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DUAL LANE RUNWAY STUDY

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May 1974

Final Report

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16. Abstract

An interservice adhoc Dual Lane Runway (DLRW) Committee was established in January 1971, to develop, evaluate and demonstrate dual lane runway design criteria, modes of operation and site selection criteria.

In support of this effort, data was collected on dual lane runway operations at Cleveland Hopkins, Boston Logan, Los Angeles International, and Atlanta Hartsfield International Airports. The Lincoln Laboratory of MIT was employed to conduct real time (man-in-the-loop) and fast time (canned program) computer simulations of dual lane runway configurations and operation strategies. The bulk of their work dealt with using one runway for arrivals only and one runway for departures only. The dual lane analysis was extended by the Airport Design Branch of the Systems Research and Development Service (SRDS) to include modes of operation where both runways were used for arrivals and one or more runways for departures. A model predicting potential missed approaches was used for this effort.

The purpose of this report is to summarize the finding of Lincoln Laboratory and the Airport Design Branch, and make recommendations to the agency concerning the design, location and operation of dual lane runways.

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I. BACKGROUND

The interservice adhoc Dual Lane Runway (DLRW) Committee was established to develop, evaluate and demonstrate dual lane runway design criteria, modes of operation and site selection criteria. Analytical efforts in support of these goals for high density commercial airports are complete. The findings, conclusions and recommendations in this report reflect the consensus of the dual lane runway committee composed of:

Jack Clark, Chairman - SRDS
Jack Burke - Airports Service
Myles Reynolds - Air Traffic
Gerald Gibson - Flight Standards

As used in this report, dual lane runways are defined as two parallel runways at least 700 feet apart, but less than 2500 feet apart centerline to centerline.

In support of this effort, the Lincoln Laboratory of MIT was employed to make real time (man-in-the-loop) and fast time (canned program) computer simulations of dual lane runway configuration possibilities and operational strategies. Their final report is contained in FAA-RD-73-60, entitled "Dual Lane Runway Study" available from the National Technical Information Service, Springfield, Va. 22151. Additional support is contained in FAA-RD-73-97, "Analyses of Dual Lane Runways" by Airport Design Branch, SRDS.

Figure 1 contains a summary of the seven configurations and operational strategies explored. They were:

1. Single Runway. This was used as a baseline for capacity comparisons.
2. High Speed Exits. These were analyzed from a velocity/placement standpoint.
3. Centerline Spacing. Separations from 700 - 2499 feet were considered to determine the sensitivity of flow rate to lateral spacing.
4. Threshold Stagger. This was considered from the standpoint of reducing runway crossing problems.
5. Midpoint Crossings. This runway crossing strategy was considered as a means of feeding departures to an outboard runway.
6. Median Parallel Taxiway. This concept was explored to determine if it provided added "operational flexibility", and how this could be quantified.
7. Segregated Operations. Analysis was made to determine the operational benefits of segregating arrival and departure operations to a particular runway.

In this report, segregated operations are defined as arrival operations only on one runway (either inner or outer) and departure operations only on the other runway. If arrivals and departures operate on both runways, that is referred to as mixed operations. "Inner" and "outer" runway designations are in reference to the terminal building.

The following assumptions underlie the findings, conclusions and recommendations of the dual lane runway committee:

1. Saturation arrival and departure demands exist.
2. Aircraft will accept exit speeds of 40 and 60 mph.
3. ILS capability is provided on at least one runway.

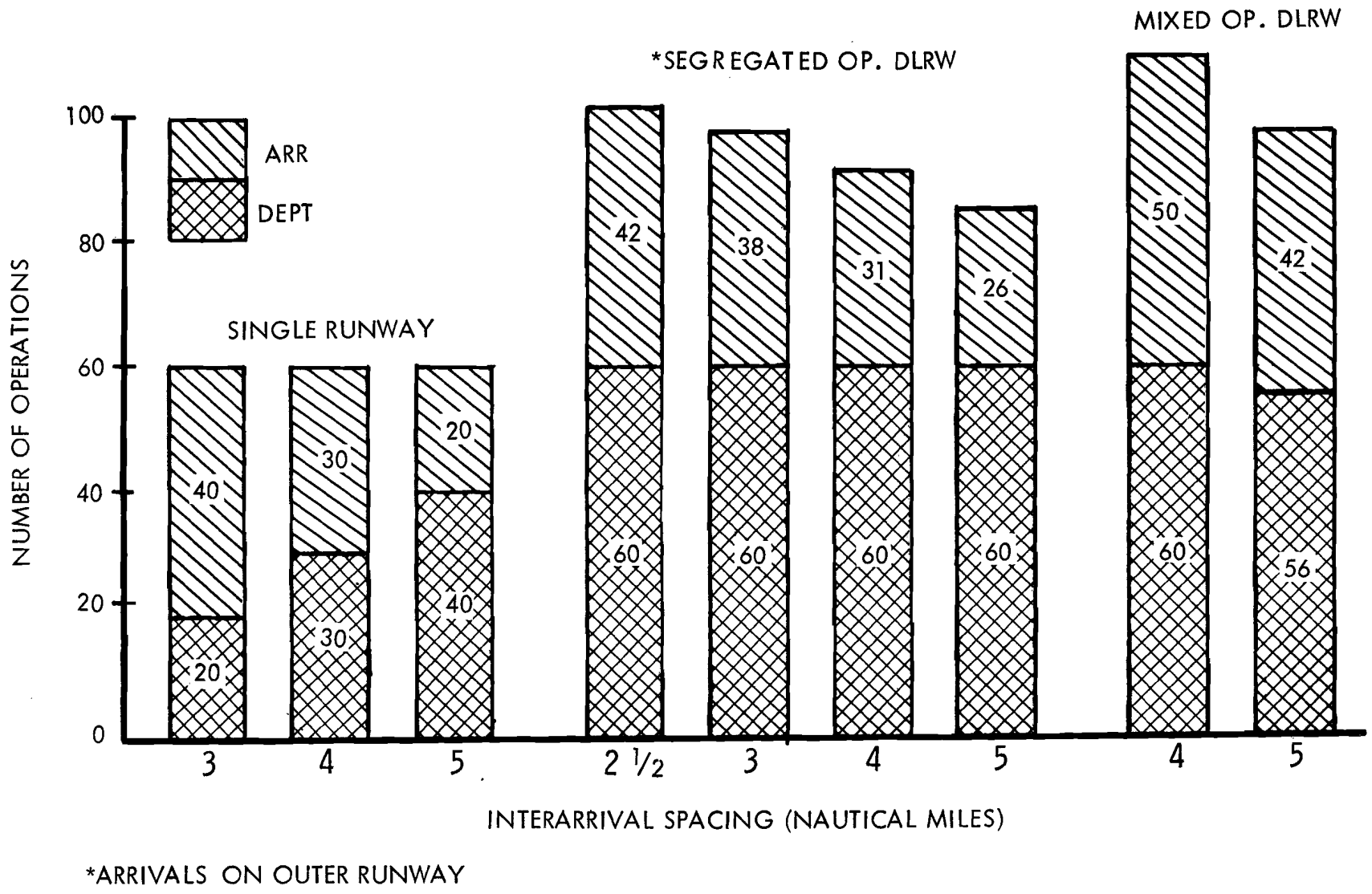
Additionally, the following assumptions were used in the analytical and simulation studies of dual lane runways as given in this report:

1. Aircraft mix of:
   20% Heavy Jets (747/DC10/L1011)
   40% Large Jets (707/DC8)
   30% Medium Jets (727/DC9)
   10% General Aviation Aircraft
2. Aircraft dynamics as given in Figure 2.
3. Constant uniform arrival and departure demand exists.

II. FINDINGS

1. Flow-Rate. Typical dual lane runway flow-rates for a variety of interarrival spacings and modes of operation are listed in Figures 3 and 4.

A dual lane runway can handle 70% more traffic than a single runway under basic VFR meteorological conditions (1000 feet ceiling and 3 miles visibility) or better with arrival aircraft on IFR flight plan. A dual lane runway can handle 60% more traffic than a single runway with visibility less than 2 miles and ceiling less than 1000 feet. For visibilities between 2 and 3 miles, flow-rates are similar to those for basic VFR. Dual lane runways can accommodate a range of IFR arrival demand rates from 30 to 38 operations/hour, depending on actual site conditions such as aircraft mix, Air Traffic Control environment, runway/taxiway configuration and arrival demand scheduling. Current dual lane runways are being operated at an arrival rate of 30 an hour for the above aircraft mix.



*ARRIVALS ON OUTER RUNWAY

Figure 3 Basic VFR Dual Lane Runway Flow-Rates

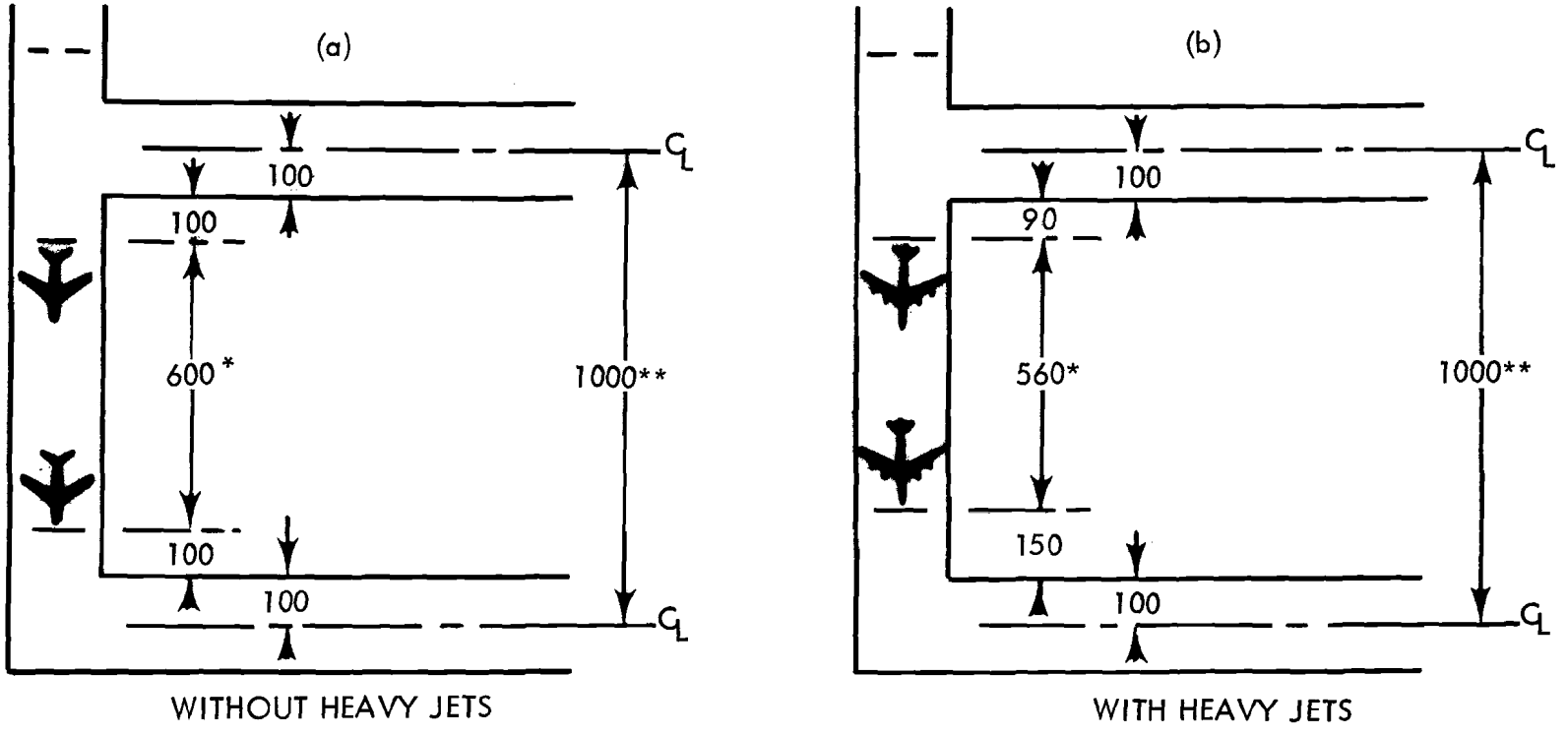
2. Aircraft Holding Capability. With segregated outboard departures or mixed operations, storage capability for holding two aircraft between the runways is required to maintain a high level of operations. Figure 5 indicates flow rate will fall off by approximately 15% if this minimum storage requirement is not met. Where storage is provided for more than two aircraft (say 2499 feet), no additional capacity increases are observed. Departure delay figures from the simulation indicate that holding one aircraft between the runways is insufficient to support a departure rate of 60 per hour. With heavy jets as the design aircraft, the physical space for holding two aircraft translates into a minimum of 1000 feet centerline spacing. Reference Figure 6. Additional spacing may be required because of the taxi breakaway jet blast of large and heavy aircraft.

3. Runway Centerline Spacing. Capacity was found to be insensitive to centerline spacings between 1000 feet and 2499 feet. For outboard departures, as already shown, a minimum of 1000 feet will be required for departure storage area. For outboard arrivals, 1000 feet centerline spacing provides adequate runout distance for stopping (1400 feet) on angled exits. An arrival exiting 60 mph on a 30° turnoff can decelerate to a stop 200 feet short of the inner runway edge.

The 1000 feet spacing also affects the psychology and strategy involved with outboard arrivals. In the simulation, the controllers tended to give an exiting arrival preference over departures when the spacing was less than 1000 feet. The departure may be ready for take-off, but the controller chooses to let the arrival proceed at a relatively high speed and cross the inner runway. This had a tendency to reduce the voice channel loading, but decreases the departure rate as well.

If a demand in excess of 100 operations an hour is anticipated, a mixed mode of operation is required and centerline spacing equal to or greater than 2500 feet should be considered to minimize wake turbulence constraints.

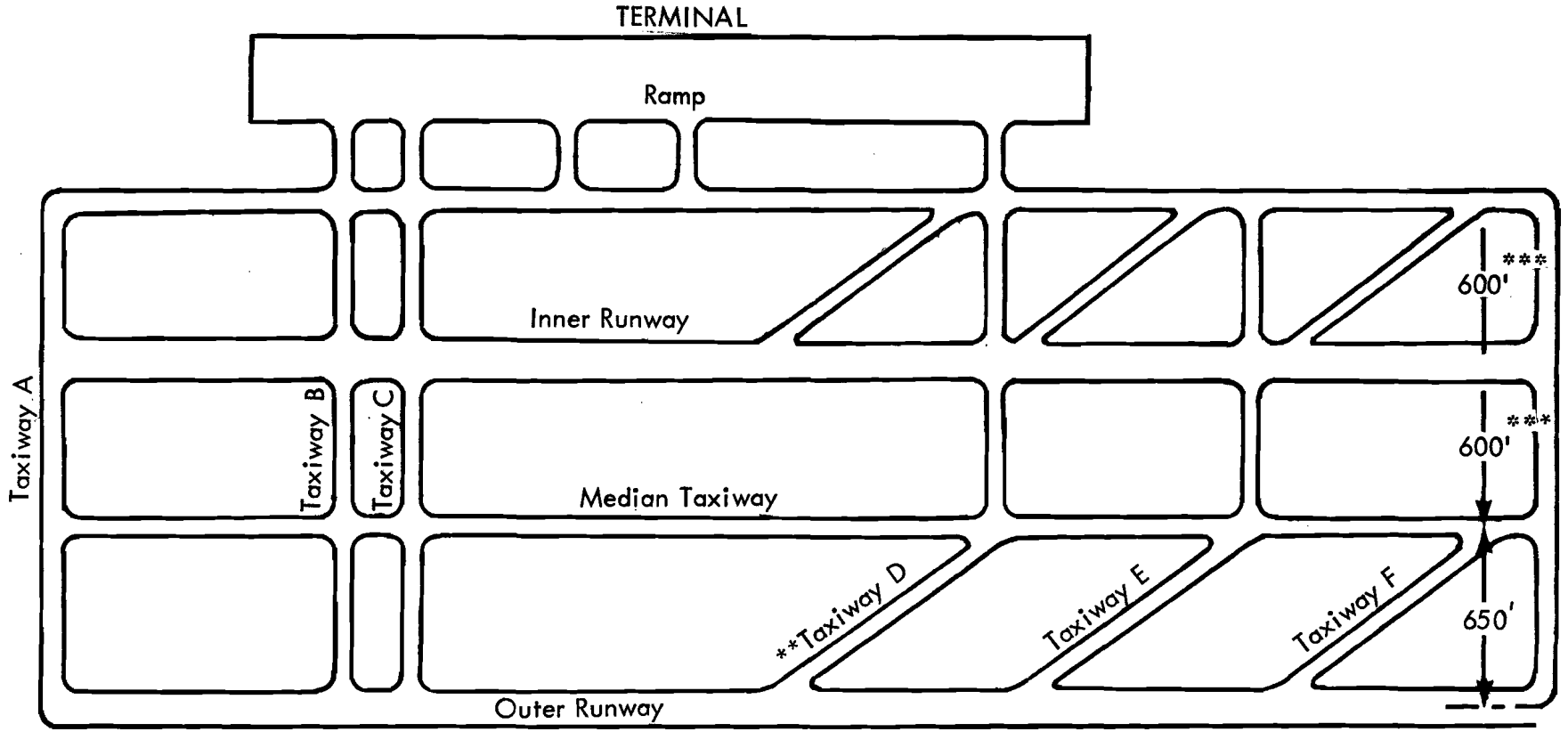
4. Arrival/Departure Preference. Simulation experiments show the rate of operations to be independent of which runway is used for arrivals and departures (when a minimum of 1000 feet centerline-to-centerline separation is provided). Field observations show a decided controller preference for segregated operations with arrivals on the outer runway. Another factor favoring inboard departures is the location of the ILS equipment. When the glide slope antenna is between or inboard of the dual lane runways, departures taxiing to an outboard runway may cause glide slope interference.



* AIRCRAFT TYPE	AIRCRAFT LENGTH
B 747	230'
DC10	180'
L1011	180'
707/DC8	150'
727	133'
DC9	104

**Dimensions reflect physical minimums only. Additional seperation may be desired to reduce jet blast.

Figure 6 - Aircraft Holding Area Between Thresholds.



*The exit taxiway layout shown is for operations from left to right only. Mirror images of Taxiways D, E, and F should be designed if bi-directional capability is desired.

** Taxiways D, E, and F provide 1300 feet of runout distance. This is adequate runout for 40 mph exits.

*** Required by AC 150/5335-1A dated 5/15/70 for CAT II operation or when widebody jets are anticipated.

Figure 7 - Suggested Parallel Taxiway Configuration*

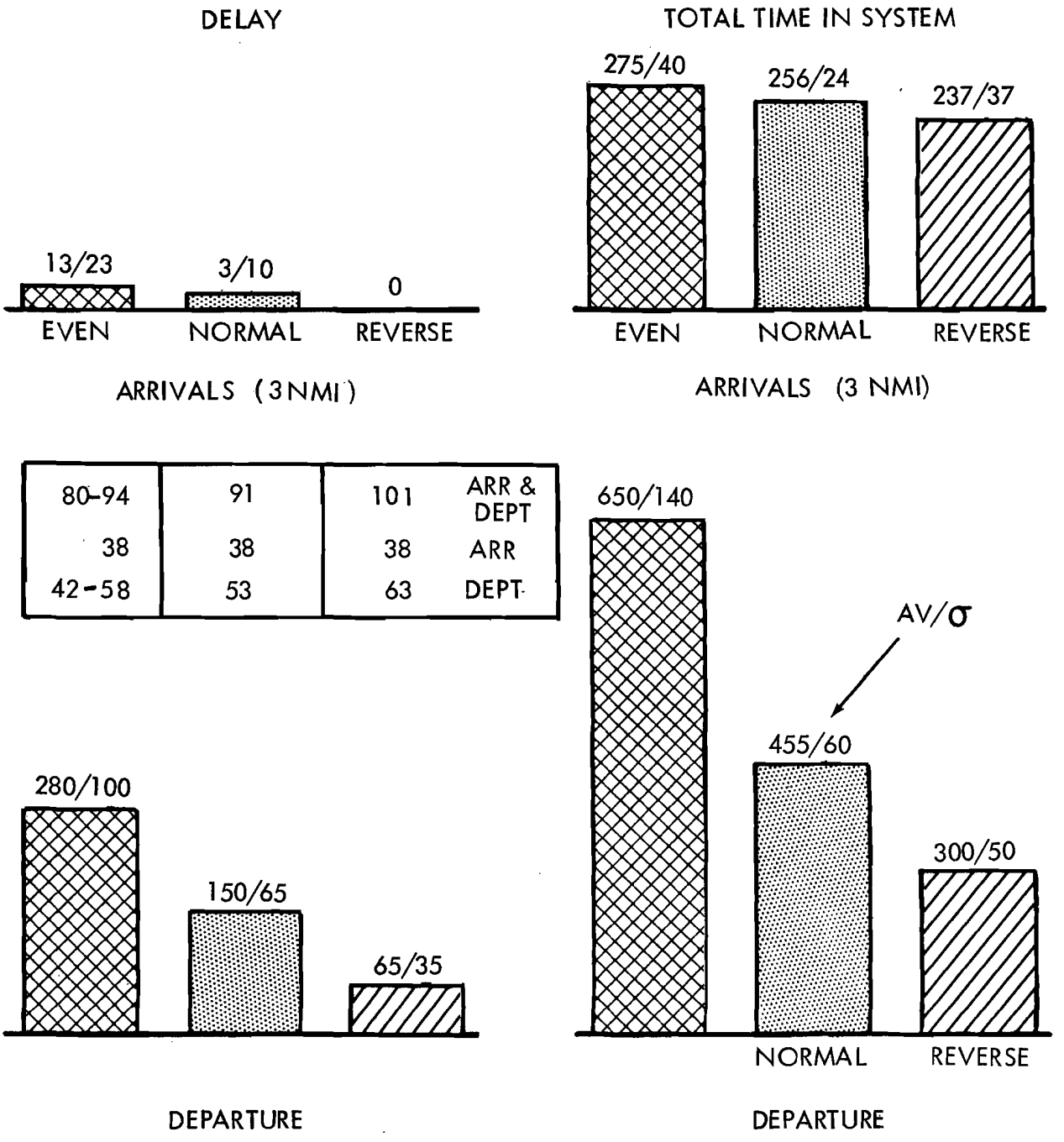


Figure 8 - Analysis of Mode of Threshold Stagger by Real Time Simulation For Segregated Operations