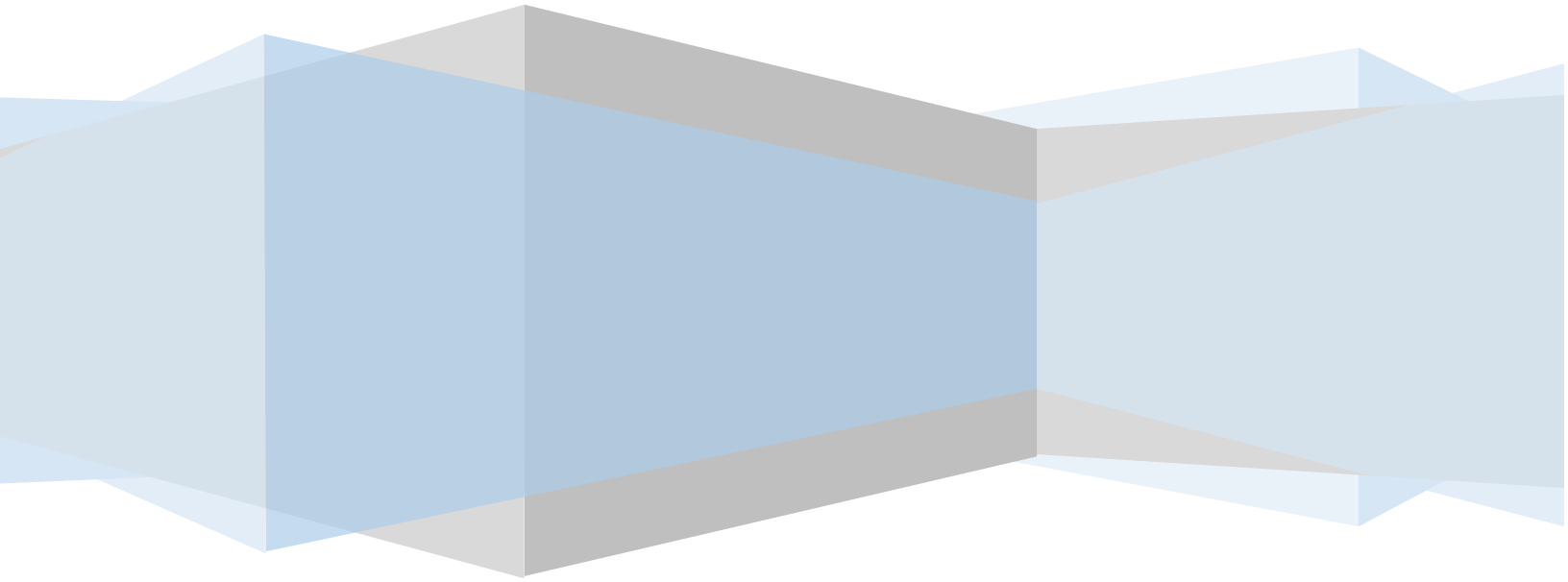
POST OPERATIONS ANALYSIS REPORT

March, 2025

CENTRAL COMMAND CENTER, C-ATFM, DELHI



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A. Executive Summary

Average Domestic air traffic (31 days) has recorded an increase of 0.2% whereas the average international air traffic has decreased by 6.7 % in the month of March 2025 as compared to February '25.

On average, the Indian Airports in the ATFCM area saw 5048 IFR flights per day in the month of March 2025. The peak days were on 07th March 2025 (5282 IFR flights). Thursday's were the busiest days throughout this month with an average of 5149 IFR flights per day.

Total Thirty Two (32) ATFM measures were applied this month during periods of congestion at Bengaluru, Chennai, Delhi, Hyderabad and Mumbai Airport.

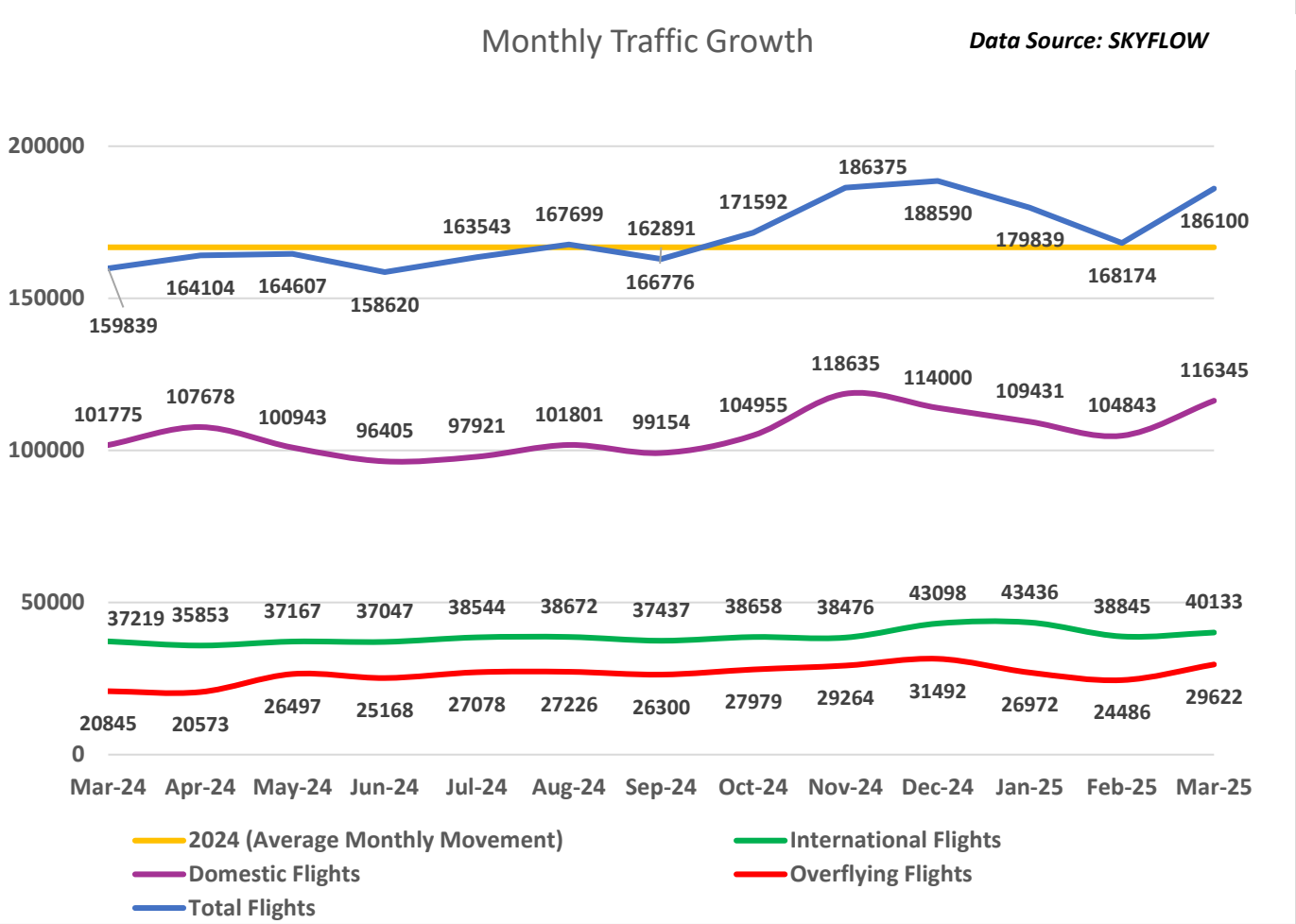


Figure 1: Monthly Traffic Growth

The graph above depicts the Domestic, International and Overflying Air traffic in Indian ATFCM Area during the last 13 months (March'24 to March'25).

B. Traffic Analysis

I. Air Traffic Movement at Major Airports in India

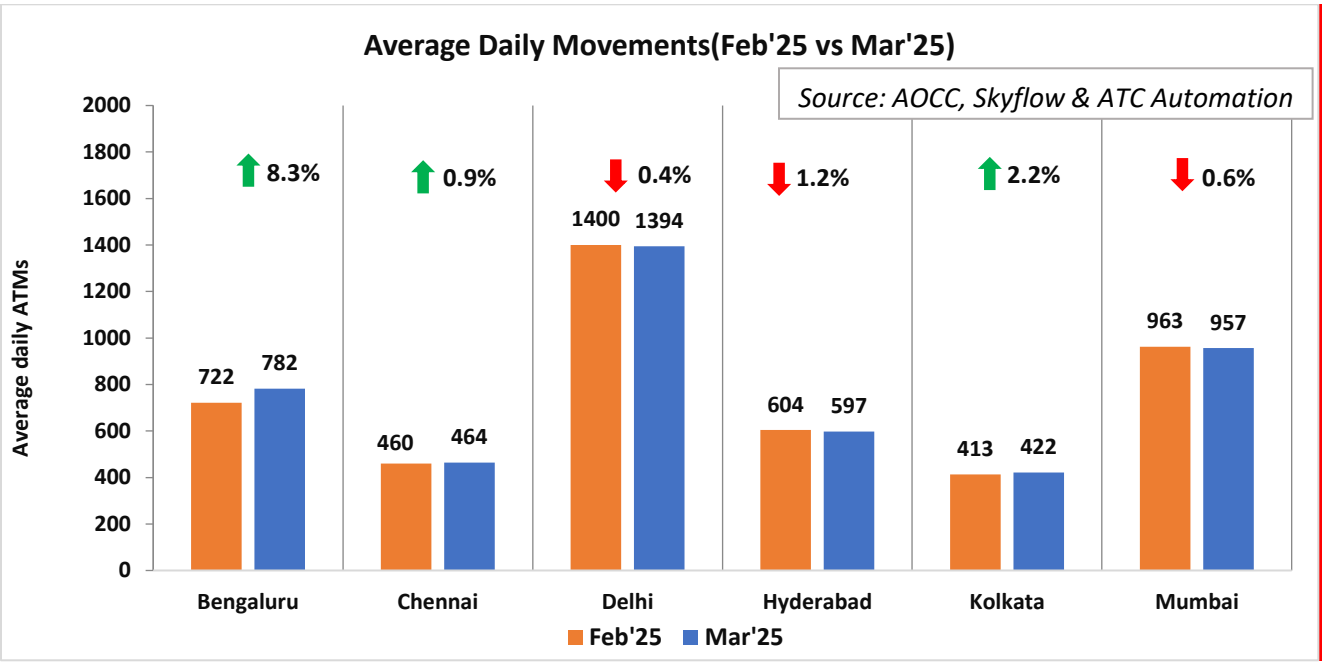


Figure 2: Average Daily Movements (Feb '25 vs Mar'25)

The above chart depicts the percentage change in average daily ATMs at six major Airports in March 2025 as compared to the previous month February 2025.

Airports\Year	Avg. Daily ATMs (YoY) for six major airports				
	Mar'21	Mar'22	Mar'23	Mar'24	Mar'25
Bengaluru	529	494	713	718	782
Chennai	327	311	414	406	464
Delhi	1185	1025	1285	1330	1394
Hyderabad	399	353	490	525	597
Kolkata	357	331	384	398	422
Mumbai	723	577	910	955	957

Air Traffic Movement for each day in March 2025 is plotted for Delhi, Mumbai, Bengaluru and Hyderabad Airport along with the percentage change w.r.t. Avg. Daily Movements for the same month.

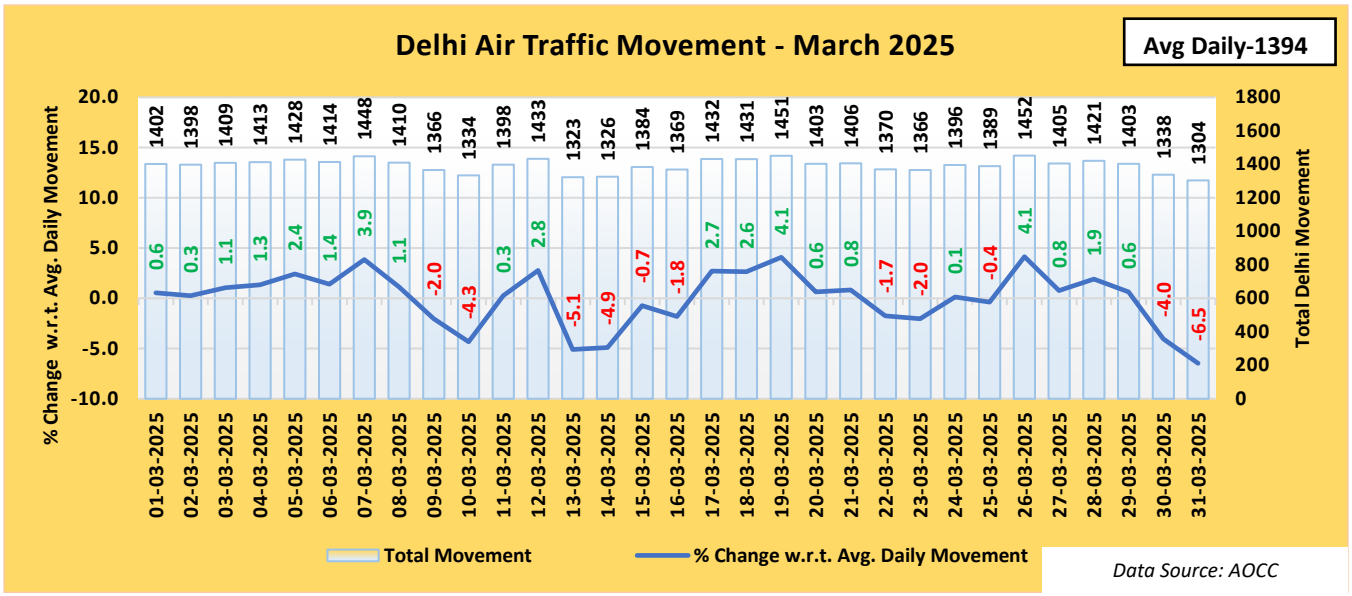


Figure 3: Air Traffic Movement for Delhi –Mar'25

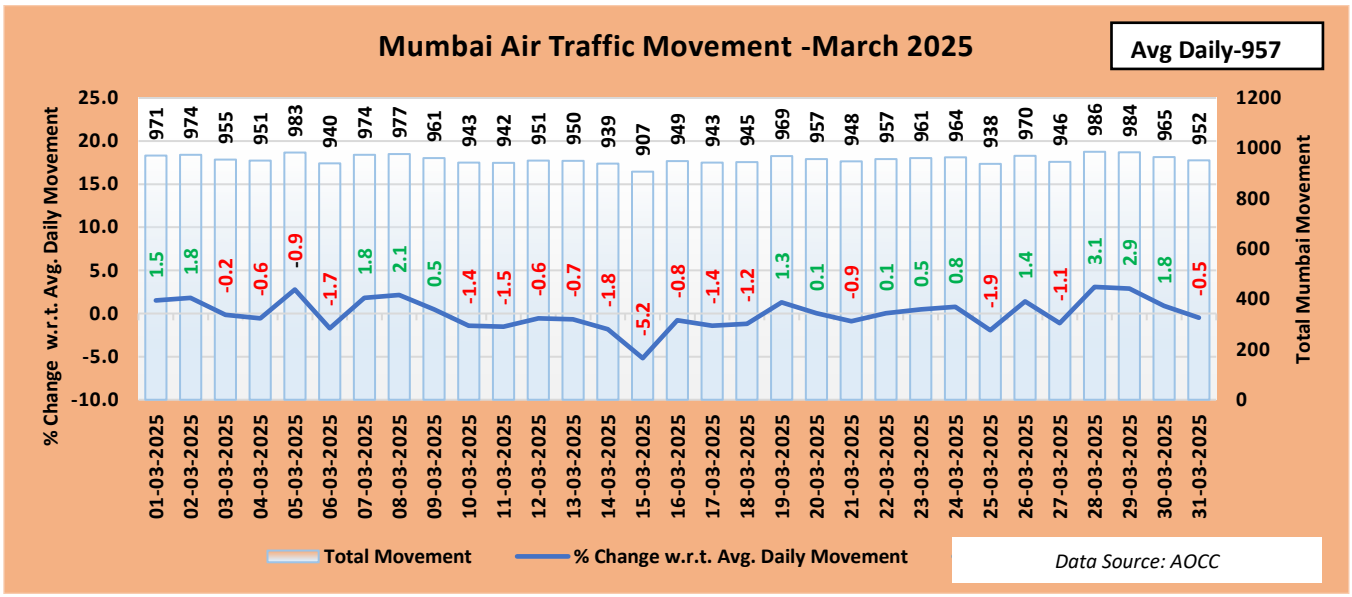


Figure 4: Air Traffic Movement for Mumbai – Mar'25

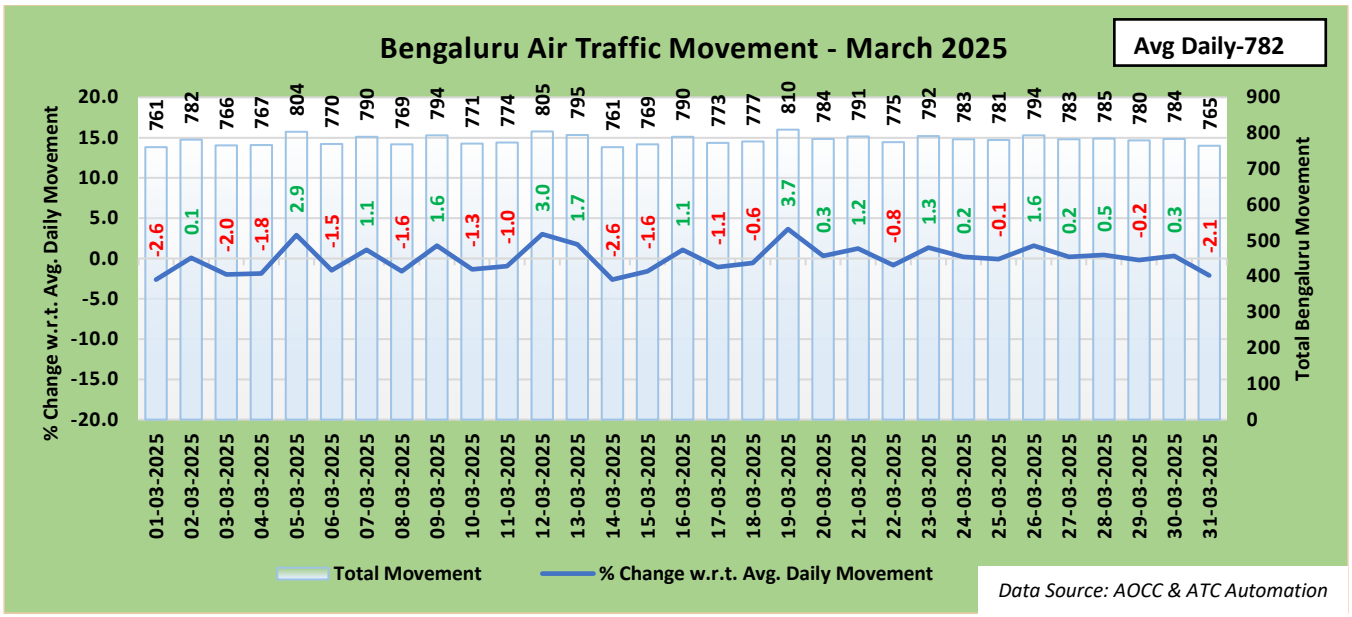


Figure 5: Air Traffic Movement for Bengaluru – Mar'25

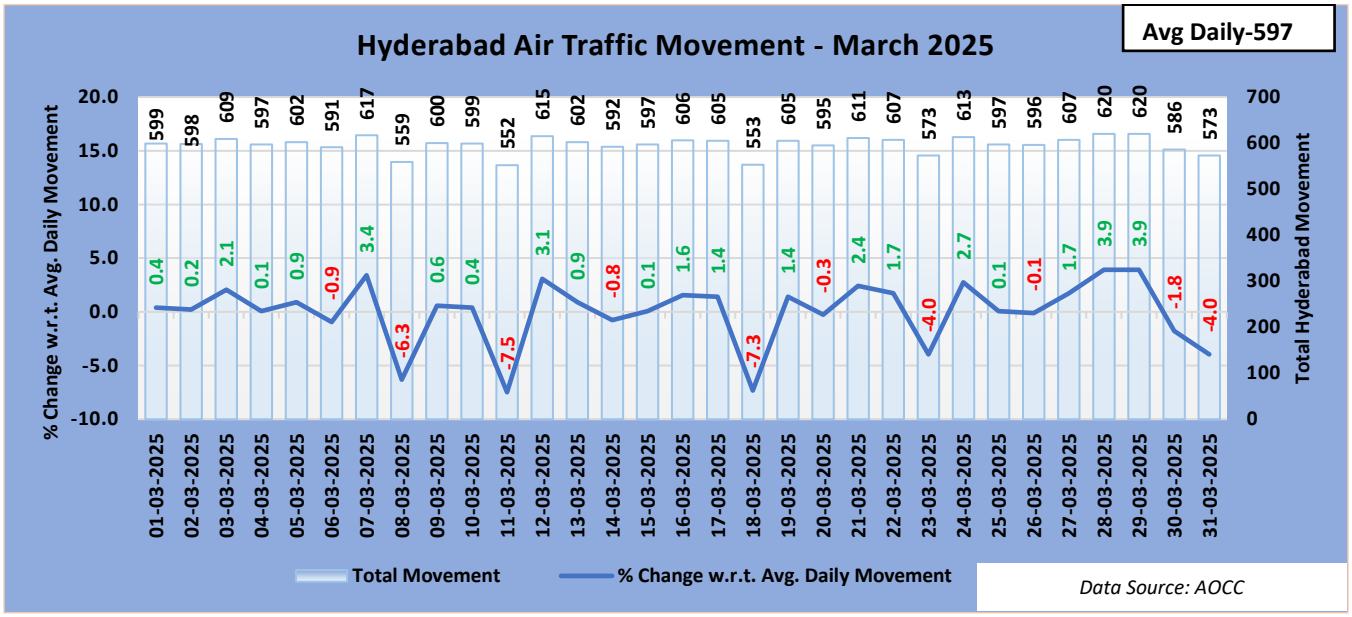


Figure 6: Air Traffic Movement for Hyderabad – Mar'25

It can be concluded from the above charts that the ATM at Delhi, Mumbai, Bengaluru and Hyderabad exceeds the average daily movement for 20 days, 14 days, 16 days and 21 days respectively in the month of March 2025.

II. Comparison of total ATMs (YoY) and Monthwise

The total Air traffic movement(ATMs) including Passenger and other flights such as Cargo flights, International scheduled, International non-scheduled, Domestic scheduled, Domestic non-scheduled, Air taxi & commercial business flights at six major Indian Airports namely Delhi, Mumbai, Bengaluru, Hyderabad, Kolkata and Chennai is plotted for the month of March for two consecutive years 2024 and 2025 respectively. Air Traffic movement is also plotted Airline wise for the last six months for the major Scheduled Operators.

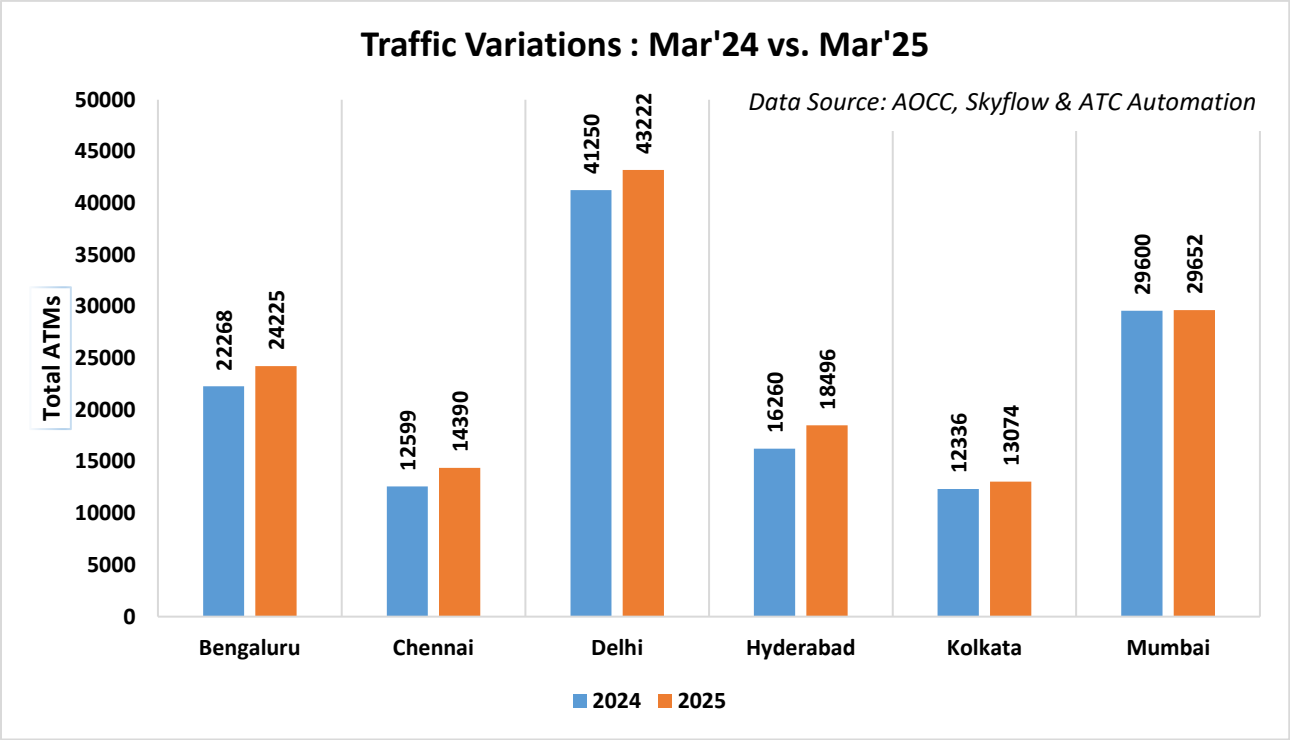


Figure 7: Traffic Variation (YoY)

III. Flight Operations – Airlinewise

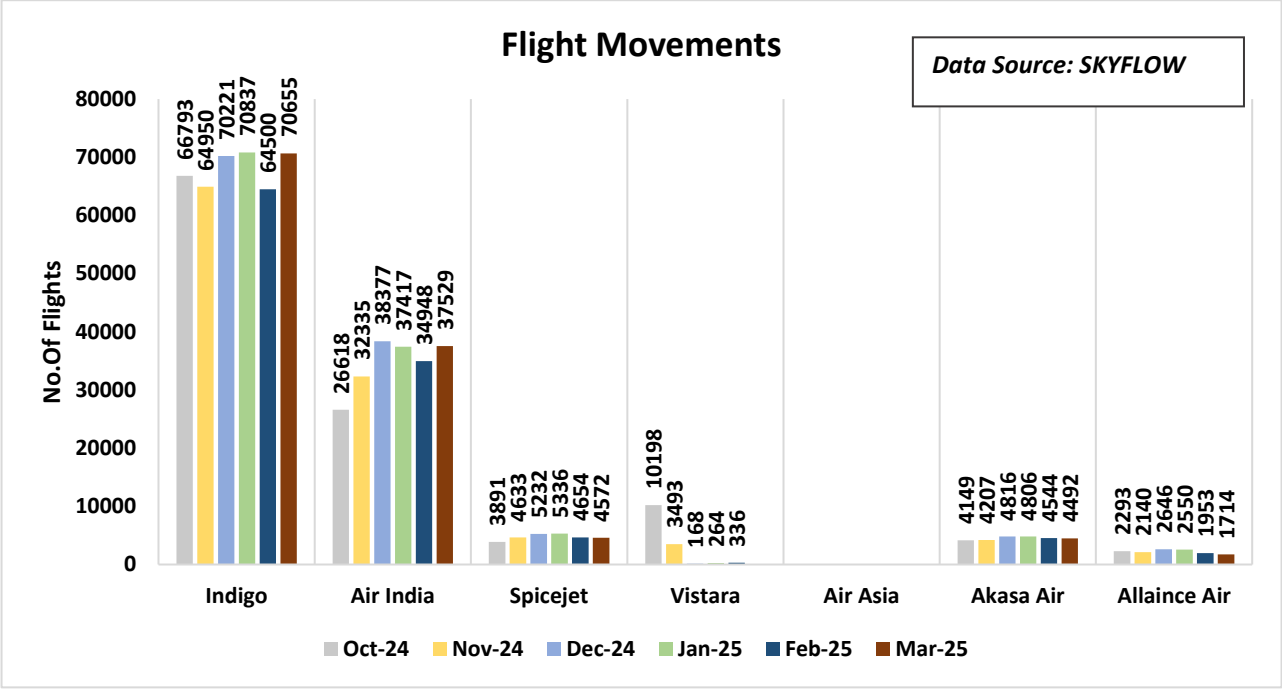


Figure 8: Flight Movements –Airlinewise

Inference:

1. Indigo, Air India and Alliance air airlines have recorded an increase in the monthly average .Flight movement in March'25 as compared to February'25 while Spicejet and Akasa airlines have recorded a decline during the same period.

C. ATFM Post Operations – CDM Analysis

I. Introduction

Analysis Period **1st – 31st March 25**

Back Ground During the above mentioned period, **Six (06)** ATFM measure was applied **for Bengaluru Airport, Eight (08)** ATFM measures were applied **for Chennai Airport, Two (02)** ATFM measures were applied **for Delhi Airport, One (01)** ATFM measure was applied **for Hyderabad Airport and Fifteen (15)** ATFM measures were applied **for Mumbai Airport** due to the following reasons as illustrated in the bar chart below:–

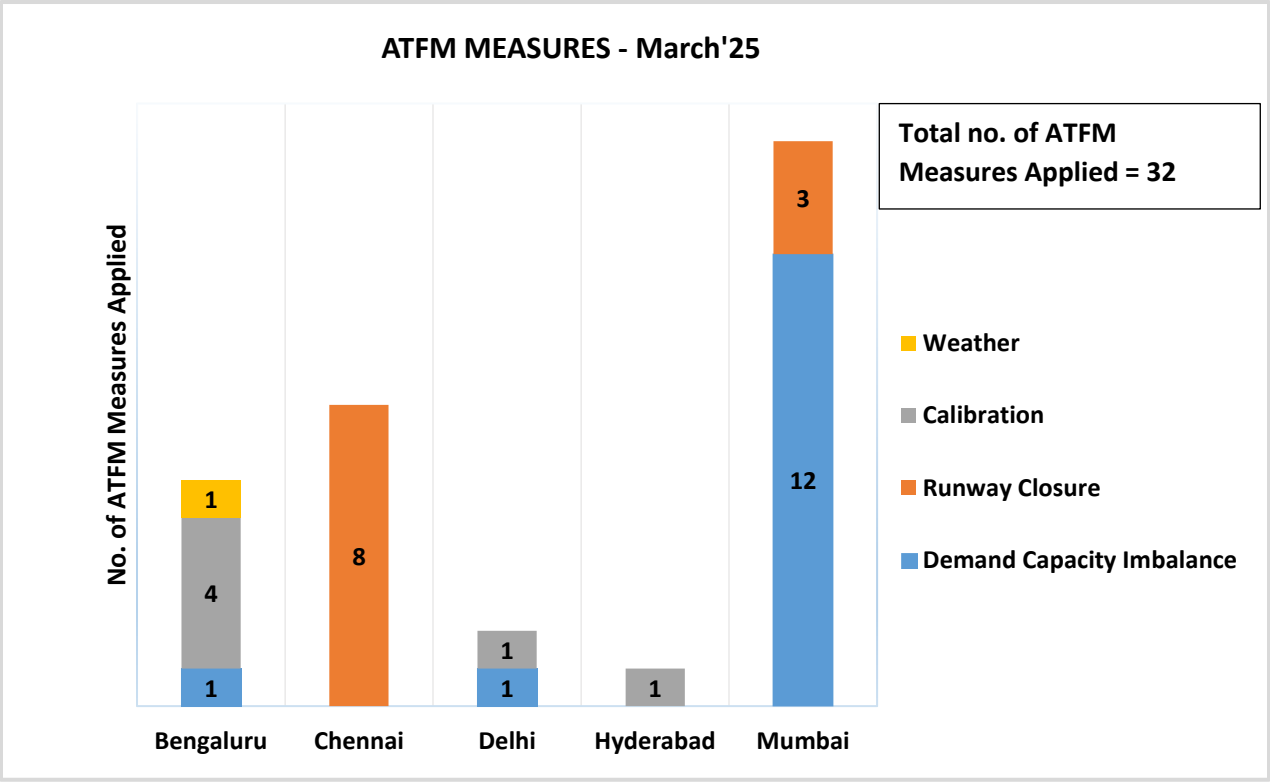


Figure 9: ATFM Measures –Mar'25

II. ATFM Measures Overview

Constrained Airport	Bengaluru	Chennai	Delhi	Hyderabad	Mumbai
Number of ATFM measures applied	6	8	2	1	15
Average ATFM Ground delay(in min) due to measures*	43.9	24.4	20	18.3	22.3
Maximum ATFM Ground delay(in min) due to measures	109	46	36	37	69
% Compliance	96.8	95.9	99.3	100	98.3

Note: * $Average\ ATFM\ Delay = \frac{Total\ ATFM\ Delay}{Total\ Domestic\ Arrivals}$

Total Arrivals	1831
Total International Arrivals(exempted)	327
Total affected flights in scenario (Domestic Arrivals)	1504
Total Domestic Arrivals with zero ATFM delay	93
Total Domestic Arrivals with ATFM delay	1411

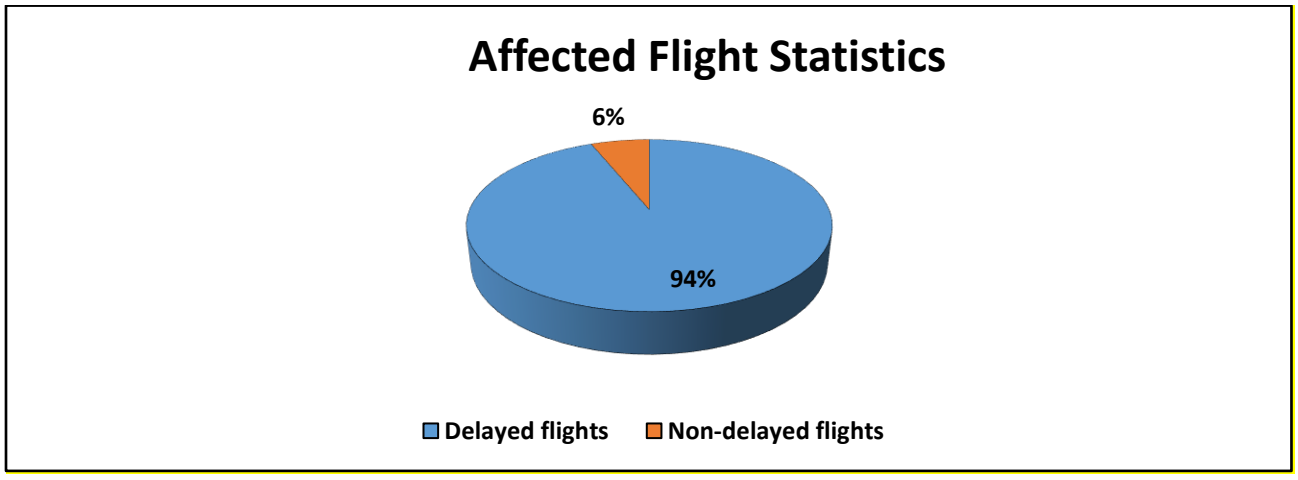


Figure 10: Affected Flight Statistics –Mar'25

III. Overall Compliance

Total arrivals	1831
Domestic arrivals	1504
Flights with complete data (ATOT)	1496
Flights with incomplete data	3
Flights Not Operated	5
Compliant*	1464
Non-Compliant	32

*Total No. of Revised CTOTs issued = 501 (Compliance calculation for flights which were issued revised CTOT is w.r.t. new CTOT issued)

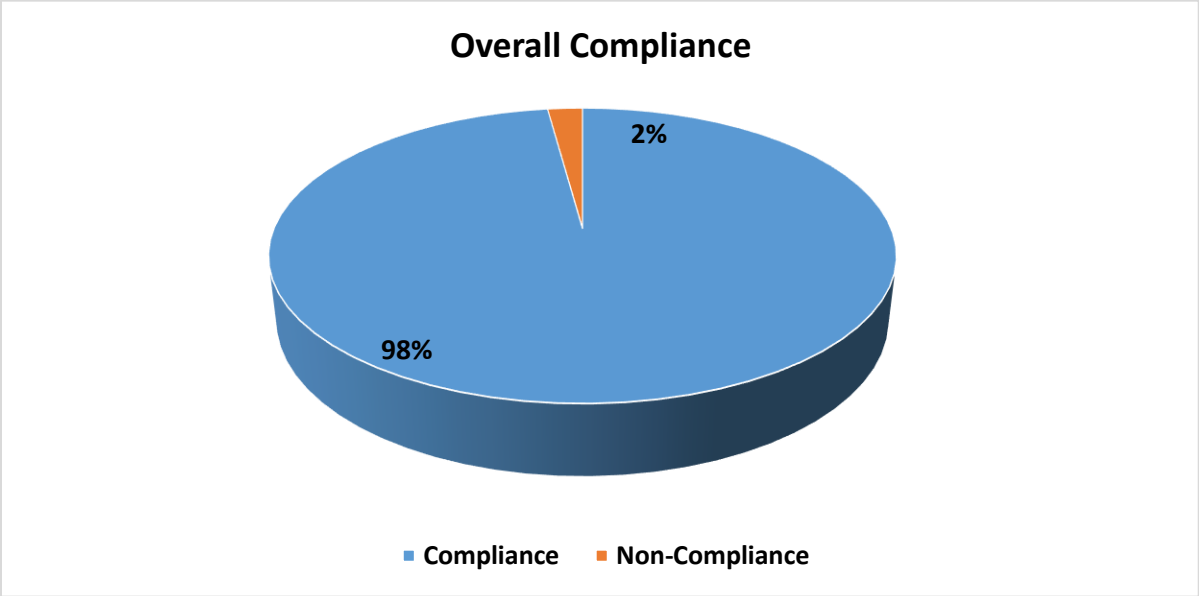


***Figure 11*: Overall Compliance – Mar'25**

NOTE: Flights with required data (i.e. ATOT) are only considered for compliance measurement

Out of the total domestic arrivals with complete data in the CDM scenario, 98% arrivals are compliant for the month of March 2025.

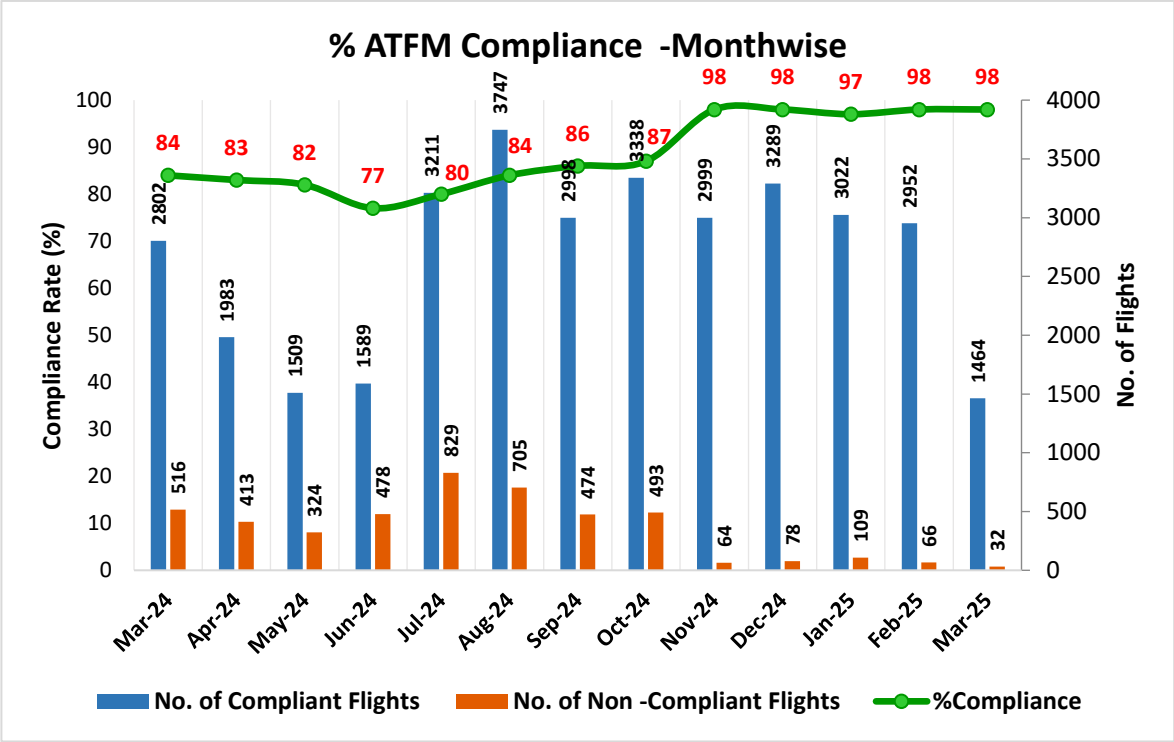


Figure 12: Compliance(Monthwise)

Inference

1. Out of the total arrivals captured(1831 flights) during the CDM scenario for the constrained Airports, 82.1% of flights i.e. domestic arrivals(1504 flights) were candidates for ground delay(participating).
2. Out of these Domestic Arrivals(1504), 93.8% (1411 flights) are assigned ATFM ground delay.
3. Out of the total arrivals captured(1831 flights) to the constrained Airport during the ATFM scenario, 77.1% of flights(1411 flights) were assigned ATFM Ground Delay.

IV. CTOT Compliance rate – Airportwise

MUMBAI FIR (97%)*	Compliant	Non Compliant	% Compliant
Ahmedabad	44	1	98%
Aurangabad	5	0	100%
Mumbai	61	4	94%
Bhuj	1	0	100%
Vadodara	4	0	100%
Bhopal	17	1	94%
Gondia	1	0	100%
Hirasar, rajkot	10	0	100%
Indore	20	0	100%
Jabalpur	6	0	100%
Jalgaon	2	0	100%
Jamnagar	15	2	88%
Kandla	5	0	100%
Kolhapur	7	0	100%
Keshod	3	0	100%
Nagpur	19	0	100%
Nasik	3	0	100%
Pune	17	0	100%
Shirdi	5	0	100%
Surat	10	0	100%
Udaipur	16	1	94%
KOLKATA FIR (99%)*	Compliant	Non Compliant	% Compliant
Prayagraj	7	0	100%
Agartala	3	0	100%
Ayodhya	12	0	100%
Siliguri	19	0	100%
Varanasi	34	0	100%
Bhubaneswar	32	0	100%
Kolkata	82	2	98%
Chakeri	3	0	100%
Durgapur	8	1	89%
Darbhanga	8	0	100%

Deoghar	3	0	100%
Gorakhpur	10	0	100%
Guwahati	15	0	100%
Gaya	1	0	100%
Jharsuguda	7	0	100%
Khajuraho	1	0	100%
Aizawl	1	0	100%
Patna	22	1	96%
Ranchi	17	0	100%
Raipur	13	0	100%
DELHI FIR (98%)*	Compliant	Non Compliant	% Compliant
Agra	1	1	50%
Amritsar	10	0	100%
Adampur	1	0	100%
Chandigarh	24	1	96%
Dehradun	13	1	93%
Delhi	201	1	100%
Hindon	4	1	80%
Kangra	1	0	100%
Gwalior	1	0	100%
Jodhpur	3	1	75%
Jaipur	36	0	100%
Jaisalmer	1	0	100%
Jammu	5	0	100%
Leh	4	0	100%
Lucknow	33	0	100%
Pantnagar	1	0	100%
Srinagar	11	0	100%
CHENNAI FIR (98%)*	Compliant	Non Compliant	% Compliant
Agatti	1	0	100%
Hal Bangalore	3	2	60%
Bangalore	102	1	99%
Belgaum	1	0	100%
Vijayawada	18	0	100%
Coimbatore	31	0	100%
Kochi	48	2	96%
Calicut	5	0	100%

MOPA Goa	20	1	95%
Gulbarga	1	0	100%
Goa	54	0	100%
Hubli	4	1	80%
Shamsabad, Hyderabad	79	1	99%
Begumpet Hyderabad	1	0	100%
Vijaynagar	1	0	100%
Kannur	10	0	100%
Madurai	22	0	100%
Mangalore	18	0	100%
Chennai	53	0	100%
Mysore	1	0	100%
Nanded	0	1	0%
Port Blair	13	0	100%
Pondicherry	2	0	100%
Rajahmundry	4	1	80%
Shivamogga	3	0	100%
Salem	2	0	100%
Tuticorin	9	0	100%
Tirupati	6	0	100%
Tiruchirappally	13	0	100%
Thiruvananthapuram	13	0	100%
Visakhapatnam	7	2	78%

**FIR wise compliance rate (decimals rounded off to nearest integer value).*

Note: The above list contains only those airports which had flights to the Constrained Airport and are affected by ATFM measures.

Airports with % compliance less than the average compliance(98%) for the month are highlighted in red.

V. CTOT Compliance rate – Airlinewise

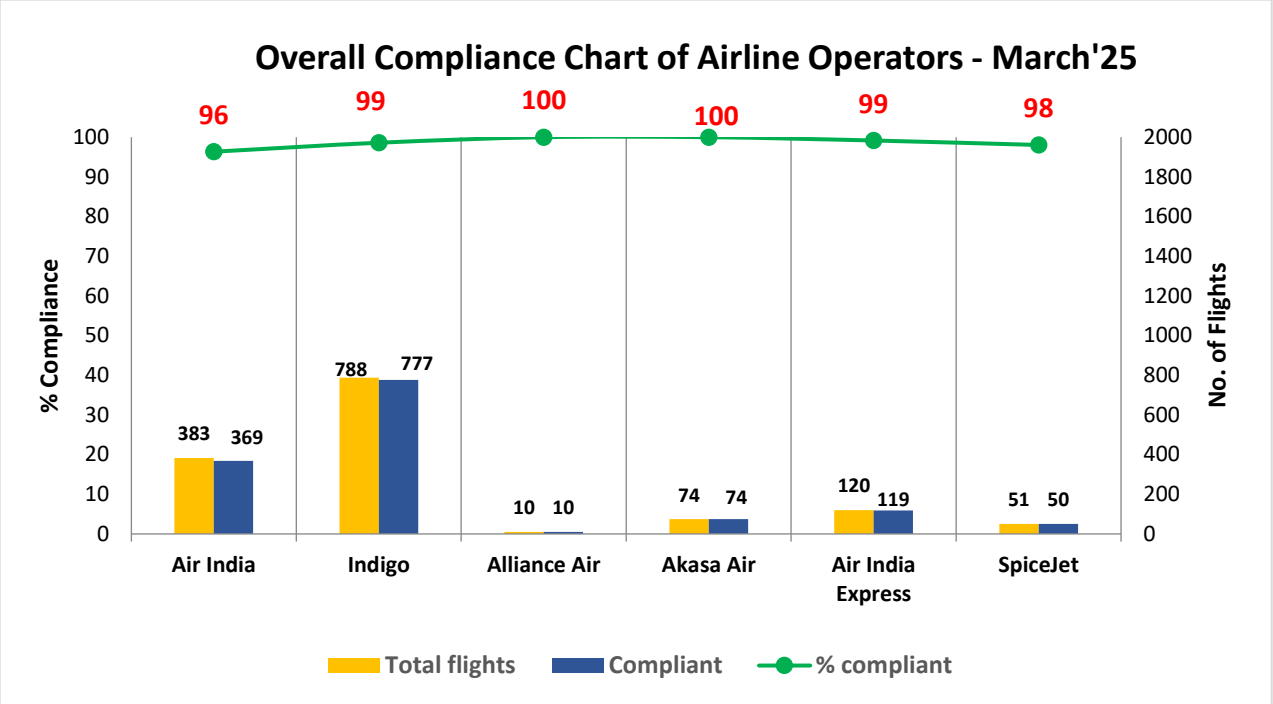


Figure 13: Airline wise Compliance –Mar'25

Inference

1. Kolkata region record the highest compliance of 99% whereas Mumbai region has the lowest percentage compliance of 97%.
2. Akasa, Indigo, Alliance air and Air India Express Airlines have a CTOT compliance higher than or equal to the average recorded compliance for the month of March'25.

VI. Reason For Non Compliance

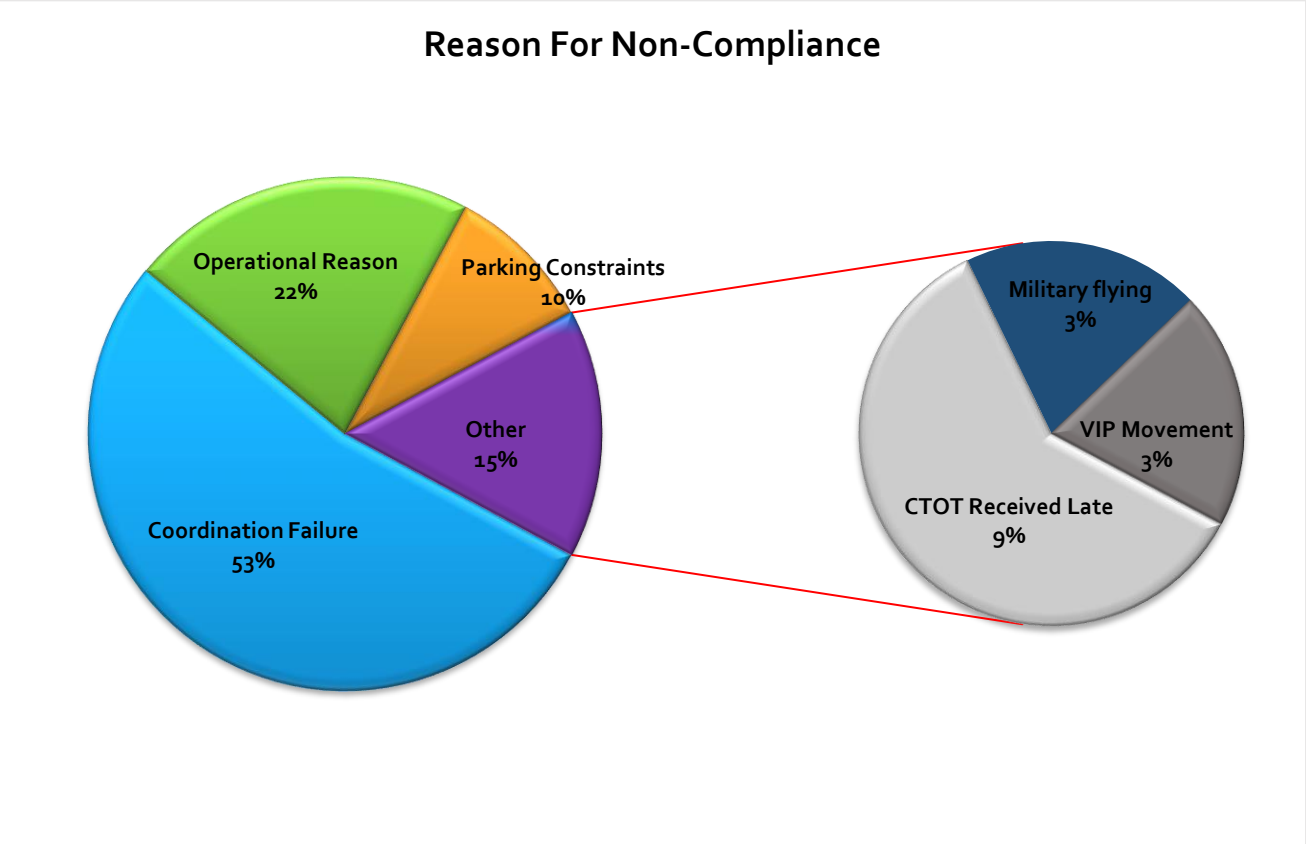


Figure 14: Reason for Non-Compliance as provided by FMPs

Inference:

1. 53 % of CTOT Non- Compliance was reported by concerned FMPs to be due to coordination failure & parking constraints at various airports.
2. 22 % of the CTOT Non- compliance was due to operational reasons (due to congestion at holding point, calibration flight and delay in taxi) .
3. 10 % of the CTOT Non- compliance was due to parking bay constrain.
4. 9 % of the CTOT Non- compliance was reported by concerned FMPs to be due to late receipt of CTOTs and by the time the aircraft had already initiated pushed back or startup.
5. 3 % of the CTOT Non- compliance was reported by concerned FMPs to be due to VIP Movements & Miliatary flying.

VII.Air Delay during the CDM Scenario period

Average Air Delay to domestic arrivals* within the CDM Scenario period for Bengaluru,Chennai, Delhi, Hyderabad and Mumbai was 10.3,9.6,8.2,18.6 and 11.8 minutes respectively.

**Note: Only calculated for domestic arrivals with both ATOT and ALDT information*

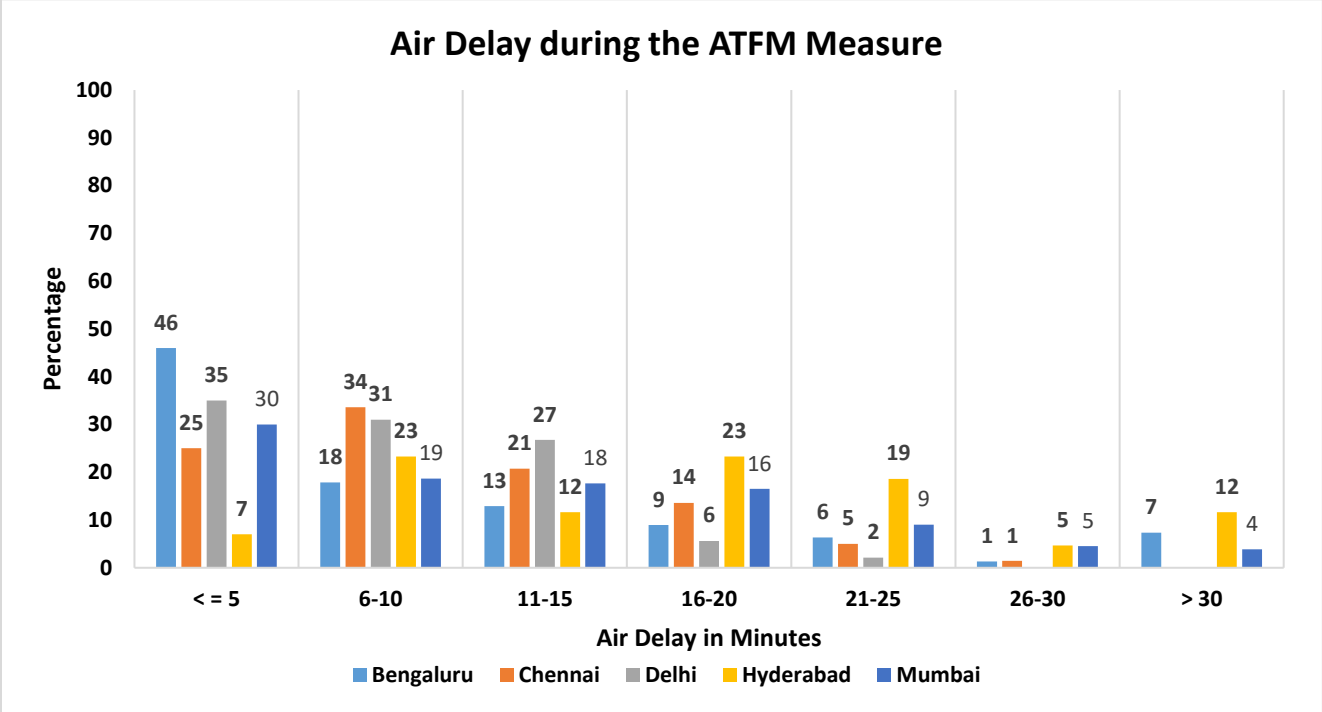


Figure 15: Air Delay distribution during the CDM period

Inference

1. 64% of domestic arriving flights to Bengaluru had an Air delay of equal to or less than 10 minutes during the CDM period.
2. 59% of domestic arriving flights to Chennai had an Air delay of equal to or less than 10 minutes during the CDM period.
3. 66% of domestic arriving flights to Delhi had an Air delay of equal to or less than 10 minutes during the CDM period.
4. 30% of domestic arriving flights to Hyderabad had an Air delay of equal to or less than 10 minutes during the CDM period.
5. 49% of domestic arriving flights to Mumbai had an Air delay of equal to or less than 10 minutes during the CDM period.

VIII. Tangible Benefits due to ATFM Measures

A modest attempt is made to find out the tangible benefit of ATFM measures applied.

Assumptions:

•When ATFM measures are not in force, all flights take off at their ETOT where Estimated take off time(ETOT)= Estimated off block time(EOBT) + default taxi time

•All flights have an Estimated elapsed time(EET) as calculated by SKYFLOW using the Flight Plan information and Basic Aircraft data.

Methodology:

Air delay (with ATFM measures in force) is calculated during the period when ATFM measures are in force by summing the air delay for all the flights landing at constrained Airport.

i.e. **Total Air Delay = ∑ (Actual Flying time – SKYFLOW calculated EET)**

Air delay (with no ATFM measures) is calculated as the sum of Air delay for all the flights during the above said period with no ATFM measures in place and the air delay for each flight is the difference in its ideal landing time and its ideal estimated landing time.

Total Air Delay (with no ATFM measures) = **∑ (Ideal LDT - Ideal ELDT)**

*Ideal LDT is taken by assuming every flight is landing at a specified interval based on the Arrival acceptance rate(AAR) defined,

*Ideal ELDT = ETOT + SKYFLOW calculated Flying time

Fuel Saving Calculation :

Great Circle Distance(GCD)* was calculated for all the arrivals during the ATFM Measure from the point of origin to destination. Assuming Airbus 320 as reference aircraft for flights (flight distance equal to or less than 3000 nm) and B777 for international flights (flight distance more than 3000nm):

Fuel consumption (Kgs / nm) for each affected flight in the scenario was then calculated using the Reference document: ICAO Carbon emissions calculator methodology, version10, Appendix C: ICAO Fuel Consumption Table.

The Fuel consumed per minute(Kg/min) was calculated for each affected flight.

Total Air Delay(with ATFM Measures)= 17445 mins

Total Air Delay (with no ATFM measures) = 32889 mins

Reduction in Air delay due to ATFM measures= (32889-17445) = **15444 mins**

Fuel Saving Calculation:

Total Fuel saved during the ATFM Measure: ***8,87,597.61 Kg***

Total reduction in CO_2 emission : 3.16(KgCO_2/kg fuel)* 8,87,597.61 **Kg** ***= 28,04,808.45 Kg***

**GCD (Great Circle Distance): The distance between origin and destination airports is derived from latitude and longitude coordinates originally obtained from ICAO Location Indicators database.*

3.16 = constant representing the number of tonnes of CO2 produced by burning a tonne of aviation fuel.

D. Glossary

ATFM Parameters	Definition
Affected Flight statistics	An insight of participating traffic in the scenario i.e. ratio of the domestic arrivals to the constrained airport affected by ATFM measures (assigned delay by the Ground Delay Program) to the domestic arrivals not affected by ATFM measures (not assigned any delay) within the CDM scenario.
ATFM Ground delay	ATFM ground delay defined as CTOT-ETOT (Calculated take off time – Estimated take off time)
Average ATFM delay	$\frac{\boldsymbol{Total\ monthly\ ATFM\ delay\ (in\ minutes)}}{\boldsymbol{Total\ Domestic\ Arrivals}}$
Maximum ATFM delay	Maximum ATFM delay (in minutes) assigned in the month
Overall compliance rate	Defined as monthly ATFM departure slot adherence rate of regulated flights. Flights having ATOT within theATFM Slot Tolerance Window (STW) of minus 5 to plus 10 minutes of CTOTs, are considered as compliant flights
CTOT Compliance rate of Airline operators	An overview of CTOT compliance rate of various Airline operators
CTOT Compliance rate of Airports within different Regions	An overview of CTOT compliance rate of Airports within 4 FIRs
Air delay statistics	Air delay defined as difference between AET & EET, whereAET(actual elapsed time) can be obtained from (ALDT-ATOT) and estimated elapsed time(EET)can be obtained from FPL/RPL or (CLDT-CTOT). **Therefore, Air delay = AET-EET** Average Air Delay is calculated as: $\boldsymbol{Average\ Air\ Delay} = \frac{\boldsymbol{Total\ Air\ Delay\ to\ domestic\ arrivals\ (with\ values\ greater\ than\ zero)}}{\boldsymbol{Total\ Domestic\ Arrivals}}$ *CLDT: Calculated Landing Time* *CTOT: Calculated Take off Time* *ALDT: Actual Landing Time* *ATOT: Actual Take off Time*

Annexure-A

Compliance by Airlines with Flight Planning Requirements of Common Business rules(CBR)- March 2025.

I. Introduction:

Accurate and timely input in respect of flight intent is paramount to the correct traffic demand projection and eventually effective ATFM implementation. FPLs remain the main source of tactical demand prediction for ATFM systems. Early filing of error free FPL helps in improving the lead time required for ATFM measures and reduces the number of unexpected flights(pop-up). This in turn helps in improving the accuracy of demand-capacity imbalance prediction and optimizes slot utilization.

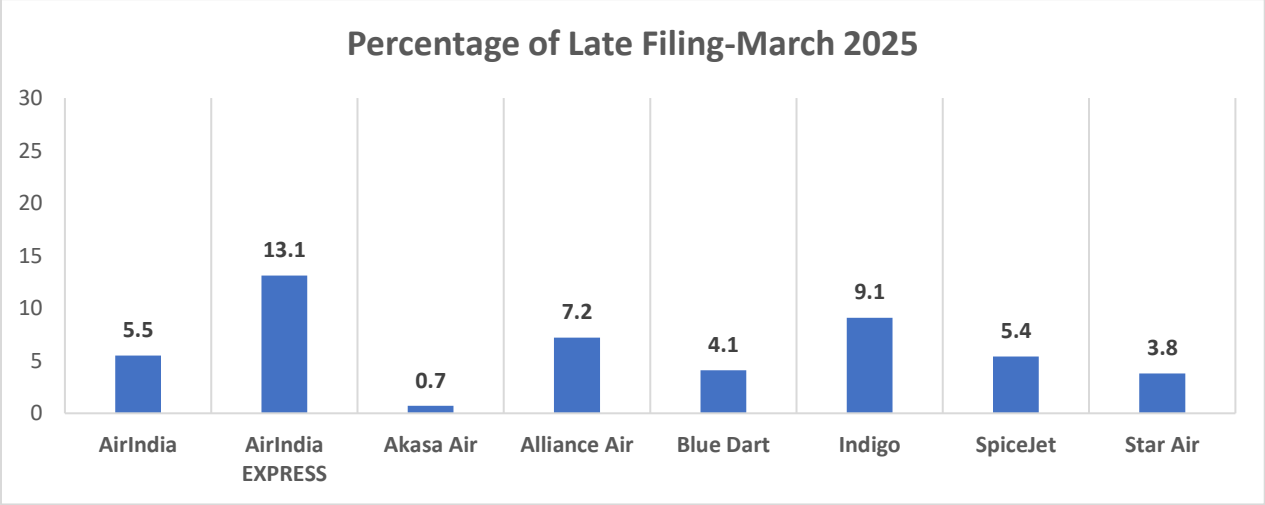
AIP India, ENR 1.9 section 4 on Flight Planning in the context of ATFM recommends Flight Planning requirements for all Airline Operators –

a) Flight plans shall be submitted at least 3 hours before the estimated off block time (EOBT);
b) The window for filing FPL is between 3 Hours and 120 Hours (Five days) before the EOBT. Earlier filing of FPL will give a realistic demand data to the CCC and hence the requirement of ATFM measures can be identified early for better planning. Late filing of a flight plan will lead to inaccuracies in predicting the demand and may lead to undesirable delay.

II. Analysis

A. An analysis has been conducted to find out the difference between the flight plan filing time and filed EOBT for all the FPLs received at ATFM system from 1st March 2025 to 31st March 2025.
The purpose of the analysis is to monitor the compliance with provisions of AIP India, section 4, ENR 1.9 regarding Flight Planning requirements in context of the ATFM.

This flight plan filing requirement has been reiterated through the recently agreed ATFM common business rules (CBR) document and is recognized as a metrics to be monitored regularly for any improvement.



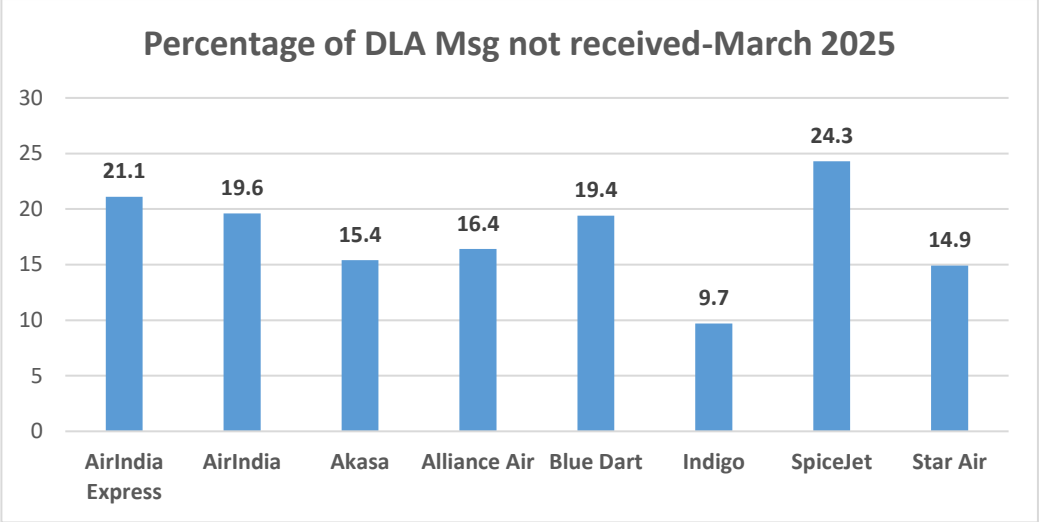
The table below lists number of filed flight plans (FPLs) with less than 3 Hours prior to EOBT:

Name of Airline	Late Filed FPL	Total No. Of FPL	% Delayed Filing
AirIndia	1271	23084	5.5
AirIndia EXPRESS	2025	15450	13.1
Akasa Air	32	4649	0.7
Alliance Air	132	1826	7.2
Blue Dart	25	613	4.1
Indigo	6613	72325	9.1
SpiceJet	264	4806	5.4
Star Air	52	1355	3.8
Total no. of FPLs for Scheduled Airlines	**10414**	**124108**	**8.3**

B. For the analysis of non-receipt of DLA (Delay) messages for flight plans filed, the EOBT of FPL received has been compared with Actual Take off time (ATOT)received through DEP(Departure)messages.
Thus, only those FPLs were considered for analysis for which DEP messages were available and no associated DLA messages was received.

The Table below lists number of flights for which no DLA message was received in March 2025. **{(EOBT of original FPL)- (ATOT received)} > 30 minutes)**

Name of Airline	DLA Message not received	Total No. of flights considered for analysis	% of flights for which no DLA message was received
AirIndia Express	2352	11145	21.1
AirIndia	3569	18124	19.6
Akasa	560	3630	15.4
Alliance Air	158	961	16.4
Blue Dart	103	530	19.4
Indigo	5234	53540	9.7
SpiceJet	848	3490	24.3
Star Air	69	462	14.9



C. For analysis of non-receipt of CNL (cancel) messages for march 2025, annulled FPLs were considered for which no CNL/DEP/DLA messages were received. A FPL gets annulled in SKYFLOW system, if it doesn't get activated through Dep message /surveillance data/ manual activation by FMP within a defined system parameter.

The table below lists the number of Flights for which no CNL Msg. was received in March 2025:

Name of Airline	CNL message not received	No. of flights annulled
AirIndia Express	78	83
AirIndia	55	58
Akasa	4	4
Alliance Air	122	122
Blue Dart	11	11
Indigo	179	182
SpiceJet	87	90
Star Air	11	12

-End OF Report-