

# Airport Capacity

Outline/Notes for Class

SYST 460/450

# Factors that Affect Airport Capacity

1. Space & Number of Runways
2. Geometric Layout of Runways
3. Wind Direction & Strength
4. Safety (ATM Runway Dependence)
5. Safety (ATM Separation Reqs)
6. Safety (Runway Occupancy Time)
7. Fleet Mix & Sequencing
8. Mix of Movements
9. Visibility, Ceiling & Precipitation
10. Noise Considerations

# Space & Number of Runways

- Number of runways vs. Number of Active Runways
  - Are runways be used simultaneously?
- Space
- Increasing runway capacity = add new runway
  - Near impossible

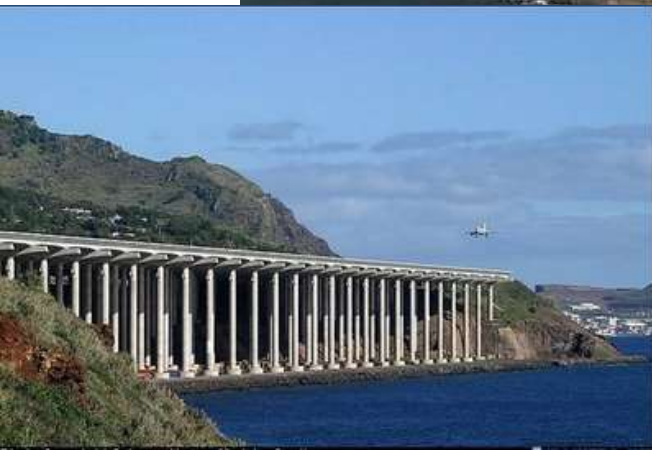
# Old Hong Kong Airport



Photo Copyright Samuel Lo

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# Funchal, Madeira - Portugal

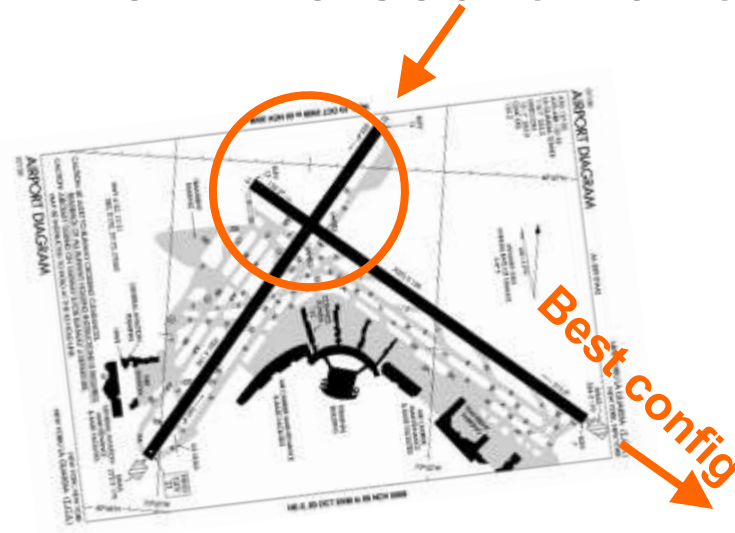


# Geometric Layout of Runways

- *Runway Configurations*
  - Demand
  - Weather conditions (visibility, wind direction/speed)
  - Noise restrictions
- *Dependence*
  - Separation requirements

# Geometric Layout of Runways

- Intersecting
  - LGA
  - Highest capacity when intersection at one end
- Converging
- Diverging

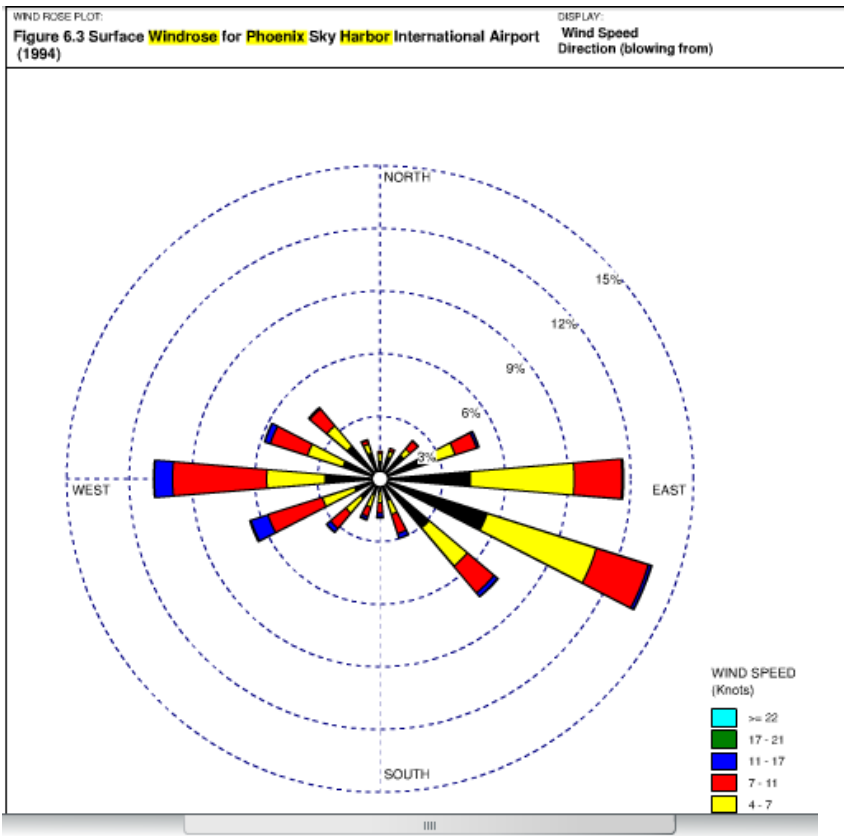


# Wind Direction & Strength

- Crosswinds > 25 knots
- Tailwinds < 5-6 knots
- Winds < 5 knots – use all runways

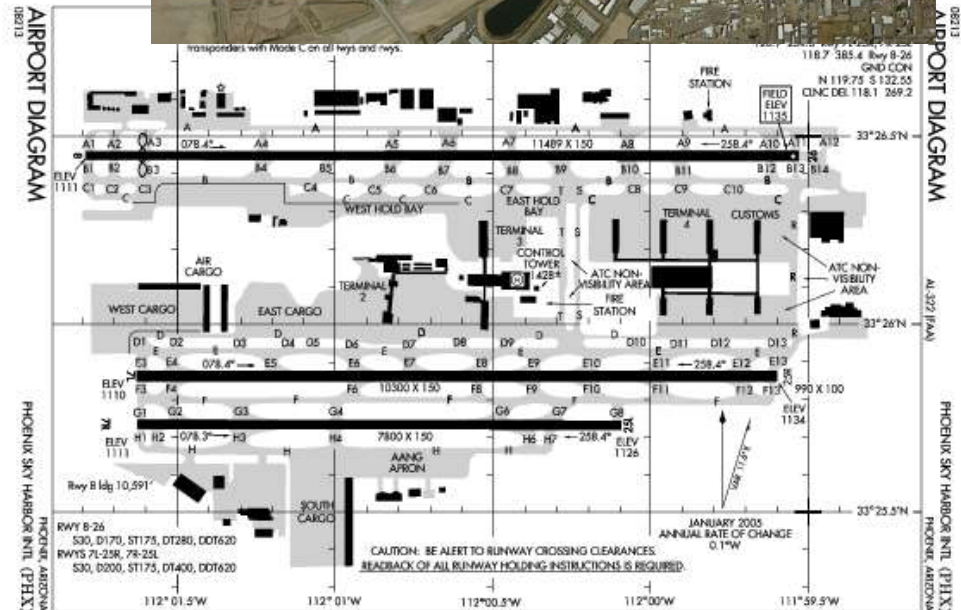


# Windrose - KPHX



LVI Services

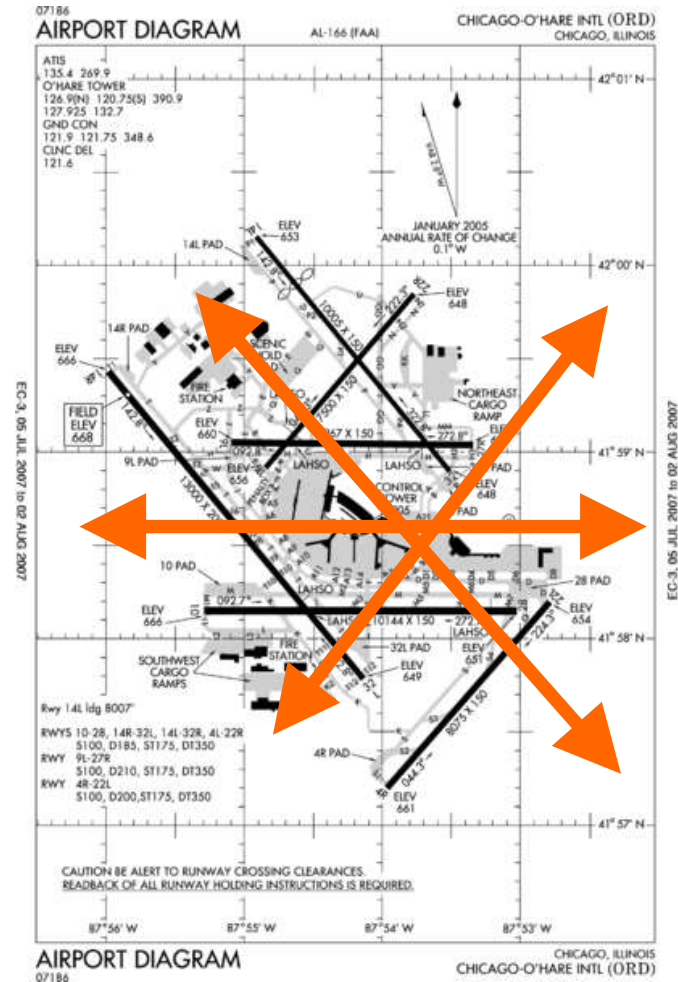
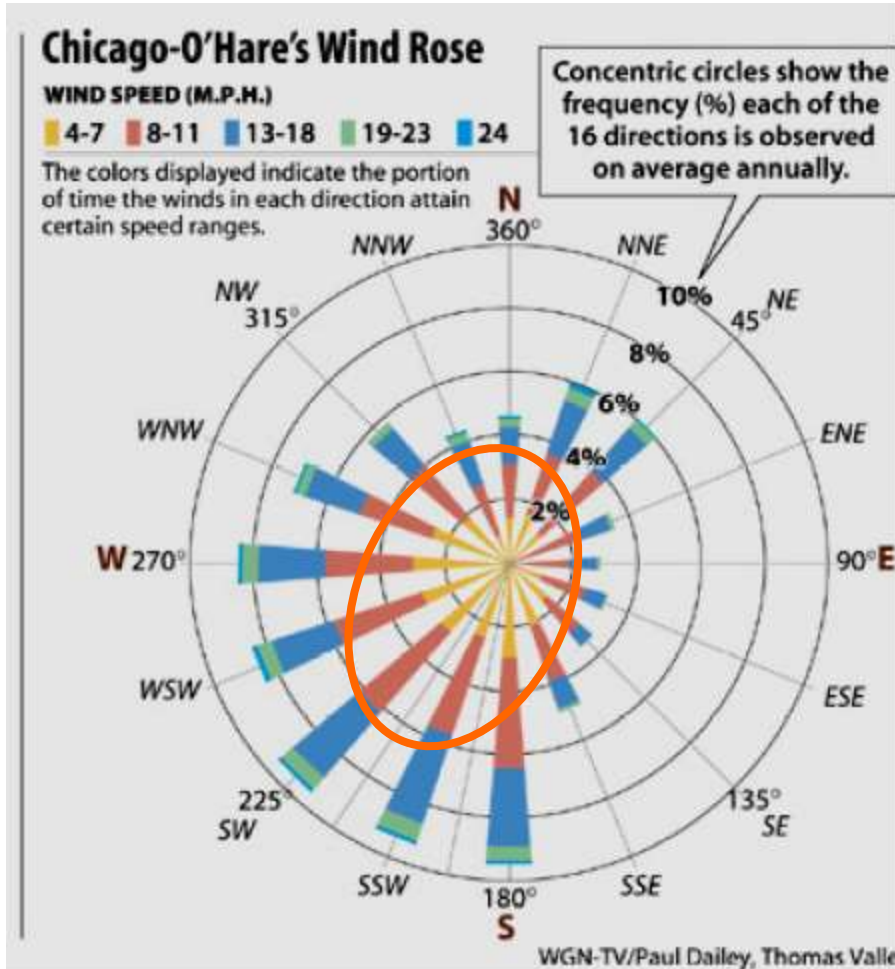
Phoenix Sky Harbor



SW-4, 23 OCT 2008 to 20 NOV 2008

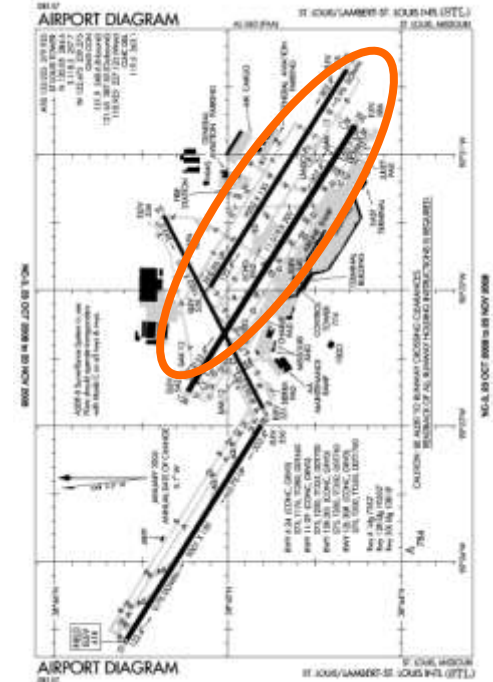


# Windrose - KORD



# ATM Runway Dependence

- Multi-runway airports with parallel runways must operate as ...
- Separation < 2500 ft
  - Single runway (AA, DD)
  - Arrival touches down (AD)
  - Departure is clear of Runway (DA)
- Separation 2500 to 4300
  - 1.5nm (AA)
  - Independent (AD, DA, DD)
- Separation > 4300 ft
  - Independent (AA, AD, DA, DD)



# ATM Separation Reqs

- IFR vs VFR
- Minimum separations for IFR
  - Minimum Longitudinal distance that must be maintained at all time between two aircraft operating on the same runway
    - A-A
    - D-D
    - A-D
    - D-A
- Class of Aircraft
  - Heavy 255,000
  - Large 41,000 to 255,000 lbs
  - Small < 41,000lbs
  - B757



# ATM Separation Reqs

Lead-Trail Separation Distance (nm)		Trailing Aircraft			
		<b>H</b>	<b>B757</b>	<b>L</b>	<b>S</b>
Leading Aircraft	<b>H</b>	4	5	5	5/6
	<b>B757</b>	4	4	4	5
	<b>L</b>	2.5/3	2.5/3	2.5/3	$\frac{3}{4}$
	<b>S</b>	2.5/3	2.5/3	2.5/3	2.5/3

# Runway Occupancy Time

- Simultaneous Runway Occupancy Rule
- Trailing aircraft cannot touch-down on runway before leading aircraft is clear of the runway
- Runway Occupancy Time
  - Average = 45 seconds
  - Standard Deviation = 6 seconds
- High-speed exits

# Mix of Aircraft & Sequencing of Movements

- Consider 50% Heavy & 50% Small
- First-Come-First-Served:
  - 25% pairs = H-S (6nm separation)
  - 25% pairs = H-H (4nm)
  - 25% pairs = S-H (2.5nm)
  - 25% pairs = S-S (2.5nm)
    - Expected Distance between Lead-Follow = 0.9375 nm
- Increase percentage of Heavy increases separation distance
- “Homogeneous” fleet mix
- Constrained Position Shift

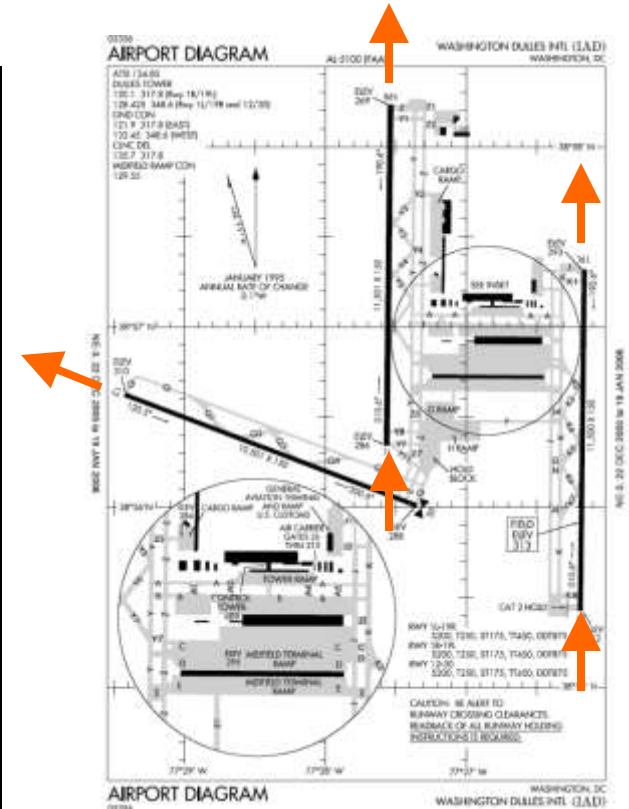


# Mix of Movements

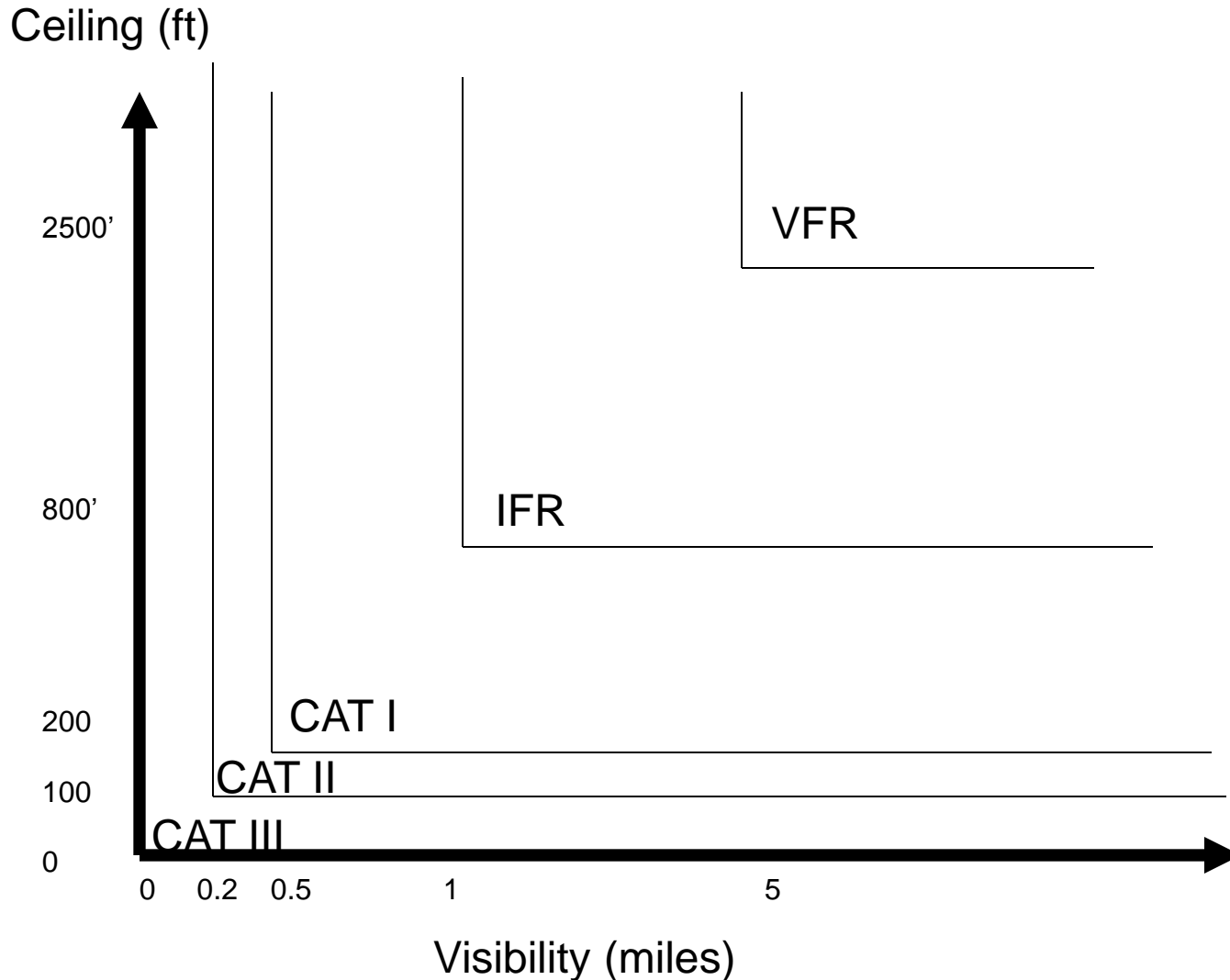
- Mix of Arrivals and Departures on each runway
- Capacity for Departure-only runway greater than Arrival-only runways
  - Same fleet mix
    - 60 departures per hour
    - 45 arrivals per hour
- Banked airports arrivals, then + 1 hour delays

# Mix of Movements

ID	Runway	Departure	Arrival	Totals
IAD	01L	180	540	720
	01R	346	420	766
	30	428	0	428
	Subtotals	954	960	1,914
DCA	01	287	341	628
	03	122	49	171
	33	99	120	219
	Subtotals	508	510	1,018
BWI	33L	0	379	379
	33R	116	131	247
	28	388	0	388
	Subtotals	504	510	1,014



# Visibility, Ceiling, Precipitation



VFR operations used to avoid separation reqs for runway operations AND dependent runway use

# Noise Considerations

1. Ronald Reagan Washington National Airport is one of the most stringently noise-controlled airports in the United States.
2. National's nighttime noise rules are among the most restrictive in the country.
3. Under the Authority's regulations, aircraft may be only operated after 9:59 p.m. and before 7:00 a.m. if the noise level for the aircraft type and model meets National Airport's strict noise standards which are designed to minimize sleep interference.
4. If the noise limitation is violated, the aircraft operator is subject to a civil penalty up to \$5,000 per violation.

# Noise Considerations

- Pilots of turbojet aircraft departing to the north
  - fly northwest over the Potomac River corridor or
  - fly northeast over the Anacostia River corridor,
- Pilots of turbojet aircraft departing to the south follow the Potomac River corridor.
- In good visibility, pilots departing to the northwest follow the Potomac River corridor to the vicinity of the Georgetown Reservoir about four miles from the airport.
  - There they have the option of continuing to follow the river corridor visually or follow an instrument heading until they are approximately ten nautical miles from the airport. After this point, they are turned by air traffic control either west or east to their departure route.
- In good visibility, when aircraft take off to the south, they follow the Potomac River for at least five miles before being turned to their departure route. Pilots using the Anacostia River route follow the river to a point five nautical miles from National before being turned to their departure route.
- When visibility is poor or when strong wind conditions exist, pilots are directed by Air Traffic Control to follow specific headings.

# Continuous Descent Arrivals

