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WORKING PAPER

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ASSEMBLY — 38TH SESSION

TECHNICAL COMMISSION

Agenda Item 38: Other issues to be considered by the Technical Commission

SIMULTANEOUS OPERATIONS ON NEAR PARALLEL RUNWAYS: REQUIREMENTFOR GUIDELINES

(Presented by India)

EXECUTIVE SUMMARY

This paper presents India's experience of successful near parallel runway operations for enhancing capacity. The paper discusses the preliminary mathematical model developed by India which can form the basis for further rigorous work on the subject by the Technical panel to facilitate uniform application of guidelines for simultaneous operations on near parallel Runways.

Action: The Assembly is invited to:

a) note the preliminary mathematical model adopted by IGI airport, Delhi, and

b) note the safe and successful conduct of operations of operations on near parallel runways contributing to enhance capacity.

c) request the Council to consider developing suitable guidelines for simultaneous operations on near parallel runways in Doc 9643, *Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways* (SOIR) after a detailed study of variables involved in the process using mathematical models/simulations.

Strategic Objectives:	This working paper relates to the Safety and Environmental Protection and Sustainable Development of Air Transport Strategic Objectives
Financial implications:	Not applicable.
References:	Annex 14 — *Aerodromes*

1. BACKGROUND

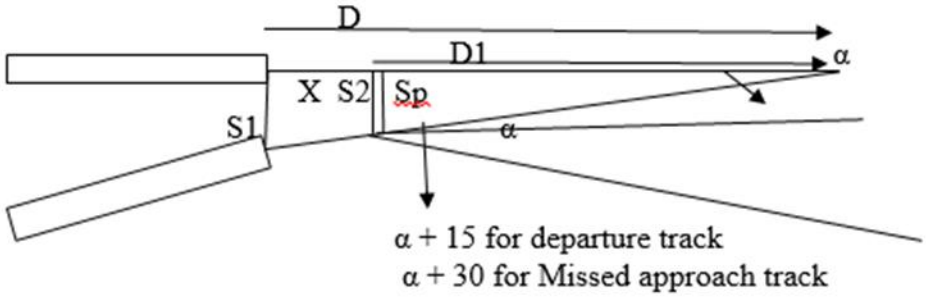
1.1 IGI Airport, New Delhi has witnessed traffic growth of nearly 300% in last ten years. With a view to handling the growing traffic safely and efficiently, there was a need to enhance capacity of the airport by using all the three near parallel runways for simultaneous operations. Prior to operationalisation of the newly constructed third runway 29, the closely spaced converging RWY 28 and

RWY 27 were used in segregating dependent mode and capacity was enhanced to 44 movements per hour from 35 movements per hour using single RWY. With the operationalisation of RWY 29, the parallel runways 28 and 29 were operated in mixed mode and capacity was enhanced to 65 movements per hour. The need for use of near parallel RWY arose when in 2009, it was planned to rehabilitate RWY 28/10, rendering it unavailable for operations for long period and fall in capacity was a big concern. Therefore, it was required to have mixed mode operation on the near parallel RWY 29 and RWY 27. However, to accommodate growing traffic demand, simultaneous operation on three RWYs were conceptualised. The challenge was to operate departures and arrivals on all the three RWYs which comprised closely spaced and converging RWY 27 and RWY 28 and also converging pair of RWY 27 and 29.

1.2 Though the Manual on simultaneous operations on parallel and near parallel runways (Doc 9643) (SOIR) provides detailed guidelines for simultaneous operations on parallel runways, as referred to in Section 5.1.2 of the Document, no special procedures have been developed for simultaneous operations to near parallel runways. Each situation is considered on a case by case basis and is dependent on a number of variable conditions.

1.3 **Mathematical Model**: Considering the above and the need for utilizing all the three runways efficiently, Airports Authority of India has developed a preliminary mathematical model as given below:

Near Parallel Runways – Non-intersecting Runways whose extended centerlines have a convergence or divergence angle of 15 deg or less.



Let, α = Angle of Convergence between runways

S_1 = Minimum spacing between runways at converging end.

X = Minimum distance from end of runway before which departing aircraft cannot turn.

Thus at this point, two aircraft come to the closest distance S_2.

S_2= Minimum spacing between runways' extended centrelines at converging end at which aircraft can initiate turn. Thus, this is the closest distance between aircraft and **hence safety critical**.

S_p= Minimum distance between the tracks of two aircraft, where the tracks become parallel.

S_p should be equal to or greater than the minimum spacing between parallel runways specified for particular simultaneous operation as per SOIR.

As the time taken to turn by α (max 15 deg) will be very less, S_p will be just greater than S_2.

Therefore, if S_2 meets the minimum spacing requirement between two parallel runways for a particular simultaneous operation given in Annex 14, then such operation could be possible.

D = distance from convergence point to DER(Departure End of Runway).

D_1= distance from convergence point to the point where turn can be initiated.

Tan $\alpha = S_1/D = S_2/D_1$

As per SOIR (Doc 9643), departure tracks should diverge by 15 deg immediately after departure. Therefore, in case of near parallel runways, departing aircraft should diverge by α+15 deg immediately after departure. Similarly, aircraft carrying out missed approach should diverge by α+30 deg instead of 30 deg in case of near parallel runways.

These divergences should ideally be shared by both the aircraft as far as practicable so that the required divergence of tracks is achieved at the earliest.

Here X= D - D_1= Distance required for aircraft to reach minimum height for any turn.

Departure –

As departing aircraft cannot be expected to turn before reaching a height of 400 ft above DER, so the minimum distance required for departure to take a turn with average gradient of 7%,
X = 400/0.07/6076 NM = 0.94 NM =1 nm (approx.).
This distance X may be **more than the minimum** in order to meet obstacles clearance, special user airspace or environmental requirements and accordingly, the value of S_2 will change.

Missed approach –

Aircraft carrying out missed approach can take a turn after SOC (Start of Climb), which will be near threshold. This point of turn may vary depending upon obstacles, special user airspace, environmental requirements or multiple runway operations e.g. aircraft carrying out missed approach may be required to take a turn only after the end of runway.

1.4 The characteristics of the 3 runways 27, 28 and 29 and the dependencies are as given below.

1.4.1 The convergence characteristics of near parallel runways 27 and 29 are as follows:

a) spacing 3010m and 3550m at two ends;
b) convergence angle 12deg;
c) their extended central line meet at 7.6 NM; and
d) thresholds of RWY29 and RWY 27 are staggered by 2127M (1.15NM).

1.4.2 The convergence characteristics of near parallel runways 27 and 28 are as follows:

a) spacing 450m and 1100m at two ends;
b) convergence angle 13deg; and

c) their extended central line meet at 1.08 NM.

Applying the criteria for Runways 27 and 29 at Delhi,

S_1= 3010 M, α = 12 deg

D = 3010/Tan 12 = 14160 M

D_1 = 14160 – 1852 = 12308M

$S_2 = D_1 * \tan \alpha = 12308 * \tan 12 = 2616$ M> 1525 M

1.5 With the above simple mathematical model and after simulation trials, it has been found to be feasible to conduct simultaneous operations on near parallel runways at Delhi airport, subject to other conditions mentioned in SOIR. But considering various variables involved in the process, further rigorous mathematical treatment would be required.

1.6 Nevertheless, keeping in view the need for enhancing the capacity and safety, the following modes of operation, effectively utilising all the three Runways for Westerly flow have been implemented at IGI Airport.

a) RWY 27 arrivals only;

b) RWY 28 departures only; and

c) RWY 29 both arrivals and departures.

Accordingly SIDs, missed approach tracks and ATC procedures were modified.

1.7 Dependent approaches are permitted on Runway 27 and 29. Diagonal separation of 3NM is maintained between aircraft established on Localizers of RWY27 and RWY29 instead of 2NM required for dependent approaches on parallel runways.

1.8 Simultaneous independent departures are conducted from runway 27 and 29. The SIDs have been suitably modified for this purpose.

1.9 Segregated operations on closely spaced RWY 27 and RWY 28 are permitted with the condition for departure from RWY 28 to roll before the arrival on RWY 27 reaches 3NM so that in case of go-around, 3 NM radar separation is ensured between the departing aircraft and aircraft carrying out missed approach.

1.10 By conducting simultaneous operations on near parallel runways as described above, 76 movements per hour have been achieved, whereas capacity of 85 movements per hour is achievable.

1.11 However, for conducting such simultaneous operations on near parallel runways with confidence, mathematical simulations/modelling needs to be carried out for such operations on **near parallel** runways with appropriate runway configurations to ensure that Target Level of Safety is achieved and the conditions under which such operations are possible.

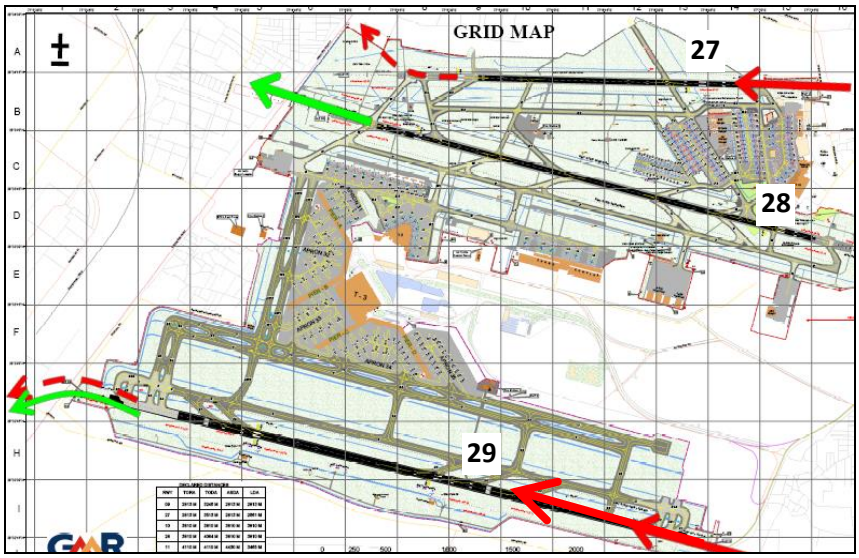


Figure-1

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