hong Kong, China)

SUMMARY

This paper presents the runway capacity optimization efforts and its tangible benefits achieved through collaboration between the Air Navigation Service Provider (Hong Kong Civil Aviation Department) and the Meteorological Authority (Hong Kong Observatory) in Hong Kong, China.

Through detailed analysis of historical surface wind data collected at the Hong Kong International Airport (HKIA), ‘firebreaks’ are built in the seasonal scheduling capacity of the HKIA to match with the time with highest probability of runway change triggered by a diurnal wind variation. This in turn reduces possible delay to air traffic due to runway change in the strategic planning phase of ATFM.

1. INTRODUCTION

1.1 As highlighted in the ICAO Regional Framework document, close collaboration between Air Traffic Management (ATM) and Meteorology (MET) units is essential in all phases of ATFM.

1.2 Despite HKIA being an international hub airport with high traffic demand, there are certain intervals in the daily schedule of the airport whereby the declared runway capacity is strategically lowered. Hong Kong China implemented “firebreaks” since 2013 during these brief periods of reduction in declared runway capacity (normally one or two hours per interval) with a view to catering for routine events such as runway changes and acting as buffers to absorb delays.

1.3 During every runway change at HKIA, a brief period of time (~ 6 minutes) with no runway movement is operationally required for ATC to switch on the relevant Instrument Landing System and reposition traffic to the new runway, which may induce a reduction of up to eight flight movements during that period.

1.4 A review of the schedule was carried out and a diurnal wind variation study was conducted

to identify the hours in a day when a runway change is most likely to happen and to justify the insertion of such firebreaks among high schedule demand, thus serving the purposes of strategically optimizing operational efficiency and minimizing traffic delay.

2. DISCUSSION

2.1 A runway change is typically triggered by the change of wind direction and speed at the airport. Therefore, aligning the firebreaks with the results of the diurnal wind variation study could help reduce the overall traffic delay at the strategic planning phase of ATFM.

2.2 Daily wind data from anemometers located at various locations along the runways at HKIA were collected and analyzed. The wind data were labelled as E_wind and W_wind when the wind direction falls in the eastern and western parts of the crosswind boundary (see Fig.1). In the general case, E_wind (W_wind) suggests RWY07 (RWY25) is being used. Occasions of tail wind of five knots or more with reference to runway-in-use were identified as a basis for the need of a runway change. A pattern of diurnal wind variation in general was observed and illustrated in Fig.2 and 3. It is found that the peaks in the wind change diagrams match with the timing of onset and retreat pattern of sea breeze occurred at HKIA, which is situated on an island surrounded by waters. The sea breeze circulation is a common and fairly predictable cause to change the wind flow at HKIA.

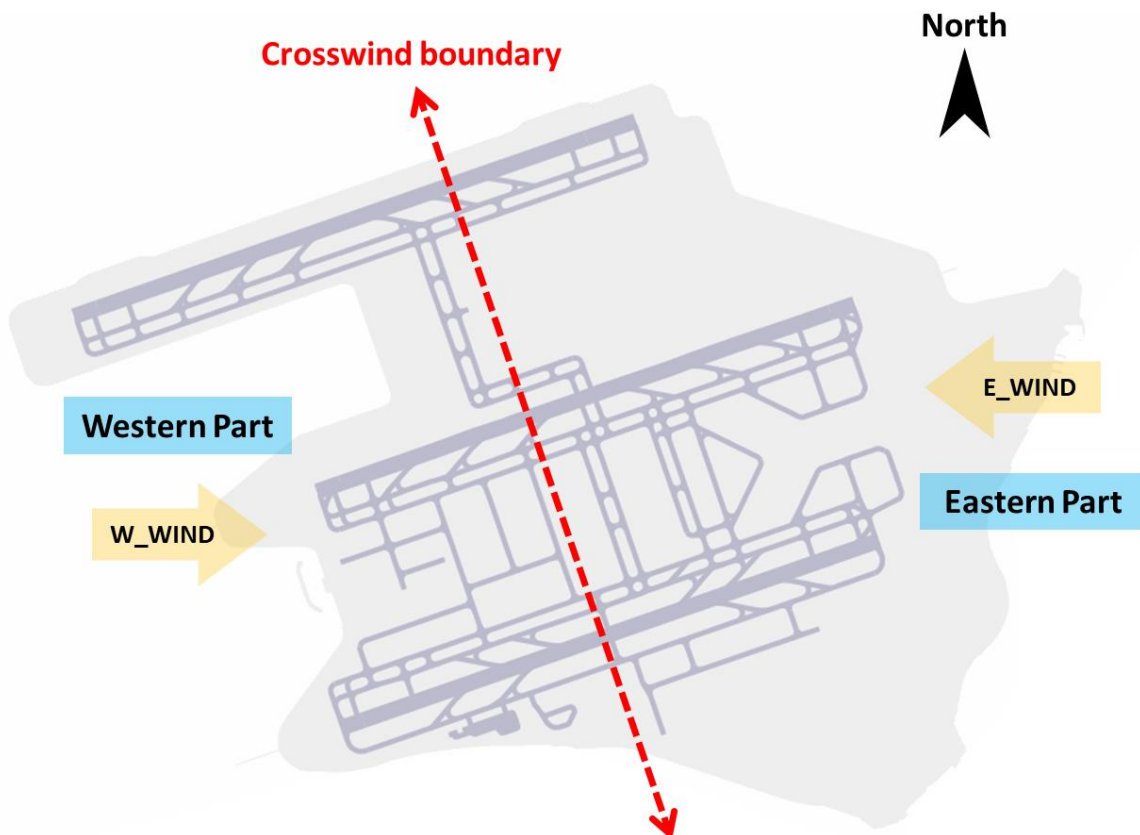


Fig.1: Illustration of W_wind and E_wind at HKIA

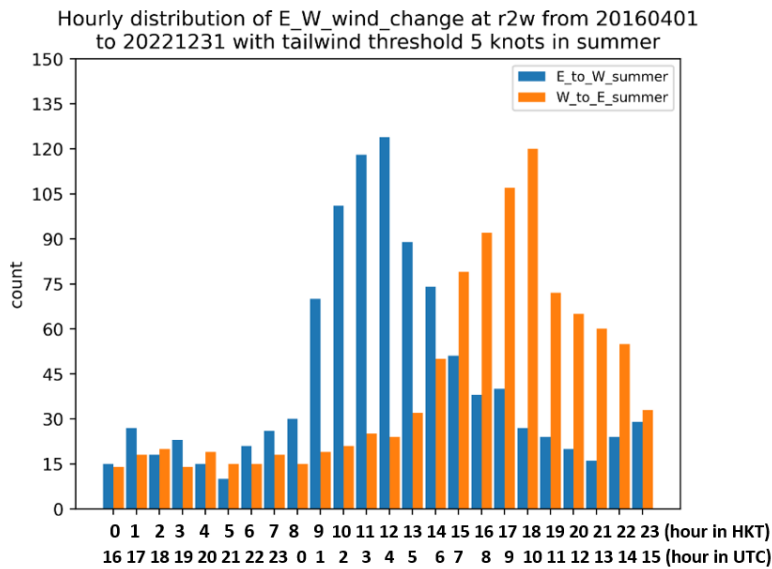


Fig. 2: Hourly distribution of wind change at TDZ for RWY07C in Summer (Apr – Oct)

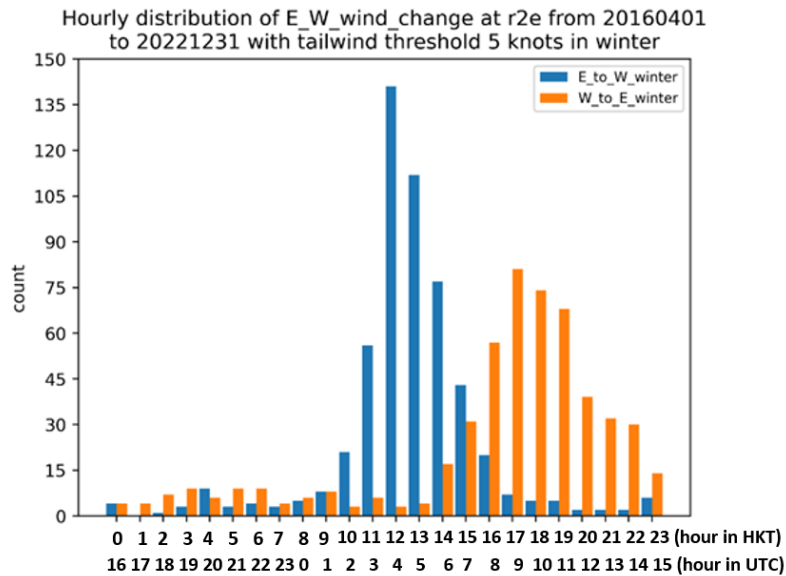


Fig. 3: Hourly distribution of wind change at TDZ for RWY25C in Winter (Nov – Mar)

2.3 Inserting firebreaks at appropriate intervals of Summer 2023 schedule (see Fig. 4) which tie in with the wind change patterns and correspond with higher runway change probability could potentially reduce airborne/ground delays induced by the change, thus minimizing the need of initiating ATFM measures. Firebreak schedule in Winter 2023 will also be revised to match the time intervals corresponding to relatively high runway change probability as shown in Fig.2.

Runway Capacity																								
Hour(UTC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Arrivals	33	33	35	34	34	34	34	35	35	34	34	36	34	34	34	32	32	20	20	20	20	20	24	28
Departures	35	35	34	34	34	34	34	34	34	34	34	34	34	34	34	32	32	20	20	20	20	20	20	35
Total	68	68	69	66	65	66	68	69	69	65	66	69	68	67	67	64	64	38	32	32	32	32	32	63

Fig. 4: Firebreak schedule of HKIA in Summer (Black boxes: original firebreaks; Green boxes: revised firebreaks implemented since April 2023)

2.4 The implementation of revised firebreak schedule aims at reducing airborne delay for arrivals. The following tables summarize the qualitative tangible operational benefits in terms of reduction in delay (HH:MM:SS) brought to each aircraft on average, after shifting the first firebreak and the second firebreak in the summer schedule.

	1st Firebreak of Summer 2023 Schedule		
	Maximum	Minimum	Average
Total Reduction of Delay	9:00:00	0:00:00	4:30:00
Average Reduction of Delay / Flight	0:04:09	0:00:00	0:02:05
Flight affected	130	0	65

Table 1: Reduction of delay in shifting the first firebreak in Summer 2023 Schedule

	2nd Firebreak of Summer 2023 Schedule		
	Maximum	Minimum	Average
Total Reduction of Delay	20:30:00	0:36:33	10:33:16
Average Reduction of Delay / Flight	0:06:45	0:00:56	0:03:51
Flight affected	182	68	125

Table 2: Reduction of delay in shifting the second firebreak in Summer 2023 Schedule

2.5 Since above reduction of delay was calculated considering different possible traffic conditions with combination of different aircraft types, some aircraft might benefit more from the new firebreak schedule and the possible maximum and minimum reduction of delays were provided in in the tables. For the first firebreak, the revised schedule has reduced on average 2 minutes 5 seconds of airborne delay for each arrival and it benefits total 65 aircraft. For the second firebreak, the revised schedule has reduced on average 3 minutes 51 seconds of airborne delay for each arrival and it benefits total 125 aircraft.

2.6 The tangible operational benefits in para 2.4 and 2.5 above highlights the importance of collaboration between ANSP and the MET Authority.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the information contained in this paper;
- b) note the tangible operational benefits achievable through collaboration between ANSP and the MET Authority;
- c) share the strategies used in strategic phase of ATFM; and
- d) discuss any relevant matters as appropriate.
