



Ways to Increase Airport Capacity

How Can Runway Occupancy Time Be Reduced?



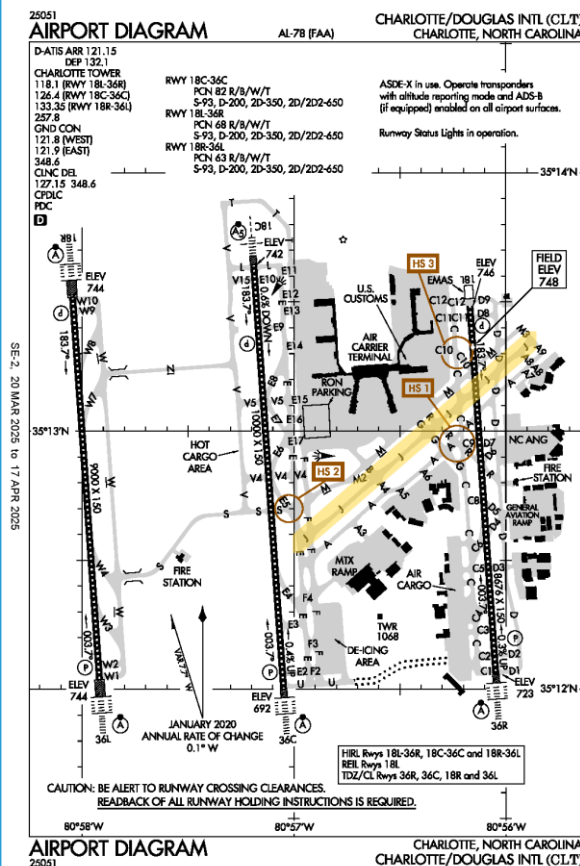
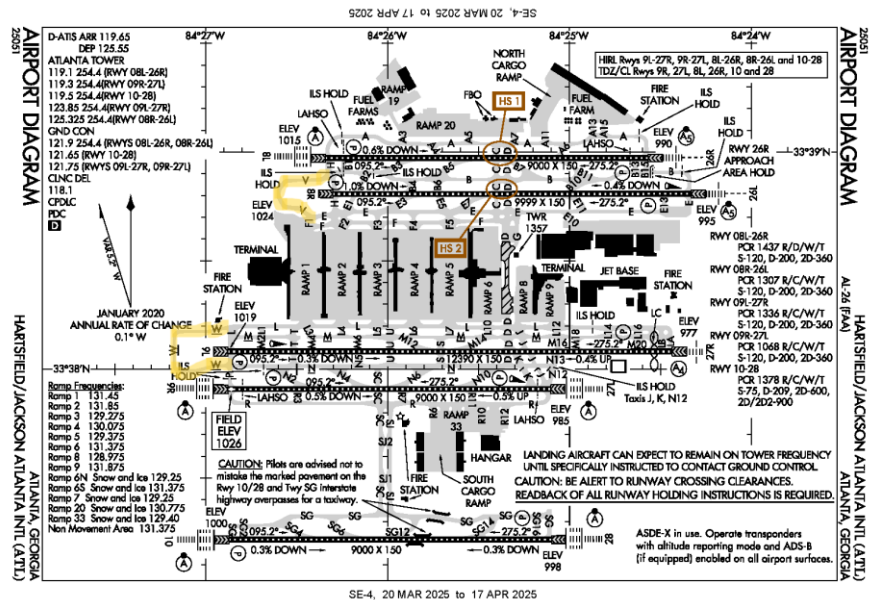
**Federal Aviation
Administration**

Improving Airport Capacity: Three Cases Studies

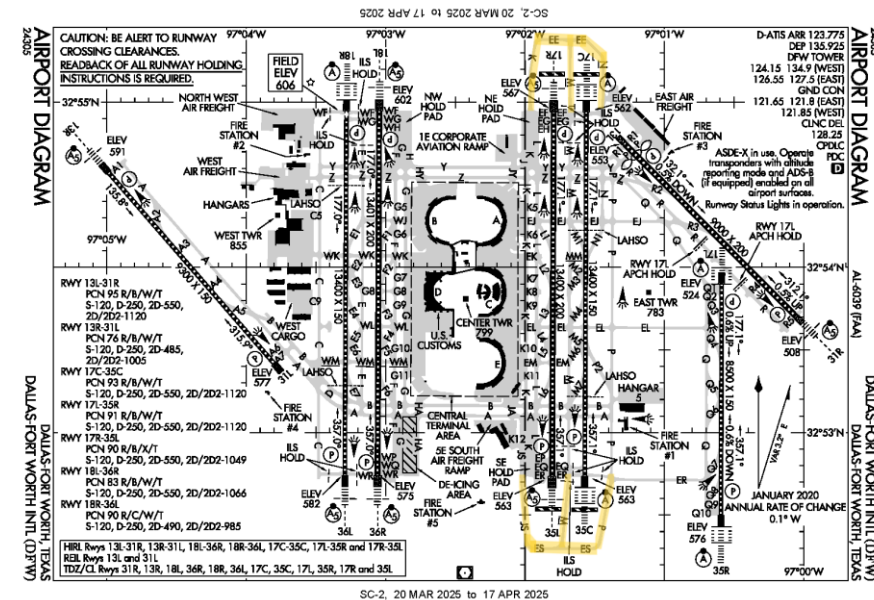
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CLT diagonal runway converted to taxiway

ATL End Around Taxiways

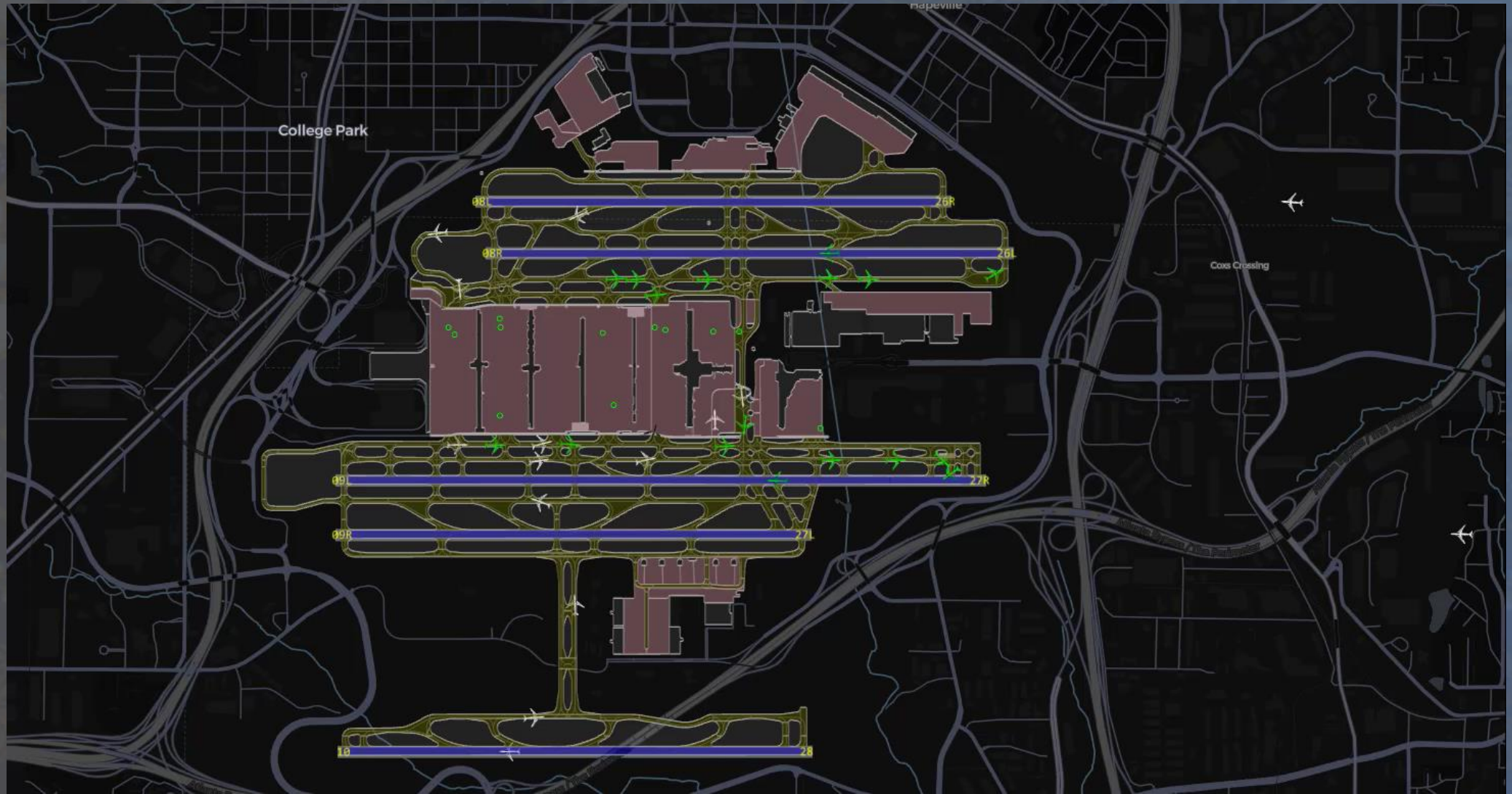


DFW End Around Taxiways



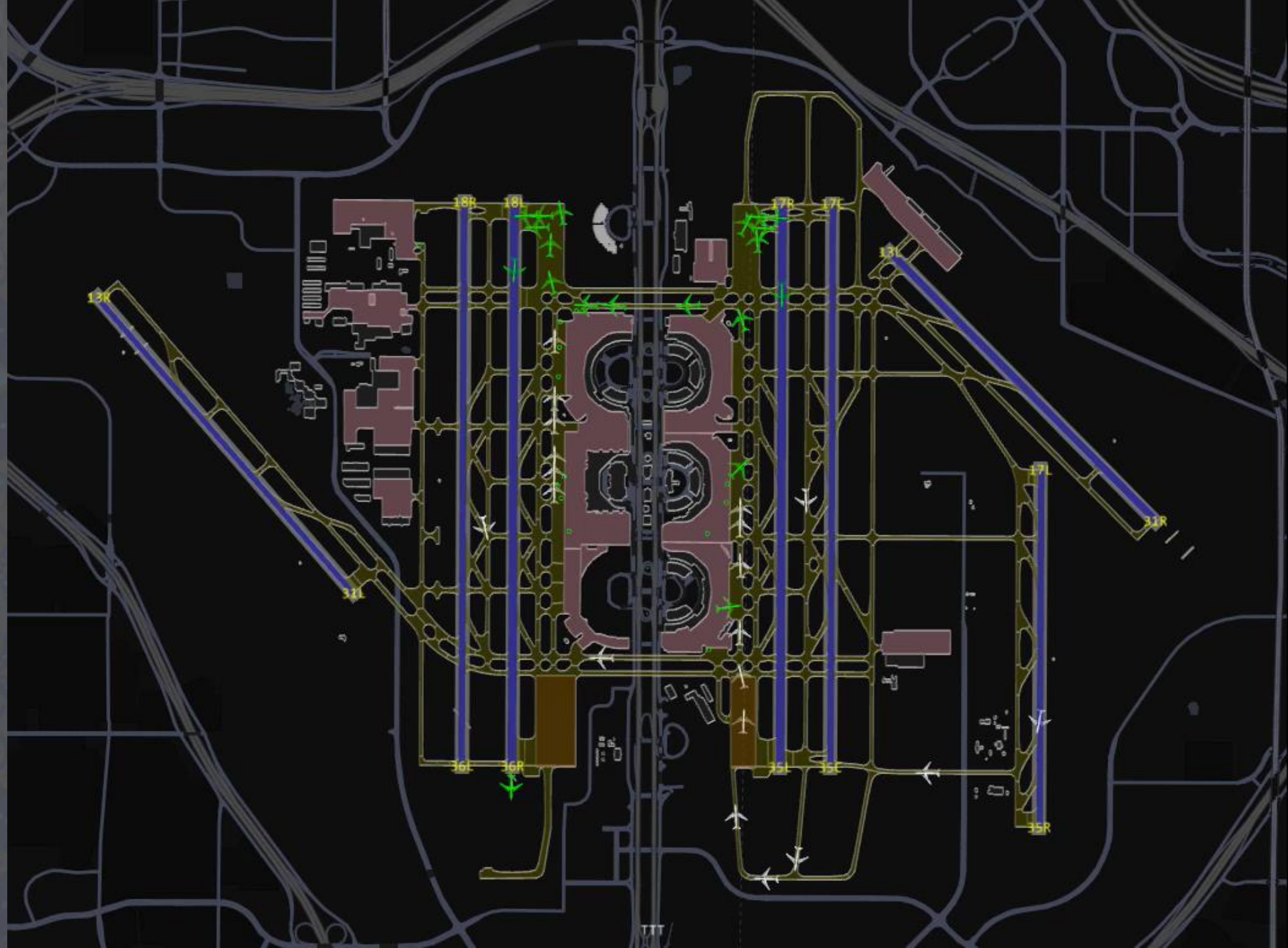
ATL Surface Movements

West side, end around taxiways allow for uninterrupted taxiing and flow of departures regardless of arrival volume



DFW Surface Movements

**East side of airport
has end around
taxiway, west side
has to stop
departures to allow
arrivals to cross the
departure runway**





CLT Surface Movements

Growth at CLT has created surface constraints, and the solution was to build a third parallel to the west and convert the diagonal runway to taxiways.

CLT airport has decommissioned Runway 5/23 and it is now used as taxiways to facilitate movement of aircraft from one side of the airport to the other.

Factors affecting Runway Capacity / Throughput

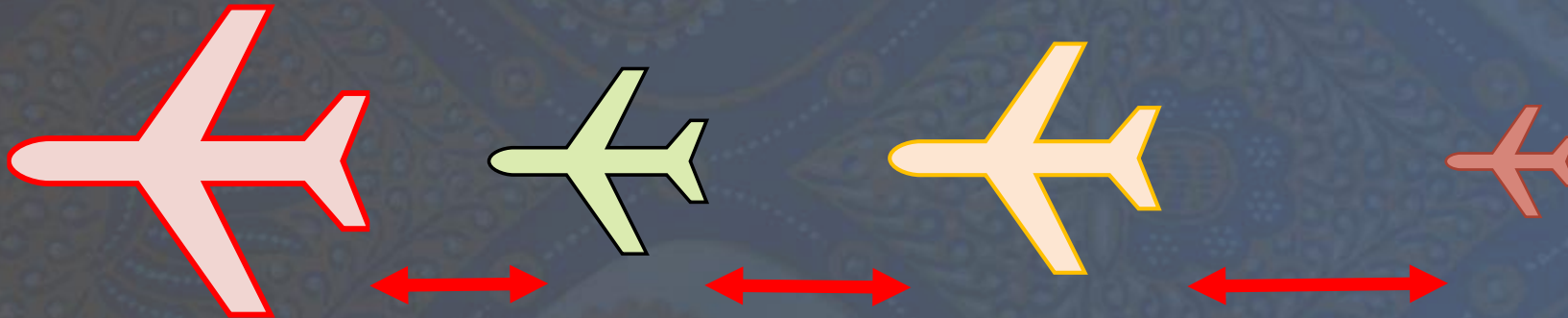
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Arrival and Departure Throughput depends on time separation

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- Runway capacity / throughput is directly linked to the **applied separation / spacing**
- Every **constraint** counts, and **every time saving matters**



90s average separation means 40 landings per hour

86s average separation means 42 landings per hour

Key Factors

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Arrival / Departure separation / spacing

- Applicable / applied minima
 - Air separation
 - Surveillance minima
 - Wake Turbulence
 - Ground separation/spacing
 - Runway Occupancy Time – ROT
 - Gap (crossing, single runway mixed mode)
- Aerodrome Infrastructure → separation constraints
 - Runway entries / exits (per RWY direction)
 - Runway mode of operations
 - Runway (APP-DEP) system
 - Independent
 - Dependent Parallel
 - Crossing
- Traffic Mix / Aircraft categories



Spacing for Runway Occupancy Time (ROT)

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Time at which the aircraft has “**vacated**” the runway

ROT-A / AROT

Determination =

Time at which the aircraft has “**vacated**” the runway

– Time at which the aircraft is above runway threshold

ROT-D / DROT

=

Time at which the aircraft is passing the departure runway threshold

–

Time at which the aircraft has “**entered**” the runway

→ Local definition of runway ‘vacation’ to be provided



ROT Definition

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ROT – Runway Occupancy Time

- Arrival ROT: “A-ROT” or “ROTA”
- Departure ROT: “D-ROT” or “ROTD”

ROT definition?

- ICAO ?
- EASA ?
- EUROCONTROL ?

➔ Definition of ‘Runway not occupied’ :

*“Aircraft cleared from **Runway protected area**”*

➔ Runway vacation ?



ICAO ATM Docs do not use the term “runway vacated” but Aircraft clear of the runway-in-use.

For aircraft operating on the same runway, the following separation minima of ICAO PANS-ATM Doc 4444 are applicable:

- §7.10.1 Separation of landing aircraft and preceding landing and departing aircraft using the same runway: “...a landing aircraft will not normally be permitted to cross the runway threshold on its final approach until the preceding departing aircraft has crossed the end of the runway-in-use, or has started a turn, or until all preceding landing aircraft are clear of the runway-in-use.”

In ICAO understanding, it is considered as self-evident that the runway is vacated when the Aerodrome Control Tower establishes, through visual observation, that the aircraft is clear of the runway-in-use.

How to evaluate if runway is vacated by arrival traffic?

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Detection aircraft position against reference position (e.g. taxiway holding points)

- Visually
- Use ground surveillance (for detecting that the airframe is outside the runway protected area)
 - Based on the Aircraft transponder location
 - Use reference Taxiway Holding Points
 - Use reference Landmark for additional optimisation



ICAO Doc 4444 Reduced Runway Separation Minima (RRSM) between aircraft using the same runway

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7.11.7 Reduced runway separation minima which may be applied at an aerodrome shall be determined for each separate runway.

The separation to be applied shall in no case be less than the following minima:

Note *Category 3 aircraft*: all other aircraft (> 7 tons / Jets)

a) landing aircraft:

...

3) a succeeding landing aircraft may cross the runway threshold when a preceding Category 3 aircraft:

- i. has landed and has passed a point at least 2 400 m from the threshold of the runway, is in motion and will vacate the runway without backtracking; or**
- ii. is airborne and has passed a point at least 2 400 m from the threshold of the runway;**

ROT analysis to define reduced MRS

ROT definition

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1. ROT vacation

= Time at which the aircraft has vacated the runway – Time at which the aircraft is above runway threshold

Local definition of runway vacation to be provided

2. ROT 2400 m

= Time at which the aircraft is on the RWY at 2400 m from the RWY threshold – time at RWY threshold

→ **ROT = min (ROT vacation, ROT 2400 m)**

- 3) a succeeding landing aircraft may cross the runway threshold when a preceding Category 3 aircraft:
 - i) has landed and has passed a point at least 2 400 m from the threshold of the runway, is in motion and will vacate the runway without backtracking; or
 - ii) is airborne and has passed a point at least 2 400 m from the threshold of the runway;

Thank you.